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EFFECTS OF CIRCUIT TRAINING PROGRAM ON SELECTED PHYSIO-PHYSICAL FITNESS VARIABLES OF GOVERNMENT AND PRIVATE SCHOOL STUDENTS

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ABSTRACT
Physical education is important in the wellbeing of pupils' health, fitness and lifelong engagement with physical activity. However, not too many school children are able to benefit from the regular training programmes that are organised in an organised manner which helps to improve physical fitness and physiological fitness. This study examines how a 12-week circuit training programme influences selected physiological and physical fitness variables among male students from government and private schools. The study involved 80 male students aged 14 to 19 years, selected from Hazaribagh district schools in Jharkhand, and assessed through a methodology incorporating pre-test and post-test control groups. Vital signs, blood pressure, resting heart rate, strength, endurance, agility, and speed were among the factors. For 12 weeks, individuals in the experimental group engaged in a circuit training program five days a week, while participants in the control group maintained their regular activities. The findings showed that while the other physiological indicators showed positive but not statistically significant changes, the experimental group had higher improvement, especially in physical fitness metrics. The research findings suggest that circuit training is an effective, practical and cost-efficient school-based intervention to improve student fitness in government and private schools.

KEYWORDS: Circuit training, Physical fitness, Physiological variables, School students, Experimental study

1. INTRODUCTION

Physical education is an essential component of the curriculum that helps kids develop in a balanced way through physical activity, motor learning, fitness development, health education, discipline, collaboration, and lifelong fitness Physical education in the school provides structured opportunities for students to develop cardiovascular endurance, muscular strength, flexibility, agility, speed and functional capacity. Physical activity during adolescence is of special importance, when physical, physiological, psychological and social development is so dynamic. Recent studies have shown that structured training with high intensity circuit and interval execution can positively influence physical and lung related variables in males, and this makes it relevant to consider this type of structured training as an effective method to enhance physical and physiological capacity [1].

This is a practical and efficient training method. Circuit training means doing a series of exercise stations one after the other with short rest breaks in between. Combines body weight, resistance, endurance and functional exercises and can be used to target several fitness components in one training session. This kind of training is proven to be advantageous in enhancing cardiorespiratory fitness and muscular strength important qualities in school children and in the physically active population as well [2]. Additionally, it has been demonstrated that school-based circuit training helps elementary school students' local muscle endurance. Thus, making it appropriate for primary school use [3]. School students differ in fitness, activity habits, facilities and access to organised physical education. Circuit training may provide a structured and adaptable means of enhancing specific physical and physiological properties.

Physical fitness of school students is an important issue because decrease in activity levels, absence of structured physical activity, academic stress and sedentary lifestyle can negatively affect one's performance and health. The benefits of physical activity interventions with school children have been demonstrated and organised physical activity programmes can make a significant contribution to student health [4]. These are just some of the examples of the value of physical activity participation during the school years for long-term health development that can be found in more general research on physical activity behaviour in children and youth [5]. But many students, especially in disparate school environments, may not be provided the same opportunities in systematic fitness training. The students' physical and physiological responses to a structured training programme can be influenced by differences in infrastructure, sport facilities, supervision, training exposure and participation between government and private schools.

The current investigation aims to determine the problem whether a structured circuit training programme can produce significant changes in selected physio-physical fitness variables of government and private school students. Other studies have demonstrated the physiological relevance of such training methods, showing that circuit and interval training can make a physiological impact on vital capacity and VO_2 max [6]. Agility drills, speed and quickness drills, and jump roping

are beneficial for agility along with circuit training [7]. Circuit-based training with associated drills has also been demonstrated to improve upper-body muscular endurance [8]. The results show that circuit training may improve physical fitness and physiological functions. However, further studies are needed to compare this training method with other training methods within a structured framework of school aged students.

The current research focuses on the male student population from both government and private schools in Hazaribagh district, Jharkhand. A total of 80 students take part in the study. The participants were divided into two equal groups, with 40 students assigned to the experimental group and 40 to the control group. The experimental group consisted of twenty children from public schools and twenty from private schools. Likewise, the control group included 20 students from public schools and 20 from private schools, all ranging in age from 14 to 19 years. The circuit training programme is twelve weeks, five days a week. Vital capacity, blood pressure, and resting heart rate are chosen physiological variables. Agility, speed, strength and endurance are selected physical fitness variables. Some of the study's limitations are lifestyle, food habits, climate, daily routine, motivation and students' activities outside the training program.

This research is important because the results can be used in physical education, school fitness program and health promotion for students. Structured training has been shown to improve speed and agility in male students in a 12-week circuit training programme [9], leading to the use of circuit training for school-age students. Also, the relationship between game-based and conventional physical education programs and the improvement of physical fitness and mental health among elementary school children has been found [10]. School-based interventions have the potential to influence health-related physical fitness and health-related outcomes positively, which are important indicators of student well-being [11]. Hence, the results of this research can be useful for training physical education teachers, coaches and school administrators for designing suitable training programs aiming at improving the physio-physical fitness of students in public and private educational institutions. The aims of the research are:

- To examine A twelve-week circuit training program's impact on a few physical fitness metrics of male government and private school students.
- To investigate how a twelve-week circuit training program affected a few physiological traits of male students attending government and private schools.
- To examine how the control and experimental groups differed in a few physio-physical fitness indicators before and after testing.

