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# Assessing the Psychological and Physiological Impact of 4 Weeks of Surya Namaskar among Physical Education students: A Comparative Study Based on Gender Differences

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## ABSTRACT

**Background:** The comprehensive health benefits of Surya Namaskar, a traditional yoga practice that combines dynamic postures with breath control and concentration, are increasingly being acknowledged. Although its effectiveness in enhancing mental and physical health has been established, less is known about how it affects gender, especially in academic populations that are physically active.

**Objectives:** In this study, students in Physical Education participated in a 4-week Surya Namaskar intervention, and the psychological (anxiety, disruption of focus, worry, felt stress) and physiological (resting heart rate, blood pressure, body mass index) effects were compared based on gender.

**Method:** A stratified random sampling technique was used to select 80 Physical Education students (40 males, 40 females; aged 18–24), who were then assigned to experimental and control groups. The intervention group (n = 40) engaged in daily 30-minute Surya Namaskar sessions for four weeks under guided instruction, while the control group continued their standard academic routine. Pre- and post-intervention assessments employed validated scales (Sports Anxiety Scale-2 and Global Measure of Perceived Stress) alongside standard physiological measurement protocols. Data were analysed using SPSS (version 27). Descriptive statistics were calculated for all variables. Paired sample t-tests assessed within-group changes from pre- to post-intervention, while independent sample t-tests evaluated post-test differences between groups and across genders to determine statistical significance ($p < .05$).

**Result:** The experimental group demonstrated improvements in physiological parameters, such as lower resting heart rate, blood pressure, and BMI, and substantial decreases ($p < 0.05$) in all psychological markers after the intervention. Although both male and female participants experienced improvements, males exhibited greater reductions in perceived stress and Body Mass Index (BMI). In contrast, females showed more pronounced improvements in blood pressure and concentration-related outcomes. Overall results, however, showed no statistically significant gender differences ($p > .05$).

**Conclusion:** The study confirms that Surya Namaskar is an effective technique for improving students' physical and mental well-being in physical education classes, regardless of gender. To promote student well-being in the face of intellectual and physical pressures, the findings encourage its systematic inclusion in the academic curriculum.

**Keywords:** Yoga; Surya Namaskar; Gender Differences; Physical Education; Anxiety; Stress; Resting Heart Rate; Body Mass Index; Blood Pressure; Yoga in Physical Education.

## 1. Introduction

Surya Namaskar is a traditional yoga practice that combines a series of twelve dynamic postures executed in a steady, rhythmic flow, coordinated with mental focus and breath control (pranayama). With roots in traditional Hatha Yoga, it improves flexibility, strength, cardiovascular endurance, and mental equilibrium while acting as a physical exercise and a meditation discipline [1]. For facilitating parasympathetic activation and stress reduction, each posture is synchronized with inhalation or exhalation, establishing a harmonious connection between movement and respiration [2]. Historically, Surya Namaskar has been practiced at sunrise to honour solar energy, symbolizing vitality and inner awakening [3]. Its structured flow promotes muscular coordination, spinal mobility, and respiratory efficiency, making it a comprehensive exercise for physical and mental well-being [4]. Recent research confirms that it enhances mental and physical wellness in various populations. To support holistic health, regular practice of Surya Namaskar is an integrated yoga practice that balances physical movement, pranayama (controlled breathing), and meditation. The dynamic sequence helps to regulate respiratory rhythm and autonomic balance by alternating postures that are executed in time with inhalation and exhalation [5]. By focusing attention

on breathing and physical sensations, this integration promotes a meditative state that improves mindfulness and lowers psychological stress [6]. Breath regulation activates the parasympathetic nervous system, contributing to emotional stability and reduced physiological arousal [5]. While the meditative element fosters mental clarity and present-moment awareness, the physical component concurrently enhances muscular tone, flexibility, and circulation. Surya Namaskar is a powerful technique for psychological resilience and inner balance in addition to physical training because of the way movement, breath, and mindfulness work together.

Yoga's numerous advantages for students' physical, mental, and emotional health have made its incorporation into physical education curricula extremely popular in recent years. By improving physical flexibility, postural alignment, respiratory efficiency, and psychological resilience, yoga, in contrast to traditional fitness exercises, promotes the holistic development of students [7]. Institutes of Physical Education in Assam are becoming more aware of their ability to help students develop the self-control, focus, and stress management skills necessary for both academic and athletic success [8].

