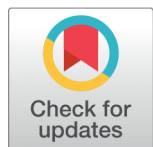


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Effectiveness of Aromatherapy in Reducing Clinical Examination Anxiety among Nursing Students in Selected Nursing College, Bengaluru

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Abstract

Background: Anxiety is a natural reaction of the body toward stress. College students frequently experience anxiety, particularly first-year nursing students who are exposed to a wide range of health care subjects and clinical postings. Preventive measures can help reduce anxiety levels among nursing students and improve their exam results. **Objectives:** This study aimed to evaluate the effectiveness of aromatherapy in reducing clinical examination anxiety among nursing students. **Method:** A true experimental two-group pre-test and post-test design with an experimental and a placebo group was adopted. Ninety-four nursing students were selected based on inclusion and exclusion criteria and were randomly assigned to either group. Baseline characteristics, pre-test anxiety levels, and biophysiological measures were collected. Aromatherapy was given to the experimental group after the pre-test. A post-test with the same tools was taken 15 minutes after the intervention. The same process was followed for the placebo group; however, instead of aromatherapy with essential oil, they were provided with three drops of normal water on a non-absorbent cloth for 15 minutes. **Findings:** The mean anxiety scores in the pre-test phase were 47.47 ± 4.02 (experimental group) and 45.43 ± 3.66 (placebo group) ($t = 2.574$, $p = 0.012$), indicating a statistically significant baseline difference. In the post-test phase, the mean anxiety score was 42.38 ± 3.55 (experimental group) and 48.13 ± 4.76 (placebo group) ($t = -6.632$, $p \leq 0.001$), indicating a significant difference after the intervention and revealing that aromatherapy had a calming effect before the examination. **Novelty:** The article presents a placebo-controlled research evidence to support the use of lemon essential oil aromatherapy as an intervention because of its low costs and effectiveness in decreasing the number of psychological and physiological signs of feelings of anxiety during clinical examination in nursing students.

Keywords: Clinical examination anxiety; Nursing Students; Aromatherapy; Lemon oil; Objective structured clinical examination

1 INTRODUCTION

Anxiety is a very common psychological reaction to perceived stress and is becoming increasingly recognized as a major concern for students in health professional programs. Nursing students, specifically, report experiencing a great deal of both academic and clinical stress as a result of their heavy course loads, clinical obligations, and constant evaluation. One such assessment where this is particularly true is the Objective Structured Clinical Examination (OSCE). The OSCE is commonly utilized by educators to assess the clinical competency, communication skills, and decision-making ability of nursing students. Although the OSCE is viewed as a reliable means of assessing the practical skills of nursing students, the high expectations placed on students to perform well during an OSCE often results in increased anxiety, which can negatively affect the students' emotional well being, academic performance, and clinical preparedness^{(1), (2)}.

Studies, completed at various educational settings, have reported moderate to high frequencies of exam related anxiety among nursing students. There is evidence to suggest that higher than average anxiety is related to lower than average academic achievement, impaired focus/concentration and greater psychological distress^{(3), (4), (5), (6), (7), (8), (9)}. For instance, correlational and experimental research have demonstrated that decreased test anxiety leads to improved academic achievement and enhanced student confidence during clinical assessments^{(3), (8)}. Furthermore, chronic anxiety experienced by nursing students has been associated with burn out, inadequate coping mechanisms and increased attrition rates, emphasizing the need for effective interventions to improve psychological well-being and academic success within academic settings⁽⁹⁾. Overall, these findings support the urgent need for preventions and supportive strategies that can be implemented into academic settings.

In recent times, non-pharmaceutical alternatives such as complementary and alternative therapies have developed as new ways of reducing stress and anxiety without using medications. Of all of these, aromatherapy has become a popular approach because it is an inexpensive and safe form of therapy. Aromatherapy is defined as the therapeutic use of aromatic plant-based essential oils to evoke physiological and emotional responses through either inhaling the oil or applying it on the skin⁽¹⁰⁾. Once the essential oil is stimulated by the senses, the aroma stimulates the olfactory (smell) system that then communicates with the limbic (emotion, memory, stress response) area of the brain. The combination of stimulation of both the limbic and olfactory systems is responsible for relaxation, improved mood stability, and decreased levels of anxiety⁽¹¹⁾.

