COMPARISON OF TRAINING EFFECTS OF CONTINUOUS AND INTERVAL CIRCUIT TRAINING METHODS

A SYNOPSIS OF THE THESIS SUBMITTED TO THE JADAVPUR UNIVERSITY FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ARTS

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JANUARY, 2024

INTRODUCTION

Modern education explores various innovations to progress our society. Peoples are more interested on new scientific exploration which can make an advance universe. Globally those who are living in developed countries behind them they have the strong educational structure. So, fundamental need in education is to development of a nation and equally public health as most emergent asset. Public health is closely related with increase the capability of creation and production of realistic materials based on technology. Physical activity is the "best buy" in public health. (Morris, 1994). A man as a social member he or she has several responsibilities in the area of family, profession, social work etc. But most of time they have under unsatisfied, depressed and unhealthy condition, nothing materialized which is the exact necessity on the time. Where physical Activity is the precious base of quality living but there, peoples are gradually trend to remain inactive and spending life depending on machine. It is the new challenge how the people will start a new journey with healthy life and environment. Not only the inactivity but nutrition and environment are the most effective component to make an efficient healthy life. Human body composed of various systems that allow maintaining a state of homeostasis. We must remember that living a sedentary lifestyle can put a rigid wall in the way of improving our health. It could be social, mental, or physical health. In view of Good health it can simply carry success in a person's life. A person with an attractive and good body structure may not be healthy or in quality health. Peoples are in modern times, have regarded health as one of the most expensive values in life. Now a days' Health is considered as one of the most significant values for a human being as well as for nations. So health is primary requirement for every people to uphold the nation advancement. Society is growing gradually with rapid development of industrial sector also. For any working area of profession to every people there most demanded component is physical and mental health. Satisfaction, self control, communicative ability, good habit, precise behavior and physical capability these all are under physical and mental health. Those peoples are inactive and poor focused on their own health they always want to consult with doctor for every simple unbalance of body function, this is a sign of unsound conditions in the state.

Each human being should grow physical fitness intended for a joyful and efficient existing. The completely fit individual has an energetic and cheerful attitude towards living. Fitness is the man's supreme requirement. Physical fitness is the capability to survive a complete and compatible life. It can increase self-confidence and mentally alert of a person. Clarke and Clarke (1989) found that physical fitness is not a static factor and it varies from

individual to individual and in the same person from time to time depending on factors. The Physical fitness can be classified into two types; such as a) Health related physical fitness b) Performance related physical fitness. Health-related physical fitness consists of several elements, including cardiovascular endurance, flexibility, muscular strength, body composition and muscular endurance. But performance related physical fitness refers to things like power, speed, agility, reaction time, balance, and coordination. Physical fitness improves when he/she consciously adopts physical exercise. Exercise is the activity which is planned, structured, and repetitive for the intention of conditioning any part of the body. The many health benefits have been shown due to regular Exercise in many research studies. Similarly present research study conducted with different physical training methods to observe the improvement of physical fitness, anthropometrical and physiological components of human body. These training methods consisted with different types of physical exercises. The people who make exercise as an essential part of their daily routine they are happier and more efficient than others people.

Nowadays, everyone agrees that training is an essential component of any program that is systematized and grounded in science and serves as a means of achieving the highest level of achievement. Commonly the term 'Training' is used as a process of systemic instruction or activity for the purpose of physical, psychological and intellectual improvement. Thought and process of training may vary according to deferent fields. In our society there are so many field or spaces which are connected with our life activity, such as education, sports, technology, industry, health, agriculture etc. To get achievement in each and every sector there require adequate training for execute accurate skill on their specified demands. Similarly in the field of sports for improvement of sports performances there require scientific and systematic training. The term sports training is particularly used in the perspective of athletics, sports and games which could be a training of sports persons, coaches and teachers of physical education. Generally sports' training is the well structured systematic and scientific instruction or activity according to demands of individual capability for the enhancement of sports performance. Sports training implies continuous and designed activity for reach towards actual destination as a true success by execute of skills. Athletes can develop a deeper understanding of their own sport and learn the importance of maintaining physical and mental well-being through sports training. Reaching peak performance in a specific sport is the primary intent of sports training for athletes. In scientific view of sports training present study adopted deferent types of sports training

methods to identify the effects on physical fitness, anthropometrical and physiological components.

Sports performance highly depends on physical fitness, anthropometrical and physiological components of the human body. Generally all the components are very vital for sports performance in competition and for preparation for competition to improve these components basically need a good training programme on basis of individual requirement. Many research studies found that scientific application of sports training methods can improve the physical fitness efficiency (Maniazhagu, 2022; Prasanna et al., 2020; Rani, 2018; Kumar, 2016; Al-Haliq, 2015; Vinayagamoorthi and Sakthivel, 2014; Cregg, 2013; Babu & Kumar, 2013; Meethal and Najeeb, 2013 & Reddy; 2012). Physiological components such as heart rate, blood pressure, blood, blood lactic acid etc. these are the essential factor for sports performance. Internal physiological functions are connected with external body movements. Many research studies established that physical training may effective to improve physiological potentiality. Holmgren et al. (1960) and Venkateswarlu (1975) while working on young athletes have shown the reduction of pulse rate due to different training methods. There are significant positive changes due to implication of physical training on blood lactate concentration (Hurley et al, 1984; Bandyopdhyay, 1984 & Connet et al., 1985). Yoshida et al., (1982) studied on healthy male college students and found that endurance training decreased blood lactate content during the sub-maximal exercise significantly. On the other side Richardson & Hardman, (1989) found a significant relationship between blood lactate concentrations with endurance time.

Research findings of a number studies proved that the sports person's anthropometric characteristics are too related with high athletic performances. BMI, Percentage of body fat, Height, Weight, Thigh girth, Calf girth etc. as Anthropometrical components all are very vital for successfully skill execution. Glick & Kaufmann, (1976) observed lowering of the body weight due to physical training. Adeniran & Toriola (1988) found a result on some school going boys significant reduction of percentage of body fat among the trained comparison with untrained students. Alex Stewart (2021) concluded Jump Squat have positive effects on calf girth. Dixon, (2017) determined the positive relation between the thigh girth ratio and performance in events from 800m-5000m run. Specified training programme can enhance the thigh and calf girth of an athlete's (Saini & Bhardwaj, 2018; Vinu, 2012 & Ashwini, 2017).There are different training methods in the field of sports training. Some methods are

continuous training, interval training, circuit training, interval circuit training, continuous circuit training etc.

The study investigates different anthropometrical, physical fitness and physiological variables as a mark of improving sports training. An earnest endeavour was made aware of the prior research conducted in the field, the gaps and weaknesses of the earlier studies, the methodology used and process was carried out by the professional personnel's and literature. A brief summary of review of literature about the related area as searched by the researcher from various sources have been presented in the chapter two. Based on the research conducted in this area, it can be said that not much work has been done so far for the estimation of the assessment of the impact of an interval and continuous training program on physiological, physical fitness, and anthropometric components for 13-16 years students. As such, the approach taken in this study was based on the observation of the effects of two training programs. The experts of the field were formulated the training programs applied by the investigator with the help of number of assistants to comparison and Investigating the effects of continuous and interval circuit training on physical fitness, physiology, and anthropometric variables.

STATEMENT OF THE PROBLEM

The investigator was designed to initiate research work related to the evaluation of the impact of 12-weeks training program on various aspects and to measure and determine the Effects of interval and continuous circuit training on anthropometric, physical fitness and physiological parameters. Accordingly, the researcher stated the problem of the study as **"Comparison of Training Effects of Continuous and Interval Circuit Training Methods".**

OBJECTIVES OF THE STUDY

1. To observe the influence of both continuous and interval circuit training on anthropometrical, physical fitness and physiological variables.

2. To compare the effect of interval circuit training, continuous circuit training and a control group regarding anthropometric variables.

3. To compare the training impact of interval circuit training, continuous circuit training and a control group regarding physical fitness variables.

4. To compare the impact of interval circuit training, continuous circuit training and a control group regarding physiological variables.

DELIMITATIONS OF THE STUDY

The study has the following delimitations: -

   i. Subjects of the present investigation were selected from Purulia Cricket Academy, Purulia district of West Bengal.

   ii. Data has been collected from one academy of a particular place of Purulia district of West Bengal.

   iii. The subjects' ages were restricted to 13 to 16 years old.

   iv. For the purposes of this study, only male subjects were considered.

   v. The selected participants were split up into three equal groups: control Group (CG-20), the experimental group - I for Interval Circuit Training (ICT-20) and the experimental group-II for Continuous Circuit Training (CCT-20).

   vi. To observe the effect of training the researcher was restricted him into few anthropometrical, physical fitness and physiological variables.

   vii. Total twelve weeks could be allotted for the training period, and there could only be three days per week.

LIMITATIONS OF THE STUDY

The study has the following limitations: -

   The study's limitations come from the following factors, over which the researcher did not have control.

   i. Despite the use of standard instruments, the researcher could not effort to use the latest sophisticated instruments for collection and analysis of the data.

   ii. Due to financial stringency the researcher was bound to cut off so many important anthropometrical and physiological variables for the present study.

   iii. Due to inability in initial screening (due to financial limitation) the researcher was unable to select participants from various districts of West Bengal. It might have

been more appropriate for the current study to determine the training program's effects.

iv. The time was also the limiting factors for the study.

v. The scholar also did not have any direct control over the life style, food habit and general activity pattern of the subjects.

HYPOTHESIS OF THE STUDY

The researcher after studied the review of the related literature, formulated the null hypothesis for the present investigation. The null hypothesis set and stated was taken as:

1. There would be no significant influence in any anthropometric variables due to interval circuit training.

2. There would be no significant influence in any anthropometric variables due to continuous circuit training.

3. There would be no significant difference in anthropometric variables among interval circuit training group, continuous circuit training group and control group.

