EDUCATION
RESEARCH SERVICE

ORIGINAL ARTICLE

Aromatherapy for test anxiety in chiropractic students: *A feasibility study*

Breanne M. Wells, DC, MS, Lia M. Nightingale, PhD, Dustin C. Derby, EdD, Stacie A. Salsbury, PhD, RN, and Dana Lawrence, DC, MMedEd, MA

Objective: Up to 85% of college students experience test anxiety, which may contribute to decreased academic performance. The purpose of this study was to assess the feasibility of recruiting chiropractic students for a randomized trial involving aromatherapy for anxiety reduction.

Methods: This study enrolled chiropractic students who were randomly assigned to separate rooms during a biochemistry test. Waterless diffusers dispersed a lemon and rosemary blend of essential oils in the experimental room and water in the control room. Students completed pretest surveys rating current and general anxiety. Posttest surveys included rating current anxiety. Analysis of covariance (ANCOVA) was preformed to determine within- and between-group differences for current anxiety. Feasibility was the primary aim, and the statistical significance of anxiety test scores between rooms was the secondary aim.

Results: Sixty-four students were included in the study. The feasibility of research methods was noted for adherence to the study protocol (informed consent, randomization, and survey distribution and completion) and resource allocation. Design improvements are required in recruitment methods, follow-up surveys, and intervention blinding. ANCOVA for between-group comparisons showed no statistically significant difference between groups' pre- and posttest anxiety scores ($p = .22$). Two reported side effects, eye and sinus irritation, could not be attributed to treatment group. Most students were willing to use aromatherapy for test anxiety in the future.

Conclusion: We demonstrated feasibility in conducting a randomized study to measure the influence of aromatherapy on test anxiety in chiropractic students. A powered, randomized study is needed to determine if aromatherapy may be effective in reducing test anxiety.

Key Indexing Terms: Education; Chiropractic; Aromatherapy; Educational Assessments

J Chiropr Educ 2021;35(1):50–58 DOI 10.7899/JCE-18-36

INTRODUCTION

Test anxiety is defined as the experience of distress, worry, or fear before, during, or after a test that can cause mental distraction, difficulty with memory recall, and physical symptoms, such as nausea, diarrhea, headache, and tachycardia, and may result in poor performance.[1,2] Among college students, test anxiety may contribute to decreased academic performance.[2–5] Test anxiety can also impact a person's ability to learn, stimulate task-irrelevant thinking, and reduce intrinsic motivation and cognitive capabilities available for tasks, thus decreasing academic achievement.[6]

Various interventions have been studied to identify strategies to reduce test anxiety.[6–9] Most studies are small feasibility studies with certain methodological issues associated with them, such as attrition, insufficient classroom size, and survey timing.[10] Aromatherapy has been shown to be an effective way to reduce test anxiety in college students.[2,10–12] Aromatherapy is a natural treatment using the chemical structure and effects of essential oils that are extracted and distilled from a plant's flower, bark, stems, roots, peel, or leaf.[11,13–15] It has been linked to positive physiological effects and improved exam scores in nursing students.[11] The most common yet rare adverse events with essential oils are eye, mucous membrane, and skin irritation and sensitization, particularly to oils containing phenols and aldehydes.[16] Essential oils can be absorbed into the body through the olfactory system, which is connected to the limbic system and thus may relate to human emotions.[12]

Rosmarinus officinalis (rosemary) was associated with reduced overall anxiety and increased self-esteem in elderly Korean women[15] and enhanced performance, attention, and memory in healthy adults.[14,17] A study involving graduate nursing students showed that rosemary decreased

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-09-19 via free access

test anxiety. Students also reported that rosemary helped recall information needed for testing, cleared the mind, and improved concentration and focus.[2] Aromatherapy has also been shown to be a safe, easy, and cost-effective method for reducing test anxiety.[2]

Citrus limon, also known as lemon, is another essential oil with positive effects on cognitive function, attention, and memory.[13] The effects of lemon have been studied in college nursing students and were noted to be an effective strategy to reduce test anxiety.[10] It also had positive effects on anxiety in elderly Korean women.[15]

Rosemary and lemon essential oils have been blended together in previous research to heighten concentration and memory.[13] The blend also enhanced the ability to form abstract ideas in patients with Alzheimer's disease.[13] Inhalation of essential oils via a diffuser has been previously utilized without reported adverse events.[2,10] The safety of these 2 essential oils was demonstrated by routine laboratory tests of blood analysis and biochemical examinations before and after treatment of the oils. A wide margin of safety was determined for rosemary and lemon essential oils, as no side effects of oil use were found.[13]

