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Original Research Article

Effect of Fartlek Training on Cardio Respiratory and Muscular Endurance among College Students

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Abstract

Background: Since everyone has been forced to stay inside their homes owing to the pandemic and online classes are being held nowadays which leads to a increase in physical inactivity. Physical inactivity is a significant public health issue. It is the fourth top risk factor for mortality and the seventh most common risk factor for cardiovascular disease globally. The Swedish word "Fartlek" means "speed play" and refers to a training approach that combines interval training with nonstop training. Since fartlek can be performed at any time and from any location, this study looked at how fartlek affected college students.
Aim: The aim of this research is to determine how fartlek training affects college students cardio respiratory, and muscular endurance.
Methodology: Based on the inclusion and exclusion criteria, thirty college students were chosen for this study. The intervention was done for total of six week in which they were given warm up exercises for 10 minutes followed by fartlek training and a cool down period of 10 minutes, the total intervention time was given for a total of 30 min. The 12 minutes Cooper test and Queen's College step test were used to gauge the students' cardiorespiratory fitness, while the squat test was used to gauge their muscular endurance. Outcome measures were taken both before and after the intervention was administered. An analysis was done following the test. Software called Statistical Package for the Social Sciences (SPSS) was used for the statistical analysis. To analyze within the group, paired t-tests were utilized.
Results: Analysis of the pre-test and post-test outcomes within the group was done using the paired t test. From the pre-test and post-test findings, it can be seen that the outcome measures employed for both the cardiorespiratory and muscular endurance both showed a statistically significant improvement.
Conclusion: According to the data analysis and the findings in this study it can be found that there was a significant effect on the cardio respiratory and muscular endurance of the college students due to the Fartlek training.

Keywords: Fartlek Training, ccardiorespiratory endurance, 12-minute cooper's test, queens' college step test, squat test, muscular endurance.

Introduction

Fartlek, which translates to "speed play" in Swedish, is a training approach that mixes continuous and interval training. The exercise program puts strain on both the aerobic and anaerobic systems because to its changing intensity and uninterrupted nature.

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Fartlek was created in 1937 by Swedish coach Gosta Holmer, and other physiologists have since endorsed it. It was created for the humiliated Swedish cross-country running teams that Paavo Nurmi and the Finns had defeated throughout the 1920s. Holmer's plan focused on both speed and endurance training at a faster than race pace. For the knowledgeable runner who has been doing interval training to increase their anaerobic threshold and build speed, it is often regarded as an advanced training method. The average runner, however, might also gain from a simplified version of Fartlek training to add variation to the training regimen [1,2]. Fast running intervals followed by slower running

intervals are the basic components of a fartlek workout. This fundamental idea makes it possible to tailor fartlek training to a range of training needs, personalities, and fitness levels [3].

A typical fartlek is primarily run on a road or pavement using existing milestones as indicators or guides. One might brisk vigorously from one light pole to the following pole, then jog to the next corner and exert medium effort for a few blocks, the jogs between four light poles and brisk vigorously to a stop sign, and so on, for a certain total time or distance [3]. The greatest thing about fartlek is that you don't need to repeat the same extent of the interval over and over again [4]. Fartlek can be done in the forestland or open country, on sand or road, around a golf course and football field, up and down dunes or hills, and/or over flat ground or on a track. "Freedom—that was Fartlek's appeal [5].

Cardio-respiratory endurance tests the body's ability to function during extended periods of activity. An individual with great cardio-respiratory endurance can continue engaging in high-intensity activities for an extended amount of time without becoming exhausted. Measuring a person's cardio respiratory endurance requires us to inspect how well their body takes in and utilizes oxygen. For the muscles to function correctly during high-intensity or prolonged periods of exercise, there must be an adequate supply of oxygen and other nutrients. Fatigue develops if the muscles do not receive enough nutrition, which leads to waste products building up. Physical performance can be directly impacted by a person's level of cardiorespiratory endurance [6]. Muscular endurance is the ability to continue contracting a muscle, or group of muscles, against resistance, such as weights or body weight, over some time. Improving upon the performance of these muscles means they can continue to contract and work against these resistances/forces. More repetitions of a workout, such push-ups or squats, can be performed by a person with greater muscular endurance [7].