4. There would be no significant influence in any physical fitness variables due to interval circuit training.

5. There would be no significant influence in any physical fitness variables due to continuous circuit training.

6. There would be no significant difference in physical fitness variables among interval circuit training group, continuous circuit training group and control group.

7. There would be no significant influence in any physiological variables due to interval circuit training.

8. There would be no significant influence in any physiological variables due to continuous circuit training.

9. There would be no significant difference in physiological variables among interval circuit training group, continuous circuit training group and control group.

SIGNIFICANCE OF THE STUDY

This present study would be significantly useful in Physical Education as well as educational sector in the following ways –

i. This study helps to provide adequate knowledge on effect of circuit training on secondary level students.

ii. To find out which type of circuit training is beneficial to improve their anthropometrical, physical fitness and physiological variables.

iii. The result will provide information for future investigation within the disciplines of sports and physical education.

iv. Present study can help to provide knowledge to the sports trainer who also tries to provide perfect training toward sports person.

v. This study can help to general people about physical activity and active life style.

vi. From beginner to advance athletes will get precious motivation and advance movement by this investigation.

REVIEW OF RELATED LITERATURE

Kim et al. (2018) examined how a 12-week circuit training program affected the risk factors for metabolic syndrome and health-related physical fitness in obese female college students. According to the study's findings, the circuit training group's body weight, body fat percentage, and body mass index were all considerably lower than those of the control group.

Contrò et al. (2017) were carried out a study comparing the influence of various circuit training methods to ascertain which is the best for losing weight and for particular disorders associated to being overweight. The findings indicated that the aerobic-tone-aerobic group reduced total body mass and body fat more than the other groups. The aerobic-circuit-aerobic group significantly lowered body fat, total body mass, and low-density lipoprotein cholesterol. All circuit protocols are ideal for decreasing total body fat and body mass.

Badami & Baragundi, (2017) carried out a study to compare key metrics of cardiopulmonary fitness between students studying physical education (PE) and medical education (ME). Subject data has been collected both before and following the Astrand-Ryhming step test (ARST). Compared to students studying medical education, Students in physical education showed a noticeably greater percentage of recovery in terms of respiratory rate, blood pressure, and pulse rate.

Prasanna et al. (2020) investigated towards the effect on Speed, Muscular Endurance and Cardio Respiratory Endurance along with university students by Continuous and Interval training method. This study found that significantly positive improvement in Speed, Muscular Endurance and Cardio Respiratory Endurance when comparing the experimental groups to the control group.

Khan et al. (2019) investigated the effects of continuous, moderate-intensity training methods combined with interval training on aerobic capacity. Following six weeks of training, in both groups, the resting heart rate, blood pressure, and respiratory rate were reduced. According to this study, both groups' aerobic capacity (Vo2max) significantly improved.

Benda et al. (2015) were conducted a thorough comparison of the effects on cardiovascular structure and function, physical fitness, and quality of life of patients with heart letdown between continuous and high intensity interval training. The findings revealed that the specified training significantly improved the physical fitness parameters, but no differences were observed between high intensity interval training and continuous training.

Al-Haliq (2015) finished a study examining how a circuit training program might improve university students' physical fitness levels. The investigator designed the examinations to evaluate the fitness parameters based on the Physical Fitness Course participants. After post-test measurements, it was found that the participants' level of physical fitness had clearly improved.

Reddy (2012) compared the performance measures of 60 boys students from Scheduled Tribe / Scheduled Caste (ST/SC) and non- ST/SC category using Interval and the continuous circuit training methods. According to the investigation, interval circuit training methods showed statistically significant speed improvements in the case of SC/ST exclusively. For the continuous circuit training method, SC/ST boys' 800 M performance increased as well. Boys from S C/S T and non- ST/SC are generally better at the endurance, leg strength and agility through the continuous and intermittent circuit training program.

Adling & Bangar (2017) were a study carried out to determine how aerobic training affects particular physiological and physical parameters. The results showed that aerobic training can help with improving resting heart rate, vital capacity, muscular endurance, and cardio-respiratory endurance.

Roy et al. (2014) consisted of a study to determine the female athletes' anaerobic threshold levels for various running distances. Increased blood lactate accumulation has been found to differ significantly between the pre- and post-training phases for various gradual running distance increases, including 250, 300, 350, and 400 meters. Regarding the training effect, however, there was a decrease in blood lactate accumulation (250 mt. -1.98%, 350 mt. -.30%, and 400 mt. -1.39%), with the exception of 300 mt. (which increased by 2.66%).

Chittibabu & Akilan (2013) investigated to determine how Basketball-specified endurance circuit training method affected the heart rates and aerobic capacities of high school male students those who were basketball players. The study's findings showed a significant difference in resting heart rate and peak heart rate between control group and experimental group.

Cal (1973) conducted this study to find out how an interval bench stepping training program affected the metabolic energy mechanisms. The findings of the research determined seven weeks of interval training method has no effect on maximal alactic capacity. A seven-week interval training program has no effect on maximal lactic capacity.

METHODOLOGY

SELECTION OF THE SUBJECTS

This study involved a total of sixty boys (N = 60) as subjects. The subjects were randomly selected after medical screening from purulia cricket academy, Purulia district of West Bengal. Subjects in the research were between the ages of 13 to 16 years. They all were under skill practices on pre beginner section and joined at Purulia Cricket academy for one to three months only. Lottery method was use to conduct simple random sampling process. Homogeneity was tested based on their personal data and performance in the initial stage. For present study, after sixty (60) boys were chosen as subjects and they were distributed into three equal groups using a simple random grouping technique, each group was consisted of twenty (N= 20) students. The experimental groups were intervened through scientifically structured continuous circuit training and interval circuit training program separately for twelve weeks whereas the control group was free from intervention of any kind of structured training program.

SELECTION OF THE VRIABLES

Researcher studied the many scientific literatures regarding to various training methods in the field of sports. After reviewed the literatures and discussed with professional coaches, expert and supervisor researcher selected following variables in three heads namely anthropometric, Physical fitness and Physiological variables. From the area of anthropometrical perspective following parameters were considered- BMI, Body-weight, Percentage of body fat, Calf girth, and Thigh girth. On physical fitness perspectives following parameters were considered- Speed, Agility, Flexibility, Leg explosive strength, and Cardio respiratory Endurance. On view of Physiological perspectives of human body following parameters were considered- Heart rate and Blood lactic acid.

THE DESIGNE OF THE STUDY

The experimental setup for the present study included sixty subjects (N = 60). Sixty (60) subjects in total were randomly assigned to three groups (ICT, CCT, and CG), each with twenty (20) subjects. The two experimental groups in this study were the Continuous Circuit Training group (CCT), the Interval Circuit Training group (ICT) and another was Control group (CG). Both of experimental Groups underwent circuit training following continuous and interval method respectively for twelve (12) weeks, three (3) days in a week. The CG they were stopped from participating in specified training methods but involved in their regular routine schedule of the academy of cricket skill practices. Before and after the training, each subject underwent testing on selected variables. The study was under experimental type of research and for this investigation pre-test post-test control group design was applied.

TRAINING PROGRAMME

Experimental group- I (ICT) trained on interval circuit training method whereas experimental group-II (CCT) trained by continuous circuit training method and group- III (CG) was in under control. The researcher have reviewed the several research literature regarding the effects on the human body of both continuous and interval circuit training methods (Reddy, 2012; Pan, 1999 & Themistocleous et al., 2021). After reviewed the researcher discussed with fitness trainer, coaches, exercise expert and supervisor and selected the training methods along with specific exercises. There were eight stations with the same eight physical exercises (spot jump, push ups, high knee, sit ups, box jump, squat thrust,

shuttle run and steps ups) for both the interval circuit training and the continuous circuit training methods.

At first 7 minutes warming up activity with jogging, shuffling and stretching was mandatory for both of groups. Whereas the stations for the experimental groups I (ICT) and II (CCT) were similar, the recovery times and procedures for changing between the stations differed. Although the interval circuit training group took two minutes of active rest before restarting the circuit, the continuous circuit training group did not have a recovery period. Those who were in interval circuit training method they were involved with slow jogging from one station to another station and those who were in continuous circuit training they carried normal walking from one station to another station. Every day, both experimental groups performed a total of three circuits (3- Sets). One instructor was allotted, where situated starting and finishing line those who access stopwatch and whistle. One instructor had been observed over all circuit activities. For each performer was a peer who guided individual score sheet and a stop watch. Training was performed three days a week. Training continued for twelve weeks in total. Group III served as the control group (CG), which only engages in their regular activities on a daily basis. Both of experimental groups performed on circuit according to their maximum individual effort and capacity. First four weeks followed the load 70 % of their maximum capacity. After completion of first four weeks researcher again recorded maximum capacity of the students and fifth to eight weeks followed the progression of load 75 % of their maximum capacity. Again same as before determined the maximum capacity and ninth to twelve weeks followed the progression of load 80 % of their maximum capacity.

CRITERION MEASURES

After reviewing the literature the following standardized tests and instruments were selected. On Anthropometric variables- BMI: Weight (kg) / Height (m^2), Body weight: Standard Weighing machine, percentage of Body fat (%): Slim guide Skin folds callipers (Jackson & Pollock, 1978), Calf girth & Thigh girth: Steel tape. Physical fitness variables- Speed: 50 yards dash (AAHPER, 1976), Agility: 4 x 10m shuttle run (AAHPER, 1976), Leg explosive strength: Standing broad jump (AAHPER, 1976), Cardio Respiratory Endurance: Harvard Step test (Brouha, Lucien , 1943), Flexibility: Sit-and-reach test (Modified) (Johnson & Nelson, 1982), Blood Lactic Acid: Harvard step test (Brouha, Lucien , 1943) & Lactate Pro Analyzer (Arkary Global Business, Inc, Kyoto, Japan), Heart rate: Harvard step

test (Brouha, Lucien , 1943) [Electronic Digital stop watch, bench (ht.20 inches) & Metronome].