While some scientists have doubts about the effectiveness of Aromatherapy for Anxiety in a Clinical or Academic Setting, there is growing body of research that demonstrates the effectiveness of aromatherapy in reducing anxiety in both clinical and academic settings. Specifically, randomized controlled trials and quasi-experimental studies have indicated that inhalation of aromatic essential oils (such as lavender, rose, and lemon) can decrease anxiety levels among college students and healthcare professionals^{(12), (13)}. For example, researchers have found that lemon essential oil is effective at decreasing anxiety and improving mood. This is due in part to the ability of lemon essential oil to affect neurotransmitter function, specifically by modulating GABA, which is associated with relaxation responses^{(11), (14)}. As well as providing psychological benefits, aromatherapy has also been shown to decrease physiological indicators of anxiety, such as heart rate and blood pressure. Thus, aromatherapy is a holistic intervention that may be used to address both the mental and physical responses to stress. Additionally, systematic reviews and meta-analyses have supported aromatherapy as a low-cost and safe method of intervention, when compared to other pharmacologic interventions; and this method is relatively easy to implement with minimal side effects⁽¹⁵⁾.

Although there are increasingly large amounts of international research that support the use of aromatherapy in many ways (including its health and well-being benefits), the current state of the literature also contains some very important knowledge gaps. For example, most previous studies were conducted with populations other than Indians (or other developing countries), or in hospital-based clinical study settings; which limits the generalizability of the results to nursing students in India.^{(12), (13), (16)} Also, most studies did not employ a strong experimental design using a placebo control to investigate whether aromatherapy was effective at reducing anxiety (in this case, exam anxiety) during high stress academic examinations, such as OSCE's. In addition, while many different essential oils have been investigated, there has been no empirical evidence collected on the effects of lemon essential oil as a low cost, easily available option to reduce clinical examination anxiety in nursing students. Finally, few studies have examined both psychological outcomes (such as anxiety levels), and physiological outcomes (such as heart rate and blood pressure), to develop a comprehensive understanding of the efficacy of an intervention.

Identifying the gaps will allow for developing relevant, affordable, and evidence-based approaches to support students during stressful periods related to academic (exams) and clinical (evaluations) assessments. As such, the purpose of the current study was to assess whether inhaling lemon essential oil could reduce anxiety among nursing students during clinical exams. The study used an experimental design with a placebo control group to examine both physiological and psychological symptoms of anxiety, to add relevance to the body of research on complementary therapies, as well as to provide support for the inclusion of alternative therapies into nursing education and student wellness initiatives.

2 METHODOLOGY

Ethical approval was obtained from the institutional ethical committee. (IEC No.PGN-16). Participants were provided with detailed information regarding the study and were informed of their right to withdraw at any time. Written informed consent was obtained from all participants. A true experimental two group, pre-test and post-test design with experimental and placebo group was adopted for the study. The study was conducted among 94 BSc nursing and General Nursing and Midwifery (GNM) students of a nursing college located at south Bangalore. The study included a placebo and an experimental group. The study included male and female nursing students aged between 18 – 23 years, studying first year BSc and GNM nursing, present on the day of examination, who were willing to participate and had a state trait anxiety score of more than 37. Participants were excluded, if they refused to participate, had applied perfume on the day of the exam, had history of asthma/ respiratory disorders, had an allergic reaction to the oil/ smell, if they were under psychiatric medications/ treatment and had a state trait anxiety score of less than 37. Based on the previous literature on effectiveness of aromatherapy in reducing test anxiety the sample size was calculated using 80% power, a 5 % level of significance. The final estimated sample size was 32 nursing students in each placebo and experimental group.

2.1 Intervention

Lemon oil and its content of analysis was procured from Kazima aromatics and cosmetics, Delhi. For the experimental group 3 drops of lemon oil was palced on a non absorbent cloth at 15 cm distant from the nostrils, for 15 min prior to examinaton. Similarly 3 drops of normal water was placed on a non absorbent cloth at a distance of 15 cm from the nostrils for the students in the placebo group for 15 min. Under the supervision of the researcher, the participants were observed for any adverse effect during the whole process.

2.2 Materials & outcome measures

Section 1: Baseline Performa to assess the sample characteristics - It consisted of details related to baseline characteristics; information related to studies, anxiety and information related to clinical variables.

Section 2: State trait anxiety inventory scale (STAI), to assess the level of anxiety among nursing students. The STAI scale is a validated 20 item self-report assessment device which includes separate measures of state and trait anxiety. The score ranges from 20-80 with higher scores correlating to sever anxiety. Each scale asks 20 questions and are rated on a 4-point rating scale from 1 (not at all) to 4 (very much so).

Section 3: Biophysiological parameters, systolic blood pressure, respiratory rate and pulse rate are assessed through calibrated sphygmanometer, observation and palpation. The normal respiratory rate for adults is typically 12 to 20 breaths per minute. An abnormal respiratory rate can be either too fast or too slow, tachypnea (> 20 breaths per minutes), bradypnea (<12 breaths per minute). Pulse rate assessed through palpation. The normal pulse rate for adults generally falls between 60 to 100 beats per minute at rest. An abnormal pulse rate can be, Tachycardia (> 100 beats per minute), Bradycardia (< 60 beats per minute). The normal systolic blood pressure is around 90–120 mmHg in adults.