Since physical inactivity is the fourth most major risk factor for death and the seventh most frequent risk factor for cardiovascular disease worldwide, it poses a serious threat to public health [8,9]. Physical inactivity is a major risk factor for cardiovascular disease, type 2 diabetes, osteoporosis, and several types of cancer, in addition to contributing to premature mortality. Inadequate physical activity/exertion is responsible for roughly 3.2 million fatalities and 32.1 million DALYs (or about 2.1% of global DALYs) each year. Individuals who do not engage in at least 30 minutes of moderate-intensity physical activity most days of the week have a 20% to 30% higher risk of all-cause mortality than those who do. In 2008 it is estimated that 31.3% of the people aged 15+ were insufficiently active (males 28% and females 34%). The cut-point of smaller than 150 minutes of moderate activity per week (or equivalent) was selected since a vast and strong body of scientific substantiation shows that people meeting this threshold have advanced levels of health-related fitness, a lower risk profile for developing numerous disabling medical conditions, and lower rates of several chronic NCDs than people who are inactive[9]. According to the World Health Organization (WHO), in developing countries, almost half of the adult population does not accumulate enough physical activity for health benefits. Physical activity is a crucial behavioural risk factor that is evaluated in most general health surveys due to its significance for the prevention of chronic diseases [8,9]. Because of the hectic pace of modern life, it is difficult to find enough time for regular exercise. In this instance, the Fartlek training program comes in handy because it takes less time and has the ability to do the exercises in a variety of ways as one would wish. Gerschler Fartlek training is a type of fartlek training that is designed to help the participants get fit quickly using a steady pace and intervals. Fartlek training is mostly utilized for the athletic performance population and there is still a lack of evidence on the role of Non-athletics benefit from fartlek training. So, this research was carried out to determine the impact of the Fartlek exercise on college students.

Methodology

Study Design: Single group pre and post-test experimental study design
Sampling Method: Convenient Sampling
Sample Size: 30 subjects
Study Duration: 6 months
Intervention period: 6 weeks
Frequency: 3 times/week
Study Setting: Medical trust Institute of Medical Sciences, Irumpanam, Kochi,

Inclusion Criteria

1. Age: 18-25 yr old
2. Gender: males
3. College Students
4. 12 minute Cooper run test

Exclusion Criteria

1. Non cooperative
2. Neurological disorders
3. Cardiopulmonary conditions
4. Any medications
5. Musculoskeletal disorders or disability
6. Mentally ill
7. Metabolic Disorders

Outcome Measures

1. 12 Minute Cooper run test
2. Queen's College Step test
3. Squat Test

Materials Required

1. Stopwatch

2. 15 inch/16 inch step
3. Measuring Tape
4. Metronome
5. Running Track/Ground
6. Marker Cones
7. Recording Sheets

Procedure

The participants in this study were college students from medical trust Institute of Medical Sciences, who had been qualified through the inclusion and exclusion criteria that had been set prior to this procedure or training protocol. The participants had been briefed thoroughly about the study and their consent was received for the study. A total of 30 college students had been recruited in to this study by following the inclusion criteria which consisted of the participants age group being between 18 to 25 who are college students and the majority of the subjects were males, and the exclusion criteria included anyone who had any cardio-respiratory, neurological, metabolic, or musculoskeletal diseases, was taking any medications/drugs, was mentally sick, or was otherwise psychologically disturbed and participants who were not cooperative or not willing to participate in the ethical committee approval and along with the 12 minute run test which which served as both a screening test and a pre and post-outcome measure. Written consent and approval from the students were taken and all the participants were organized into a single group. Before the training commenced the demographic information and the pre-outcome assessments were collected from each participant, the pre-outcome assessments consisted of 12 minute cooper run test, queens college step test, squat test. After the pre-outcome measures were taken, the participants were introduced into the training program, which started with warm up exercises that were given for 10 minutes, which consisted of static and dynamic stretching, walking lunges, jumping jacks and high knees exercises were performed followed by Fartlek training for 10 min was given and exercise intensity given to participants were decided with borg's perceived rate of exertion score. The participants received fartlek training using the Gerschler fartlek method, which is used to get fit faster with steady running and which was explained to the patient in their native tongue. In this fartlek method, the participants vigorously stride for 30 seconds and jog for 90 seconds, which is then repeated with a 15 second drop in recovery jog (e.g., 30-90, 30-75, 30-60, 30-45, 30-30, and 30-15-30), and this is repeated three more times[10]. After the fartlek training was done 10 min of cool down exercises such as slow walking, self stretches, ankle pump movements and breathing exercise were given to the participants. This training method was given to the participants for 3 times a week and this intervention completely lasted for 6 weeks with a total 18 sessions thoroughly implemented to the participant group.

