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Research Article

Effect of Exercise on Selected Fitness Variables in Injibara, Ethiopia

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ABSTRACT

Aim: The aim of this study was to determine the effect of exercise on selected fitness variables in Injibara, Ethiopia.

Method: To achieve the purpose of this study, a true experimental design in a randomized pre-test post-test control group design was employed. However, a simple random sampling technique was used to select sixty male subjects and randomly assigned to two Equal Groups of EG (n = 30) and CG (n = 30). The ages of the subjects ranged from 18 to 50 years. Furthermore, EG was exposed to calisthenics exercises each lasting twelve weeks, for three non-consecutive days per week, i.e., Monday, Wednesday, and Friday, each lasting 40-60 minutes at 50-74% HR max moderate intensity in the morning session. But CG did not perform the selected exercise other than the usual daily routines. Both groups had taken pre-test and post-test measurements. The pre-test of the two groups was measured by the Harvard Step test for cardio-vascular fitness, a push-up test for muscular endurance, and a sit-and-reach test for flexibility. A post-test measurement on the same parameters was taken after twelve weeks. However, test results were analyzed statistically with a paired t-test to compare the paired mean difference within the group from pre-test to post-test results of the exercise. All the statistical tests were calculated using the Statistical Package for Social Science (SPSS) version 26 on a computer system. However, the level of statistical significance was set at $p \leq 0.05$. The test findings were tallied, evaluated, appropriately interpreted, and displayed in table 1 in connection to fitness variables.

Results: According to the analyzed data, the results obtained from the EG showed significant differences in cardio-vascular fitness, muscular endurance, and flexibility but not in the CG.

Conclusion: Based on this finding, it can be concluded that moderate calisthenics exercise has a positive effect on the improvement of selected fitness variables in fitness trainees.

Keywords: Exercise; Fitness; Health; Training; Variables

INTRODUCTION

Exercise is crucial for the health and well-being of people of all ages, whether they exercise regularly or moderately [1]. Therefore, the importance of physical exercise includes not only performance improvement but also improving health [2]. In addition, exercise is beneficial to one's health since it improves the mental and physical well-being of those who are ill [3]. As a result, setting a daily goal is an excellent way to maintain a healthy level of physical activity [4]. Nevertheless, thirty minutes of moderate exercise three times per week is beneficial to one's health [5]. As a result, physiological, cognitive, and psychological well-being benefit from exercise [6].

Fitness is the highest level of human potential obtained through regular physical activity [7]. It enhances general health by avoiding weight gain and lowering body mass index, as well as improving athletic performance [8]. Overall, fitness refers to both a condition of good physical health and a person's ability to live a socially and economically productive life in its broadest sense [9]. As a result, the majority of people achieve fitness by combining regular exercise with a healthy diet [10].

Today, most people are aware that regular physical exercise can positively affect many aspects of our physical, mental, emotional, and social well-being. However, many of the people who were involved in regular physical exercise in Injibar town did not know the methods and the appropriate principles of exercise. This might have limited their further progression and intensity of exercise, and this trend might have developed poor fitness levels compared to the expected norms. Thus, this study was conducted to fill that gap. That is why the main objective of this study was to determine the effect of exercise on selected fitness variables in Injibara, Ethiopia.

MATERIALS AND METHODS

Study area

The study was conducted at Injibara town, located in Awi Zone, Amhara region, which lies 445 km north-west of Addis Ababa, the capital city of Ethiopia, and 122 km south-west of Bahir Dar, the capital city of the Amhara National Regional State (ANRS). Injibara is a relatively high-altitude town whose elevations vary from 2,540 m to 3,000 m, with an average altitude of 2,552 m above sea level [11].

Study design

To achieve the purpose of this study, a true experimental design in a randomized pre-test post-test control group design was employed. This design controls all internal threats to validity. Because of strict random assignment of subjects, it is assumed that the two groups are equivalent on all important dimensions and that there are no systematic differences between the two groups. This enabled the researcher to compare participant groups and measure the degree of change that occurred as a result of interventions.

Population, sampling, and sampling techniques

For this study, eighty-five Injibara town male fitness trainees were selected purposely from the target population. Based on inclusion criteria, only seventy-two male fitness trainees fulfilled the criteria and volunteered to participate in the study, of which twelve male fitness trainees declined to participate in the study. However, to manage the study properly, only sixty students were selected by simple random sampling techniques. Then the study subjects were randomly assigned into two equal groups of EG (n = 30) and CG (n = 30), respectively.

