



EVALUATION OF MINDFULNESS AND AROMATHERAPY FOR STRESS REDUCTION IN PSYCHOLOGY STUDENTS

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ABSTRACT

Stress is a common problem among college students, and the effectiveness of coping strategies is debated. This study compared the practice of mindfulness alone or conjugated to aromatherapy in the perception of stress and physiological signs of students of psychology. Thirty volunteer students participated in random, simple and crossed tests, with half of the sample in each protocol: G0 (baseline)/G1 (mindfulness) followed by G2 (mindfulness and aromatherapy with lavender oil) or G3 (mindfulness and aromatherapy with copaiba oil). After a single session of 10 min of each modality, physiological and sensory data were collected and analyzed by descriptive or inferential statistics, considering $P < 0.05$. There was only a reduction in mean arterial pressure for G3 in comparison to G0, without differences between groups for systolic and diastolic blood pressure, heart rate, oxygen saturation or temperature. Relaxation was evident for G2 and G3 compared to G1, which also improved intragroup performance. G2 demonstrated greater intensity and familiarity with odor while G3 had greater pleasantness but no differences with G2. There was greater expression of tranquility and well-being after all protocols, with reduced emotions compared to G1 and greater diversity in G2, such as longing and light euphoria. Mindfulness combined with aromatherapy suggests being more beneficial to mitigate stressful signs and symptoms, and copaiba oil emerges as a promising

aroma for more immediate effects, as well as lavender. Long-term studies are necessary to deepen preliminary outcomes.

Keywords: Stress. Psychological. Aromatherapy. Mindfulness. Lavandula. Copaifera.

INTRODUCTION

Stress is the complex perception and physiological response to challenging situations, whether external or internal stimuli, modulating cognition, emotion and behavior (Amaral; Oliveira, 2019; Lyra; Nakai; Marques, 2010). The physiological reaction stems from neuroendocrine alterations in the hypothalamus-pituitary-adrenal (HPA) axis, with dysregulation of neurotransmitters and hormones (Deiss *et al*, 2023). Pathological stress leads to disabilities of individuals in productive phase, including diabetes, hypertension, overweight, cardiac ischemic disease, cerebrovascular disease and depression, showing its impact as a public health problem (Amaral; Oliveira, 2019; Lyra; Nakai; Marques, 2010). Labor stress is already well recognized and harms different categories of health professionals, reducing satisfaction and quality of care (Maciel *et al*, 2018).

Stress in health students ranges from 45 to 100%, with 4% to 15% in its pathological form (Murakami *et al*, 2024). Mental health problems reach 10 to 20% of young people up to 24 years (Rocha *et al*, 2021). For undergraduates from Maranhão, the “university” variable was the main stressor, quoted four times more than work and relationship (Dias; Sousa; Vilanova-Campelo, 2023). Academic, social and financial demands lead to stress, anxiety, depression and inattention, affecting physical and mental health and students’ performance (Carpena; Menezes, 2018; Lyra; Nakai; Marques, 2010). Brazil is the country with the largest number of anxious individuals in the Americas, about 7.5% of the population (Nirino; Silva; Pucci, 2022) and six out of ten university students are affected by anxiety (Forini; Lima, 2025).

Investigations of mechanisms for coping with university stress have focused on metropolitan regions of the Southeast and South Region to the detriment of others in Brazil (Rizzi; Giacomoni, 2023) for students in pharmacy (Moreira *et al*, 2017; Rodrigues; Evangelista; Tescarollo, 2018; Silva; Gouveia; Tescarollo, 2022), medicine (Murakami *et al*, 2024; Silveira *et al*, 2021), psychology (Moreira *et al*, 2017; Nirino; Silva; Pucci, 2022), physiotherapy (Moreira *et al*, 2017; Murakami *et al*, 2024),

nursing (Gherardi-Donato *et al*, 2020), physical education (Dias; Sousa; Vilanova-Campelo, 2023), occupational therapy, nutrition and speech therapy (Murakami *et al*, 2024). The Psychology course of the Federal University of Ceará at the Campus Sobral had a dropout of 5.1% in the pandemic and today reaches 1.7% (INEP, 2024), in an interior city with a high HDI of 0.714 (IBGE, 2025). Despite the integrated teaching work with significant content and active methodologies increasing the engagement of students (Castro-Silva; Maciel; Araújo, 2020), 20% burnout rate for these students alarms the necessary discussion of coping strategies (Castro-Silva; Maciel; Melo, 2021).