12 Minute Cooper Test

This test is used to find the cardio respiratory endurance of the participants. The basic goal of the test is to determine how far an individual can travel in 12 minutes. It is typically conducted on a running track with markers or cones placed at various intervals to facilitate measuring the distance. Before engaging in any fitness assessment, engage in a quick 10 to 15-minute warm-up of easy to moderately demanding activities. A stopwatch is required to make sure the person is running for the correct length of time. Then note the total distance the participants have covered in 12 minutes in miles or kilometres [11]. Then we can calculate the VO2 max using the formula:VO2max (men) = (22.351 x kilometers) - 11.288 [11].

Queen's College Step Test

Cardio respiratory fitness is assessed using the Queen's College Step Test, a submaximal exercise test. The test entails walking up and down on a 15-inch step or stool for 3 minutes at a fixed rate of 22 steps per minute for females and 24 steps per minute for males while employing a four-step cadence, doing step up and up followed by step down and down for 3 minutes continuously. Heart rate was monitored at the radial pulse before and after the test, and it was tallied from 5 to 20 seconds of recovery for 15 seconds before multiplying it by 4 to get the beats per minute (bpm) needed to calculate the maximum amount of oxygen in the blood (VO2 max). Formula to calculate for men's VO2max (ml/kg/min) = 111.33 - (0.42 x heart beats(bpm)) [12].

Squat Test

The squat test mostly evaluates the muscular endurance of the lower limb of the body. In order to maintain stability and proper form, stand with your feet shoulder-width apart and your arms out in front of you or behind your ears. For the spine to remain neutral, the gaze should be straight but slightly downward. Then, shift your weight into your heels by bending your knees and bringing your hips back and down. Go back to your normal standing position when your knees are approximately 90 degrees. Up until you feel fatigued and your form starts to lose its appropriate shape, perform as many repetitions as you can. The number of repetitions that is done by the participants are then recorded before and after the intervention is given to them [13].

Statistical analysis and interpretation

Microsoft Excel and the Statistical Package for the Social Sciences (SPSS) Program (SPSS.20) were used to conduct the results' statistical analysis. The data analysis method employed was the student's t-test. The findings of the pre-test and post-tests were compared between groups using the paired t-test. Fartlek training

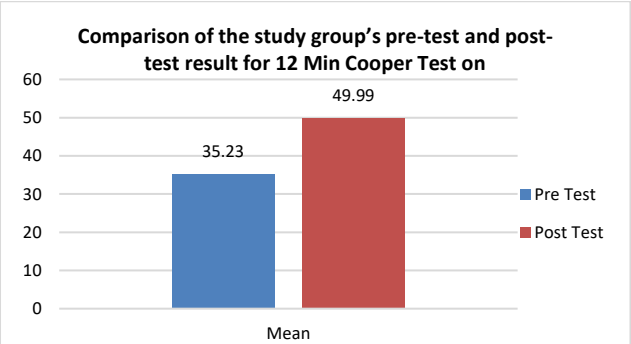
is the independent variable, and the 12 min Cooper test, the Queen's College step test, and the Squat test are the dependent variables.

Comparison of Pre-test and Post-test Result for the 12 Min Cooper Test on the Study Group

The experimental group's pre-test and post-test mean values of the test were 35.23 and 49.99, respectively, while the test's pre and post-test standard deviations were 6.2 and 7.8, respectively. The resulting t-value was 26.56 and the p value was <0.01, indicating that the test was successful. The analysis reveals that there has been a considerable improvement in the experimental study group as a result.

Table 1 shows the paired t-test for 12 Min Cooper Test

12 min cooper test	Mean	SD	Mean Difference	t	df	P-value
Pre-test	35.23	6.25	14.75	26.56	29	<0.01
Post-Test	49.99	7.83				



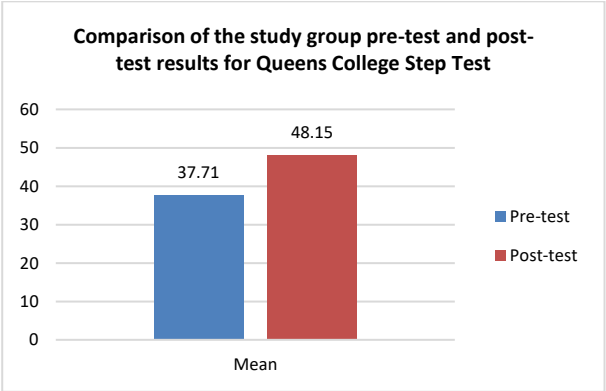
Graph 1: Displays a graphical comparison of the pre-test and post-test results for the 12-minute Cooper test.