Inclusion and exclusion criteria

All subjects selected to participate in the study were in good physical condition. Subjects were included in this study after signing a participation agreement and attending the training program until the trial ended. Only men between the ages of 18 and 50 were eligible to take part in this study. Subjects who showed an interest in participating in the study are included. On the other hand, participants in the pilot study were not included. The study excluded people with bone and joint problems and those who were using medications.

Source of data

Both primary and secondary data sources were utilized in this study. Therefore, the primary data collected from fitness trainees was based on the designed experimental parameters, and secondary data

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was gathered from a variety of sources, including papers, periodicals, books, online sources, and unpublished booklets.

Variables and tests

Based on the primary purpose of the study and the appropriateness of variables to be determined in relation to fitness trainees, the following study variables, tests, equipment, and measurement units were chosen to carry out this experimental research.

Control of data quality

Standard instruments were used to precisely measure variables designated for data collection and verify the validity and reliability of the test measurements. The tools employed to measure the test variables were of good quality. Measurements were obtained three times from each variable of the study participants at the same time of day and in identical environmental conditions to ensure uniformity and dependability of data and consistency of measurements. To ensure that the measurements were properly calibrated before each testing session, they were scheduled for the same day and time throughout the testing schedule. Moreover, the same examiner took the measurements for each test.

Study duration

For systematic data collection, the subjects were divided into experimental groups and control groups. It should be noted that the experimental group was exposed to different exercise training programs for twelve weeks, for three non-consecutive days per week, i.e., Monday, Wednesday, and Friday, each lasting 40-60 minutes at 50-74% HR max moderate intensity in the morning session, and the control group did not perform the selected exercise other than the usual daily routines. Before every training session, the experimental group did ten minutes of warm-up exercise. Therefore, prior to the commencement of experimental interventions, pre-test measurements were done within the first week of the twelve-week training program, while post-tests were performed within the first week following the completion of the training program. Furthermore, the training protocol is detailed in the table 2 below.

Table 1: Variables and tests.

No.	Variables	Tests	Equipment's	Unit of Measurement
1	CVF	Harvard step test	12-inch step & stopwatch	30 steps per minute
2	ME	Push up test	Stopwatch & mats	Repetition per minute
3	Flexibility	Sit and Reach test	20cm high box	Centimetres

Key: CVF: Cardio Vascular Fitness; ME: Muscular Endurance

Table 2: The training protocol.

Treatment	Exercise Program
Frequency	3 days per week
Intensity	Moderate (50 to 74% HR max)
Time of exercise	12 weeks (3 months)
Type	Calisthenics exercises
Duration of exercise	40 to 60 minutes
Days of exercise	Monday, Wednesday, and Friday
Session	Morning

TESTS AND DATA GATHERING PROCEDURES

Harvard step test

During WWII, the Harvard Fatigue Laboratories developed an aerobic fitness test [12].

Objective: This test aims to measure the athlete's development of cardiovascular fitness.

Equipment required: A stopwatch and a step or platform 20 inches (50.8 cm) high for men are required.

Pre-test: Explain the test procedures to the subject. Perform screening of health risks and obtain informed consent. Prepare forms and record basic information such as age, height, body weight, gender, and test conditions. Set the metronome and check the step height.

Procedure: The athlete steps up and down on the platform at a rate of 30 steps per minute for 5 minutes or until exhaustion. The athlete immediately sits down on completion of the test, and the total number of heartbeats is counted between 1 and 1.5 minutes after finishing. This is the only measure required if using the short form of the test. If the long form of the test is being conducted, there is an additional heart rate measurement at between 2 and 2.5 minutes and between 3 and 3.5 minutes.

Scoring: The Fitness Index score is determined by the following equations: For example, if the total test time was 300 seconds (if the entire 5 minutes was completed), and the number of heartbeats between 1 and 1.5 minutes was 90, 2 and 2.5 minutes was 80, and 3 to 3.5 minutes was 70, the long form Fitness Index score would be: (100 x 300)/(240 x 2) = 62.5.