Yoga interventions in college and university settings have demonstrated reductions in anxiety, emotional dysregulation, and behavioural issues while promoting mindfulness and prosocial behaviour [9]. Therefore, to promote total student wellbeing, national education policies—like India's National Education Policy 2020—promote yoga-based physical education modules. Yoga is positioned as a transformative factor in modern educational environments due to this paradigm shift from performance-centric physical training to holistic health approaches. Students who participate in physical education programs frequently encounter a special blend of academic pressure and physical effort, which can have a cumulative effect on their physical and mental health. Increased stress, exhaustion, and burnout may result from the pressure to maintain physical performance while fulfilling academic obligations [10]. Therefore, regular practice of yoga and Surya Namaskar in particular is essential to comprehending their function in stress management. By combining physical exercise, breathing techniques, and mindfulness, Surya Namaskar provides a non-invasive method of balancing the activity of the sympathetic and parasympathetic nerve systems, which helps people recover from physical stress and cognitive overload [6]. Physical education students are ideal subjects for such evaluation, as they are not only physically active but also under constant performance assessment, making them more susceptible to stress-related disorders [11]. Examining the psycho-physiological impacts of yoga on this demographic could help develop curriculum improvements that promote long-term student performance and well-being.

Gender differences in the physiological and psychological responses to yoga-based therapies are a result of a complex interaction of hormonal, biomechanical, and psychosocial factors. Females' hormonal fluctuations, particularly those in estrogen and progesterone throughout the menstrual cycle, affect cardiovascular responses and stress resilience during yoga sessions by modulating autonomic nerve system activity [12,13]. Compared to males, who typically have larger muscles and strength, women typically have more joint laxity and flexibility, which affects how well postures are executed and how muscles are engaged [14,15]. Psychologically, females are more likely to experience internalizing stress responses, which may make them more receptive to the meditative and emotional regulation aspects of yoga [16,17]. These gender-specific differences highlight the need for

differentiated approaches in yogic research and program design to ensure optimal physiological and psychological outcomes.

### 1.1. Statement of the Problem

Although yoga is becoming more widely acknowledged as a holistic approach to improving health and well-being, there is still a dearth of scientific data on the effects of Surya Namaskar on gender in student populations participating in physical education. Current studies support the psychological and physiological advantages of Surya Namaskar, few studies have looked at how these advantages differ for male and female students who frequently face demands to achieve physically and academically. It is crucial to look at whether the effects of this yoga practice differ depending on the gender differences in physiology, hormones, and psychology.

Designing inclusive and scientifically supported interventions in academic institutions is hampered by the lack of such data. In order to address the need for gender-responsive methods to holistic student health and performance enhancement, the current study intends to perform a gender-based cross-sectional examination of the psychological and physiological impacts of Surya Namaskar among Physical Education students.

### 1.2. Objectives of the Study

1. To compare the effect of a 4-week Surya Namaskar practice on somatic anxiety levels between male and female Physical Education students.

2. To compare the effect of a 4-week Surya Namaskar practice on concentration disruption levels between male and female Physical Education students.

3. To compare the effect of a 4-week Surya Namaskar practice on worry levels between male and female Physical Education students.

4. To compare the effect of a 4-week Surya Namaskar practice on perceived stress levels between male and female Physical Education students.

5. To compare the effect of a 4-week Surya Namaskar practice on overall anxiety levels between male and female Physical Education students.

6. To assess the effect of Surya Namaskar on the Resting Heart Rate of male and female Physical Education students.

7. To assess the gender specific changes in blood pressure following the Surya Namaskar regimen.

8. To compare the BMI (Body Mass Index) in male and female students after 4 weeks of Surya Namaskar practice.

### 1.3. Significance of the Study

The present study holds substantial significance as it explores the gender-based differential impact of Surya Namaskar on both psychological and physiological parameters among Physical Education students—a population uniquely subjected to concurrent academic and physical demands. Although the holistic health benefits of Surya

Namaskar are well known, little empirical research has explicitly examined how these effects may differ by gender within academic cohorts that engage in physical activity. Developing gender-sensitive, evidence-based wellness programs in physical education institute contexts requires an understanding of these differences.

## 2. Methods

**2.1. Research Design:** To examine the gender-based variations in the psychological and physiological effects of Surya Namaskar practice among Physical Education students, the current study used a comparative research approach.