Most research related to the impact of aromatherapy on study test anxiety has been done in nursing student populations.[5,10,18,19] Ours shifts the focus to a population of chiropractic students, a group that has not been studied. In chiropractic education, the composition of students is 60% males and 40% females, while that of nursing programs is 80%–100% female.[3,20,21] Previous work by Zhang and Henderson[3] illustrated the rigor and accompanying test anxiety in a 1st-year chiropractic curriculum impacting 85% of students assessed. If test anxiety causes negative physical and emotional effects and decreases academic performance, developing strategies to decrease test anxiety may have profound effects and help students succeed academically and grow into better health care professionals. Thus, gathering information in this population may help provide information to power a larger study. Additionally, it may also help find coping strategies to help students alleviate anxiety in rigorous programs of study.

Lemon and rosemary aromatherapy may be an effective way to mitigate test anxiety among chiropractic students. The 1st aim of the study was to assess the feasibility of conducting a randomized controlled study with chiropractic students. The 2nd aim was to evaluate if the between-group differences were statistically significant for the aromatherapy group having lower test anxiety than the control group.

METHODS

Sample and Setting

Approval for this study was obtained from the Palmer College of Chiropractic (PCC) Institutional Review Board (2016B177; January 9, 2017). Convenience sampling was used to recruit students enrolled in Biochemistry 1 during the spring 2017 trimester. This class is scheduled during a student's 1st trimester at PCC in Davenport, Iowa, with 5 examinations completed throughout the trimester. The study took place during the 2nd examination of the trimester testing protein structure and function and enzyme kinetics. Informed consent documents were obtained 8 days prior to the start of the study after a brief overview with the lead investigator; however, students could decide to join the study until the day before. In the overview, participants were told that they may or may not have aromatherapy on the day of the test and that the aim of the study was feasibility and to see if aromatherapy may help in alleviating test anxiety. Daily reminders about the study were given to students for 1 week prior to the study day. During the study overview, students were given the opportunity to smell the aromatherapy blend. Students who required extra time for testing were excluded from the testing sample.

Study Design

Students signed the informed consent document and were randomized equally by gender into 1 of 2 rooms to take the test using a randomization website. Rooms used for the assessment were identical in size (198 m^2 [2138 ft^2]) and layout to minimize variability and to help with blinding. The classroom was arranged in tiered seating with 4 rows. Room assignment was posted on the course page within the learning management system. On the day of the study, students reported to a designated study team member for check-in. Students were offered snacks after the test as a thank-you for participation.

Intervention

Students and the lead investigator were masked to the aromatherapy room. Students who were assigned to the experimental room took their test in a room in which a rosemary–lemon essential oil blend was diffusing. A mixture of 10 mL of rosemary essential oil and 5 mL of lemon essential oil was filled in 15-mL glass amber bottles that were dispersed via waterless diffusers. Approximately 8 mL of the rosemary–lemon mixture was diffused from each of 5 diffusers over the assessment period. The control room used identical diffusers, except that distilled water was used in place of essential oils. The 2 rooms were arranged as similar as possible to maintain consistency in testing conditions between the experimental and control groups. Ten diffusers were equally spaced throughout both rooms, 5 per room, to ensure that all participants received an equal strength and amount of aroma. A waterless diffuser is preferred in large rooms to strengthen the aroma. Study team members started the diffusers 15 minutes prior to the exam and monitored the diffusers throughout the exam. Waterless diffusers and essential oils were donated in kind by dōTERRA (Pleasant Grove, UT).

Data Collection

Students completed the Westside Test Anxiety Scale (WTAS) prior to their examination to assess baseline test anxiety levels in each group as a means to describe the sample in terms of the number of chiropractic students who potentially experience test-related anxiety impairments and to assess the equivalence of this trait between

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-09-19 via free access

Table 1 - Participant Characteristics of Biochemistry 1 Students

	Aromatherapy group ($n = 21$)	Control Group ($n = 22$)	Combined rooms ($n = 43$)
Average WTAS test anxiety score, mean (SD)	3.01 (.89)	2.6 (.77)	2.81 (.83)
Sex			
Males	10	10	20
Females	11	12	23

WTAS, Westside Test Anxiety Scale; SD, standard deviation.

the study groups. The WTAS is a general test anxiety survey consisting of 10 questions answered with a 5-point frequency scale, ranging from 1 (not true) to 5 (always true). Data from the WTAS have been shown to be reliable and valid in previous studies with health science student populations.[22–25]

As is consistent with intervention studies for anxiety, students completed a single-item, 5-point, frequency-type ordinal scale, with ratings from 1 (no anxiety) to 5 (worst anxiety ever), immediately pre- and posttest to assess current anxiety levels in relation to the aromatherapy intervention.[26] Additionally, short-answer questions on participant demographics and study habits were answered after completing the posttest current anxiety rating. Finally, students completed a 1-week e-mail follow-up survey through SurveyMonkey (San Mateo, CA) that included information on side effects, thoughts about study feasibility and test anxiety, and future use of aromatherapy to manage test anxiety.

