

Effect of Circuit Training Intervention on the Muscular Fitness Ability of 13 to 15 Years Old Female Students

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Abstract:-

➤ Introduction:

The aim of this research was to evaluate the effects of circuit training on the muscular fitness abilities of 13 to 15 years old female students.

➤ Methods:

The study was conducted using a quasi-experimental design for eight weeks. Thirty female students were selected as subjects of this study and they were selected using a lottery system of simple random methods. The measure of muscular endurance and muscular strength of the participants of the study was recorded instantly preceding and following the 8-week of circuit training intervention. The study was established the mean along with standard deviation using a paired sample T-test. Statistical Package for the Social Science (SPSS) was used to carry out all of the statistical data analysis. The statistical significance level was set at $p < 0.05$.

➤ Result:

The study was discovered that circuit training experiences a significant change on leg explosive strength (35.67 ± 3.84 and 38.60 ± 3.24 squat) of circuit group but not (37.67 ± 3.28 and 37.87 ± 3.38 squat) control group. It also improves abdominal muscle endurance (18.64 ± 2.846 and 22.93 ± 4.873 sit ups in 1 minute) of experimental group but not (21.11 ± 6.249 and 21.58 ± 5.610 sit up in 1 minute) control group. It also improves core muscle strength and endurance (76.20 ± 32.00 and 79.87 ± 34.90 second) of circuit group but not (76.20 ± 32.005 and 76.36 ± 31.87 second) control group.

➤ Conclusion:

The results of this study reveal that a circuit training intervention was successfully improving muscular endurance and muscular strength of female students. This could support school teachers in specific physical education teachers to arrange circuit training

schedule in the schools to improve schoolchildren's muscular endurance and muscular strength.

Keywords:- Circuit Training, Muscular Fitness, Physical Education, and Physical Fitness.

I. INTRODUCTION

Physical fitness is providing a great significance value for the health of children (Ortega et al., 2008). Physical education in schools setting is can be to meet the goals of ways of life successfully (Gizachew, 2012). To promote a good ways of life, Schools have been the desirable places to promote a good ways of life by closely indicate the school children with low fitness performance (Ortega et al., 2008). Physical fitness training programs are the good method to develop physical fitness performance (Donnelly et al., 2009). Study shows that physical activity training programs and health promotion strategies could be developed to improve physical fitness (Ortega et al., 2008). Circuit training could be used to meet the physical fitness training needs of school children (Dorgo et al., 2009).

Circuit training satisfy the amount of training volume needs with in a short period of time, which successfully minimizes the time devoted to training (Alcaraz et al., 2008). Using circuit training, the children can easily achieve the least attainable motor skills using varied exercise in circular training at a given time (Viciano et al., 2012). Doing exercise by moving from one exercise to the other improve the function of circulatory system (Reilly, 2006). Sport training program is one of the methods or wings to meet the mission of education in schools (Danish et al., 2005).

As reported by (Kumar, 2013), circuit training could be important part of training programs in schools to enhance cardio-vascular performance of students in physical education class. Similarly, another study shows that circuit training over six weeks can also improve muscular endurance and flexibility in physical education students (Kumaran, 2018).

As recommended by (Mayorga-Vega et al., 2013) it is stated that circuit training intervention can be tested with varied durations of training. Similarly, (Kumar, 2013) recommended that further study should be conducted on circuit training and its contribution to other fitness components than what was investigated. Thus, this research study was undertaken to give experimental proofs for effect of circuit training intervention on the muscular fitness ability of 13 to 15 years old female students.

II. RESEARCH METHODS

A. Study Area

The research was conducted in Dilla Town, Gedeo Zone, South Nations Nationalities and People Region States (SNNPRS), Ethiopia, 359km from Addis Ababa. It is situated at an elevation of roughly 1476 m above sea level and is situated between 6° 22' and 6° 42' N and 38° 21' and 38° 41' E longitude.

B. Design of the Study

The research was conducted utilizing a quasi-experimental design that lasted for 8 weeks, from February 25 to April 25, 2019.

C. Population of the Study

The study population was female students at Bethel Primary School. This school has 220 female students and 219 male students, for a total of 439 students in grades one through eight. From that population, 53 female students were aged 13–15. Bethel Primary School has one male health and physical education teacher.