ADMINISTRATION OF THE TEST:

Age: Age of the subject was recorded in completed years and it was noted according to their date of birth. In this study age ranged of the subjects were 13 to 16 years based on their academy records.

Body weight: The subjects were in minimum clothing without any footwear. Instructed to Subject`s weight should be evenly distributed on both feet and stand straight with forward looking. The Standard Weighing machine was used to measure the body weight with sufficient lighting surface where conducted the measurement. The Investigator was recorded on proper observation.

Height: A person's height is measured when they are standing, from their vertex to the floor. The individual was instructed to stand straight on the ground without shoes and heel together with looking forward. The Height was recorded in Meter (m) with the help of Standard Steel or cloth tape.

Anthropometrical Variables

BMI (Body Mass Index): BMI was composed by measurement of height and weight ratio of an individual. BMI was calculated from the following formula: BMI (Body Mass Index) = Weight (in kg) / Height^2 (in meter)

Percentage of Body fat (%): The Jackson and Pollock based on the thickness of three different skin fold measurement, i.e., i) Chest, ii) Abdomen, and iii) Thigh gives an estimate of body fat percentage of an individual. Calliper used by Finger was two inch apart and pinch the skin of specified location and used skin fold calliper. Recorded the thickness of specified location in millimetre (mm). On the basis of total fat percentage of three locations According to Jackson and Pollock data table obtained a score which was recorded for an individual.

Calf girth: Instructed to subject straight stand with the feet parallel to each other. The point of maximal calf circumference was identified and the measurement of circumference taken with great care. The measurement of calf circumference was recorded to the nearest inches as the score of individual subject.

Thigh girth: Instructed to subject straight stand with the feet parallel to each other. The point of maximal thigh circumference was identified and the measurement of circumference taken with great care. The measurement of thigh circumference was recorded to the nearest inches as the score of individual subject.

Physical Fitness Variables

Speed (50 Yard Dash): Students start from a standing position (hands cannot touch on the ground). Front foot of the performer must be behind the starting line. The Starting commands were "On your mark", Set and sound by clapper. On the sound of clapper students ran 50 yards as fast as possible across the finish line. The score was the elapsed time from clapper sound to crosses the finish line with torso which recorded by second. The nearest tenth of a second as the score for 50 yard dash.

Agility (4 x 10m shuttle run): Two parallel lines are marked 10 meters apart on the ground surface. The two wooden blocks are placed on the line and the students were asked to start from the back of the second line. On the signal "Ready" the performer places their front foot behind the starting line. After the command "Go!" performer runs to the blocks, picks one up, runs back to the starting line and places the block on or behind the starting line, then runs back and picks up the second block which performer carries back across the starting line. Two trials are performed. Two attempts are performed for each performer. Some rest Allowed between two trails. Better time Recorded of the two trails to the nearest tenth of a second as the score of the test.

Leg explosive strength (standing broad jump): Pupils stands slightly apart with the feet parallel to each other and the toes just behind the starting line mark. Preparatory to jumping, the performer bends the knees and swings the arms to forward drive and the performer attempts to jump as far forward as possible. There three attempts were allowed. The score is the distance in meters between the starting line and the nearest point where any part of the subject's body touches the pit. Three trials were permitted, and then the best performance was recorded as the score.

Cardio Respiratory Endurance (Harvard Step test): The body was erect when the subject steps on to the bench. For five minutes, the person on the bench moves up and down at a pace of thirty steps per minute (every two seconds) or unless he feel that he must stop before then because of exhaustion. With a "GO" order from the assistant, the subject begins the test and

the stopwatch is turned on. The assistance person assures the athlete keeps up the necessary pace in steps per minute. After five minutes or complete of test assistant takes the subject's pulse rate for 1 to 11/2, 2 to 21/2, 3 to 31/2 minutes. Obtained score was computed with this formula:

PEI = Duration of exercise in seconds x 100 / 2 x sum of pulse counts in recovery.

Flexibility (Modified Sit-and-Reach test): After aligning the yardstick's 15-inch mark with a line on the ground, secure the ends of the stick with tape. Sliding his seat back beyond the yardstick's zero end, he took a seat and aligned his heels with the near edge of the 15-inch mark. Reach forward slowly and touch the tips of both hands as far down the stick as you can, keeping your knees locked and your heels no wider than five inches apart. The score was calculated from the three best trials, each measured to the closest quarter of an inch.

Physiological Variables

Blood Lactic acid concentration: To measure Blood lactate level Harvard Step test was used. For each individual blood lactate has been taken in four phases. At first taken blood in resting position before Harvard step test, second time after complete stepping immediately taken the blood, third time seven minutes after exercise and at last fifteen minute after exercise taken blood sample. The blood samples were collected from each student's fingertip. Blood lactate level was measured through lactate pro analyzer (arkray global business, inc, kyoto, japan). After blood test result in number according to lactate analyser was recorded as the score.

Heart Rate:

Previously instructed to all subjects about the measurement of heart rate. The subject's **resting heart rate** was measured at the beginning of the morning. No food substance was taken by the students before the test. They were informed to rest completely for thirty minutes prior to having their heart rates taken. In complete relaxed condition resting heart rate was taken. After the warm up in active rest situation just **before the start of exercise** (Harvard step test) heart rate was taken very carefully. **After Immediate of exercise** (Harvard step test) subject was seated and the heart rate was taken. In sitting position during rest **after completion of seven minutes of exercise** (Harvard step test) again heart rate was taken. Same as before position **after completion of fifteen minutes of exercise** (Harvard

step test) heart rate was taken. Heart rate was taken and recorded as beat/ minute (bpm) for each subject.

STATISTICAL PROCIDURE

Mean, SD and 't' test was calculated for the score on the pre and post-test. Each variable separately and are presented in tabular form in the chapter-IV. For comparison among post test score among means of each parameters within three group's analysis of variance (one way ANOVA) was used. For determine the exact location of difference among three groups least significant difference (LSD) was applied as a Post Hoc test. The level of significance for the study was set at the.01 and .05 levels which were deemed reasonable for the study.

RESULTS AND DISCUSSION

Results are presented and discussed under three major aspects such as

1. Anthropometrical variables, 2. Physical fitness variables and 3. Physiological variables

PERSONAL DATA:

The Mean and SD of age for ICT, CCT & CG groups were 14.35 ± 0.988, 13.75 ± 0.638 & 13.85 ± 0.745. The Mean and SD of weight for three (ICT, CCT & CG) groups were 52.60 ± 9.511, 48.50 ± 6.117 & 51.05 ± 4.058. Similarly, Mean and SD of height for ICT, CCT & CG groups were 1.596 ± 0.050, 1.554 ± 0.059 & 1.579 ± 0.049. From the result of the personal data it may safely be stated that the subjects of three (ICT, CCT & CG) different groups accepted for the study were of homogenous in nature.

ANTHROPOMETRICAL VARIABLES:

BMI (Body Mass Index): The mean and standard deviation (Mean ± SD) values of BMI on pre-test and post test of three (ICT, CCT & CG) groups were 20.57± 3.09, 20.07± 2.06, 19.54± 4.15 and 20.51± 2.44, 20.32± 1.63, 20.79 ± .89 respectively. The t- values of three (ICT, CCT & CG) groups were .389, -1.959 and -1.369. According to obtain t-value of each group between pre test and post test it was statistically not significant at 0.05 level since the table value 2.093 for the df 19 which was higher than the obtained value.

The analysis of variance (One-way ANOVA) was computed on **post-test mean** of three (ICT, CCT & CG) groups, the observed 'F' value of BMI was .355 that was statistically not significant at 0.05 level as it is lesser than table value of ***3.15.*** Thus, indicating insignificant differences among the three groups.

Discussion on BMI: Present study showed that BMI was changed but not significant among three groups after the implication of specified circuit training programme. Similar results were found from the findings of other research reports (Azad et al., 2011; Seo et al., 2021 & Ouerghi et al., 2017). However, compared to the continuous circuit training (CCT) and interval circuit training (ICT) groups, the BMI level was slightly higher in the control group (CG). This study signified that level of BMI was slightly decreased for CCT and ICT groups. It implies that physical training have positive effect on BMI. Kim et al., (2018) found a study where for 12 weeks, circuit training significantly reduced BMI. The current investigation's findings revealed that there were no appreciable differences among the three groups. Russomando et al., (2020) reports that when comparing the beneficial effects of high intensity interval training and moderate intensity continuous training protocols, no significant interaction was found, suggesting that both protocols had comparable effects on all parameters examined.

Body Weight: The mean and standard deviation (Mean ± SD) values of Body weight on **pre-test and post test** of three (ICT, CCT & CG) groups were 52.60 ± 9.51, 48.50± 6.11, 51.05± 4.05 and 52.40 ± 7.86, 49.10 ± 5.19, 91.90 ± 4.05 respectively. The t- values of three (ICT, CCT & CG) groups were, .48, 1.87 and 3.10. t- value of control group (CG) was statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t-value of interval circuit training group (ICT) and continuous circuit training group (CCT) was statistically not significant at 0.05 level since the table value was higher than the obtained value.

The analysis of variance (One-way ANOVA) was computed on **post test mean** of three (CCT, ICT & CG) groups, the observed 'F' value of body weight was 1.805 which was statistically not significant at 0.05 level as it is lesser than table value of 3.15, thus indicating insignificant differences among the three groups.