Data Analysis

A feasibility study evaluates whether a research study can be implemented, should the researchers proceed with a study, and, if so, how.[27] Secondary outcome measures explored the relationship for between- and within-group differences for current anxiety, rated pre- and posttest. This was evaluated with analysis of covariance (ANCOVA). ANCOVA helps to increase the sensitivity of F tests of main effects and interactions by reducing the error variance. It also assesses within- and between-group differences.[28] Missing values were not analyzed. Descriptive statistics assessed demographic data. The data were analyzed using SPSS version 22.0 (Chicago, IL). Qualitative questions were assessed with content analysis.

RESULTS

Participant Characteristics

Eighty-nine students were enrolled in Biochemistry 1. The exact number of students present on the day the study was introduced was 75; 11 students were ineligible due to special testing accommodations. Participant characteristics were similar between the control and aromatherapy groups (Table 1). All were between 18 and 29 years of age. The average general test anxiety score on the WTAS was higher for the aromatherapy room, which was found to have moderately high test anxiety (3.00 out of 5), compared to the control room, which had a high normal rating for test anxiety (2.60 out of 5). The overall average WTAS score for both rooms was 2.8, which is considered in the high range of normal test anxiety.[25] A mean comparison between treatment and control groups indicated equality of variances between groups (Levene test; $F = .950$, $p = .335$) but only chance differences ($t[52] = 1.605$, $p = .116$). Eighteen students included qualitative comments about the impact of test anxiety on their academic performance. Six students reported positive attributes from test anxiety, such as "it helps me focus." Twelve students noted negative aspects of test anxiety, such as "it impedes my performance on

exams because I try to get done quickly to get out of the exam." One student offered a mixed comment on test anxiety: "It makes me want to study harder to do well on the test; however, during the test, it impacts my performance because it makes it hard to concentrate, and I often second-guess my answers."

Aim 1: Feasibility

Our primary aim of feasibility was assessed according to the criteria presented in Table 2. The table depicts study results in reference to key parameters of feasibility/pilot studies published in the literature.[27,29] Reflecting on the aspects of feasibility revealed several gaps that were uncovered. Table 3 describes how to improve on the gaps from this study for future investigations.

Acceptability

Acceptability of the aromatherapy clinical study received mixed ratings on feasibility. The response rate was considered low, with 43 out of 64 eligible students (67%) enrolling in the study. However, 85.7% of students affirmed their willingness to use aromatherapy in the future to reduce test anxiety.

On the follow-up questionnaire, 8 students mentioned positive qualitative comments about the use of aromatherapy within the testing environment, such as "It had calming effects," "It's an interesting field of study, and I think it would help people relax and concentrate on exams," "It creates a calmer atmosphere and helps center thoughts," "I think it has positive effects," "I believe it had a positive impact on my testing experience," "It made the test more enjoyable to take," and "The aromatherapy made the room smell pleasant and was one less thing I didn't need to think about." One student offered this negative comment: "I don't think I benefited. I found the smell a little distracting."

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-09-19 via free access

Table 2 - Feasibility Results

Aspect of Feasibility	Measurement Parameter	Findings	Feasible	Unfeasible
Acceptability of aromatherapy study by students	Number of eligible students.	64 eligible students; 130 students would be needed for a powered study.		X
	Willingness of students to be randomized.	43 out of 64 (67%) enrolled.		X
	Qualitative comments from the follow-up survey.		X	
	Students' willingness to use aromatherapy in the future.	85.7% willing to use aromatherapy in future.	X	
Adherence to study protocol	Recruitment methods.	1 d of recruitment yielded 67% enrollment.		X
	Randomization procedures.	Students randomized equally by gender with a randomization website.	X	
	Informed consent procedures.	All informed consent documents were complete.	X	
	Student check-in procedures.	All students checked into appropriate classroom.	X	
	Testing room setup.	5 diffusers set up in each room and diffusing at established settings.	X	
	Survey distribution and collection.	Study team ($n = 8$) collected all surveys.	X	
Data collection	Participant characteristics.	43 students completed.	X	
	WTAS.	43 students completed.	X	
	Pretest anxiety scale.	43 students completed.	X	
	Posttest anxiety scale.	43 students completed.	X	
	1-wk online follow-up questionnaire.	30 out of 43 students.		X
Resource allocation	2 classrooms of identical size and layout for testing, plus additional room for nonparticipants.	Obtained 2 identical classrooms for study, plus nonparticipant test room.	X	
	3 extra proctors.	Obtained 3 extra proctors.	X	
	Extra time for students to complete and collect surveys.	Students had no class before or after the test, which allowed time to complete/collect surveys.	X	
	Essential oils and diffusers.	Donated in kind by dōTERRA.	X	
Blinding	Students not correctly guessing their room assignment.	100% of students correctly guessed their room assignment.		X
Side effects	Self-reported side effects on follow-up questionnaire.	2 side effects reported on follow-up questionnaire.	X	