2. LITERATURE REVIEW

Circuit training and other conditioning methods' effects on physiological and physical fitness have been studied in a number of populations in the past. The use of circuit training has been popular due to the integration of strength, endurance and speed training, along with cardio exercises, into a series of stations. This is highly time efficient and can be used to enhance multiple fitness components. The study investigated the effects of circuit training, fartlek training, and small-sided games on the improvement of maximum oxygen uptake in futsal athlete. The results showed that structured training techniques could enhance aerobic capacity, but the study was conducted amongst athletes and primarily on VO_2max, with little focus on other physio-physical variables of the school environment [12].

Research conducted by student futsal athletes also showed that the VO_2max is influenced by training techniques and lung vital capacity. The relevance of this study is that it relates respiratory function to aerobic performance; thus, physiological factors like vital capacity should be considered when assessing training effects. The sample, however, was restricted to futsal players and the results cannot be extrapolated to the general school population in different educational contexts [13]. In the same way, another comparison study between circuit and interval training showed that futsal players improved their VO_2max. The strength of this research is the experimental approach while its weakness is that it was conducted on trained players and not school level comparing government and private schools.

Circuit training-induced physiological changes have also been observed in studies with adult and tactical populations. Tactical circuit training was shown to have a greater beneficial effect on blood pressure and vascular health compared to traditional resistance training. This suggests that, in addition to the more typical muscular fitness benefits, circuit training might also yield cardiovascular advantages. The population, however, included firefighters and tactical personnel, and because of their differences in age, training, and physiological requirements, these are not the same as adolescent school students [15]. The study with sport science students showed that a circuit training programme for 12 weeks enhanced Components of physical fitness pertinent to health: muscular strength, muscular endurance, and flexibility. This is in line with the fitness benefits of circuit training but not school students [16].

Specific physical fitness components have been investigated in other studies. It was concluded that circuit training could enhance the explosive power of leg muscle, and circuit training is important for strength and power development [17]. HIRC also resulted in higher CR and metabolic responses compared to ST in soccer players. This implies that the circuit formats might generate more acute physiological demands, but the study focused on short-term responses and not long-term outcomes of school-based interventions [18]. A study that compared endurance training with circuit resistance training in healthy young adult women showed that there were improvements in cardiovascular risk factors and body composition markers. This represents the general health benefits that can be seen with structured physical activity, but the population and variables were not the same as adolescent male school students [19].

Research more relevant to the study of today has demonstrated that circuit training can increase several fitness components. For eight weeks, male sport science students participated in a circuit training program that greatly improved their anaerobic capacity, cardiovascular endurance, muscular strength, and agility. Multiple fitness variables were used in this study, which was not performed in a school environment, and physiological variables (blood pressure, vital capacity, and resting heart rate) were not studied together [20]. Study findings on Variations in Physical fitness among male students

in government and private educational institutions did find some differences in selected fitness variables, which suggest that differences in facilities, training exposure and physical education opportunities may be responsible for differences in fitness Condition of pupils in public and private educational institutions. The present study was, however, comparative and not examining the effect of a structured circuit training intervention [21]. Another study found that circuit interval training improved female badminton players' vital capacity and VO_2 max, indicating the physiological efficacy of training regimens. However, it was done in the context of female athletes, and not on male school students or on a comparison between government and private schools [22].

Overall, findings from earlier research indicate that circuit training can improve aerobic capacity, muscular strength, agility, endurance, explosive power, blood pressure, vital capacity, and various other fitness-related aspects. However, much of the current research has been conducted on athletes, university students, female participants, tactical populations or specific sport groups. There hasn't been much research done on how a structured 12-week circuit training (CT) program affects male schoolchildren's physiological and physical fitness metrics. Limited evidence is also available to compare students from government and private schools in the same experimental design. Accordingly, the current investigation seeks to address the gap by examining how a 12-week circuit training program affects specific physical fitness metrics male students of government and private school.

3. METHODOLOGY

3.1 Research Design

The study employed an experimental approach to assess the effects of a circuit training program on particular physical health indicators among students attending both public and private schools. A design with a control group that included pre-test and post-test was employed. The participants were divided into two groups: an experimental group and a control group. During the study duration, the experimental group participated in a structured circuit training program, whereas the control group continued without any specific training intervention.

Five days a week of training were provided during the 12-week intervention. Measurements were taken both prior to and following the training program's 12-week intervention phase. The design made it possible for the researcher to determine if schoolchildren in the circuit training and control groups differed significantly in a few physiological and physical fitness characteristics.

3.2 Population and Sample

The study group included students from both public and private schools. Hazaribagh district, Jharkhand. The total number of students selected as subject of the study were 80 male students, who were randomly sampled. The sample comprised the pupils from both public and private educational institutions.

The subjects selected were split up Divided into two categories. The experimental cohort was made up of 20 government schoolboys and 20 private school boys. The control group was made up of 40 students, comprising 20 boys from public schools and 20 boys from private institutions. Hence, the overall sample size for the study consisted of 80 students.