Mindfulness is defined as consciousness without judgments, acceptance of the present moment and compassionate orientation with experiences, emotional regulation and resilience (Alvarado-García *et al*, 2025; Gherardi-Donato *et al*, 2020; Rizzi; Giacomoni, 2023). Based on old meditative practices, mindfulness is used in alternative medicine to improve mental health in university students (Alvarado-García *et al*, 2025; Forini; Lima, 2025). Its practice can be individual or collective, in a work team or community, promoting greater awareness, collaboration and well-being (Carpena; Menezes, 2018). Meditation sitting with attention to breathing, physical sensations and emotional states enables body perception (Silveira *et al*, 2021). There is increased metacognitive consciousness and HPA axis regulation, which reduces cortisol, relieves symptoms of stress and anxiety, improves sleep, social support and life satisfaction (Alvarado-García *et al*, 2025). Mindfulness interventions focus on improving academic stress followed by anxiety (Forini; Lima, 2025). In Brazil, one in six university students practices mindfulness or meditation, with smaller scores for stress and larger awareness and acceptance (Rizzi; Giacomoni, 2023).

On the other hand, aromatherapy composes Integrative and Complementary Practices (ICP) within the Unified Health System in Brazil (Pessoa *et al*, 2023; Rodrigues; Evangelista; Tescarollo, 2018). Essential oils are used to balance the body and promote physical and mental health (Hedigan *et al*, 2024; Silva; Gouveia; Tescarollo, 2022), with better administration by inhalation (Jacob; Oliveira, 2024; Luan *et al*, 2023). The olfactory pathway directly accesses the limbic system, responsible for hunger, fear, sexual arousal, pleasure, sleep and memory, without

passing through the thalamus like other sensory systems (Amaral; Oliveira, 2019; Luan *et al*, 2023). Due to the rapid activation of olfactory synapses with the amygdala and hippocampus, essential oils modulate positive emotions and evoke happy memories, reducing stress, anxiety, depression and increasing well-being and immunity (Lyra; Nakai; Marques, 2010; Pessoa *et al*, 2023; Silva; Gouveia; Tescarollo, 2022). Aromatherapy mitigates the damaging effects of chronic, high intensity stress (Amaral; Oliveira, 2019) and contributes to therapies such as attention deficit hyperactivity disorder (ADHD) (Jacob; Oliveira, 2024).

It promotes a reduction in heart and respiratory rate, blood pressure, oxygen saturation and stress level and increases muscle relaxation, providing better quality of life (Lopes *et al*, 2021; Santos *et al*, 2021). As accessibility advantages, it is a cheap practice, applicable by a multidisciplinary health team (Musarezaie *et al*, 2024; Rahmawati *et al*, 2022; Santos *et al*, 2021), as a non-drug and non-invasive strategy (Pessoa *et al*, 2023; Rahmawati *et al*, 2022). Some studies claim that the results are still inconclusive by the low number of participants (Luan *et al*, 2023; Lyra; Nakai; Marques, 2010). Careful use of essential oils is recommended, considering quality, composition, properties, administration, concentration and frequency (Silva; Gouveia; Tescarollo, 2022).

Essential lavender oils have anti-inflammatory, antioxidant and antimicrobial properties, variables according to flavonoid and phenolic components (Sweeney *et al*, 2025). *Lavandula angustifolia* oil has a high ester content (Jacob; Oliveira, 2024), generates parasympathetic nervous activity and promotes relaxation, acting as a moderate anxiety regulator in students (Amaral; Oliveira, 2019; Rahmawati *et al*, 2022), floating mood stabilizer, sedative (Rahmawati *et al*, 2022; Silva; Gouveia; Tescarollo, 2022) or antispasmodic (Jacob; Oliveira, 2024).

Lavender is the most cited essential oil in aromatherapy practices (Hedigan *et al*, 2024; Malloggi *et al*, 2021; Mendes *et al*, 2023; Pessoa *et al*, 2023). It is a safe oil without side effects, used in skin contact, but its psychotherapeutic benefits are best enjoyed through inhalation (Hedigan *et al*, 2024; Jacob; Oliveira, 2024; Malloggi *et al*, 2021; Rahmawati *et al*, 2022). Its aroma generates changes in the cortical activity of brain waves (Jacob; Oliveira, 2024). Lavender activates the amygdala and

hippocampus in the limbic system and stimulates emotions and behavior (Lopes *et al*, 2021), although there is controversy about memory (Malloggi *et al*, 2021).

Copaiba is a medicinal plant of the Brazilian Amazon, and its most frequently topical oil displays anti-inflammatory, antimicrobial, antitumoral and healing properties, with dental, cardiorespiratory, anti-hemorrhoidal, purgative or anesthetic applications (Cardinelli *et al*, 2023; Ferro *et al*, 2018). The ability to provide relief from chronic pain and discomfort has been the subject of investigation due to its analgesic properties, being a potentially effective alternative for the treatment of muscle and joint pain and even migraines (Silva *et al*, 2024). Given the potential of copaiba oil to regulate signaling pathways of cellular metabolism, growth, immunity, and nerve cell apoptosis, there is a need for further toxicological studies to ensure safe dosage and efficacy due to the lack of clinical trials in humans (Cardinelli *et al*, 2023; Ferro *et al*, 2018).

