

Effectiveness of 4-7-8 Breathing Technique on Memory and Concentration in Physiotherapy Students - A Pilot Study

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ABSTRACT

Background & Purpose: Physiotherapy students frequently experience high academic stress, which negatively affects memory and concentration. Breathing-based relaxation techniques have demonstrated beneficial effects on stress reduction and cognitive enhancement. The 4-7-8 breathing technique, designed to modulate autonomic activity and promote parasympathetic dominance, may offer additional cognitive benefits compared with general deep-breathing practices.

Methodology: A randomized controlled trial was conducted among 24 undergraduate physiotherapy students (aged 18–24 years). Participants were randomly allocated into an Experimental Group (Group A; n=12) receiving the 4-7-8 breathing protocol and a Control Group (Group B; n=12) receiving a standard deep-breathing protocol. Both interventions were administered 3–5 times per week for 8 weeks. Memory and concentration were assessed pre- and post-intervention using the Mizan Meta-Memory and Meta-Concentration Scale (MMSS). Data were analyzed using paired and independent t-tests with significance set at $p < 0.05$.

Results: Significant within-group improvements were observed in both groups. Group A showed a greater increase

in MMSS scores (mean difference: 10.8 ± 6.72 ; $p < 0.001$; Cohen's $d = 1.60$), while Group B demonstrated a mean increase of 7.17 ± 6.38 ($p = 0.003$; Cohen's $d = 1.12$).

Conclusion: Both breathing techniques improved memory and concentration; however, the 4-7-8 breathing technique demonstrated a greater magnitude of cognitive enhancement.

Keywords: 4-7-8 breathing, memory, concentration, physiotherapy students, stress management, cognitive performance.

INTRODUCTION

Memory is fundamentally defined as a mental process that encompasses the retaining, encoding, and retrieving information about the environment.¹ More specifically, it refers to the cognitive capacity to hold and access sensations, impressions, and concepts and serves as a crucial repository where students can recall past experiences, retain and store information that can be accessed as per need.²

This vital cognitive function is expressed through various forms, including explicit memory and implicit memory.² Temporally, memory is divided into short-term memory, and long-term memory, which is working memory, that holds information for brief periods, and is essential for fundamental daily tasks such as language comprehension,

spatial navigation, and problem- solving. For students, this capability is fundamentally linked to their cognitive abilities, directly affecting their classroom performance. Strong memory skills, coupled with mental resilience, enable students to remember lessons, articulate their thoughts, and inspire them to learn and explore various topics. Effective memorization strategies can help organize and link information, facilitating its transfer to long-term memory for more prolonged retention. Three widely used memorization techniques are repetition, visualization, and association.²

Short-term memory is primarily mediated by the frontal and parietal lobes, whereas long-term memory involves extensive regions of the brain.³ Nevertheless, the overall functionality of memory, as well as the consolidation of short-term memory into long-term memory, is reliant on the hippocampus.³ This pivotal structure is characterized by a high concentration of glucocorticoid receptors and exhibits the most pronounced response to stress, playing a critical role in memory processes.³ Memory impairments occur when the brain struggles to store, manage, and retrieve memories effectively, leading to several consequences for students. Those with poor memory often experience slower cognitive processes, leading to increased stress.

Concentration is defined as the mental state where all senses and mind are focused on a particular task, as stated by Kumar (2003).⁴ It is also described as an approximate frame of mind at which point the mind focuses on certain characteristics of the environment.⁵ The significance of concentration is profound in the context of both learning and teaching, especially in the classroom. It is crucial for effective education and is essential for fostering a productive learning environment by minimizing decentralization and distractions.⁵ Greater levels of attention are associated with improved memory performance. Without focus in the classroom, students will not remember the subject being taught; conversely, even good

concentration may be useless without the corresponding memory capacity.⁶

However, when this mental state is compromised, the learning process suffers. Insufficient attention and focus will hinder effective learning and, consequently, directly impede academic progress.⁵ Hence, it is essential to have targeted interventions to address concentration and memory deficits.

