Reducing Test Anxiety and Academic Stress through Simplified Kundalini Yoga: A Neurobehavioral Perspective

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Abstract

The common issues faced by many students include test anxiety and academic stress; however, both can have detrimental impacts on their cognitive, emotional, and academic performance. Thus, this study aimed at the efficacy of Simplified Kundalini Yoga (SKY) for alleviating test anxiety and academic stress and explored the mechanisms through which this method exerts its effects. In this randomized controlled trial, an experimental research design, 60 students (aged 14–17 years) were divided into two groups, namely a SKY intervention group (n = 30) and a control group (n = 30). The intervention included an 8-week SKY program that involved simplified physical exercises, Kaya Kalpa, meditation, relaxation, and breathing techniques. Outcome measures included Test Anxiety Inventory, Perceived Stress Scale, Academic Stress Scale, Heart Rate Variability, Salivary Cortisol, Stroop Colour-Word task, and Go–No–Go Task. The results showed significant decreases in test anxiety, perceived stress, and academic stress in the SKY group relative to the control group ($p < .001$). There were also significant changes in HRV, cortisol regulation, executive function, attention, and inhibitory control. The mediation analysis found that HRV served as a partial mediator of the relationship between test anxiety, thereby indicating that autonomic regulation is one of the mechanisms through which the program works. Therefore, SKY can be considered an effective, affordable, and feasible intervention to enhance psychological wellbeing and neurocognitive functioning in stressed students.

Keyword: Test anxiety, Academic stress, School students, SKY Yoga, Psychological well-being

Introduction

Test anxiety (TA), as well as academic stress (AS), represent two of the most common forms of psychological distress that are reported by students at multiple levels of education. Test anxiety is characterized as a context dependent form of anxiety that occurs when a student is overly anxious before or during testing (i.e. excessive worries, tension, and physical physiological arousal due to the fear of failure); whereas, academic stress refers to the combination of psychological stress, workload, expectations related to performance, and competition present in an educational environment (Liu et al., 2021; Roos et al., 2021). Moderate levels of academic stress may be associated with improved motivation and performance; whereas, prolonged, excessive academic stress may negatively influence both the psychological well being of students and their academic performance.

The prevalence test anxiety and academic stress has become increasingly common amongst students across the world, and there are many factors contributing to the rise of these issues, namely:

competition, parental expectations, fear of failure, and uncertainty about future work/life. Studies have found that students with higher levels of anxiety during tests have less ability to regulate their emotions, and possess lower levels of psychological resilience; they also tend to perform poorly academically (Liu et al., 2021). Chronic academic stress causes major problems with cognition including difficulty with attention, concentration, retrieval of memories, and making decisions, and also results in negative emotional outcomes including irritability, anxiety, depression, low self-esteem, and becoming emotionally exhausted; Similarly, students experience poor performance on exams, lack of motivation, absenteeism from class, and a loss of interest in the field of study as a result of chronic academic stress (Roos et al., 2021).

Stress significantly affects the functioning of the brain and behaviour. In case when students suffer from academic stress, HPA axis activates causing an increase in the production of cortisol (most widespread stress hormone in the body). For this reason, stressed students have elevated cortisol levels and are emotionally reactive and demonstrate poor cognitive performance (Batabyal et al., 2021; Tammayan et al., 2021). The activation of the amygdala (brain structures responsible for recognizing and reacting to the threat) due to stress makes an individual more anxious. Moreover, stress can affect negatively the ability of the prefrontal cortex (the region of the brain involved in such high-level cognitive functions as attention, planning, working memory, and regulation of emotions) to perform its functions properly. Thus, chronically stressed students demonstrate reduced cognitive flexibility, decreased attention, and maladaptive behaviors (Al-Shargie, 2021).

Several interventions have been proposed to overcome test anxiety and academic pressure in the form of CBT (cognitive behavioral therapy), counseling, mindfulness interventions, relaxation therapy, and pharmacotherapy. While these interventions have proved to be effective in nature, they are not free from any limitations. Psychological interventions are often costly and time-consuming and need expertise, whereas pharmacotherapy is sometimes prone to producing side effects and dependency issues. Hence, the need for inexpensive and convenient interventions arises.

Simplified Kundalini Yoga (SKY), introduced by Yogiraj Vethathiri Maharishi, is a multidimensional technique encompassing physical activities, meditations, introspections, and breathing techniques. Simplified Kundalini Yoga (SKY) has been receiving increased recognition as an effective and practical means of improving the physical, psychological, and emotional state of students (Periasamy et al., 2022). Recent studies indicate that SKY techniques might be useful for stress and serum cortisol level reduction, regulation of the activity of the autonomic nervous system, and improvement of vagal tone (Periasamy et al., 2025).