This study investigated the clinical effectiveness of mindfulness alone or conjugated to aromatherapy with lavender or copaiba essential oil in the perception of stress and physiological signs of students of psychology in a Brazilian inland city.

METHODOLOGY

Ethical Aspects

The study was conducted according to the bioethical principles in force in research with humans. The protocol was approved by the Research Ethics Committee of Vale do Acaraú State University under the submission protocol n. 88065525.1.0000.5053 and approval report n. 7.553.122. All participants were approached in person and invited as volunteers of the research by signing the Free and Informed Consent Form (FICF).

Study Design

The sample recruited in the first half of 2025 a total of 48 students from the third period of a psychology course in a public institution in Sobral, state of Ceara, located in the northeast region of Brazil. As inclusion criteria, they were screened over 18 years old with a signed FICF. Exclusion criteria included individuals with cardiorespiratory decompensation or adverse reactions to essential oils. The final

sample of 30 volunteers values the phenomenology of the study, representing 62.5% of the class and 15.63% of the total number of psychology students at the university.

An experimental, clinical, crossover study was conducted. Participants were randomly assigned to groups in single-blind way, with no knowledge of the type of therapy being administered. Only the research team knew the groups and maintained confidentiality throughout the experiment. Each session involved a group of 10 volunteers arranged in a small circle in a private, air-conditioned space measuring 30m², without interruptions, visual or auditory distractions. Participants' confidentiality was maintained, with measurements or responses documented in writing rather than verbalized in the group, with participants not named but coded by number.

The first stage (baseline or G0) collected initial physiological data. Two alternating therapeutic cycles were conducted with each group, where final physiological data and initial and final sensory data were collected. Mindfulness was provided to all groups for 10 minutes, during which a facilitator trained the volunteers' attention to breathing and sensations, according to the following collective instructional script:

Maintain an upright but relaxed posture. If you're sitting, your feet should touch the floor, and your hands should rest in your lap. Close your eyes. Bring your attention to your hearing. When we close our eyes, our sense of smell naturally becomes more sensitive, and we perceive scents that previously went unnoticed. Just smell that scent. Now, gently direct your attention to your breathing. Feel the air moving in and out of your lungs. Observe the movement your breath causes in your body: the rising and falling of your chest, the expansion of your abdomen... Just feel it. If, at any point, a memory, an emotion, or a thought arises that captures you, simply acknowledge it. Notice that you've engaged with this experience and gently allow it to pass. Thoughts also come and go. Bring your focus to that scent; does it evoke any memories? What sensations do you feel in your body? Notice this flow. Now, once again, bring your attention back to your breathing, as you did at the beginning. Feel the air. Stay present.

For aromatherapy, an ultrasonic diffuser of essential oils was used far to one meter as each participant, ensuring the same inhalation proportionality for the 10 minutes. The three groups were: G1, with mindfulness and placebo aromatherapy by vaporization of distilled water alone; G2, with mindfulness and aromatherapy with

lavender essential oil (10 drops per 100ml); and G3, with mindfulness and aromatherapy with white copaiba essential oil (10 drops per 100ml). Essential oils are described in Table 1.

Table 1: Essential oils used in aromatherapy.

Group	Product	Composition informed by manufacturer (GC-MS)*
G2	Fine lavender (Bulgarian) Lazslo™, Therra Aroma e Sabores, MG, Brazil. Extracted from <i>Lavandula angustifolia</i> . Batch: LZ2367, Validity: 05/2027, Price: R\$79.00 or US\$14.63.	linalool (31.00%), linalyl acetate (30.70%), terpene-4-ol (5.67%), (Z)- β -ocimene (5.12%), lavandulyl acetate (4.66%), (Z)- β -farnesene (4.20%), trans- β -caryophyllene (4.19%), (E)- β -ocimene (2.36%), 3-octanone (1.38%), 1,8-cineole (1.31%), α -terpineol (1.28%), lavandulol (1.00%), hexyl acetate (0.98%), borneol (0.73%), myrcene (0.64%), hexyl butanoate (0.61%), caryophyllene oxide (0.37%), limonene (0.36%), camphor (0.35%), neryl acetate (0.35%), p-cymene (0.25%) and 1-octen-3-ol (0.24%)
G3	White copaiba Lazslo™, Therra Aroma e Sabores, MG, Brazil. Extracted from <i>Copaifera officinalis</i> . Batch: LZ2033, Validity: 10/2026, Price: R\$49.00 or US\$9.07.	β -caryophyllene (47.79%), trans- α -bergamotene (9.32%), α -humulene (7.73%), β -bisabolene (4.88%), α -coapene (4.50%), δ -cadinene (3.96%), γ -elemene (3.67%), germacrene D (3.59%), γ -muurolene (2.48%), β -elemene (1.58%), γ -cadinene (1.36%), caryophyllene oxide (1.35%), α -muurolene (1.30%), β -selinene (0.90%), β -chamigrene (0.89%), α -cubebene (0.65%), allo-aromadendrene (0.47%), α -cadinene (0.33%), α -gurjunene (0.27%) and β -sesquiphellandrene (0.25%)

*Gas Chromatography coupled to Mass Spectrometry

Source: Research data.

