IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Effects Of Exercise Therapy And Yoga Therapy On Flexibility Among Obese College Students

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Abstract: Obesity is a critical global health issue, rising sharply due to modern lifestyle changes. In India, rapid urbanization and economic growth have fueled obesity rates, with prevalence increasing to 9.8% in women and 5.4% in men by 2022. A Lancet study shows 70% of the urban population is overweight, ranking India third globally in obesity, with an overall prevalence of 40.3%. Body Mass Index (BMI) is a widely used metric for assessing and classifying obesity. It is determined by dividing an individual's weight in kilograms by the square of their height in meters (kg/m²). This study investigate whether exercise and yoga therapies on flexibility could result in positive changes in obese people. A total of 150 obese male college students (ages 18–21) from St. Benedict's Group of Institutions, St. Anthony's Institution Bangalore, were selected using purposive random sampling participants were randomly assigned to three groups of 50 each:

Exercise Therapy, Yoga Therapy, and Control, with a 16-week intervention, conducted six days a week in the morning for an hour. BMI measurements were taken before and after the intervention to evaluate its effects. The data so obtained was analyzed using mixed two-way repeated measures ANOVA. The study revealed a significant reduction in BMI across all groups except the control group. Both intervention groups demonstrated substantial improvements, with variations in the degree of effectiveness between the two approaches. The findings suggest that both exercise and yoga therapies are effective interventions for increased flexibility among obese college students. Incorporating structured physical activity and yoga programs may be a practical strategy to combat obesity in young adults.

Key words: Exercise, Yoga, Therapy, Flexibility, Obese.

I. INTRODUCTION

Obesity is a major global health concern that has escalated over the past few decades, affecting millions worldwide. The World Health Organization (WHO, 2021) defines obesity as an excessive accumulation of body fat that increases the risk of various chronic diseases, including cardiovascular disorders, diabetes, and musculoskeletal complications. Among college students, sedentary lifestyles, poor dietary habits, and reduced

physical activity contribute significantly to obesity (Ng et al., 2014). While obesity is often associated with metabolic and cardiovascular health risks, its impact on musculoskeletal function, particularly flexibility, is frequently overlooked (Sung et al., 2017).

Flexibility is a key component of overall physical fitness, allowing for a full range of motion in the joints, reducing stiffness, and preventing musculoskeletal disorders (Behm et al., 2016). Reduced flexibility in obese individuals can lead to poor posture, joint stiffness, and an increased risk of injuries, ultimately affecting daily activities and overall quality of life. The accumulation of excessive fat around the joints can limit movement, causing discomfort and impairing functional mobility (Tsiros et al., 2011). Additionally, obesity is linked to biomechanical inefficiencies, which can further exacerbate joint stress and musculoskeletal pain, increasing the likelihood of developing osteoarthritis and lower back pain (Vincent et al., 2010).

Role of Exercise Therapy and Yoga Therapy

To address the negative effects of obesity on flexibility, structured physical activity interventions such as exercise therapy and yoga therapy have gained significant attention. Exercise therapy involves systematic and targeted physical activities designed to enhance flexibility, strength, endurance, and overall fitness (Thivel et al., 2018). Specific stretching exercises, dynamic movements, and resistance training can significantly improve joint mobility and reduce stiffness in obese individuals (Guedes et al., 2019). Regular participation in exercise therapy not only enhances flexibility but also contributes to weight loss, reduces cardiovascular risk factors, and improves metabolic health (Haskell et al., 2007).

Yoga therapy, on the other hand, offers a holistic approach that integrates physical postures (asanas), breathing techniques (pranayama), and meditation. Studies suggest that yoga can effectively improve flexibility and muscular coordination while also promoting relaxation and mental well-being (Patil & Nagaratna, 2020). Unlike conventional exercise programs, yoga emphasizes controlled breathing and mindfulness, which can reduce stress levels, improve proprioception, and enhance body awareness, thereby aiding flexibility improvement (Ross & Thomas, 2010). Additionally, yoga has been linked to reductions in obesity-related inflammation, improved insulin sensitivity, and better psychological well-being (Cramer et al., 2016).

Need for Comparative Research

Despite the known benefits of both exercise therapy and yoga therapy, there is limited comparative research on their effectiveness in improving flexibility among obese male college students. Given the high prevalence of obesity in this demographic, identifying the most effective intervention for flexibility enhancement is crucial for promoting physical fitness and preventing obesity-related musculoskeletal complications. Understanding the differential effects of these interventions can help design targeted fitness programs tailored to the needs of obese college students, ultimately improving their physical health and overall well-being.