3.3 Dataset Description

The data for this study was a primary data which was obtained directly from the selected school students. Selected physiological and physical fitness data were collected before and after. Vital capacity, blood pressure, and resting heart rate were physiological factors. Physical fitness characteristics included strength, endurance, speed, and agility.

Blood pressure was taken by using sphygmomanometer and recorded in mmHg. Spirometer was used to measure vital capacity in litres. Resting heart rate was taken with pulse rate monitor and recorded in beats per minute. Agility was evaluated through the shuttle run test, with the time documented in seconds. The 50-metre run was used to test speed, which was timed in seconds. They tested strength by measuring the standing broad jump in centimetres. The bent knee sit up test was used to assess endurance, which was counted as quantity of repetitions for each minute. The final data included both pre- and post-test findings for each of the selected physical-physical fitness characteristics, school type, group type, and demographic grouping.

3.4 Training Intervention

A 12-week circuit training program was followed by the experimental group. Five days a week, the instruction was conducted, and each training session was about 60 minutes long. The circuit training programme consisted of a warmup, choice of exercise stations, rest and cool down.

The exercises that were added to the circuit training programme were pull-ups, bent knee sit-ups, squat jumps, push-ups, leg raises, step-ups, ladder jumps and plank. Three sets of each exercise, using the prescribed number of reps. A rest interval of 30 seconds was given between exercise stations, and a 2-minute rest interval was given between sets. The warm-up and cool-down periods lasted five minutes and ten minutes, respectively.

Throughout the trial period, the control group did not get any specialized instruction. They carried on with their everyday routines.

3.5 Criterion Measures and Tools

Table 1 displays the chosen variables along with their corresponding testing tools.

Table 1: Criterion Measures and Testing Tools for Selected Physio-Physical Fitness Variables

Variable	Test/Equipment	Unit of Measurement

Blood Pressure	Sphygmomanometer	mmHg
Vital Capacity	Spirometer	Litres
Resting Heart Rate	Pulse Rate Monitor	bpm
Agility	Shuttle Run	Seconds
Speed	50-Meter Dash	Seconds
Strength	Standing Broad Jump	Centimetres
Endurance	Bent Knee Sit-Up	Repetitions per minute

The physical fitness variables were selected with reference to the AAHPER Youth Fitness Test battery.

3.6 Data Collection Procedure

The process of gathering data included two stages. Measurements were taken before the start of the training program for both the experimental and control groups. Post-test measurements were conducted after the completion of the 12-week circuit training program.

To guarantee consistency and avoid testing bias, all tests were conducted under comparable environmental settings. The pre-test and post-test were carried out in an identical way, utilizing the same testing tools and measurement methods. The collected data were then tabulated by groups, school types and selected variables for statistical analysis.

3.7 Data Analysis

The analysis of data utilized both descriptive and inferential statistics. The descriptive statistics, including mean and standard deviation, summarized the pre-test and post-test results of the chosen variables.

The impact of the circuit training program was evaluated by examining the pre-test and post-test results of the experimental group using a dependent t-test. The identical test was conducted on the control group to assess if any natural changes took place during the study duration. Additionally, ANCOVA was employed to examine the outcomes between the experimental and control groups, accounting for pre-test scores. The alpha level was set at 0.05.

The formula below was utilized to calculate the average:

$$\bar{X} = \frac{\sum X}{N} \quad (1)$$

Where:

$$\bar{X} = \text{Mean} \quad (2)$$

$$\sum X = \text{Sum of all scores} \quad (3)$$

$$N = \text{Number of subjects} \quad (4)$$

The following formula was used to get the standard deviation:

$$SD = \sqrt{\frac{\sum (X - \bar{X})^2}{N}} \quad (5)$$

The formula used to calculate the dependent t-test is as follows:

$$t = \frac{\bar{D}}{SD_D/\sqrt{N}} \quad (6)$$

Where:

$$\bar{D} = \text{Mean difference between pre-test and post-test scores} \quad (7)$$

$$SD_D = \text{Standard deviation of the differences} \quad (8)$$

$$N = \text{Number of paired observations} \quad (9)$$

The results were interpreted to determine whether the Certain physio-physical fitness indicators were significantly impacted by the circuit training program of government and private school students.

3.8 Ethical Considerations

After receiving approval from the appropriate school authorities, data collecting was carried out. The students were given an explanation of the study's objectives, methods, and requirements. The individuals involved were all volunteers, and informed written consent was given. Parental/guardian consent was also obtained for students under 18 years of age. All participants' identity and personal information was kept confidential.

The training programme and test protocol were carried out in a safe and hygienic way. All measurements were conducted under supervised conditions, and no student was required to engage in a measurement which he could not perform.

4. RESULTS

The findings obtained from the study are presented in the way it would show the impact of the 12-weeks program for circuit training on specific physiological and physical fitness factors of government and private school students. The pre-test and post-test results for both the experimental and control groups were utilized to reach the conclusions. To investigate modifications within each group and variations between groups, descriptive statistics, paired-sample t-tests, and ANCOVA were employed at a significance level of 0.05.\

4.1 Sample Profile

The distribution of the sample is presented first to provide an overview of the composition of the study groups. The quantity of students in government and private schools was equal for both the experimental and control groups.

