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ORIGINAL ARTICLE

Effect of lavender and rosemary aromatherapy on test anxiety in chiropractic students

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ABSTRACT

Objective: Test anxiety is a debilitating disorder that can impair cognitive performance and affect academic success. Aromatherapy is commonly used for relaxation therapy. The primary aim of the study was to determine if nasal inhaler aromatherapy, utilizing a blend of rosemary and lavender essential oils, could be a useful strategy to reduce testing anxiety in students.

Methods: This study recruited first trimester chiropractic students enrolled in both Neuroanatomy I and Biochemistry I. A randomized crossover design was utilized over 2 study days during final exams, with a 2-day wash-out period. Participants were randomly assigned into groups based on results of test anxiety analysis. On each day, students were given a nasal inhaler with either an aromatherapy blend of lavender and rosemary essential oils or distilled water as the control. Students completed pretest surveys and posttest surveys to rate their anxiety levels. Paired sample *t*-tests were performed to determine group differences in test anxiety. Both intention-to-treat and per-protocol analyses were conducted.

Results: Forty-five students were randomly assigned into the study, whereas only 38 completed per-protocol. Between group comparisons showed no statistically significant difference between change in anxiety scores between aromatherapy and control for both intention-to-treat ($p = .10$) and per-protocol ($p = .07$).

Conclusion: Use of personal inhalers and aromatherapy diffusers were not shown to reduce test anxiety in a chiropractic population under high-stakes examination. Other options should be explored for future research.

Key Indexing Terms: Test Anxiety; Aromatherapy; Chiropractic; Lavandula; Rosmarinus

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INTRODUCTION

Test anxiety is a situation-specific, bidimensional phenomenon resulting from physiological and psychological components experienced during examinations.[1] The seriousness of testing anxiety is demonstrated in impaired test performance.[2] As a result of test anxiety, test performance may not accurately reflect the acquired knowledge, understanding, and skills of college students during written and manual skill examinations. Chiropractic and medical educational institutions are known to have difficult courses and elevated credit loads.[3,4] The prevalence of test anxiety is high among general college and chiropractic students alike; although, the above normal course load of chiropractic programs may exacerbate test anxiety in chiropractic students.[3] By learning the causes and effects of test anxiety, as well as management strategies, students can benefit both academically and physically.[3–6]

Aromatherapy is 1 strategy used to reduce anxiety by college students.[4,6–10] The rise of natural alternatives has driven an increased availability and use of aromatherapy products. Aromatherapy uses the chemical components of essential oils and their effects as potential natural remedies for a variety of ailments.[9,11–13] Essential oils are made of molecules containing various chemical structures that provide therapeutic effects on the body. Systems of the body that are impacted by essential oils are, but not limited to, the nervous system, endocrine system, integumentary system, and the digestive system.[14] Specifically, the compounds linalool, limonene, and pinene have been shown to have antidepressant and antianxiety effects. An increase in exam scores is associated with implementation of aromatherapy.[6,15]

A common way of aromatherapy inhalation is the use of personal aromatherapy devices, such as nasal inhaler

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stick. A nasal or aromatherapy inhaler, also known as an aromastick, is a device that is held under the nose and inhaled, encouraging deep breathing and relaxation.[13] Anyone can simply add a drop of oil to an individual inhaler and be able to smell the essential oil molecules. Individual aromatherapy inhalers are portable, cost effective, and can be taken anywhere the student studies or takes examinations.[16]

Rosemary, scientifically known as *Rosmarinus officinalis L.*, is an aromatic evergreen shrub.[17] Major chemical constituents of rosemary essential oil include camphor, α-pinene, cineole, camphene, and α-terpene. Inhalation of rosemary essential oil was previously shown to improve cognition, mood, and memory by decreasing corticosterone concentrations, while stimulating release of dopamine. It is postulated that these effects on stress response are due to the α-pinene concentration of rosemary.[18,19] A study by McCaffrey et al[6] found that rosemary aromatherapy significantly reduced test-taking anxiety in graduate nursing students. Similarly, participants randomly assigned to rosemary essential oil aromatherapy showed significant improvement in working memory. Several other studies have confirmed the stimulatory effect of rosemary on the central nervous system.[14,20–22]