Discussion on Body Weight: Present study reflected that the Body weight was slightly decreased in case of interval circuit training (ICT) group. Many studies consistent with present study. Kim et al., (2018), Badami (2013), Alahmadi, (2014) Das, (1995) have found

significant decreased of body weight by physical training program. Vale et al., (2020) reported that one of the ways to save time in your weight management programme is interval training. The result of the study indicated that the Body weight was slightly gained in case of continuous circuit training (CCT) and control groups (CG). Brock & Legg, (1997) Shaw et al., (2022) &Van Etten et al., (1994) found significant increase of mass or body weight due to physical training program. According to Badami (2013), adults who are not physically active or who are not fit enough are at risk of developing obesity.

Percentage Of Body Fat: The mean and standard deviation (Mean ± SD) values of Percentage of Body Fat on **pre-test and post test** of three (ICT, CCT & CG) groups were 14.24 ± 7.14, 12.89 ± 4.85, 14.46 ± 4.96 and 13.24 ± 6.70, 12.02 ± 4.65, 15.46 ± 4.84 respectively. The t- values of three (ICT, CCT & CG) groups were 3.84, 5.42 and 7.38. t-Value of interval circuit training (ICT), continuous circuit training group (CCT) and control group (CG) were statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value.

The analysis of variance (One-way ANOVA) was computed on **post test mean** of three (ICT, CCT & CG) groups, the observed 'F' value of Percentage of Body Fat is 2.026 which was statistically insignificant at 0.05 level as it is lesser than table value of *3.15*. Thus implies no significant differences among the three groups.

Discussion on Percentage of Body Fat (%): Present study exposed that there was a notable decline in the percentage of body fat (%) after implication of specified circuit training programme, whereas significantly enhanced body fat percentage for control group (CG). Reduction of body fat following training had been observed by a number of researchers where Kim, (2018); Arenas, et al., (2013); Paoli, et al., (2013) and Hottenrott, (2012) were stated that to have change in human body. On the other side percentage of body fat has been increased for control group. Inactive life may be the cause of grow fat. Similar results were found from the findings of other research reports by Kim et al., (2018) & Romero-Arenas et al., (2013). This investigation displayed about Analysis the result of the study and the other investigators establishment of the research findings concluded that both types of circuit training programme can decreased or maintain of percentage of body fat.

Calf Girth: The mean and standard deviation (Mean ± SD) values of Calf Girth on **pre-test and post test** of three (ICT, CCT & CG) groups were 12.93 ± 2.07, 12.17 ± 1.13, 12.6 ± 1.90 and 13.31 ± 2.14, 12.77 ± 1.28, 12.85 ± 1.57 respectively. The t- values of three (ICT, CCT

& CG) groups were 3.09, 5.64 and 1.87. t-value of interval circuit training ((ICT) group and continuous circuit training (CCT) group was statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t- value (1.87) of control group (CG) was statistically not significant at 0.05 level.

The Analysis of Variance (One-way ANOVA) was computed on **post test mean** of three (ICT, CCT & CG) groups, the observed 'F' value of Calf Girth is .576 which was statistically not significant at 0.05 level as it is lesser than table value of *3.15.* Thus indicating not significant differences found among the three (ICT, CCT & CG) groups.

Discussion on Calf Girth: Present study showed that Calf Girth was significantly enhanced after the implication of specified circuit training programme for each group. Where comparatively among the three groups less changes observed on control group. More or less similar results were found from the findings of other research reports by (Saini & Bhardwaj, 2018) and (Ashwini, 2017). In this present study specified circuit training program adopted by several jump and step moving exercises such as Spot Jump, High Knee, box Jump, Squat Thrust, Steps up etc. (Stewart, 2010) concluded Jump Squat have positive effects on calf girth. Analysis the result of the study and the other investigators establishment of the research findings concluded that both types of circuit training programme can improve calf girth and control group have not significantly changes after twelve weeks of duration.

Thigh Girth: The mean and standard deviation (Mean ± SD) values of Thigh Girth on **pre-test and post test** of three (ICT, CCT & CG) groups were 17.77 ± 2.76, 17.02 ± 1.361, 18.17 ± 2.45 and 18.17 ± 2.47, 17.82 ± 1.33, 18.47 ± 2.04 respectively. The t- values of three (ICT, CCT & CG) groups were 2.74, 8.10 and 1.71. t-value of interval circuit training ((ICT) group and continuous circuit training (CCT) group was statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t- value (1.71) of control group (CG) was statistically not significant at 0.05 level.

The Analysis of Variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of Thigh Girth is .525 which was statistically insignificant at 0.05 level as it is lesser than table value of *3.15.*

Discussion on Thigh Girth: Present study showed that Thigh Girth was significantly enhanced after the implication of specified circuit training programme for first two groups. Where comparatively among the three groups less changes observed on control group (CG).

More or less similar results were found from the findings of other research reports by Saini & Bhardwaj (2017), and Vinu (2012). Present study conducted an organized circuit training schedule which was for 12 weeks and three days per week to identify the effect of training on thigh girth. Similarly Vinu (2012) a twelve-week circuit training program conducted three days a week resulted in a notable improvement in thigh circumference. Analysis the result of the study and the other investigators research findings concluded that both types of circuit training programme can improve Thigh girth.

PHYSICAL FITNESS VARIABLES:

Speed (Sec): The mean and standard deviation (Mean ± SD) values of speed on pre-test and post test of three (ICT, CCT & CG) groups were 8.26 ± 1.00, 8.31 ± .77, 8.50 ± 1.10 and 7.45 ± .64, 7.61 ± .65, 8.99 ± 1.42 respectively. The t- values of three (ICT, CCT & CG) groups were 7.66, 6.29 and -3.29. t-value of interval circuit training (ICT) group, continuous circuit training (CCT) group and control group (CG)was statistically significant at 0.05 level value 2.093 since the table for the df 19 which was lower than the obtained value.

The Analysis of Variance (One-way ANOVA) was computed on post test mean of three experimental groups, the observed 'F' value of Speed is 14.90 which was statistically significant at 0.05 level as it is higher than table value of $F_{(2, 57)} = 3.15$.

To determine the exact location where the differences occur among three groups for speed Post- Hoc test (LSD test) was used. Among the three paired of MD between the ICT & CG and CG & CCT were found statistically significant, since MD of 1.536, & 1.379 were higher than CD (.691)at 0.05 level. Whereas MD was found not significant in case of CCT with ICT group at 0.05 level of confidence.

Discussion on Speed: In present study formed a training schedule to improve strength, flexibility, agility, coordination etc. This attempt was indirectly influenced the speed ability. Marker (2014) found that exercises like depth jumps are an excellent way to build speed and explosive strength. Present study showed that Speed was significantly improved after the implication of specified circuit training programme for Interval and Continuous Circuit Training Group but significantly decreased the speed ability observed on control group. Similar results were found from the findings of other research reports (Krishna, 2020; Rani, 2018; Cregg, 2013; Babu& Kumar, 2013 and Reddy, 2012). Nunney (1960) found improvement in speed by circuit training method. Based on a thorough analysis of the study's

results as well as those of other researchers, it can be concluded that while both CCT and ICT circuit training programs may increase speed, the control group's speed ability those who did not participate in any physical training may have decreased.

Agility (Sec): The mean and standard deviation (Mean ± SD) values of agility on **pre-test and post test** of three (ICT, CCT & CG) groups were 11.70 ± 0.59, 12.21 ± 0.88, 11.82 ± 0.80 and 11.27 ± 0.56, 11.52 ± 0.77, 11.92 ± 0.66 respectively. The t- values of three (I.C.T, C.C.T & C.G) groups were 8.34, 5.28 and -1.07. t-value of interval circuit training (ICT) group and continuous circuit training (CCT) group was statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t-value (-1.07) of Control Group (CG) was statistically not significant at 0.05 level since the table value was higher than the obtained value.

The Analysis of Variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of Agility is 4.729 which was statistically significant at 0.05 level as it is greater than table value of *3.15.*

To determine the exact location where the differences occur among three groups for agility Post- Hoc test (LSD test) was used. Among the three paired of MD between the ICT & CG were found statistically significant, since MD of .6475 was higher than CD (.424) whereas, MD of CG with CCT was nearly significant but MD was found not significant in case of CCT with ICT at 0.05 level of confidence.

Discussion on Agility: Present study showed that Agility was significantly improved after the implication of specified circuit training programme for Interval and Continuous Circuit Training Group but no significant changes observed on control group. Similar results were found from the findings of other research reports (Kumaran et al., 2022; Reddy, 2014; Kumar, 2014; Vinayagamoorthi and Sakthivel, 2014; Rani, 2018; & Vallimurugan.et al, 2022). Kakran & Mishra, (2015) and Pandey & Chaubey, (2015) said that explosive strength is the most dominating variable for the improvement of the agility of an individual. In present research study the training programme used, had specified station wise exercises such as spot jump, box jump, high knee and squat thrust these can improve the leg explosive strength. According to Marker's (2014) findings, depth jumps and related exercises are an excellent means of enhancing both speed and explosive and absolute strength. Comparatively ICT was better effects than CCT on agility. After the completion of specified training program there ICT and CCT were better than the control group (Reddy, 2014).

Leg Explosive Strength: The mean and standard deviation (Mean ± SD) values of leg explosive strength on **pre-test and post test** of three (ICT, CCT & CG) groups were 1.77 ± .20, 1.66 ± .22, 1.63 ± .16 and 1.89 ± .21, 1.78 ± .22, 1.63 ± .15 respectively. The t- values of three (ICT, CCT & CG) groups were 11.46, 11.29 and 1.011. t-value of ICT group and CCT group was statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t- value (1.011) of control group (CG) was statistically not significant at 0.05 level.