The push-up fitness test

It is also called the "press-up test." There are many variations of the push-up test, with differences in the placement of the hands, how far to dip, the duration of the test, and the method of counting the number of completed push-ups.

Objective: This test aims to measure upper body strength and endurance.

Equipment required: Floor mat and stopwatch.

Pre-test: Explain the test procedures to the subject. Perform screening of health risks and obtain informed consent. Prepare forms and record basic information such as age, height, body weight, gender, and test conditions. Perform a standard warm-up.

Procedure: A standard push-up begins with the hands and toes touching the floor, the body and legs in a straight line, feet slightly apart, the arms at shoulder-width apart, extended and at a right angle to the body. Keeping the back and knees straight, the subject lowers the body to a predetermined point, to touch the ground or some other object, or until there is a 90-degree angle at the elbows, then returns back to the starting position with the arms extended.

Scoring: Record the number of correctly completed push-ups.

The sit and reach flexibility test

This test is widely used as a general test of flexibility [13].

Objective: This test aims to measure the flexibility of the lower back and hamstring muscles.

Equipment required: A sit and reach box, a ruler, and a step or box.

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Pre-test: Explain the test procedures to the subject. Perform screening of health risks and obtain informed consent. Prepare forms and record basic information such as age, height, body weight, gender, and test conditions. Perform a standard warm-up.

Procedure: This test involves sitting on the floor with your legs stretched out straight ahead. Shoes should be removed. The soles of the feet are placed flat against the box. The knees should be locked and pressed flat to the floor. The tester may assist by holding them down. With the palms facing downwards and the hands on top of each other or side by side, the subject reaches forward along the measuring line as far as possible. Ensure that the hands remain at the same level, not one reaching further forward than the other. After some practice reaches, the subject reaches out and holds that position for at least one to two seconds while the distance is recorded. Make sure there are no jerky movements.

Scoring: The score is recorded to the nearest centimetre or half inch as the distance reached by the hand. Some test versions use the level of the feet as the zero mark, while others have the zero mark 9 inches before the feet. There is also the modified sit and reach test, which adjusts the zero mark depending on the arm and leg length of the subject. There are some norms for the sit and reach test and also examples of some actual athletes' results.

Data analysis

The test results were statistically determined using a paired sample t-test to compare the mean difference between pre-and post-tests. All of the data was analyzed using the Statistical Package for Social Science (SPSS) version 26 on a computer system. However, the level of statistical significance was fixed at $p \leq 0.05$. The test findings were tallied, evaluated, appropriately interpreted, and displayed in tables in connection to fitness variables.

DISCUSSION

As we can see in table 3, the descriptive characteristics of study participants' mean and standard deviation of age, height, and weight were 35.51 ± 1.32, 1.77 ± 0.12, and 72.08 ± 4.90 for the Experimental Group (EG), and 34.34 ± 1.21, 1.72 ± 0.09, and 71.96 ± 4.84 for the Control Group (CG), respectively. Therefore, this shows that the characteristics of the study participants were homogeneous because they had similar or identical age, height, and weight traits at the beginning of the exercise.

As we can see in table 4, the difference in the Harvard step test average before exercise (88.14 ± 12.34) and after exercise (90.02 ± 12.23) in EG was statistically significant ($p < 0.05$) following 12-week exercise training. On the contrary, the difference in the Harvard step test average before exercise (83.32 ± 11.42) and after exercise (82.43 ±11.44) in the CG was not statistically significant ($p > 0.05$). In line with this, a similar study on the effects of 12-week exercises on selected fitness variables was conducted [14]. The exercise protocols were walking, jogging, running, and rope skipping. According to the study findings, which are parallel to the literature, calisthenics exercise can increase the performance of cardiovascular fitness.

As we can see in table 4, the difference in the push-up test average before exercise (34.24 ± 1.33) and after exercise (37.21 ± 1.14) in EG was statistically significant ($p < 0.05$) following 12-week calisthenics exercise training. On the contrary, the difference in push up test average before exercise (33.33 ± 1.12) and after exercise (31.22 ± 1.10) in the CG was not statistically significant ($p > 0.05$). Therefore,

Table 3: Characteristics of the study participants.