The two arms in this study followed alternately: a monitoring at the moment one of sequential flow G0-G1-G2 with 15 volunteers and another at the moment two of G0'-G1'-G3 with 15 volunteers, making a sample of 30 students. The interval between each mindfulness and aromatherapy in the same group was 20 minutes.

Data Collection

All participants completed a socioeconomic questionnaire with questions about age, gender, race, marital status, education, and income, as well as a clinical form about their general medical history. Physiological data included systole x diastole values (mmHg) recorded using a digital wrist blood pressure monitor (Model RGV-001, Arm Style, China); percentage oxygen saturation (SpO₂, %) and heart rate (bpm) using a portable digital fingertip oximeter (Model LK87, Fingertip Pulse,

China); and facial temperature (°C) measured using a digital infrared thermometer (Model HL-E31, AIQUE, China).

Perceptual stress data were measured with psychometric questionnaires before and after the intervention, containing two general questions. The first question, "How are you feeling before/after we started this experience?", had a scale for scoring: "1-not at all relaxed", "2-very slightly relaxed", "3-slightly relaxed", "4-moderately relaxed", "5-relaxed", "6-very relaxed" and "7-extremely relaxed".

The second question, "Right now, what feelings are you experiencing?" included one or more options: "tranquility", "well-being", "joy", "longing", "mild euphoria", "anxiety", "nausea", "discomfort", "irritation" and "sadness". The protocol after each intervention also contained three more specific questions: "How intense is the odor?" with a scale of "1-not detectable", "2-very weak", "3-weak", "4-moderate", "5-strong", "6-very strong" and "7-extremely strong"; "How pleasant is the odor?" with a scale of "1-extremely unpleasant", "2-very unpleasant", "3-unpleasant", "4-moderately pleasant", "5-pleasant", "6-very pleasant", and "7-extremely pleasant"; and "How familiar is the odor?" with scale: "1-not at all familiar", "2-very unfamiliar", "3-somewhat familiar", "4-moderately familiar", "5-familiar", "6-very familiar" and "7-extremely familiar".

Data Analysis

Data from the socioeconomic and clinical forms were compiled and analyzed descriptively, using means or relative frequencies, to provide a demographic overview of the sample. Physiological and sensory results were tabulated in Excel (Microsoft® Corporation, USA), with quantitative data expressed as mean $\pm$ standard deviation. Inferential statistical analysis was performed using Jamovi software, version 2.3.28 (Jamovi Project, Australia). Continuous or ordinal data analyzed using the Shapiro-Wilk test with normal distribution adopted the parametric ANOVA for repeated measures and Tukey's post hoc test, while those with non-normal distribution used the nonparametric Friedman test and Durbin-Conover post hoc test for multiple comparisons, considering differences significant if $P < 0.05$. To describe self-perceived emotions before and after, we created a word cloud via Wordclouds.com.