Thus, this study aims to examine the effects of exercise therapy and yoga therapy on flexibility among obese male college students. By evaluating and comparing these interventions, this research seeks to provide valuable insights into the most effective approach for improving flexibility, reducing obesity-related musculoskeletal issues, and enhancing overall functional movement.

2. Objectives and Hypothesis

Objective of the study

The primary objective of this study is to investigate and compare the effectiveness of exercise therapy and yoga therapy in increased flexibility among obese college students. The specific aims are as follows:

1. To examine the influence of exercise therapy on flexibility and its associated effects on overall health outcomes in obese college students.
2. To analyse the impact of yoga therapy on flexibility, along with its potential benefits for both health and mental well-being.
3. To evaluate and contrast the effectiveness of exercise therapy and yoga therapy in increase flexibility and supporting healthier lifestyle practices.

Hypothesis of the Study

The following are hypothesis of the present study:

1. There is significant effects of exercise therapy on flexibility among obese male college students.
2. There is significant effects of yoga therapy on flexibility among obese male college students.
3. There is significant difference between interventions groups.

3. Methodology

3.1 Study design

Given the high prevalence of college students who were obese, a decision was made to conduct intervention research with this specific population, incorporating exercise and yoga therapies. For this study constituting experimental design comprising pre- and post-test administered to both experimental groups and control group.

3.2 Participants

The study was conducted among 150 obese male college students, aged 18–21 years, who were selected from St. Benedict's Group of Institutions in Anchepalya, St. Anthony's Institution Kengeri, and other colleges at Bangalore, Karnataka.

3.2.1 Inclusion criteria

To be included in this study, the subjects could not have been participating in any exercise program other than physical education classes or exercise and yoga therapies interventions.

3.2.1 Exclusion criteria

Students with orthopaedic impairments and injuries, those who used ortho-sees /prostheses or orthopaedic equipment, and any subject with a history of orthopaedic surgical treatment were excluded.

3.3 Interventions

Students were randomly assigned into three groups of 50 each: (1) Exercise Therapy Group, undergoing structured physical training; (2) Yoga Therapy Group, practicing asanas, pranayama, and relaxation techniques; and (3) Control Group, which did not receive any intervention. The intervention lasted 16 weeks, with sessions conducted six days a week in the mornings one hours.

3.4 Data collection

Flexibility measurements were taken before and after the intervention to evaluate its effects. Flexibility was calculated using sit and reach box in centimeters.

3.5 Statistical Techniques

Statistical techniques are used to analyse and interpret data for drawing meaningful conclusions particularly to assess the statistically significant of the intervention's effects. This study employed some descriptive statistics along with mixed two-way repeated measures ANOVA to assess the statistical significance of differences increasing flexibility among the intervention groups, providing insights into the comparative effectiveness of the interventions. The software to assess the analysed was IBM SPPS (26).

3. Results and Interpretation

This section provides an overview of the findings from the analysis of Flexibility scores across different time periods, treatment groups, and their interactions. The results are presented through descriptive statistics, inferential analyses, and graphical representations to examine the effectiveness of the interventions.

The table are present the results along with interpretation

Table: 4.1 Descriptive Statistics of Flexibility Score at each Time Periods

Time	n	Minimum	Maximum	Mean	Std. Error of mean	Std. Deviation
Pre-test	150	-6.00	5.00	0.953	0.180	2.205
Post-test	150	-6.00	7.50	2.253	0.192	2.354

Interpretation: The table 4.1 displays the descriptive statistics of the flexibility scores over different time periods. The pre-test means flexibility score is 0.953 with a standard deviation (SD) of 2.205. The mean score after the training (post) is 2.253, while the SD is 2.354. Further the minimum and maximum scores for pre- test are -6.00 and 5.00 and post- test are -6.00 and 7.50 respectively.

Table: 4.2 Descriptive Statistics of the Flexibility Scores of the Subjects in each Treatment Groups Tested at Different Time Periods

Groups	Time	n	Minimum	Maximum	Mean	Std. Error of mean	Std. Deviation
Control	Pre-test	50	-6.00	4.00	0.840	0.356	2.516
	Post-test	50	-6.00	4.00	0.760	0.357	2.524
Exercise therapy	Pre-test	50	-4.00	5.00	0.990	0.313	2.212
	Post-test	50	-2.00	6.50	2.450	0.276	1.954
Yoga therapy	Pre-test	50	-4.00	5.00	1.030	0.266	1.880
	Post-test	50	-0.50	7.50	3.550	0.229	1.620

Interpretation: The above table 4.2 presents the summary statistics of flexibility with respect to pre- and post-test results for the control and experimental groups. The table provides the following:

- **Control group:** The mean and standard deviation of pre-test data of flexibility in the control group is 0.840 and 2.516 respectively with standard error of mean is 0.356. The mean and standard deviation values after the interventions (Post) is 0.760 and 2.524 respectively with standard error of mean is 0.357.

