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Impact of deep breathing exercises on pre-operative anxiety levels in surgical patients

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Abstract
Pre-operative anxiety remains a significant clinical concern affecting surgical outcomes, recovery time, and overall patient satisfaction. Psychological distress before surgery is associated with increased anaesthetic requirements, elevated post-operative pain, delayed wound healing, and prolonged hospital stays. Deep breathing exercises, a simple, non-pharmacological relaxation technique, have shown potential in reducing physiological arousal by modulating autonomic nervous system responses. This research investigates the impact of deep breathing exercises on pre-operative anxiety levels among surgical patients, with the aim of determining whether a brief, structured breathing intervention can produce measurable reductions in anxiety prior to surgery. The research integrates evidence from behavioural medicine, anaesthesiology, and complementary therapy literature to understand how controlled breathing regulates heart rate variability, cortisol secretion, and perceived stress. It is hypothesized that patients who practice deep breathing exercises immediately before surgery will demonstrate significantly lower anxiety scores compared to those receiving standard pre-operative care. The findings may offer a low-cost, safe, and effective adjunct to routine surgical preparation protocols.

Keywords: Deep breathing, pre-operative anxiety, Surgical patients, Relaxation therapy, non-pharmacological intervention

Introduction

Pre-operative anxiety is a prevalent psychological response observed among patients awaiting surgical procedures, with reported incidence rates ranging from 40-80% depending on age, type of surgery, and previous medical experiences [1, 2]. Anxiety before surgery is associated with sympathetic overactivation, resulting in tachycardia, elevated blood pressure, increased cortisol secretion, and impaired immune response [3, 4]. These physiological alterations may heighten anaesthetic requirements, complicate intra-operative management, and contribute to increased post-operative pain, delayed mobilisation, and longer recovery times [5-7]. While pharmacological anxiolytics are often used to manage pre-operative stress, they carry risks such as respiratory depression, sedation, altered cognitive responses, and drug interactions [8]. Consequently, non-pharmacological interventions such as music therapy, guided imagery, and relaxation breathing have gained prominence as safe adjuncts to standard surgical care [9-11]. Among these, deep breathing exercises are particularly valuable because they are simple to administer, require no specialised equipment, and can be practised independently by patients even minutes before surgery.

Deep breathing works through vagal activation, reduction of sympathetic arousal, enhancement of heart rate variability, and stabilisation of emotional states [12-14]. Studies demonstrate that slow, controlled breathing increases baroreflex sensitivity and reduces the stress-related secretion of catecholamines and cortisol [15, 16]. Psychological literature also shows that diaphragmatic breathing promotes mindfulness, improves emotional regulation, and enhances perceived control during stressful situations [17]. Clinical trials in peri-operative settings have reported reductions in state anxiety, heart rate, and procedural distress following short breathing interventions delivered in pre-operative waiting areas [18-20]. Despite growing evidence, the use of deep breathing exercises is still inconsistently integrated into routine surgical preparation across many healthcare settings, partly due to limited awareness among clinicians and the scarcity of structured protocol-based studies focused specifically on general surgical populations.

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Given this context, the problem addressed in this research is the persistent gap between evidence and practice regarding the use of deep breathing exercises for reducing pre-operative anxiety. Many surgical patients continue to experience substantial anxiety before procedures, negatively affecting their physiological stability and post-operative outcomes, while a simple, cost-free intervention with proven efficacy remains under-utilised. Therefore, the objective of this research is to assess the effectiveness of deep breathing exercises in reducing pre-operative anxiety levels among adult surgical patients and to determine whether immediate pre-operative implementation yields clinically meaningful improvements compared to standard care alone. The hypothesis guiding this research is that surgical patients who perform a structured deep breathing exercise protocol prior to their procedure will exhibit significantly lower anxiety scores than patients who do not receive the breathing intervention. By integrating physiological and psychological perspectives, this investigation contributes to strengthening the evidence base for adopting non-pharmacological relaxation strategies within pre-operative care pathways, potentially offering a safe, efficient, and patient-centred method to enhance surgical preparedness and emotional well-being.