The 4-7-8 breathing technique was discovered by Dr. Andrew Weil. This breathing exercise emphasizes inhaling followed by a breath hold, which helps open collateral channels and activate the parasympathetic nervous system. This activation slows the heart rate and promotes relaxation, leading to a decrease in respiration rate. The longer the duration of this practice, the more air can be expelled.⁷ Students pursuing careers in healthcare frequently report experiencing high levels of stress, which can hinder their concentration and academic success. Physiotherapy students are prone to stress or psychological distress arising more from academic challenges than social factors due to academic pressures, extensive coursework, unclear expectations, long study hours, practical sessions, assignments, and limited opportunities for rest. According to Revati Malani et. al prevalence of stress in physiotherapy student was 53%.¹⁰

Physiotherapy education is highly demanding and challenging, requiring students to navigate a complex learning environment. For some individuals, health care training can be stressful experience that may negatively impact their emotional well-being and academic performance.¹⁰ Test anxiety refers to the psychological and behavioral responses associated with worries about potential failure or negative outcomes in exams or similar evaluation situations.¹⁰ Studies have shown that physiotherapy students experience significantly higher stress and anxiety levels during both simulation-based and hospital-based clinical education compared to baseline.¹¹

Deep breathing techniques, a core component of many meditation programs, have been proven to enhance cognitive function, promote improved tissue perfusion, reduce blood pressure, optimize glucose metabolism, and strengthen immune system activity, to mitigate stress and enhance overall well-being including working memory capacity.^{12, 13,14,15,16,17} Furthermore, this helps lower cortisol and adrenaline levels which in turn, reduces heart rate and respiratory rate, eases the effort of breathing by relaxing tense respiratory muscles, and ultimately helps decrease anxiety and depression.¹⁷ Rhythmic deep breathing exercises, which are a key part of various meditation programs, typically involve breathing in and out at a specific rate that differs from normal breathing patterns.¹⁸ Hence, this study aims to evaluate the effectiveness of 4-7-8 technique on memory and concentration in Physiotherapy students. The findings of the study will provide insights on improving academic and clinical performance of upcoming physiotherapists.

Aims And Objective

Aim:

To study the effect of 4-7-8 breathing technique on memory and concentration in physiotherapy students.

Objective:

To assess concentration and memory in students using the Mizan meta – memory and Meta concentration scale for students (MMSS).¹⁸ and to find out the effect of 4-7-8 breathing technique on concentration and memory.

MATERIALS & METHODS

This experimental study was conducted among physiotherapy students of both gender aged 18-25 years using a randomized controlled trial (RCT) design to evaluate the effect of the 4-7-8 breathing technique on memory and concentration among physiotherapy student.

A total 24 participants were selected through simple random sampling using chit method from undergraduate students enrolled in physiotherapy college. The study was carried out within the physiotherapy college premises over a duration of 6 months. After selection, participants were randomly allocated into two groups: Group A (experimental group, n = 12) and Group B (Nonexperimental group, n = 12). Assessment of memory and concentration was performed for all participants using the Mizan Meta-Memory and Meta-Concentration scale.

PROCEDURE

The study commenced after approval from the Institutional Ethics Committee. All the participants were screened for inclusion and exclusion criteria. If the participants fit into the inclusion criteria, they were recruited in the study. Informed consent was taken from all the participants. Participants were instructed in their native language about the study and its benefits, risks, and confidentiality. The chit method was used to assign participants to both groups, and accordingly, the groups were decided for the experimental (n=12) and non-experimental study (n=12). Before administering the intervention, the MMSS scale was given to the participants, and the score was calculated. The room environment was comfortable. It was well-ventilated to ensure a good supply of fresh air. Students were grouped together in the college premises. Participants wore comfortable clothing. The participant's position was sitting with or without pillow support on a chair or yoga mat with eyes closed. The therapist's position was sitting or standing nearby in a relaxed posture, ensuring they could guide the participant if needed but were not causing any distraction. The 4-7-8 breathing technique was practiced by Group A for 3-5 times per week for 8 weeks, with each session lasting 30 minutes, and consisted of 3 sets including 3-4 repetition of breathing control, 3-5 repetition of deep breathing exercise, 10 repetitions of the 4-7-8

breathing technique in each set. The deep breathing technique was practiced by Group B for 3-5 times per week for 8 weeks, consisting of 3 sets including 3-4 repetition of breathing control and 3-5 repetition of deep breathing exercise in each set. The intervention was given for 8 weeks to both the group participants according to the protocol designed. Again, after this duration of 8 weeks the post-test MMSS score was calculated for Group A and Group B, and the data was analysed statistically by the statistician and accordingly, the result and conclusion were drawn.