The Analysis of variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of leg explosive strength is 8.129 which was statistically significant at 0.05 level as it is greater than table value of **3.15.**

To determine the exact location where the differences occur among three groups for leg explosive strength Post- Hoc test (LSD test) was used. Among the three mean differences between the ICT & CG and CG & CCT were found statistically significant, since MD of .258 & .143 were higher than CD (0.128) at 0.05 level. Whereas MD was found not significant in case of CCT with ICT group at 0.05 level of confidence.

Discussion on Leg Explosive Strength: The results of this study's analysis revealed that Leg explosive strength was significantly enhanced after the implication of specified circuit training programme through 12 weeks but no significant changes observed on control group. Kumar (2016), Reddy (2014), Sakthivel (2014), Meethal and Najeeb (2013), Al-Haliq (2015),Maniazhagu (2022) have particularly found improvement in leg explosive strength with the help of following training. Shekhawat & Chauhan (2021) found that the Circuit training performed on a regular basis in a systematic way it can enhances muscular strength, speed and flexibility. Present research investigation did compare with three groups in respect of leg explosive strength after specified training, here comparatively no changes observed for control group which is similar findings with Vadivel and Maniazhagu (2022) they were found Due to both the training have improved the muscular strength but no development was identified in control group.

Cardio Respiratory Endurance: The mean and standard deviation (Mean ± SD) values of Cardio Respiratory Endurance on **pre-test and post test** of three (ICT, CCT & CG) groups were 77.12 ± 5.19, 79.87 ± 3.44, 78.09 ± 6.52 and 81.44 ± 5.52, 88.01 ± 6.79, 78.04 ± 6.48 respectively. The t- values of three (ICT, CCT & CG) groups were 23.83, 9.58 and .18. t-value of interval circuit training (ICT) group and continuous circuit training (CCT) group was

statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t- value (.18) of control group (CG) was statistically not significant at 0.05 level.

The Analysis of Variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of cardio respiratory endurance is 12.97 which was statistically significant at 0.05 level as it is higher than table value of *3.15.*

To determine the exact location where the differences occur among three groups for cardio respiratory endurance Post- Hoc test (LSD test) was used. Among the three mean differences between the CCT & ICT and CG & CCT were found statistically significant, since MD of 6.567 & 9.969 were higher than CD (3.97) at 0.05 level. Whereas MD was found not significant in case of ICT with CG at 0.05 level of confidence.

Discussion on Cardio Respiratory Endurance: Present study reflected about Cardio Respiratory Endurance was significantly enhanced after the implementation of specified circuit training programme but no significant changes noticed on control group. Some related research studies were observed, from the findings of many other researchers ((Hryvniak et al., 2021; Krishna, 2020; Yunus et al., 2018; Khan et al., 2015 & Venkatseswarul, 2010) concluded that cardio respiratory endurance improved through interval and continuous training methods. Adling & Bangar (2016) came to the conclusion that pre and post-test results for cardiopulmonary endurance showed no appreciable change in the control group. Present study implies that continuous circuit training (CCT) method was effective than interval training method for Cardio respiratory endurance. Sundar et al. (2020) found continuous training was little more effective than interval method.

Flexibility: The mean and standard deviation (Mean ± SD) values of Flexibility on **pre-test and post test** of three (ICT, CCT & CG) groups were 18.07 ± 1.29, 18.10 ± 1.11, 18.05 ± 1.45 and 20.15 ± 1.59, 20.12 ± 1.41, 17.95 ± 1.34 respectively. The t- values of three (ICT, CCT & CG) groups were 16.32, 13.75 and .721. t- value of interval circuit training (ICT) group and continuous circuit training (CCT) group was statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t-value (.72) of control group (CG) was statistically not significant at 0.05 level.

The Analysis of Variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of flexibility is 15.099 which was statistically significant at 0.05 level as it is greater than table value of *3.15.*

To determine the exact location where the differences occur among three groups for flexibility Post- Hoc test (LSD test) was used. Among the three mean differences between the ICT & CG and CG & CCT were found statistically significant, since MD of 2.200 & 2.175 were higher than CD (.919) at 0.05 level. Whereas mean difference was found not significant in case of CCT with ICT group at 0.05 level of confidence.

Discussion on Flexibility: Present investigation showed that flexibility was significantly enhanced after the implication of both types of specified circuit training programme but no significant changes observed on control group. It has been observed from the conclusions of various researchers that flexibility may improved through specified circuit training methods (Dhiman, 2022; Jadhav, 2020; Nonye Ujuagu, 2020; Dharuman, 2020; Shitaneh, 2019; Rani, 2018). This study was conducted circuit training with interval and continuous mode for 12 weeks and three days per week. Girinathan and Lillypuspam (2019) were administered a training for 12 weeks and just thirty minutes a day, especially three days a week for the entire twelve-week period. There were found that interval and continuous training both can enhance flexibility.

PHYSIOLOGICAL VARIABLES:

HEARTRATE

Resting Heart Rate: The mean and standard deviation (Mean ± SD) values of Resting Heart Rate on **pre-test and post test** of three (ICT, CCT & CG) groups were 73.25 ± 1.55, 72.50 ± 1.46, 73.05 ± 1.87 and 70.20 ± 1.54, 68.20 ± 1.90, 73.40 ± 1.69 respectively. t- values of three (ICT, CCT & CG) groups were 13.65, 11.83 and 1.67. t-value of interval circuit training (ICT) group and continuous circuit training (CCT) group was statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t- value (1.67) of control group (CG) was statistically not significant at 0.05 level.

The Analysis of Variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of resting heart rate is 46.355 which was statistically significant at 0.05 level as it is greater than table value of *3.15.*

To determine the exact location of difference among three groups for resting heart rate Post- Hoc test (LSD test) was used. Among the three paired of MD between the CCT & ICT, ICT & CG and CG & CCT were found statistically significant, since MD of 2.000, 3.200 & 5.200 were higher than CD (1.08) at 0.05 level.

Heart Rate Before Activity: The mean and standard deviation (Mean ± SD) values of Heart rate before activity on pre-test and post test of three (ICT, CCT & CG) groups were 75.50 ± 1.76, 75.25± 1.61, 76.10± 1.86 and 73.30 ± 1.52, 71.15 ± 1.92, 76.40 ± 1.87 respectively. The t- values of three (ICT, CCT & CG) groups were 9.78, 9.30 and 1.55. t-value of interval circuit training (ICT) group and continuous circuit training (CCT) groups were statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t- value (1.55) of Control Group (CG) was statistically not significant at 0.05 level.

The Analysis of Variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of Heart rate before activity is 43.74 which was statistically significant at 0.05 level as it is greater than table value of *3.15.*

To determine the exact location where the differences occur among three groups for resting heart rate before activity Post- Hoc test (LSD test) was used. Among the three paired of MD between the CCT & ICT, ICT & CG and CG & CCT were found significant statistically, since MD of 2.150, 3.100 & 5.250 were higher than CD (1.128) at 0.05 level.

Heart Rate After Immediate Exercise: The mean and standard deviation (Mean ± SD) values of Heart Rate after immediate of exercise on **pre-test and post test** of three (ICT, CCT & CG) groups were 159.05 ± 5.56, 159.00 ± 5.48, 160.00 ± 4.53 and 155.60 ± 5.45, 153.15 ± 5.03, 160.50 ± 4.07 respectively. the t- values of three (ICT, CCT & CG) groups were 8.91, 19.40 and 2.12. t-value of CCT, ICT and CG groups were statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value.

The Analysis of Variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of Heart rate after immediate of exercise is 11.720 which was statistically significant at 0.05 level as it is greater than table value of *3.15.*

To determine the exact location where the differences occur among three groups for Heart Rate after immediate of exercise Post- Hoc test (LSD test) was used. Among the three

paired of mean difference between the ICT & CG and CG & CCT were found statistically significant, since MD of 4. 900 and 7. 350 were higher than CD (3.09) at 0.05 level. Whereas MD was found not significant in case of CCT with ICT group at 0.05 level of confidence.

Heart Rate after Completion of Seven Minutes of Exercise: The mean and standard deviation (Mean ± SD) values of Heart Rate after completion of Seven Minutes of Exercise on **pre-test and post test** of three (ICT, CCT & CG) groups were 104.90 ± 2.26, 105.40 ± 2.25, 105.80 ± 1.88 and 102.05 ± 2.43, 99.35 ± 2.71, 105.35 ± 1.49 respectively. The t-values of three (ICT, CCT & CG) groups were 10.39, 17.21 and 1.62. t-value of interval circuit training (ICT) group and continuous circuit training (CCT) group was statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t- value (1.62) of Control Group (CG) was statistically not significant at 0.05 level.

The analysis of variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of Heart Rate after completion of Seven Minutes of Exercise is 34.772 which was statistically significant at 0.05 level as it is greater than table value of *3.15*.

To determine the exact location where the differences occur among three groups for Heart Rate after completion of Seven Minutes of exercise Post- Hoc test (LSD test) was used. Among the three paired of MD between the CCT & ICT, ICT & CG and CG & CCT were found statistically significant, since MD of 2.700, 3.300 & 6.000 were higher than CD (1.44) at 0.05 level.

Heart Rate after Completion of Fifteen Minutes of Exercise: The mean and standard deviation (Mean ± SD) values of Heart Rate after completion of fifteen minutes of exercise on **pre-test and post test** of three (ICT, CCT & CG) groups were 90.10 ± 2.19 , 89.25 ± 2.73, 89.30 ± 2.22 and 86.00 ± 2.57, 84.70 ± 2.61, 89.60 ± 2.32 respectively. The t- values of three (ICT, CCT & CG) groups were 12.36, 15.94 and .97. t-value of interval circuit training (ICT) group and continuous circuit training (CCT) group was statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t- value (.972) of Control Group (CG) was statistically not significant at 0.05 level.

