RESEARCH PAPER

Effects of Alternate Nostril Breathing and Gayatri Mantra Chanting on Autonomic Functions and Psychological Health in Medical Students: A Randomized Controlled Trial

Boskei Chaurasia[1*], Dolly Rastogi[2], Munish Rastogi[3], Atosh Kumar[4], Jayvardhan Singh[5], Preeti Kanawjia[6]

[1] Post Graduate, Department of Physiology, GSVM Medical College, Kanpur
[2] Professor & Nodal, Department of Physiology, GSVM Medical College, Kanpur
[3] Associate Professor & Director, Institute of Health Sciences, CSJM University, Kanpur
[4,5,6] Associate Professor, Department of Physiology, GSVM Medical College, Kanpur
[*] Corresponding Author: Dr. Boskei Chaurasia, Department of Physiology, GSVM Medical College, Kanpur, Uttar Pradesh. Email: boss2383@gmail.com

Received: 12th Mar, 2026 | **Revised:** 24th Mar, 2026 | **Accepted:** 14th Apr, 2026 | **Available Online:** 30th Apr, 2026

ABSTRACT

Background:

Autonomic dysfunction and psychological disturbances such as anxiety and depression are increasingly prevalent due to stressful and sedentary lifestyles. Yogic breathing practices and mantra chanting are effective non-pharmacological interventions for improving autonomic functions and mental health. This study was planned with objectives to assess the effect of alternate nostril breathing on autonomic functions, depression and anxiety and to assess the effect of chanting of Gayatri Mantra on autonomic functions, depression and anxiety.

Material and Methods:

A randomized controlled trial was conducted involving 108 medical students. Autonomic functions were examined through cold pressor test, hand grip test, and ECG using lead 2. Psychological assessment was done using validated predesigned questionnaire HAM-D for depression and HAM-A for anxiety score.

Results:

Following 12 weeks of intervention, Group 1 and 2 showed statistically significant improvement in autonomic parameters with reduction in mean arterial pressure ($p<0.001$) during cold pressor test, handgrip test, and 30:15 ratio improved by using lead 2 in ECG. HAM-D and HAM-A scores following 12 weeks of intervention were statistically significant ($p<0.001$) in both the intervention groups as compared to the control group.

Conclusion:

Alternate nostril breathing and chanting of Gayatri Mantra significantly improve autonomic functions and reduce depression and anxiety levels. These yogic practices can be considered as cost-effective, non-invasive complementary interventions for promoting autonomic stability and psychological well-being.

Keywords: Alternate nostril breathing, Gayatri Mantra, Autonomic functions, Anxiety, Depression, Pranayama.

How to cite this article: Chaurasia B, Rastogi D, Rastogi M, Kumar A, Singh J, Kanawjia P. Effects of Alternate Nostril Breathing and Gayatri Mantra Chanting on Autonomic Functions and Psychological Health in Medical Students: A Randomized Controlled Trial. Int J Drug Deliv Technol. 2026;16(39s): 649-656. DOI: 10.25258/ijddt.16.39s.84

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

In the past two decades, autonomic dysfunction has emerged as a key contributor to cardiovascular morbidity, metabolic disorders, and psychological distress. Stress-prone, sedentary lifestyles in medical students are associated with sympathetic overactivity, reduced baroreflex sensitivity, and elevated anxiety and depressive symptoms,

creating a "metabolic–neurovegetative" risk profile. [1]

Yoga-based interventions, particularly pranayama and mantra chanting, have been shown to modulate autonomic balance, enhance parasympathetic tone, and improve mood states. Pranayama, an ancient Indian Yogic practice, involves the voluntary regulation of breathing to achieve a rhythmic and calm state of mind. The ancient Indian practice promotes relaxation, focus and inner peace, leading to a deeper state of well- being and spiritual awareness.[2]

Alternate nostril breathing (Anulom–Vilom Pranayama) is reported to reduce sympathetic dominance and improve heart-rate variability, blood pressure, and respiratory parameters. Mantra chanting, especially the Gayatri Mantra, has been anecdotally linked with calming effects, but controlled physiological data are sparse. [3]

Gayatri Mantra-Gayatri Mantra is one of the oldest available divine hymns in a ancient vedic literature. Gayatri Mantra is a standard, validated, empowerment tool aiding in effective behavioral changes leading to optimal and healthy lifestyle[4]. The sound of Gayatri Mantra creates special vibrations that activates the secret subtitle energy centres, which will help oxygenate the brain, reduce our heart rate, blood pressure and create calm brain wave activity.[5]