- **Exercise Therapy:** The mean and standard deviation of pre-test data of flexibility in the exercise therapy is 0.990 and 2.212 respectively with Std. error of mean is 0.313. Further the mean and standard deviation values after the interventions (Post) is 2.450 and 1.954 respectively with standard error of mean is 0.276.
- **Yoga Therapy:** The mean and standard deviation of pre-test data of stress in the yoga therapy is 1.030 and 1.880 respectively with Std. error of mean is 0.266. Further the mean and standard deviation values after the interventions (Post) is 3.550 and 1.620 respectively with standard error of mean is 0.299.

Table- 4. 3 Wilks' Lambda (Multivariate Analysis) of within the Time Scores

Effects	Vales	Hypothesis df	Error df	F	P-value
Time	0.155	1	147	800.011	<0.05
Time * Groups	0.214	2	147	269.700	<0.05

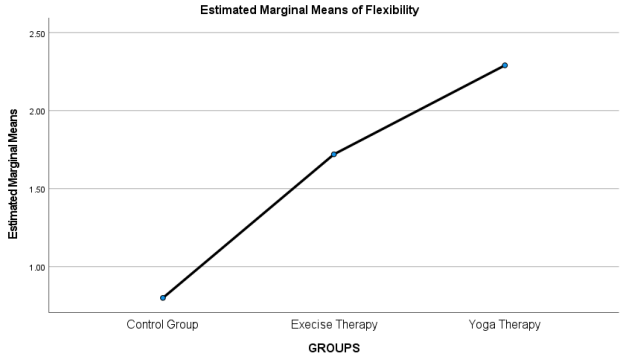
Conclusion: The main effects of time is found to be statistically significant (Wilk's Lambda = 0.155, (F (1,147) = 800.011), $p < 0.05$). This effects, however, is qualified by a significant time X group interaction (Wilk's Lambda = 0.214, (F (2,147) = 269.700), $p < 0.05$).

Table- 4.4 F-Table for Testing Significance of Treatments (Between Subjects) Effects

Source	Type III sum of squares	df	Mean score	F	P-value
Groups	113.047	2	56.523	6.258	<0.05
Error	1327.750	147	9.032	-	

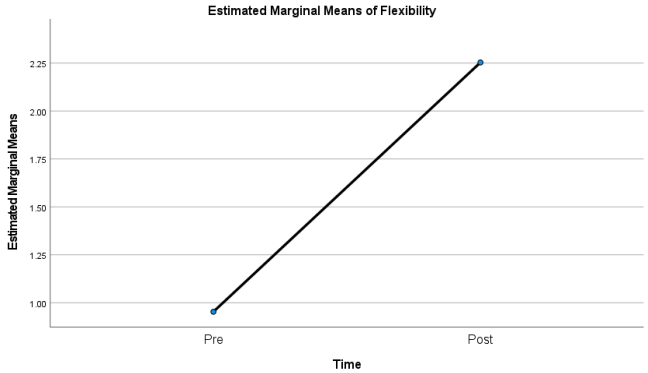
Conclusion: The main effects of treatment groups on the average flexibility score across time is found to be statistically significant (F (2,147) = 6.258), $p < 0.05$).

Figure-4.1 Marginal Means (Flexibility) Plot of Treatments



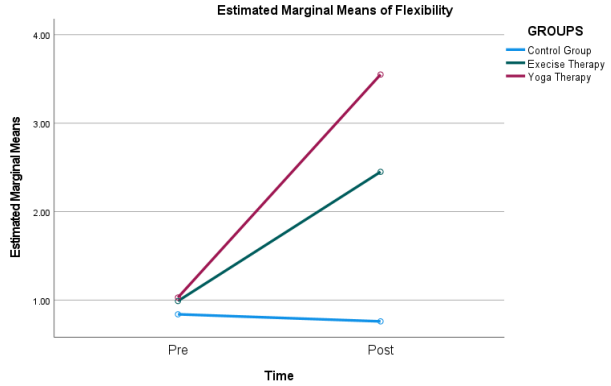
Interpretation: The means plot shown in the figure 4.1. depicts that the yoga therapy treatment group fared better than the other groups in terms of effectiveness, followed by exercise therapy, while the control group stands last in terms of relevance.

Figure- 4.2 Marginal Means (Flexibility) Plot of Time



Interpretation: This marginal means plot indicates that across groups, the mean level of flexibility exhibited a increasing trend over the two measurement occasions from pre to post, which is a clear indication of increase in the flexibility due to the training.