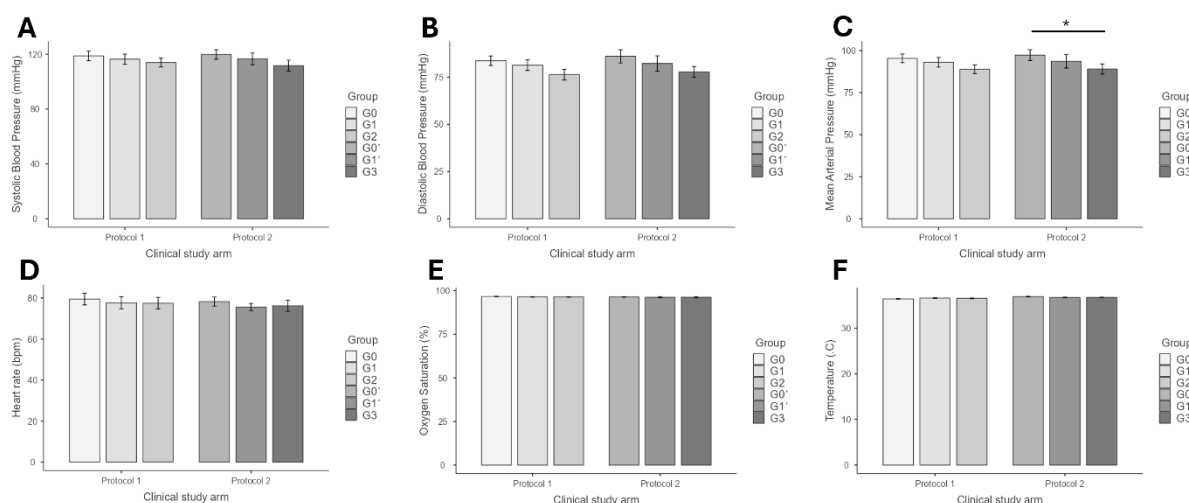
RESULTS

The sociodemographic profile included young adult participants with a mean of 20 years, prevalence of female gender (18 or 60%) over male (12 or 40%), brown or white skin color (13 or 43.33% each), black (2 or 6.67%), indigenous or not informed (1 or 3.33% each) and single (30 or 100%). The majority were just students (29 or 96.67%) and only one reported concurrent self-employment (3.33%). Eight students (26.67%) reported a monthly income between R\$700.00 and R\$1,300.00. In medical history, there was an average BMI of 23.21, with normal status (17 or 56.67%) exceeding overweight (8 or 26.67%), underweight (4 or 13.33%) and obesity (1 or 3.33%).

There were common allergic conditions, with 7 or 23.33% to inhalation of dust or animal hair, ingestion of milk, dyes and medications or heat, more frequent than respiratory diseases (3 or 10% of sinusitis or rhinitis), kidney stones (2 or 6.67% each), hypovitaminosis C or D, anemia or seizure (1 or 3.33% each). Disorders such as anxiety (8 or 26.67%), depression (2 or 6.67%), ADHD, obsessive-compulsive disorder or uninformed diagnosis (1 or 3.33% each) were mentioned, but few cases with professional monitoring by a psychologist (3 or 10%) or psychiatrist (2 or 6.67%). Use of psychoactive medication (4 or 13.33%) was higher than antibiotic, nutraceutical and antihistamine (1 or 3.33% each). There was occasional alcohol consumption (15 or 50%), ranging from biweekly to monthly and time of habit from 1 to 7 years than electronic cigarette smoke for rare frequency for 5 years (1 or 3.33%).

The physiological outcomes showed a slight tendency towards a reduction in systolic pressure (Fig. 1a), diastolic pressure (Fig. 1b) and mean arterial pressure (Fig. 1c), but there was only a significant difference in this last parameter between G0' and G3 ($P=0.039$). Heart rate (Fig. 1d), oxygen saturation (Fig. 1e) and temperature (Fig. 1f) maintained stable and similar values between the groups ($P>0.05$).

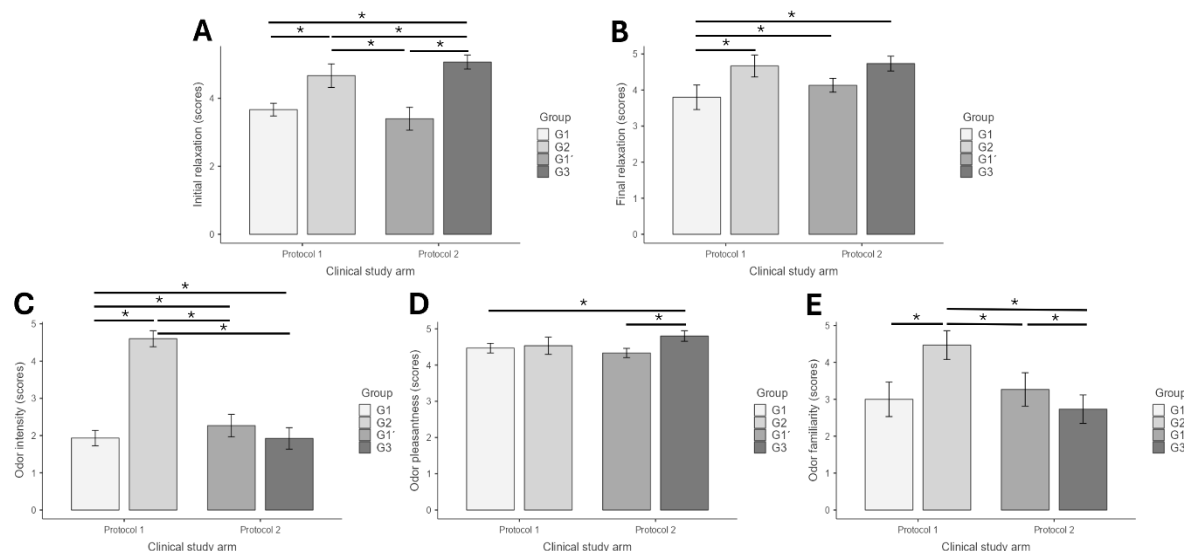
Figure 1: Physiological parameters at baseline (G0), mindfulness (G1/G1'), mindfulness with lavender oil aromatherapy (G2) and mindfulness with copaiba oil aromatherapy (G3). *P<0.05.



Source: Research data.

