

Effectiveness of Calisthenics Training on Lower Body Strength and Endurance among College Students

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ABSTRACT

INTRODUCTION: Calisthenics exercises are a form of exercise consisting of a variety of simple, often rhythmical movements, intended to increase body strength and flexibility using only one's body weight for resistance. **AIM:** The present intervention was designed to investigate whether a 2-week period of Calisthenic training has an effect on muscular strength and muscular endurance. **METHOD:** 20 healthy untrained college students were randomly divided into Calisthenics Group and Control Group. The training was performed for 3 days a week for 2 consecutive weeks. Lower body strength and muscular endurance were tested using Sargent Jump Test and Sit Ups Test. Wilcoxon Signed-Rank Test and Mann Whitney-U Test were used for within-group and between-group data analysis. **RESULT:** There was a statistically significant difference in the pre-test and post-test values of both groups. Both groups proved significantly better in managing strength and endurance, however, the comparison of the post-test data of both groups showed that no statistically significant difference was seen between both groups. **CONCLUSION:** Both the groups were individually effective in improving Strength and Endurance of College Students however 2 weeks of calisthenics training was not sufficient to provide a statistically significant result.

KEYWORDS: Calisthenics, Muscular Strength, Muscular Endurance, Sit Ups Test, Sargent Jump Test

I. INTRODUCTION

Organized physical activity plays an important role in promoting health and physical development when students tend to become less active [1]. Improving physical fitness has been a goal of physical education, from introductory programs offered by contemporary physical education teachers. This enduring interest in fitness has inspired the creation of many exercise plans and programs designed to help achieve the goal of fitness [2].

Strength training as a tool can be used not only for fitness and health purposes, but also as an attractive means for students to actively participate in physical education classes or to improve adherence to exercise programs [1].

There is currently a great deal of interest in identifying the most effective methods of strength training and endurance development, which is of particular relevance to physical education programs in schools and universities.

Calisthenics is a form of exercise that aims to increase the body's strength and flexibility using only one's own body weight as resistance. Calisthenics was invented in ancient Greece and was related to Greco-Roman gymnastics. The word Calisthenics comes from the Greek word 'kallos' meaning beauty and 'thenos' meaning strength [3].

Calisthenics is a smooth, rhythmic and fun exercise that is easy to implement alone or in a group and can be modified according to the subject's fitness levels. Calisthenic training can develop both muscular endurance and cardiovascular fitness, and improve psychomotor skills such as balance, agility and coordination [3].

EFFECTS OF CALISTHENICS EXERCISES: Calisthenics can be practiced by people of all ages and genders and when practiced correctly, without risk of injury. By adding calisthenics to your exercise routine and sticking to a good diet, great improvement in health and fitness can be observed. It Improves overall endurance, strength, energy, agility, flexibility, coordination, balance and promotes overall fitness for your health. It can improve mental health as well as psychomotor skills such as balance and coordination. It can help with psychological problems like stress, anxiety, depression, etc. and can increase self-esteem. Through Calisthenics exercises one can gain more strength, flexibility and mobility in your muscles [4].

Despite the proven benefits of Calisthenics training, relevant studies in university settings are scarce. Incorporating strength training into adult fitness programs has been shown to be effective in developing and maintaining muscle strength and endurance [4,5]. Therefore, the aim of the present study is to determine whether a calisthenics training program is sufficient to induce significant changes in lower body strength and endurance in college students.

II. METHODOLOGY AND PROCEDURE

Twenty-four healthy, untrained college students were selected. Study was done on 20 female subjects who fulfilled the Inclusion Criteria. They were randomly allocated into two groups (n=10) as Calisthenics Training Group (Group 1) and Control Group (Group 2). The Ethical Approval was obtained from the Institutional Ethical Committee. The purpose and nature of the study were explained to all participants and informed, written consent was obtained.

Inclusion Criteria: 1). College Students. 2). Both the gender. 3). Age Range (18 – 25). 4). BMI (18.5 – 24.9). 5). Demonstrate the ability to properly perform at least 1 repetition of each of the 3 exercises: push-ups, sit ups, and bodyweight-squats. 6). Willing to participate.

Exclusion Criteria: 1). Indicate having no health issues that would significantly increase adverse event risk while participating, as assessed via the Physical Activity Readiness-Questionnaire. 2). Previously participated in calisthenics training will be excluded.