**2.2. Participants:** A total of 80 Physical Education students (40 males and 40 females), aged between 18 and 24 years, were selected from various colleges and universities in Assam. The inclusion criteria required participants to be regularly engaged in physical education activities and to be free from any acute or chronic medical or psychiatric conditions.

**2.3. Sampling:** The researcher employed a stratified random sampling technique by dividing the subjects into strata based on gender. Within each stratum (males and females), participants were randomly assigned to either the treatment or control group (40 participants, 20 males and 20 females) to ensure that both gender and group assignments were balanced.

**2.4. Treatment and Variables:** The study aims to assess the level of somatic anxiety, concentration disruption, worry, stress, and overall anxiety experienced by students and the changes in their blood pressure, BMI, and Resting Heart Rate after 4 weeks of regular practice of Surya Namaskar. Each 30-minute session consisted of approximately 12 continuous cycles of Surya Namaskar, performed at a moderate pace of 2-3 minutes per cycle, guided by a certified instructor to ensure consistency in posture, breath coordination and intensity. The subjects assigned to the control group were undergoing their usual practical class routine. The pre- and post-test data were collected from subjects before and after the 4-week Surya Namaskar intervention program, ensuring consistency in timing and minimizing the influence of external variables. Pre- and post-intervention assessments were conducted at the same time of day to minimize the effects of circadian rhythms.

**2.5. Instruments:** To measure the responses of subjects on somatic anxiety, concentration disruption, worry, and overall anxiety experienced by subjects, the researcher employed the Sports Anxiety Scale-2 Questionnaire [18] and to assess the level of perceived stress experienced by athletes, the Global Measure of Perceived Stress Questionnaire [19] was used, which measures the response of subjects in a 4- and 5-point Likert Scale, respectively. Furthermore, the systolic and diastolic values of subjects were measured with a digital sphygmomanometer using standard protocol. The resting heart rate (RHR) was measured using a digital Heart Rate monitor after 10 minutes of seated rest. A digital weighing scale and a Standard Stadiometer were used to calculate the Body Mass Index (BMI) of the subjects.

**2.6. Statistical Test:** SPSS Version 27 software was used for statistical analysis of the data gathered from subjects. First, the nature of the data will be explained by the mean and standard deviation of both genders from four different groups. Then Paired Sample t-test will be used to assess the mean difference between pre-and post-test

measures of subjects from each variable (G1, G2, G3, and G4) to assess the effect of the intervention over time. The Independent Sample t-Test will be used to compare the post-test scores between the experimental and control groups of the same gender and to assess which gender benefits more from the 4-week continuous practice of Surya Namaskar, based on the post-test measures across all variables. For all the statistical tests, the significance levels will be set at 0.05. Before applying these tests, the assumption of normality and homogeneity of variance were verified using the Shapiro-Wilk test at 0.05 significance and the Levene's test, respectively, to ensure the appropriateness of parametric analysis.

## 3. Findings

**Table 1.** Descriptive Statistics of Pre- and Post-Test Results of different physiological and psychological variables of male and female participants from the treatment and control groups