The sensory outcomes showed a pattern of greater relaxation state for G2 and G3 compared to G1 or G1' ($P<0.05$), with no final differences between them except in G1' that increased relaxation after intervention (Fig. 2a-b), reinforcing the benefits of mindfulness. G2 demonstrated greater intensity and familiarity to the odor compared to the groups, while G3 had greater pleasantness compared to G1 and G1' ($P<0.05$) but with no differences with G2 (Fig. 2c-e).

Figure 2: Sensorial parameters at mindfulness (G1/G1'), mindfulness with lavender oil aromatherapy (G2) and mindfulness with copaiba oil aromatherapy (G3). *P<0.05.



Source: Research data.

Emotions before (Fig. 3a-d) and then (Fig. 3e-h) of interventions have changed, with greater expression of tranquility and well-being after the protocols. Still, there were longitudinally reduced expressions compared to G1 and G1' and greater diversity in G2, such as longing and light euphoria.

Figure 3: Emotions related to mindfulness (G1), mindfulness with lavender oil aromatherapy (G2) and mindfulness with copaiba oil aromatherapy (G3).



Source: Research data.

DISCUSSION

The sociodemographic profile of this study converges with the literature on university students and stress, with young adults (Alvarado-García *et al.*, 2025; Bai *et al.*, 2020; Carpena; Menezes, 2018; Gherardi-Donato *et al.*, 2020; Hedigan *et al.*, 2024; Liu; Lee; Wu, 2024; Lyra; Nakai; Marques, 2010; Nath; Kucukarslan, 2023; Nirino; Silva; Pucci, 2022; Rizzi; Giacomoni, 2023; Satou *et al.*, 2024), female prevalence (Alvarado-García *et al.*, 2025; Bai *et al.*, 2020; Carpena; Menezes, 2018; Enwright *et al.*, 2023; Gherardi-Donato *et al.*, 2020; Hedigan *et al.*, 2024; Liu; Lee; Wu, 2024; Lyra; Nakai; Marques, 2010; Nath; Kucukarslan, 2023; Nirino; Silva; Pucci, 2022; Rizzi; Giacomoni, 2023; Satou *et al.*, 2024) and single marital status (Alvarado-García *et al.*, 2025; Lyra; Nakai; Marques, 2010; Nath; Kucukarslan, 2023; Nirino; Silva; Pucci, 2022). Women can be more odors sensitive than men, as well as better express emotions, with more intensity (Enwright *et al.*, 2023).

The prevalence of brown skin color approached that of a group of Brazilian students (Dias; Sousa; Vilanova-Campelo, 2023) and differed from the caucasian pattern of studies in the USA (Bai *et al.*, 2020) or in Brazil (Rizzi; Giacomoni, 2023), although skin color is a neglected sociocultural factor (Forini; Lima, 2025). The monthly income of up to one minimum wage is below the annual per capita GDP of R\$25,396.38 in the city of Sobral (IBGE, 2025). Economic hardship is a predisposing factor for pathological stress, being more critical in students with purchasing power in class C (Carpena; Menezes, 2018) or family income below three minimum wages (Murakami *et al.*, 2024) compared to those who worked with an average income between 2 and 4 minimum wages in Brazil (Nirino; Silva; Pucci, 2022) or with per capita income of US\$100,000 to 199,999 in the USA (Bai *et al.*, 2020).

The most prevalent BMI was similar to a healthy weight, indicating good physical health in line with other studies (Lyra; Nakai; Marques, 2010; Nath; Kucukarslan, 2023). The moderate frequency of psychological changes such as anxiety and low professional monitoring converges with a study with a smaller sample of students receiving psychological care (Alvarado-García *et al.*, 2025), while universities with greater access to services have greater psychotherapeutic monitoring (Bai *et al.*, 2020).

Our results showed similar frequencies between therapies and medicalization, although studies indicate that psychotherapy can be twice as common as the use of psychoactive drugs (Carpena; Menezes, 2018) or medicalization may reach 65% of cases, 21% of which are psychiatric (Nirino; Silva; Pucci, 2022). Occasional alcohol consumption in half of the sample is slightly higher, while smoking was well below in another study (Nirino; Silva; Pucci, 2022). The university environment allows students to adopt unhealthy coping strategies, such as alcohol abuse and smoking (Gherardi-Donato *et al.*, 2020). It is important to emphasize that cases of chronic stress or mental health problems require professional help from a psychologist or psychiatrist to avoid harmful use of coping strategies.