D. Sample Size and Sampling Techniques

The study was utilizing lottery system of simple random sampling technique to select subjects from the study population. From 53 female students ages 13–15, thirty female students were selected to participate in the circuit training program for eight weeks. For the study, the participants grouped randomly in to control group (15 students) and an experimental group (15 students).

E. The Study Variables

In this research, the components of physical fitness i.e. muscular endurance as well as muscular strength have been dependent. On the other hand, the time for circuit training and varied activities of each station in the circuit were independent variables.

F. Eligibility Criteria

All 13- to 15-year-old female students learned during conducting a research were included as a participants of the study, while students who were no volunteers, students with injury, or dropout female students were excluded from the study.

G. Protocol of Circuit Training

At the time of 8 weeks circuit training for this research, all students have also take part in the regular physical education practical class as part of pre-planned schedules. In

comparison to control group, randomly assigned female students in the experimental group were did the three day per week regular circuit training program scheduled by the researcher to carried out the study i.e. on Monday, Wednesday, and Friday.

H. Data Collection Tools

Data is gathered through pretest and posttest of muscular fitness in specific muscular strength and muscular endurance of female students, on which the tests were done following the regular class period.

I. Experimental Measurements

➤ Squats Test

This test's goal is to keep track of how the athlete's leg strength is fit. The exam is administered as follows: Stand in front of a chair with their feet shoulder-width apart, facing away from it. Squat down and lightly touch the chair with their backside before standing back up. Repeat this motion until you become exhausted. Afterwards, record the number of squats you were able to perform (Mackenzie, 2005).

➤ Sit Up Test (60 Seconds)

The number of sit-up repetitions finished in 60 seconds was utilized to gauge abdominal muscle endurance. During this test, subjects were instructed to assume a supine position with their backs on the ground. And the same time their knees raised to around 90 degrees. They put their hands without the fingers being clasped proximity with another fingers next to the ears. In 60 seconds, they performed as many sit-ups as they could. The back was on the floor for the first sit-up, and the body was elevated to a 90-degree angle. A subject score was recorded by counting the total numbers of sit ups they successfully done within 60 seconds (Mackenzie, 2005).

➤ Plank Test

This test assesses the endurance of back or core muscles stabilization, which is a test for muscle strength. straightforward fitness test of core muscle strength. On the other way it can be utilized as a part of fitness training to enhance core strength (Mackenzie, 2005). The purpose of this test is measure the ability to maintain an elevated position for the prolonged duration. Starting with the legs straight and the weight being supported by the toes, lift the upper body off the ground utilizing their elbows and forearms. A straight line from head to toe is created when the hip is lifted off the floor. The stopwatch is on to start as soon as the participant is in the required and appropriate body position. While the subjects is not able to continue a straight back and lowers their hip, the test is over.

J. Method of Data Analysis

All the pretest and posttest results were analyzed using SPSS. To compare the means and standard deviation of the pre and posttest recorded data of the variable the study were utilize a paired sample T-test. Statistical significance level was 95% confidence interval with P-values $p < 0.05$.

III. RESULTS OF THE STUDY

A. Participants Demographic Characteristics

The participants' demographic characteristics in this study primarily included age, sex, and educational level. In this study a total of 30 female students ages 13–15 were registered as a participants of the research. All the 30 (100.0%) subjects of the participants of this research were aged from 13–15 (see Table 1).

Table 1: participants' demographic characteristics of the study subjects (n = 30)

No	age	Frequency	Percent	Class	Frequency	Percent	Sex
1	13	10	33.3	7	14	46.7	female
2	14	14	46.7	8	16	53.3	
3	15	6	20.0				
Total		30	100%		30	100%	

As shown in the above table, the participants in this study were female students aged from 13–15; of those, 10 (33.3%) are thirteen years old, 14 (46.7%) are fourteen years old, and 6 (20.0%) are fifteen years old. All participants in this study were grade eight and grade seven students, which is 14 (46.7%) students from grade seven and 16 (53.3%) students from grade eight.

B. Descriptive Statistics Of Pretest And Posttest Measure Of Muscular Fitness Parameters For The Experimental Group

As shown below in table 2, the findings of this study stated as mean and standard deviation scores for the pretest and posttest for the intervention subjects groups in terms of muscular fitness.

