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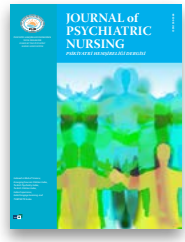

Original Article

# The effect of aromatherapy on learning and anxiety: A randomized controlled study

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## Abstract

**Objectives:** This study aimed to determine the effect of aromatherapy on nursing students' skill acquisition and anxiety experienced during skills training.

**Methods:** The population of this randomized controlled study consisted of all nursing students actively enrolled at a foundation university during the spring semester of the 2023–2024 academic year. The sample consisted of 73 students (experimental=37, control=36) who met the inclusion criteria and voluntarily participated in the study. Lemon, orange, and frankincense essential oils were used during the intervention. Data were collected using the Descriptive Information Form, State-Trait Anxiety Inventory (STAI), and Peripheral Intravenous Catheter Insertion Skills Checklist.

**Results:** No statistically significant differences were found between the experimental and control groups in terms of age, sex, or baseline STAI scores ($p>0.05$). In the experimental group, the mean pretest STAI score was 37.81±10.19, and the mean posttest score was 40.43±10.46; the difference between the scores was statistically significant ($p<0.05$). In the control group, the mean pretest STAI score was 36.38±9.94, while the mean posttest score was 38.30±10.25; the difference was not statistically significant ($p>0.05$). The mean Peripheral Intravenous Catheter Insertion Skills Checklist score was significantly higher in the experimental group (77.05±11.26) than in the control group (62.63±11.88) ($p<0.05$). No statistically significant difference was found between the groups in terms of pretest and posttest STAI scores ($p>0.05$).

**Conclusion:** Aromatherapy may have a positive effect on learning. However, aromatherapy was not found to be effective in reducing students' anxiety levels.

**Keywords:** Anxiety; aromatherapy; learning; nursing education; nursing skills

Nursing education is an integrated process in which theoretical knowledge and practical training are closely intertwined, aiming to develop students' cognitive and motor skills. The laboratory environment, where clinical skills are taught and motor skills are developed, serves as a bridge between classroom learning and clinical practice. In the laboratory, students are expected to transform target behaviors into practical skills through practice on inanimate models under the supervision of instructors.[1]

Skills laboratories, in which students perform practical applications, can be stressful environments, and this may negatively affect nursing students' performance. Performance anxiety, concerns about being underestimated by peers, lack of knowledge, and differences in skill-teaching methods among instructors may cause students to experience stress, anxiety, fear, and decreased self-confidence, consequently adversely affecting their performance.[2,3] In particular, students have been observed to experience stress, trembling hands, and

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discomfort before performing procedures involving invasive interventions. Therefore, students need to feel comfortable, confident, and cognitively receptive to learning during skills training. In this regard, new practices and alternative techniques that can be incorporated into skills training are important. In recent years, aromatherapy has been used as a method to support the acquisition of cognitive and motor skills among nursing students during practical training.[4,5]

Aromatherapy is a natural therapeutic approach that involves administering essential oils derived from plants through massage, inhalation, compresses, or bathing.[4,5] Aromatherapy administered via inhalation can be performed by applying essential oil to a tissue, using a nasal patch, or diffusing the oil into the environment through an aroma lamp.[5] Essential oils that affect the limbic system may exert modulatory effects in the periphery through autonomic pathways associated with overall organismal functioning and may be used to manage depression, anxiety, and dementia.[6] Essential oils such as eucalyptus, lemon, orange, rose, lavender, basil, and frankincense have been used to facilitate learning and reduce anxiety. Compounds such as citronellol, limonene, and linalool found in these oils have sedative effects.[7] Lemon and orange essential oils are used to reduce stress and anxiety and to enhance cognitive functions.[8] Frankincense oil has antioxidant and anti-inflammatory properties and may also reduce anxiety and positively affect concentration and memory.[9]

Due to its potential effects on reducing anxiety and enhancing concentration, aromatherapy has recently been investigated among nursing students.[10,11] A study examining the effects of aromatherapy on stress among first-year nursing students reported that inhalation of essential oils reduced students' stress levels.[12] Another study reported that nursing students perceived medicinal and aromatic plants as helpful in increasing their motivation while studying, reducing examination-related stress, and providing relaxation in stressful situations.[13] However, further studies involving different sample groups are needed to determine whether aromatherapy is effective in enhancing learning and reducing anxiety among nursing students. Although aromatherapy has been used in Türkiye for many years, studies investigating its effects among nursing students remain limited.[1,7] Therefore, this study aimed to determine the effect of aromatherapy on nursing students' skill acquisition and anxiety experienced during skills training.