Group	N	Age (Year)		Height (M)		Weight (Kg)	
		Mean	SD	Mean	SD	Mean	SD
EG	30	35.51	1.32	1.77	0.12	72.08	4.90
CG	30	34.34	1.21	1.72	0.09	71.96	4.84

Key: EG: Experimental Group; CG: Control Group; N: Subject; M: Meter; Kg: Kilogram; SD: Standard Deviation.

Table 4: Paired sample T-test results of fitness variables for the two groups of pre and post-tests.

Variables and Tests	Group	PT		POT		t	Sig. (2-tailed)
		Mean	SD	Mean	SD		
CVF (Harvard Step Test)	EG	88.14	12.34	90.02	12.23	-4.26	0.03
	CG	83.32	11.42	82.43	11.44	0.09	0.72
ME (Push-up Test)	EG	34.24	1.33	37.21	1.14	1.41	0.04
	CG	33.33	1.12	31.22	1.10	1.12	0.67
Flexibility (Sit and Reach Test)	EG	21.25	4.94	24.31	4.84	-0.55	0.03
	CG	20.13	4.02	20.33	4.34	-0.21	0.23

Key: CVF: Cardio-Vascular Fitness; ME: Muscular Endurance; EG: Experimental Group; CG: Control Group; PT: Pre-Test; POT: Post-Test; SD: Standard Deviation; t = Test of Difference; Sig. (2-tailed); Significance Level.

the findings of this present study show that the 12-week calisthenics exercise training results in a significant improvement in the muscular endurance of participants in the EG. This indicates increasing the difficulty during training is more effective for performance enhancement of muscular endurance [15].

As we can see in table 4, the difference in the sit and reach test average before exercise (21.25 ± 4.94) and after exercise (24.31 ± 4.84) in EG was statistically significant ($p < 0.05$) following 12-week calisthenics exercise training. On the contrary, the difference in the sit and reach test average before exercise (20.13 ± 4.02) and after exercise (20.33 ± 4.34) in the CG was not statistically significant ($p > 0.05$). This result was in line with the reports of flexibility performance and has a direct relation to calisthenics exercise training [16]. Therefore, it can be concluded that calisthenics exercise improves the flexibility of the muscle to be stretched than their normal length.

CONCLUSION

Based on the major findings of this study, it was concluded that a 12-week exercise program had brought significant changes in cardiovascular fitness, muscular endurance, and flexibility in the EG but no improvement in the selected fitness variables of the CG. Therefore, participants involved in exercise training (EG) were more advantageous than the CG. In addition, this study has shown that performing an exercise with different methods will result in different adaptations. Therefore, exercise participants are encouraged to increase the difficulty of exercise during training. Generally, the investigators noticed that moderate-intensity exercise training and regular participation in physical activity had a positive effect on enhancement of cardiovascular fitness, muscular endurance, and flexibility performance. As a result, the data improvement was indicative of the significant exercise effect on fitness level.

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RECOMMENDATION

Exercises should be incorporated into the training programs at different levels. As revealed by the conclusions of the study, this will help to improve the fitness and health of people. In all diversity, further research should be done in the area of fitness components because exercise has a direct influence on raising the level of a participant's health and fitness performance. Generally, it is highly expected of professionals in sports science to guide and train participants on the importance and value of exercise to improve the fitness performance of participants.

ETHICAL CONSIDERATIONS

The college of natural and computational sciences research ethics review committee of Injibara University accepted the study procedures, as did all participants' signed informed consent. Participants were informed about the research's advantages. They were told that their participation in this study is completely optional and welcomed. To guarantee that secrecy and anonymity were preserved, each participant was assigned a number and an alphabetical code. The Ethiopian national language, Amharic, has been used to translate information sheets, agreements, and consent forms.

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LIMITATIONS OF THE STUDY

During the course of this study, the researcher encountered a number of limiting factors that had an impact on the quality of the research. Since the study was experimental, the researcher attempted to select materials that were standardized. However, it was prohibitively expensive, and there was a scarcity of adequate sports equipment and proper facilities. As a result, the researcher relied on readily available instruments, which was seen as a restriction. In addition to this, variances in the subjects' behavior due to a number of psychological, social, cultural, economic, and religious factors were not properly controlled in the study. Moreover, during training and testing periods, certain extraneous variables such as lifestyle, daily routine tasks, food habits, and rest periods influenced the results of this study.

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