A higher-than-normal systolic bp (≥ 140 mmHg) indicates systolic hypertension, while too low (< 90 mmHg) may indicate hypotension.

2.3 Data Collection

Data was collected by using baseline Performa, STAI scale, calibrated sphygmomanometer, observation and palpation. The participants were randomly allocated to the experimental and placebo group by using random number generator and random number chits. The baseline anxiety level, demographic variable was assessed by the researcher. Specific intervention which included inhalation of 3 drops of lemon oil on a non-absorbent cloth placed at 15 cm distant from the nostrils, for 15 min prior to OSCE exam was administered to the participants in the experimental group. Similarly, 3 drops of normal water were placed on non-absorbent cloth at a distance of 15 cm from the nostrils for 15 min in the placebo group. Post test measure of clinical examination anxiety and biophysiological variables was measured after 15 min of intervention for both the groups.

3 RESULTS AND DISCUSSION

3.1 Baseline Characteristics of Participants

The total population of nursing students involved in the study was 94 with 47 students randomly placed in the experimental group and the other 47 students placed in the placebo group. Table 1 and Table 2 report the baseline demographic and academic attributes of the participants.

Table 1. Frequency and percentage distribution of nursing students in experimental and placebo groups for gender, age, religion, social status, family type, and choice of course. $n_1 = 47$, $n_2 = 47$

Variables	Placebo Group		Exp Group		p-value
	frequency	%	frequency	%	
Gender					
Male	10	21%	16	34%	0.167
Female	37	79%	31	66%	
Age					
17-20	37	78.72%	40	85.11%	0.717
21-23	6	12.76%	5	10.64%	
24-26	3	6.38%	1	2.13%	
> 26	1	2.13%	1	2.13%	
Religion					
Buddhism	12	25.5%	9	19.1%	0.091
Christianity	5	10.6%	15	31.9%	
Hinduism	27	57.4%	20	42.6%	
Muslim	3	6.4%	3	6.4%	
Socioeconomic status					
Lower middle class	24	51.1%	20	42.6%	0.441
Upper lower class	1	2.1%	-	-	
Upper middle class	22	46.8%	26	55.3%	
Upper class	-	-	1	2.1%	
Type of family					
Nuclear	28	59.6%	31	66%	0.315
Joint	10	21.3%	13	27.7%	
Broken	6	12.8%	2	4.3%	
Extended	3	6.4%	1	2.1%	
Choice of nursing profession					
Own	42	89.4%	37	78.7%	0.159
Parents	5	10.6%	10	21.3%	

The majority of the participants in both groups were females with a percentage of 66% females in the Experimental Group and 79% females in the Placebo Group. The majority of participants were in the 18-20 year old range which indicated that the participants included mostly early-year nursing students. The largest number of participants in both groups practiced Hinduism (57.4% in the Placebo Group and 42.6% in the Experimental Group) while, the majority of participants in both groups belonged to the upper-middle class or lower-middle class. Additionally, the majority of participants came from nuclear families and chose nursing as a career choice based on personal desire and therefore, had an intrinsic motivation for choosing their course of study.

Statistical analysis indicated no significant differences in the age ($p = 0.717$), gender ($p = 0.167$), religion ($p = 0.091$), social economic status ($p = 0.441$), family structure ($p = 0.315$) and professional career choices ($p = 0.159$) between the two groups. The establishment of baseline equivalence enhances the internal validity of the study and confirms that the primary cause for the differences found in the post test scores are due to the treatment.

Further baseline data is also available in Table 2 that outlines marital status, personal habits, parental expectations, study time, health issues, pastimes, and academic challenges. Most students indicated they were single (placebo=97.9%,

Table 2. Frequency and percentage distribution of nursing students in experimental and placebo groups for marital status, personal habit, parents' expectation, time spent for studies, illness history, hobbies, language, and subjects. $n_1 = 47$, $n_2 = 47$

