

ORIGINAL RESEARCH

A Scoping Review of Aromatherapy Evidence for Test Anxiety in Nursing Education

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Abstract

Background: Aromatherapy is a holistic intervention that is purported to relax or stimulate cognitive performance in nursing students and improve sleep disturbances depending upon the essential oil and the method of delivery. Test anxiety is a prevalent educational issue for nursing students that can lead to poor outcomes during the course of their nursing education. Test anxiety can have adverse consequences for students such as poor performance, failure, and attrition in the nursing program. **Objective:** The aims of this scoping review were to identify, summarize, and synthesize aromatherapeutic evidence implemented and evaluated in nursing education to decrease anxiety and test anxiety and improve test taking and sleep among nursing students. It also aims to propose methodologies that best utilize aromatherapy in nursing education. **Methodology:** A scoping review of the research evidence was done using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (2021). **Results:** Nine studies (2008-2019) were identified from the United States, the Philippines, and Turkey. The majority of designs were reported as RCTs (random control trials), with small non-diverse samples reported. Lavender, rosemary and lemon oil were administered via inhalation and hand massage methods. Anxiety and test anxiety were evaluated using scales (Cognitive Test Anxiety, Westside Test Anxiety Scale, State Trait Anxiety Inventory) and vital sign data. Test anxiety decreased with aromatherapy hand massage, and lavender and rosemary scents. Pulse rate decreased while blood pressure was non-significant. Studies did not use sleep disturbances as a variable. **Conclusions and Recommendations:** Various essential oils and delivery methods were used to mitigate anxiety and test anxiety among nursing students; however, there is limited data available to understand the design, chemistry and concentration of the essential oils used in the studies. There should be comprehensive reports of the design and evidence for use in nursing education.

Keywords: Aromatherapy, Nursing education, Nursing students, Anxiety, Test Anxiety, Sleep disturbances

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A Scoping Review of Aromatherapy Evidence for Test Anxiety in Nursing Education

Background

Anxiety, particularly test anxiety, is a common problem and health issue among nursing students. This subjective experience places nursing students at great risk for difficulty concentrating, decreased attention span, and misinterpretations of information; circumstances that can lead to inhibiting learning and poor educational performance outcomes. Test taking is a demanding high stakes event in nursing programs worldwide with strict progression policies (Dawood et al., 2016; Quinn & Peters, 2017; Spurlock, 2013). Pressure on undergraduate students to succeed will become even more intense in the next two years in the United States, when in 2023, the National Council Licensing Examination (NCLEX) will introduce a new passing standard (80% in non-technical language). Aromatherapy is the therapeutic use of essential oils from plants for the enhancement of physical, emotional, and spiritual wellbeing. Aromatherapy is often used by students outside of the educational or clinical environment. Aromatherapy is a possible intervention that can be used in nursing education to decrease student anxiety.

Aromatherapy

Treatment for test anxiety includes counseling, desensitization therapy, relaxation, and aromatherapy. Aromatherapy, with its focus on the therapeutic use of plant oils, has the ability to decrease anxiety in humans through the use of natural oils, particularly *Lavandula angustifolia* (lavender) without the potential for adverse reactions or side effects of conventional anxiolytic drugs (Greenberg & Narain, 2017). Aromatherapy is administered through cutaneous (e.g., massage), oral (e.g., pill or tea), or nasal (e.g., electronic diffuser, nasal inhaler, and cotton balls infused with oil placed near the head while sleeping or resting) routes. Essential oil is produced by steam-distillation of the flowering heads and leaves of the plant or in the case of most citrus by cold pressing the rinds. This review is limited to lavender, rosemary, and citrus (orange, lemon, lime, and grapefruit) essential oils.

Anxiety, Test Anxiety and Sleep Disturbance

Anxiety is considered a normal feeling, but in moderation. Anxiety can range from mild to panic levels and at a high level, students can experience detrimental effects. Test anxiety is a type of state anxiety, experienced as concern or fear before, during, or following a test or performance assessment (Farner et al., 2019). Test anxiety in nursing students negatively affects test scores, sleep quality, and overall academic success (Gibson, 2014). Anxiety over academic performance can lead to inadequate sleep and sometimes insomnia. Insomnia is difficulty falling asleep or staying asleep, waking up too early, experiencing low energy and difficulty concentrating, and suffering from irritability.

Measures of Anxiety, Test Anxiety, and Sleep Quality

The high incidence of test anxiety across disciplines has required the development of tools to measure this type of anxiety. The Test Anxiety Inventory (TAI) (Spielberger, 1980) is a 20-item Likert

scale and the most widely used. The TAI is sensitive to worry, the cognitive concern about consequences of failure. Worry impairs performance and emotionality or psychological arousal evoked by evaluative stress. This can lead to impaired performance. The State-Trait Anxiety Inventory (STAI) measures anxiety among adults. It differentiates between temporary episodic anxiety or state anxiety and the long-standing quality of trait anxiety using a scale consisting of two sets of twenty items (Spielberger et al., 1983). The Westside Test Anxiety Scale (WTAS) is a brief, ten-item instrument designed to identify students with anxiety impairments who could benefit from an anxiety-reduction intervention (Driscoll, 2007). The Cognitive Test Anxiety Scale (Cassaday & Johnson, 2002) is a 40-item scale focusing solely on cognitive anxiety, not emotionality or procrastination. The Stroop Test (SCWT) is a neuropsychological test used to evaluate the ability to inhibit cognitive interference that occurs when processing a specific stimulus feature that impedes the simultaneous processing of a second stimulus attribute (Scarpina et al., 2017). The visual analogue scale (VAS) consists of a line with verbal anchors on each end, i.e., “no anxiety on the far left” and “the most anxiety imaginable” on the far right. The subject places a mark corresponding to their anxiety rating (Hornblow & Kidson, 1976). Pulse is the number of heart beats in one minute. Blood pressure measures the force of blood against the arteries as it circulates throughout the body. With stress, the body releases the hormones cortisol and adrenaline that can make the heart beat faster and the blood pressure rise (Olpin & Hesson, 2021). The Pittsburgh Sleep Quality Index (PSQI) is a questionnaire used to assess sleep quality. It is a 19-item self-reported questionnaire that evaluates sleep quality over the past month. The test yields seven sleep components related to sleep routines, including period of sleep, sleep disruption, sleep latency, habitual sleep efficiency, use of sleep medicine, daytime dysfunction due to sleepiness, and overall sleep quality (Buysse et al., 1989).

