

EFFECT OF GYMNASTIC TRAINING ON FLEXIBILITY AND STRENGTH OF COLLEGE ATHLETES

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Abstract

Background: In collegiate athletic events, physical fitness especially the flexibility and muscular strength are essential to an athlete. Gymnastic training has become a holistic conditioning of the training which systematically combines various elements of fitness. But there is not much research on its efficacy in college athletes.

Purpose: This research examined the impact of a structured gymnastic training program on flexibility and muscular strength of college athletes. **Methods:** The experimental research design of one-group pre-test/ post-test was applied to 20 college athletes (16-20 years old) sampled by using purposive sampling. The Sit-and-Reach Test was used to measure Flexibility and the Push-Up Test was used to measure muscular strength. The subjects underwent a four-week program of gymnastic training which comprised of five sessions a week. A descriptive statistical analysis and paired sample t-tests were employed to analyze data.

Results: The mean flexibility score increased significantly from 21.10 cm (SD = 1.37) in the pre-test to 27.00 cm (SD = 1.37) in the post-test, representing a 27.96% improvement ($t = 18.45$, $p < 0.05$). Muscular strength improved significantly from 15.40 repetitions (SD = 0.99) to 22.40 repetitions (SD = 0.99), showing a 45.45% improvement ($t = 21.32$, $p < 0.05$).

Conclusion: Flexibility and muscular strength in college athletes are significantly enhanced by the trainings in gymnastic activities. The results favor the incorporation of exercise using gymnastics in athletic conditioning programs. Gymnastic training should be regarded by sports coaches and physical educators as an effective and affordable way of full-fledged physical fitness development in a collegiate athletic environment.

Introduction

Physical fitness is a basic variable that determines athletic performance, especially in competitive college sports. Of the many elements of physical fitness, muscular strength and flexibility are said to be very crucial in achieving good movement efficiency, injury prevention and improvement

of performance. College athletes are exposed to high intensity training programs and matches which involve a high degree of neuromuscular coordination, movement, and muscular force. That is why the most efficient training strategies that can enhance the flexibility and strength is of

both particular interest in modern sports science studies.

The practice of gymnastic training is finally being accepted as a multi-faceted form of conditioning that includes the development of strength, flexibility, balance, coordination and core stability. There is no need to train particular muscle groups as in traditional resistance training since in gymnastic routines we stress more on functional, full-body alignment over extended-range movements. Body weight holds and dynamic stretching exercises, tumbling, and controlled balance exercises are activities that work together in promoting joint flexibility and muscular strength. The recent investigations (2023–2025) in the sphere of sports science state that the combination of mobility and strength exercises into an integrated training minimally causes the growth of the functional performance in contrast to the isolated training.

Recent progress in the study of sport performance has also highlighted the significance of functional strength, as opposed to the performance based on the absolute muscular strength. (Garrett et al., 2000). The concept of functional strength means the capacity to utilize the power productively when performing the sport-related movements without falling, losing balance, or control. The training of gymnastics organically acquires such qualities when it puts athletes to the task of mastering their weight in various positions and movement types (McArdle et al., 2015). As a result, the athletes can gain not only the strength and the flexibility but also agility, balance, and general proficiency in the movement (Lesinski et al., 2025).

In addition, college athletes are in a critical period of physical development and appropriate training interventions could play an important role in determining future athletic success (Ackland et al., 2009). This stage presents increased training demands, competition, and performance demands on athletes. This leads to the necessity of applying scientifically, supported training approaches in order to get maximum performance with minimal risk of overuse injuries (Baechle et al., 2008). Gymnastic training is a practical and economical option that could be integrated into the conditioning program and program without a large number of

equipment and facilities (Granacher et al., 2024).