Anxiety is a multifaceted emotional response to perceived threats, uncertainty or challenges to one's self- esteem. It encompasses feelings of fear, worry and physical tension and can be triggered by a range of factors from identifiable sources to unknown or ambiguous stimuli.[6]

Depression is a mood disorder marked by persistent sadness and loss of interest, disproportionately effects younger adults. Those aged 18-29 are roughly three times more likely to experience depression than individuals aged 60 or older, potentially due to life transitions, social pressures, and ongoing brain development.[7]

The practice of pranayama and Gayatri Mantra chanting not only calms the mind but also positively influences autonomic functions, leading to improved physiological balance.The increase of competitions and stress of medical students has lead to psychological disturbance. To get rid of these disturbances, several studies on Mantra chanting and breathing practices have been done for assessment of psychological parameters and autonomic functions in isolation. Despite the growing evidence base, there is a paucity of randomized controlled trials comparing structured alternate nostril breathing with structured Gayatri Mantra chanting on both autonomic and psychological outcomes.

The present study was designed with following objectives to study the effect of Pranayama and effect of Gayatri Mantra chanting on;

1) Psychological parameters (HAM-D, HAM -A)
2) Autonomic functions.

MATERIALS AND METHODS

Study design and setting

This was prospective, randomized controlled trial conducted in a GSVM Medical College, Kanpur. The study protocol was reviewed and approved by the Institutional Ethics Committee and Central Trials Registry of India (approval no.: CTRI/2025/04/084277) dated 07/04/2025). Written informed consent was obtained from all participants.

Study population and sample size

A total of 108 first year undergraduate students were enrolled.. Students coming to the Department of Physiology, GSVM Medical College, Kanpur and fullfilled the criteria of exclusion and inclusion.

Selection of subjects:

Inclusion criteria -

1) Students in age group of 18 -25 years of either gender.
2) Subjects not doing any regular Yogic or Mantra practice.

Exclusion Criteria–

1) History of any psychiatric illness, spinal injury, respiratory disorder and any drug aur hormonal therapy.
2) Inability to comply the intervention.
3) Inability to comply with study or follow up.

Methodology :

A pretested and predesigned questionnaire was used to collect data from the participants in working proforma including their age, gender, address, contact number, personal history, family history, general examination, anthropometric examination and autonomic function tests. HAM-D scale for rating of depression and HAM-A scale for rating of anxiety.

Autonomic function test:

A) Cold Pressor test - Cold pressure test is defined as a non-invasive test that evaluates endothelial function by immersing a hand in ice cold water, which activates the sympathe-adreno-medullary

system and typically results in increased coronary blood flow in healthy individuals. In person with endothelial dysfunction, this increase is absent or reduced, indicating alteration in the vasodilatory mechanism. The cold pressor test is used clinically to evaluate autonomic function and left ventricular function and considered as the best sympathetic reactivity test.[8]

B) Handgrip test:

A hand grip test is a quick, noninvasive method to assess overall muscle strength, particularly in the forearms and hands. It is an isometric exercise in which the subject is asked to maintain hand grip against resistance. Its significantly increases heart rate and blood pressure. Isometric hand grip test is one of the best sympathetic reactivity tests.[9]

C) *Hamilton Rating Scale for Depression (HAM-D)* - The Hamilton rating scale for depression has been considered the gold standard questionnaire for assessing severity of depression and widely used in research. Its mainly consist of 17 -items questionnaire with experienced over the past week.[10]

D) Hamilton Anxiety Rating Scale (HAM-A)- *The HAM-A is a widely used ,clinician* - administered tool for assessing anxiety severity, with inter-rater reliability of 0.92 and good convergent validity as it strongly correlates with other established measures of anxiety such as State-Trate Anxiety Inventory (STAI). It shows good internal consistency (Cronbach's alpha=0.92-0.95).[11]

Group 1 – Alternate nostril breathing (Anulom–Vilom Pranayama)

Participants were trained in a standardized alternate-nostril breathing technique under a certified yoga instructor. Participants recorded daily practice in a log-sheet; adherence was considered acceptable if ≥80% sessions were completed.

Group 2 – Gayatri Mantra chanting

Participants received a 10-minute audio-based orientation on correct pronunciation and rhythm. The intervention consisted of: Chanting of the Gayatri Mantra (Rigveda X.164.48) with transliteration and meaning 12 repetitions per minute, synchronized with slow, deep breathing 20 minutes per day, 5 days per week, for 12 weeks Participants were instructed to chant in a quiet, seated environment and avoid distractions.

Group 3 – Control group

Students continued their usual academic and lifestyle activities without any structured breathing or chanting practice. They were advised not to start yoga or formal meditation during the study period.