| Variables | G1: Male (Experimental) | G2: Female (Experimental) | G3: Male (Control) | G4: Female (Control) |
|---|---|---|---|---|
| | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD |
| Somatic Anxiety (Pre) | 2.65 ± 0.39 | 2.53 ± 0.50 | 2.46 ± 0.49 | 2.42 ± 0.45 |
| Somatic Anxiety (Post) | 2.39 ± 0.45 | 2.23 ± 0.51 | 2.60 ± 0.50 | 2.53 ± 0.43 |
| Concentration Disruption (Pre) | 2.68 ± 0.56 | 2.50 ± 0.35 | 2.51 ± 0.35 | 2.38 ± 0.60 |
| Concentration Disruption (Post) | 2.35 ± 0.70 | 2.18 ± 0.40 | 2.61 ± 0.37 | 2.47 ± 0.62 |
| Worry (Pre) | 2.48 ± 0.42 | 2.46 ± 0.52 | 2.30 ± 0.36 | 2.61 ± 0.56 |
| Worry (Post) | 2.14 ± 0.50 | 2.15 ± 0.59 | 2.40 ± 0.39 | 2.70 ± 0.52 |
| Stress (Pre) | 21.28 ± 3.29 | 20.51 ± 4.69 | 21.27 ± 4.94 | 18.65 ± 4.11 |
| Stress (Post) | 18.52 ± 3.70 | 17.81 ± 4.44 | 22.21 ± 4.91 | 19.65 ± 4.17 |
| Anxiety (Pre) | 37.12 ± 4.42 | 37.15 ± 4.32 | 37.85 ± 4.52 | 37.27 ± 5.02 |
| Anxiety (Post) | 33.64 ± 4.97 | 32.92 ± 4.60 | 38.90 ± 4.75 | 38.35 ± 5.03 |
| Body Mass Index (Pre) | 22.64 ± 2.09 | 23.00 ± 1.79 | 23.60 ± 1.90 | 22.83 ± 2.68 |
| Body Mass Index (Post) | 22.12 ± 2.14 | 22.53 ± 1.74 | 23.80 ± 1.98 | 23.17 ± 2.67 |
| Resting Heart Rate (Pre) | 76.42 ± 4.33 | 78.33 ± 5.84 | 77.84 ± 4.28 | 77.16 ± 5.38 |
| Resting Heart Rate (Post) | 72.34 ± 4.22 | 73.82 ± 5.73 | 79.15 ± 4.73 | 78.18 ± 5.60 |
| Systolic Blood Pressure (Pre) | 122.51 ± 7.74 | 119.96 ± 5.69 | 116.48 ± 7.07 | 117.34 ± 4.85 |
| Systolic Blood Pressure (Post) | 117.30 ± 7.85 | 114.22 ± 5.72 | 117.5 ± 7.25 | 118.23 ± 4.93 |
| Diastolic Blood Pressure (Pre) | 77.43 ± 4.41 | 74.71 ± 5.12 | 75.65 ± 5.89 | 76.57 ± 6.53 |
| Diastolic Blood Pressure (Post) | 74.59 ± 4.44 | 71.84 ± 5.56 | 76.92 ± 6.13 | 77.73 ± 6.04 |

Table 1 reveals a comparative analysis of pre- and post-test mean scores across psychological and physiological variables among male and female participants from experimental (G1, G2) and control (G3, G4) groups. The experimental groups showed significant improvements in psychological outcomes, including decreases in somatic anxiety, worry, stress, concentration disruption, and total anxiety. Reduced body mass index, decreased resting heart rate, and systolic and diastolic blood pressure were among the physiological parameters that showed improvement in the experimental groups. The intervention was effective in improving the experimental participants' psychological and physical health, as evidenced by the control groups' either slight improvement or decline in these metrics.

To check whether the results of descriptive statistics are statistically significant or not at a 0.05 significance level, the Paired sample t-test will be used to compare pre-and post-test results within each group. The Independent Sample t-test will be used to compare post-test scores between the experimental and control groups of the same gender (e.g., G1 vs. G3 for males and G2 vs. G4 for females) to determine whether the intervention has a statistically significant effect compared to usual routine activity. Additionally, to determine which gender gains more from Surya Namaskar.

**Table 2.** Paired Samples t-Test Results Comparing Pre- and Post-Intervention Anxiety Scores in Treatment and Control Groups