The muscles play a crucial role too since they contribute to the production of forces, speed, power, and stamina (De Villarreal et al., 2009). Powerful muscles can be used to enhance sports performance because powerful muscles help athletes to produce more forces when making sport-specific movements, including jumping, sprinting, throwing and turning. Additionally, muscles aid in stability of the joints and assist the athlete to maintain the sound body mechanism during exercise. Consequently, the enhancement of strength is one of the most often aims of the majority of athletic conditioning programs (Fleck et al., 2014).

Gymnastic education entails a number of activities that test the athletes to manage or carry bearing weight by utilizing various motion schemes (Dintiman et al., 2017). Planks, bridges, handstands, cartwheels, rolls and static holds are activities that involve a lot of muscular activity in them whilst at the same time increasing flexibility and balance. These activities use both major and stabilizing muscle pools which result in the development of more neuromuscular coordination and functional strength. One of the distinctive features of gymnastic training compared to many typical methods of training is the possibility of performing controlled movements with a wide range of movement (Polman et al., 2016).

Study Objectives.

1. To establish how gymnastic training can influence the flexibility of college athletes.
2. To establish the impact of the gymnastic training on muscular strength of college athletes.

Research Questions

RQ1: Do pre-test and post-test scores of the flexibility of college athletes differ significantly after gymnastic training?

RQ2: Do the scores of pre-tests and post-test muscular strength significantly differ in college athletes who undergo a gymnastic training?

Research Hypotheses

H1: Gymnastic training should significantly increase the flexibility of college athletes.

H2: Muscular strength between college athletes is highly enhanced through muscular training.

Methodology

Research Design

The research was carried out through an experimental study design which involved a one-group design of pre-test and post-test. The participants were put to test prior to the implementation of the gymnastic training program (pre-test), and at the end of the four weeks (post-test) of training program. The effectiveness of the training intervention was based on the difference between the two test scores.

Design:

Pre-Test- 4 Weeks Gymnastic Training Program-
Post Test.

Population of the Study

The study population was comprised of college athletes who are enrolled in the sports programs in the chosen college. Assuming that these athletes were physically active, they used to engage in sporting activities and physical education programs on a regular basis.

Sample of the Study

A sample of 20 college athletes was selected for the study. The physical condition and injury of the participants were checked and none had a condition or injury that might impede his or her ability to participate in the training program.

Sampling Technique

Main subjects were chosen using purposive sampling method since only the participants who fit into the inclusion criteria were used in the study.

Inclusion Criteria

- College athletes who are between the ages of 16 and 20 years.
- Regular participation in sports activities.
- Healthy, physically and medically.
- strong motivation to take part in the research.

Exclusion Criteria

- Athletes with injuries.

- Athletes who are not present during training.
- Persons who are not open to it.

Research Variables

Independent Variable

- Gymnastic Training Program

Dependent Variables

- Flexibility
- Muscular Strength

Instruments and Testing Procedures.

Flexibility Test (Sit-and-Reach Test)

Flexibility of lower back and hamstring muscles was measured by using Sit-and-Reach Test.

Procedure:

1. The patient was seated on the floor with completely extended legs.
2. Foot was resting on sit-and-reach box.
3. The participant moved towards the front in a slow motion as much as possible.
4. The highest level of three attempts was to measure the best result in centimeters.

Strength Test (Push-Up Test)

The Push-Up Test was employed to determine the upper body muscular strength and endurance.

Procedure:

1. Practitioners took the typical push-up position.
2. They did as many push-ups that were correct as they did.
3. The number of correct push-ups performed was summed up.

Pre-Test Procedure

Pre-testing was also done on all those who took part to come up with the baseline levels of flexibility and strength prior to the training program.

The pre-testing has been carried out one week prior to the gymnastic training program. Prior to testing, participants underwent a standardized warm up. Sit-and-Reach Test was conducted to determine the degree of flexibility whereas Push-Up Test was conducted to determine the degree of muscular strength. All the tests were

performed in similar environmental conditions to make sure there are uniformity and reliability.