The hypotheses of this study were as follows:

**H0.1:** There is no significant difference between nursing students in the experimental and control groups in terms of their checklist scores during the procedure.

**H0.2:** There is no significant difference between nursing students in the experimental and control groups in terms of their post-aromatherapy state anxiety scores.

**What is presently known on this subject?**

- Skills laboratories can be stressful environments for students, which may affect their performance and learning outcomes.

**What does this article add to the existing knowledge?**

- This study found that aromatherapy had a positive effect on students' skill acquisition; however, it was not effective in reducing their anxiety levels.

**What are the implications for practice?**

- Given aromatherapy's positive effect on skill acquisition, its use during skills training in laboratory settings may be beneficial.

**H1.1:** There is a significant difference between nursing students in the experimental and control groups in terms of their checklist scores during the procedure.

**H2.1:** There is a significant difference between nursing students in the experimental and control groups in terms of their post-aromatherapy state anxiety scores.

## Materials and Method

### Study Design

This study used a randomized controlled trial design.

### Setting and Time

The study was conducted during the spring semester of the 2023–2024 academic year at a foundation university.

### Population and Sample

The study population consisted of all nursing students actively enrolled at a foundation university during the spring semester of the 2023–2024 academic year. The study sample consisted of nursing students enrolled in the Department of Nursing during the specified academic year (n=81). The inclusion criteria were being enrolled in the Fundamentals of Nursing course for the first time, having no cardiovascular or respiratory disease (e.g., asthma or chronic obstructive pulmonary disease), having no allergy to odors or essential oils, not being pregnant, having no condition that could impair the sense of smell, being aged 18 years or older, and voluntarily agreeing to participate in the study. Data were collected before and after peripheral intravenous (IV) catheter insertion. Incomplete completion of data collection instruments, having a diagnosed psychiatric disorder, having previously received skills training on IV catheter insertion or having previously performed IV catheter insertion, and experiencing any adverse effects during the study constituted the exclusion criteria.

According to the power analysis, with a 95% confidence interval, a significance level of 5%, and an effect size of 0.760, the required sample size was calculated as 42 participants, with 21 participants in each group (df=20; t=1.725).[10] Accounting for possible withdrawals and missing data, the study began with 77 students (experimental=39, control=38), who were then randomized.