It is uncertain what kind of evidence is available in the literature about aromatherapy and its mitigating effects on anxiety, test anxiety, and sleep in nursing students. For these reasons, the authors determined that a scoping review was in order to systematically map the research done in this area and to identify any existing gaps in the literature.

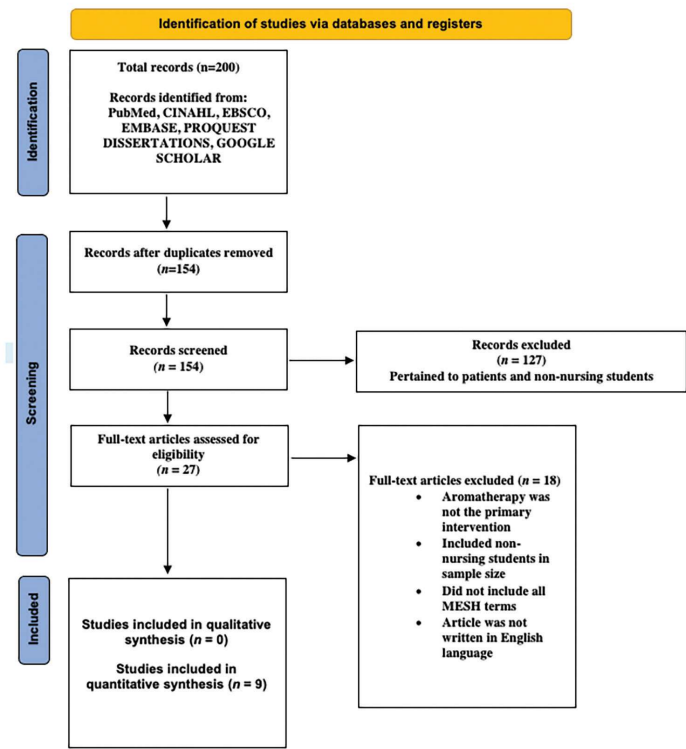
The Review

Study Design

This review used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Tricco et al., 2021). The research question that guided this review was, “What is the research evidence and recommendations on aromatherapy for use in nursing education in performance testing for nursing students?” The following steps were used to conduct the search: identify the research questions; identify relevant studies; select studies; organize the data; synthesize the results (Figure 1).

Figure 1

PRISMA Search Strategy Flow Chart*



To be included in the review, papers needed to focus on aromatherapy as the sole intervention to mitigate test anxiety or performance examination anxiety, and/or sleep quality and disturbances in nursing students. Peer-reviewed reports were included if they were: published between January 1, 2000 – April 30, 2021, involved nursing students 18 years old or higher, and described a measure for test anxiety or sleep. Quantitative cohort studies written in English and in full text format were included. Databases used to identify potentially relevant documents included PubMed, CINAHL, EBSCO, and EMBASE. The search for grey literature included ProQuest Dissertations, Theses, and Google Scholar. The search terms and strategies were drafted by the authors and an experienced reference librarian. The final search results were exported into a Word table, duplicates removed, and abstracts reviewed by the two authors. The authors screened the same publications (Table 1 and Table 2).

*Page, M., McKenzie, J., Bossuyt, P., Boutron, I., Hoffmann, T., Mulrow, C., Shamseer, L., Tetzlaff, J., Akl, E., Brennan, S., Chou, R., Glanville, J., Grimshaw, J., Hróbjartsson, A., Lalu, M., Li, T., Loder, E., Mayo-Wilson, E., McDonald, S. ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372(71). doi:10.1136/bmj.n71

Table 1

Search Terms

Nursing Students	Aromatherapy	Anxiety and Test Anxiety	Sleep Disturbances
“nursing students”	(Aromatherapy) OR Volatile oils	“test anxiety scale”[MeSH Terms] OR (“test”[All Fields] AND “anxiety”[All Fields] AND “scale”[All Fields]) OR “test anxiety scale”[All Fields] (“anxiety”[MeSH Terms] OR “anxiety”[All Fields]) AND (“weights and measures”[MeSH Terms] OR (“weights”[All Fields] AND “measures”[All Fields]) OR “weights and measures”[All Fields] OR “scale”[All Fields])	Pittsburgh[All Fields] AND (“sleep”[MeSH Terms] OR “sleep”[All Fields]) AND quality[All Fields] AND (“abstracting and indexing as topic”[MeSH Terms] OR (“abstracting”[All Fields] AND “indexing”[All Fields] AND “topic”[All Fields]) OR “abstracting and indexing as topic”[All Fields] OR “index”[All Fields])
“Nursing education” OR Nursing education undergraduate OR Nursing education graduate	((Lavender) OR Lavender oil) OR lavender essential oil (“lavandula”[MeSH Terms] OR “lavandula”[All Fields] OR “lavender”[All Fields]) AND (“oils, volatile”[MeSH Terms] OR (“oils”[All Fields] AND “volatile”[All Fields]) OR “volatile oils”[All Fields] OR (“essential”[All Fields] AND “oil”[All Fields]) OR “essential oil”[All Fields])		