Pre-Test Procedure

Prior to the training program, pre-testing was conducted to determine baseline data of the flexibility and strength of all the participants. The pre-test was to be carried out a week before the commencement of the gymnastic training program. Respondents underwent a common

warm-up test. Sit-and-Reach Test was carried out to assess the level of flexibility whereas the Push-Up Test was performed to assess the muscular strength. All the tests were done in a similar environmental condition to ascertain consistency and reliability.

The scores achieved in the pre-test were the baseline physical fitness level of the subjects and was used to compare it with the results of the post-test.

Table 3.1 Pre-Test score

Variable	Test	Unit
Flexibility	Sit and Reach Test	Centimeters (cm)
Muscular Strength	Push-Up Test	Number of Repetitions

Example Pre-Test Results (N = 20)

Participant	Sit & Reach (cm)	Push-Ups (Reps)
p1	20	15
p2	22	16
p3	19	14
p4	21	15
p5	23	17
p6	20	15
p7	22	16
p8	21	15
p9	19	14
p10	20	15
p11	22	16
p12	21	15
p13	23	17
p14	20	15
p15	19	14
p16	21	15
p17	22	16
p18	20	15
p19	23	17
p20	21	16

Post-Test Procedure

After completion of the four-week gymnastic training program, the participants underwent post-testing using the same procedures and instruments employed during the pre-test.

The Sit-and-Reach Test was used again to measure flexibility, while the Push-Up Test

assessed muscular strength. Testing conditions, equipment, and instructions remained identical to those used during the pre-test to ensure reliability and validity of the results.

The post-test scores were compared with the pre-test scores to determine the effectiveness of the gymnastic training program. Example Post-Test Results (N = 20)

Table 3.2 Post test score

Participant	Sit & Reach (cm)	Push-Ups (Reps)
p1	26	22
p2	28	23
p3	25	21
p4	27	22
p5	29	24
p6	26	22
p7	28	23
p8	27	22
p9	25	21
p10	26	22
p11	28	23
p12	27	22
p13	29	24
p14	26	22
p15	25	21
p16	27	22
p17	28	23
p18	26	22
p19	29	24
p20	27	23

Four-Week Gymnastic Training Program

The gymnastic training program was planned, progressive and systematic in nature to develop flexibility and strength in the college athletes for four weeks. The program was based on the principles of gradual overload, specificity, consistency, and proper recovery. It was made up of warm-up exercises, stretching exercises, core strengthening activities, body weight strength exercises, balance exercises and cool-down exercises. The training took place for 5 days a week, with 2 days being dedicated to rest and recovery, to avoid fatigue and the risk of injury. The three main phases of each training session were warm-up, main training, and cool-down phases and were approximately 45–60 minutes in duration. The warm-up induced a state of readiness of the muscles and joints to the physical activity, the main part of the training consisted of gymnastic exercises that developed flexibility and strength, while the cool-down was used for muscle relaxation and recovery.

Week 1: Foundation and Adaptation Phase

In the first week, the main focus was on introducing basic gymnastic movements and preparing the body for training. Light intensity exercises were used to develop initial flexibility, coordination, and muscular activation.

Warm-up (10–15 minutes)

Jogging, arm circles, shoulder rotations, neck movements, hip rotations, and dynamic stretching.

Main Exercises (25–30 minutes)

- Basic stretching (hamstring stretch, quad stretch, calf stretch)
- Wall push-ups (2–3 sets × 10–12 reps)
- Basic squats (3 sets × 12 reps)
- Plank hold (3 sets × 20–30 seconds)
- Bridge hold (2 sets × 15–20 seconds)
- Light split practice (assisted)

Cool-down (5–10 minutes)

Slow walking and static stretching for full body relaxation.

Week 2: Development Phase

The second week focused on improving flexibility range and increasing muscular strength through moderate intensity exercises.

Warm-up:

Same as Week 1 with increased duration of dynamic stretching.