Adherence to Study Protocol and Data Collection

Students, proctors, and study team members adhered to most aspects of the study protocol, which also demonstrates the feasibility of this study. Study team members ($n = 8$) attended a training session to streamline the events taking place the day of the study. Students signed the informed consent document, checked their room assignment online with the learning management software, reported to the study team members to check in before the test, took the test, and filled out the surveys before and after the test. The randomization software allowed equal allocation to study groups by gender. All students filled out the surveys on the day of the test. However, only 30 of 43 students (70%) completed the 1-week online follow-up survey, demonstrating the need for follow-up reminders in future studies.

Resource Allocation

Allocating the testing rooms was challenging because 3 rooms were needed: 1 for students not in the study and 2 others, an experimental room and a control room, for students in the study. The 2 rooms in the study also needed to be the same dimensions and layout. Working with other instructors to obtain 2 identical rooms was necessary, as other courses needed to shift to different rooms to accommodate this study. Additionally, 3 extra proctors were needed to complete this study, 1 for each of the rooms, as the lead instructor needed to float between rooms to check on all the students and was positioned outside of the 2 study rooms. Students committed an extra 5 minutes before and after the test to fill out surveys. This was possible because the test was scheduled when no other classes were scheduled before or afterward in those rooms.

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-09-19 via free access

Table 3 - Improvements for Future Studies

Gaps Uncovered	How to Address in a Future Study
More students enrolled would provide a powered representation for statistical analysis.	Recruit from a larger sample that can be powered of at least 130 students for a moderate to small effect size.
1 d and 1 method of recruitment would not be enough for a powered sample.	Try different recruitment techniques over multiple days.
We learned student thoughts about test anxiety and aromatherapy. Students have test anxiety, and they are interested in strategies to reduce it. Students are also willing to use aromatherapy in the future.	Students are accepting of aromatherapy. Possibly try different oils or methods of aromatherapy, such as personal diffusers, or try different test anxiety management techniques.
Not all students may have attended class on the recruitment day.	Having multiple recruitment days and techniques could increase enrollment.
Only 70% of enrolled participants completed the online follow-up survey a week later.	Send participants multiple e-mail reminders to fill out the survey.
Students were able to tell what room they were in; thus, blinding participants' sense of smell is difficult.	Use different oils that have a neutral scent.
2 students reported side effects in the online questionnaire. It was an anonymous survey, and we were not able to follow up with them.	Trying alternative methods of aromatherapy inhalation, such as individual nasal inhalers instead of waterless diffusers so that students can control their own dosage. Have a method to track students' anonymous online surveys.
Students were not overall anxious before the test.	Choose a testing situation that produces more test anxiety.

This type of study would be difficult to schedule with classes surrounding the test.

Blinding and Side Effects

Overall, 100% of students correctly guessed their room assignment, indicating that our blinding procedures (active dispensers running in each room) were insufficient to mask students to their treatment groups. There were 2 recorded side effects reported; however, we cannot tell if they were in the aromatherapy group because the 1-week follow-up survey was deidentified. The recorded side effects reported were "My eyes started to burn slightly; I sat in the front, so maybe I was too close" and "The smell was a little strong for me since I had never done it before; my sinuses seemed to get a little stuffy."

Aim 2: Influence of Aromatherapy on Test Anxiety

There were enough students who filled out the surveys to provide information for data analysis. Assumptions of independent observations, normal distribution, and equal variance for ANCOVA were verified and met.[28] Students were allocated to only one treatment group; homogeneity of variance was met with the Levene test ($p = .76$). The Kolmogorov-Smirnov test for normality was met ($p = <.001$). Results showed no statistically significant difference between groups for pre- and posttest current anxiety scores ($p = .22$); however, the effect size was small ($\eta^2 = .12$). The insignificant results of the between-group analysis with ANCOVA ($p = .22$) for the room assignment indicate that the within-group data need not be analyzed. Since the differences between the rooms were not significant, the within-room differences would not be either. The interaction between room assignment with pre- and posttest scores was not significant ($p = .50$). However, anxiety scores decreased after completion of the test in both rooms and were statistically significant with a small effect size ($p = .01$, $\eta^2 = .08$)[30] (Table 4). Data from the WTAS exhibited high reliability ($\alpha = .898$ for both rooms (Table 5). Table 6 shows student perceptions about test anxiety and aromatherapy from a short-answer questionnaire student filled out after their biochemistry test.