((Lemon) OR Lemon oil) OR lemon essential oil
Rosemary [All Fields] AND ("oils, volatile"[MeSH Terms] OR ("oils"[All Fields] AND "volatile"[All Fields]) OR "volatile oils"[All Fields] OR ("essential"[All Fields] AND "oil"[All Fields]) OR "essential oil"[All Fields])
Orange AND <i>Citrus aurantium</i> L. var. <i>amara</i>
Lime AND <i>Citrus aurantifolia</i>

Table 2*Inclusion and Exclusion Criteria*

Inclusion	Exclusion
Nursing students over the age of 18	
Peer reviewed manuscripts	Abstracts only
English language	Published in non- English language
RCT, cohort studies	Qualitative studies; systematic or literature reviews; study protocols; conference abstracts; unpublished dissertations or commentaries
Anxiety, Test Anxiety and Sleep Measurement tools	Measurement tool development studies

Search Outcomes

An initial scan of the title and abstracts produced large numbers of irrelevant studies particularly those related to patients and other student populations. The search of the databases yielded 154 potentially relevant articles. There were 12 duplicates which were removed. Of these, 27 full text versions of the articles were obtained. Each article was reviewed by the two team members. Of the 27 full text articles located, 18 were eliminated from the review since they were in non-English (Korean, Portuguese, and Arabic) languages and one study was excluded since it utilizes aromatherapy in nursing students in conjunction with music therapy, which is not a modality considered in this review (Son et al., 2019). Nine of the articles met the full inclusion criteria. The final analysis included articles from the Philippines (n=1), Turkey (n=3), and the United States (n= 5) (Table 3).

Table 3*Summary of Studies Included in the Review*

Title, Year, Authors, Country	Design	Purpose	Data collection Instruments	Sample and Intervention	Results
Effect of Inhaled Lemon Essential Oil on Cognitive Test Anxiety Among Nursing Students (2019) Johnson, C. E. United States	RCT - pretest–posttest	To assess the effect of aromatherapy (Citrus limon [lemon] essential oil) on cognitive test anxiety among nursing students.	Student demographic information (age and gender) Cognitive Test Anxiety Survey (CTAS) scores were measured pre- and postintervention.	39, nursing students (unspecified year), randomized into two groups, control and experimental.	Neither the control nor the experimental group demonstrated a statistically significant change in the CTAS score from pretest to posttest (p= 0.19).

Aromatherapy Hand Massage for Test Anxiety and Self-Efficacy in Nursing Students: A Pilot Study (2019)	RCT	To determine if aromatherapy hand massage (HM) could improve test anxiety and self-efficacy in nursing students.	Student demographic information (age, gender, language, education, race, marital status, CAM use, allergies).	14, undergraduate nursing students, from a large urban university in the midwestern United States with a convenience sample of senior-level students enrolled in an accelerated baccalaureate nursing program was selected from a critical care nursing course.	No significant differences were found, but analysis of the percentage change from the means demonstrated the largest decrease in test anxiety in the AHM group (AHM = -12.4%, HM = -8.63%, C = -1.76%). Self-efficacy trends followed a similar pattern (AHM = 5.93%, HM = -3.03%, C = 0.52%).
Farner, J, Reed, M., & Bielawski			The Westside Test Anxiety Scale (WTAS) was selected to measure participants' pre- and postintervention test anxiety.	Participants were randomized to receive lavender aromatherapy hand massage (AHM), unscented HM, or no intervention (C) 60 minutes before an examination.	
United States			The General Self-Efficacy Scale (GSES) was chosen to measure pre and post-intervention self-efficacy		
Effects of Aroma Inhalation on Anxiety and Vital Signs of Nursing Students during Their First Blood Drawing Practice (2017)	RCT	Determine effects of orange and lavender oil on anxiety & vital signs before performance of first blood draw on a person.	Student Demographic Information Form	72, 1st grade {year} nursing students- equally assigned to control or treatment groups	The results indicate that aroma inhalation did not lead to a difference between the groups in terms of their mean VAS scores ($p > 0.05$)
Çevik, K., Ince, S. Ayceman, N. & Ergini, E.			Visual Analogue Scale (VAS)		
Turkey			State-Trait Anxiety Inventory (STAI)		
			Vital Signs Follow-up Form		