Comparison of Queen's College Step Test Result from the Study Group's Pre-test and Post-test

In the experimental study group, the Queen's College step test pre-test and post-test mean values were 37.71 and 48.15, respectively, while the test's pre-test and post-test standard deviation were 1.32 and 1.23, respectively. The degree of freedom was 29. The t-value obtained was 51.03 and the p-value was <0.01. The analysis reveals that there has been a considerable improvement in the experimental study group as a result.

Table 2 shows the paired t-test for Queen's College Step Test

Queens college step test	Mean	SD	Mean Difference	t	df	P-value
Pre-test	37.71	1.32	10.44	51.03	29	<0.01
Post-test	48.15	1.23				



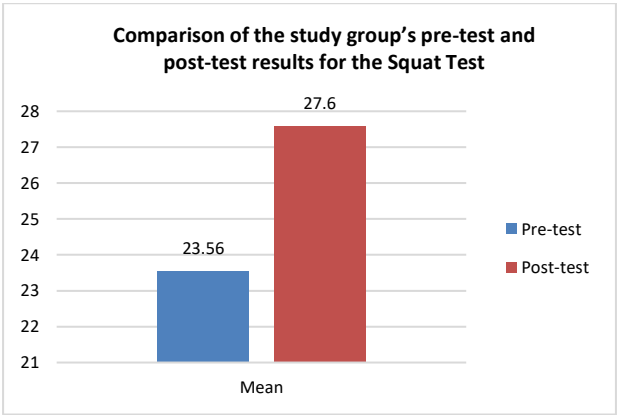
Graph 2: Displays the Graphical comparison of the pre-test and post-test of Queen's College step on the study group

Comparison Squat Test Result from the Study Group's Pre-test and Post-test

The experimental study group's pre- and post-test results for the squat test had a mean value of 23.56 and 27.6 respectively, while the test's pre-test and post-test results of standard deviations at 2.23 and 2.40, respectively. The degree of freedom in this test was at 29. The t-value was 24.82 and the p-value is <0.01. The analysis demonstrates that the experimental research group has significantly improved as a result.

Table 3 shows the paired t-test for the Squat Test

Squat Test	Mean	SD	Mean Difference	t	df	P-value
Pre-test	23.56	2.23	4.04	24.82	29	<0.01
Post-test	27.6	2.40				



Graph 3: Displays the Graphical comparison of the pre-test and post-test result of Squat Test on the study group

Discussion

In this study, college students cardio respiratory and muscular endurance will be examined in relation to the effects of fartlek training. Cardio respiratory endurance

can be referred as the capacity of the heart and lungs to provide oxygen to working muscles that are constantly engaged in physical activity, cardio respiratory endurance is one of the most important indicators of our physical health [11]. Muscular endurance is the capacity of a muscle group to carry out repeated contractions for an amount of time that results in muscular exhaustion or to maintain a particular percentage of the maximum voluntary contraction for a prolonged period of time [14]. A total of 30 participants were selected for this study with their consent and the outcome measures of each participants were taken before and after the intervention period or duration of 6 weeks.

The level of difficulty a participant receives ought to be able to improve their cardiac output and stroke volume as well as their local blood flow and aerobic metabolism in those specific muscle groups. In order for any adaptations to occur, the exercise period should be just over the individual's tolerance level for exercise. Exercises has always had an effect on almost all the system of a human body, and these adaptations are very well reflected on the cardio-respiratory system or as an improvement in the VO2 max of the individual [15]. An overwhelming amount of evidence suggests that, if the stimulus is enough, any previously untrained personnel will always adapt to endurance training program. The improvements can be observed mainly in red blood cell volume within weeks leading to increase in oxygen carrying capacity, stroke volume and hence oxygen transport capacity [16]. The Fartlek training has an active recovery phase, and during this phase, the ATP is stored in the section of the muscle stores, the oxygen associated with the myoglobin that was depleted during the work period is restored by the aerobic system, and an increase in VO2 max occurs [15].