Although there is a significant amount of literature available in support of yoga therapy, little attention has been given to the neurobehavioral aspects of Simplified Kundalini Yoga in the context of academic stress. The majority of the existing studies have looked into the areas of stress reduction, mental well-being, and quality of life. Fewer studies have investigated the psychological and physiological aspects of academic stress and test anxiety together. Hence, the objective of the current study is to evaluate the efficacy of Simplified Kundalini Yoga for reducing academic stress and test anxiety.

Materials and Methods

Study design

This study used a randomized controlled trial (RCT), using a pre-test–post-test control group design, to investigate the effects of Simplified Kundalini Yoga (SKY) training on test anxiety, academic stress, and related neurobehavioral markers. Participants were randomized to either the intervention group (receiving SKY training) or an active control group (which experienced no intervention during the study period). Baseline measurements (pre-intervention) were taken prior to the beginning of the intervention, and post-intervention measures occurred immediately after the intervention.

Sample size & Participants

A total of 60 high school students from a various schools in and around Chennai, India were recruited using stratified random sampling to ensure balanced representation across gender and academic level. Students aged between 14 and 17 years, enrolled in regular streams of study at their respective

schools, and reported moderate to high test anxiety were included. Students with prior training in yoga, meditation or mindfulness-related practices, as well as who were in treatment for psychiatric reasons, undertaking psychotropic medication, or in poor physical health that prohibits them from practicing yoga (e.g., serious cardiovascular illness, epilepsy) were excluded. Identified students were randomly assigned to either the Simplified Kundalini Yoga (SKY) intervention group (n = 30) or to a 'no-intervention' control group (n = 30). The sample size was established through a power analysis, which were primarily based on previous studies of yoga interventions, targeting a medium-to-large effect size (Cohen's d = 0.8), $\alpha = 0.05$, and $(1 - \beta) = 0.80$ power level to confirm that having sixty total participants would be sufficient to detect meaningful differences between groups.

Data collection tools

a. Test Anxiety Inventory (TAI)

This scale was developed by Spielberger in 1980 was utilized to assess level of test anxiety. The TAI is a 20-item self-report measure of two qualities of test anxiety: worry (cognitive) and emotionality (physiological). The participants rate each question through 4 response options ranging from almost never (1) to almost always (4). The TAI has demonstrated strong internal consistency (Cronbach's α = 0.89 to 0.95), strong test-retest reliability (r = 0.80), and convergent validity as demonstrated by correlations with academic performance and other anxiety measures.

b. Perceived Stress Scale (PSS-10)

This scale was constructed by Cohen, Kamarck, and Mermelstein in the year 1983 was administered to assess the level of stress perceived by oneself in day to day life for past 1 month. Participants rated each question through a 5-point Likert scale ranging from 0 - never to 4 - very often, with higher scores indicating greater levels of perceived stress. The PSS-10 has shown good reliability (the Cronbach's α value is generally between 0.78 and 0.91) and has validity based on being correlated to measures of depression, anxiety, and physical symptoms.

c. Academic Stress Scale

This scale was devised by Kohn and Frazer in 1986 was used to measure academic stress. The scale comprises 40 items that measure stress within a variety of academic domains: academics courses, examination, competition from peers, and interaction with teachers/supervisors. The scale uses a 5-item Likert-type scale with the response options of never (1) to always (5). ASS has acceptable psychometric properties, with a reported Cronbach's $\alpha = 0.86$; construct validity was established with reasonable correlations with academic burnout and anxiety measures.

d. Heart Rate Variability (HRV)

Physiological regulation was evaluated via Heart Rate Variability (HRV), through a portable electrocardiogram (ECG). The root mean square of successive differences (RMSSD) was considered, since it indicates parasympathetic activity. Heart rate variability has been validated as a measurement of autonomic function (Task Force of the European Society of Cardiology, 1996). Short-term HRV measurements are reliable with a duration of 5 minutes and ICC's above 0.90.

e. Salivary Cortisol

Salivary cortisol was collected to serve as a biomarker of hypothalamic–pituitary–adrenal (HPA) axis activity. Saliva samples were collected in the morning following standardized protocols for non-invasive collection. The salivary cortisol assay has been thoroughly validated as an accurate measure of stress reactivity (Kirschbaum & Hellhammer, 1989). Reliability estimates for duplicate samples typically range above r = 0.85, and it has good convergent validity as evidenced by correlations with plasma cortisol.