Lavender, scientifically known as *Lavandula angustifolia,* is an aromatic flower of the lavender plant known for its calming effects and sedative nature.[9,14] Major chemical constituents of lavender essential oil are linalool, linalyl acetate, myrcene, cis-linalool oxide, lavandulyl acetate, trans-linalool oxide, and ocimene.[16] Research has shown that inhalation of lavender oil has positive stimulatory effects on the central nervous system and brain.[1,20–23]

Previous research shows the prevalence of test anxiety among chiropractic and other university students[2,4]; however, there remains minimal evidence related to reducing test anxiety. Because aromatherapy inhalers are affordable and easy to bring to any examination, they may be a possible strategy to decrease testing anxiety for chiropractic students who experience negative emotional and physical effects. The goal of this study is to assess the role of a rosemary-lavender oil blend on test anxiety utilizing personal diffusers during a high-stakes examination.

METHODS

Sample and Setting

Following approval by Palmer College of Chiropractic institutional review board, convenience sampling was used to recruit students who were eligible if they were dual enrolled in both Biochemistry I (BC) and Neuroanatomy I (CNS). These first trimester courses were chosen due to similar difficulty level, and both final exams were given first thing in the morning on the first and second day of finals week.

During recruitment in BC, informed consent was provided, and students were given a brief overview of the study. After the overview, students were given the opportunity to smell the aromatherapy blend in the nasal inhaler. The recruited students filled out the informed consent document, demographic information, and rated their anxiety level at that moment on a Westside Test Anxiety Scale (WTAS). The WTAS consists of 10 questions ranging from 1 to 5, with 1 being "not true" to 5 being "always true." Previous studies have indicated that data from WTAS is reliable.[24,25] Following completion of the WTAS, data were deidentified and used for randomization into 2 groups stratified by gender. Students were excluded from the study if they were not dual enrolled in both courses.

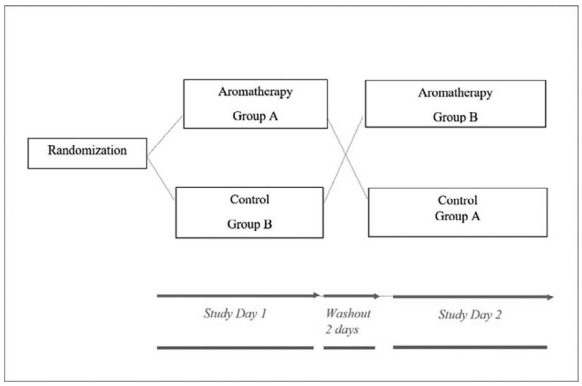

Figure 1 - Flow diagram of the randomized, crossover design used in this study.

The crossover study took place during 2 days of the October 2018 trimester final examinations. Participants were expected to report to their assigned rooms 20 minutes early on both days. Students were blinded to their assigned group. Group A received aromatherapy on day 1 and control on day 2, whereas Group B received the control on day 1 and aromatherapy on day 2. A washout period of 2 days occurred between testing days, as displayed in Figure 1. Additionally, students were asked to refrain from wearing perfume on testing days.

Intervention

Bench top research determined that a 50/50 mixture of rosemary and lavender oils (dōTERRA, Pleasant Grove, UT, USA) yielded a pleasant mixture, not overwhelmed by a single scent. For each personal inhaler, 5 drops of each oil were found to have a strong enough aroma to last through the duration of the test. Similar volume of distilled water was dropped onto the control inhalers. Nasal inhalers were assembled by study members 2 hours prior to the start of the final examination.

Final Exam Test Anxiety Measurement

Before the start of each final exam, students were asked to assess their current level of test anxiety on an 11-point Likert scale, ranging from 0 (no anxiety) to 10 (worst anxiety ever). Immediately following each exam, students rated their anxiety again on the same 11-point Likert scale along with an additional questionnaire. Items on the additional questionnaire included the number of times students smelled their personal inhaler during the exam, side effects of the aromatherapy that may have occurred, and number of hours spent studying for the exam.