Table 2 The Pretest and Posttest Descriptive Statistics for the Experimental Groups

No	Variables	Group	Test				P-Value
			Pre-test		Post-test		
			Mean	± S.D	Mean	± S.D	
1	Leg strength (squat in number)	experimental	35.67	±3.84	38.60	±3.24	0.00
2	Abdominal muscle endurance (sit up in 1 minute)	experimental	18.64	±2.846	22.93	±4.873	0.000
3	Core muscle strength and endurance (plank in seconds)	experimental	76.20	±32.00	79.87	±34.90	0.00

As denoted in the above Table 2, the pretest mean score for the experimental groups are: the pretest and posttest means and standard deviation (SD) scores of the experimental groups squat test record were 35.67 ±3.84 and 38.60±3.24 number of squat in the order already mentioned with a significant values P = 0.00. This suggests that circuit training intervention enhances performance of leg strength in school female students. The pretest and post-test means and SD scores of the in the intervened groups' sit-up test record were 18.64±2.846 and 22.93± 4.873 sit-ups per one minute, in the already mentioned order, with a statistically significant values of P=0.00. This shows that the abdominal muscle endurance performance level in female students could be enhanced by circuit training intervention.

The pretest and posttest means and SD scores of the experimental groups plank test record were 76.20±32.00 and 79.87±34.90 seconds, in the order of the already mentioned, with a statistically significant value of P=0.00. This reveals that the core muscle strength and endurance performance of female students could be improved by utilizing circuit training intervention.

C. Descriptive Statistics For The Pretest And Posttest Data Of Muscular Strength And Endurance Parameters For The Control Group

As indicated here below in table three, the results of this research described as mean and standard deviation for the pretest and posttest for the control groups in terms of muscular strength and muscular endurance.

Table 3 Pretest and Posttest Record Descriptive Statistics for the Control Groups

No	Variables	Group	Test				P-Value
			Pre-test		Post-test		
			Mean	± S.D	Mean	± S.D	
1	Leg explosive strength (Squat in number)	Control	37.67	±3.28	37.87	±3.38	0.77
2	Abdominal muscle endurance (Sit up in 1 minute)	Control	21.11	±6.249	21.58	±5.610	0.710
3	Core muscle strength and endurance (Plank seconds)	Control	76.20	±32.005	76.36	±31.87	0.982

As stated here above in table 3, the pretest and posttest record mean and standard deviation scores for the control groups are: in terms of squat test in number, the pre and posttest records mean and standard deviation for the control group were 37.67±3.28 and 37.87±3.38 respectively, with a significant difference value P = 0.77. It reveals that in the

control group there was not enhancement in the leg explosive strength performance in female students, who performed the same test with experimental group.

In terms of, a one minute sit up test, the pretest and posttest means and SD scores recorded from female students

of the control group were 21.11 ± 6.249 and 21.58 ± 5.610 sit-ups per minute, in the respective orders, with a significant difference value of $P = 0.710$. It indicates that the abdominal muscle strength performances of female students were not enhanced in the control group.

Finally, in terms of plank test, the pretest and posttest means and SD scores recorded from the control group were 76.20 ± 32.005 and 76.36 ± 31.87 seconds, in the respective test time, with a significant difference values of $P = 0.982$. This shows that among the control group who performed the same test, there is no core strength and endurance performance enhancement in the control group.

IV. DISCUSSION

In this study, the results stated above reveal that the muscular strength and muscular endurance performance in female students could be enhanced by utilizing the 8-weeks circuit training and can be installed in the primary school physical education practical class setting. The results of this research potentially show that, the 8 weeks circuit training could improve legs explosive strength, core muscle strength and abdominal muscle strength in female students.

In terms of muscular strength, this study was assessing utilizing squat test to which tells about how fit the female students in leg explosive strength. Female students leg explosive strength performance assessed preceding and followed the 8 weeks circuit training by squat test in the experimental group were recorded 35.67 ± 3.84 and 38.60 ± 3.24 number of squat in the respective order of time with a statistical significant values results $P = 0.00$. These reveal that the leg explosive strength performance of female students in the experimental group, could be improved using the 8 weeks circuit training. The finding of this study is in agreements with investigation carried out by (Sonchan et al., 2017). The study states that leg explosive strength could be improved by circuit training at varied numbers of weeks. The finding stated that significant improvement was found in the physical variable of leg explosive strength. The findings of this study also agreed with the research results described by (Rani & Malik, 2017).