Treatment protocol for Group A

Set 1 - 3-4 reps Breathing control followed by 3-5 reps Deep breathing exercise 10 rep of 4-7-8

Set 2 - 3-4 reps Breathing control followed by 10 reps of 4-7-8

Set 3 - 3-4 reps breathing control followed by 10 reps of 4-7-8 1 breathing control

Treatment protocol for group B

Set 1- 3-4 reps Breathing control followed by 3-5 reps Deep breathing exercise

Set 2 - 3-4 reps Breathing control followed by 3-5 reps Deep breathing exercise

Set 3- 3-4 reps breathing control followed by 3-5 reps Deep breathing exercise

Statistical Analysis

The data was analysed SPSS version 26, software package. Descriptive analysis included participant characteristics i.e., age, gender distribution, and number of sessions attended in both groups by calculation of means, standard deviations (SD), standard error (SE). The Shapiro–Wilk test was used to confirm normality of the data across pre- and post-test MMSS scores. Within-group A and Group B comparisons were carried out using paired samples t-tests. Independent samples T-test was used to compare pre-test and post test score between Group A and Group B. P value of <0.05 was considered as statistically significant at a confidence interval of 95%.

RESULT

A total of 24 participants were included in the study and were equally allocated into two groups: Group A (n = 12) and Group B (n = 12). In both groups, females constituted 75% (n = 9) of the participants, while males accounted for 25% (n = 3). The mean age of participants in Group A was 22.1 ± 1.24 years, with a median age of 22.5 years. The age of participants ranged from 20 to 24 years. In Group B, the mean age was 21.4 ± 1.93 years, with a median age of 21.5 years and an age range of 18 to 24 years. Regarding treatment adherence, participants in Group A attended a mean of 38.5 ± 2.43 sessions, with attendance ranging from 35 to 42 sessions. Participants in Group B attended a mean of 39.6 ± 3.03 sessions, with attendance ranging from 35 to 44 sessions.

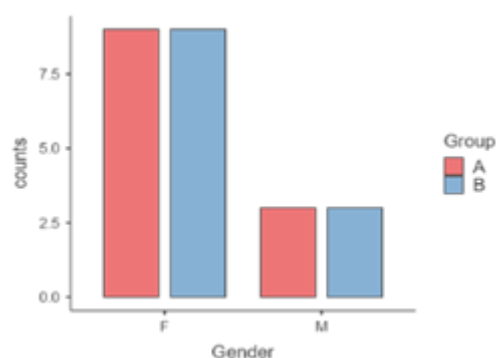
Normality was evaluated using the Shapiro–Wilk test. In Group A, the test yielded a W value of 0.909 with a p-value of 0.205, while in Group B, the W value was 0.937 with a p-value of 0.455. Since the p-values for both groups were greater than 0.05, the data were considered normally distributed.

Graph 4 presents the comparison of MMSS score changes between Group A and Group B. The mean post-pre MMSS score difference was 10.8 ± 6.72 in Group A and 7.17 ± 6.38 in Group B. The median scores were 9.5 and 8.5 for Groups A and B, respectively. These findings indicate a greater improvement in MMSS scores in Group A compared to Group B.

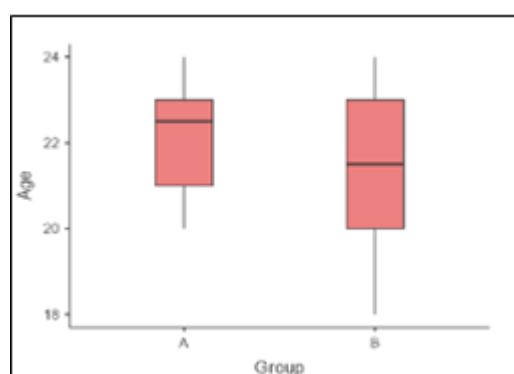
An independent samples t-test was performed to compare the MMSS score differences between the two groups. Although Group A demonstrated a higher mean improvement than Group B, the difference was not statistically significant ($p = 0.194$). The mean difference between the groups was 3.58 points, with a 95% confidence interval ranging from -1.96 to 9.13. As the confidence interval included zero, the observed difference was not considered statistically significant. The effect size analysis revealed a Cohen's d

value of 0.547, indicating a moderate effect size. These findings suggest that while Group A showed greater improvement in

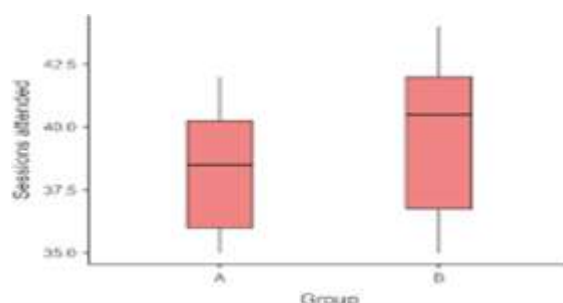
MMSS scores, the difference between the two interventions did not reach statistical significance.



