THE EFFECTS OF CIRCUIT TRAINING PROGRAM ON CARDIOVASCULAR ENDURANCE BY WOMEN COLLEGE STUDENTS

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Abstrak

The recommended rate of physical activity is at least 30 minutes of moderate intensity physical activity, preferably done at least 3 times a week, to increase and maintain individual health related fitness (ACSM, 1998). Hence, in this study, the researcher investigates the effects of an intervention program using 10 – 15 minutes of circuit training program (physical conditioning) for the duration of 10 weeks during the sports athletics co-curriculum activities to enhance health related fitness (cardiovascular endurance) by college students. Therefore, this study is to investigate the effectiveness of intervention program towards the level of health-related fitness (cardiovascular endurance) using the fitness test.

The purpose of this study is to investigate the effects of circuit training program (circuit training) on health related fitness (cardiovascular endurance) by 60 women college students. A quasi experimental design was adapted for this study, using pretest-posttest control group design, which uses circuit training as independent variable, while dependent variable are health-related fitness test instruments namely cardiovascular endurance (12 minutes run).

Before the commencement of the study, an independent T-test analysis was conducted on the pretest data of both groups. It was found that there was no statistically significant different in the mean scores between control group and experimental group (1298.33 ± 171.95, 1230.00 ± 138.71; all P>0.05). Then, from the paired T-test analysis, there were no statistical significant differences in cardiovascular endurance within control group (1298.33 ± 171.95, 1283.33 ± 233.54; all P>0.05). But for experiment group, cardiovascular endurance showed a significant difference between pre-test and post-test data (1230.00 ± 138.71, 1325.00 ± 1325.00 ± 181.83; all P<0.05). Hence, the circuit training program had an effect on the cardiovascular endurance component. While using the independent T-test analysis on both groups, there were not significant difference in the post test mean scores for control group and experiment group for component of cardiovascular endurance (1283.33 ± 233.53, 1325.00 ± 181.82; all P>0.05).

All subjects do have some change, but the effects of the circuit training program were not significant enough to be conclusive. The circuit training program was effective in improve the level of cardiovascular endurance by women college students.

INTRODUCTION

In order to develop physical fitness, Pete & Hohn (1994) suggested an intervention program which involved physical activities in three or more days per week for 20 minutes per session at a heart rate of at least 60% maximal heart rate. The type of

physical activity and duration depended on the type of sports and the people involved in it whether they were athlete or non athlete.

Other ways to improve health related fitness is the use of circuit training (Krampf, 1993; Norvell & Belles, 1993; Moen, 1996; Davis, 2003; Gotshalk, Berger & Kreamer, 2004). Circuit training can be used to improve muscular strength, muscular endurance, flexibility, cardiovascular and body composition (Moen, 1996; Davis, 2003; Gotshalk, et al., 2004). The set up of circuit training through the muscular system using various stations must have appropriate exercises to strengthen and stretch those muscles to improve physical fitness (Moen, 1996).

RESEARCH QUESTION

1. Is there any significant difference between the pretest and posttest mean scores of the cardiovascular endurance in 120 minutes of sport co-curriculum activities within the control group ?
2. Is there any significant difference between the pretest and posttest mean scores of the cardiovascular endurance in 120 minutes of sport co-curriculum activities within the experiment group?
3. Is there any significant difference in the posttest mean scores of cardiovascular endurance in 120 minutes of sport co-curriculum activities between the control group and experiment group?

METHODOLOGY

A quasi experimental design is adapted for the purpose of this study. The control group underwent normal class activities during the weekly two hours period while the experimental group participated in the normal class activities, and with additional specially designed intervention program known as circuit training. For this study, a common pre-test and post-test was administered to the experimental group and control group prior to the initiation of the training and at the beginning and conclusion of the ten weeks experimental treatment.

The control group underwent normal 120 minutes of sports athletics co-curriculum activities, while the experimental group received specially designed circuit training program for a duration of 10 - 15 minutes and also underwent normal 120 minutes of sports athletics co-curriculum activities. The five activities of the circuit training, namely, bend-leg curl-up; lateral jump; burpee, sit-up; and bench step.This sports co-curriculum activity was carried out once a week for a duration of 10 weeks. Every session will last 120 minutes from 8.00 a.m. till 10.00 a.m. every Tuesday.

Instrumentation

For the purpose of this study, the test batteries administered for the pre-test and post-test consisted of the following test items adapted from AAPHERD (1999) for cardiovascular endurance: Test item for cardiovascular endurance (reliability = .94) (Cooper, 1982). The 12-minutes run-walk test was used to measure the aerobic power. It is easier to use and administered to measure time.