Table 2: Distribution of Participants According to Group and School Type

Group	Government School Students	Private School Students	Total
Experimental Group	20	20	40
Control Group	20	20	40
Total	**40**	**40**	**80**

The overall count of schoolboys involved in the research was 80 (refer to table 2). The experimental group consisted of 40 students, with 20 from government schools and 20 from private institutions. The participants were split into two groups: one control group and one experimental group. The control group was made up of 40 students, with 20 coming from public schools and 20 from private schools. This fair allocation allowed the groups to be similar in the research.
The overall structure of the research is outlined using a simple experimental model. It depicts the sequence of pre-test evaluation, intervention, and post-test assessment.

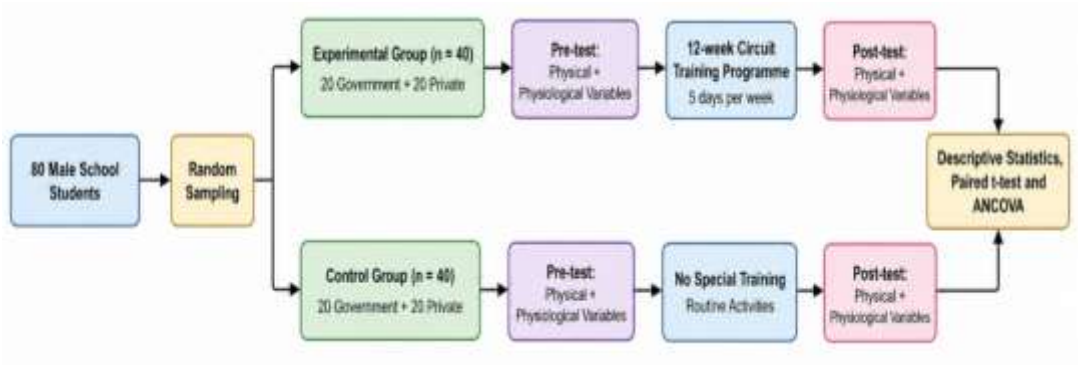

Figure 1: Experimental Design of the Study

Figure 1 illustrates the design of the control group for the pre-test and post-test conducted in the study. Prior to the intervention, both groups underwent testing. The experimental group went through the 12-week circuit training programme, and the control group went through normal activities. Both groups were retested at the end of the intervention period.

4.2 Impact of Circuit Training on Physical Fitness in Government School Students

The physical fitness levels of students in public schools are outlined to show the enhancement in physical fitness before and after the intervention. The variables chosen were agility, speed, arm strength, core strength, leg strength and endurance. For agility, speed and endurance, lower scores are better, while for strength variables, higher scores are better.

Table 3: Comparison of Physical Fitness Metrics Before and After Testing among Students in Public Schools

Variable	Group	Pre-test Mean ± SD	Post-test Mean ± SD	t-value	p-value	Result
Agility	Control	12.98 ± 0.475	13.07 ± 0.491	-1.273	0.218	Not Significant
Agility	Experimental	12.986 ± 0.473	12.950 ± 0.482	6.767	0.000	Significant
Speed	Control	9.502 ± 0.899	9.463 ± 0.932	1.775	0.092	Not Significant
Speed	Experimental	9.711 ± 0.969	9.682 ± 0.960	5.966	0.000	Significant
Arm Strength	Control	6.400 ± 0.882	6.700 ± 1.031	-1.831	0.083	Not Significant
Arm Strength	Experimental	5.800 ± 0.833	6.350 ± 1.136	-2.773	0.012	Significant
Core Strength	Control	11.950 ± 0.998	12.000 ± 1.414	-0.271	0.789	Not Significant
Core Strength	Experimental	10.900 ± 0.788	11.750 ± 0.910	-10.376	0.000	Significant
Leg Strength	Control	1.660 ± 0.041	1.665 ± 0.040	-1.561	0.135	Not Significant
Leg Strength	Experimental	1.613 ± 0.055	1.627 ± 0.056	-9.200	0.000	Significant
Endurance	Control	2.447 ± 0.053	2.442 ± 0.052	1.291	0.212	Not Significant
Endurance	Experimental	2.499 ± 0.048	2.475 ± 0.043	7.151	0.000	Significant

Table 3 presents the average, standard deviation, t-value, p-value, and significance level for selected physical fitness variables of students in public schools. The results show that most of the variables in the control group did not demonstrate statistically significant differences. At the conclusion of the 12-week circuit training regimen, the experimental group exhibited substantial improvements in multiple physical fitness metrics. The most improvement was seen in agility, speed, arm strength, core strength, leg strength and endurance.

4.3 Impact of Circuit Training on Physiological Variables in Government School Students

The physiological responses of public-school students were utilized to evaluate the impact of circuit training on cardiovascular and respiratory variables. The chosen variables included vital capacity, resting heart rate, diastolic pressure, and systolic pressure.