DISCUSSION

Principal Findings

The main goal of this study was to assess the feasibility of a larger study of the influence of aromatherapy for test anxiety in chiropractic students. Examples of feasibility include recruiting students and having them adhere to study protocol. Aspects of feasibility that could be

Table 4 - Analysis of Covariance Data Analysis

	SS	*df*	MS	*F*	*p*	η^2
Between treatment	10.11	3	3.3	3.5	.22	.119
Anxiety	99.4	1	99.4	103.0	.001	.572
Room assignment	1.5	1	1.5	1.5	.22	.019
Condition	6.2	1	6.2	6.4	.01	.077
Room × condition	.50	1	.50	.50	.48	.006

SS, sum of squares; *df*, degrees of freedom; MS, mean square; η^2, partial eta squared; F, F distribution

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-09-19 via free access

Table 5 - Reliability of the Westside Test Anxiety Survey (WTAS)

Data Reliability of WTAS	Aromatherapy Room	Control Room
Alpha	.898	.898
K	10	10
Mean	30.05	26.00
Variance	77.86	62.57
SD	8.82	7.9

K, number of questions; SD, standard deviation.

improved include inclusiveness of students who require special accommodations for testing, finding a sample with higher test anxiety, a new blinding method, and follow-up on the 1-week short-answer survey.

Study Strengths

Students were recruited, separated into groups, and completed their exams and surveys in their prospective rooms on the day of the test. Additionally, 85.7% of the study participants stated they would consider using aromatherapy in the future, demonstrating acceptability of the intervention. Students followed study protocol. All who signed the informed consent document the week before the test followed through and reported to their individual testing room on the day of the exam. Chance differences between treatment and control groups within the current study indicated that both groups possessed similar levels of test anxiety. The sample size serves as an estimate for a powered study in the future.[19]

A new finding from this study is that test anxiety is dependent on the time frame surrounding the test. The highest number of students reported anxiety right before the test and during the test, suggesting that a short-acting intervention such as aromatherapy might be useful. Students who have testing issues weeks to days before the test may not benefit from a short-term intervention like aromatherapy and other long-term strategies, such as counseling, might be more beneficial.[31]

Study Weaknesses

The response rate was 67% of the class with 1 official recruiting day, where 75 of 89 students were present. Students not in attendance during recruitment may not have known enough about the study to decide to join. Additional recruitment time would potentially increase participation in the study. Future studies should incorporate multiple recruitment techniques and days.[32] A future powered study should incorporate a completed sample size of 130 students to be 80% sure to detect a moderate to small effect size.[33] In addition to the short recruitment period, not all students opted to smell the aromatherapy ahead of time. Encouraging all students to smell the aroma ahead of time may have prevented the few recorded side effects experienced.

There were 11 students enrolled in the course who required special testing accommodations and were unable to participate in the study due to extra time requirements. Furthermore, the mere thought of switching classrooms on test day may have given some students anxiety and prevented them from wanting to enroll due to being in an unfamiliar environment.[34] Feasibility aspects that could improve the rigor of the study include finding a cohort where the test situation produces more anxiety and potentially might include students with special accommodations.

Every student correctly guessed their room assignment, indicating that the aromatherapy room was easily identified. Some aroma may have escaped the room from the doors opening and closing when students, investigators, and proctors entered and exited the rooms before and after the test, and this may have influenced blinding. It is difficult to blind senses; however, our study tried to do this by making the rooms look as similar as possible with the sights and sounds of the waterless diffusers running. Blinding was difficult in this study. Having a different blend of oils that simply smell neutral, without affecting mood, may be a better control in the future. Furthermore, individual aromatherapy methods may help with blinding.[11] Ideas for individual aromatherapy methods include personal inhalers or bracelets.[35] This could reduce potential side effects and eliminate the need to acquire additional testing rooms. Additionally, there was no assigned seating for test day; thus, students who sat closer or farther from the diffusers may have inhaled different doses of aroma, and this also could have influenced side effects.