Statistical analysis

Data were analyzed using SPSS (version 26.0). Continuous variables are presented as mean ± standard deviation. Within-group changes (pre- vs. post-intervention) were analyzed using **paired t-test.** Between-group comparisons on outcome variables were performed using **one-way ANOVA** followed by **post-hoc Tukey's test** when appropriate. A *p-value* < 0.05 was considered statistically significant.

RESULTS

Baseline characteristics

A total of 108 participants were randomized (36 per group). In the Alternate Nostril Breathing (ANB) group, a total of 36 participants were included, comprising 12 females and 24 males. The Control group consisted of 36 participants, including 19 females and 17 males. Similarly, the Gayatri Mantra (GM) chanting group included 36 participants, of whom 19 were females and 17 were males.

Table - 1 : Group-wise gender distribution

	Group	Gender	Age (Years)
N	ANB	Female	12
		Male	24
	Control	Female	19
		Male	17
	GM	Female	19
		Male	17

The study population consisted of **108 participants**, equally distributed among the **ANB, Control, and GM groups** with 36 in each group. The baseline anthropometric characteristics of the participants were comparable across the ANB, Control, and GM groups. The mean age of participants was similar among the groups, being 19.7 ± 1.73 years in the ANB group, 19.9 ± 1.58 years in the Control group, and 19.0 ± 1.36 years in the GM group.Similarly, no significant differences were observed in height, weight, and body mass index (BMI) among the groups. The mean height ranged from 168 to 170 cm, while the mean weight varied between 61.7 and 63.6 kg. The BMI values were also comparable, ranging from 21.1 to 22.3 kg/m² across all groups.

Table 2 : Comparison of anthropometric measurements between ANB, GM and control group

	Group	Age	Height (cm)	Weight (kg)	BMI
Mean±SD	ANB	19.7 ±1.73	169± 8.23	62.8 ±11.8	22.1 ±3.48
	CONTROL	19.9 ±1.58	170± 8.16	61.7 ±13.2	21.1 ±4.05
	GM	19.0 ±1.36	168± 9.79	63.6 ±15.0	22.3 ±4.10

The results show that both the ANB and GM groups experienced a reduction in HAM-D and HAM-A scores after the intervention, indicating an improvement in depression and anxiety levels. The reduction was more pronounced in the GM group, suggesting greater effectiveness. In contrast, the control group showed a slight increase in both HAM-D and HAM-A scores after the intervention, indicating no improvement or a worsening of symptoms. Overall, the findings suggest that both interventions were beneficial, with Gayatri Mantra chanting demonstrating superior outcomes compared to ANB, while symptoms persisted in the Control group.

Table - 3 : Comparison of HAM-D and HAM-A scores between ANB, GM & Control group at baseline and after intervention

	Group	HAM-D (Base-line)	HAM-D After intervention	HAM-A (Base-line)	HAM-A After intervention
Mean±SD	ANB	14.6 ±3.78	4.89± 2.34	18.0 ±4.55	11.2± 3.11
	CONTROL	16.2 ±3.48	18.5± 3.68	19.3 ±5.08	21.0± 5.14
	GM	15.1 ±2.79	1.78± 1.10	16.9 ±2.16	7.75± 1.66

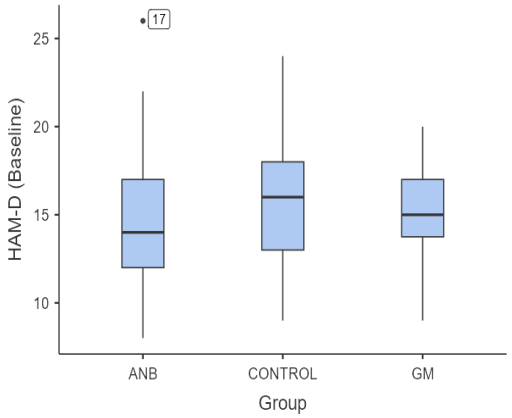

Figure 1 : BOX & WHISKERS PLOT OF BASELINE HAM-D SCORE
HAM-D (Baseline)

The Control group demonstrated a slightly higher median HAM-D score compared to ANB and GM groups, whereas the ANB group showed relatively lower median values. The interquartile ranges overlapped considerably across all groups, indicating homogeneity of baseline depression severity.Although a mild outlier was observed in the ANB group, the overall distribution suggests that participants in all three groups had comparable baseline depressive symptom severity prior to intervention.