Selection of Circuit Training Exercises

In this study, an intervention program will be introduced known as circuit training. This specially designed circuit training in a form of general health-related fitness exercises will be used to increase the level of fitness. The five activities of circuit training exercises are adapted from Hockey (1996) which is divided into five levels as shown in Table 1.

Table 1
Circuit Training Activities

Activity	Level I	Level II	Level III	Level IV	Level V
Bend-leg curl-ups	7	10	14	20	26
Lateral jump	20	25	30	35	40
Burpee	6	9	13	18	24
Push-up	6	10	14	18	24
Bench step	7	11	15	20	25

(Adapted from Hockey, R. V. (1996). *Physical Fitness: The pathway to healthy living* (8th ed.). St. Louis: Mosby-Year Book, Inc.)

Procedures for circuit training activities

The following procedures are being used as guidelines while doing the activities of the circuit training.

a) Practice each exercise before starting the circuit.
b) Ten minutes are allocated for the students to complete two laps of the circuit.
c) If two laps of activities around the circuit are completed before the allocated 10 minutes time has lapsed, the remainder of the time left can be spent on light jogging.

Procedures for each of the five activities in the circuit training are described below:-

1. Bend-leg curl-ups

a. Lie down flat on the ground about shoulder width wide.
b. The knees should be flexed at a right angle.
c. The arms are folded across the chest with chin held as close to chest as possible
d. Curl up until the elbows touch the upper part of the thigh and then return until the lower back is in contact with the ground.
e. This completes one repetition.
f. Do according to their levels for 30 seconds.

2. Lateral Jump

a. Jump laterally across the imaginative middle line on the ground as fast as possible

b. Both feet are kept together and parallel to the line.
c. Count each time a jump is made.
d. Do according to their levels for 30 seconds.

3. Burpee
   a. Start in a standing position with the legs straight.
   b. Assume a squat position, extend the legs backward as in a push-up position
   c. Reverse the position to a squat position
   d. Back to an upright position.
   e. This completes one repetition.
   f. Do according to their levels for 30 seconds.
4. Push-up
   a. Start from the front-leaning rest position with the head, back, hips, and legs in a straight alignment.
   b. the body is lowered so that the chest slightly touches the floor.
   c. The body should remain straight throughout this exercise.
   d. the arms are extended as the body is raised to the starting position.
   e. This complete one repetition.
   f. A modified push-up is used is the subject could not perform the regular push-up with the knee touching the ground instead of the feet (toes).
   g. Do according to their levels for 30 seconds.
5. Bench step
   a. A bench is used.
   b. Step up on the bench with alternate legs (right leg then left leg, or vice versa)
   c. Step down from the bench with alternate legs (right leg then left leg, or vice versa).
   d. This completes one repetition.
   e. Do according to their levels for 30 seconds.

Table 2
Sports Athletic Co-Curriculum Activities Program

Week	Study	Content
1	Wk 1: Pretest	Introduction to Sports Athletics Co-curriculum Activities
2	Wk. 2	Introduction of Basic Coaching : Principles of training
3	Wk. 3	Principles of training: (a) Individualisation, (b) Adaptation (c) Overload
4	Wk. 4	Principles of training (a) Specification, (b) reversibility (c) Variety
5	Wk. 5	Planning a training program : Periodisation
6	Wk. 6	Type of training: (a) Circuit training; (b) Weight training
7	Wk. 7	Type of training: (a) Interval training (b) Weight training
8	Wk. 8	Type of training : (a) Callisthenics Continuous training
9	Wk. 9	Basic Rules of Athletic
10	Wk. 10 Posttest	Track events : Running (Short, middle & long distance)
11		Track events : Relay

12	Track events : Hurdles & walking
13	Field events : Jumping (High jump & Long Jump
14	Field events : Throwing (Discuss, Shot Putt & Javelin)
15	Evaluation

This sports co-curriculum activity was carried out once a week for a duration of 10 weeks. Every session will last 120 minutes from 8.00 a.m. till 10.00 a.m. every Tuesday.

Instructional procedures for control group

The control group consists of 30 subjects (N=30). The actual time allocated for sports athletics co-curriculum activities is 120 minutes from 8.00 a.m. till 10.00 a.m. on every Tuesday. It will start off with warm-up routine which is divided into specific and general warm-up sessions. General warm-up includes stretching and calisthenics exercises, light jogging and running. Specific warm-up depends on the sports athletics co-curriculum activities of the week. This warm-up session will take about five to seven minutes. After warm-up, the instructor will continue on with the weekly lessons on sports athletics co-curriculum activities. These activities will include performing the various sport coaching training program, exercises and drills. The lessons will end with all subjects doing the warm-down which includes light stretching, slow jogging, walking and breathing exercises.