Graph 1: Gender-wise distribution between Group A and Group B participants



Graph 2: Mean age of Group A and Group B participants



Graph 3: Sessions attended by Group A and Group B



Graph 4: Comparison of descriptive statistic within group A and Group B MMSS Score

The number of participants in each group A and B was 12. Group A had a mean of 10.8, while group B had a mean of 7.17. This suggests that, on average, Group A had a higher post-pre score than Group B. The median for Group A was 9.5 and for Group

B was 8.5. Group A had (SD $\pm$ 6.72) and Group B had (SD $\pm$ 6.38). Group A had standard error of 1.94 and Group B had a standard error of 1.84. A standard error indicates that the sample mean was a more precise estimate of the population mean.

Table 1:

Independent Samples T-Test										
Independent Samples T-Test										
							95% Confidence Interval			
		Statistic	df	p	Mean difference	SE difference	Lower	Upper		Effect Size
Post-Pre test MMSS Score	Student's t	1.34	22	0.194	3.58	2.67	-1.96	9.13	Cohen's d	0.547
Note. $H_0: \mu A \neq \mu B$										

DISCUSSION

The primary objective of this pilot study was to evaluate the effect of the 4-7-8 breathing technique on memory and concentration among physiotherapy students, a population that frequently encounters significant academic and clinical stressors. The study enrolled 24 participants, aged 18 to 24 years, who were randomly assigned via the chit method into an Experimental Group (Group A, 4-7-8 technique) and a Non-Experimental Group (Group B, Deep breathing technique). Memory and concentration were measured both pre- and post- intervention using the validated Mizan Meta-Memory and Meta-Concentration Scale (MMSS).¹⁸

Upon the Statistical analysis it was observed within-group comparisons using paired samples t-tests demonstrated statistically significant improvements in memory and concentration scores for both groups. Group A (4-7-8 breathing) showed a substantial improvement from pre-test (28.8 $\pm$ 5.64) to post-test (39.6 $\pm$ 4.17), resulting in a significant mean gain of 10.8 points (t (11) =-5.54, p<0.001), associated with a large effect size (Cohen's d=1.60). Similarly, Group B (Control) also achieved a statistically significant improvement from

pre-test (25.9 $\pm$ 5.21) to post-test (33.1 $\pm$ 6.87), with a mean gain of 7.17 points (t (11) =-3.89, p=0.003), reflecting an equally large effect size (Cohen's d=1.12). A subsequent between-group comparison of the change scores (post-pre) using an independent samples t-test revealed that Group A exhibited a numerically higher mean improvement (10.8 $\pm$ 6.72) compared to Group B (7.17 $\pm$ 6.38). Despite this difference, the result was not statistically significant (t (22) =1.34, p=0.194).

The finding that both groups achieved significant internal improvements highlights the general effectiveness of incorporating structured wellness techniques into a student's routine, with the gain in the control group likely attributable to non-specific benefits of controlled deep breathing. While statistical significance was not reached between the groups, the data registered a medium effect size (Cohen's d=0.55), suggesting that the 4-7-8 breathing technique was practically superior in enhancing cognitive function compared to the control technique. The failure to achieve p<0.05, despite the clear numerical superiority of Group A (a difference of 3.63 points) and the calculated medium effect size, may be strongly attributed to a Type II

error resulting from the inherent limitations of the small sample size (N=24) in this pilot study, limiting its statistical power. The greater gain in Group A is consistent with the proposed mechanism that the specific timing and breath-hold of the 4-7-8 technique induce a more potent parasympathetic nervous system activation and subsequent gamma-aminobutyric acid release compared to a non-specific deep breathing protocol.