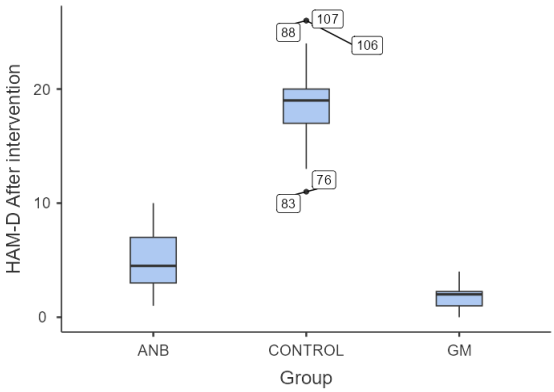

Figure 2 : BOX & WHISKERS PLOT OF HAM-D SCORE AFTER INTERVENTION

The box plot depicts that after 12-weeks of intervention period, a marked reduction in Hamilton Depression Rating Scale (HAM-D) scores was observed in both the Alternate Nostril Breathing (ANB) and Gayatri Mantra (GM) groups compared to the Control group. The GM group demonstrated the lowest median HAM-D scores after intervention, followed by the ANB group, whereas the Control group maintained comparatively higher median values with few outliers.The minimal overlap between the intervention groups (ANB and GM) and the Control group indicates a clinically meaningful

reduction in depressive symptom severity following the interventions. These findings suggest that both alternate nostril breathing and chanting of the Gayatri Mantra were effective in reducing depression scores, with comparatively greater improvement observed in the GM group at the end of the study period.

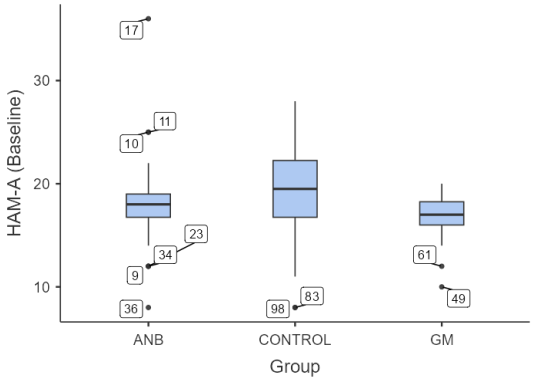

Figure 3 : BOX & WHISKERS PLOT OF BASELINE HAM-A SCORE

HAM-A (Baseline)

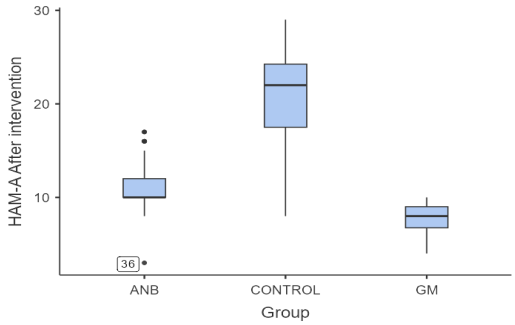

Figure 4 : BOX & WHISKERS PLOT OF HAM-A SCORE AFTER INTERVENTION

HAM-A After intervention

Table 4: Comparison of CPT & HGT difference of mean arterial pressure (at Pre and Post exposure) at before and after intervention

	Group	CPT_PRE_DIFF	CPT_POST_DIFF	HGT_PRE_DIFF	HGT_POST_DIFF
Mean ±SD	ANB	15.4± 9.50	11.2± 2.60	19.8± 8.95	15.6± 3.61
	CONTROL	16.2± 4.59	10.3± 5.43	20.0± 7.87	21.3± 2.59
	GM	15.3± 6.70	11.0± 2.62	18.1± 6.44	15.7± 2.28

CPT pre-difference is the difference of mean arterial pressure (MAP) measured at baseline (0 min) and at 2 minutes before intervention.CPT post difference is the difference of mean arterial pressure measured at baseline (0min) and at 2 minutes after intervention. MAP rises by 10-20 mm hg within 2 minutes of cold exposure. HGT pre difference is the difference of mean arterial pressure measured at baseline (0 min) and at 2 minutes before intervention. HGT post difference is the difference of mean arterial pressure measured at baseline (0 min) and at 2 minutes after intervention.MAP rises by 13-20 mm hg within 2minutes of sustained contraction during hand grip test**.**

The results indicate that both the ANB and GM groups experienced a decrease in CPT and HGT difference of mean arterial pressure values following the intervention, reflecting an improvement in cardiovascular response and autonomic regulation. On the other hand, the control group did not show similar improvement, with HGT values increasing after the intervention. Overall, the findings suggest that both ANB and GM had a beneficial effect on autonomic and cardiovascular responses, while no positive change was seen in the control group.