Table 4: Evaluation of Physiological Variables Among Government School Students Before and After Testing

Variable	Group	Pre-test Mean ± SD	Post-test Mean ± SD	t-value	p-value	Result
Systolic Blood Pressure	Control	115.900 ± 2.633	116.300 ± 2.408	-1.000	0.330	Not Significant
Systolic Blood Pressure	Experimental	116.000 ± 2.919	115.850 ± 2.621	0.278	0.784	Not Significant
Diastolic Blood Pressure	Control	73.150 ± 2.323	72.550 ± 2.038	1.500	0.150	Not Significant
Diastolic Blood Pressure	Experimental	70.500 ± 6.117	69.150 ± 6.183	6.469	0.000	Significant
Vital Capacity	Control	0.590 ± 0.039	0.596 ± 0.039	-1.674	0.110	Not Significant
Vital Capacity	Experimental	0.548 ± 0.038	0.567 ± 0.037	-11.831	0.000	Significant
Resting Heart Rate	Control	69.950 ± 2.282	69.650 ± 2.680	1.031	0.316	Not Significant
Resting Heart Rate	Experimental	70.950 ± 1.637	70.300 ± 1.625	4.333	0.000	Significant

Note: Significant at $p < 0.05$.

Table 4 presents the comparison of selected physiological variables between the pre-test and post-test for students attending government schools. The control group showed no significant physiological differences between the two testing rounds. The experimental group showed improvements in particular physiological measures, including diastolic blood pressure, vital capacity, and resting heart rate. These findings suggest that circuit training may improve cardiovascular and respiratory health.

4.4 Effect of Circuit Training on Fitness Levels in Students of Private Schools

The physical fitness results of private school students are presented to determine whether the training programme produced measurable improvements in motor fitness and strength-related variables.

Table 5: Comparison of Physical Fitness Variables before and after Testing among Private School Students

Variable	Group	Pre-test Mean ± SD	Post-test Mean ± SD	t-value	p-value	Result
Agility	Control	13.000 ± 0.547	12.999 ± 0.548	0.123	0.904	Not Significant
Agility	Experimental	12.545 ± 0.518	11.994 ± 0.540	10.332	0.000	Significant
Speed	Control	8.743 ± 0.543	8.792 ± 0.535	-2.040	0.055	Not Significant
Speed	Experimental	8.494 ± 0.542	8.410 ± 0.589	2.938	0.008	Significant
Arm Strength	Control	5.500 ± 1.000	5.300 ± 0.923	1.453	0.163	Not Significant
Arm Strength	Experimental	6.100 ± 0.911	7.050 ± 0.825	-19.000	0.000	Significant
Core Strength	Control	11.500 ± 1.147	11.150 ± 1.089	1.789	0.090	Not Significant
Core Strength	Experimental	13.300 ± 1.780	14.350 ± 1.814	-11.917	0.000	Significant
Leg Strength	Control	1.618 ± 0.059	1.614 ± 0.058	1.633	0.119	Not Significant
Leg Strength	Experimental	1.638 ± 0.059	1.664 ± 0.062	-8.850	0.000	Significant
Endurance	Control	2.413 ± 0.049	2.419 ± 0.050	-0.900	0.379	Not Significant
Endurance	Experimental	2.395 ± 0.060	2.340 ± 0.060	41.039	0.000	Significant

Note: Significant at $p < 0.05$.

Table 5 presents the results of pre-test and post-test evaluations for agility, speed, arm strength, core strength, leg strength, and endurance among students in private schools. The majority of the physical fitness factors exhibited no notable changes

in the control group. Nonetheless, following the training program, the experimental group demonstrated notable enhancements in physical fitness metrics, especially agility, speed, arm strength, and core strength.
Graphical comparison of physical fitness variables helps to illustrate direction and amounts of change. It backs up the statistical results as detailed in the physical fitness tables.