Thirty out of 43 students (70% of consented participants) filled out the 1-week follow-up survey. This is

Table 6 - Short-Answer Questions From Participants

	Aromatherapy Group ($n = 21$)	Control Group ($n = 22$)	Combined Rooms ($n = 43$)
Previous test anxiety *n* (%)			
Yes	20 (95.2)	21 (95.5)	41 (95.4)
No	1 (4.8)	1 (4.5)	1 (4.7)
Future use of aromatherapy *n* (%)	(missing $n = 1$)		
Yes	17 (85)	19 (86.4)	36 (85.7)
No	3 (6.8)	3 (13.6)	6 (14.3)
Student attempts to reduce anxiety *n* (%)			
Yes	18 (85.7)	17 (77.3)	35 (81.4)
No	3 (14.3)	5 (22.7)	8 (9.1)

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-09-19 via free access

slightly lower compared to other test anxiety follow-up rates of having 39 out of 46 students responding posttest survey 24 hours later (85% of consented participants).[10] The follow-up survey was online and not in class; thus, students who do not check their e-mail may forget to complete it. Follow-up surveys were submitted anonymously; therefore, it was unknown who responded, so we could not follow-up. Future studies need more follow-up with students to get higher completion rates. Attrition is common in other aromatherapy studies.[10] All students were between 18 and 29 years of age; thus, results may not be applicable to other populations. The primary goal of this study was to examine questions related to the feasibility of conducting a larger-scale study. As such, we did not establish an a priori power analyses to guide appropriate statistical testing, making generalizability difficult.

Study Significance

Nursing students are similar to chiropractic students in that they experience test anxiety, some experiencing moderate to high levels of test anxiety. Our study results are also like the nursing studies in that students' test anxiety is lower after the test; whether that is the result of the aromatherapy or the result of the test being over is undetermined in our study. However, in the nursing studies, the effect of aromatherapies on reducing test anxiety does have statistical significance.[10,11,18] With regard to gender, our study had significantly more male participants than in the nursing studies. Previous research has shown that females are more sensitive to odors than males, which may have led to a difference in the statistical significance of the results.[36]

According to Zhang and Henderson,[3] 85% of 166 chiropractic students suffer from moderate to high test anxiety. Our study agreed, showing that 95.4% of 43 students have experienced test anxiety before. Students may have joined this study because they have experienced test anxiety in the past and are interested in management strategies. Our study may have reported slightly higher test anxiety in these chiropractic students because it was a test day, whereas Zhang and Henderson's study did not survey students on a particular test day.

The data of other studies from the WTAS are comparable to ours.[22] Similar studies have used the WTAS and gained pertinent information about students' test anxiety levels. These studies also show that students tend to have moderate levels of test anxiety.[37] Our study results are similar in that chiropractic students have a moderate level of test anxiety. These similar findings across studies help speak to the validity of the WTAS.[38]

Additionally, 81.4% of students have tried methods to reduce anxiety previously. The most common strategy was deep breathing exercises. Additional methods included preparation music and aromatherapy. These methods have been researched previously in other studies and pose promise for additional anxiety management strategies.[11,18] All the methods mentioned are nonpharmacological, including aromatherapy. Additionally, a study of 105 clinicians attending a clinical course were surveyed about their thoughts about aromatherapy, and most agreed that there is an increased need for research because patients ask clinicians about aromatherapy and clinicians do not feel confident in their ability to give advice.[39] Researching more about the effect of aromatherapy on test anxiety in a population of future doctors may add to their knowledge and confidence in their ability to give future patients information.

Future Research

Future studies should determine test anxiety in high-performing vs low-performing students. Reducing test anxiety is beneficial when it hinders students, but some students use test anxiety to motivate them to study hard and would not benefit from reducing it.

CONCLUSION

This study demonstrated that it was feasible to recruit students to measure the influence of aromatherapy on test anxiety. The class participation rate of 71% suggests that recruitment methods may require modification to reduce the potential for bias. Study results indicate that aromatherapy was not associated with a reduction in test anxiety, although students were willing to consider aromatherapy use in the future. A further study with stronger statistical power to detect differences between groups and with higher methodological rigor is needed to fully answer this question.

ACKNOWLEDGMENTS

The authors thank Yasmeen Khan for her assistance with classroom monitoring.

FUNDING AND CONFLICTS OF INTEREST

Waterless diffusers and essential oils were provided in-kind by dōTERRA (Pleasant Grove, UT). This study was conducted in a facility constructed with support from a Research Facilities Improvement Program Grant (C06-RR15433) from the National Institutes of Health, National Center for Research Resources. The funding bodies had no role in the design of this study; in the data collection, analysis, or interpretation processes; or in the writing of this article. The authors have no conflicts of interest to declare relevant to this work.