The Effect of Lavender Aromatherapy to Junior Nursing Students' Anxiety, Concentration and Memory Retention (2018)	Quasi-Exp	Determine the effects of Lavender aromatherapy on junior nursing students' anxiety, concentration and memory retention	State-Trait Anxiety Intervention (STAI) Stroop Effect Tool to test concentration Return demonstration assessment tool to test memory retention	55 Junior nursing students enrolled in the first semester of school year 2017-2018 scheduled for a return demonstration in the nursing lab.	Paired t-test in the 3 measures were significant ($p < 0.000$).
Fernandez, M., Ferrer, M., Flores, K., Florido, A., Foronda, K., & Lazalita, L.					
Philippines					
Effectiveness of Aromatherapy in Reducing Test Anxiety Among Nursing Students (2015)	RCT	To identify the effectiveness of aromatherapy in decreasing test anxiety levels in nursing students.	Personal demographic information (age and gender) State-Trait Anxiety Inventory (STAI)	91, 2nd year nursing students at Faculty of Health Sciences, Ataturk University, during the 2013-2014 academic years assigned to experimental or control groups 15 minutes prior to an exam.	No statistically significant difference was found between mean final exam scores of the students in the experimental group (66.90 ± 10.65) and the mean final exam scores of the students in the control group (66.51 ± 11.31) ($p > 0.05$) State-Trait Anxiety Inventory mean scores of the students in the experimental group (39.45 ± 3.88) was lower than the mean scores of the students in the control group (41.44 ± 4.69), and the difference between the groups was statistically significant ($p < 0.05$)
Kavurmacı, M., Küçükoğlu, S., & Tan, M.					
Turkey					
Effect of Aromatherapy on Cognitive Test Anxiety Among Nursing Students (2014)	RCT, pre-test-post test	To assess the effect of aromatherapy (Citrus limon [lemon] essential oil) on cognitive test anxiety among nursing students,	Cognitive Test Anxiety Survey (CTAS)	39, Sophomore nursing students: control group in classroom without aromatherapy and intervention group in a classroom with citrus lemon essential oil	There were no significant differences between the control and study groups in relation to preintervention cognitive anxiety scores (mean [μ] = 78.17 and μ = 73.62), respectively. In the control group, there was a 3-point decrease in cognitive test anxiety scores between pretest and post-test. However, there was a significant decrease in cognitive test anxiety scores in the students who received aromatherapy, compared to those who did not ($p = 0.10$). Age and gender were not moderating variables in this study.
Johnson, C. E.					
United States					

The effects of Lavender and Rosemary Essential Oils on Test-Taking Anxiety Among Graduate Nursing Students (2009) McCaffrey, R., Thomas, D. J. & Kinzelman, A. United States	RCT	This study evaluated the ability of aromatherapy to reduce test-taking stress and anxiety during nursing school examinations.	Test Anxiety Scale (TAS) Vital signs (blood pressure and pulse) Focus group discussions	40 graduate nursing students in their final year of their FNP program prior to 3 exams.	There was no significant difference between pre- and posttest mean scores on test 1 where no aromatherapy was used. A significant difference between pre- and posttest means was noted during test 2 when lavender essential oil was used ($t = 3.45$, $p = .003$). A significant difference was also noted between means of pre- and posttests on test 3 where rosemary essential oil was used ($t = 2.01$, $p = 0.01$). There was a significant decrease in test anxiety as evidenced by scores on the Test Anxiety Measure on posttest measures for both test 2 (lavender) and test 3 (rosemary).
Using Aromatherapy to Reduce Nursing Students Stress: a Pilot Study (2008) McCaffrey R. United States	RCT	To examine the ability of lavender and rosemary, used as aromatherapy, to reduce test-taking anxiety and stress.	Perceived Stress Scale (PSS) Vital signs (blood pressure and pulse) Focus group discussions	34, graduate nursing students in their last clinical course of their FNP program prior to 3 exams.	Paired t tests: Showed no significance with blood pressure measurements pre-or-posttest. Showed significant difference in pulse measurement; pulse was lower on post-test than pre-test. Showed no difference in PSS results for exam 1, but showed significant differences for exam 2 using lavender and exam 3 using rosemary. Focus group data indicated students preferred using rosemary and felt it was effective, whereas Lavender relaxed them too much and felt it negatively hindered their focus during the exam.
Effects of Aroma Inhalation on Examination Anxiety (2008) Kutlu A.K., Yilmaz E., & Çeçen, D. Turkey	RCT	To determine the effect of aromatherapy on test anxiety.	State-Trait Anxiety Intervention (STAI) Blood pressure Pulse Sociodemographic questionnaire (student department, nursing/ midwifery/ health official), gender, age, education, place of residence (with family, alone, in hostel), and working vs not working.	50 students in study group and 45 students in control group. All students were from departments of nursing, midwifery, and health official at Manisa Health Science College, Celal Bayar University. The study was carried out in the surgical diseases examination.	The mean anxiety score of the study group (42.76 ± 12.48) was lower than that of the control group (51.51 ± 12.21), and the difference between the groups was statistically significant ($p = 0.002$). This study shows that aroma inhalation decreases examination anxiety.

Results

The number of publications included in this review indicates research on aromatherapy for nursing students with test anxiety is limited. To examine the included research studies, these are organized in categories such as study population (specifically nursing students), the performance/testing conditions, the essential oil intervention used, and the anxiety and test anxiety and sleep measures.

Study Population

The samples of nursing students included undergraduate and graduate students enrolled in traditional 4 year and accelerated baccalaureate and advanced practice nursing programs, at various stages in the curricula – beginning, second year and final semester. Public and private institutions in three countries, the United States, the Philippines and Turkey were represented. Kutlu (2008) did not report data on the students' placement in the curriculum. The sampling technique used was convenience, with sample numbers that ranged from a low of 14 to a high of 91 subjects. The samples were predominantly composed of Caucasian, females and ranged in age from 18 – 55 years of age. Ethnicity was omitted in the reports of six studies (Cevik et al., 2017; Fernandez et al., 2018; Johnson, 2014; Kavurmaci et al., 2014; Kutlu et al., 2008; McCaffrey, 2008; McCaffrey et al., 2009) while age was omitted in three studies (Fernandez et al., 2018; McCaffrey, 2008; McCaffrey et al., 2009). Fernandez et al. (2018) gave no report of gender. These studies focused on nursing students as the sample, but did not report complete demographic data that might affect study design, results, and implications. None of the studies examined associate degree students in their sample.

Performance and Testing Conditions

Testing conditions included written classroom examinations (Johnson, 2014; Johnson, 2019; McCaffrey 2008; McCaffrey et al., 2009), laboratory skill performance, such as return demonstration (Fernandez et al., 2018), and venous blood draws on human subjects (Çevik et al., 2017). Various performance conditions were used to test aromatherapy effects on anxiety and test anxiety. The range of performance conditions were important for nursing education since they can be helpful in pinpointing triggers to test anxiety that faculty may not be sensitive to.