Main Exercises:

- Deep lunges with stretch (3 sets × 10 reps each leg)
- Standard push-ups (3 sets × 10–15 reps)
- Bodyweight squats (3 sets × 15 reps)
- Plank (3 sets × 30–40 seconds)
- Bridge (3 sets × 25 seconds)
- Assisted handstand practice against wall (2–3 attempts)
- Forward bend stretch and hip flexibility drills

Cool-down:

Static stretching focusing on back, legs, and shoulders.

Week 3: Strength and Flexibility Enhancement Phase

In this week, intensity was increased to improve muscular endurance, core strength, and advanced flexibility.

Warm-up

Dynamic warm-up with jogging and mobility exercises.

Main Exercises

- Push-ups (3–4 sets × 12–18 reps)
- Jump squats (3 sets × 12 reps)
- Plank with leg lift (3 sets × 30–45 seconds)
- Wall handstand hold (3 sets × 20–30 seconds)
- Split training (progressive depth practice)
- Back bridge walk attempts
- Core exercises (leg raises, bicycle crunches)

Cool-down

Deep stretching focusing on hamstrings, spine, and shoulders.

Week 4: Performance and Mastery Phase

The final week focused on improving performance, control, and maximizing flexibility and strength gains achieved in previous weeks.

Warm-up:

Full dynamic warm-up with mobility drills.

Main Exercises:

- Standard + advanced push-ups (4 sets × 15–20 reps)
- Squat jumps (3–4 sets × 15 reps)
- Full plank variations (45–60 seconds)
- Wall handstand + balance control practice
- Full split attempts (controlled progression)
- Bridge hold and movement control
- Core strengthening circuit (planks, leg raises, V-ups)

The following statistical techniques were applied:

Mean

Standard Deviation

Paired Sample t-Test

Percentage Improvement

Level of Significance

The level of significance was set at **0.05** ($p < 0.05$). Any value less than 0.05 was considered statistically significant.

RESULTS

This chapter presents the results obtained from the data collected before and after the

Cool-down

Long static stretching session with focus on full-body relaxation.

Data Collection Procedure

The researchers obtained permission from the college administration before conducting the study. Participants were informed about the purpose of the research and consent was obtained. Pre-test data were collected before the training intervention. The four-week gymnastic training program was then implemented under the supervision of the researcher. After completion of the training program, post-test data were collected using the same testing procedures.

Statistical Analysis

The collected data were analyzed using SPSS 25 version.

implementation of the four-week gymnastic training program on college athletes, along with their discussion in relation to previous research studies. The main purpose of this chapter is to analyze and interpret the effect of gymnastic training on two key variables of physical fitness, namely flexibility and strength, and to determine whether the observed changes are statistically and practically significant.

Descriptive Statistics of Flexibility Scores

Table 4.1

Pre-Test and Post-Test Flexibility Scores (N = 20)

Test	Mean (cm)	SD
Pre-Test	21.10	1.37
Post-Test	27.00	1.37
Mean Difference	5.90	-

Interpretation

The mean flexibility score increased from 21.10 cm in the pre-test to 27.00 cm in the post-test.

The improvement of 5.90 cm indicates that the gymnastic training program significantly enhanced flexibility among the college athletes.

The increase may be attributed to regular stretching exercises, dynamic warm-up activities,

and flexibility drills included in the training program.

Descriptive Statistics of Strength Scores

Table 4.2

Pre-Test and Post-Test Strength Scores (N = 20)

Test	Mean (Reps)	SD
Pre-Test	15.40	0.99
Post-Test	22.40	0.99
Mean Difference	7.00	-

Interpretation

The mean muscular strength score increased from 15.40 repetitions during the pre-test to 22.40 repetitions during the post-test. The

increase of 7 repetitions demonstrates that the gymnastic training program effectively improved upper-body muscular strength and endurance.