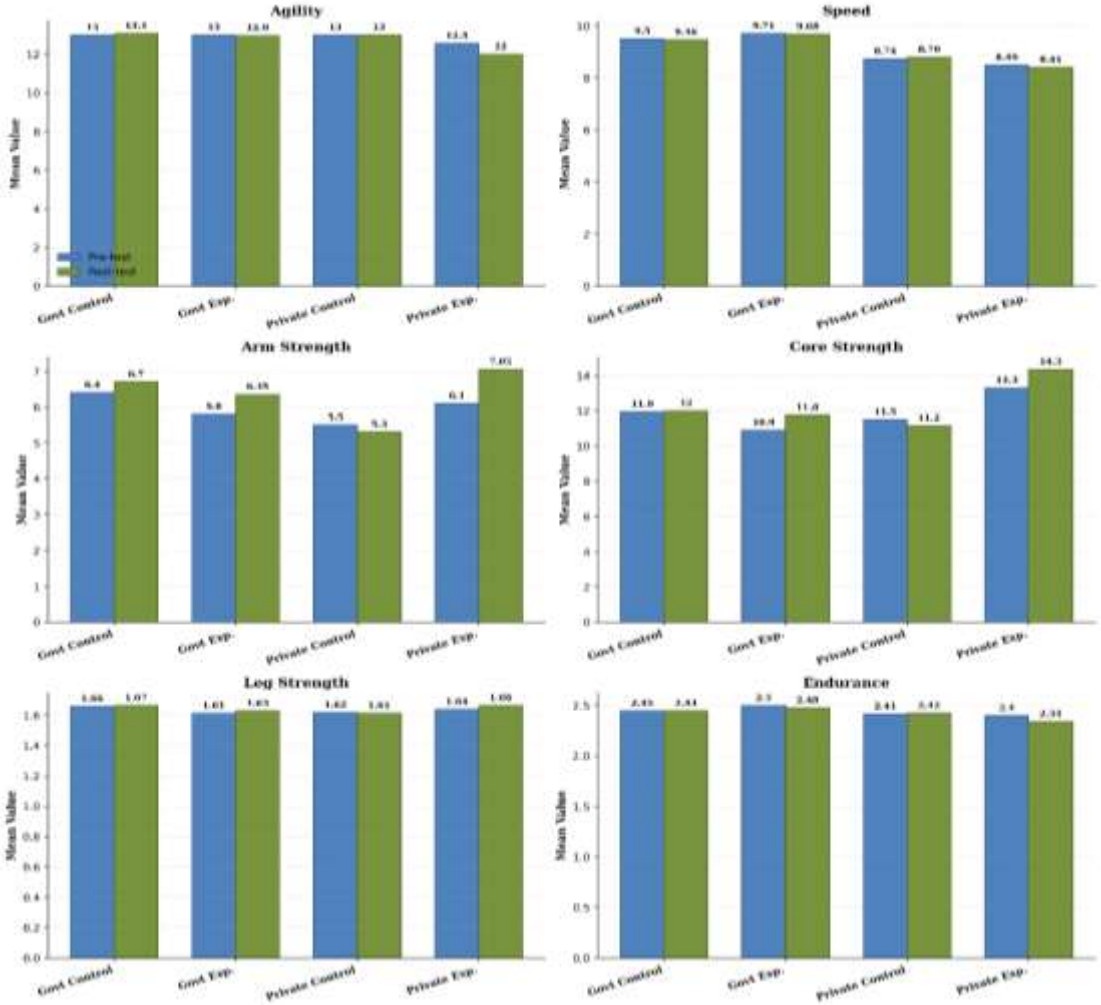

Figure 2: Mean Comparison of Physical Fitness Variables before and after Circuit Training

Figure 2 displays the average comparisons of chosen physical fitness variables prior to and following the 12-week circuit training program. The graph illustrates that the experimental group demonstrated more significant advancements in strength, endurance, speed, and agility compared to the control group. The graphic trend is in agreement with the statistical results and shows that circuit training improved physical fitness in school children in certain aspects.

4.5 Impact of Circuit Training on Physiological Factors in Private School Students

The physiological results of the private school students are displayed to emphasize the changes of cardiovascular and respiratory functioning following the circuit training course.

Table 6: Comparison of Physiological Variables Before and After Testing among Students in Private Schools

Variable	Group	Pre-test Mean ± SD	Post-test Mean ± SD	t-value	p-value	Result
Systolic Blood Pressure	Control	115.000 ± 2.492	115.200 ± 2.419	-1.000	0.330	Not Significant
Systolic Blood Pressure	Experimental	115.650 ± 2.680	115.950 ± 2.012	-0.719	0.481	Not Significant
Diastolic Blood Pressure	Control	68.250 ± 3.369	67.700 ± 4.066	1.446	0.164	Not Significant
Diastolic Blood Pressure	Experimental	70.900 ± 4.351	72.350 ± 4.965	-3.309	0.004	Significant
Vital Capacity	Control	0.551 ± 0.051	0.543 ± 0.045	1.680	0.109	Not Significant
Vital Capacity	Experimental	0.565 ± 0.040	0.585 ± 0.036	-10.420	0.000	Significant

Resting Heart Rate	Control	74.200 ± 1.823	74.500 ± 1.960	-0.972	0.343	Not Significant
Resting Heart Rate	Experimental	67.550 ± 4.084	66.100 ± 3.985	10.722	0.000	Significant

Note: Significant at $p < 0.05$.

Table 6 presents a comparison of SBP, DBP, VC, and HR of students from private schools before and after the test. The control group exhibited no notable physiological change. The experimental group demonstrated larger enhancements in specific physiological metrics by the conclusion of the training duration. The findings indicate that circuit training could positively influence physiological function.

The physiological changes are also graphically presented to give a better comparison of the mean scores obtained before and after the test.