About the Authors

Breanne Wells is an assistant professor at the Palmer College of Chiropractic (1000 Brady Street, Davenport, IA 52803; breanne.wells@palmer.edu). Lia Nightingale is an associate professor at the Palmer College of Chiropractic (1000 Brady Street, Davenport, IA 52803; lia.nightingale@palmer.edu). Dustin Derby is the senior director of institutional research and effectiveness at the Palmer College of

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-09-19 via free access

Chiropractic (1000 Brady Street, Davenport, IA 52803; dustin.derby@palmer.edu). Stacie Salsbury is an assistant professor at the Palmer College of Chiropractic, Palmer Center for Chiropractic Research (741 Brady Street, Davenport, IA 52803; stacie.salsbury@palmer.edu). Dana Lawrence is the associate provost of education and research at Parker University (2500 Walnut Hill Lane, Dallas, TX 75229; dlawrence@parker.edu). Address correspondence to Breanne Wells, Palmer College of Chiropractic, 1000 Brady Street, Davenport, IA 52803; breanne.wells@palmer.edu. This article was submitted December 7, 2018; revised April 9 and August 20, 2019; and accepted September 30, 2019.

Author Contributions

Concept development: BMW, DL, LMN, BMW. Design: BMW, LMN, DED, SAS, DL. Supervision: BMW, LMN, DED, SAS, DL. Data collection/processing: BMW, LMN, DED. Analysis/interpretation: BMW, LMN, DED. Literature search: BMW. Writing: BMW, LMN, DED. Critical review: BMW, LMN, DED, SAS, DL.

© 2021 Association of Chiropractic Colleges

REFERENCES

1. Cassady J. Cognitive test anxiety and academic performance. *Contemp Educ Psychol*. 2002;27:270–295.
2. McCaffrey R, Thomas DJ, Kinzelman AO. The effects of lavender and rosemary essential oils on test-taking anxiety among graduate nursing students. *Holist Nurs Pract*. 2009;23:88–93.
3. Zhang N, Henderson CNR. Test anxiety and academic performance in chiropractic students. *J Chiropr Educ*. 2014;28:2–8.
4. Pekrun R, Goetz T, Titz W, Perry RP. Academic emotions in students' self-regulated learning and achievement: a program of qualitative and quantitative research. *Educ Psychol*. 2002;37:95–105.
5. Phillips AP. Reducing nursing students' anxiety level and increasing retention of materials. *J Nurs Educ*. 1988;27:35–41.
6. Hjeltnes A, Binder P-E, Moltu C, Dundas I. Facing the fear of failure: an explorative qualitative study of client experiences in a mindfulness-based stress reduction program for university students with academic evaluation anxiety. *Int J Qual Stud Health Well-being*. 2015;10:27990.
7. Meseke CA, Bovée ML, Gran DF. Impact of collaborative testing on student performance and satisfaction in a chiropractic science course. *J Manipulative Physiol Ther*. 2009;32:309–314.
8. Meseke CA, Nafziger R, Meseke JK. Student attitudes, satisfaction, and learning in a collaborative testing environment. *J Chiropr Educ*. 2010;24:19–29.
9. Lusk M, Conklin L. Collaborative testing to promote learning. *J Nurs Educ*. 2003;42:121–124.
10. Johnson CE. Effect of aromatherapy on cognitive test anxiety among nursing students. *Altern Complement Ther*. 2014;20(2):84–87.
11. Kutlu AK, Yilmaz E, Çeçen D. Effects of aroma inhalation on examination anxiety. *Teach Learn Nurs*. 2008;3:125–130.
12. Kim M, Hwangbo HH. Randomized trial evaluating the aroma inhalation on physiological and subjective anxiety indicators of the nursing students experiencing the first intravenous injection. *Int J Bio-Sci Bio-Technol*. 2010;2:29–38.
13. Jimbo D, Kimura Y, Taniguchi M, Inoue M, Urakami K. Effect of aromatherapy on patients with Alzheimer's disease. *Psychogeriatrics*. 2009;9:173–179.
14. Moss M, Cook J, Wesnes K, Duckett P. Aromas of rosemary and lavender essential oils differentially affect cognition and mood in healthy adults. *Int J Neurosci*. 2003;113:15–38.
15. Rho K-H, Han S-H, Kim K-S, Lee MS. Effects of aromatherapy massage on anxiety and self-esteem in Korean elderly women: a pilot study. *Int J Neurosci*. 2006;1447–1455.
16. Ali B, Al-Wabel NA, Shams S, Ahamad A, Khan SA, Anwar F. Essential oils used in aromatherapy: a systemic review. *Asian Pac J Trop Biomed*. 2015;5:601–611.
17. Sayorwan W, Ruangrungsi N, Piriyapunyporn T, Hongratanaworakit T, Kotchabhakdi N, Siripornpanich V. Effects of inhaled rosemary oil on subjective feelings and activities of the nervous system. *Sci Pharm*. 2013;81:531–542.
18. Kavurmaci M, Küçükoğlu S, Tan M. Effectiveness of aromatherapy in reducing test anxiety among nursing students. Indian *J Tradit Knowl*. 2015;1:52–56.
19. Kiberd MB, Clarke SK, Chorney J, d'Eon B, Wright S. Aromatherapy for the treatment of PONV in children: a pilot RCT. *BMC Complement Altern Med*. 2016;16:450.
20. Kizhakkeveettil A, Vosko AM, Brash M, Ph D, Philips MA. Perceived stress and fatigue among students in a doctor of chiropractic training program. *J Chiropr Educ*. 2016.
21. Tung YJ, Lo KKH, Ho RCM, Tam WSW. Prevalence of depression among nursing students: a systematic review and meta-analysis. *Nurse Educ Today*. 62018;3:119–129.
22. Afzal H, Afzal S, Siddique SA, Naqvi SA. Measures used by medical students to reduce test anxiety. *J Pak Med Assoc*. 2012;62:982–986.
23. Rajiah K, Saravanan C. The effectiveness of psychoeducation and systematic desensitization to reduce test anxiety among first-year pharmacy students. *Am J Pharm Educ*. 2014;78.
24. Ali M, Asim H, Edhi AI, et al. Does academic assessment system type affect levels of academic stress in medical students? A cross-sectional study from Pakistan. *Med Educ Online*. 2015;20:27706.
25. Driscoll R. Westside Test Anxiety Scale validation. 2007. https://eric.ed.gov/?q=driscoll+Westside+Test+Anxiety+Scale+validation&id=ED495968.