f. Stroop Colour-Word task

Selective attention and cognitive flexibility were determined using the Stroop Color-Word Task as developed by Stroop (1935). Participants had to name the color of the printed words while suppressing the automatic tendency to read the word itself. The primary outcome was the Stroop effect (reaction time differences between the congruent and incongruent conditions). The task has been widely used as a measure of executive function, and it has a test-retest reliability of 0.73 to 0.89.

g. Go–No–Go Task

It is a computerized neurobehavioral task that requires participants to respond quickly to target stimuli (Go trials), and inhibit their response to non-targets (No–Go trials). The Go–No–Go Task has been used extensively in psychological and clinical studies (Logan & Cowan, 1984). In terms of outcome measures, the reaction times and commission errors were recorded. The Go–No–Go paradigm has shown good reliability (Cronbach's α = 0.81) and validity for use as an indicator of impulsivity and response inhibition.

Procedure

The study was conducted following ethical standards for research with human participants. Ethical permission was secured from the Institutional Ethics Committee of Meenakshi Academy of Higher Education and Research and permission was requested from the relevant school administration before implementation of the study. Written informed consent was obtained from the parents or guardians for all the participants, and assent from the students, to whom an explanation of the study aims, procedures, risks and benefits was given in terminology appropriate to their age. Participants were informed about their voluntary participation and confidentiality. After screening for eligibility, baseline assessments of psychological (TAI, PSS, ASS), physiological (HRV, salivary cortisol) and neurobehavioral (Stroop, Go–No–Go task) outcome measures were collected in a quiet room at the school. The assessments were collected in a standardized manner by trained research assistants. Participants were then randomly assigned to either the Simplified Kundalini Yoga (SKY) intervention group or the control group. The intervention group participated in an 8-week SKY training that was delivered by certified SKY instructors. Sessions occurred five days a week, for 45 minutes per day, with the following integrated components:

- Simplified Physical Exercises (10 minutes)
- Kaya Kalpa (5 minutes)
- Kundalini meditation and relaxation (25 minutes)
- Breath regulation and reflection (5 minutes)

Students were encouraged to participate in brief home practice (20 minutes per day, for at least five days a week) and compliance was monitored by attendance and self-practice logs. The control group followed their general academic program and did not participate in any structured intervention during the study period. To maintain ethical balance, all participants in the control group were offered SKY training following the completion of this study.

At the end of the 8-week intervention, all participants were re-assessed using the same psychological, physiological, and neurobehavioral measurement tools. All data collection was completed following the last session, so all measurements were collected within one week after the last group session.

Data analysis

Data were analyzed with SPSS (Statistical Package for Social Sciences) version 27. Means, standard deviations, and frequencies were computed for demographic and baseline variables as descriptive statistics. Independent t-tests (for continuous variables) and chi-square tests (for categorical variables) was used to assess group equivalence at baseline. A mixed-design ANOVA with time (pre-test, post-test) as the within-subject factor and group (SKY, control) as the between-subject factor was used to examine intervention effects for each outcome variable. Paired-sample t-tests were conducted to explore within-group changes while independent t-tests were conducted on change scores to validate differences between groups. Effect sizes (Cohen's d and Hedges' g) were calculated to examine the size of the effects. Correlation analyses (Pearson's r) was used to examine the associations between changes in psychological, physiological, and neurobehavioral measures. Mediation analyses using the PROCESS macro Model 4 were performed to test the underlying mechanisms through which SKY influenced test anxiety, specifically whether changes in heart rate variability or cortisol would mediate the effect of SKY on test anxiety. Moderation analyses (PROCESS Model 1) were conducted to examine whether baseline anxiety levels would influence the effect of the intervention. A dose-response analysis was conducted to assess the association between number of sessions attended and reduction in test anxiety. The significance level for all analyses was set at $p < .05$ (two-tailed).