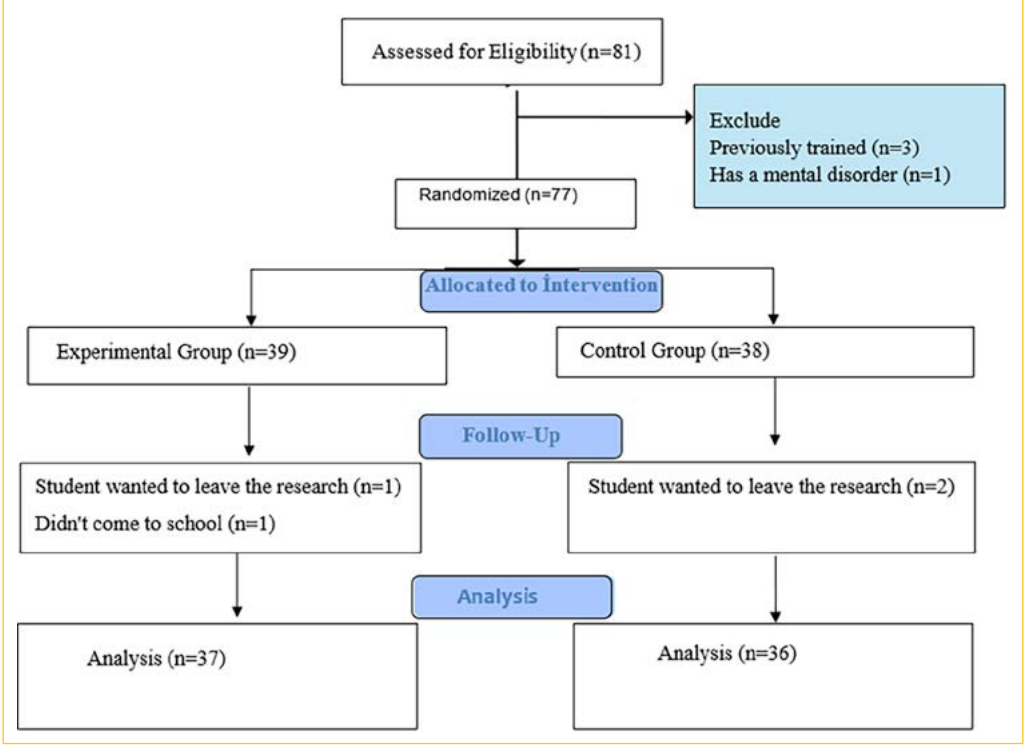


**Figure 1.** CONSORT flow diagram.

Students who met the inclusion criteria were listed by student identification number to create the sampling pool, and simple randomization was performed using https://www.calculatorsoup.com.[14] The study was completed with 73 students (experimental=37, control=36) due to failure to meet the inclusion criteria, absence from the university on the day of the intervention, and participants' desire to withdraw during the procedure (Fig. 1). A post hoc power analysis indicated that the study's statistical power was 0.99.

The study used single blinding. The students were blinded to their group allocation, whereas the researchers were aware of the group assignments.

## Data Collection Instruments

The data were collected using the Descriptive Information Form, State-Trait Anxiety Inventory (STAI), and Peripheral Intravenous Catheter Insertion Skills Checklist.

**Descriptive Information Form:** The form included questions assessing students' age, sex, school of graduation, diagnosis of a psychiatric disorder, and whether they had previously performed IV catheter insertion.

**State-Trait Anxiety Inventory:** Developed by Spielberger, Gorsuch, and Lushene, the inventory consists of two subscales: State Anxiety and Trait Anxiety. Each subscale contains 20 items. Since the present study aimed to assess anxiety before the procedure, the State Anxiety Inventory (SAI) was used.[15] Öner and Le Compte adapted the State-Trait Anxiety Inventory into Turkish.[16] The State Anxiety Inventory contains 10 reverse-scored items (items 1, 2, 5, 8, 10, 11, 15, 16, 19, and 20). Total scores range from 20 to 80, with higher scores indicating higher levels of anxiety and lower scores indicating lower levels of anxiety. Scores of 0–19 indicate no anxiety, 20–39 mild anxiety, 40–59 moderate anxiety, and 60–79 severe anxiety.[16] The Cronbach's alpha coefficient of the scale was 0.86, while the Cronbach's alpha coefficient in the present study was 0.89.

## Peripheral Intravenous Catheter Insertion Skills Checklist

The researchers developed this instrument based on the literature; it consists of 25 procedural steps evaluated using a five-point rubric (0–4 points), with a maximum total score of 100 points.[17,18] The checklist includes subheadings for required materials, purpose, and procedural steps, with a total of 25 steps.

To establish content validity, the checklist was submitted to three faculty members specializing in Fundamentals of Nursing and two practicing nurses for expert review. The Cronbach's alpha coefficient based on expert evaluation of the checklist was 0.88.

## Materials Used

Lemon (Citrus limon), orange (Citrus sinensis), and frankincense (Boswellia carterii) essential oils and two ceramic aromatherapy lamps (oil burners) were used.

### Data Collection Procedure

After receiving routine theoretical training on intravenous catheter insertion, the students participated in the study in the nursing skills laboratory. The laboratory in which the intervention was conducted had an area of 135 $m^2$. To prevent interaction between the students, the experimental group underwent the intervention on a different day from the control group. For the experimental group, two oil burners containing a mixture of essential oils were used, with six drops in total in each burner. The essential oil mixture consisted of lemon, orange, and frankincense oils in a 2:2:2 ratio. Approximately 15 minutes before the experimental group entered the laboratory, the essential oils were allowed to diffuse throughout the environment. The students were then asked to complete the Descriptive Information Form and State Anxiety Inventory. Students in the control group completed the Descriptive Information Form and State Anxiety Inventory before entering the laboratory.

During skills training, one researcher demonstrated IV catheter insertion to both the experimental and control groups using a simulation mannequin. Each student performed the procedure once on the mannequin. During the experimental group assessment, aromatherapy was also administered in the assessment laboratory, as in the training laboratory, and students were exposed to the scent of the essential oils while being evaluated. To minimize assessment bias, a researcher other than the instructor who provided the training evaluated the procedure using a standardized checklist for each student. Students in the control group completed the State Anxiety Inventory again immediately after the skills training and were subsequently taken to another laboratory for assessment of their skill acquisition.