The control group and experimental group will have the same lessons plan for the week in sports athletics co-curriculum activities for ten weeks as shown in Table 3.2. The instructor for the control group and experimental group will be different person but who is very experienced and qualified lecturer in physical and health education with more than 15 years of teaching in the teacher training college. A common pretest and posttest are administered prior to the start of the circuit training and at the conclusion of the 10 week period of study.

Instructional procedures for experimental group

The experimental group consists of 30 subjects. The time allocated for sports athletic co-curriculum training program is 120 minutes from 8.00 a.m. till 10.00 a.m. on every Tuesday. The training session will start off with warm-up routine together with the control group doing general and specific warm-up. After about five to seven minutes of warm-up, the experimental group will then be instructed to participate in the circuit training doing the five activities (bend-leg curl-up, lateral jump, burpee, push-up, and bench step) at different level on the first week depending on their performance in the 12-minutes run/walk test. Table 3 shows the criteria used in determining the starting level of each of the subjects. They are encouraged to perform according to the ability because different people have different ability and fitness level.

If the subjects are able to complete the two laps of circuit training activities less than the allocated time, they will move up to the next level the following week. And if the subjects are not able to complete the two laps of circuit training activities of any level within the allocated time, they will move back to the lower level except Level I which is the lowest. The highest possible level is Level V as shown in Table 2.

At the end of the ten weeks of circuit training, the subjects should be able to be in Level II or above, if there is an improvement in their level of physical fitness. This circuit training will take about 10 - 15 minutes for the subjects to complete. The

subjects will start doing the two laps of circuit training according to their level after the lecturer has blown the whistle and stop when the time expire in the 10 - 15 minutes for the subjects. At the end of the circuit training, the subjects will record their performance of their respective Level each week for eight weeks in their circuit training score sheet.

Table 3
Criteria for determination of the initial starting level for circuit training

Classification for 12-minutes run/walk	Distance covered (meters)		Initial circuit level
	Men	Women	
Very poor	< 1899	<1399	Level I
Poor	1900 – 2199	1400 – 1599	Level II
Average	2200 – 2499	1700 – 1999	Level III
Good	2500 – 2799	2000 – 2399	Level IV
Excellent	>2800	>2400	Level V

(Adapted from Hockey, R. V. (1996). *Physical Fitness: The pathway to healthy living* (8th ed.). St. Louis: Mosby-Year Book, Inc.)

After participating in the circuit training, the instructor will continue on with the weekly lessons on sports athletic co-curriculum training program. These activities will include performing the various coaching exercise and drills on sports athletic co-curriculum training program. The weekly activities will end with all subjects doing the warm-down which includes light stretching, slow jogging, walking and breathing exercises. The control and experimental group will have the same lesson plan for the respective week in sports athletic co-curriculum training program for ten weeks. A common pretest and posttest are administered prior to the start of the circuit training and at the conclusion of the 10 week period of study.

RESEARCH FINDING

Analyses using descriptive statistics and Independent T-test of pretest data of control group and experimental group on the cardiovascuar endurance component.

As shown in Table 4, in the cardiovascular endurance component, both groups, namely, control group and experimental group, recorded a mean score of 1264.17, a standard deviation of 158.67, and with a range from 900 to 1550. The mean score of control group is 1298.33, with a standard deviation of 171.95. Its minimum and maximum scores were 900 and 1550 respectively. The experimental group recorded a

mean score of 1230.00, a standard deviation of 138.71, and with a minimum range of 900 and a maximum range of 1400. Here, in the cardiovascular endurance, the control group recorded a higher mean score of 68.33.

Table 4
Comparison of Pretest scores using descriptive statistics for control group and experimental group on the five components of physical fitness

		N	Mean	Std. Deviation	Minimum	Maximum
Cardiovascular Endurance	Control	30	1298.33	171.95	900	1550
	Experimental	30	1230.00	138.71	900	1400
	Total	60	1264.17	158.67	900	1550

Based on Table 5, it showed that the pretest mean score of control group was 1298.333, and a standard deviation of 171.948. The mean score for experimental group was 1230, with a standard deviation of 138.713. Their differences in the mean scores were 68.333. The independent T-test analysis on the mean scores between the two groups showed the value of t = 1.694 ($p > .05$), which was not significant. From the statistical analysis, there was no significant difference (sig. [2 tailed] = .096) of pretest mean scores between control group and experimental group for cardiovascular endurance component.