| Gender | Group | Variables | Mean (Pre) | Mean (Post) | t | df | p-value |
|---|---|---|---|---|---|---|---|
| Female Participants | Treatment Group | Somatic Anxiety | 2.53 | 2.23 | 8.01 | 19 | .001 |
| | | Concentration Disruption | 2.50 | 2.18 | 6.65 | 19 | .001 |
| | | Worry | 2.46 | 2.15 | 5.39 | 19 | .001 |
| | | Stress | 20.51 | 17.81 | 7.28 | 19 | .001 |
| | | Anxiety | 37.15 | 32.92 | 8.92 | 19 | .001 |
| | | Body Mass Index (BMI) | 23.00 | 22.53 | 7.25 | 19 | .001 |
| | | Resting Heart Rate (RHR) | 78.33 | 73.82 | 8.40 | 19 | .001 |
| | | Systolic Blood Pressure | 119.96 | 114.22 | 11.07 | 19 | .001 |
| | | Diastolic Blood Pressure | 74.71 | 71.84 | 8.45 | 19 | .001 |
| Female Participants | Control Group | Somatic Anxiety | 2.42 | 2.53 | -5.11 | 19 | .001 |
| | | Concentration Disruption | 2.61 | 2.70 | -3.84 | 19 | .001 |
| | | Worry | 2.38 | 2.47 | -3.07 | 19 | .001 |
| | | Stress | 18.65 | 19.65 | -9.33 | 19 | .001 |
| | | Anxiety | 37.27 | 38.35 | -4.97 | 19 | .001 |
| | | Body Mass Index (BMI) | 22.83 | 23.17 | -10.77 | 19 | .001 |
| | | Resting Heart Rate (RHR) | 77.16 | 78.18 | -6.44 | 19 | .001 |
| | | Systolic Blood Pressure | 117.34 | 118.23 | -5.41 | 19 | .001 |
| | | Diastolic Blood Pressure | 76.57 | 77.73 | -6.29 | 19 | .001 |
| Male Participants | Treatment Group | Somatic Anxiety | 2.65 | 2.39 | 4.61 | 19 | .001 |
| | | Concentration Disruption | 2.68 | 2.35 | 6.15 | 19 | .001 |
| | | Worry | 2.48 | 2.14 | 8.95 | 19 | .001 |
| | | Stress | 21.28 | 18.52 | 8.05 | 19 | .001 |
| | | Anxiety | 37.12 | 33.64 | 7.49 | 19 | .001 |
| | | Body Mass Index (BMI) | 22.64 | 22.12 | 7.34 | 19 | .001 |
| | | Resting Heart Rate (RHR) | 76.42 | 72.34 | 9.30 | 19 | .001 |
| | | Systolic Blood Pressure | 122.51 | 117.30 | 9.59 | 19 | .001 |
| | | Diastolic Blood Pressure | 77.43 | 74.59 | 6.67 | 19 | .001 |
| Male Participants | Control Group | Somatic Anxiety | 2.46 | 2.60 | -6.41 | 19 | .001 |
| | | Concentration Disruption | 2.51 | 2.61 | -5.79 | 19 | .001 |
| | | Worry | 2.30 | 2.40 | -5.42 | 19 | .001 |
| | | Stress | 21.27 | 22.21 | -8.24 | 19 | .001 |
| | | Anxiety | 37.85 | 38.90 | -5.58 | 19 | .001 |
| | | Body Mass Index (BMI) | 23.60 | 23.80 | -4.16 | 19 | .001 |
| | | Resting Heart Rate (RHR) | 77.84 | 79.15 | -5.18 | 19 | .001 |
| | | Systolic Blood Pressure | 116.48 | 117.58 | -5.79 | 19 | .001 |
| | | Diastolic Blood Pressure | 75.65 | 76.92 | -5.24 | 19 | .001 |

*$p< 0.05$

The results in Table 2 revealed statistically significant reductions in somatic anxiety, concentration disruption, worry, stress, and overall anxiety scores among female participants in the treatment group (all $p < .001$), with corresponding decreases in physiological measures such as BMI, resting heart rate (RHR), systolic and diastolic blood pressure. Similarly, female participants in the control group also showed statistically significant improvements in all measured variables ($p < .001$); however, the magnitude of change was comparatively lower, suggesting a possible influence of extraneous factors or placebo effect. Among male participants in the treatment group, a similar trend was observed, with significant reductions in psychological parameters (e.g., somatic anxiety: $t = 6.47$, $p < .001$; anxiety: $t = 8.34$, $p < .001$) and physiological indicators (e.g., BMI: $t = 13.22$, $p < .001$; systolic blood pressure: $t = 9.61$, $p < .001$). Notably, the male control group also showed significant but relatively smaller changes across variables (e.g., somatic anxiety: $t = 4.46$, $p < .001$), highlighting the effectiveness of the intervention.

**Table 3.** Independent Sample t-Test Comparing Post-Test Scores Between Experimental and Control Groups within each Gender