### Statistical Analysis

The data were analyzed using SPSS version 22.0. The normality of the data distribution was assessed using the Shapiro–Wilk test and visual methods (histograms and Q–Q plots). Continuous variables were presented as mean±standard deviation (mean±SD), and Pearson's chi-square test was used for categorical variables. The analysis indicated that age did not follow a normal distribution ($p<0.05$). In contrast, peripheral intravenous catheter insertion skill scores (checklist scores) and State Anxiety Inventory scores followed a normal distribution ($p>0.05$). Accordingly, the Mann–Whitney U test was used for between-group comparisons of non-normally distributed variables. Independent-samples t-tests were used for between-group comparisons of normally distributed variables. Within-group pretest–posttest comparisons were performed using the paired-samples t-test because the parametric assumptions were met. Cohen's d was calculated to determine the effect size.[19] Effect sizes were interpreted as small (0.20), medium (0.50), and large (≥0.80). A p value of <0.05 was considered statistically significant in all analyses.

### Ethical Considerations

Before the study commenced, institutional permission was obtained from the institution where the study was conducted, and approval was obtained from the Fenerbahçe University ethics committee (No. 34.2024fbu, date: February 20, 2024). The study was conducted in accordance with the principles of the Declaration of Helsinki. All students were informed about the purpose and procedures of the study, that their data would not be shared with third parties, and that they could withdraw from the study at any time. Students who did not consent to participate in the study received routine skills training. The ClinicalTrials.gov registration number was NCT06381544.

## Results

When the descriptive characteristics of the students in the experimental and control groups were examined, no statistically significant difference was found between the groups in terms of age ($Z=-0.113$, $p=0.910$). Similarly, no significant difference was found between the groups in terms of sex distribution ($\chi^2=0.205$, $p=0.651$). There was also no statistically significant difference between the groups in terms of baseline anxiety levels (STAI pretest scores) ($t=-0.603$, $p=0.548$). These findings indicate that the experimental and control groups were homogeneous at baseline ($p>0.05$) (Table 1).

When the mean checklist and STAI scores were compared between the groups, the mean checklist score was 77.05±11.26 in the experimental group and 62.63±11.88 in the control group. The experimental group had higher mean checklist scores than the control group, and the 14.42-point difference between the groups was statistically significant ($p<0.05$). According to Cohen's d effect size analysis conducted to determine the effect of aromatherapy on checklist scores, aromatherapy had a large effect on skill acquisition (Cohen's $d=1.24$). The H1.1 hypothesis was accepted. No statistically significant difference was found between the groups in terms of STAI posttest and pretest scores ($p>0.05$) (Table 2), and H0.2 was not rejected.

When the pretest and posttest STAI anxiety scores of the students in the experimental group were compared, the difference between the two measurements was statistically significant ($t=-2.722$, $p<0.05$), and the students' anxiety scores increased at posttest. No statistically significant difference was found between the mean pretest and posttest anxiety scores in the control group ($t=-1.507$, $p>0.05$) (Table 3).

**Table 1. Characteristics of students in the experimental and control groups (n=73)**

| | Experimental group (n=37) Mean (SD) | Control group (n=36) Mean (SD) | Test | p |
|---|---|---|---|---|
| Age | | | | |
| Mean (19.83, SD=1.75) | 19.81 (SD=1.63) | 19.86 (SD=1.89) | 0.122* | 0.904 |
| Sex | | | | |
| Female (n=53) | 26 | 27 | 0.205** | 0.651 |
| Male (n=20) | 11 | 9 | 0.205** | 0.651 |
| STAI pretest | | | | |
| Mean (37.10, SD=10.02) | 37.81 (SD=10.19) | 36.38 (SD=9.94) | -0.603* | 0.548 |
| STAI post test | | | | |
| Mean (39.89, SD=10.40) | 41.43 (SD=10.46) | 38.30 (SD=10.25) | -1.290* | 0.201 |

*: Independent-samples t-test, **: Chi-square test. n: Number of participants; SD: Standard deviation; STAI: State-trait anxiety inventory.

**Table 2. Comparison of the mean checklist and STAI scores of students in the experimental and control groups**

| | Experimental group (n=37) Mean (SD) | Control group (n=36) Mean (SD) | Test | p |
|---|---|---|---|---|
| Checklist score | 77.05 (SD=11.26) | 62.63 (SD=11.88) | -5.319* | **0.00** |
| STAI pre-test | 37.81 (SD=10.19) | 36.38 (SD=9.94) | -0.603* | 0.548 |
| STAI post-test | 41.43 (SD=10.46) | 38.30 (SD=10.25) | -1.290* | 0.201 |

*: Independent-samples t-test. n: Number of participants; SD: Standard deviation; STAI: State-trait anxiety inventory.