Variables	Placebo Group		Exp Group		p-value
	frequency	%	frequency	%	
Marital Status					
Married	1	2.1%	2	4.3%	> 0.557
Unmarried	46	97.9%	45	95.7%	
Personal Habit					
Alcoholism	-	-	1	2.1%	> 0.315
None	47	100%	46	97.9%	
Parents' Expectation of Result					
Distinction	21	44.7%	20	42.6%	0.497
First Class	24	51.1%	22	46.8%	
Second Class	2	4.3%	5	10.6%	
Time spent for regular studies					
0 hr-1 hr	12	25.53%	14	29.78%	0.882
2 hrs-4 hrs	40	59.57%	41	55.32%	
5-7 hrs	3	6.38%	4	8.51%	
>7 hrs	4	8.51%	2	4.25%	
History of illness/hospitalization					
No	44	93.6%	37	78.7%	0.036*
Yes	3	6.4%	10	21.3%	
Hobbies					
Cooking	6	14.89%	1	6.38%	0.429
Music/Dance	17	29.78%	13	25.53%	
Nature/Travel	1	4.25%	4	8.51%	
Arts	6	10.63%	9	10.63%	
Reading/Writing	5	12.76%	7	17.02%	
Sports/Games/Yoga	12	21.27%	13	34.04%	
Any issue with language and fluency					
Yes	17	36.2%	14	29.8%	0.510
No	30	63.8%	33	70.2%	
Any difficulty with the subjects					
Yes	20	42.6%	25	53.2%	0.302
No	27	57.4%	22	46.8%	
If yes mention subjects name					
Anatomy /Physiology	10	50%	10	40%	0.112*
Microbiology	1	5%	11	44%	
FON	3	15%	2	8%	
Psychology/ Sociology	6	30%	11	44%	

*Significant

experimental=95.7%). Most students reported having few or no habits like drinking alcohol, and most students reported their parents expect them to achieve excellent grades and thus have moderate to high levels of academic stress.

Both groups had the same amount of study time with approximately 75% reporting 2-4 hours per day. There was a significant difference between the two groups for the students who reported an illness history ($p = 0.036^*$) and the students' perception of the subjects difficulty ($p = 0.302$). These differences however, did not significantly impact the findings of the study's anxiety intervention.

These baseline findings are consistent with earlier studies reporting that nursing students commonly experience academic stress associated with parental expectations and demanding coursework^{(6), (7)}. Establishing comparable demographic characteristics between groups ensures that the study findings are reliable and attributable to the aromatherapy intervention.

3.2 Distribution of Educational and Living Characteristics

The distribution of participants by academic program is presented in Figure 1. The largest numbers of participants in both study groups were enrolled in GNM programs; 36 percent of all participants were pursuing a BSc Nursing degree. A statistical comparison of the two groups demonstrated that there was no statistically significant difference between the groups ($p > 0.09$), which suggested that students' educational background had no effect on their pre-study anxiety levels.

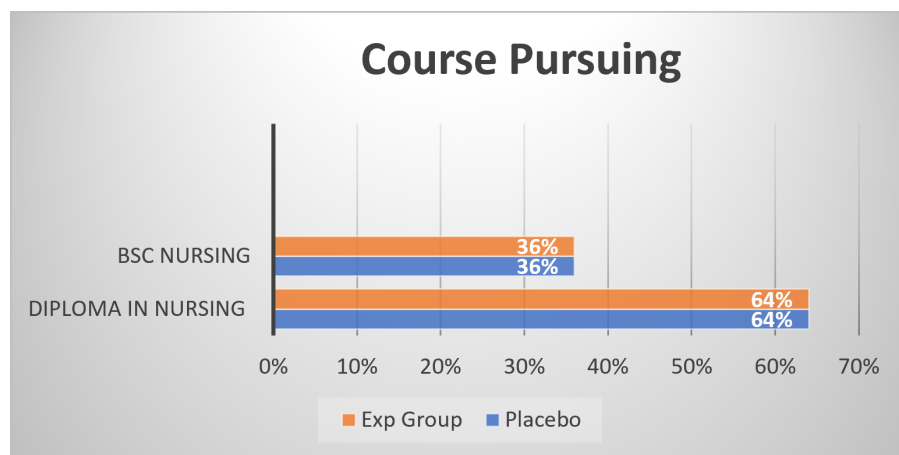


Fig 1. The percentage distribution of subjects according to the course pursuing.

Figure 2 illustrates how participants were categorized by their place of residence. The majority of students resided in hostels (57% of the placebo group and 45% of the experimental group). Rented accommodation and paying guest arrangements were the second most common forms of residency for students. There was no statistical difference found between the two groups regarding where they lived ($p=0.4$) which provided an indication that the living environment was similar for all participants.

The study method patterns are shown in Figure 3. The majority of students used self-study as their study method. In the placebo group, 85% used self-study while in the experimental group, 89% used it. Only a small portion of the participants used group discussions. There was no statistical significance ($p = 0.5$) to show differences in how they prepared for school.

These results are in line with previous reports that suggested the use of self-directed learning as the prevalent method of study among the nursing-students taking exams⁽⁸⁾. Like lifestyles and educational patterns also indicate similarity of comparison among groups and increase validity of interventions outcome.

3.3 Comparison of Pre-test and Post-test Anxiety Levels

The comparison of anxiety levels before and after intervention in both groups is presented in Table 3.