| Variable | Group | Mean Difference | t-value | df | p-value | Interpretation |
|---|---|---|---|---|---|---|
| Somatic Anxiety | Male (G1:G3) | -0.20500 | -1.342 | 38 | .188 | Not Significant |
| Concentration Disruption | Male (G1:G3) | -0.26050 | -1.461 | 38 | .152 | Not Significant |
| Worry | Male (G1:G3) | -0.26000 | -1.819 | 38 | .077 | Not Significant |
| Stress | Male (G1:G3) | -3.68850 | -2.673 | 38 | .011 | Significant |
| Anxiety | Male (G1:G3) | -5.26250 | -3.420 | 38 | .002 | Significant |
| Body Mass Index (BMI) | Male (G1:G3) | -1.68200 | -2.576 | 38 | .014 | Significant |
| Resting Heart Rate | Male (G1:G3) | -6.81700 | -4.808 | 38 | .001 | Significant |
| Systolic Blood Pressure | Male (G1:G3) | -0.28600 | -1.374 | 38 | .905 | Not Significant |
| Diastolic Blood Pressure | Male (G1:G3) | -2.32650 | -1.374 | 38 | .178 | Not Significant |
| Somatic Anxiety | Female (G2:G4) | -0.30400 | -2.007 | 38 | .052 | Not Significant |
| Concentration Disruption | Female (G2:G4) | -0.51600 | -3.507 | 38 | .001 | Significant |
| Worry | Female (G2:G4) | -0.31700 | -1.645 | 38 | .108 | Not Significant |
| Stress | Female (G2:G4) | -1.84000 | -1.349 | 38 | .185 | Not Significant |
| Anxiety | Female (G2:G4) | -5.42650 | -3.559 | 38 | .001 | Significant |
| Body Mass Index (BMI) | Female (G2:G4) | -0.64000 | -0.896 | 38 | .376 | Not Significant |
| Resting Heart Rate | Female (G2:G4) | -4.36550 | -2.435 | 38 | .020 | Significant |
| Systolic Blood Pressure | Female (G2:G4) | -4.00350 | -2.369 | 38 | .023 | Significant |
| Diastolic Blood Pressure | Female (G2:G4) | -5.88350 | -3.202 | 38 | 003 | Significant |

In Table 3, an independent samples t-test was conducted to compare post-test scores between experimental (G1 for males, G2 for females) and control groups (G3 for males, G4 for females) within each gender to evaluate the effectiveness of the intervention on anxiety-related psychological and physiological parameters. Among male participants, significant differences were observed between the experimental and control groups in stress, anxiety,

body mass index, and resting heart rate, favouring the experimental group. These results suggest that the intervention had a substantial impact on both psychological distress and physical health markers in males. However, no significant group differences were found for somatic anxiety, concentration disruption, worry, systolic blood pressure, or diastolic blood pressure ($p > .05$), indicating limited post-intervention differentiation in these specific parameters.

Among female participants, the experimental group showed significantly lower post-test scores in concentration disruption, anxiety, resting heart rate, systolic blood pressure, and diastolic blood pressure, compared to the control group. These findings suggest that the intervention was effective in reducing cognitive anxiety symptoms and improving physiological parameters in females. No significant group differences were observed in somatic anxiety, worry, stress, or BMI ($p > .05$), which may reflect gender-specific responses or variability in treatment efficacy. Overall, the results indicate that the intervention had a differential but generally positive impact on post-intervention outcomes, particularly in reducing anxiety and improving select physiological indicators across both genders.

**Table 4.** Independent Samples t-Test Comparing Post-Test Scores between Male and Female Participants across Variables

| Variables | Mean (Male) | Mean (Female) | t-value | df | p-value | Mean Difference | Interpretation | Effect Size |
|---|---|---|---|---|---|---|---|---|
| Somatic Anxiety | 2.39 | 2.23 | 1.075 | 38 | .289 | 0.166 | Not Significant | 0.340 |
| Concentration Disruption | 2.35 | 2.18 | 0.915 | 38 | .366 | 0.166 | Not Significant | 0.289 |
| Worry | 2.14 | 2.15 | -0.069 | 38 | .945 | -0.012 | Not Significant | -0.022 |
| Stress | 18.52 | 17.81 | 0.547 | 38 | .587 | 0.710 | Not Significant | 0.173 |
| Anxiety | 33.64 | 32.92 | 0.473 | 38 | .639 | 0.717 | Not Significant | 0.150 |
| Body Mass Index | 22.12 | 22.53 | -0.670 | 38 | .507 | -0.414 | Not Significant | -0.212 |
| Resting Heart Rate | 72.34 | 73.82 | -0.929 | 38 | .359 | -1.479 | Not Significant | -0.294 |
| Systolic Blood Pressure | 117.30 | 114.22 | 1.413 | 38 | .166 | 3.071 | Not Significant | 0.447 |
| Diastolic Blood Pressure | 74.59 | 71.84 | 1.724 | 38 | .093 | 2.745 | Not Significant | 0.545 |