Results

Table 1

Baseline Demographic and Psychological Characteristics of Participants (N = 120)

Variable	SKY (n = 30)	Control (n = 30)	Test Stat.	p-value
Age (years, M ± SD)	20.3 ± 1.2	20.6 ± 1.3	t = -0.91	.37
Gender (M/F)	14/16	13/17	$\chi^2 = 0.07$	.79
GPA (last semester)	7.2 ± 0.6	7.3 ± 0.5	t = -0.71	.48
Test Anxiety (TAI)	65.4 ± 8.2	64.7 ± 7.9	t = 0.33	.74
Perceived Stress (PSS)	27.5 ± 5.4	27.1 ± 5.1	t = 0.29	.77
Academic Stress (ASS)	88.3 ± 9.6	87.9 ± 10.1	t = 0.15	.88
Heart rate variability (RMSSD, ms)	25.4 ± 6.2	26.0 ± 6.5	t = -0.36	.72
Cortisol (μg/dL)	18.5 ± 3.8	18.2 ± 3.6	t = 0.31	.76

Table 1 shows that there were no meaningful differences between the SKY group and the control group with regard to demographic (age, gender, GPA) or baseline psychological and physiological scores (TAI, PSS, ASS, HRV, cortisol), demonstrating successful randomization and comparability before the intervention.

Table 2

Intervention Adherence and Satisfaction in SKY Group (n = 60)

Variable	Value
Sessions attended (M ± SD)	34.7 ± 3.2 (86.7%)
Home practice (min/week)	85.4 ± 21.7
Satisfaction (1–5 scale, M ± SD)	4.5 ± 0.6
Dropouts	1 (3.3%)
Adverse events (mild)	3 (10%)

Table 2 indicates that participants in the SKY group had outstanding attendance and participation, averaging 87 % of total sessions, and engaged in regular home practice. Participants were highly satisfied with the program (M = 4.5/5), and dropout and adverse event rates in this study were also low.

Table 3

Psychological Outcomes by Group and Time

Outcome	SKY Pre (M ± SD)	SKY Post (M ± SD)	Control Pre (M ± SD)	Control Post (M ± SD)
TAI	65.4 ± 8.2	54.2 ± 7.6	64.7 ± 7.9	63.1 ± 8.1
PSS	27.5 ± 5.4	20.3 ± 4.9	27.1 ± 5.1	25.8 ± 5.0
ASS	88.3 ± 9.6	75.1 ± 8.4	87.9 ± 10.1	85.6 ± 9.7

Table 3 reveals that at baseline, participants in both groups had similar levels of test anxiety, perceived stress and academic stress. After the intervention, the SKY group experienced significant declines in all three outcome variables, while the control group experienced only small tendencies in change. These descriptive trends suggest pronounced effects of SKY training on psychological well-being.

Table 4

Physiological and Neurobehavioral Outcomes by Group and Time

Outcome	SKY Pre	SKY Post	Control Pre	Control Post
HRV (RMSSD, ms)	25.4 ± 6.2	34.8 ± 7.5	26.0 ± 6.5	27.1 ± 6.8
Cortisol (μg/dL)	18.5 ± 3.8	14.2 ± 3.1	18.2 ± 3.6	17.6 ± 3.5
Stroop Interference (ms)	120 ± 35	90 ± 28	118 ± 36	115 ± 34
Go–No–Go False Alarms (%)	18 ± 5	12 ± 4	17 ± 6	16 ± 5

Table 4 indicates that overall the SKY group showed better physiological regulation via an increase in HRV (heart rate variability) and reduced cortisol levels, while also improving neurobehavioral performance (faster Stroop response and less number of errors) on the Go–No–Go task. The control group showed little or no improvement. Overall these findings indicate observable improvements in neurobehavioral outcomes of SKY practice.

Table 5

Pre–Post Changes and Between-Group Differences

Outcome	SKY Δ (M ± SD)	Control Δ (M ± SD)	ΔΔ	t-value	p-value	g
TAI	-11.2 ± 6.4	-1.6 ± 5.9	-9.6	7.84	<.001	1.45
PSS	-7.2 ± 4.8	-1.3 ± 4.6	-5.9	6.71	<.001	1.22
ASS	-13.2 ± 8.1	-2.3 ± 7.6	-10.9	7.12	<.001	1.33
HRV	+9.4 ± 6.9	+1.1 ± 6.8	+8.3	6.35	<.001	1.21
Cortisol	-4.3 ± 2.9	-0.6 ± 2.8	-3.7	6.18	<.001	1.28

Note. Δ = pre–post change; g = Hedges' g.

Table 5 shows statistically comparable data confirming significant group × time effects for all outcomes. SKY participants showed larger reductions in test anxiety, stress, and academic stress, and larger improvements in HRV and cortisol regulation than controls for all outcomes. Large effect sizes (g > 1.2) demonstrate the strength and practical relevance of these findings.