Figure- 4.3 Marginal Means (Flexibility) Plot of Treatment X Time



Interpretation: Since the plots (lines) are overlapped it indicates an interaction between treatments and time. However, this marginal mean plot also indicates that among the experimental groups, the flexibility scores is increase due to the treatments. There is a increase in the post-test when compared with pre-test score in the two experimental groups.

Table- 4.5 Multivariate Testing Significance of Time (Within-Subjects) Effects in Each Treatment Category

Groups	Value	Hypothesis df	Error	F	P-value
Control	0.993	1	147	1.010	> 0.05
Exercise therapy	0.304	1	147	336.352	< 0.05
Yoga therapy	0.128	1	147	1002.049	< 0.05

Conclusion: The following conclusions can be drawn from the above table 4.5:

- **Control Group**: The effects of time in the control group is found to be statistically insignificant (Wilks' Lambda value is 0.993, (F (1,147) = 1.010) and p > 0.05).
- **Exercise Therapy**: There is a significant difference between pre and post among the exercise therapy group (Wilks' Lambda value of 0.304, (F (1,147) = 336.352) and p < 0.05). This indicates that the exercise therapy is effective on flexibility.

- **Yoga Therapy**: In this group it shows a significant difference (Wilks' Lambda value 0.128, (F (1,147) = 1002.049) and $p < 0.05$) in flexibility between pre and post, which is an clearly indication of more effectiveness of yoga therapy on flexibility.

Table: 4.6 Pairwise Comparison of Flexibility Score between Treatments with respect to Pre and Post-Test

Time	(I) GROUPS	(J) GROUPS	Mean Difference (I-J)	Std. Error of Mean	p-value
Pre-test	Control	Exercise Therapy	-0.150	0.444	> 0.05
	Control	Yoga Therapy	-0.190	0.444	> 0.05
	Exercise Therapy	Yoga Therapy	-0.040	0.444	> 0.05
Post-test	Control	Exercise Therapy	-1.690	0.413	< 0.05
	Control	Yoga Therapy	-2.790	0.413	< 0.05
	Exercise Therapy	Yoga Therapy	-1.100	0.413	< 0.05

Conclusion: The pairwise comparisons on the average Flexibility score (average over time) is presented in the above table 4.6

- **Pre- test:** At initial time period (pre) the flexibility is found to be statistically insignificant ($p > 0.05$) between as pairwise of different treatments.
- **Post- test:** After the treatment (post) period it is found that these exist a statistically significant difference in the flexibility between as pairwise of different treatments ($p < 0.05$).

Table: 4.7 Percentage of Relative Changes on flexibility in Experimental Groups

Groups	Post-Exercise Therapy	Post-Yoga Therapy
Pre- Exercise therapy	29.41%	-
Pre- Yoga therapy	-	36.67%

Interpretation: Table 4.7 shows that obese college students in the exercise therapy and yoga therapy groups improved their flexibility by 29.41% and 36.67%, respectively. The yoga therapy group demonstrated a greater increase in flexibility compared to the exercise therapy group.

5. Discussion of Findings

The study confirms that targeted interventions yoga therapy and exercise therapy contribute significantly to flexibility improvement**,** with yoga demonstrating a greater impact on static flexibility and exercise enhancing dynamic movement efficiency. Research highlights that yoga improves range of motion (ROM) in the spine, hips, and hamstrings, making it particularly beneficial for obese individuals with restricted mobility (*Grabara, 2017*). In contrast, exercise therapy strengthens neuromuscular coordination and tendon elasticity**,** leading to functional movement gains (*Medeiros & Cini, 2016*). Studies show that combining both yoga and exercise maximizes flexibility improvements, reduces muscle stiffness, and enhances postural alignment (*Foster & Lucia, 2019*). Therefore, integrating both approaches into fitness routines is ideal for promoting overall flexibility and musculoskeletal health, especially for those with obesity-related mobility limitations.

Recommendations

To maximize flexibility, combining yoga and exercise therapy is recommended, as yoga enhances static flexibility while exercise improves functional movement efficiency. Flexibility training should be conducted 3–5 times per week, incorporating progressive stretching techniques such as PNF and static stretching to gradually improve the range of motion (ROM). Strengthening the core and back muscles through yoga postures and resistance exercises enhances spinal flexibility and posture, reducing the risk of muscle stiffness and imbalances. Warm-up and cool-down routines should be included to prevent injuries and maintain joint mobility. For obese individuals, low-impact flexibility exercises like chair yoga and water-based stretching are recommended to reduce joint strain. Regular flexibility assessments help track progress and adjust training programs as needed. Overall, incorporating a well-balanced flexibility routine improves mobility, prevents injuries, and enhances musculoskeletal health, making it essential for both general fitness and obesity management.

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