Table 1 - Participant Characteristics of Those Who Completed Per-Protocol

	Intention-to-Treat (ITT)			Per-Protocol (PP)		
	Gender		Average	Gender		Average
	Male, %	Female, %	Age, yr	Male,%	Female, %	Age, yr
Aromatherapy first (Group A)	41	59	22.7	37	63	22.5
Control first (Group B)	44	56	22.9	37	63	22.6

Statistics

Deidentified data were entered into Excel (Microsoft Corp, Redmond, WA, USA) and analyzed using SPSS version 22.0 (IBM Corporation, Armonk, NY, USA). Both intention-to-treat principals utilizing mean imputation for missing data and per-protocol samples were analyzed. Pretest and posttest anxiety scores were compared between the intervention and control group with paired samples *t*-tests. A Shapiro-Wilk test was used to assess normality. Descriptive statistics assessed participant characteristics and postexam survey questions. A *p*-value of $< .05$ was considered statistically significant.

RESULTS

A total of 92 students were enrolled in both BC and CNS. Twenty-three other students were in either 1 course or the other but did not qualify to participate in the study because they were not enrolled in both courses. There were 45 total students who were randomly assigned into the study and analyzed under intention-to-treat analysis, including 43% male and 57% female. Thirty-eight participants had completed all data collection points and in the correct groups (per-protocol). Mean WTAS for the group was 2.7, putting our cohort into the high-normal test anxiety range. Participant characteristics were similar across all groups, as shown in Table 1.

All results were found to be normally distributed. Pretest anxiety and change in test anxiety were assessed for each exam day regardless of treatment to evaluate the influence of the exam on student test anxiety. Paired *t*-test results indicate that there was no significant difference between anxiety scores before both exams ($p = .32$) and between the overall change in anxiety following the exams ($p = .10$). Therefore, student anxiety was similar both before and after each test, indicating different exams produced similar effects.

Anxiety scores of the students before and after the examination for all participants randomly assigned into the trial are found in Table 2. Overall, intention-to-treat analysis did not show a significant difference between use of aromatherapy compared with the control ($p = .10$).

Table 3 represents the participants of the study that followed study procedures, only including students who complied with all study procedures and completed all data collection points. Aromatherapy again did not influence test anxiety measures ($p = .07$) when both groups were considered.

Table 4 reveals additional information gained from the study participants from the short answer questionnaire. Most of the participants smelled the inhalers 1 to 5 times during each examination. In the aromatherapy group on the second day of the study, 100% of students reported that they would consider using aromatherapy in the future to reduce test anxiety. Similarly, 88% of students in the control group agreed on aromatherapy use in the future. Three study participants reported having adverse effects. One student reported that the aromatherapy blend "kind of upset his stomach." Two other study participants indicated that they had side effects; however, they did not report what the side effects were in the short answer questionnaire.

DISCUSSION

Assessing the value of aromatherapy nasal inhalers to help chiropractic students with test anxiety was the main goal of the study. Although, there was no statistical difference between groups regarding test anxiety levels, important insight on aromatherapy and test anxiety was gained. The results show that the use of aromatherapy

Table 2 - Pretest and Posttest Anxiety Scores Completed by Intention-To-Treat

		Day 1			Day 2			Within Group Difference
		Pretest	Posttest	Change	Pretest	Posttest	Change	
Aroma first (Group A)	Mean (SD)	5.1 (1.8)	3.1 (2.3)	2.0 (2.1)	4.6 (1.9)	2.6 (1.9)	2.0 (1.7)	$p = .98$
	Sample size	23	23	23	23	23	23	
Control first (Group B)	Mean (SD)	5.3 (2.4)	4.4 (2.7)	0.9 (1.5)	5.0 (2.7)	2.8 (2.4)	2.2 (2.5)	$p = .03$
	Sample size	23	23	23	23	23	23	
Treatment effect	Mean (SD)	—	—	—	—	—	—	−0.7 (2.7)
	95% CI	—	—	—	—	—	—	−1.5 to 0.1
	Sample size	—	—	—	—	—	—	45
	t-test (*p* value)	—	—	—	—	—	—	$p = .10$