The results in Table 4 indicated no statistically significant gender differences in any of the measured variables ($p > .05$). Specifically, for psychological constructs such as somatic anxiety ($t(38) = 1.075$, $p = .289$, $d = 0.340$), concentration disruption ($t(38) = 0.915$, $p = .366$, $d = 0.289$), worry ($t(38) = -0.069$, $p = .945$, $d = -0.022$), stress ($t(38) = 0.547$, $p = .587$, $d = 0.173$), and anxiety ($t(38) = 0.473$, $p = .639$, $d = 0.150$), the mean differences between male and female groups were minimal and non-significant. Similarly, physiological indicators including BMI ($t(38) = -0.670$, $p = .507$, $d = -0.212$), resting heart rate ($t(38) = -0.929$, $p = .359$, $d = -0.294$), systolic blood pressure ($t(38) = 1.413$, $p = .166$, $d = 0.447$), and diastolic blood pressure ($t(38) = 1.724$, $p = .093$, $d = 0.545$) did not show statistically significant differences between genders, though the effect sizes for systolic ($d = 0.447$) and diastolic blood pressure ($d = 0.545$) approached moderate levels.

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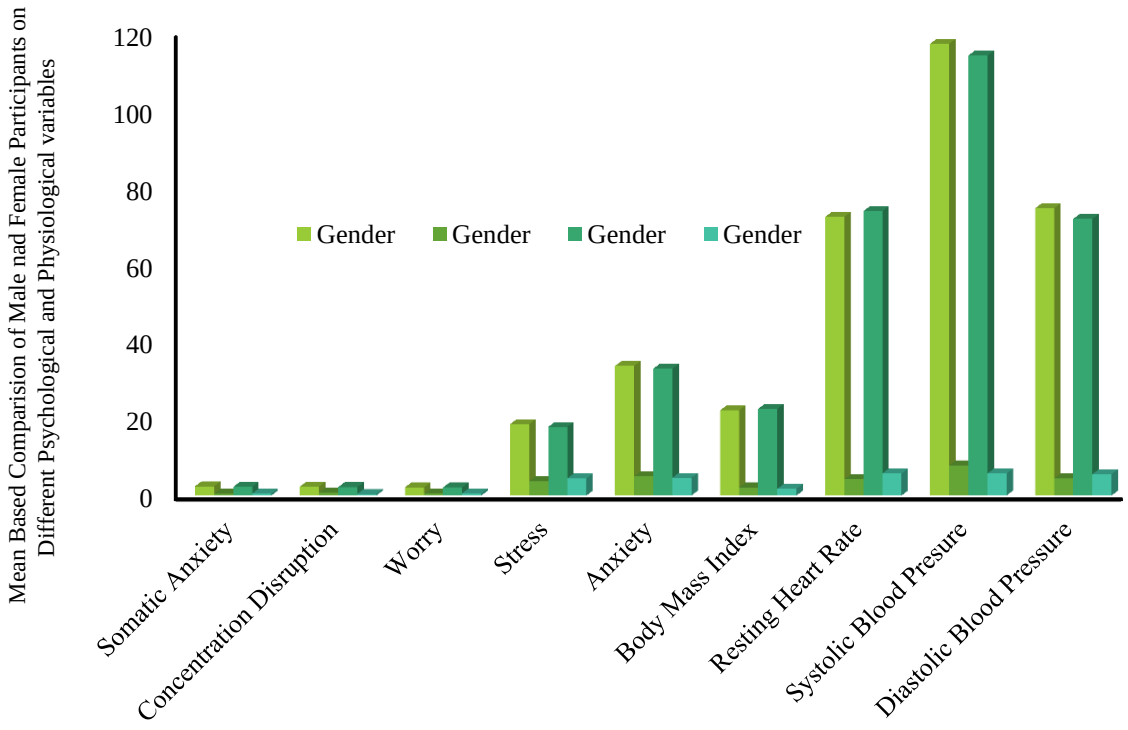


**Figure 1.** Graphical Representation of Mean Value of Male and Female Participants on Different Psychological and Physiological Variables