The theoretical effectiveness of the 4-7-8 technique is strongly supported by the known neurobiological relationship between stress and cognitive function.⁸ Stressful situations typically trigger the activation of the sympathetic nervous system (SNS) and the hypothalamic-pituitary-adrenal (HPA) axis), which results in the release of stress hormones, primarily cortisol. Cortisol readily crosses the blood-brain barrier and subsequently binds to glucocorticoid receptors in the hippocampus and amygdala—structures vital for memory encoding, retrieval, and emotional regulation.⁸ This binding can disrupt the consolidation of long-term memories and is believed to cause the short-term memory lapses often observed under heightened pressure.² Conversely, the 4-7-8 breathing exercise acts as a powerful self-regulation technique specifically designed to activate the parasympathetic nervous system (PNS) through a slow, controlled pattern that includes a crucial breath hold.⁷ This parasympathetic nervous system activation, mediated via the vagus nerve, immediately promotes a state of physiological relaxation, slowing the heart rate, and reducing generalized arousal.⁷ Furthermore, this sustained slow pattern enhances collateral circulation and oxygenation, signaling the brain to increase the release of GABA (gamma-aminobutyric acid), the principal inhibitory neurotransmitter.⁷ The increased gamma-aminobutyric acid helps suppress the production of cortisol and adrenaline, effectively mitigating the anxiety and depression often associated with the shallow

breathing patterns that contribute to mild hypoxia and impaired cognitive function.⁷

The practical benefits and superior effectiveness of the 4-7-8 intervention were further supported by the qualitative feedback gathered from Group A participants. Their reviews consistently noted substantial improvements across several crucial domains: participants reported better sleep quality with reduced mid-sleep disturbances, observed enhanced concentration when performing the technique before studying, indicated improved memory and recall of learning, and noted a general decrease in perceived stress levels. These self-reported outcomes provide ecological validity for the quantitative findings, reinforcing the belief that the technique serves as an effective, holistic tool for reducing the stress and anxiety that interfere with student cognitive processes. Furthermore, the study's findings align with external literature, including the study by Gulfian Kurt Aktas et al., which validated the 4-7-8 technique's effectiveness in reducing anxiety in bariatric surgery patients⁷ and the research by Pratibha Pradip Pandekar, which suggested its role in reducing dyspnea, anxiety, and depression in patients with moderate Chronic Obstructive Pulmonary Disease.^{7,17} This consistency across diverse clinical populations strengthens the conclusion that the 4-7-8 breathing technique is a broadly effective intervention for stress and anxiety reduction, which directly and positively impacts the dependent variables of memory and concentration observed in this student population.

In conclusion, the findings from this study strongly suggest that the 4-7-8 breathing technique significantly improved memory and concentration in physiotherapy students, demonstrating a substantial numerical advantage over the control group. The results underscore the effectiveness of this accessible, cost-effective, and non-specialized wellness technique in mitigating the adverse effects of academic stress on cognitive performance. This research

provides valuable, evidence-based data that supports the implementation of the 4-7-8 breathing technique as an essential component of student wellness programs aimed at fostering effective coping strategies and promoting the holistic well-being and academic success of future healthcare professional

Summary

This pilot study evaluated the effectiveness of the 4-7-8 breathing technique on memory and concentration in undergraduate physiotherapy students who frequently experience high academic stress. The rhythmic 4-7-8 method was hypothesized to activate the parasympathetic nervous system, thus reducing stress hormones and enhancing cognitive performance. An experimental pre- and post-trial design was used with 24 participants (aged 18–24), randomly divided into an experimental group (Group A,) and a non-experimental group (Group B,). Group A practiced the 4-7-8 technique for 8 weeks. Memory and concentration were measured using the MMSS scale. Results showed both groups improved significantly post-intervention. Group A (4-7-8 breathing) demonstrated a greater, highly significant improvement (Pre-test mean: 28.8 ± 5.64 ; Post-test mean: 39.6 ± 4.17 ; $p < 0.001$, Cohen's $d = 1.6$) compared to Group B (Pre-test mean: 25.9 ± 5.21 ; Post-test mean: 33.1 ± 6.87 ; $p = 0.003$). ($p = 0.194$), a medium effect size (Cohen's $d = 0.55$) was observed, suggesting potential benefit. The findings support integrating the 4-7-8 breathing technique as a simple, cost-effective strategy to manage academic stress and enhance cognitive performance.

CONCLUSION

According to the results of the present study, it can be concluded that the 4-7-8 breathing technique of Group A and deep breathing technique of Group B yielded positive outcomes but 4-7-8 breathing technique had a more significant impact on improving memory and concentration in

physiotherapy students compared to the deep breathing technique.

Declaration by Authors

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