Baseline assessment was taken before the initiation of training period which includes Sit Ups Test and Sargent Jump test. Subjects in both groups practiced the training for 40 minutes a day, thrice a week for 2 weeks, which included 10 minutes of warm up (Jog, One Leg Standing Knee Flexion, Bodyweight Calf Raises, Bodyweight Squats, Bodyweight Countermovement Jumps) [6], Calisthenics Training as mentioned in Table 1 and Regular Exercise Training as mentioned in Table 2 were performed for 25 minutes, followed by 5 mins of cool down Jog. 1 min rest was given between each exercise, whereas 30 secs rest was given between each set of exercise.

Table 1. Calisthenics Training Protocol for Group 1

<i>Exercises</i>	<i>Week 1</i>	<i>Week 2</i>
Plyo Jacks	2x10	2x15
Skater Hops	1x10 (each side)	1x15 (each side)
Dive Bomber Push Ups	1x10	1x15
Single Leg Deadlift Hops	1x10 (each side)	1x15 (each side)
Pistol Squat	1x6 (each side)	1x8 (each side)
Air Bike Crunches	2x10	2x15
Super Plank with Leg Raise	2x10	2x15
Mountain Climber	2x10	2x15
Superman	2x10	2x15

Table 2. Regular Exercise Training Protocol for Group 2

<i>Exercises</i>	<i>Week 1</i>	<i>Week 2</i>
Forward Lunges	1x10 (each side)	1x15 (each side)
Single Limb Deadlifts	1x10 (each side)	1x15 (each side)
Thoracic Elevation	1x10	1x15
Bilateral Straight Leg Raising	1x10	1x15
Modified Bridge	1x10 (each side)	1x15 (each side)
Curl Ups	1x10	1x15
Trunk Side Bending	1x10 (each side)	1x15 (each side)
Quadruple Leg Lifts	1x10 (each side)	1x15 (each side)
Clam Exercise	1x10 (each side)	1x15 (each side)

III. OUTCOME MEASURES

1) Sit Ups Test^[7]

PURPOSE: To measure the endurance of abdominal muscles.

EQUIPMENT: A stopwatch, a mat or dry turf or clean floor, paper and pen.

METHOD: The subject was to lie on the back with knees bent, feet on the floor and with heels not more than 12 inches from the buttock. The angle of the knees should be less than 90°. The subject was asked to put his hand on the back of the neck with finger clasped and to place the elbows squarely on the mat or turf or floor. The subject's feet were held by a companion to ascertain that the feet do not leave the surface and remain touching it. Then the subject was asked to tighten the abdominal muscle and to bring the head and elbows to the knees. The entire above process constitutes one sit-up. The timer gives the starting signals ready, go! At the word 'go' the timer starts the stopwatch and the subject starts the sit-ups performance as quickly as possible with his best effort. The tester starts counting the number of sit-ups performed. After 60 second, the timer gives the signal stop and the subject stops.

2) Sargent Jump Test^[8]

PURPOSE: The vertical jump test involves measuring the difference between the standing reach and the height reached at the peak of a vertical jump.

EQUIPMENT: Measuring tape, chalk/marker for marking the wall.

METHOD: The player stands side on to a wall and reaches up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips is marked or recorded. This is called the standing reach height. The athlete then stands away from the wall, and leaps vertically as high as possible using both arms and legs to assist in projecting the body upwards. Attempt to touch the wall at the highest point of the jump. The difference in distance between the standing reach height and the jump height is the Score. Participants performed each jump 3 times, and the best of three attempts is recorded.

RELIABILITY: Vertical jump reliability has been reported to range between 0.90 and 0.99.

IV. DATA ANALYSIS

In this study, data collected were statistically analyzed by Statistical Package for Social Sciences (SPSS) computer program (version 26) for Windows and the data were reported as mean \pm SD. Wilcoxon Signed-Rank Test was used to analyze the change in strength and endurance before and after training protocol within groups, whereas Mann Whitney-U Test was used to find out the statistical differences between two groups. The level of significance was fixed at 0.05.

V. RESULTS

Pre-test and Post-test values in Group 1 were analyzed using Wilcoxon Signed-Rank Test (Table 3). The pre-intervention mean score of Sargent Jump Test was 35.70 and Sit Ups Test was 24.60 whereas post-intervention score of Sargent Jump Test was 39.40 and Sit Ups Test was 26.90 and was statistically significant ($p < 0.05$) in subjects who followed Calisthenics Training.