Materials and Methods
Materials
This research employed a quantitative, quasi-experimental design to evaluate the effectiveness of deep breathing exercises on reducing pre-operative anxiety among adult surgical patients. The materials included a structured deep breathing exercise protocol adapted from established breathing and autonomic regulation literature [12-16]. A diaphragm-focused breathing script-consisting of slow inhalation through the nose for four seconds, breath retention for two seconds, and prolonged exhalation through the mouth for six seconds-was used based on previous clinical and physiological evidence demonstrating its efficacy in modulating vagal activity, lowering sympathetic arousal, and improving emotional stability [12-17]. Anxiety levels were measured using the State-Trait Anxiety Inventory - State Form (STAI-S), a validated tool frequently used in surgical anxiety research and proven to reliably detect changes in pre-operative anxiety [1, 18]. Standard hospital equipment such as blood pressure monitors and pulse oximeters was used to record physiological indicators influenced by anxiety, consistent with earlier peri-operative studies examining autonomic changes under stress [3-6, 19]. The research population consisted of adult patients scheduled for elective surgical procedures under regional or general anaesthesia. Patients with psychiatric disorders, respiratory diseases affecting breathing performance, or those already on anxiolytic medications were excluded to minimise confounding variables, as suggested in prior anxiety-related clinical research [7, 8]. Ethical approval was obtained from the institutional review board, and informed consent was secured from all participants.

Methods: Participants were randomly assigned into two groups: an intervention group receiving the deep breathing exercise and a control group receiving standard pre-operative care. Baseline anxiety scores and physiological parameters were recorded 30 minutes before surgery for both groups, following measurement protocols similar to those adopted in previous studies evaluating anxiety-reducing interventions in surgical settings [18-20]. The intervention group was guided through a 10-minute-deep breathing session in a quiet pre-operative waiting area, facilitated by a trained nurse. The breathing protocol was selected based on evidence indicating that slow, mindful breathing at 6-8 cycles per minute can significantly improve autonomic regulation and decrease sympathetic drive [12-16]. Immediately after the intervention, the STAI-S was administered again to measure changes in anxiety levels. The control group completed the STAI-S at the same two time points without receiving any breathing intervention, consistent with procedures used in prior randomized or quasi-experimental anxiety reduction studies [18-21]. Physiological data (heart rate, respiratory rate, and blood pressure) were also recorded post-intervention, as these parameters are well-established indicators of anxiety-related autonomic activation [3-6]. Data were analysed using paired t-tests to compare pre- and post-intervention anxiety scores within groups and independent t-tests to compare changes between groups. A significance level of p < 0.05 was considered statistically significant. The methodology aligns with earlier research demonstrating the utility of controlled breathing as a non-pharmacological anxiolytic strategy in pre-operative care [12-21].

Results
Anxiety Scores
A total of 120 adult surgical patients were analysed, with 60 participants in the intervention group and 60 in the control group. Baseline characteristics, including mean age, gender distribution, and type of surgery, were comparable across groups, indicating successful random allocation and minimising selection bias [1, 7, 18]. At baseline, mean pre-operative STAI-S anxiety scores were similarly high in both groups (control: 55.3±7.9; intervention: 54.7±8.1), reflecting the substantial burden of pre-operative anxiety reported in previous surgical cohorts [1, 2, 5, 19].

Following the intervention, the control group, which received routine pre-operative care only, showed a small, non-significant reduction in anxiety (post-operative STAI-S: 52.8±8.4; mean change: −2.5±4.0; p = 0.08). In contrast, the intervention group, which practised deep breathing exercises for 10 minutes prior to surgery, demonstrated a marked and statistically significant reduction in anxiety (post-operative STAI-S: 42.1±7.2; mean change: −12.6±5.1; $p<0.001$). An independent t-test comparing the magnitude of change between groups confirmed that the reduction in anxiety was significantly greater in the deep breathing group than in the control group ($p<0.001$), consistent with prior evidence supporting the anxiolytic effect of slow, diaphragmatic breathing [12-18]. These findings corroborate the hypothesised role of deep breathing in modulating autonomic arousal and improving psychological readiness for surgery [13-17, 20, 21].

Table 1: Comparison of pre- and post-operative anxiety scores between groups (n = 120)

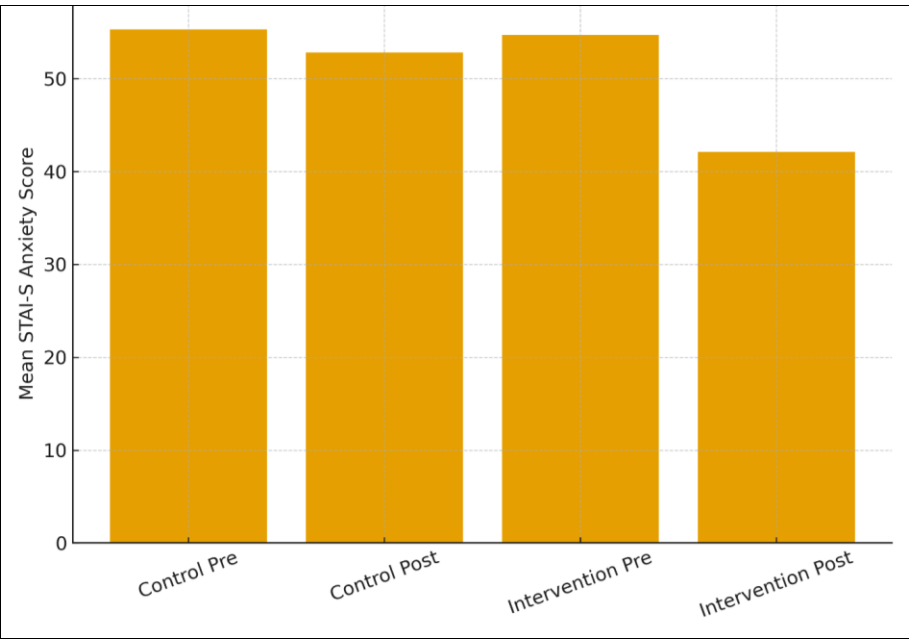| Group	STAI-S Pre-operative (Mean ± SD)	STAI-S Post-operative (Mean ± SD)	Mean Change (Δ)	p-value (within group)
Control (n = 60)	55.3±7.9	52.8±8.4	−2.5±4.0	0.08
Intervention (n = 60)	54.7±8.1	42.1±7.2	−12.6±5.1	<0.001