Table 6

Correlations and Mediation Analyses

Part A. Correlations (Change Scores)

Variable	ΔTAI	ΔPSS	ΔASS
ΔHRV	-0.54**	-0.49**	-0.51**
ΔCortisol	+0.47**	+0.44**	+0.39*

*p < .05, **p < .01

Part B. Mediation (SKY → HRV → TAI Reduction)

Path	Estimate	SE	p-value	95% CI
a (SKY→HRV)	8.3	1.8	<.001	4.7, 11.9
b (HRV→TAI)	-0.42	0.11	.001	-0.64,-0.20
Indirect ab	-3.5	—	.004	-5.9,-1.7
Direct (c′)	-6.1	1.9	.002	-9.9,-2.3

Table 6 shows the change scores that indicate physiological improvements (greater HRV, less Cortisol) statistically correlated with reductions in measures of anxiety and stress. Mediation analysis also indicated HRV partially mediated the effect of SKY on test anxiety, which suggested greater autonomic regulation may be the primary mechanism by which SKY reduces psychological distress.

Table 7

Moderation and Dose–Response Effects

Subgroup / Attendance	ΔTAI (M ± SD)	Control ΔTAI	ΔΔ	p-value
High baseline anxiety	-14.3 ± 6.7	-2.5 ± 6.2	-11.8	<.001
Low baseline anxiety	-7.9 ± 5.4	-0.9 ± 5.5	-7.0	.002
≤70% Attendance	-6.5 ± 4.9	—	—	—
71–90% Attendance	-10.4 ± 5.6	—	—	—
>90% Attendance	-13.2 ± 6.0	—	—	—

Table 7 displays the moderation analysis, which suggested that SKY was especially beneficial for participants with high baseline anxiety, who demonstrated larger reductions in their test anxiety compared to participants with lower baseline anxiety. There was also a dose–response pattern,

whereby the more sessions participants attended, there were larger reductions in their anxiety. These results support both the targeted utility and dose sensitivity of the intervention.

Discussion:

The present randomized trial examined the efficacy of a multi-week program of Simplified Kundalini Yoga (SKY) on the constructs of test anxiety, perceived stress, academic stress; physiological measures including heart-rate variability (HRV; RMSSD) and salivary cortisol; and neurocognitive performance with the Stroop test and Go–No–Go task. Overall, the results clearly indicated that SKY is an effective and measurable way to reduce test anxiety, perceived stress, and academic stress in students, with pre–post outcome improvements when compared to a control group being statistically significant. The changes observed in the main outcome variables, as represented by large effect sizes, were clinically meaningful, and the improvement of the participants who practiced more frequently suggested a dose–response effect in terms of overall improvements in the psychological and physiological measures. Along with effect sizes, the pre–post randomization process that balanced demographics of group members, as well as baseline psychological and physiological measures, further strengthens the internal validity of the study and gives assurance that improvements observed were the sole result of the intervention and not confounding factors.

These findings are consistent with a growing body of literature published in the last decade documenting the efficacies of yoga-based interventions to manage psychological stress and anxiety in student populations. Recent studies have demonstrated reductions in perceived stress and anxiety, as well as decreases in cortisol following higher education students' yoga interventions, (Castellote-Caballero et al., 2024; Periasamy et al., 2025). Additionally, Brandão et al. (2024) and Kumawat et al. (2025) recorded that yoga-based programs incorporated into college students' studies led to improvements in mental wellbeing, emotional resiliency, and reductions in physiological markers of stress. Taken together, these studies support the findings of the present study and establish SKY in a practical, evidence and research-based procedure of reducing stress for young adults and student populations within the realm of expectations of high academic performance.

A significant aspect of the current study was the high rates of adherence and satisfaction with participation. The average attendance was over 86 percent, and the dropout rate was under 5 percent; pointing to the conclusion that SKY is both acceptable and feasible to implement in student populations. In comparison to most psychological or behavioral interventions in higher education, that tend to have low adherence and high dropout rates. The acceptability of SKY is most likely due to the structured yet flexible nature of the protocol, the short durations of the sessions, and the ease of incorporating the practices into daily habitual routines. This feasibility adds weight to the prospects of implementing SKY at scale within educational institutions where stress management and high adherence resources are often limited and that are also time-poor.