## 4. Discussion

The current study aimed to investigate the effects of a four-week Surya Namaskar intervention on various psychological and physiological traits in students from the physical education department, with a focus on their gender. The findings add credence to the increasing amount of research indicating that consistent yoga practice, especially Surya Namaskar, can greatly reduce stress, boost psychological well-being, and improve autonomic regulation [7,20]. Both male and female participants in the treatment group showed statistically significant decreases in somatic anxiety, worry, disturbance of focus, perceived stress, and total anxiety levels after the intervention, which is in line with earlier findings. This is consistent with earlier studies showing that yoga exercises promote emotional control and mental clarity by eliciting parasympathetic activation and reducing sympathetic arousal [5]. Furthermore, Surya Namaskar's holistic benefits are further highlighted by changes in physiological markers like resting heart rate, systolic and diastolic blood pressure, and BMI, which support its role in fostering metabolic balance and cardiovascular efficiency [3].

Notably, gender-specific analysis showed complex trends. Stress, anxiety, BMI, and resting heart rate all showed substantial improvements among male participants, although other measures showed non-significant benefits. Anxiety, blood pressure readings, resting heart rate, and disturbance of attention were all statistically reduced in female individuals. These results are consistent with other research indicating that women may benefit more from mind-body therapies because they are more likely to internalize stress reactions at baseline and engage more strongly with yoga's mindfulness elements [16,17]. Even though the type and direction of benefits may differ,

Surya Namaskar is generally equally helpful for both genders, as evidenced by the lack of significant gender differences across post-test results (as shown by independent samples t-tests). Moderate impact sizes in systolic and diastolic blood pressure warrant consideration, indicating potential gender-based physiological sensitivities that future studies should explore more fully.

Despite some variations, the non-significant results in the control groups support the superiority of the organised intervention over regular exercise. These findings support recommendations for including organised yoga modules in physical education curriculum, especially in settings where students are under pressure to perform well and experience psychological stress [9,10].

## 5. Conclusion

The findings of this study highlight the efficacy of a four-week Surya Namaskar practice in enhancing both psychological and physiological well-being among Physical Education students. Participants in the experimental group demonstrated marked reductions in anxiety, stress, concentration disruption, and physiological indicators such as resting heart rate, blood pressure, and BMI. These improvements were observed in both male and female groups, indicating the universal applicability of the intervention. Although some gender-based differences were noted in the extent of change—such as greater improvement in cardiovascular parameters among females—no statistically significant gender differences were found overall. This suggests that Surya Namaskar is an equally beneficial practice for both sexes. The intervention proved to be superior to routine physical activity alone, emphasising its value in academic settings where students often face performance-related stress.

## 6. Future Research Direction

1. Future studies should adopt longitudinal designs to assess the sustained impact of Surya Namaskar on psychological and physiological parameters over extended periods.

2. Investigations exploring the effects of varying intensities, frequencies, and cycle counts of Surya Namaskar could help determine optimal practice regimens for different populations.

3. Incorporating biomarkers such as cortisol, serotonin, or heart rate variability may offer deeper insights into the neuroendocrine mechanisms underpinning stress reduction.

4. Brief interviews or reflective feedback could capture participants' subjective experiences and perceived benefits, complementing quantitative findings.

5. Evaluating Surya Namaskar alongside other yoga or mindfulness practices may help isolate its unique contributions to well-being.

## 7. Limitations

Despite yielding positive outcomes, the study has certain limitations. The sample was restricted to a specific age group (18–24 years) and limited to Physical Education students from institutions in Assam, which may reduce the generalizability of findings to broader populations. The short duration of the intervention (four weeks) may not

capture the long-term effects of Surya Namaskar on psycho-physiological health. Additionally, although validated instruments were used, self-reported psychological data may be influenced by response bias or social desirability. Finally, the study did not control for other lifestyle factors such as diet, sleep quality, or additional physical activity, which could have confounded the results. Future studies with larger, more diverse samples and extended follow-up periods are needed to confirm and expand upon these findings.

## Declarations

**Source of Funding**

This study received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

**Competing Interests Statement**

The authors declare no conflict of interest.

**Consent for publication**

The authors declare that they consented to the publication of this study.

**Authors' contributions**

All the authors equally took part in the literature review, manuscript writing, and analysis of the data.

**Availability of data and materials**

Supplementary information is available from the authors upon reasonable request.

**Institutional Review Board Statement**

Not applicable for this study.

**Informed Consent**

All participants in this study voluntarily gave their informed consent prior to their involvement in the research.

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