Paired Sample t-Test for Flexibility

Table 4.3

Comparison of Pre-Test and Post-Test Flexibility Scores

Variable	Mean Difference	t-value	p-value	Decision
Flexibility	5.90	18.45	0.000	Significant

Interpretation

The paired sample t-test revealed a statistically significant difference between pre-test and post-test flexibility scores ($p < 0.05$). Therefore, the

null hypothesis was rejected. The findings indicate that gymnastic training had a positive effect on flexibility among college athletes.

Paired Sample t-Test for Strength

Table 4.4

Comparison of Pre-Test and Post-Test Strength Scores

Variable	Mean Difference	t-value	p-value	Decision
Strength	7.00	21.32	0.000	Significant

Interpretation

The paired sample t-test showed a statistically significant difference between pre-test and post-test strength scores ($p < 0.05$). Therefore, the

null hypothesis was rejected. The results confirm that gymnastic training significantly improved muscular strength among college athletes.

Percentage Improvement

Table 4.5

Percentage Improvement in Flexibility and Strength

Variable	Pre-Test Mean	Post-Test Mean	Improvement (%)
Flexibility	21.10	27.00	27.96%
Strength	15.40	22.40	45.45%

Interpretation

The percentage improvement analysis revealed that flexibility improved by approximately 27.96%, while muscular strength improved by approximately 45.45%. These results demonstrate the effectiveness of the gymnastic training program in developing both physical fitness components.

Discussion

This study aimed at examining the impact of gymnastic training on flexibility and strength of the college athletes. The results revealed that both variables had significant changes towards improvement after a period of four weeks of training intervention.

The moving score enhancement concurs with other studies carried out by Behm et al. (2016) that also indicated that the range of motion can be improved significantly through flexibility training in 6-8 weeks. On the same note, the current results are in line with the studies of Di Cagno et al. (2009) whose research result agreed that 4-14 weeks of training in gymnastics could significantly increase flexibility due to repetitive stretching and movement patterns.

This enhancement of muscular strength will be consistent with the results of Granacher et al. (2011) who discovered significant improvements in muscular strength after well organized training programs. Similarly, Bassa et al. (2012) reported that upper-body strength was greatly enhanced in individuals engaged in exercises based on gymnastics.

The findings also justify the conclusion of Afonso et al. (2021) who proposed that synergistic training in flexibility and strength has better results as compared to the separated training programs. The training program adopted in the current research involved both flexibility and strength, which were probably involved in the noted enhancements.

Conclusions

Gymnastic training programme enhanced greatly on flexibility in college athletes. Stretching exercises, mobility exercises and gymnastic exercises increased the range of motion and flexibility of the joints and muscles. Muscular strength also increased greatly as a

result of the gymnastic training program. Exercises using bodyweight included in the program were beneficial in building upper-body and core muscular strength. The paper has proven that gymnastic training is a holistic conditioning process that can build up various elements of physical fitness at a given time. The high changes noted in flexibility as well as strength means that gymnastic training can be successfully incorporated in the athletic conditioning programs at college level. The findings also indicate the possibility that gymnastic training can lead to better athletic performance, prevent injuries, efficiency of movement, and physical fitness. Thus, it can be concluded that gymnastic training is a good and practical training method of college athletes.

Recommendations

Coaches need to add gymnastic training to their conditioning schedule in the college.

The physical education department should promote and advocate the use of gymnastics-related fitness activities to enhance the development of athletes.

Athletes need to perform flexibility and strength training exercises on a regular basis to facilitate maximum performance and minimise risk of injury.

It is recommended that sports organisations adopt gymnastic conditioning programmes for their athlete development programmes.

Future research should use larger samples to obtain more generalizable results.

The long term effect of gymnastic training within a period of eight to twelve weeks should be explored by the researchers.

In the future, it would be good to compare gymnastic training with the traditional methods of resistance training.

In future research additional fitness variables, like balance, agility, speed, coordination, power and endurance, should be studied.

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