The practice of mindfulness is rare among psychology students, with up to 95% never having practiced it (Nirino; Silva; Pucci, 2022), while the overall graduation rate can reach 29% (Bai *et al.*, 2020). Mindfulness programs for university students to manage stress are quite heterogeneous, with weekly face-to-face

meetings of 2 to 6 sessions (Carpena; Menezes, 2018; Pan *et al.*, 2024) or 8 or more sessions (Alvarado-García *et al.*, 2025; Azevedo; Menezes, 2021; Bai *et al.*, 2020; Gherardi-Donato *et al.*, 2020; Liu; Lee; Wu, 2024; Nirino; Silva; Pucci, 2022; Pan *et al.*, 2024; Silveira *et al.*, 2021), where focus groups feature 5 to 11 participants (Forini; Lima, 2025; Gherardi-Donato *et al.*, 2020) or 12 to 16 participants (Azevedo; Menezes, 2021; Nath; Kucukarslan, 2023; Nirino; Silva; Pucci, 2022; Silveira *et al.*, 2021), reaching up to 45 students, although fewer will benefit more from the practice (Forini; Lima, 2025), in a space of up to 2m² per individual (Azevedo; Menezes, 2021).

The time of 20 to 30 minutes (Nath; Kucukarslan, 2023; Pan *et al.*, 2024) was closer to our intervention, although there are periods of 1 h (Alvarado-García *et al.*, 2025; Liu; Lee; Wu, 2024), up to 2 h (Bai *et al.*, 2020; Carpena; Menezes, 2018; Gherardi-Donato *et al.*, 2020; Pan *et al.*, 2024; Silveira *et al.*, 2021) or above that time (Azevedo; Menezes, 2021; Carpena; Menezes, 2018). Longer practices include 5-minute diaphragmatic breathing exercises, 15-30 minutes of seated focused meditation, variations of meditative practices with walking and meditative eating, and final experience exchanges (Carpena; Menezes, 2018). The single-session mindfulness option, with a small group in a welcoming space and focusing on breathing and emotions, was a preliminary analysis and methodological limitation of this study. On the other hand, a more flexible mindfulness practice would improve adherence and outcomes (Forini; Lima, 2025).

Mindfulness in university students around the world has shown reduced anxiety, depression, and stress, improved attention, self-care, and physical health, but no difference in sleep quality, social functioning, or subjective well-being (Pan *et al.*, 2024). Mindfulness can reduce stress in the resistance, near-exhaustion, and general phases and increase the facets of describing and not reacting to control (Carpena; Menezes, 2018). Young university students after mindfulness had better emotional regulation to family stress, while controls exacerbated negative emotion, rumination and interference (Bai *et al.*, 2020).

Mindfulness reduced stress, increased attention, and improved psychological quality of life in nursing students (Gherardi-Donato *et al.*, 2020; Liu; Lee; Wu, 2024) and also in psychology students it promoted a reduction in depression and anxiety (Nirino; Silva; Pucci, 2022). These findings justify the beneficial subjective effects of

the mindfulness group. There are few studies that measure post-mindfulness benefits and how long they last (Forini; Lima, 2025). Autonomous continuity may involve adherence to short weekly practices (Azevedo; Menezes, 2021) up to monthly frequency (Bai *et al*, 2020), improving self-care, personal organization, and understanding of emotions up to 6 months after the intervention. A large dropout of up to 72% of students in a mindfulness program was associated with academic overload (Nirino; Silva; Pucci, 2022).

The use of educational technologies for health promotion, such as a virtual assistance program, could be a good response to the lack of time claimed by young people (Forini; Lima, 2025; Rocha *et al*, 2021). A possible placebo effect of G1 with only mindfulness without aromatherapy could be corroborated by statements where inhalation practices without active ingredients can generate good results by themselves, even for the short time for relaxation (Lyra; Nakai; Marques, 2010) or result from the brain's response to the treatment environment (Luan *et al*, 2023).

Aromatherapy was one of the most cited ICP by pharmacy students in Brazil, exceeding 60% of the sample (Rodrigues; Evangelista; Tescarollo, 2018). Despite knowledge about aromatherapy and its association with anxiety or analgesia, only a tenth of health students reported their own use and less than two percent knew how to name fragrances for the practice (Moreira *et al*, 2017). A study of medical students showed that two-thirds had never used essential oils, but would be interested in trying them (Mendes *et al*, 2023).

This reflects the university's incipient knowledge of aromatherapy, which is not yet integrated into traditional curricula. Experimental conditions are heterogeneous for aromatherapy, which can be individualized with an olfactory strip close to the nose (Hedigan *et al*, 2024; Silva; Gouveia; Tescarollo, 2022), mask attached to the face or cotton (Lyra; Nakai; Marques, 2010; Malloggi *et al*, 2021; Nath; Kucukarslan, 2023) or done by direct collective inhalation from the environment, for up to 10 (Malloggi *et al*, 2021; Satou *et al*, 2024), 20 (Lopes *et al*, 2021; Pei *et al*, 2024; Rahmawati *et al*, 2022; Rodrigues; Evangelista; Tescarollo, 2018) or 30 minutes (Dias; Sousa; Vilanova-Campelo, 2023; Nath; Kucukarslan, 2023).

Our study converged with the cross-model of other authors (Satou *et al*, 2024; Enwright *et al*, 2023), but because it always started with mindfulness and finished

with aromatherapy, it only needed a few minutes break, unlike the 2-day (Enwright *et al*, 2023) or 1 week washouts (Satou *et al*, 2024).