Table 3 - Pretest and Posttest Anxiety Scores Completed Per-Protocol

		Day 1			Day 2			Within Group Difference
		Pretest	Posttest	Change	Pretest	Posttest	Change	
Aroma first (Group A)	Mean (SD)	5.4 (1.8)	3.2 (2.3)	2.1 (2.0)	4.7 (1.9)	2.6 (2.0)	1.9 (1.7)	$p = .93$
	Sample size	19	19	19	19	19	19	
Control first (Group B)	Mean (SD)	5.5 (2.5)	4.6 (2.9)	0.8 (1.6)	5.4 (2.7)	2.9 (2.5)	2.5 (2.6)	$p = .02$
	Sample size	19	19	19	19	19	19	
Treatment effect	Mean (SD)	—	—	—	—	—	—	−0.8 (2.7)
	95% CI	—	—	—	—	—	—	−1.7 to 0.5
	Sample size	—	—	—	—	—	—	38
	t-test (*p* value)	—	—	—	—	—	—	$p = .07$

decreased the anxiety of participants, according to the posttest anxiety questionnaire, although it was not statistically significant. The results of the WTAS indicate that most students experience anxiety. It is important to get a baseline anxiety for students because many students experience anxiety in varying degrees and at different times.[26]

In addition to test anxiety, nursing, dental, and medical students demonstrated moderate to severe anxiety during the COVID-19 pandemic.[27–29] Depression levels are closely related to anxiety levels and were also impacted in college students during the epidemic as well.[27] Another study showed that anxiety related to COVID-19 is more prevalent in people younger than 40 years of age potentially due to increased access to information.[28,29] This may also be why college students have increased anxiety during the epidemic.

This study is the first known use of personal aromatherapy nasal inhalers in a chiropractic setting. The study by Wells et al[4] utilized lemon and rosemary essential oils on chiropractic student test anxiety using waterless diffusers. Our study tried to improve on the feasibility study by Wells et al[4] by using a different aromatherapy blend applied to individual nasal inhalers, utilizing a crossover design, and a higher stake testing period of final exams. Even with these modifications, the results of our study failed to demonstrate a statistically significant difference in students' test anxiety. Similarly, test anxiety measurements in high stakes testing in a nursing program utilizing lemon essential oil distributed via personal aromatherapy diffusers also showed no statistical difference between use of aromatherapy and control.[30]

Aromatherapy combined with music therapy demonstrated a reduction in test anxiety and stress in nursing students.[31] University students also had a decrease in test anxiety after doing mindfulness-based coloring.[31] Combining different methods to reduce test anxiety may be beneficial to help students and could be useful for further investigation.

McCaffrey et al[6] reported that a blend of rosemary and lavender essential oils did reduce test anxiety in nursing school students. Our study is comparable due to the utilization of the same essential oils and the fact that nursing student credit hours and class work requirements are comparable with that of chiropractic students.[4,6] Our method of delivering the oil to the study participant varied. In this study it was delivered via a nasal inhaler that was

Table 4 - Results From Postfinal Short Answer Questionnaire

		Day 1 – Biochemistry Exam		Day 2 – Central Nervous System Exam	
		Aromatherapy (Group A), %	Control (Group B), %	Aromatherapy (Group B), %	Control (Group A), %
Number of times inhalers were smelled	0	9	35	0	42
	1–5	61	65	55	54
	6–10	22	0	45	0
	11–15	4	0	0	0
	16+	4	0	0	0
Hours studied for exam	0–4	26	4	15	7
	5–9	44	39	40	35
	10–14	17	3	30	35
	15–19	13	17	15	15
	20+	3	0	0	8
Future use aromatherapy	Yes	Not asked	Not asked	100	88
	No	Not asked	Not asked	0	12
More difficult test	CNS	Not asked	Not asked	25	40
	BC	Not asked	Not asked	75	60

BC: Biochemistry I; CNS: Neuroanatomy I.

filled with the essential oil blend, whereas McCaffrey et al[6] used full-room diffusers in the classroom.