Essential Oil Interventions

The essential oils used in the studies were lavender, rosemary and lemon. Three of the nine studies reported the manufacturer and country of origin of the oil. The most commonly used essential oil delivery methods were nasal inhalation using a handheld personal inhaler (Johnson, 2019; McCaffrey, 2008; McCaffrey et al., 2009) and whole room environmental mechanical diffusers (Cevik et al., 2017; Fernandez et al., 2018; Johnson, 2014). Oil impregnated cotton cloths placed 15-20 cm from the nose (Kavurmaci et al., 2014), incense placed around a classroom (Kutlu et al., 2008) and aromatherapy hand massage (Farner et al., 2019) were each used once. The essential oil treatment began prior to beginning the exam (McCaffrey et al., 2009), 15 minutes before the exam (Johnson, 2014; Kavurmaci et al., 2014; Kutlu et al., 2008), 30

minutes prior (Fernandez et al., 2018), within 60 minutes of the exam (Farner et al., 2019) and during the exam (Cevik et al., 2017; Johnson 2019; McCaffrey et al., 2009). The amount of essential oil used in the personal inhalers varied from 3 – 9 drops. Dilution of the essential oil (EO) in 50 – 100 ml. of water in mechanical diffusers was reported in two studies but concentration properties were not discussed in the reports. Six of the nine studies screened the participants for allergies and respiratory issues such as asthma pre-intervention. Sensitivity to essential oils is a known side effect of aromatherapy and it is common to see fragrance free policies in place in health care agencies and other workplaces. McCaffrey (2008) and McCaffrey et al. (2009) reported information from focus groups post intervention regarding the lavender and rosemary aromas and their effect on test taking. The subjects reported that lavender was alternately too relaxing or caused them agitation as they were fighting to stay alert. On the other hand, rosemary cleared their heads and provided clarity of thought.

Sleep, Anxiety, Test Anxiety Measures

None of the located evidence explored sleep quality and sleep disturbance. Two of the studies used the Test Anxiety Scale (TAS) (McCaffrey 2008; McCaffrey et al., 2009), four used the State Trait Anxiety Inventory (STAI) (Cevik et al., 2017; Fernandez et al., 2018; Kavurmaci et al., 2014; Kutlu et al., 2008), and two used the Cognitive Test Anxiety Scale (CTAS) (Johnson 2014; Johnson 2019). The Westside Test Anxiety Inventory (WTAS) and the General Self Efficacy Scale (GSES) was used once (Farner et al., 2019), as was the Stroop Effect assessment tool (Fernandez et al., 2018). These measures of anxiety and test anxiety are traditionally used to assess the study variables and have been found to be valid and reliable for use in the study populations (Farner, 2019; Johnson, 2014; McCaffrey et al., 2009). Three studies measured vital signs – blood pressure and pulse (Kutlu et al., 2008; McCaffrey 2008; McCaffrey et al., 2009). Kutlu et al. (2008) measured anxiety using a Visual Analogue Scale (VAS). Measurement of vital signs and use of a VAS are common measures of anxiety and stress and are suggested tools that are low cost and simply measured. Pulse was more sensitive to change than blood pressure in the studies that measured vital signs but the location of the pulse was only discussed by Cevik et al. (2017). Only five studies reported significant effects on test anxiety from aromatherapy. Kutlu, Yilmaz, and Çeçen (2008) found that the mean anxiety score of the study group (42.76 ± 12.48) was lower than that of the control group (51.51 ± 12.21), and the difference between the groups was statistically significant ($p = 0.002$). McCaffrey et al. (2009) found that there was a significant decrease in test anxiety as evidenced by scores on the Test Anxiety Measure on posttest measures for both test 2 (lavender) ($t = 3.45$, $p = 0.003$) and on test 3 (rosemary) ($t = 2.01$, $p = 0.01$). Johnson (2014) reported a significant decrease in cognitive test anxiety scores among students who received aromatherapy compared to those who did not ($p=0.10$). Kavurmaci et al. (2015) found that State-Trait Anxiety Inventory mean scores of students in the experimental group (39.45 ± 3.88) was lower than the mean scores of students in the control group (41.44 ± 4.69), and the difference between the groups was statistically significant ($p < 0.05$). Fernandez et al. (2018) found that paired t-test in the 3 measures were significant ($p < 0.000$).

Discussion

The purpose of this scoping review was to identify, summarize, and synthesize current evidence relevant to aromatherapy use in nursing education for nursing students to help reduce test and performance anxiety, and improve sleep quality. This review included studies that presented interventions used by nurse educators to manage performance and testing anxiety.

Evidence on aromatherapy in nursing education is characterized by predominately small samples with methodology and reporting that is incomplete. None of the studies in this review presented a complete picture of their methodology in the full text report to the extent that another researcher could replicate their study.

Only three of the studies reported information on the manufacturer and country of origin of the oil used in the study. The manufacture and extraction methodology used to obtain essential oils are not standardized between manufacturers or countries, thus the purity and safety of the resulting oil can be suspect. Commercially available oils may be adulterated. Product integrity verification of the essential oils through Gas Chromatography/Mass Spectrometry (GC/MS) analysis identifies all of the constituents within a specific essential oil and the percentage of each constituent. If the information is not provided, it may cast doubt on the results (Lilllehei et al., 2015). Essential oil is produced by steam distillation of the flowering heads and leaves of the plant; or in the case of most citrus, by cold pressing the rinds. Many essential oils are manufactured with a solvent that can produce allergic or sensitivity reactions (Buckle, 2016). Three studies did not report pre-screening the subjects for allergy or sensitivity to the essential oils during the informed consent process and prior to the intervention (Farner et al., 2019; McCaffrey, 2008; McCaffrey et al., 2009). This may be a failure to report rather than a failure to address potential health issues. Nonetheless, it is an apparent gap in practice and research procedures.