Prior to receiving this intervention, most of the students in the experimental group (70.2%), and the majority of the students in the placebo group (53.2%), were experiencing moderate to high levels of anxiety; this reflects a broad prevalence of test-taking anxiety among nursing students. A significant decrease in anxiety was noted in the experimental group after they received an aromatherapy treatment. The experimental group had 66% of the students move into a moderate/low level of anxiety, and there was a substantial decrease in the number of students who experienced high anxiety, and this was found to be statistically significant ($p < 0.001$).

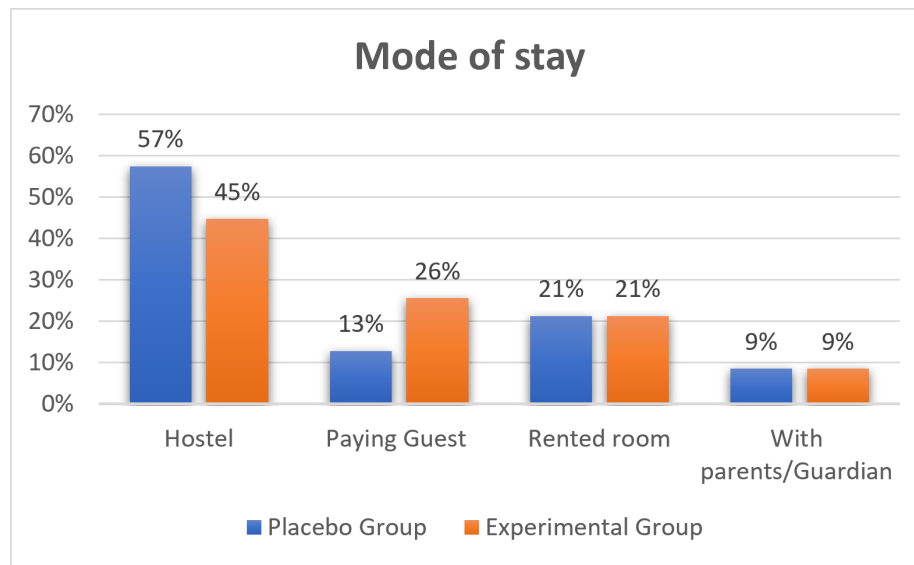


Fig 2. The percentage distribution of subjects according to the mode of stay.

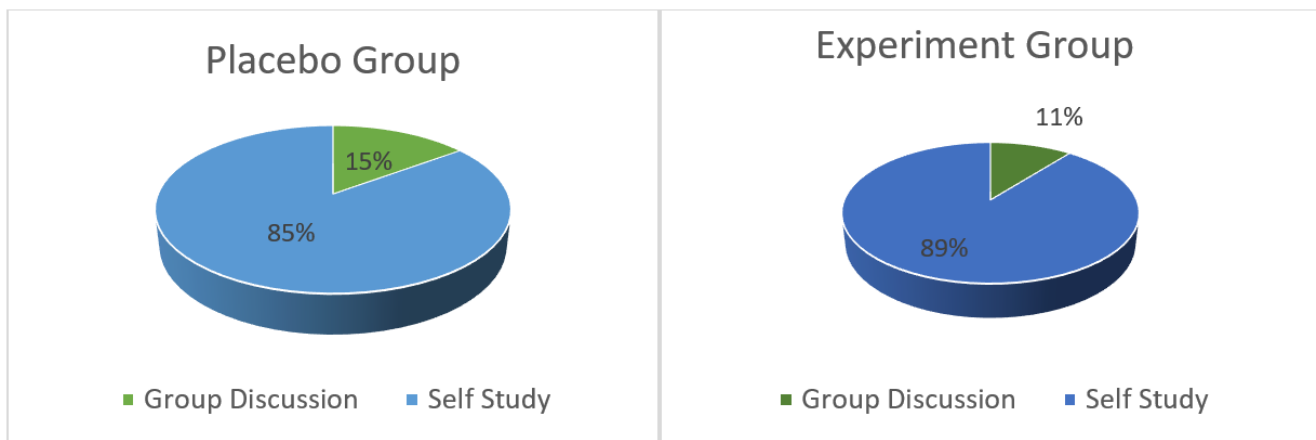


Fig 3. The distribution of samples according to the pattern of study.

Table 3. Pretest and posttest anxiety levels of nursing students belonging to both the placebo and experimental groups. $n_1 = 47$, $n_2 = 47$

Anxiety level	Experimental Group				p-value	Placebo Group				p-value
	Pretest		Post test			Pretest		Post test		
	f	%	f	%		f	%	f	%	
Mild Anxiety (≤ 37)	0	0.0%	3	6.4%	<0.001*	0	0.0%	1	2.1%	0.007*
Moderate low (38-44)	12	25.5%	31	66.0%		21	44.7%	6	12.8%	
Moderate High (45-54)	33	70.2%	13	27.7%		25	53.2%	37	78.7%	
Severe (≥ 55)	2	4.3%	0	0.0%		1	2.1%	5	6.4%	

* Significant

No such beneficial changes occurred with the placebo group. Most students remained at either moderate or high levels of anxiety, and the amount of change that did occur was instead a statistically significant increase in anxiety ($p = 0.007$).

