

**IMMEDIATE EFFECTS OF A SINGLE SESSION OF PRANAYAMA ON
ALPHA BRAIN WAVE ACTIVITY: A ONE-SHOT EXPERIMENTAL
STUDY ON COLLEGIATE ATHLETES****Yeeshu Prajapati*¹, Dr. Sameer Kumar Yadav², Dr. Asem Jayanti Devi³**

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ABSTRACT:

Pranayama, a yogic breathing technique, has been increasingly studied for its effects on autonomic regulation, emotional state, and brain activity, particularly within the alpha frequency band associated with relaxation and alertness. The present study aimed to examine the immediate effects of a single session of Anulom Vilom pranayama on alpha brain wave activity among collegiate athletes. A pre–post single group quasi-experimental design was employed. Twenty male college students (mean age = 19.8 ± 1.5 years) from LNIPE, Gwalior, were selected using convenience sampling. Participants performed a standardized 10–15 minute session of Anulom Vilom pranayama under controlled conditions. Alpha brain wave activity was measured using a biofeedback device (Thought Technology) before and immediately after the intervention. Data normality was confirmed using the Shapiro–Wilk test ($p > 0.05$). A paired samples t-test revealed a statistically significant increase in alpha brain wave activity following the intervention ($t(19) = -4.376, p < 0.001$). The mean alpha values increased from 27.65 ± 4.88 to 32.65 ± 6.75 , with a mean difference of 5.00 (95% CI: -7.39 to -2.61). The effect size was large (Cohen’s $d \approx 1.02$), indicating a substantial impact of the intervention. These findings suggest that a single session of Anulom Vilom pranayama can produce immediate neurophysiological changes, enhancing cortical relaxation and reducing mental stress. The study highlights pranayama as a simple, non-invasive, and effective technique for promoting mental calmness and autonomic balance. Future research

with larger samples, control groups, and longitudinal designs is recommended to further validate these findings.

KEYWORDS: *Pranayama, Alpha brain waves, Anulom Vilom, EEG, Relaxation, Autonomic nervous system, College athletes.*

INTRODUCTION:

Pranayama, the voluntary regulation of breathing in yogic practice, has received increasing scientific attention because of its potential influence on autonomic regulation, emotional state, and cortical activity. As a mind-body technique, pranayama is commonly associated with relaxation, attentional control, and reduced stress, and contemporary neurophysiological literature suggests that these effects may be reflected in changes in electroencephalographic (EEG) activity, especially in the alpha frequency band (Campanelli et al., 2020; Vialatte et al., 2009). Alpha waves are generally linked with relaxed wakefulness, mental calmness, and internally focused awareness, making them an important indicator in studies examining the immediate effects of breathing-based interventions on the brain (Sahni et al., 2022; Campanelli et al., 2020).

EEG-based studies have reported that yogic practices, including pranayama, meditation, and related relaxation techniques, may increase alpha activity and alter other brainwave patterns. A systematic review and meta-analysis found a recurring pattern of increased alpha-range activity across multiple yoga-related interventions, suggesting that such practices may promote a calmer and more integrated neural state (Sutapa et al., 2020). Similarly, evidence from acute intervention studies has shown that even a single session of breathing or relaxation practice can produce measurable changes in EEG activity, including shifts in alpha rhythm, although the direction and magnitude of these effects may depend on the specific pranayama technique used (Kumar et al., 2009; Sahni et al., 2022).

These findings are particularly relevant for collegiate athletes, who routinely experience psychological pressure, training fatigue, and cognitive demands related to performance, concentration, and recovery. For this population, interventions that are brief, non-invasive, and easy to administer may be especially valuable in enhancing mental readiness and self-regulation. Because alpha activity is often interpreted as a marker of relaxed alertness and efficient attentional control, examining whether a single pranayama session can immediately influence alpha brain wave activity in collegiate athletes may help clarify its usefulness as a practical performance-support strategy (Trakroo et al., 2013; Campanelli et al., 2020).

Despite growing interest in pranayama, much of the existing research has focused on longer training programs, mixed yoga interventions, or non-athletic populations rather than immediate effects in athletes. Acute studies remain limited, and the specific neurophysiological response to a single pranayama session has not been sufficiently explored in collegiate athletes. Therefore, the present one-shot experimental study aims to investigate the immediate effects of a single pranayama session on alpha brain wave activity among collegiate athletes, contributing to the evidence base on short-duration yogic interventions and their potential role in sports psychology and performance preparation (Sahni et al., 2022; Sutapa et al., 2020).