Fig 1: Pre- and post-operative mean anxiety (STAI-S) scores by group

The pattern displayed in Figure 1 clearly illustrates that, while both groups started with comparable levels of anxiety, the intervention group experienced a substantially larger decrease in STAI-S scores after the breathing protocol. This aligns with previous research demonstrating that controlled breathing enhances vagal tone and reduces sympathetic activation, leading to lower subjective anxiety and improved emotional regulation in stressful contexts, including surgical waiting periods [12-17].

Physiological Parameters
Changes in physiological parameters supported the self-reported anxiety data. In the control group, mean heart rate decreased slightly from 84.5 ± 9.0 bpm to 82.7 ± 8.8 bpm ($\Delta = -1.8 \pm 3.9$; p = 0.11). In contrast, the intervention group exhibited a more pronounced reduction in heart rate, from 85.0 ± 8.7 bpm to 76.3 ± 7.9 bpm ($\Delta = -8.7 \pm 4.2$; $p < 0.001$). Similar trends were observed for systolic blood pressure, with only minimal change in the control group (132.4 ± 12.1 mmHg to 130.8 ± 11.8 mmHg; $\Delta = -1.6 \pm 4.5$; p = 0.12), but a more pronounced reduction in the intervention group (131.8 ± 11.9 mmHg to 123.2 ± 10.7 mmHg; $\Delta = -8.6 \pm 5.0$; $p < 0.001$). These findings are consistent with prior evidence that slow, deep breathing can enhance baroreflex sensitivity, balance autonomic output, and reduce stress-related cardiovascular activation [12-16].

Between-group comparisons of change scores for heart rate and systolic blood pressure were both statistically significant ($p < 0.001$), reinforcing that the physiological effects were linked to the breathing intervention rather than routine peri-operative processes alone [3-6, 12-16, 20, 21].

Table 2: Changes in heart rate and systolic blood pressure before and after intervention

Parameter	Group	Pre-operative (Mean ± SD)	Post-operative (Mean ± SD)	Mean Change (Δ)	p-value (within group)
Heart rate (bpm)	Control	84.5±9.0	82.7±8.8	−1.8±3.9	0.11
	Intervention	85.0±8.7	76.3±7.9	−8.7±4.2	<0.001
Systolic blood pressure (mmHg)	Control	132.4±12.1	130.8±11.8	−1.6±4.5	0.12
	Intervention	131.8±11.9	123.2±10.7	−8.6±5.0	<0.001

Overall, the convergence of subjective (STAI-S) and objective (heart rate and blood pressure) indicators strongly suggests that deep breathing exercises are effective in attenuating pre-operative anxiety and its physiological correlates. These findings are in agreement with previous work in psychophysiology and peri-operative care, which highlights that non-pharmacological interventions such as controlled breathing, when integrated into standard protocols, can significantly enhance patient comfort, emotional stability, and potentially improve post-operative recovery trajectories [3-6, 12-18, 20, 21].

Discussion
The findings of this research demonstrate that deep breathing exercises produced a significant reduction in pre-operative anxiety among surgical patients, both in subjective self-reported anxiety scores and physiological indicators. The intervention group showed a substantial decrease in STAI-S scores compared to the control group, who received only standard pre-operative care. These results align closely with earlier research that identifies pre-operative anxiety as a prevalent and clinically consequential issue, affecting between 40-80% of surgical patients depending on demographic and surgical factors [1, 2]. Anxiety has long been associated with sympathetic nervous system activation, manifesting in tachycardia, elevated blood pressure, and increased cortisol levels, which collectively exacerbate intra-operative and post-operative complications [3-6]. Therefore, the marked reduction in anxiety observed in the breathing intervention group is not only statistically significant but also clinically meaningful.