In contrast, the pretest and posttest of leg explosive strength using squat test score of means and SD recorded from the control group were 37.67 ± 3.28 and 37.87 ± 3.38 in the already mentioned orders with a significant difference values $P = 0.77$. This shows that among the control groups who performed the same test, there is no leg explosive strength performance enhancement.

In this study, the abdominal muscle strength performance of female students in the experimental group was assessed by using a 1 minute sit up test, and the results of the test, recorded at the baseline of the training i.e. instantly proceeding the first training day and following the final training day at the end of the 8th weeks were 18.64 ± 2.846 and 22.93 ± 4.873 sit-ups per minute, in the respective order of time, with a statistical significant value of $P = 0.00$. This reveals that the 8 weeks circuit training

could enhance the abdominal muscle endurance performance of female students. Another investigations conducted by (Kumaran, 2018; Mayorga-Vega et al., 2013), they state that circuit training could improve the muscular endurance performance of students. It also agreed with the investigations reported by (Rani & Malik, 2017). But not significant ($P > 0.05$, $P = 0.710$) in the control group, with a 21.11 ± 6.249 and 21.58 ± 5.610 sit-ups per minute as pretest and posttest means, respectively.

Finally, the core muscle strength and endurance was assessed by plank test in the experimental groups among female students. The results recorded from the test during pretest and posttest which is described as means and SD scores were 76.20 ± 32.00 and 79.87 ± 34.90 seconds, in the already stated orders, with a statistically significant value $P = 0.00$ which is $P < 0.05$. This shows that, the 8 weeks circuit training intervention in the experimental groups could improve the core muscle strength and endurance of female students. This result is in consistence with the investigations conducted on the effect of circuit training muscular fitness as in the reports (Sonchan et al., 2017).

On the other hand female students core muscle strength and endurance in the control group was tested by the same test i.e. plank test and the results collected from the test during pretest and posttest which is analyzed as means and SD scores were 76.20 ± 32.005 and 76.36 ± 31.87 seconds, in the already stated orders, with a statistically significant value $P = 0.982$ which is $P > 0.05$. This indicates that, female student's core muscle strength and endurance in the control group were not enhanced in the given time frame.

V. CONCLUSION

The findings of this research revealed that muscular fitness which means muscular strength and muscular endurance performance of female students could be enhanced using the 8 weeks circuit training intervention. This study concludes that the 8 weeks circuit training program could improve the abdominal muscle, core muscle strength and endurance, and leg explosive strength. This investigation reveals that a circuit training can be installed into the primary schools physical education syllabus. Alternatively it can be incorporated in to the teaching session of practical class, which means utilizing circuit training as an additional exercise, to meet the intended benefits. These helps to improve the primary school student muscular strength and muscular endurance performance.

➤ Ethics Approval and Consent to Participate

The research was conducted in agreement with Dilla University's ethical standards. Necessary information's were addressed to the study participants; taking part in this study was volunteered that the subjects of the study could withdraw as per their interest; consent was given at a level that the children could understand. Verbal informed consent was used in this study in, the process of agreeing to take part in a study based on all relevant information about the benefit and harms of a study. This was because of a participants were below 18 years of age, they are considered as children

and is not eligible to give consent. All subjects of the study were informed verbally about the study's purpose, risks, and benefits before being allowed to participate in the intervention.

Consent of publication:- In this study the consent of publication is not applicable.

Supporting data availability:- The supporting data of this research can be available if request from the corresponding author.

Competing interests:- The authors of this study state that there is no conflict of interest.

Research funding:- The study was is funded by Dilla University

Authors' contributions:-

Conceptualization of the study; - Getahun, Haileyesus, and Abera

Formal analysis the data; - Getahun, Haileyesus, Elsabet, Abera and Kalkidan

Methodology development; - Getahun, Haileyesus, Abera, Elsabet, and Kalkidan

Validation of the findings; - Getahun, Haileyesus, Abera, Elsabet, and Kalkidan

Writing original draft of the study; - Getahun, Haileyesus

Writing -review & edit the study; - Getahun, Haileyesus, Abera, Elsabet and Kalkidan

Software; - Getahun,

Supervision:- Haileyesus and Abera

ACKNOWLEDGMENTS

The authors want to express their gratitude to the subjects of this study for their volunteer, and involvement in the present research, in particular staffs of sport science department at Dilla University, Bethel Primary School female students, the owner and director of Bethel Primary School, and the health and physical education teacher.

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