These study findings also confirm previous studies⁽³⁾ which have shown that students in a nursing program experienced a considerable reduction in their exam anxiety following stress management interventions. In addition, random controlled trials using both pharmacy and nursing students found that aromatherapy was significantly better at reducing test anxiety when used on those subjects versus controls^{(12), (16)}. This confirmation of the findings from this current study provides additional evidence for the use of aromatherapy as an anxiety reduction strategy based upon its ability to be applied across various populations.

Also, the finding that anxiety was decreased in the treatment group is supportive of the theoretical mechanism that aromatherapy can influence the limbic system through olfactory stimulation and induce relaxation. The fact that the anxiety level did not decrease in the placebo group indicates that the decreases in anxiety seen in the treatment group were due to the therapeutic properties of lemon essential oil rather than the psychological expectations associated with receiving a treatment.

3.4 Effect of Aromatherapy on Physiological Variables

To measure the physical effects of aromatherapy, physiological measurements of anxiety were measured using systolic blood pressure, pulse rate and respiration rate. Table 4 gives the comparison of the physiological parameters before and after the intervention.

Table 4. Pre- and post-interventional biophysiological variable mean, standard deviation, and “t” value in experimental and Placebo group.
 $n_1 = 47, n_2 = 47$

Variable	Experimental Group					Placebo Group				
	Pre-test		Post-test		p-value	Pre-test		Post-test		p-value
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Systolic BP	111.51	12.80	102.02	13.96	0.001*	109.62	11.05	110.64	13.70	0.509
Pulse	82.57	7.54	77.85	8.10	< 0.001*	80.64	8.64	84.85	10.38	0.007*
Respiration	19.87	1.90	19.45	2.05	0.259	19.06	3.08	19.60	2.82	0.315

* Significant

The pre- to post-inhalation differences were found to be statistically significant for all three physiological measures examined. The mean systolic blood pressures of the experimental subjects were found to be 111.51 ± 12.80 mmHg prior to inhaling lemon essential oil and 102.02 ± 13.96 mmHg after inhaling it. These data were found to be statistically different ($p = 0.001$). Pulse rates of these subjects also were significantly reduced from 82.57 ± 7.54 beats per min to 77.85 ± 8.1 beats per min ($p < 0.01$) after they had inhaled the oil. These results are consistent with those typically found after activation of the parasympathetic nervous system (i.e., the relaxation response). Respiration rates of the experimental subjects tended to be slightly lower after they had inhaled the oil (from 19.87 ± 1.9 to 19.45 ± 2.05 breaths/min), but the differences were not statistically significant ($p = 0.259$).

In contrast, the subjects who received the placebo did not show evidence that their physiological responses were altered favorably by receiving the placebo. Their mean systolic blood pressures actually increased from 109.62 ± 11.05 mmHg to 110.64 ± 13.70 mmHg during the test session ($p = 0.509$). Furthermore, their pulse rates were significantly increased from 80.64 ± 8.64 beats per min to 84.85 ± 10.38 beats per min ($p = 0.007$) during this time period.

These findings are in line with previous studies which demonstrated a reduction of cardiovascular indicators post aromatherapy intervention. For example Borzoo et al.⁽¹⁷⁾, reported statistically significant reductions in physiological parameters associated with anxiety among nursing staff after being exposed to aromatherapy. Additionally, a number of systematic reviews have demonstrated that aromatherapy has a positive effect on autonomic nervous system activity resulting in decreased blood pressure and heart rate⁽¹⁵⁾.

3.5 Comparison Between Experimental and Placebo Groups

The comparison of physiological parameters between experimental and placebo groups before and after intervention is presented in Table 5.

The baseline showed no statistical difference between the treatment group and the control group for systolic blood pressure ($p = 0.445$), pulse rate ($p = 0.25$), and respiration rate ($p = 0.129$), thus showing that at baseline the two groups were homogeneous. However, by the time of the post-test, there was a statistically significant difference in both systolic blood pressure ($p = 0.003^*$) and pulse rate ($p = < 0.001^*$) between groups. The experimental group had a significantly lower average systolic blood pressure

Table 5. Pre and post-interventional biophysiological variable mean, standard deviation, and “t” value in experimental and Placebo group

Variables	Pre-test				t-value	p-value
	Experimental group		Placebo Group			
	Mean	SD	Mean	SD		
BP	111.51	12.80	109.62	11.05	-0.768	0.445
Pulse	82.57	7.54	80.64	8.64	-1.157	0.250
Respiration	19.87	1.90	19.06	3.08	-1.532	0.129
Variables	Post-test				t-value	p-value
	Experimental group		Placebo Group			
	Mean	SD	Mean	SD		
BP	102.02	13.96	110.64	13.70	3.021	0.003*
Pulse	77.85	8.10	84.85	10.38	3.645	<0.001*
Respiration	19.45	2.05	19.60	2.82	0.293	0.770

(mean = 102.02 ± 13.96 mm Hg) than the placebo group (mean = 110.64 ± 13.70 mm Hg). In addition, the experimental group had a significantly lower pulse rate (mean = 77.85 ± 8.1 bpm) than the placebo group (mean = 84.85 ± 10.38 bpm). No significant differences were found for respiration rates ($p = 0.770$).