Measuring physiological components to see the impact of the oil on the body requires further investigation. Participants from other aromatherapy studies show significant changes in their bodies physiology when inhaling essential oils. The physiological parameters that have been looked at include blood pressure, heart rate, respiratory rate, skin temperature, and brain wave activity.[6,20,22] The electroencephalogram results of the study by Sayorwan et al[20] showed decreased alpha 1 and alpha 2 waves, as well as increased beta waves in the anterior part of the brain. These results indicate that inhalation of rosemary essential oil provides stimulatory effects to the brain and an overall positive impact on autonomic nervous system function and mood.[20] Autonomic nervous system results from Hongratanaworakit[22] show that rosemary essential oil increased blood pressure and respiratory rate, which means that autonomic arousal occurred. The same study also demonstrated positive emotional results with rosemary essential oil aromatherapy. Furthermore, an increased overall attentiveness, alertness, vigor, and cheerfulness was reported by the participants of the study.[22]

Results may have been impacted by the amount of male and female participants. It is important to acknowledge that female participants are not only more sensitive to odors than male participants,[4] but research has demonstrated that females experience more test anxiety than males.[26] Additionally, females are more emotional than males, and therefore, express emotions, such as anxiety, more intensely.[26] The current study was nearly balanced in gender, like Wells et al.[4] Other studies consisted of nearly all females, potentially impacting research results.[30]

Lower test scores were associated with higher levels of test anxiety; however, they also found that students with high test anxiety who were placed in a neutral control condition with no induced stress or self-awareness outscored the students with lower test anxiety.[32] This concept of analyzing the student's exam scores to the various level of anxiety in the students would be something to investigate further. To do this, a thorough evaluation of test anxiety levels for each participant needs to be assessed with more specific questions, such as the Cognitive Test Anxiety Score form that Cassady[32] used.

Chiropractic, like aromatherapy, is recognized as a complementary and alternative therapy. In a feasibility study involving aromatherapy for test anxiety in a chiropractic student population, 85.7% of chiropractic students considered using aromatherapy in the future.[4] In our study, 100% of the aromatherapy group and 88% of the control group on day 2 also indicated that they would use aromatherapy in the future.[4] Future studies should explore the reasons behind aromatherapy use.

Only 3 students reported experiencing adverse effects during the study. One student wrote that the aromatherapy oil upset his stomach. It is also possible that the student had nausea, which is a reported symptom of test anxiety.[33,34] The intended use for the lavender and rosemary was to decrease anxiety. Peppermint essential oil has been shown to help with nausea.[13] Future studies could add peppermint essential oil to the blend to help with the nausea symptom of test anxiety. The other 2 students who indicated experiencing adverse effects of the aromatherapy blend did not report them. A study by Dyer et al[13] indicated that cancer participants did not experience any ill effects from the aromastick and that its odor did not intrude into the spaces of others.

Limitations

The nasal inhalers are bright white plastic tubes and are the size and comparable shape to a feminine product. Therefore, the look of the nasal inhaler may have played into some disinterest in smelling the essential oils in front of peers. Additionally, the nasal inhaler is made of a plastic twist-on cap that covers the stand with the cotton absorption strip that contained the essential oil blend. To smell the essential oils, the participants had to take the cap off the nasal inhaler. As a result of taking the cap on and off during the test, participants may have decided to get through the exam instead of following through with smelling the nasal inhaler as often as they would have liked. Furthermore, the sample size was small, and the students ranged from ages 20 to 29 years; therefore, results may vary for other populations.

Out of 92 students who were eligible, only 45 students chose to participate in the study. It is possible that the students who chose to not participate in the test did not want to arrive early on the day of their final examination. Another reason for the lack of participation could be that students did not like the smell of the essential oil blend when it was passed around in class. Of the 45 students who chose to participate in the study, only 38 students chose to follow through the study protocol as planned from start to finish. Students who did not complete the study went to the wrong assigned room, forgot to check in to take the pretest survey, or did not complete posttest survey and/or short-answer questionnaire. As a result of the group size in this study, future studies should try to recruit a larger sample.

Improvements upon this research topic for further studies include measuring physiological components to see the impact of the oil on the body, increasing the study population, looking at how the stress of the exam may have affected the exam scores positively or negatively, and using other forms of measurement of test anxiety, such as the Cognitive Test Anxiety Scale survey that contains more specific questions regarding test anxiety and students.[32]

CONCLUSION

This is the first study to assess the effect of using a personal aromatherapy device on test anxiety in a chiropractic student sample using a randomized, controlled crossover design. Use of personal inhalers and aromatherapy diffusers were not shown to reduce test

anxiety in these students during a high-stakes examination. Therefore, future research should explore other options.

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