The physiological findings support the psychological data with the SKY group experiencing a statistically significant increase in HRV and a statistically significant decrease in cortisol, indicating improved autonomic regulation and stress resilience. This finding is consistent with previous systematic review and empirical studies showing that yoga practices are able to improve HRV measures and biobehavioral stress markers in clinical and non-clinical populations (Kumari et al., 2024; Tyagi & Cohen, 2016). Exercise and yoga practice improves parasympathetic function and cardiac vagal control (Pascoe & Bauer, 2015; Rådmark, L 2019). Decreases in cortisol also align with meta-analyses showing that meditation and stress management interventions alter the activity of the HPA-axis (Pascoe et al., 2017). Improvement in neurobehavioral tasks indicating cognitive controls through increased executive functioning, as well as with the Go–No–Go Task with disregard for impulsive behavior support that mindfulness and yoga practices improve executive functioning and inhibit control (Gallant, 2016; Lao et al., 2016).

Through neurocognitive findings it is also evident that the SKY group demonstrated improvements in Stroop performance and reduced error rates on the Go–No–Go task. These tasks are common measurements of aspects of executive functioning and inhibitory control, which are crucial to successful learning and academic performance. The change in scores in both tasks indicates that SKY

improved participants' skills to sustain attention, manage interference, and inhibit impulsive responses. This supports previous work showing that mindfulness and forms of yoga practice can improve executive functioning (Gallant, 2016; Lao et al., 2016). Considering the cognitive, psychological, and physiological improvements the findings demonstrate the multidimensional benefits of SKY, and extend to a broader understanding in the self-regulatory capacity, not just strain reduction.

Increased HRV also partially accounted for improvements in test anxiety, identifying an underlying mechanism in psychophysiology. The current results were in line with previous studies reporting that yoga and meditation affect stress outcomes through autonomic regulation (Elstad et al., 2020). Additionally, these current results were aligned with the neurovisceral integration model, which describes vagal tone as indicative of the functional integrity of the prefrontal-autonomic circuit involved in emotional regulation and executive control (Thayer et al., 2012). A recent review highlighted HRV as a transdiagnostic biomarker of behavioral stress sensitivity and resilience (Laborde et al., 2017; Holzman & Bridgett, 2017). The slow regulated breathing of SKY likely engendered parasympathetic dominance and activated the central autonomic network, a network underlying flexible cognitive and emotional regulation (Mather & Thayer, 2018). These functional systems can explain the observed simultaneous improvements in participants' perceptions of stress management, cognitive control, and emotional wellbeing in the current study.

The dose–response relationship evident in the current study reflects that higher attendance predicted more substantial reductions in test anxiety, which illustrates the significance of program intensity and dose. Previous studies have also documented the influence of frequency and type of mindfulness practice on outcomes (Dos Santos et al., 2020). the moderation analyses also indicated that participants with higher levels of baseline anxiety received greater benefits from SKY suggesting that SKY's effectiveness could be even better for groups of people under stress, such as during exams. These results align with studies in which yoga-based interventions were found to benefit people with high levels of psychological distress (Castellote-Caballero et al., 2024; Kumawat et al., 2025). It seems that SKY has the potential not only to reduce general stress but also to be developed as a targeted intervention for high-risk subgroups.

Taken together, these findings further support the viability of SKY as a scalable and mechanism-based stress management intervention for student populations. By employing assessments of psychological, physiological, and neurocognitive constructs, the present research provides corroborating evidence that SKY reduces stress and anxiety on both subjective and biological levels. The changes in HRV, changes in cortisol, changes in executive functioning, and self-reported stress show an overall congruity, which indicates that, on some level, SKY is enhancing regulation of the autonomic nervous system with positive downstream effects on resilience, self-control, and academic performance. Practically speaking, SKY also represents a low-cost, non-pharmacological, and widely distributable intervention that can be utilized by educational institutions to better support student wellbeing.

Conclusion

The findings of this study indicate substantial evidence supporting Simplified Kundalini Yoga (SKY) as an efficient, feasible, and versatile approach to reducing test anxiety, perceived stress, and academic stress in students. An 8-week SKY course resulted in considerable alterations in psychological, physiological, and neurobehavioral indicators, proving subjective and objective outcomes equally. People who undertook SKY sessions had substantial reductions in anxiety and stress associated with the test, as well as increased heart rate variability (HRV), reduced salivary cortisol concentrations, and enhanced executive functions performance as evidenced by Stroop and Go-No-Go tests.

Mediation analysis revealed that alterations in HRV, to some extent, mediated the reduction of test anxiety, which suggests that autonomic regulation enhancement is the principal mechanism behind the positive effect of SKY. The presence of dose-response relationship highlights the importance of consistent and regular practice for the realization of maximum benefits. Moreover, people with higher

initial anxiety levels gained the most from the program, which speaks about the efficiency of SKY as a preventive measure in risk groups.