It is important to know the botanical name of a plant since the common name can include different species that have different chemistry and actions. For example, one lavender is soothing and calming (*Lavandula angustifolia*) while another is stimulating (*Lavandula lactifolia*). *Lavandula* is a native plant ranging from Southern Europe to the Mediterranean Sea with upward of 30 species, subspecies, and hybrids. Lavender's main components are 1,8-cineole B-ocimene, camphor, linalool, linalyl acetate, and terpinen-4-ol (Koulivand et al, 2013). Lavender's core constitutes linalyl acetate and linalool, and whole lavender essential oil is used in aromatherapy or inhalation (Setzer, 2009). Historically, lavender is believed to be relaxing, and utilized for its anxiolytic and calming effects. Several studies were conducted on lavender essential oil effect and mechanism of action on the human neuronal tissues and it is suggested that inhaled lavender oil affects the limbic system (amygdala and hippocampus) (Koulivan et al., 2013). *Lavandula angustifolia* essential oil is a demonstrated anxiolytic that improves sleep and reduces anxiety in animals and humans, without the potential for adverse reactions or side effects of conventional hypnotics and anxiolytics (Park & Lee, 2004; Son et al., 2019). Only three studies in this review reported the botanical names of the plant used to make the essential oil (Cevik et al., 2017; Johnson, 2014; Johnson, 2019).

Three studies used rosemary oil in the intervention. *Rosmarinus officinalis* L. is classified as a small, perennial shrub, part of the mint family (Sayorwan et al., 2013). Rosemary essential oil compounds include linalool and flavonoids (genkwanin, luteolin, and antiprostaglandin). Neurotransmitters, such as enkephalin and endorphins, are secreted by these components which cause sedative effects and therefore reduce anxiety and stress (Fayazi et al., 2011). Historically, rosemary has been credited to enhance memory strength. Research has determined it has anti-inflammatory and antimicrobial properties, which are useful in decreasing cortisol and providing protection from oxidative stress (Atsumi & Tonosaki, 2007). It may also assist in test-taking anxiety through a sense of clarity, increased focus, and improved memory function. These main ethno-pharmacological uses of rosemary have been validated by neuro-pharmacological studies (Rahbardar & Hosseinzadeh, 2020).

Orange, lemon, lime and grapefruit extracts are under the citrus umbrella. The most commonly used citrus oil in aromatherapy is *Citrus aurantium* L. var. *amara* or neroli oil. It has similar effects on cognition just like rosemary. Orange oil was used by Cevik et al. (2017) with no apparent significant effect on anxiety. Johnson (2014; 2019) used lemon oil in her two intervention studies. Lemon oil (*Citrus lemon*) *D-limonene* is regarded as energizing and uplifting as reported by one study that showed subject's norepinephrine levels elevated, endocrine system stimulated and mood improved (Kiecolt-Glaser et al., 2007). Inhaling lemon essential oil (EO) causes anti-stress effects through modulating the 5-HT and dopamine (DA) activities in mice. Lemon EO also induced significant changes in neuronal circuits involved in anxiety and pain in rats after prolonged exposure (for 2 weeks), improved creativity and mood, and thought to have affected heart rhythm (Campêlo et al., 2011; Ceccarelli et al., 2004; Komiya et al., 2006; Ogeturk et al., 2010). Lime, *Citrus aurantifolia*, is used for its energizing aroma due to Pinene and d-Limonene Linalool, which are known to increase mental alertness and cognitive function (Dososky & Setzer, 2018). Grapefruit, *Citrus paradisi*, energizes primarily via +/- Limonene and is recognized as a mood booster and stress relief providing an anxiolytic effect. None of the studies reported in this review used lime or grapefruit oils; both scents may be productive areas for future research. Generally, citrus essential oils are non-toxic, non-mutagenic, and are not hazardous in pregnancy (Dososky & Setzer, 2018; Tisserand & Young, 2014).

There is a lack of robust statistically significant evidence from the review. Areas for future research in nursing education include studies with larger sample sizes and studies that include greater diversity in the student sample. Researchers should consider collaborative multi-site designs. Larger studies and those with inclusion of ethnic minorities are needed to improve the generalizability and validity of research outcomes. Greater diversity can address the cultural nuances surrounding scents. For example, lavender scent is associated with death in some cultures and age groups since lavender oil was historically used in embalming (Micozzi, 2018; Olpin & Hesson, 2019).

Future studies could address the appropriateness of the oil used for the intervention. Is lavender sufficient for an anxiolytic effect? Alternatively, is lemon oil conducive to clarity and improved

memory? What is the titration or dosage of the essential oil administered? How many drops of the oil are sufficient for an anxiolytic or clarity effect? What is the efficacy of a nasal inhaler versus a sachet or a room diffuser? Research may also address the most efficacious delivery method. Lastly, studies should address the less studied citrus essential oils (lime, grapefruit, orange) since their chemical components are thought to be mood elevating, energizing, and invigorating and have potential beneficial effects on cognitive function.

Limitations

Study findings should be considered in the context of limitations, which inform future research directions. There is minimal published literature between 2000 and April 2021 on the use of aromatherapy within the nursing student population, particularly investigating the relationship between nursing students and test-taking anxiety. Thus, it was challenging to find current literature using relevant Medical Subject Heading (MeSH) terms. Accessing articles on this topic, including studies written in all other languages outside of English, and those that are mixed methods may increase the breadth of evidence located.