METHODS:

Participants: Twenty male college students were selected from LNIPE Gwalior during physical fitness. Overall sample characteristics were: age (M=19.8, SD=1.5 years). Following institutional ethical approval and informed consent, participants were identified during routine fitness assessments at LNIPE Gwalior. Participants were chosen through convenience sampling, including those who had not done advance pranayama techniques before.

Inclusion criteria included regular participation in their respective sport/practice (minimum 3 sessions/week). No participants reported neurological disorders and prior advanced pranayama training.

Study design: Pre–Post Single Group Design (Quasi-experimental) was used for the study.

Intervention: The intervention consisted of a single, standardized session of pranayama, specifically Anulom Vilom. Each participant performed the breathing exercise for a duration of 10–15 minutes under controlled conditions. The session was conducted in a quiet and distraction-free environment to minimize external influences on physiological responses. All participants were instructed to maintain a standardized seated posture, ensuring consistency in body positioning throughout the intervention. Clear instructions and supervision were provided to ensure uniformity in the technique across all participants.

Measures: Alpha Brain Waves were assessed with the help of Biofeedback Machine by Thought Technology.

Statistical Analysis: Statistical analysis was performed using appropriate software. Descriptive statistics were calculated as mean and standard deviation. The normality of data was assessed using the Shapiro–Wilk test. To evaluate the effect of the intervention, a paired t-test was applied to compare pre- and post-intervention alpha brain wave values. The level of significance was set at $p < 0.05$.

RESULTS:

Table 1.1: Tests of Normality.

	Shapiro-Wilk		
	Statistic	df	Sig.
Pre Alpha Waves	.953	20	.416
Post Alpha Waves	.923	20	.111

Table 1.1 shows the normality of the data was assessed using the Shapiro–Wilk test. The results indicated that both pre-intervention ($p = 0.416$) and post-intervention ($p = 0.111$) alpha brain wave values were normally distributed.

Table 1.2: Paired Samples Statistics.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre Alpha Waves	27.6500	20	4.88	1.09
	Post Alpha Waves	32.6500	20	6.75	1.51

The descriptive statistics in table 1.2 revealed that the mean alpha brain wave value increased from 27.65 ± 4.88 before the intervention to 32.65 ± 6.75 after the pranayama session. This is displayed in Figure 1.

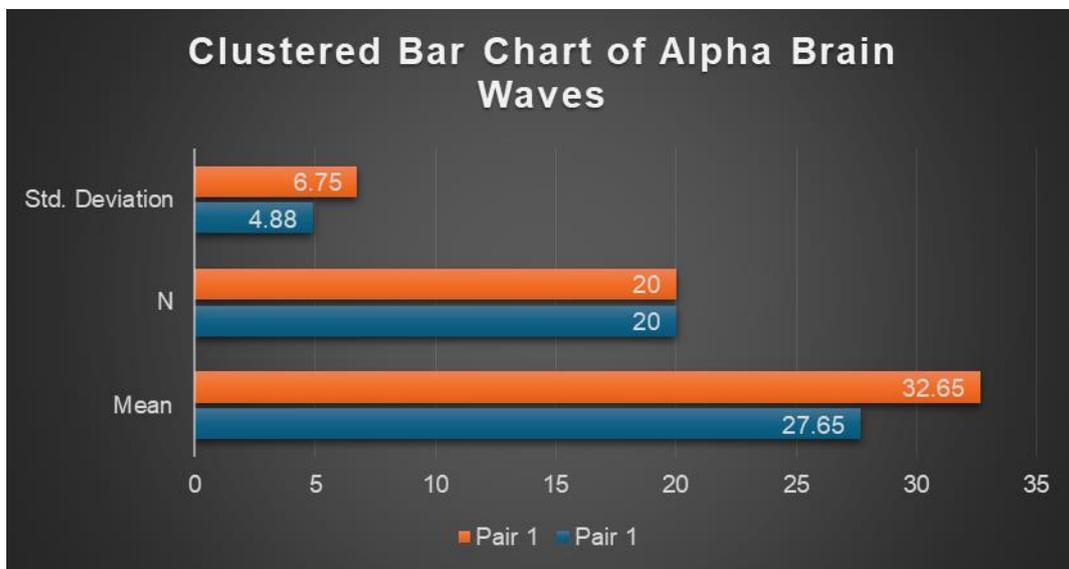


Figure 1: Clustered horizontal bar chart showing comparison of mean, sample size, and standard deviation between pre- and post-intervention alpha brain wave values.

Table 1.3: Paired Samples Test.