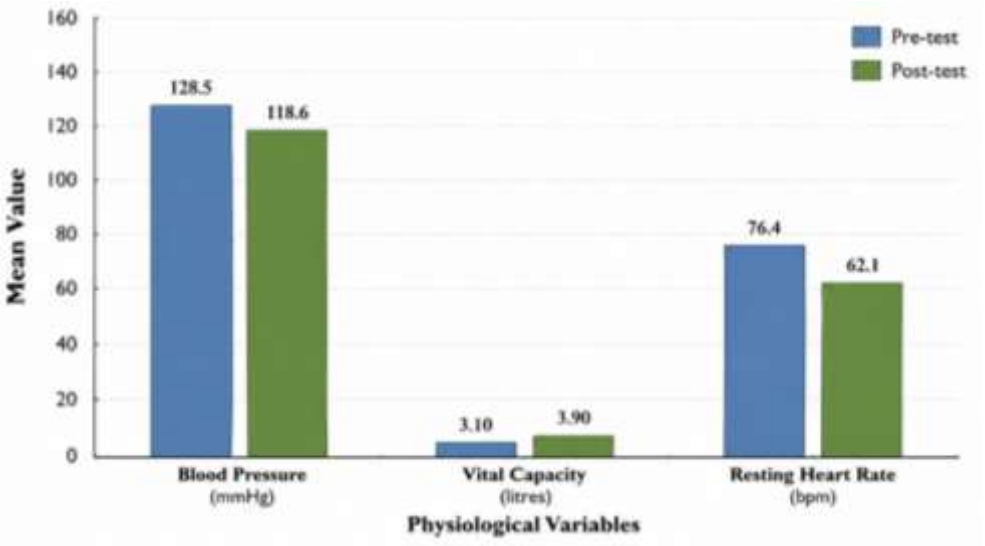

Figure 3: Mean Comparison of Physiological Variables before and after Circuit Training

Figure 3 illustrates the average differences in chosen physiological variables before and after the intervention. The graph depicts variations in blood pressure, vital capacity, and resting heart rate within the experimental group. The trend is in line with the statistical findings, which showed physiological adaptation following the 12-week training programme.

4.6 Adjusted Comparison between Experimental and Control Groups

ANCOVA was employed to control for pre-test scores and re-evaluate the differences in post-test scores between the experimental and control groups. This analysis made it easier to compare the impact of the treatment.

Table 7a: ANCOVA Summary of Selected Physio-Physical Fitness Variables among Government School Students

Variable	F-value	p-value	Partial Eta Squared	Result
Agility	3.256	0.079	0.081	Not Significant
Speed	2.767	0.105	0.071	Not Significant
Arm Strength	0.007	0.935	0.000	Not Significant
Core Strength	0.181	0.673	0.005	Not Significant
Leg Strength	1.502	0.228	0.040	Not Significant
Endurance	0.630	0.432	0.017	Not Significant
Systolic Blood Pressure	0.324	0.572	0.009	Not Significant
Diastolic Blood Pressure	9.077	0.005	0.201	Significant
Vital Capacity	0.067	0.798	0.002	Not Significant
Resting Heart Rate	0.967	0.332	0.025	Not Significant

Table 7b: ANCOVA Summary of Selected Physio-Physical Fitness Variables among Private School Students

Variable	F-value	p-value	Partial Eta Squared	Result
Agility	3.256	0.079	0.081	Not Significant
Speed	1.966	0.169	0.052	Not Significant
Arm Strength	0.960	0.334	0.026	Not Significant
Core Strength	4.886	0.034	0.119	Significant
Leg Strength	0.395	0.534	0.011	Not Significant
Endurance	1.239	0.273	0.033	Not Significant
Systolic Blood Pressure	5.985	0.019	0.143	Significant
Diastolic Blood Pressure	0.101	0.752	0.003	Not Significant
Vital Capacity	0.339	0.564	0.009	Not Significant

Resting Heart Rate	1.435	0.239	0.038	Not Significant

Note: Significant at $p < 0.05$

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The ANCOVA results for government and private school students, controlling for pre-test scores are provided in Tables 7a and 7b. Adjusted effects were significant for diastolic blood pressure in government school students and core strength and systolic blood pressure in private school students. No significant adjusted group differences were found for the other variables.

4.7 Circuit Training Programme Structure

The structure of the training program is presented to demonstrate the intervention used for the experimental group. This figure will help readers to understand the exercise sequence and training format.

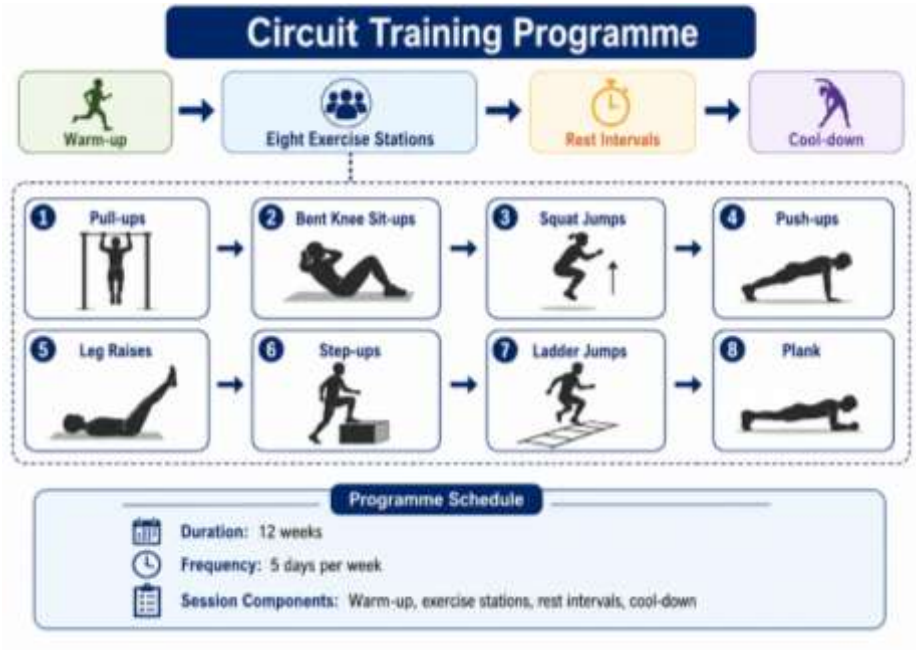

Figure 4: Structure of the Circuit Training Programme

Figure 4 shows the eight exercise stations included in the circuit training programme: pull-ups, bent knee sit-ups, squat jumps, push-ups, leg raises, step-ups, ladder jumps, and plank. Each session included warm-up, exercise stations, rest intervals, and cool-down. The programme was conducted five days per week for twelve weeks.