For assessing the cardio respiratory endurance of the participants there were 2 outcome measures that was used and they are, the 12 minute cooper run test and the queens college step test. In the 12-minute cooper run test the pre-test recorded an average mean value of 35.24 ml/kg/min and the post-test after the intervention was given was recorded at a mean value of 49.99 ml/kg/min. Hence it was shown that the 12 min cooper test showed a statistically significant improvement in cardio respiratory endurance. The Queens College step test was another outcome measure used and its pretest had recorded an average mean value of 37.71 ml/kg/min and the posttest had recorded an average mean value of 48.15 ml/kg/min, therefore it can be seen that there was a statistically significant improvement in the cardio respiratory fitness. So, both outcome measures showed there was a significant improvement in the cardio respiratory endurance. An improvement in the cardio respiratory endurance shows that the aerobic fitness level has increased which leads to the improvement in the muscular endurance of a person [17]. The reason for this is mostly due to the four essential components of aerobic fitness, which are maximum oxygen uptake (VO2max), exercise economy, lactate/ventilatory threshold, and oxygen uptake kinetics, there are additional variables that may help in determining the endurance performance, and that are related to the 4 essential factors are the velocity at VO2max (V-VO2max) and the maximal lactate steady state or critical power [14]. Any improvement seen in these metrics or factors will translate into an increased in the muscle endurance, and the squat test was used for assessing the lower limb endurance and the pre test had given a mean average value of 23.56 sqauts by the participants and the post test after the intervention had shown that the mean value was at 27.6 squats before exhaustion and the test revealed that there was a significant improvement, which is supported by the test's findings indicating there was a considerable improvement in that area.

Studies carried out by Patil, Methe, Shah, and others. An experimental investigation on the impact of fartlek training on young, obese females maximum oxygen consumption (VO2 max) reveals that fartlek training has been shown to significantly improve VO2 max in these young, obese females [18]. According to a 2017 study by Dr. Nimeshkumar Chaudhari, fartlek training had a positive impact on men's university students' speed and cardiopulmonary endurance. When comparing the experimental group to the control group in this study, researchers observed that there is a considerable improvement [19].

A 2019 study by Dr. A. Palanisamy on the effects of fartlek training on muscle endurance in cross-country runners has demonstrated that there was a significant improvement on the endurance of the cross-country runners in the experimental group as compared to the control group [20]. Dr. S. Manikandan conducted a second study on the impact of fartlek training on handball players' cardio respiratory and muscular endurance, and the findings indicate that the 12 weeks of fartlek training significantly improved the players' cardio respiratory and muscular endurance [21]. The impact of fartlek training on students studying physical education's speed and stamina was examined in the study by Sameer Bashir and Bilal Ahmad Hajam (2017). In this study, it was discovered that fartlek training improved the endurance of the physical education students in the experimental group more than the control group [22].

The statistical results of this study indicate that college students who participated in the Fartlek training program had a considerable improvement in their cardio-respiratory, and muscular endurance.

Figure 1 Shows the Queens College Step Test

Figure 2. Shows the Squat Test

Figure 3. Shows the 12 Minute Cooper Test

Strength of the Study

- The Fartlek method of training stresses the body's anaerobic and aerobic systems simultaneously.
- Due to the continuous nature of Fartlek training and the variable changes in intensity, results are shown in a shorter amount of time and more calories are consumed both during and after the exercise [23].
- The Fartlek regime has an upper hand as it does not require any specialized equipment for the method and is one of the most flexible training regimes any individual can construct in their own time and choose a course to their liking or preferences.
- Fartlek can be done from anywhere if you are able to run at varying intensities and fartlek can be done at any given time by the individual as he does not need anything extra special equipment's. This degree of freedom is said to be the greatest strength of Fartlek training.

Limitations of the Study

- The limitations of this study were that the individuals diet and lifestyle changes was not changed from their current life, with diet and more better lifestyle the changes could also be of a higher standard.
- This study was of short-term duration.
- The only participants in this study were male college students between the ages of 18 and 25, who had sedentary lifestyles and had modest sports backgrounds
- Little sample sizes were used for this investigation, however larger samples may have been used.
- Since this was conducted in a more sedentary college students there are possible injury risks due to adding fast speed-work to the body, so the progression has to be made gradually and it has to make sure they are performing fartlek training properly.
- This study does not account for the prolonged effect of fartlek training in any of these participants as the intervention was only done for a time period of six weeks.

Future of the Study

- This study could be done on a larger population or a larger sample size.
- To confirm the long-term effects of Fartlek training, a follow-up study could be carried out.
- Intervention duration can be increased depending on the population group involved eg: cross-country runners, long distance marathon runners, athletes etc.
- This study can also be done on females.
- Could be done in a more regular basis

Conclusion

Based on the values obtained in this study it has been established that there has been a statistically significant positive impact on cardio-respiratory endurance and muscle endurance of the college students due to the intervention given. The following conclusions and hypotheses were validated within the confines of this study based on the data analysis and findings.

- ✧ The cardiorespiratory endurance of the college students has significantly improved.
- ✧ The muscle endurance of the college students has significantly improved.

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Conflict of interest: None

Ethics clearance: Approved on October 18, 2021 by the Medical Trust Hospital's institutional ethical committee.

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