Table 3. Comparison of Pre-test and Post-test values of Strength and Endurance of Group 1

<i>Outcome Measures</i>	<i>Pre-test</i>	<i>Post-test</i>	<i>Z value</i>	<i>p value</i>
Sargent Jump Test	35.70 \pm 8.19	39.40 \pm 8.83	-2.83	0.005
Sit Ups Test	24.60 \pm 5.27	26.90 \pm 5.02	-2.83	0.005

Pre-test and Post-test values in Group 2 were analyzed using Wilcoxon Signed-Rank Test (Table 4). The pre-intervention mean score of Sargent Jump Test was 31.80 Sit Ups Test was 20.70 whereas post-intervention score of Sargent Jump Test was 33.60 and Sit Ups Test was 24.00 and was statistically significant ($p < 0.05$) in subjects who followed Regular Training.

Table 4. Comparison of Pre-test and Post-test values of Strength and Endurance of Group 2

<i>Outcome Measures</i>	<i>Pre-test</i>	<i>Post-test</i>	<i>Z value</i>	<i>p value</i>
Sargent Jump Test	31.80 \pm 7.78	33.60 \pm 8.36	-2.84	0.004
Sit Ups Test	20.70 \pm 3.59	24.00 \pm 3.85	-2.85	0.004

Post-test values of strength and endurance of between Group 1 & Group 2 were analyzed by Mann Whitney-U Test (Table 5). The post-test Mean difference of strength (3.70) of Group 1 was greater than post-test mean strength (1.80) of Group 2. The post-test Mean difference of endurance (2.30) of Group 1 was lesser than post-test mean endurance (3.30) of Group 2. However, the results did not show a statistically significant change ($p < 0.05$) between the two groups.

Table 5. Comparison of Post-test values of Strength and Endurance between Group 1 and Group 2

<i>Outcome Measures</i>	<i>Group 1 Post-test</i>	<i>Group 2 Post-test</i>	<i>U value</i>	<i>p value</i>
Sargent Jump Test	39.40 \pm 8.83	33.60 \pm 8.36	27.50	0.08
Sit Ups Test	26.90 \pm 5.02	24.00 \pm 3.85	31.00	0.14

VI. DISCUSSION

The purpose of the study was to find out the effect calisthenics exercise and regular exercise on physical performance of college students. The initial hypothesis was that this type of training would provide significant effects which would support the insertion of calisthenics training in the college context.

Our results showed a statistically significant increase in the strength and endurance of college students after both interventions. Both groups proved significantly better in managing strength and endurance, however, the comparison of the post-test data of both groups indicate that no statistically significant difference was seen between both groups after 2 weeks of consistent training.

Findings from **Guerra LA, Dos Santos LR et al (2019)** prove that significant improvements were observed in the muscle strength of the school children after the application of an 8-week systematic calisthenics exercise program ^[1]. Similarly, **Thakur R, Vidhale SG (2016)** concluded that an 8-week calisthenics program was effective in improving physical fitness of students ^[9]. Consistent with the results of the above study is the study by **Gist NH, Freese EC et al (2015)** proved that a 4-week protocol of short-duration, low-volume, high-intensity whole-body calisthenics can sustain metabolic capacities and enhance physical performance on armed forces personnel without equipment ^[10].

However, a study by **Tsourlou T, Gerodimos V et al (2003)** where aerobic-calisthenics training did not improve muscular fitness either or body composition following a 10-week aerobic-calisthenics program when compared to aerobic-weight training program ^[11]. The above results were supported by a study conducted by **Marcinik EJ, Hodgdon JA et al (1984)** found that aerobic calisthenic training was ineffective in eliciting significant changes in muscular strength after a consistent training of 10 weeks when compared to aerobic circuit weight training ^[12].

Some of the limitations of this study include small sample size and recruitment of female subjects. Future studies can be done with larger sample size and different population. Similar Training Regimen can be compared with other training regimes such plyometric training, SAQ training and circuit training with different intensities of training and various other parameters can be measured as well.

VII. CONCLUSION

In the present study it was concluded that both the groups are individually effective in improving Strength and Endurance of College Students. The systematic program of Calisthenics Training showed significant improvement in the mean difference of strength and endurance in college students after 2 weeks of consistent training, though they were not proven to be significantly effective than Regular Exercise Training. However, considering the practicality of calisthenics exercises, its use as a substitute to Regular Exercise Training is viable and recommended.

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