The results are also a suggestion that aromatherapy does have physiological effects of relaxation. The same has been observed in randomized controlled trials where greater improvements in blood pressure and pulse rate were observed with use of essential oils and greater relaxation and less anxiety^{(12), (13)}.

3.6 Effectiveness of Aromatherapy Based on STAI Scores

The effectiveness of aromatherapy in reducing anxiety was further evaluated using the State-Trait Anxiety Inventory (STAI) scale, as presented in Table 6 and Table 7.

Table 6. Pre- and post-interventional anxiety score in experimental and Placebo group. $n_1 = 47$, $n_2 = 47$

Test	Experimental Group				Placebo Group			
	Mean	SD	Range	p-value	Mean	SD	Range	p-value
Pre-Test	47.47	4.02	41 – 58	< 0.001*	45.43	3.66	39 – 56	< 0.001*
Post Test	42.38	3.55	32 – 48	-	48.13	4.76	30 – 59	-

*Significant

The mean STAI score for the experimental group had a statistical decrease from 47.47 ± 4.02 in the pre-test to 42.38 ± 3.55 in the post-test ($p \leq 0.001$) which represents improved emotional stability and a lower level of anxiety among the participants after the aromatherapy treatment. On the other hand, the mean STAI scores for the placebo group increased from 45.43 ± 3.66 to 48.13 ± 4.76 . An increase in anxiety levels would be expected due to the normal development of anxiety as students experience stress related to examinations without therapeutic support.

Table 7 demonstrated a statistically significant difference ($t = -6.632$, $p \leq 0.001$) in the post-test STAI scores between the two groups. These results indicate that aromatherapy resulted in better anxiety-related outcomes than did a placebo.

Table 7. Comparison of pre- and post-test anxiety scores of subjects in the experimental group. $n_1 = 47$, $n_2 = 47$

Test	Experimental group			Placebo Group			t-value	p-value
	Mean	SD	Range	Mean	SD	Range		
Pre-test	47.47	4.02	41, 58	45.43	3.66	39, 56	-2.574	0.012
Post-test	42.38	3.55	32, 48	48.13	4.76	30, 59	-6.632	<0.001

These results support other randomized clinical trials done with nursing students that demonstrated a statistically significant decrease in anxiety after participants received aromatherapy treatments using essential oils like lavender and rose^{(12), (16)}. In addition to this, Mozarab et al.⁽³⁾, found that nursing students who participated in anxiety-reducing programs had significant

improvements in anxiety management. The observed decrease in anxiety scores also supports the hypothesis that olfactory stimulation can influence how we process emotions by activating the limbic system thereby causing us to relax and lessening our stress response^{(11), (14)}.

3.7 Association Between Anxiety Levels and Demographic Variables (Table 8 and Table 9)

The association between pre-interventional anxiety levels and selected demographic variables was analyzed and is presented in Table 8 and Table 9.

Table 8. Association of pre-interventional anxiety score with selected demographic variables in the experimental group. $n_1 = 47$

Experimental Group					
Variables	Levels	Mean	SD	t-value	p-value
Gender	Female	48.13	3.95	$t = 1.595$	0.118
	Male	46.19	3.97		
Course Pursuing	BSc Nursing	46.12	3.62	$t = -1.773$	0.083
	GNM Nursing	48.23	4.09		
Parents expectations of result	Distinction	49.2	4.01	$F = 5.988$	0.005
	First class	46.86	3.52		
	Second class	43.2	2.17		
Pattern of studying	Group discussion	45.2	4.02	$t = -1.346$	0.185
	Self-study	47.74	3.98		

There were no statistically significant correlations identified between the level of anxiety experienced by participants in the Experimental Group (Table 8) and demographic characteristics including gender ($p = 0.118$), course type ($p = 0.083$), and study patterns ($p = 0.185$). A statistically significant correlation was however identified between students' anxiety levels and their parents' expectations regarding their academic performance ($p = 0.005$), i.e., students with parents who expect them to achieve distinctions are experiencing greater anxiety than other students.