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-09-19 via free access

26. Davey H, Barratt A, Butow P, Deeks J. A one-item question with a Likert or Visual Analog Scale adequately measured current anxiety. *J Clin Epidemiol*. 2007;60:356–360.
27. Eldridge SM, Lancaster GA, Campbell MJ, et al. Defining feasibility and pilot studies in preparation for randomised controlled trials: development of a conceptual framework. *PLoS One*. 2016 Mar 15;11(3): e0150205. doi: 10.1371/journal.pone.0150205. eCollection 2016
28. George D, Mallery P. *SPSS for Windows Step by Step: A Simple Guide and Reference*. 3rd ed. Boston, MA: Allyn & Bacon; 2001.
29. Shanyinde M, Pickering RM, Weatherall M. Questions asked and answered in pilot and feasibility randomized controlled trials. *BMC Med Res Methodol*. 2011;11: 117. doi:10.1186/1471-2288-11-117.
30. Ellis P. Thresholds for determining effect size. 2009. http://www.polyu.edu.hk/mm/effectsizefaqs/thresholds_for_interpreting_effect_sizes2.html. Accessed May 8, 2016.
31. Wolgensinger L. Cognitive behavioral group therapy for anxiety: recent developments. *Dialogues Clin Neurosci*. 2015;17:347–351.
32. Dillman DA, Smyth JD, Christian LM. *Internet, Mail and Mixed-Mode Surveys*. Hoboken, NJ: John Wiley & Sons; 2009.
33. Ellis P. *The Essential Guide to Effect Sizes: Statistical Power, Meta-Analysis, and the Interpretation of Research Results*. Cambridge, UK: Cambridge University Press; 2010.
34. Mayo Clinic Staff. Anxiety symptoms and causes. 2015. https://www.mayoclinic.org/diseases-conditions/anxiety/symptoms-causes/syc-20350961.
35. Schneider R. There is something in the air: testing the efficacy of a new olfactory stress relief method (AromaStick®). *Stress Heal*. 2016;32:411–426.
36. Seo H-S, Lee S, Cho S. Relationships between personality traits and attitudes toward the sense of smell. *Front Psychol*. November 2013;4:article 901. doi: 10.3389/fpsyg.2013.00901
37. Rivaz M, Momennasab M, Shokrollahi P. Effect of collaborative testing on learning and retention of course content in nursing students. *J Adv Med Educ Prof*. 2015;3:178–182.
38. Sańchez J. Rosner, B. *Fundamentals of Biostatistics*. 3rd ed. Boston, MA: PWS-Kent, Boston; 1990.
39. Pearson A, Cutshall S, Hooten W, Rodgers N, Bhagra A. Perspectives on the use of aromatherapy from clinicians attending an integrative medicine continuing education event. *BMC Complement Altern Med*. 2019; 19:174.

Downloaded from https://prime-pdf-watermark.prime-prod.pubfactory.com/ at 2025-09-19 via free access