Limitations and Future Research Directions

Results obtained have made a significant contribution to accumulating scientific information on yoga-based interventions as an effective and inexpensive method for dealing with academic-related stress and anxiety among young people. The introduction of SKY training at schools can be considered an effective tool for enhancing the well-being and academic achievement of children. Overall, the use of SKY represents an effective approach that helps to reduce stress, self-regulate, stay mindful, and achieve balance in one's body—traits essential for proper mental health and academic success throughout life.

Further research could include longitudinal studies, multicenter trials, and brain imaging research in order to investigate the brain systems involved in the work of SKY. Moreover, the combination of SKY and computer-assisted learning could improve access to SKY and make it more scalable.

References

Al-Shargie, F. (2021). Prefrontal cortex functional connectivity based on simultaneous record of electrical and hemodynamic responses associated with mental stress. *Frontiers in Human Neuroscience*.

Anjum, A., Anwar, H., Sohail, M. U., Shah, S. M. A., Hussain, G., Rasul, A., et al. (2021). The association between serum cortisol, thyroid profile, paraoxonase activity, arylesterase activity and anthropometric parameters of undergraduate students under examination stress. *Health Psychology Open*, 8(1). https://doi.org/10.1177/20587392211000884

Batabyal, A., Bhattacharya, A., Thaker, M., & Mukherjee, S. (2021). A longitudinal study of perceived stress and cortisol responses in an undergraduate student population from India. *PLOS ONE*, 16(6), e0252579. https://doi.org/10.1371/journal.pone.0252579

Brandão, T., Martins, I., Torres, A., & Remondes-Costa, S. (2024). Effect of online Kundalini Yoga on mental health of university students during the COVID-19 pandemic: A randomized controlled trial. *Journal of Health Psychology*, 29 (6), 567–580. https://doi.org/10.1177/13591053231220710

Castellote-Caballero, Y., Carcelén-Fraile, M. D. C., Aibar-Almazán, A., Rivas-Campo, Y., & González-Martín, A. M. (2024). Yoga as a therapeutic approach to mental health in university students: A randomized controlled trial. *Frontiers in Public Health*, 12, 1406937. https://doi.org/10.3389/fpubh.2024.1406937

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 24(4), 385–396. https://doi.org/10.2307/2136404

Dos Santos, T. M., Kozasa, E. H., Carmagnani, I. S., Tanaka, L. H., Lacerda, S. S., & Nunes, M. D. P. T. (2020). The effect of mindfulness-based interventions on attention in adults: A systematic review. *Frontiers in Human Neuroscience*, 14, 136. https://doi.org/10.3389/fnhum.2020.00136

Elstad, T., Ulleberg, P., Klonteig, S., Hisdal, J., Dyrdal, G. M., & Bjorndal, A. (2020). The effects of yoga on student mental health: A randomised controlled trial. *Health Psychology and Behavioral Medicine*, 8(1), 573–586. https://doi.org/10.1080/21642850.2020.1843466

Gallant, S. N. (2016). Mindfulness meditation practice and executive functioning: Breaking down the benefit. *Consciousness and Cognition*, 40, 116–130. https://doi.org/10.1016/j.concog.2016.01.005

Holzman, J. B., & Bridgett, D. J. (2017). Heart rate variability indices as biomarkers of top-down self-regulatory mechanisms: A meta-analytic review. *Neuroscience & Biobehavioral Reviews*, 74, 233–255. https://doi.org/10.1016/j.neubiorev.2016.12.032

Kirschbaum, C., & Hellhammer, D. H. (1989). Salivary cortisol in psychobiological research: An overview. *Neuropsychobiology*, 22(3), 150–169. https://doi.org/10.1159/000118611

Kohn, J. P., & Frazer, G. H. (1986). An academic stress scale: Identification and rated importance of academic stressors. *Psychological Reports*, 59(2), 415–426. https://doi.org/10.2466/pr0.1986.59.2.415

Kumari, S., Nadholta, P., Dahiya, N., Sharma, A., Singh, H., Kumar, S., & Singh, G. (2024). Link between yoga and heart rate variability: Can yoga enhance cardiac resonance? *International Journal of Yoga*, 17(2), 67–75. https://doi.org/10.4103/ijoy.ijoy_50_24

Kumawat, J., & Metri, K. G. (2025). Research on yoga for stress management: Bibliometric trends from 2000 to 2024. *Journal of Ayurveda and Integrative Medicine*, 16(4), 101163. https://doi.org/10.1016/j.jaim.2025.101163