In addition, in the Placebo Group (Table 9), a statistically significant correlation was identified between course type and anxiety levels ($p = 0.025$), i.e., students taking a BSc Nursing degree experience slightly more anxiety than those studying for a GNM.

Table 9. Association between pretest clinical examination anxiety score and selected demographic variable in Placebo group. $n_2 = 47$

Placebo Group					
Variables	Levels	Mean	SD	t-value	p-value
Gender	Female	44.92	3.78	$t = -1.872$	0.068
	Male	47.3	2.54		
Course Pursuing	BSc Nursing	47	2.5	$t = 2.321$	0.025*
	GNM Nursing	44.53	3.95		
Parents expectations of results	Distinction	44.19	3.12	$F = 2.629$	0.083
	First class	46.58	3.93		
	Second class	44.5	0.71		
Pattern of studying	Group discussion	45.14	2.85	$t = -0.219$	0.828
	Self-study	45.48	3.82		

These results go in line with earlier studies which found academic expectations and course-related demands as key sources of examination anxiety in nursing students^{(7), (9)}. Parental expectation has been cited to be one of the major predictors of student stress and performance apprehension in school⁽⁸⁾.

3.8 Critical Comparison with Previous Studies

Research has shown a consistent pattern of finding aromatherapy to be effective for reducing student anxiety as indicated by many prior studies. Studies done using randomized designs from regions including Iran have reported substantial decreases in anxiety ratings based on aromatherapy intervention when using lavender and rose essential oil^{(12), (16), (17)}. Prior research involving nursing personnel has also found that there were substantial reductions in both stress and anxiety experienced by those who received an aromatherapy treatment⁽¹⁸⁾.

In comparison with a number of prior studies, this research investigates lemon essential oil. Lemon essential oil has been identified as having fewer research studies than lavender and rose essential oils. The present investigation demonstrated that lemon essential oil can promote wakefulness, increase the mood, and reduce the body's response to stressors through the neurotransmitter modulation pathways, in particular the GABAergic pathway^{(11), (14)}.

In addition, while a large number of the prior studies were based on the evaluation of the psychological effects, the current study examined both psychological and physiological measures. As such, it provides further support for the comprehensive health benefits of aromatherapy.

3.9 Unique Contribution of the Present Study

The present study makes several important contributions to the existing body of knowledge:

1. Context-Specific Evidence in Indian Settings: The bulk of the past aromatherapy research has been carried out in either international or clinical contexts. This paper offers evidence among nursing students in an Indian academic setting, which adds to the relevance and applicability of the results to the local education.

2. Use of a Placebo-Controlled Experimental Design: The blank control group also enhances internal validity and proves that the observed changes were caused by the therapeutic action of lemon essential oil instead of the psychological expectations.

3. Focus on Lemon Essential Oil: Contrary to most of the earlier research that tended to concentrate more on lavender and rose oils, the present research took a definite test on the lemon essential oil, which is affordable, common, and acceptable in most cultures.

4. Comprehensive Outcome Assessment: Concurrent analysis of psychological (STAI scores) and physiological (blood pressure, pulse rate, respiration rate) data is the evidence of the success of aromatherapy.

These characteristics will make the current study stand out of the previous ones and contribute more strongly to complementary therapy in nursing education.

3.10 Implications for Practice

The outcomes from the current investigation indicate that inhaled use of lemon essential oils through aromatherapy could be an effective, easy to implement and inexpensive way to reduce student's anxiety associated with testing (examinations) in academic environments.

Including complimentary therapy methods in educational programs for nursing will likely have positive effects on nursing students' mental health, and potentially improve their academic performance and support professional growth.

Lastly, these results support developing formalized protocols for managing test day anxiety utilizing complimentary therapy modalities to assist students in high stress academic situations.

4 CONCLUSION

The present study showed that clinical examination anxiety among nursing students was significantly decreased by inhaling aromatherapy using lemon essential oil. The mean STAI scores of the experimental group decreased from 47.47 ± 4.02 to 42.38 ± 3.55 ($p \leq .001$), while anxiety increased in the placebo group. Additionally, the experimental group showed significant decreases in both systolic blood pressure (from 111.51 ± 12.80 mmHg to 102.02 ± 13.96 mmHg; $p = 0.001$) and pulse rate (from 82.57 ± 7.54 beats per minute to 77.85 ± 8.1 beats per minute; $p < .01$), demonstrating the physiologic effects of relaxation caused by aromatherapy.

Overall, these results show that lemon essential oil aromatherapy is an effective, low cost, noninvasive method to decrease anxiety among nursing students during stressful clinical exams. The limitations of this study are that it only occurred at one school, and it was a short-term intervention. Future studies will need to have larger multicenter studies, longer term follow up studies, and compare the effectiveness of different types of essential oils used as part of a comprehensive program of stress relief for students.

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