The Analysis of Variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of HR after completion of fifteen minutes of exercise is 20.461 which was statistically significant at 0.05 level as it is greater than table value of *3.15*.

To determine the exact location where the differences occur among three groups for HR after completion of fifteen minutes of exercise Post- Hoc test (LSD test) was used. Among the three paired of MD between the ICT & CG and CG & CCT was found statistically significant, since MD of 3.600 and 4.900 were higher than CD (1.58) at 0.05 level. Whereas MD was found not significant in case of CCT with ICT groups at 0.05 level of confidence.

Discussion on Heart Rate:

After the 12 weeks training decreased the Heart rate after the implication of specified continuous and interval circuit training programme on different (five) states but Control group students' heart rate was more or less same as before. In comparison on five different phases among three groups were significant. In respect of resting heart rate after 12 weeks of training CCT was better than ICT which is significant whereas both of training groups was better than CG which also was significant in Post-Hoc Test. In respect of heart rate before exercise after completion of 12 weeks of training observed the changes same as resting heart rate. In respect of heart rate after immediate exercise after 12 weeks of training CCT and ICT was better than CG which was significant whereas CCT with ICT was not significant in Post-Hoc Test. After 12 weeks of training in respect of heart rate after completion of seven minutes of activity changes observed same as resting heart rate. After 12 weeks of training in respect of heart rate after completion of fifteen minutes of activity CCT and ICT was better than CG which was significant whereas CCT with ICT was not significant in Post-Hoc Test.

In present study accordingly heart rate was recorded at resting condition, after immediate complete of exercise and during recovery period. The majority of research (Khan et al. 2019; Adling and Bangar, 2016; Miller, 2014; Akilan, 2013) shows that exercise causes a considerable decrease in resting heart rates, which is consistent with the results of the current study. After the analysis of result present study observed CCT & ICT both have positive effects to reduction of heart rate but CCT group was slightly better improvement then ICT and CG. Khan et al, (2019) showed the reduction of heart rate can be achieved through both Continuous and Interval training. Control group was delayed to recover towards normal condition than CCT and ICT groups. Where is in view of total five phases of post test

heart rate was higher than training groups. Badami (2012) concluded the pulse rates in resting period, during maximal exercise, and after finishing the Astrand-Ryhming Step Test (ARST) and 5 minutes after ARST physical education students showed considerably lower pulse rates. Students in Physical Education had a higher percentage of heart rate of recovery at five minutes after ARST than students in Medical Education. Buchheit et al. (2006), who found that trained men's pulse rates recovered from exercise more quickly. Analysis the result of the study and the other investigators establishment of the research findings concluded that both types of circuit training programme have positive influence on HR in resting or during recovery period. Training with continuous circuits is superior to training with intervals.

BLOOD LACTIC ACID

Blood Lactic Acid Before Exercise: The mean and standard deviation (Mean ± SD) values of BLA before exercise on **pre-test and post test** of three (ICT, CCT & CG) groups were 1.78 ± .29, 1.75 ± .25, 1.78 ± .303 and 1.59 ± .29, 1.49 ± .24, 1.76 ± .30 respectively. The t-values of three (ICT, CCT & CG) groups were 7.32, 5.98 and .54. t-value of interval circuit training (ICT) group and continuous circuit training (CCT) group was statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t- value (.54) of control group (CG) was statistically not significant at 0.05 level.

The Analysis of Variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of BLA before exercise is 4.80 which was statistically significant at 0.05 level as it is greater than table value of *3.15.*

To determine the exact location where the differences occur among three groups for BLA before exercise Post- Hoc test (LSD test) was used. Among the three mean differences between the CCT & CG were found statistically significant, since MD of .275 was higher than CD (0.180) at 0.05 level. Whereas MD was found not significant in case of ICT with CCT and CG with ICT groups at 0.05 level of confidence.

Blood Lactic Acid After Immediate Exercise: The mean and standard deviation (Mean ± SD) values of BLA after immediate of exercise on **pre-test and post test** of three (ICT, CCT & CG) groups were 9.80 ± 1.32, 9.75 ± 1.46, 9.94 ± .76 and 8.45 ± 1.24, 8.11 ± 1.23, 9.95 ± .76 respectively. The t- values of three experimental (ICT, CCT & CG) groups were 9.00, 7.58 and .073. t-value of interval circuit training (ICT) group and continuous circuit training

(CCT) group was statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t- value (.073) of Control Group (CG) was statistically not significant at 0.05 level.

The Analysis of Variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of BLA after immediate of exercise is 15.701 which was statistically significant at 0.05 level as it is greater than table value of ***3.15.***

To determine the exact location where the differences occur among three groups for BLA after immediate of exercise Post- Hoc test (LSD test) was used. Among the three mean differences between the ICT & CG and CCT & CG were found statistically significant, since MD of 1.495 and 1.840 were higher than CD (0.698) whereas mean difference was found not significant in case of CCT with ICT group at 0.05 level of confidence.

Lactic Acid After Completion of Seven Minutes of Exercise: The mean and standard deviation (Mean ± SD) values of BLA after completion of seven minutes of exercise on **pre-test and post test** of three (ICT, CCT & CG) groups were 8.79 ± 1.06, 9.00 ± .90, 9.09 ± .65 and 7.51 ± 1.18, 7.04 ± 1.03, 9.19 ± .675 respectively. The t- values of three (ICT, CCT & CG) groups were 9.31, 10.48 and 2.23. t-value of three (ICT, CCT & CG) groups were statistically significant at 0.05 level, since the table value 2.093 for the df 19 which was lower than the obtained value.

The analysis of variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of BLA after completion of seven minutes of exercise is 26.132 which was statistically significant at 0.05 level as it is greater than table value of ***3.15.***

To determine the exact location where the differences occur among three groups for BLA after completion of seven minutes of exercise Post- Hoc test (LSD test) was used. Among the three paired mean difference between the ICT & CG and CG & CCT were found statistically significant, since MD of 1.680 and 2.145 were higher than CD (0.624) at 0.05 level. Whereas MD was found not significant in case of CCT with ICT group at 0.05 level of confidence.

Blood Lactic Acid after Completion of Fifteen Minutes of Exercise: The mean and standard deviation (Mean ± SD) values of BLA after completion of fifteen minutes of exercise on **pre-test and post test** of three (ICT, CCT & CG) groups were 7.84 ± 1.03, 8.00 ± .89, 8.09 ± .61 and 6.55 ± 1.07, 6.30 ± .81, 8.11 ± .65 respectively. The t- values of three

(ICT, CCT & CG) groups were 6.39, 10.05 and .18. t- value of interval circuit training group (ICT) and continuous circuit training (CCT) groups were statistically significant at 0.05 level since the table value 2.093 for the df 19 which was lower than the obtained value. Wherein t- value (.184) of Control Group (CG) was statistically not significant at 0.05 level.

The Analysis of Variance (One-way ANOVA) was computed on **post test mean** of three groups, the observed 'F' value of BLA after completion of fifteen minutes of exercise is 25.546 which was statistically significant at 0.05 level as it is greater than table value of *3.15.*

To determine the exact location of difference among three groups for BLA after completion of fifteen minutes of exercise Post- Hoc test (LSD test) was used. Among the three paired of MD between the CCT & ICT, ICT & CG and CG & CCT were found statistically significant, since MD of 0.245, 1.560 & 1.805 were higher than CD (0.624) at 0.05 level.

Discussion on Blood Lactic Acid:

BLA was measured before on-set of exercise, immediate after exercise, after completion of 7 minutes of exercise and after completion of 15 minutes of exercise. Most other researchers have noted that blood samples are collected for lactate analysis between three and five minutes following physical activity (Sawkaet et al., 1979; McMaster et al., 1989; Keskinen et al., 2007 & Vescovi et al., 2011). For this study researcher was selected Harvard step test as an activity. Similarly Chaloupk (1973) observed the effects of interval training programme on different physiological condition and measured the lactic acid after bench stepping for his research investigation. Normally after completion of long physical activity muscles goes under fatigue. This research study showed that after complete of Harvard step test all the three groups goes under fatigue because of the build up of lactic acid in the muscles. Similarly other researchers (Astrand, 1960; & Karlsson & Saltin, 1971) have also shown a slightly higher accumulation of lactic acid during the initial part of the recovery following exhaustion exercise. Research has shown that completing light exercise instead of resting during the recovery phase can accelerate the removal of LA from blood and muscles after intense to maximal exercise (Belcastro & Bonen, 1975; Hermansen & stensvold, 1972 & Dodd et al., 1984). Roy et al., (2014) concluded that an eight-week training program has a beneficial effect on the physiological system; For example, improved sports performance is associated with a higher anaerobic threshold level.

After the 12 weeks training decreased the amount of lactic acid after the implication of specified continuous and interval circuit training programme on different (four) states but

Control group students' bold lactic acid amount was increase on post test score respectively for each phases. In comparison on four different phases among three groups were significant. In respect of blood lactic acid before exercise after 12 weeks of training CCT was better than ICT but not significant whereas, both of training groups were better than CG where CCT was significantly better than CG in Post-Hoc Test. In respect of blood lactic acid after immediate exercise CCT and ICT was better than CG which is significant whereas CCT with ICT was not significant in Post-Hoc Test. whereas blood lactic acid after seven minutes of exercise have observed changes same as after immediate of activity. At the last phase of lactic acid collection where after fifteen minutes of activity CCT and ICT was better than CG and are significant whereas CCT was better than ICT which was also significant in Post-Hoc Test.