Table 5
Independent T-test analysis of pretest mean scores between control group and experimental group for cardiovascular endurance component

Type	Mean	Mean Difference	Standard Deviation	t	Sig. (2-tailed)
Control	1298.333	68.333	171.948	1.694	.096
Experimental	1230.000		138.713		

Paired T-test analysis within control group on the cardiovascular endurance

The first research question was to find out if there were any significant differences of the mean scores of the pretest and posttest within the control group. Hence, the paired T-test analysis were used to test for any significant difference of the mean scores within the control group of 120 minutes of sports athletics co-curriculum activities using pretest and posttest measures of five physical fitness components.

Table 6
Paired T-test analysis on cardiovascular endurance component within control group

	Mean	Mean Difference	Standard Deviation	t	df	Sig. (2-tailed)
Pretest	1298.33	-15	171.95	- .523	29	.605
Posttest	1283.33		233.54			

Based on the pair T-test within control group as shown in Table 6, the mean scores of pretest and posttest were 1298.33 and 1283.33 respectively, which had a difference of -15. Their standard deviations were 171.95 for pretest and 233.54 for posttest. The paired T-test on the mean scores within control group showed that *t*-value = .523 ($p > .05$), which was not significant. The statistical analysis showed that there was no significant difference (Sig. [2-tailed] = .605) in the mean scores between pretest and posttest of cardiovascular endurance component within control group. Although, the differences between the mean scores of pretest and posttest by -15, it had showed some improvement in their cardiovascular endurance within the control group of 120 minutes of sports athletics co-curriculum activities, but it was found to be not statistically significant.

Pair T-test analysis within experimental group on the cardiovascular endurance

The second research question was to find out if there were any significant differences of the mean scores of the pretest and posttest within the experimental group. Hence, the paired T-test analysis were used to test for any significant differences of the mean scores within experimental group of 120 minutes of sports athletics co-curriculum activities using pretest and posttest measures of the cardiovascular endurance component.

Based on the pair T-test within experimental group from Table 7, the mean score of pretest and posttest were 1230.00 and 1325.00 respectively, which had a difference of -95. Their standard deviations were 138.71 for pretest and 181.83 for posttest. The paired T-test of mean scores within experimental group showed that *t*-value = 5.326, which was significant ($p < .05$). There was a positive difference between the pretest and posttest mean scores of 95, which indicated that within the experimental group of 120 minutes of sports athletics co-curriculum activities, it had showed an improvement in their cardiovascular endurance component, and this increase was statistically significant (Sig. [2-tailed] = .001)

Table 7
Paired T-test analysis on cardiovascular endurance components within experimental group

	Mean	Mean Difference	Standard Deviation	t	df	Sig. (2-tailed)

Pretest	1230.00	95	138.71	5.326	29	.001
Posttest	1325.00		181.83			

Independent T-test analysis of posttest mean scores between control group and experimental group on the cardiovascular endurance component.

The third research question was to find out if there was any significant difference in the mean scores of posttest between control group and experimental group of the five health related fitness components. In order to find out the answer for the third research question, an Independent T-test of the posttest mean scores between control group and experimental group for all the five components of physical fitness were used.

Table 8
Independent T-test analysis of posttest mean scores between control group and experimental group on cardiovascular endurance component

Type	Mean	Mean Difference	Standard Deviation	t	Sig. (2-tailed)
Control	1283.33	-41.67	233.53	-.771	.444
Experimental	1325.00		181.82		

Based on Table 8, it showed that the mean scores of pretest for control group was 1283.33, and a standard deviation of 233.53. While the mean scores for experimental group was 1325.00 with a standard deviation of 181.82. Their differences in the mean scores were -41.67. The independent T-test analysis on the mean scores between the two groups showed that *t*-value = -.771 ($p > .05$), was not significant. From the statistical analysis, there was no significant differences (Sig. [2-tailed] = .444) of the posttest mean scores between the control group and experimental group for cardiovascular endurance component of 120 minutes sports athletic co-curriculum activities..

DISCUSSION

Based on the pretest and posttest test that had been carried out for within control group, the first research question was answered:

Is there any significant difference between the pretest and posttest mean scores of the cardiovascular endurance in 120 minutes of sport co-curriculum activities within the control group?

The research findings showed in Table 6 that the mean scores of pretest and posttest were 1298.33 and 1283.33 respectively, which had a difference of -15. Their standard deviations were 171.95 for pretest and 233.54 for posttest. The statistical analysis of paired showed that *t*-value = .523 ($p > .05$), which was not significant. The statistical analysis showed that there was no significant difference (Sig. [2-tailed] = .605) in the

mean scores between pretest and posttest of cardiovascular endurance component within control group. Although, the differences between the mean scores of pretest and posttest by -15, it had showed some improvement in their cardiovascular endurance within the control group, but it was found to be not statistically significant. This can be concluded that level of health related fitness of cardiovascular endurance component did not improve within the control group of 120 minutes of sports athletics co-curriculum activities.