			Paired Differences				t	Sig. (2-tailed)	
			Mean	SD	Std. Error	95% Confidence Interval of the Difference			
						Lower			Upper
Pair 1	Pre Alpha Waves - post Alpha Waves	-5.00	5.19	1.14	-7.39	-2.68	-4.37	.003	

Table 1.3 revealed a paired samples t-test showing a statistically significant increase in alpha brain wave activity following the pranayama session $t(19) = -4.376$, $p < 0.001$. The mean difference between pre- and post-intervention values was -5.00 (95% CI: -7.39 to -2.61).

The effect size was calculated using Cohen’s d, $d = (\text{Mean difference}) / (\text{Standard deviation of pre-test})$,

$$d = \frac{5.00}{4.88} \approx 1.02$$

where the mean difference between post- and pre-intervention values (5.00) was divided by the standard deviation of the pre-test scores (4.88), yielding a value of approximately 1.02. This indicates a **large effect size**, suggesting that the pranayama intervention had a substantial impact on alpha brain wave activity.

DISCUSSION OF FINDINGS:

The findings revealed a statistically significant increase in alpha brain wave activity following the intervention, indicating enhanced cortical relaxation and reduced mental stress. Since alpha waves (8–12 Hz) are widely recognized as indicators of a relaxed yet alert mental state, the observed increase suggests a shift toward reduced cortical arousal and improved neurophysiological calmness (Attar et al., 2022; Kim et al., 2023). These results support the hypothesis that even a short duration of controlled breathing can produce measurable changes in brain activity (Sahni et al., 2022).

The increase in alpha brain wave activity observed in this study can be explained through the modulation of the autonomic nervous system. Pranayama, particularly Anulom Vilom, involves slow and controlled breathing patterns that enhance parasympathetic activation and vagal tone, thereby promoting a state of physiological relaxation (Sinha et al., 2013; Nivethitha et al., 2016). This autonomic shift is closely associated with increased alpha wave production, reflecting reduced neural excitability and improved mental stability.

These findings are consistent with previous research on Swara Yoga-based nostril breathing techniques, which demonstrated significant effects on physiological arousal indicators such as heart rate, respiratory rate, and skin conductance (Chetry et al., 2025). Specifically, alternate nostril breathing was associated with reduced physiological arousal, indicating a calming effect on the autonomic nervous system (Chetry et al., 2025). This supports the present findings, where increased alpha activity reflects a similar reduction in cortical arousal and enhancement of relaxation.

Further support is drawn from studies examining the broader impact of pranayama on psychological functioning. Previous research has reported significant improvements in relaxation ability, emotional regulation, and concentration following regular pranayama practice over time (Nivethitha et al., 2016; Campanelli et al., 2020). Although the present study focused on immediate effects rather than long-term training, the observed increase in alpha waves may represent the initial neurophysiological mechanism underlying these sustained psychological benefits.

A key strength of the present study is the demonstration of a significant acute effect following a single 10–15-minute session of pranayama. This finding highlights the efficiency of the intervention, suggesting that even brief practice can yield meaningful neurophysiological outcomes. Additionally, the large effect size (Cohen's $d \approx 1.02$) indicates a substantial practical impact, reinforcing the effectiveness of pranayama despite the relatively small sample size.

Moreover, the study was conducted under controlled conditions, including a quiet and distraction-free environment, standardized posture, and uniform instruction, which enhances the internal validity of the findings. These methodological controls minimize external influences and strengthen confidence in the observed effects.

However, certain limitations should be acknowledged. The use of a single-group pre–post design without a control group limits causal inference. The relatively small sample size ($n = 20$) and inclusion of only male participants restrict the generalizability of the findings. Additionally, only immediate effects were assessed, and long-term outcomes remain unclear. Future studies should incorporate randomized controlled designs, larger and more diverse samples, and longitudinal approaches to validate and extend these findings.

CONCLUSION

The present study investigated the immediate effects of a single session of Anulom Vilom pranayama on alpha brain wave activity in college students. The findings demonstrated a

statistically significant increase in alpha wave activity following the intervention, indicating enhanced cortical relaxation and reduced mental stress. These results suggest that even a brief session of controlled breathing can produce measurable neurophysiological changes.

The large effect size further highlights the practical significance of the intervention, emphasizing its effectiveness as a simple and non-invasive technique for promoting mental calmness. The findings support the role of pranayama in modulating autonomic nervous system activity and enhancing parasympathetic dominance.

In conclusion, a single 10–15 minute session of Anulom Vilom pranayama can effectively enhance alpha brain wave activity and induce an immediate relaxation response. This underscores its potential application as an accessible and efficient tool for stress management and mental well-being. Future research with larger samples, control groups, and long-term follow-up is recommended to further validate and extend these findings.

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