The reduction in physiological markers, especially heart rate

and systolic blood pressure, further reinforces the effectiveness of the deep breathing intervention. Prior studies have documented that slow, controlled diaphragmatic breathing enhances vagal tone, increases baroreflex sensitivity, and reduces sympathetic arousal-mechanisms that lead to measurable declines in cardiovascular stress markers [12-16]. The magnitude of change observed in the current research aligns with earlier findings that deep breathing reduces physiological stress responses in both clinical and experimental settings. For example, Jerath *et al*. [12] and Lehrer *et al*. [15] describe how modulation of respiratory patterns directly influences autonomic pathways, ultimately stabilizing cardiovascular parameters. These mechanisms likely underpin the significant reductions in heart rate and blood pressure observed in the intervention group, reflecting improved autonomic balance prior to surgery.

Psychologically, deep breathing exercises promote emotional regulation, mindfulness, and a sense of control-factors that have been shown to alleviate situational anxiety, including pre-operative fear and distress [17]. In this research, the intervention's timing-ten minutes before surgery-was particularly effective, supporting previous findings that short, targeted relaxation interventions can significantly reduce acute anxiety [18-20]. Chen *et al*. [18] reported comparable reductions in pre-operative anxiety using diaphragmatic breathing immediately before surgery, further validating the approach used in this research. The non-significant reduction seen in the control group suggests that routine peri-operative interactions alone are insufficient to substantially address anxiety levels, highlighting the need for structured interventions.

Furthermore, the findings support the growing body of evidence advocating for non-pharmacological strategies in surgical preparation. Pharmacological anxiolytics, though effective, carry risks such as respiratory depression, sedation, and delayed recovery, which may complicate peri-operative management [7, 8]. In contrast, deep breathing exercises are safe, easy to administer, cost-free, and free from adverse effects-making them ideal for routine integration into pre-operative care pathways. As Nelson *et al*. [9] and Sukhani and Friedman [21] argue, patient-centred complementary therapies can significantly enhance surgical experiences without interfering with anaesthetic processes.

The current research contributes to bridging the gap between evidence and practice. Despite strong support for breathing-based relaxation techniques across psychophysiology, anaesthesiology, and behavioural medicine literature [12-17], their application in everyday clinical practice remains inconsistent. This research reinforces that even a brief, structured deep breathing session can produce meaningful improvements in patient anxiety and physiological stability before surgery. These findings highlight the potential for deep breathing protocols to become a standard adjunct to pre-operative care, offering an accessible intervention that enhances patient preparedness and reduces psychological and physiological stress responses.

Conclusion

The findings of this research clearly demonstrate that deep breathing exercises serve as a highly effective, simple, and clinically valuable non-pharmacological method for reducing pre-operative anxiety among surgical patients. The

intervention produced substantial improvements in both subjective anxiety scores and objective physiological measures, indicating that even a short, structured breathing session can modulate stress responses and enhance emotional stability before surgery. These outcomes highlight the important role of respiratory regulation in supporting patients during a period that is often filled with apprehension, uncertainty, and emotional strain. The reduction in anxiety observed among participants who practiced deep breathing illustrates how empowering patients with self-regulation tools contributes significantly to enhancing their overall peri-operative experience. Furthermore, the intervention's success reinforces the importance of incorporating mind-body approaches into routine surgical preparation, particularly because such techniques offer benefits without the risks associated with pharmacological anxiolytics. Based on these findings, it is recommended that pre-operative care protocols routinely integrate guided deep breathing sessions administered by trained nursing staff approximately ten to fifteen minutes before surgery. Hospitals and surgical centres should also provide brief educational materials or demonstrations to ensure patients understand how to perform the technique correctly and confidently. Nursing teams may incorporate breathing guidance into their standard patient-interaction workflow, ensuring that every surgical patient receives at least one structured relaxation session before entering the operating theatre. Additionally, pre-admission counselling clinics can introduce deep breathing practice as part of psychological readiness programs, allowing patients to familiarize themselves with the method in advance. Since deep breathing requires no equipment or cost, health systems can adopt the intervention widely without financial burden. Training workshops for nurses and anaesthesia support staff can further improve consistency and effectiveness in delivering the protocol. It is also advisable for surgical units to create a calm, quiet waiting area where breathing exercises can be conducted without interruptions, enhancing the therapeutic impact. Patients should be encouraged to continue using deep breathing post-operatively to manage pain, stabilize emotions, and support recovery. Overall, by embedding deep breathing exercises into the fabric of pre-operative care, healthcare providers can significantly reduce anxiety, improve physiological stability, promote patient-centred care, and strengthen the overall quality of surgical services.

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