4.8 Overall Findings

The overall findings showed that some physical fitness characteristics among kids were positively impacted by the 12-week circuit training program. The experimental groups showed improvement in most of the variables selected when compared to the control groups. The greatest improvements were observed in the following fitness measures: agility, speed, muscular strength, core strength, leg strength and endurance. Physiological measures (including blood pressure, resting heart rate, and vital capacity) also improved. This research is consistent with the benefits of circuit training as a structured adolescent adolescent conditioning program in public and private schools.

5. DISCUSSION

The findings from the present study indicated that certain physiological and physical fitness factors improved in male schoolchildren after the 12-week circuit training program. Unlike the control group, the experimental group showed a greater improvement from the pre-test to the post-test, indicating that structured circuit training was more effective than standard school activities. This enhanced agility, speed, strength and endurance could be the result of repeated training of multi-station exercises with fast movements, muscle work, body control and prolonged work. Circuit training integrates resistance and aerobic training along with functional training and limited rest periods, which can stimulate the cardiovascular and muscular systems throughout. As the training combines resistance, aerobic and functional training with little rest time, it stimulates the cardiovascular and muscular systems throughout the training which helps to develop overall fitness.

There was a significant enhancement in physical fitness parameters. than there was in physiological variables. This could be due to the relative rapidity of how physical performance variables are sensitive to repeated movement practice, neuromuscular coordination and muscular adaptation. Physiological parameters like blood pressure, vital capacity and resting heart rate, however, might take longer to train, need a more rigorous control of lifestyle factors, and need to be trained at a more consistent level to produce greater measurable changes. However, the experimental group displayed a positive direction of development, suggesting that consistent circuit training may be advantageous for enhancing physiological efficiency.

The results are corroborated by the findings of the previous studies, which established that circuit training and the like conditioning techniques can increase aerobic capacity, VO_2max, muscular strength, muscular endurance, agility, anaerobic performance and cardiovascular endurance [12,14,16,20]. The similarities corroborate the notion that circuit training is a good multi-component training program. The current research expands on this knowledge by providing a structured 12-week circuit training regimen for boys in public and private educational institutions, including those at the university level, along with athlete.

According to the results of this study, it can be determined that circuit training can be effectively utilized in different situations like public schools compared to private institutions. While there may be differences in sports facilities, exposure to organised training, and physical education opportunities between the various school types, the structured nature of the programme offered a common training stimulus to both groups. The finding is useful for practice as circuit training has minimal equipment requirements, can be conducted in small spaces and is adaptable to students' fitness levels. Thus, circuit training can be utilized as a practical approach in school to enhance students' fitness in regular school time.

There are some limitations to the study. The sample comprised only male students in the age group 14-19 years from selected government and private schools in Hazaribagh district, so the results may not be extrapolated to female students, other age groups or students from other parts of the country. Lifestyle, dietary intake, sleep, motivation and climatic conditions and physical activity outside of the training programme were not optimally controlled. Selected physical fitness and physiological variables were also studied.

Larger numbers of school students, female students, a broader age range, and schools from various districts should be included in future studies. Future studies could also evaluate the effects of varying intensities of training, longer periods of intervention, and other factors (body composition, VO_2max, flexibility, stress, and academic performance). Circuit training programme benefits would be better understood if long-term follow up studies were conducted to see whether the benefits of circuit training last after the programme.

6. CONCLUSION

The present the study looked at how a twelve-week circuit training program affected a few chosen physio-physical fitness metrics of male public and private educational institutions students. The study involved 80 male students, divided into an experimental group and a control group. The experimental group participated in a structured circuit training program, whereas the control group continued their standard practices. The intervention occurred five times a week over a period of 12 weeks. The findings indicated that the experimental group experienced a more significant enhancement compared to the control group following the intervention. Physiological factors like blood pressure, vital capacity, and resting heart rate showed positive links with minor enhancements, while physical fitness factors such as agility, speed, strength, and body endurance demonstrated noticeable improvements. The results indicated that circuit training is an effective, practical and school applicable tool to improve student fitness. The use of a structured, low-cost circuit training programme at public and private educational institutions can be supported by the evidence provided by this study within the field of physical education. For educators in physical education, coaches, and school administrators, it offers helpful insights into how to apply strategies to improve students' health and fitness in an applicable way. The study was however limited to the school boys of age group 14-19 years in selected schools of Hazaribagh district. Future research should include female students, larger sample sizes, longer duration of interventions, and other variables such as body composition, VO_2max, flexibility, and academic performance.

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