According to Fox & Mathews, (1981) that training causes a decrease in the accumulation of lactic acid during a given sub maximal exercise. On the other side Accumulation of Lactic acid depends on intensity and volume of exercise. Views of Mc Ardle et al., (1991) lactic acid becomes greater as exercise become more intense. Here according to students' maximum capacity training load was calculated and implemented proper intensity and volume of training activity. Previously discussed present investigation followed particular types of interval and continuous circuit training methods and according to result of this study interval and continuous both of circuit training has positive effects on lactic acid concentration. Equally a research study (Roy, Paul & Bandopadhaya, 2014) found that an appropriate extended interval training program improves the anaerobic threshold level and reduced blood lactate accumulation. In this study those who were under control group they losses lactic acid tolerance capability than before after experiment of 12 weeks. For control group students' lactic acid amount was increase on post test score respectively for four phases. When comparing the maximal exercise performance with the ventilator anaerobic threshold, Tripathi and Banerjee (1992) showed that the trained group's aerobic status was superior to the untrained groups.

After the observation CCT & ICT both have positive effects to reduction of lactic acid accumulation than pre test score but CG was not improved on lactic acid accumulation than before. Control group was delayed to recover towards normal condition than CCT and ICT groups. Many investigators have reported similar findings to the current study in the majority of studies (Chaloupka, 1973 Sjodin et al., 1981 İpekoğlu et al, 2018, Goodwin & Harris, 2007) denotes significant reductions about amount of lactic acid concentration and physiological efficiency in response to physical training.

4.5. TESTING OF HYPOTHESIS

In hypothesis **1** it is expected that there would be no significant influence in any anthropometric variables- BMI, Body-weight, Percentage of body fat, Calf girth, Thigh girth due to interval circuit training.

The findings of the study stated that hypothesis 1 relating to anthropometric variables such as BMI and Body-weight is accepted whereas Percentage of body fat, Calf girth and Thigh girth is rejected.

In hypothesis **2** it is expected that there would be no significant influence in any anthropometric variables- BMI, Body-weight, Percentage of body fat, Calf girth, Thigh girth due to continuous circuit training.

The findings of the study stated that hypothesis 2 relating to anthropometric variables such as BMI and Body-weight is accepted whereas Percentage of body fat, Calf girth and Thigh girth is rejected.

In hypothesis **3** it is expected that there would be no significant difference in anthropometric variables- BMI, Body-weight, Percentage of body fat, Calf girth, Thigh girth among interval circuit training group, continuous circuit training group and control group.

According to the study's findings indicated that no significant difference on anthropometric variables- BMI, Body-weight, Percentage of body fat, Calf girth, Thigh girth among continuous circuit training group, interval circuit training group and control group after experiment. Hence the hypothesis 3 is accepted.

In hypothesis **4** it is expected that there would be no significant influence in any physical fitness variables- Speed, Agility, Flexibility, Leg explosive strength and Cardio respiratory endurance Due to interval circuit training.

According to the study's findings indicated that significant improvement on physical fitness variables- Speed, Agility, Flexibility, Leg explosive strength and Cardio respiratory endurance Due to interval circuit training. Hence the hypothesis 4 is rejected.

In hypothesis **5** it is expected that there would be no significant influence in any physical fitness variables- Speed, Agility, Flexibility, Leg explosive strength, Cardio respiratory endurance due to continuous circuit training.

According to the study's findings stated that significant improvement on physical fitness variables- Speed, Agility, Flexibility, Leg explosive strength and Cardio respiratory endurance Due to continuous circuit training. Hence the hypothesis 5 is rejected.

In hypothesis **6** it is expected that there would be no significant difference in physical fitness variables- Speed, Agility, Flexibility, Leg explosive strength, Cardio respiratory endurance among interval circuit training group, continuous circuit training group and control group.

According to the study's findings indicated that there is significant difference in physical fitness variables- Speed, Agility, Flexibility, Leg explosive strength, Cardio respiratory endurance among continuous circuit training group, interval circuit training group and control group after experiment. Hence the hypothesis 6 is rejected.

In hypothesis **7** it is expected there would be no significant influence in any physiological variables- Heart rate and blood lactic acid concentration due to interval circuit training.

According to the study's findings stated significant influence in physiological variables- Heart rate and blood lactic acid concentration due to interval circuit training. Hence the hypothesis 7 is rejected.

In hypothesis **8** it is expected that there would be no significant influence in any physiological variables- HR and BLA concentration due to continuous circuit training.

According to the study's findings indicated that significant influence in physiological variables- Heart rate and blood lactic acid concentration due to continuous circuit training. Hence the hypothesis 8 is rejected.

In hypothesis **9** it is expected that there would be no significant difference in physiological variables- HR and BLA concentration among interval circuit training group, continuous circuit training group and control group.

The findings of this investigation stated that there is significant difference in physiological variables- HR and BLA concentration among continuous circuit training group, interval circuit training group and control group after experiment. Hence the hypothesis 9 is rejected.

SUMMARY AND CONCLUSSION

To get success in every sector there require systematic training for execute accurate skill on their specified demands. Similarly, in the realm of sports, scientific and methodical training ought to be necessary to improve athletic performance. Sports training is a designed and continuous procedure aim to reach at actual destination as a true success by execute of proper skills. A complete sportsman is not complete with physical fitness, skill, tactics and technique but need to possess cognitive functions, personality traits, interest, habits, attitude, emotional stability etc. thus, training is required with systematic and scientific variation for the enhancement of above all these components.

Sports' training is mainly focused on maximum level of performance ability of a sports person in a specified sport. In scientific view of sports training present study adopted deferent types of sports training methods to identify the effects on physical fitness, anthropometrical and physiological components.

Each and every area or field it has hold a particular destination which based on own way of principles. Training means planned activity with the help of scientific support for preparation to achieve the goal. Same as in the area of sports activities, principles of the sports training methods are the strong guidance for the trainer, coaches, teachers and sportsmen to formulation, implementation and control of effective sports training programme for athletes or team. After the theoretical analysis about the science of sports training deferent principles were established by many researcher, investigator, educationist etc. (Harre; 1979, Matawejew; 1981, Singh; 1984). From many of principles some selected principles of the sports training are follows- a) Principle of Continuity, b) Principle of progression of Load, c) Principle of Individualization, d) Principle of Balance, e) Principle of Recovery, f) Principle of Specificity, g) Principle of Variation, h) Principle of Planned & Systematic Training, i) Principle of Cyclicity:

Sports performance highly depends on physical, physiological and anthropometrical components of human body. Previously discussed about the concept and how it important for an athletes and general peoples. Physical fitness can be divided into two categories: performance-related fitness and health-related fitness. Muscular strength, muscular endurance, body composition, flexibility, and cardiovascular endurance are all components of health-related physical fitness these all the components are very important for every normal life activity and However, performance related physical fitness is associated with speed,

33

power, coordination, agility, balance, and reaction time basically all the components are very vital for sports performance. To prepare for competition simply need a well-structured training programme on basis of individual demand. Many research study fund that scientific sports training methods can improve the physical fitness efficiency (Maniazhagu, 2022; Krishna, 2020; Rani, 2018; Cregg; 2013, Babu & Kumar; 2013, Reddy; 2012 & Sakthivel 2014).

Physiological components like as heart rate, blood pressure, blood, blood lactic acid etc. these all are the essential to promote sports performance. Internal physiological functions are associated with external body movements. Many research studies established that physical training may effective to improve physiological potentialities. Holmgren et al. (1960) and Venkateswarlu (1975) while working on young athletes have shown the reduction of pulse rate due to different training methods. Significant positive changes found due to implication of physical training on blood lactate concentration (Hurley et al, 1984; Bandyopdhyay, 1984 &Connet et al., 1985). Yoshida et al. (1982) studied on healthy male college students and found that endurance training decreased blood lactate content during the sub-maximal exercise significantly. On the other side Richardson and Hardman (1989) found a significant relationship between blood lactate concentrations with endurance time.

Research finding of a number study proved that the sports person's anthropometric characteristics are too related with high athletic performances. BMI, Percentage of body fat, Height, Weight, Thigh girth, Calf girth etc. as Anthropometrical components all are essential factor for successful skill execution. Glick and Kaufmann (1976) observed lowering of the body weight due to physical training. Adeniran and Toriola (1988) found a result on some school going boy's significant reduction of percentage of body fat among the trained comparison with untrained students. Alex Stewart (2021) concluded Jump Squat have positive effects on calf girth. Specified training programme can enhance the thigh and calf girth of an athlete's (Saini & Bhardwaj, 2017; Vinu, 2012 &Ashwini, 2017).

Accordingly, the present study was planned to initiate research work related to the estimation of effect of 12 weeks of proposed scientific training program formulated by expert of the field on different parameters to measure and compare the training effect of continuous and interval circuit training methods on physical fitness, physiological and anthropometric variables. Researchers are attempting to determine the study's objectives, which include observing the training effects of both continuous and interval circuit training on

physiological, anthropometric, and physical fitness variables, as well as comparing the training effects of the three groups with regard to anthropometric, physiological, and physical fitness variables.

This study involved a total of sixty boys (N = 60) as subjects. The subjects were randomly selected after medical screening from purulia cricket academy, Purulia district of West Bengal. Subjects in the research were between the ages of 13 to 16 years. For present study, after primary selection of sixty (60) boys as subjects they were distributed into three equal groups using a simple random grouping technique, each group was consisted of twenty (N= 20) students. The experimental groups were intervened through scientifically structured continuous circuit training and interval circuit training program separately for twelve weeks whereas the control group was free from intervention of any kind of structured training program.