Is there any significant difference between the pretest and posttest mean scores of the cardiovascular endurance in 120 minutes of sport co-curriculum activities within the experiment group?

Based on the pair T-test within experimental group (with intervention program) of 120 minutes of sports athletics co-curriculum activities for cardiovascular endurance component, there was a statistically significant difference in the mean scores. Based on Table 7, the mean score of pretest and posttest were 1230.00 and 1325.00 respectively, which had a difference of -95. Their standard deviations were 138.71 for pretest and 181.83 for posttest. The paired T-test of mean scores within experimental group showed that *t*-value = 5.326, which was significant ($p < .05$). There was a positive difference between the pretest and posttest mean scores of 95, which indicated that within the experimental group, there was an improvement in their cardiovascular endurance component, and this increase was statistically significant (Sig. [2-tailed] = .001). Hence, it can be generalized that the additional intervention program (circuit training) of 10 – 15 minutes that was given to the experimental group did give an effects on the level of health related fitness towards the subjects. This circuit training of 10 – 15 minutes gave some stress to the muscles of the body inclusive heart. The stress then causes physiological changes in the body for adaptation. The process of adaptation that lead to the improvement of level of health related fitness was found in other research findings (Norvell & Belles 1993; Keul, et al, 1996; ACSM, 1998; Ignico, Richhart & Wayda, 1999; Fairclough, 2003).

Is there any significant difference in the posttest mean scores of cardiovascular endurance in 120 minutes of sport co-curriculum activities between the control group and experiment group ?

The third research question was to find out if there was any significant difference in the mean scores of posttest between control group and experimental group of the cardiovascular endurance components. In order to find out the answer for the third research question, an Independent T-test of the posttest mean scores between control group and experimental group for all the cardiovascular endurance components were used.

The research findings indicated that in comparison between control group and experimental group (with 10 – 15 minutes of intervention program) of 120 minutes of sports athletics co-curriculum activities showed that there was no statistically significant differences in their posttest mean scores. As shown in Table 8, the mean scores of pretest for control group was 1283.33, and a standard deviation of 233.53. While the mean scores for experimental group was 1325.00 with a standard deviation of 181.82.

Their differences in the mean scores were -41.67. The independent T-test analysis on the mean scores between the two groups showed that *t*-value = -.771 (p > .05), was not significant. Hence, there was no statistical significant differences (Sig. [2-tailed] = .444) of the posttest mean scores between the control group and experimental group for cardiovascular endurance component of 120 minutes of sports athletics co-curriculum activities.

Implications

Most of the studies (Pate & Hohn, 1994; ACSM, 1998; Ignico, Richhart & Wayda, 1999; Faigenbaum, et al., 2002; Engels, et al., 2002) showed that physical fitness exercise are best carried out three times a week for a training time of 30 minutes with high intensity to show any increase in the level of health related fitness. But, this study that had been carried out for 120 minutes of sports athletics co-curriculum activities throughout 8 continuous weeks did show an increase of level of physical fitness amongst women college towards the cardiovascular endurance.

Even though the intervention program was carried out once a week in the sports athletics co-curriculum activities, the application of GAS principles (Seyle, 1956) was important to increase the level of health related fitness. These intervention program should involved all the major muscles in the body in order to give the necessary and appropriate effects or stress towards cardiovascular endurance as found in previous studies (ACSM, 1998; Krampf, 1993; Norvell & Belles, 1993; Moen, 1996; Davis, 2003; Gotshalk, Berger & Kreamer, 2004).

In this study, it was also found that during the 120 minutes of sports athletics co-curriculum activities which was held once a week, there was no statistically significant difference in improving the level of health related fitness (cardiovascular endurance component) towards the women college students within control group. Whereas, the group with an additional intervention program did showed a statistically significant increase in the cardiovascular endurance component. The recommended rate of physical activity is at least 30 minutes of moderate intensity physical activity, preferably done at least 3 times a week, to increase and maintain individual health related fitness (Pate & Hohn, 1994; ACSM, 1998; Ignico, Richhart & Wayda, 1999; Faigenbaum, et al., 2002; Engels, et al., 2002). Hence, in this study, although the intervention program of 10 -15 minutes was held once a week of intervention program in the weekly 120 minutes of sports athletics co-curriculum activities, there was a statistically significant increase in health related fitness (cardiovascular endurance component).

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