Conclusion

High stakes testing will likely increase for undergraduate students by 2023 in the United States as the licensing exam will be changing, and will test the candidates' clinical judgement and critical thinking in new ways. The change in the licensing testing will likely increase students' pre-existing anxiety. This review is useful in improving the general knowledge of the different, but positive effects that lavender, rosemary and citrus oils have on anxiety and test anxiety and cognitive test anxiety in nursing students. Although studies demonstrate that lavender, rosemary, and lemon essential oils have significant and effective alternative therapy with anxiolytic or cognitive improvement effects, there is minimal research conducted in this area. This may be due to the general methodological limitations in studying (inhalation) lavender therapy; including small sample sizes, differences or lack of research regarding proper dosage, short-term duration of lavender use, and variability in administration methods.

References

- Atsumi, T. & Tonosaki, K. (2007). Smelling lavender and rosemary increases free radical scavenging activity and decreases cortisol level in saliva. *Psychiatric Research*, 150(1), 89-96. <https://doi.org/10.1016/j.psychres.2005.12.012>
- Buckle, J., 2016. *Clinical aromatherapy: Essential oils in healthcare*. Churchill Livingstone.
- Buyse, D., Reynolds, C., Monk, T., Berman, S., & Kupfer, D. (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Research*, 28(2), 193–213. [https://doi.org/10.1016/0165-1781\(89\)90047-4](https://doi.org/10.1016/0165-1781(89)90047-4)
- Campêlo, L. M., de Almeida, A. A., de Freitas, R. L., Cerqueira, G. S., de Sousa, G. F., Saldanha, G. B., Feitosa, C. M., & de Freitas, R. M. (2011). Antioxidant and antinociceptive effects of citrus limon essential oil in mice. *Journal of Biomedicine & Biotechnology*, 2011, 678673. <https://doi.org/10.1155/2011/678673>
- Cassady, J. & Johnson, R. (2002). Cognitive test anxiety and academic performance. *Contemporary Educational Psychology*, 27, 270-295. <https://doi.org/10.1006/ceps.2001.1094>
- Ceccarelli, I., Lariviere, W. R., Fiorenzani, P., Sacerdote, P., & Aloisi, A. M. (2004). Effects of long-term exposure of lemon essential oil odor on behavioral, hormonal and neuronal parameters in male and female rats. *Brain Research*, 1001(1-2), 78–86. <https://doi.org/10.1016/j.brainres.2003.10.063>
- Çevik, K., Ince, S., Ayçeman, N., & Ergin, E. (2017). Effects of aroma inhalation on anxiety and vital signs of nursing students during their first blood drawing practice. *International Journal of Health Sciences and Research*, 7(2): 243-252.
- Dawood, E., Ghadeer, H.A., Mitsu, R., Almutary, N., & Alenezi, B. (2016). Relationship between test anxiety and academic achievement among undergraduate nursing students. *Journal of Education and Practice*, 7, 57-65.
- Dosoky, N. & Setzer, W. (2018). Biological activities and safety of citrus spp. Essential oils. *International Journal of Molecular Sciences*, 19(7), 1966. <https://doi.org/10.3390/ijms19071966>
- Dossey, B. & Keegan, L., (2016). *Holistic nursing: A handbook for practice*. 7th ed. Aspen Publishers.
- Driscoll R. (2007). Westside Test Anxiety Scale Validation. *Education Resources Information Center*. ERIC Number: ED495968.
- Farner, J., Reed, M., Abbas, J., Shmina, K., & Bielawski, D. (2019). Aromatherapy hand massage for test anxiety and self-efficacy in nursing students: a pilot study. *Teaching and Learning in Nursing*, 14, 225-230. <https://doi.org/10.1016/j.teln.2019.04.008>
- Fayazi, S., Babashahi, M., & Rezaei, M. (2011). The effect of inhalation aromatherapy on anxiety level of the patients in preoperative period. *Iranian Journal of Nursing and Midwifery Research*, 16(4):278-83.
- Fernandez, M., Ferrer, M., Flores, K., Florido, A., Foronda, K., & Lazalita, L. (2018). The effect of lavender aromatherapy to junior nursing students' anxiety, concentration and memory retention. *Advances in Nursing Science & Research*. <https://doi.org/10.39127/ANSR-102/10002>
- Ghasemzadeh Rahbardo, M. & Hosseinzadeh, H. (2020). Therapeutic effects of rosemary (*Rosmarinus officinalis* L.) and its active constituents on nervous system disorders. *Iranian Journal of Basic Medical Sciences*, 23(9), 1100–1112. <https://doi.org/10.22038/ijbms.2020.45269.10541>
- Gibson, H. (2014). A conceptual view of test anxiety. *Nursing Forum*, 49, 267-277 <https://doi.org/10.1111/nuf.12069>
- Greenberg, M. & Narain, A. (June, 2017). Relax with lavender. *American Nurse Today*. 1-5.
- Hornblow, A. R. & Kidson, M. A. (1976). The visual analogue scale for anxiety: A validation study. *Australian & New Zealand Journal of Psychiatry*, 10(4), 339–341. <https://doi.org/10.3109/00048677609159523>