After reviewed the literatures and discussed with professional coaches, expert and supervisor researcher selected following variables in three heads namely anthropometric, Physical fitness and Physiological variables. From the area of anthropometrical perspective following parameters were considered- BMI, Body-weight, Percentage of body fat, Calf girth, and Thigh girth. On physical fitness perspectives following parameters were considered- Speed, Agility, Flexibility, Leg explosive strength, and Cardio respiratory Endurance. On view of Physiological perspectives of human body following parameters were considered- Heart rate and Blood lactic acid

The experimental setup for the present study included sixty subjects (N = 60). Sixty (60) subjects in total were randomly assigned to three groups (ICT, CCT, and CG), each with twenty (20) subjects. The two experimental groups in this study were the Continuous Circuit Training group (CCT), the Interval Circuit Training group (ICT) and another was Control group (CG). Both of experimental Groups underwent circuit training following continuous and interval method respectively for twelve (12) weeks, three (3) days in a week. The CG they were stopped from participating in specified training methods but involved in their regular routine schedule. Before and after the training, each subject underwent testing on selected variables. The study was under experimental type of research and for this investigation pre-test post-test control group design was applied.

After reviewed the researcher discussed with fitness trainer, coaches, exercise expert and supervisor and selected the training methods along with specific exercises. There were

eight stations with the same eight physical exercises for both the interval circuit training and the continuous circuit training methods. Structure of an individual subjects training procedure as these way, At first 7 minutes warming up activity with jogging, shuffling and stretching was mandatory for both of groups. Whereas the stations for the experimental groups I (ICT) and II (CCT) were similar, the recovery times and procedures for changing between the stations differed. Although the interval circuit training group took two minutes of active rest before restarting the circuit, the continuous circuit training group did not have a recovery period. Those who were in interval circuit training method they were involved with slow jogging from one station to another station and those who were in continuous circuit training they carried normal walking from one station to another station. Every day, both experimental groups performed a total of three circuits (3- Sets). One instructor was allotted, where situated starting and finishing line those who access stopwatch and whistle. One instructor had been observed over all circuit activities. For each performer was a peer who guided individual score sheet and a stop watch. Training was performed three days a week. Training continued for twelve weeks in total. Group III served as the control group (CG), which only engages in their regular activities on a daily basis. Both of experimental groups performed on circuit according to their maximum individual effort and capacity. First four weeks followed the load 70 % of their maximum capacity. After completion of first four weeks researcher again recorded maximum capacity of the students and fifth to eight weeks followed the progression of load 75 % of their maximum capacity. Again same as before determined the maximum capacity and ninth to twelve weeks followed the progression of load 80 % of their maximum capacity.

The data were collected according to specific procedures. The results are presented in tabular forms as well as in graphical structure. All the data were gathered from two 'states' where one was before the start of the training programme and the other was after completion of 12 weeks of training programme.

Results were discussed and analyzed under three different aspects such as Anthropometric, Physical fitness and Physiological variables.

On anthropometric parameters Percentage of body fat (%), Calf and Thigh girth were significant for ICT and CCT groups on pre test and post test score after training but CG was not significant. BMI was not significant for three groups on pre test and post test score after the training. Body weight was not significant for ICT and CCT groups on pre test and post

test score but CG was significant after training. In comparison among three groups were not significant for all the anthropometrical parameters on post test score after training. **All the physical fitness parameters** were significant on pre test and post test score for CCT and ICT groups after training. Without speed no significant result observed on all the physical fitness parameters for control group (CG), wherein speed was significant for control group. In comparison among three groups were significant for all the physical fitness parameters on post test score after training. **On Physiological Parameters** all phases of HR and BLA were significant on pre test and post test score for CCT and ICT groups after training. Wherein after completion of seven minutes of exercise was significant for control group without this phase all phases of HR and BLA were not significant for CG. In comparison among three groups were significant for all the phases of HR and BLA on post test score after training.

CONCLUSIONS

Present research study has its own limitations and considering these perspectives following precise conclusions are drawn on the basis of the research findings.

On anthropometric variables

1. BMI was not changed significantly for ICT, CCT & CG after the completion of training and in comparison among three groups were not significant after training.

2. **Body weight** was not changed significantly for ICT and CCT groups but significantly changed for control group. In comparison among three groups were not significant after training.

3. Percentage of body fat (%) was significantly decreased for ICT and CCT groups but significantly increased for control group. In comparison among three groups were not significant after training.

4. Calf Girth was significantly enhanced for CCT and ICT groups and control group was not significant. Where comparatively among the three groups were not significant after training.

5. Thigh Girth was significantly enhanced for CCT and ICT groups and control group was not significant. Where comparatively among the three groups were not significant after training.

On Physical Fitness variables

6. Speed was significantly improved for ICT and CCT Group but significantly decreased the speed ability for control group. Where comparatively among the three groups were significant after training. In Post- Hoc test CCT with ICT was not significant But CG with ICT and CG with CCT was significant.

7. Agility was significantly improved for ICT and CCT Group but not significant changes for control group. In comparison among three groups were significant after training. In Post- Hoc test CCT with ICT and CG with CCT were not significant. But CG with ICT was significant.

8. Leg explosive strength was significantly enhanced for ICT and CCT Group but not significant changes observed on control group. In comparison among three groups were significant after training. Where CCT with ICT groups were not significant but ICT and CCT with CG was significant.

9. Cardio Respiratory Endurance was significantly improved for CCT and ICT but no significant changes observed on control group. In comparison among three groups were significant after training. Where CCT with ICT and CG with CCT groups were significant but ICT CG was not significant.

10. Flexibility was significantly enhanced for ICT and CCT Group but not significant changes observed on control group. In comparison among three groups were significant after training. Where CCT with ICT groups were not significant but ICT and CCT with CG was significant.

On Physiological Variables

On Heart Rate:

11. Resting heart rate was significantly decreased for CCT and ICT groups but not significant changes observed in control group. In comparison among three groups were significant after training. Where CCT was significantly better than ICT but CCT and ICT both of training groups were significantly better than CG.

12. Heart rate before exercise was significantly decreased for CCT and ICT groups but not significant changes observed in control group. In comparison among three groups were

significant after training. Where CCT was significantly better than ICT but CCT and ICT both of training groups were significantly better than CG.

13. Heart rate after immediate of exercise was significantly decreased for CCT and ICT groups but significantly increased in control group. In comparison among three groups were significant after training. Where CCT and ICT groups were not significant but CCT and ICT both of training groups were significantly better than CG.

14. HR after completion of seven minutes of exercise was significantly decreased for CCT and ICT groups but not significant changes observed in control group. In comparison among three groups were significant after training. Where CCT was significantly better than ICT but CCT and ICT both of training groups were significantly better than CG.

15. HR after completion of fifteen minutes of exercise was significantly decreased for CCT and ICT groups but not significant changes observed in control group. In comparison among three groups were significant after training. Where CCT with ICT was not significant but CCT and ICT both of training groups were significantly better than CG.

On Blood Lactic Acid:

16. Blood Lactic acid before exercise was significantly decreased for CCT and ICT but not significant changes observed in CG. In comparison among three groups were significant after training. Where CCT was better than ICT but ICT and CCT groups were better than CG but not significant.

17. Blood Lactic acid after immediate of exercise was significantly decreased for CCT and ICT but not significant changes observed in CG. In comparison among three groups were significant after training. Where CCT with ICT was not significant but ICT and CCT groups were significantly better than CG.

18. BLA after completion of seven minutes of exercise was significantly decreased for CCT and ICT but significantly increased in control group. In comparison among three groups were significant after training. Where CCT with ICT was not significant but CCT and ICT were significantly better than CG.

19. BLA after completion of fifteen minutes of exercise was significantly decreased for CCT and ICT but not significant changes observed in control group. In comparison among

three groups were significant after training. Where CCT and ICT were significantly better than CG and CCT were significantly better than ICT.

CONCLUDING REMARKS:

From the findings of this study and after critical analysis of data it appears that both the groups have improved significantly in selected anthropometrical, physical fitness and physiological parameters. Whereas inter group analysis did not reflect very positive results from which it can be concluded that the ICT group is better than CCT or CCT is better than ICT. Critical analysis have clearly shown that so far anthropometric parameters are concern no significant differences between the two groups existed before and after the training. In Physical fitness only significant deference found in cardio respiratory endurance between the two groups where CCT was better than ICT. In other parameters of physical fitness differences are existed but not statistically significant.

However in physiological parameters some remarkable observations were made while both the groups were critically analyzed. Resting heart rate, immediate before activity and immediate after seven minutes of exercise (Harvard step test), HR (Heart rate) of CCT found significantly lower than that of ICT. Similarly BLA (Blood Lactic Acid) after fifteen minutes completion of exercise was found significantly lower in CCT group than ICT group. This observation is not unusual since cardio respiratory endurance was better in CCT group than ICT group.

Finally from these findings it may safely be concluded that both the training is effective in development of physical fitness and physiological potentialities. However, since continuous circuit training (CCT) has better in development of cardio respiratory endurance and thereby influenced the accumulation of BLA. Possibly it would not be fair to arrive in such an impression that continuous circuit training (CCT) was better than Interval circuit training (ICT).

RECOMMENDATIONS

From the findings of the present research study following recommendation have been drawn for the physical education teacher, sports scientist, coaches, exercise expert, physical trainer, sports person, research scholar and general peoples.

1. Present study delimited to 13-16 years of age group, same study can be conducted with female and other age groups.

2. Present study was delimited to specific anthropometrical, physical, and physiological parameter which can be extent to its feasibility in other related study.

3. Similar research may be conducted with greater number of subjects.

4. Future research may be conducted on detail molecular and cellular level analysis to unveil more potential effect of circuit training on different set up.

5. Correction study among blood lactic, oxygen uptake and heart rate may reveal a true picture of physiological adaptations which was not covered that I have studied may be immensely useful.

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Countersigned by the supervisor   Signature of the Candidate

Dated: Dated: