



EFFECTIVENESS OF YOGA AND FITNESS TRAINING PROGRAMS IN IMPROVING FLEXIBILITY, ENDURANCE, AND STRESS MANAGEMENT AMONG STUDENTS

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ABSTRACT

This study aims to examine the effect of structured Yoga and Fitness Training Programs (FTP) on flexibility, cardiorespiratory endurance, and stress management of the undergraduate students in the academic year 2022. In modern universities, students' health and learning ability are being affected due to physical inactivity, sedentary academic programs and growing psychological stress. In this context, yoga and fitness training stand out as evidence-based cost-effective intervention. Randomised controlled experimental design was used, with 180 undergraduate students of age 18-22 years allocated to three groups as: Yoga Group (n=60), Fitness Training Group (n=60) and Control Group (n=60). A structured 12 week training programme (five sessions per week, 60 minutes per session) was provided for both intervention groups. Flexibility was determined with the Sit-and-Reach Test, Cardiorespiratory Endurance was determined with the VO2 Max estimation protocol and perceived stress was measured using the Perceived Stress Scale (PSS-10). The paired t-test and one-way ANOVA ($\alpha = .05$) were used to analyse data. Results showed that the Yoga Group had a significant gain in flexibility (+7.4 cm; $p=0.001$) and the highest decrease in the perceived stress (mean PSS reduction: -7.6; $p=0.001$). The Fitness Training Group had the greatest increase in cardiorespiratory endurance (mean increase in VO2 Max: +6.8 ml/kg/min; $p=0.001$) and experienced a significant decrease in stress (mean decrease in PSS: -5.6; $p=0.002$). No significant change was found in any of the variables in the Control Group. The results support the high effectiveness of both intervention modalities, but with different domain-specific benefits. The research calls for the compulsory inclusion of Yoga and fitness training in the curricula of institutional education for the sake of holistic wellness of the students.



KEYWORDS : Yoga, Fitness Training Program, Flexibility, Cardiorespiratory Endurance, Stress Management, Undergraduate Students, Physical Education, Wellness.

1. INTRODUCTION

In the current higher education scene, there is high competition, non-regular sleep habits, prolonged sitting, and increasing psychosocial pressures. All these factors collectively affect the physical fitness and mental health of the university students, making them highly susceptible to chronic non-communicable diseases, anxiety disorders, and burnout. The World Health Organization (2020) has identified physical inactivity as the fourth leading risk factor for global deaths, and a call to action has been issued to implement physical activity interventions that prevent deaths in young adult populations.

Yoga is an ancient Indian practice that combines physical postures (asanas), controlled breathing (pranayama), and meditation, and it has become popular worldwide as a holistic approach to health. Yoga has been shown to be effective in improving musculoskeletal flexibility, respiratory efficiency, and decreasing cortisol mediated stress response in numerous scientific investigations (Cramer et al., 2013; Goyal et al., 2014). At the same time, structured fitness training program including aerobic exercises, resistance training and functional movement patterns has shown great improvement in cardiovascular endurance, muscular strength and psychological resilience (Warburton et al., 2006; Donnelly et al., 2009).

Even though there is growing international evidence of the benefits of both approaches, there is a lack of comparative studies between the two specifically focusing on the Indian undergraduate population for the post-COVID-19 year of 2022. The school year of 2022 was especially significant, since the lengthy period of inactivity, higher screen time, and increased anxiety associated with online learning were ending, and students were returning to in-school learning experiences. This transitional stress plus the ruptured patterns of physical activity prompted a context that required empirical research.

Thus, this present study aimed to systematically assess and compare the effectiveness of a 12-week yoga program and a 12-week fitness training program in improving three important health parameters (flexibility, cardiorespiratory endurance, and perceived stress levels) among undergraduate students during the year 2022. The results of this study aim to inform the design and implementation of student wellness programs based on evidence for physical education practitioners, institutional administrators, and policy-makers..

2. OBJECTIVES OF THE RESEARCH

The following specific objectives guided this research investigation:

- 1) To compare and evaluate the pre-test and post-test flexibility, cardiorespiratory endurance and perceived stress of students in the Yoga Group, Fitness Training Group and Control Group.
- 2) To find out the impact of the Yoga Programme on the flexibility and the level of perceived stress of the undergraduate students after 12 weeks.
- 3) To assess the impact of the Fitness Training Programme (60 sessions of training over 12 weeks) on the improvement of cardiorespiratory endurance and decrease of perceived stress among the undergraduate students.
- 4) To assess the relative superiority of yoga and fitness training with respect to the three parameters, namely flexibility, endurance and stress management.
- 5) To provide evidence-informed suggestions for incorporating yoga and fitness training in Physical Education curriculum at higher educational institutions.

3. HYPOTHESES OF THE RESEARCH

The following research hypotheses were developed and tested at the 0.05 level of significance:

- **H1:** The flexibility score of the yoga group will be statistically significantly greater at the end of the 12-week intervention program.
- **H2:** There will be a statistically significant increase in cardiorespiratory endurance (VO2 Max) in the Fitness Training Group after the 12-week intervention program.
- **H3:** The null hypothesis is that there will be no statistically significant decrease in perceived stress scores in the Yoga Group after the 12 week intervention programme (H0).
- **H4:** After the 12-week intervention program, the Fitness Training Group will have a statistically significant lower perceived stress score.
- **H0:** There will be no difference in the level of flexibility, endurance, and stress scores between the pre-test and post-test measures for the control group.

4. RESEARCH METHODOLOGY

4.1 Research Design

A pre-test post-test randomized controlled experimental design was conducted to analyze the impact of Yoga and fitness training on flexibility, cardiorespiratory endurance and psychological stress. The total 180 undergraduate students (87 Male and 93 Female; 19.5 ± 1.2 years mean age) were selected from a university in Maharashtra, India, via purposive sampling and divided into three groups each containing 60 students: Yoga Group (YG), Fitness Training Group (FTG) and Control Group (CG). Participants were healthy undergraduates ages 18-22 years without contraindications to exercise and were included. The five groups were given 12 weeks structured programmes with 60 minutes sessions per week, with the Control Group engaging in their normal activities. Flexibility (Sit and Reach test), endurance (Rockport One Mile walk Test), and perceived stress (PSS-10) were evaluated. Descriptive statistics, paired t-tests (for intra-group changes) and ANOVA with Scheffe post hoc tests (for inter-group comparisons) were used for data analysis at $p \leq 0.05$.

5. THEORETICAL FRAMEWORK

The theoretical framework for this study is based on three complementary theories: (1) the Biopsychosocial Model of Health (Engel, 1977), (2) the Stress-Buffering Hypothesis (Cohen & Wills, 1985), and (3) the Self-Regulation Theory (Bandura, 1986).

The Biopsychosocial Model suggests that biological, psychological, and social factors interact to determine the outcome of health. Yoga and fitness training work on all three physiologically to strengthen musculoskeletal and cardiovascular function, psychologically to improve mood and self-efficacy, and socially to create a sense of community and well-being.

Self-Regulation Theory (Bandura, 1986) highlights the importance of self-efficacy and goal-directed behavior in maintaining health-promoting behaviors. Self-regulatory capacities are inbuilt in structured physical training programs as the students are expected to attend regularly, realize their goals through steps, and monitor themselves, thus promoting adherence to the program.

According to the Stress-Buffering Hypothesis (Cohen & Wills, 1985), physical exercise and social support could buffer the harmful impact of stressors on health. The mindfulness aspects of yoga and the social context in which group fitness training takes place are posited to enhance such buffering mechanisms, and this will lessen the perceived stress of the students engaged in yoga training.

The combined use of these three frameworks offers a solid theoretical basis for the expected changes in physical fitness parameters and psychological stress measures after structured yoga and fitness training interventions.

6. DATA ANALYSIS AND INTERPRETATION

Table 1: Demographic Profile of Participants

Group	n	Male	Female	Mean Age (yrs)
Yoga Group	60	28	32	19.4 ± 1.2
Fitness Training Group	60	30	30	19.7 ± 1.4
Control Group	60	29	31	19.5 ± 1.1
Total	180	87	93	19.5 ± 1.2

Note: Data are means \pm standard deviations. No significant differences were found between the groups at baseline in age or gender ($p > 0.05$).

Table 2: Pre-test and Post-test Flexibility Scores (Sit-and-Reach Test, cm)

Group	Pre-test (cm)	Post-test (cm)	Mean Gain (cm)	p-value
Yoga Group	24.3 ± 3.1	31.7 ± 2.8	+7.4	0.001**
Fitness Training Group	23.8 ± 3.4	28.2 ± 3.0	+4.4	0.003**
Control Group	24.1 ± 2.9	24.5 ± 3.1	+0.4	0.612 (ns)

Note: ** p<0.01 (highly significant); ns = not significant. The Yoga Group showed the highest absolute gain in flexibility (+7.4 cm), which was significantly greater than that of the Fitness Training Group (+4.4 cm) and Control Group (+0.4 cm).

Table 3: Pre-test and Post-test Cardiorespiratory Endurance (VO2 Max, ml/kg/min)

Group	Pre-test (ml/kg/min)	Post-test (ml/kg/min)	Mean Gain	p-value
Yoga Group	32.6 ± 4.2	36.1 ± 3.8	+3.5	0.004**
Fitness Training Group	32.1 ± 4.5	38.9 ± 4.1	+6.8	0.001**
Control Group	32.4 ± 4.0	32.7 ± 4.1	+0.3	0.741 (ns)

Note: ** p < 0.01 (highly significant); ns = not significant. The Fitness Training Group had the greatest improvement in VO2 Max (+6.8 ml/kg/min), which was statistically significantly greater than the Yoga Group (+3.5 ml/kg/min). There was little change in the Control Group (+0.3 ml/kg/min).

Table 4: Pre-test and Post-test Perceived Stress Scale Scores (PSS-10)

Group	Pre-test PSS	Post-test PSS	Mean Reduction	p-value
Yoga Group	22.4 ± 3.6	14.8 ± 3.1	-7.6	0.001**
Fitness Training Group	21.9 ± 3.8	16.3 ± 3.4	-5.6	0.002**
Control Group	22.1 ± 3.5	21.8 ± 3.6	-0.3	0.831 (ns)

Note: ** p < 0.01 (highly significant); ns = not significant. There was a significant decrease in PSS scores in both intervention groups. The Yoga Group showed a greater reduction in stress (-7.6) than the Fitness Training Group (-5.6). There was almost no change (-0.3 points) in the control group.

Interpretation: Table 2, Table 3, and Table 4 together demonstrate clear benefits for each modality of intervention in the different domains. Yoga is clearly superior in increasing flexibility and reducing perceived stress and Fitness Training is superior in increasing cardiorespiratory endurance. On all three variables, both the interventions were found to be significantly more effective than the control condition. From these results it can be seen that a holistic programme for the wellness of students would best include aspects of both the two modalities to make sure that students can have a balanced physical and psychological health outcome.

7. FINDINGS OF THE STUDY

The key findings emerging from the data analysis are presented below:

- 1) The Yoga Group had statistically significant improvements in flexibility from a pre-test mean of 24.3 ± 3.1 cm to a post-test mean of 31.7 ± 2.8 cm (mean change: +7.4 cm, p=0.001), which is a 30.5% increase over 12 weeks.
- 2) The Fitness Training Group had the greatest gains in cardiorespiratory endurance, with VO2 Max increasing from 32.1 ± 4.5 ml/kg/min to 38.9 ± 4.1 ml/kg/min (mean change: +6.8 ml/kg/min, p=0.001), a 21.2% increase.
- 3) In the Yoga Group, the greatest difference was found for perceived stress as measured by the PSS (from 22.4 ± 3.6 to 14.8 ± 3.1; mean difference -7.6 points; p=0.001) with a 33.9% decrease in perceived stress.

- 4) Similarly, the Fitness Training Group had statistically significant decreases in PSS score (21.9 ± 3.8 to 16.3 ± 3.4 ; mean difference: -5.6 points; $p=0.002$), which equates to a 25.6% decrease in perceived stress.
- 5) Flexibility (+0.4 cm; $p=0.612$), VO_2 Max (+0.3 ml/kg/min; $p=0.741$), and PSS (-0.3 points; $p=0.831$) showed no statistically significant changes over the 12 weeks in the Control Group, which demonstrated no meaningful spontaneous improvement without structured intervention.
- 6) Statistically significant inter-group differences were found by one-way ANOVA for all three variables (flexibility: $F=14.32$, $p<0.001$; VO_2 Max: $F=18.76$, $p<0.001$; PSS: $F=16.91$, $p<0.001$), thus supporting the differential effectiveness of the two intervention modalities.

8. DISCUSSION

The results obtained from the present study corroborate and add to the existing literature on the physiological and psychological benefits of yoga and fitness training in young adult population. The Yoga Group showed considerable flexibility improvement that was consistent with the results of the systematic yoga intervention in university students reported by Grabara and Szopa (2015). This is because the muscle groups targeted by the asanas used in the present study (Paschimottanasana, Trikonasana and Uttanasana) specifically include the hamstring musculature and lumbar spine, which are the muscle groups assessed by the Sit-and-Reach Test.

The cardiorespiratory endurance improvements in the Fitness Training Group are in line with what is known from the field of exercise physiology. As the aerobic circuit training progresses, the cardiovascular system is progressively overloaded, causing adaptations in the central system such as increased stroke volume, cardiac output and cellular oxygen extraction (Warburton et al., 2006). The change in VO_2 Max in the FTG was clinically significant at 21.2%, and was consistent with the findings of Bassett and Howley (2000) who developed dose-response relationships between the frequency of aerobic training and resulting improvements in cardiovascular fitness in young adults.

Yoga has been shown to reduce stress in this study and this observation has been corroborated by neurobiological studies. Yoga practice upregulates the parasympathetic nervous system, decreases levels of cortisol and increased levels of catecholamines and increases the level of gamma-aminobutyric acid (GABA) in the brain, which is well documented by Streeter et al. (2010). This mindfulness and meditative element within the yoga protocol seems to be more effective in stress reduction, as compared to fitness training alone, which resulted in a 25.6% reduction in PSS scores.

The stress-reducing effect of fitness training is less potent than yoga, but still clinically and statistically significant. The results are consistent with the meta-analytic results reported by Salmon (2001) and Landers and Arent (2007) of regular aerobic exercise being a proven anxiolytic and antidepressant intervention. Aerobic exercise-induced release of endorphins, enkephalins, and monoamine neurotransmitters is a well-established psychobiological mechanism for stress attenuation. The lack of significant differences in the Control Group in any of the three variables supports the concept that significant physiological and psychological improvements must occur in a structured, progressive, supervised training environment. No spontaneous improvement in the CG is of importance to validate the observed treatment effects in the two experimental groups.

Combined, these results indicate that the combined yoga and fitness training program would provide a holistic benefit in terms of flexibility, endurance, and stress. Future research needs to focus on the best dosage, sequence, and sustainability of these integrated programs in the context of university physical education curricula.

9. HYPOTHESIS TESTING

Table 5 provides a combined summary of the results from the hypothesis testing using paired t-tests and one-way ANOVA for each of the research hypotheses.

Table 5: Summary of Hypothesis Testing Results

Hypothesis	F-value	t-value	p-value	Decision
H1: Yoga improves flexibility	14.32	6.18	0.001**	Accepted
H2: FTP improves endurance	18.76	8.44	0.001**	Accepted
H3: Yoga reduces stress	16.91	7.63	0.001**	Accepted
H4: FTP reduces stress	12.54	5.81	0.002**	Accepted
H0: No sig. diff. (Control)	0.48	0.51	>0.05 (ns)	Rejected

Note: ** $p < 0.01$ (highly significant at 0.05 level of significance); ns = not significant; FTP = Fitness Training Programme.

- **H1**—Accepted: The yoga group showed statistically highly significant improvement ($t=6.18$, $p=0.001$) in their flexibility, proving that 12 weeks of yoga can efficiently improve flexibility of the hamstring and lower back among undergraduate students.
- **H2**- Accepted: For the Fitness Training Group, there was a statistically highly significant improvement in VO_2 Max ($t=8.44$, $p=0.001$), which indicated that the 12-week aerobic fitness training program was effective in improving cardiorespiratory endurance.
- **H3** — Accepted: Yoga was found to be superior in reducing the PSS scores among undergraduate students and the Yoga Group obtained a statistically highly significant reduction in PSS scores ($t=7.63$, $p=0.001$).
- **H4** — Accepted: Structured aerobic and resistance training was also found to be effective at reducing PSS scores ($t=5.81$, $p=0.002$), supporting the stress-buffering benefits of structured aerobic and resistance training.
- **H0** — Rejected: The results for this control group revealed that there was no statistically significant difference in all three variables measured ($p>0.05$ for all); hence, the null hypothesis has been upheld; there was no spontaneous change (or improvement) without structured intervention.

10. CONCLUSION

The findings of the present research study bring strong empirical support for the effectiveness of yoga and fitness training programs on three key health parameters of the undergraduate students during the academic year 2022 in a domain-specific manner. The Yoga Programme was most effective in promoting musculoskeletal flexibility (30.5% improvement) and in reducing perceived psychological stress (33.9% reduction), while the Fitness Training Programme was more effective in advancing cardiorespiratory endurance (21.2% improvement) and also achieved significant stress reduction (25.6%). The results of both interventions were statistically highly significant ($p \leq 0.01$) when compared with the control group, where no meaningful changes were seen over the course of the study. The findings have important implications for physical education policies and the design of student wellness programmes. Overall, the evidence indicates that neither yoga nor fitness training can be regarded as a universal best practice; both types of intervention have unique health-enhancing qualities that are complementary. Hence, the inclusion of structured Education of Yoga and fitness training programs as integral parts of the Physical Education curriculum in all higher education institutions is strongly recommended as it is an essential and non-substitutable pillar of holistic health of students. Moreover, in the post-pandemic academic environment of 2022, students are likely to have increased stress levels, and their physical fitness is likely to have been affected by many months of sedentary online learning, making the need for such programs to be implemented in time particularly urgent. There needs to be collaboration between physical education departments, sports councils, and student welfare bodies for the development of accessible, evidence-based, and inclusive wellness programs to meet the physical and mental needs of the current youth. Longitudinal studies to follow up on these outcomes over one or more academic years and studies that include biochemical stress markers like salivary cortisol are necessary to further bolster evidence.

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