- Johnson C. E. (2014). Effect of aromatherapy on cognitive test anxiety among nursing students. *Alternative and Complementary Therapies*, 20(2), 84-87. <https://doi.org/10.1089/act.2014.20207>
- Johnson C. E. (2019). Effect of inhaled lemon essential oil on cognitive test anxiety among nursing students. *Holistic Nursing Practice*, 33(2), 95-100. <https://doi.org/10.1097/HNP.0000000000000315>
- Kavurmaci, M., Küçükoglu, S., & Tan, M. (2015). Effectiveness of aromatherapy in reducing test anxiety among nursing students. *Indian Journal of Traditional Knowledge* 14(1):52-56
- Kiecolt-Glaser, J., Graham, J., Malarkey, W., Porter, K., Lemeshow, S., & Glaser, R. (2008). Olfactory influences on mood and autonomic, endocrine, and immune function. *Psychoneuroendocrinology*, 33(3):328-339. <https://doi.org/10.1016/j.psyneuen.2007.11.015>
- Komiya, M., Takeuchi, T., & Harada, E. (2006). Lemon oil vapor causes an anti-stress effect via modulating the 5-HT and DA activities in mice. *Behavioural Brain Research*, 172(2), 240-249. <https://doi.org/10.1016/j.bbr.2006.05.006>
- Koulivand, P. H., Khaleghi Ghadiri, M., & Gorji, A. (2013). Lavender and the nervous system. *Evidence-Based Complementary and Alternative Medicine: eCAM*, 2013, 681304. <https://doi.org/10.1155/2013/681304>
- Kutlu, A., Yilmaz, E., & Çeçen, D. (2008). Effects of aroma inhalation on examination anxiety. *Teaching and Learning in Nursing*, 3, 125-130. <https://doi.org/10.1016/j.teln.2008.04.005>
- Lawless, J. (2014). *The encyclopedia of essential oils*. Harper Thorsons.
- Lillehei, A., Halcon, L., Svik K., & Reis, R. (2015). Effect of inhaled lavender and sleep hygiene in self-reported sleep issues: A randomized controlled trial. *Journal of Alternative and Complementary Medicine*, 21(7), 430-438. <https://doi.org/10.1089/acm.2014.0327>
- McCaffrey R. (2008). Using aromatherapy to reduce nursing students' stress: A pilot study. *Beginnings (American Holistic Nurses' Association)*, 28(4), 26-27.
- McCaffrey, R., Thomas, D. J., & Kinzelman, A. O. (2009). The effects of lavender and rosemary essential oils on test-taking anxiety among graduate nursing students. *Holistic Nursing Practice*, 23(2), 88-93. <https://doi.org/10.1097/HNP.0b013e3181a110aa>
- Micozzi, M. S. (2019). *Fundamentals of complementary, alternative, and integrative medicine*. Elsevier.
- Ogeturk, M., Kose., E., Sarsilmaz., M., & Akpinar., B. (2010). Effects of lemon essential oil aroma on the learning behaviors of rats. *Neurosciences*, 15(4):292-293. PMID: 20956933
- Olpin, M. & Hesson, M. (2021). *Stress management for life: A research-based, experiential Approach*, 3rd ed. Wadsworth/Cengage Learning.
- Page, M., McKenzie, J., Bossuyt, P., Boutron, I., Hoffmann, T., Mulrow, C., Shamseer, L., Tetzlaff, J., Akl, E., Brennan, S., Chou, R., Glanville, J., Grimshaw, J., Hróbjartsson, A., Lalu, M., Li, T., Loder, E., Mayo-Wilson, E., McDonald, S. ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372(71). doi:10.1136/bmj.n71
- Park, M. K. & Lee, E. S. (2004). The effect of aroma inhalation method on stress responses of nursing students. *Taehan Kanho Hakhoe chi*, 34(2), 344-351. <https://doi.org/10.4040/jkan.2004.34.2.344>
- Quinn, B. & Peters, A.A. (2017). Strategies to reduce nursing student test anxiety: A literature review. *The Journal of Nursing Education*, 56(3), 145-151. <https://doi.org/10.3928/01484834-20170222-05>
- Sayorwan, W., Ruangrunsi, N., Piriyaunyporn, T., Hongratanaworakit, T., Kotchabhakdi, N., & Siripornpanich, V. (2013). Effects of inhaled rosemary oil on subjective feelings and activities of the nervous system. *Scientia Pharmaceutica*, 81(2), 531-542. <https://doi.org/10.3797/scipharm.1209-05>
- Scarpina, F., & Tagini, S. (2017). The stroop color and word test. *Frontiers in Psychology*, 8:557. <https://doi.org/10.3389/fpsyg.2017.00557>
- Setzer, W. N. (2009). Essential oils and anxiolytic aromatherapy. *Natural Product Communications*, 4(9): 1305 - 1316. <https://doi.org/10.1177/1934578X0900400928>
- Son, H. K., So, W. Y., & Kim, M. (2019). Effects of aromatherapy combined with music therapy on anxiety, stress, and fundamental nursing skills in nursing students: A randomized controlled trial. *International Journal of Environmental Research and Public Health*, 16(21), 4185. <https://doi.org/10.3390/ijerph16214185>
- Spielberger, C. D. (1980). *Test anxiety inventory*. Consulting Psychologists Press.
- Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the state-trait anxiety inventory*. Consulting Psychologists Press.
- Spurlock, Darrell. (2013). The promise and peril of high-stakes tests in nursing education. *Journal of Nursing Regulation*, 4, 4-8. [https://doi.org/10.1016/S2155-8256\(15\)30172-1](https://doi.org/10.1016/S2155-8256(15)30172-1)
- Tisserand, R.; Young, R. (2014). *Essential oil safety*, 2nd ed. Elsevier.
- Tricco, A., Lillie, E., Zarin, W., O'Brien, K., Colquhoun, H., Levac, D., Moher, D., Peters, M., Horsley, T., Weeks, L., Hempel, S., Aki, E., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M., Garritty, C. ... Straus, S. (2018). PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine*, 169(7):467-473. <https://doi.org/10.7326/M18-0850>