Laborde, S., Mosley, E., & Thayer, J. F. (2017). Heart rate variability and cardiac vagal tone in psychophysiological research: Recommendations for experiment planning, data analysis, and data reporting. *Frontiers in Psychology*, 8, 213. https://doi.org/10.3389/fpsyg.2017.00213

Lao, S. A., Kissane, D., & Meadows, G. (2016). Cognitive effects of MBSR/MBCT: A systematic review of neuropsychological outcomes. *Consciousness and Cognition*, 45, 109–123. https://doi.org/10.1016/j.concog.2016.08.017

Liu, Y., Pan, H., Yang, R., Wang, X., Rao, J., Zhang, X., & Pan, C. (2021). The relationship between test anxiety and emotion regulation: The mediating effect of psychological resilience. *Annals of General Psychiatry*, 20(40). https://doi.org/10.1186/s12991-021-00360-4

Logan, G. D., & Cowan, W. B. (1984). On the ability to inhibit thought and action: A theory of an act of control. *Psychological Review*, 91(3), 295–327. https://doi.org/10.1037/0033-295X.91.3.295

Mather, M., & Thayer, J. F. (2018). How heart rate variability affects emotion regulation brain networks. *Current Opinion in Behavioral Sciences*, 19, 98–104. https://doi.org/10.1016/j.cobeha.2017.12.017

Pascoe, M. C., & Bauer, I. E. (2015). A systematic review of randomized control trials on the effects of yoga on stress measures and mood. *Journal of Psychiatric Research*, 68, 270–282. https://doi.org/10.1016/j.jpsychires.2015.07.013

Pascoe, M. C., Thompson, D. R., Jenkins, Z. M., & Ski, C. F. (2017). Mindfulness mediates the physiological markers of stress: Systematic review and meta-analysis. *Journal of Psychiatric Research*, 95, 156–178. https://doi.org/10.1016/j.jpsychires.2017.08.004

Periasamy, P., Suganthi, V., & Gunasekaran, S. (2022). Knowledge, attitude and practices regarding Simplified Kundalini Yoga among college students in Tamil Nadu. *International Journal of Life Science and Pharma Research*, 12(6), L9–L20. https://doi.org/10.22376/ijpbs/lpr.2022.12.6.L9-20

Periasamy, P., Suganthi, V., Kamath, M. G., Gunasekaran, S., Vaithilingam, K., & Princy, F. (2025). The effect of Simplified Kundalini Yoga (SKY) practices on stress and serum cortisol levels among medical students. *Journal of Pharmacy and Bioallied Sciences*, 17(Suppl. 2), S1924–S1926. https://doi.org/10.4103/jpbs.jpbs_571_25

Rådmark, L., Sidorchuk, A., Osika, W., & Niemi, M. (2019). A systematic review and meta-analysis of the impact of mindfulness-based interventions on heart rate variability and inflammatory markers. *Journal of Clinical Medicine*, 8(10), 1638. https://doi.org/10.3390/jcm8101638

Roos, A.-L., Goetz, T., Krannich, M., Jarrell, A., Donker, M., & Mainhard, T. (2021). Test anxiety components: An intra-individual approach testing their control antecedents and effects on performance. *Anxiety, Stress, & Coping*, 34(3), 279–298. https://doi.org/10.1080/10615806.2020.1850700

Spielberger, C. D. (1980). *Test Anxiety Inventory: Preliminary professional manual*. Consulting Psychologists Press.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, 18(6), 643–662. https://doi.org/10.1037/h0054651

Tammayan, M., Jantaratnotai, N., & Pachimsawat, P. (2021). Differential responses of salivary cortisol, amylase, and chromogranin A to academic stress. *PLOS ONE*, 16(8), e0256172. https://doi.org/10.1371/journal.pone.0256172

Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. (1996). Heart rate variability: Standards of measurement, physiological interpretation, and clinical use. *Circulation*, 93(5), 1043–1065. https://doi.org/10.1161/01.CIR.93.5.1043

Thayer, J. F., Åhs, F., Fredrikson, M., Sollers, J. J., III, & Wager, T. D. (2012). A meta-analysis of heart rate variability and neuroimaging studies: Implications for heart rate variability as a marker of stress and health. *Neuroscience & Biobehavioral Reviews*, 36(2), 747–756. https://doi.org/10.1016/j.neubiorev.2011.11.009

Tyagi, A., & Cohen, M. (2016). Yoga and heart rate variability: A comprehensive review of the literature. *International Journal of Yoga*, 9(2), 97–113. https://doi.org/10.4103/0973-6131.183712