DISCUSSION

The present randomized controlled study was undertaken to evaluate the effect of alternate nostril breathing and chanting of Gayatri Mantra on autonomic functions, anxiety and depression. Our study consisted of 108 randomly selected undergraduate medical students with the mean age in ANB group (n=36) was **19.7 ± 1.73 years**,**19.9 ± 1.58 years** in the Control group, and **19.0 ± 1.36 years** in the GM group

The result of our study showed that mean arterial pressure response to the cold pressure test and hand grip test was significantly reduced following 12 weeks of alternate nostril breathing. This suggest a reduction in sympathetic reactivity in ANB group and shifted towards parasympathetic dominance. The findings of our study are supported by **Pai V et al (2024),** they found that mean arterial pressure was decreased in the ANB group as compared to control group after alternate nostril breathing.[11] Another study done by **Telles S et al (2017)** supports our study, as they observed significant decrease ($p<0.05$) in mean arterial pressure following alternate nostril breathing.[53]

The result of our study revealed a significant reduction in depression and anxiety level after 12 weeks of ANB. Specifically, following intervention, a marked reduction in mean HAM-D scores to **4.89 ± 2.34**. Similarly, after intervention, mean HAM-A scores decreased in the ANB group to **11.2 ± 3.11**. Depression and anxiety have been associated with autonomic imbalance characterized by reduced parasympathetic tone and elevated sympathetic activity which can be improved by ANB. A statistically highly significant difference was observed in post-intervention depression scores measured by the Hamilton Depression Rating Scale (HAM-D) ($p<0.001$), indicating a significant effect of the interventions on depressive symptoms across the groups. Similarly, post-intervention anxiety scores assessed using the Hamilton Anxiety Rating Scale (HAM-A) showed a statistically highly significant difference among the groups ($p<0.001$).The findings of our study are supported by previous research conducted by **Sharma V K et al (2024)**, which demonstrated the significant reduction in depression and anxiety score as compared to control group, indicating a positive impact of ANB on psychological factors (depression, anxiety).[13] The findings of our study are also supported by **Gaur S et al (2020)** found that after yogic practices there was increase in delta, alpha and gamma amplitude, which is helpful for body relaxation.[14] These indirectly helps in reducing stress, anxiety and depression. Another study done by **Telles S et al (2019)** highlighted that the level of anxiety decreased immediately after yoga breathing.[15]

The result of our study showed significant balance in autonomic functions and very significant reduction in depression and anxiety after 12 weeks of chanting of Gayatri Mantra. Specifically, following chanting of Gayatri Mantra, the mean CPT post-intervention difference of mean arterial pressure decreased in the GM group was (11.0±2.62). Post-intervention, the mean HGT difference scores of mean arterial pressure were reduced in the GM group (15.7 ± 2.28). Following chanting of Gayatri Mantra, the GM groups demonstrated a marked reduction in mean HAM-D scores to **1.78 ± 1.10**. After intervention, mean HAM-A score decreased in the GM group to **7.75 ± 1.66**.

The findings of our study are supported by **Kesar et al (2023)**,they reviewed that with regular mindful chanting of Gayatri Mantra had significant effect on depression and anxiety. It significantly affects the autonomic nervous system and improve mental health.[16] Another study done by **Dua R et al (2023)** support our study that comprising pranayama and Gayatri Mantra chanting significantly reduced depression and anxiety.[17] Additional support of our study comes from the study done by **Dudeja J P (2017)**, who explored that chanting of Gayatri Mantra controlled blood pressure ; reduced stress ,anxiety and depression.[18] However, several limitations should be acknowledged. First, the sample comprised only medical students, limiting generalizability to other age groups or clinical populations. Second, blinding of participants was not feasible, and the study lacked physiological biomarkers such as heart-rate variability time-domain or frequency-domain indices. Third, follow-up beyond 12 weeks was not conducted, so long-term sustainability of effects remains unknown. Finally, intensity and adherence were self-reported, which may introduce measurement bias.

CONCLUSION

In conclusion, the present study demonstrates that regular practice of alternate nostril breathing combined with chanting of Gayatri Mantra significantly improves autonomic functions and reduces symptoms of depression and anxiety. The intervention enhances parasympathetic activity, restores sympathovagal balance, and promotes emotional regulation. The beneficial effects observed in both physiological and psychological domains highlight the integrative nature of mind–body practices.

These findings support the incorporation of structured yogic breathing and mantra chanting as complementary therapeutic approaches for improving mental health and autonomic stability. Further large-scale, randomized controlled trials with long-term follow-up are recommended to validate these findings and explore the underlying neurophysiological mechanisms in greater depth.

Conflict of Interest-None
Financial Support- No

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