**Table 3. Comparison of within-group STAI scores in the experimental and control groups**

| | STAI pre-test Mean (SD) | STAI post-test Mean (SD) | Test | p |
|---|---|---|---|---|
| Experimental group | 37.81 (SD=10.19) | 40.43 (SD=10.46) | -1.507* | 0.010 |
| Control group | 36.38 (SD=9.94) | 38.30 (SD=10.25) | -2.722* | 0.141 |

*: Paired-samples t-test. n: Number of participants, SD: Standard deviation; STAI: State-trait anxiety inventory.

## Discussion

This randomized controlled study was conducted to determine the effect of aromatherapy on skill acquisition and anxiety experienced during skills training among nursing students. The findings showed that the experimental and control groups were comparable in terms of age, sex, and baseline anxiety scores.

A statistically significant difference was found between the experimental and control groups in terms of peripheral intravenous catheter insertion checklist scores. Therefore, aromatherapy may have positively affected students' learning. It has been suggested that odors may enhance learning by establishing more neural connections in the brain.[20] Previous studies conducted in different fields and age groups have demonstrated positive effects of aromatherapy on learning and cognitive functions.[21–23]

Because previous studies have frequently examined the effects of aromatherapy on anxiety among nursing students, the present study's examination of the effects of lemon, orange, and frankincense oils on learning is a distinctive aspect of this research. Further high-quality studies are needed to provide stronger evidence in this area.

In the present study, although no significant difference was found in anxiety scores among students in the control group, a statistically significant difference was observed among students in the experimental group, with their anxiety scores increasing. Previous studies have frequently reported that aromatherapy reduces anxiety before skills practice and examination-related anxiety. Studies conducted with nursing students have demonstrated that aromatherapy can affect stress, examination anxiety,[24] the learning of Fundamentals of Nursing skills,[10] and state anxiety.[25] Similarly, studies conducted among students in health sciences and pharmacy programs have reported that aromatherapy reduces stress and anxiety.[26] However, the essential oils used in these studies differed, and the effects of individual oils may also vary.[8] In the present study, the increase in anxiety scores among students in the experimental group may have been partly attributable to the different types of oils used. On the other hand, because aromatherapy was not used

during the other laboratory sessions attended by the experimental group and informed consent was obtained from the students before the study, their awareness of the intervention may have increased. This may have contributed to increased anxiety among the students. Previous studies have also investigated the combined use of aromatherapy and music therapy.[10] The use of aromatherapy as a standalone intervention in the present study may have limited its potential to reduce anxiety.

Studies reporting no significant effect of aromatherapy on anxiety are also available in the literature. Some studies have found no significant differences between experimental and control groups in anxiety experienced during skills training and students' vital signs following aromatherapy[1] or in examination anxiety.[27,28] A systematic review examining the effects of aromatherapy on anxiety and stress reported that 70% of the included studies demonstrated positive effects of aromatherapy.[5] However, the researchers emphasized concerns about essential oil dosage, participant safety, and potential sources of bias. Therefore, the development and implementation of standardized protocols for aromatherapy interventions have been recommended. In this regard, further studies with larger sample sizes are needed.

### Limitation

The findings of this study are limited to the sample in which the study was conducted. The State Anxiety Inventory was used to assess anxiety. Vital signs, a Visual Analog Scale, clinical observations, or other objective measures were not used. Future studies should consider assessing anxiety using both objective and subjective measures. The intervention was performed only once and focused on a single skill. Future studies could examine different skills and repeated skill assessments. Because there is no standardized aromatherapy protocol in the literature, the generalizability of the findings may be limited. In addition, the nursing educators who completed the checklist were also exposed to the aromatherapy intervention. Therefore, future studies may consider requiring evaluators to wear masks to minimize potential bias.

## Conclusion

The findings suggest that pre-intervention aromatherapy may have a positive effect on learning among students in the experimental group. However, state anxiety scores increased in the experimental group, whereas no change was observed in the control group. Previous studies investigating the effects of aromatherapy on anxiety have reported inconsistent findings. Differences in the types and ratios of essential oils used, as well as variations in study methodology, may account for these discrepancies. Further research is needed to establish stronger evidence regarding the effects of aromatherapy, and standardized protocols and guidelines should be developed.

**Ethics Committee Approval:** The study was approved by the Fenerbahçe University Non-interventional Clinical Research Ethics Committee (no: 34.2024fbu, date: 20/02/2024).

**Informed Consent:** Informed consent was obtained from the students prior to the study.

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