The number of aromatherapy sessions varies greatly, including single interventions (Lopes *et al*, 2021; Luan *et al*, 2023; Satou *et al*, 2024) up to six sessions (Dias; Sousa; Vilanova-Campelo, 2023; Hedigan *et al*, 2024; Rodrigues; Evangelista; Tescarollo, 2018; Santos *et al*, 2021), being reported in isolation that the physiological benefits are immediately evident in the first session (Santos *et al*, 2021).

The concentration of essential oil is important, as on average only 1/3 of the inhaled air passes through the lungs and of this value 70% is actually absorbed by the body, with a minimum of 10 drops per session being recommended for healthy adults (Lyra; Nakai; Marques, 2010). When adopting this protocol, there was a very distinct aromatic perception among the groups tested. Further studies are needed to identify the minimum effective dosages in order to form a better defined therapeutic window, as well as toxic levels (Lyra; Nakai; Marques, 2010).

In the mixed methods evaluation, a study with nursing students showed good adherence and ease with mindfulness and problems with aromatherapy, as there were preferences for aromas and concerns about allergies (Moore; Montgomery; Cobbs, 2021). physical education students using guided meditation and aromatherapy with lavender and frankincense oil reduced state anxiety, with no differences in trait anxiety and stress (Dias; Sousa; Vilanova-Campelo, 2023).

In university students, mindfulness meditation combined with aromatherapy using *Cananga odorata* oil, with similar levels of β -caryophyllene, germacrene D and δ -cadinene to copaiba oil and lower levels of linalool compared to lavender, reduced stress more than the therapies alone (Nath; Kucukarslan, 2023), such as the present study. Aromatherapy adheres to use with other complementary methods (Musarezaie *et al*, 2024) but measuring physiological components to determine the impact of essential oils on the body requires more research (Enwright *et al*, 2023).

Lavender species are anxiolytic and sedative and are used to treat stress and anxiety through inhalation (Hedigan *et al*, 2024; Lopes *et al*, 2021). There are studies showing a wide reduction in hemodynamic responses with lavender, including systolic and diastolic blood pressure, mean arterial pressure and heart rate (Lopes *et*

al, 2021; Lyra; Nakai; Marques, 2010; Malloggi *et al*, 2021), overcoming placebo (Kim *et al*, 2021; Lopes *et al.*, 2021). Lavender is beneficial for heart patients (Lopes *et al.*, 2021) and even in cases of anosmia, its inhalation decreased the heart rate (Satou *et al*, 2024). There was similarity to a study with a small reduction in blood pressure and heart rate after aromatherapy (Rodrigues; Evangelista; Tescarollo, 2018). The absence of changes with lavender for oxygen saturation and temperature was verified (Lopes *et al*, 2021), although there are claims of reduction (Malloggi *et al*, 2021) or increase in temperature (Lyra; Nakai; Marques, 2010).

Four drops 3 times a day for 45 days did not differ from the control in terms of cortisol, TSH and T4 levels, and were not as useful in regulating stress (Deiss *et al*, 2023). Synergies are beneficial, with 1% lavender and bergamot 3 times a day for 20 days reducing irritability, headache, cervical or lumbar pain, insomnia, heart rate and fatigue (Camargo; Carvalho, 2019). Lavender with rosemary (5 drops each) did not affect anxiety, but it was a pleasant and strong blend, not overwhelmed by a single aroma, with less expression of discomfort (Enwright *et al*, 2023). Lavender at 50% with other oils (bitter orange, ylang-ylang and cedar) in 2 drops per 5mL in 7 sessions of 10 minutes reduced stress and anxiety (Lyra; Nakai; Marques, 2010).

Lavender is a familiar scent, which can have positive or negative sensory associations (Hedigan *et al*, 2024), but its hedonic perception has greater pleasantness, familiarity and intensity than vetiver and ylang ylang and a higher frequency of well-being, softness and serenity (Silva; Gouveia; Tescarollo, 2022). Single inhalation by university students of lavender oil in 5 drops per 100mL promoted high satisfaction, with expressions of relaxation, tranquility, calm, well-being, drowsiness, lightness and joy (Rodrigues; Evangelista; Tescarollo, 2018), corroborating the results.

Inhaling lavender fragrance for just 4 seconds generates a central nervous system response, evoking memories, and individuals feel calm and relaxed (Luan *et al*, 2023). Memory improvement with lavender during exam periods can also be seen in university students, with 5 drops in 30mL of water for 15 minutes for at least 3 days (Rahmawati *et al*, 2022) or even in a single intervention for 10 minutes (Musarezaie *et al*, 2024), which may explain the diversity of emotions expressed.

Lavender oils have linalool and linalyl acetate as their main active ingredients (Hedigan *et al*, 2024; Sweeney *et al*, 2025) that have complementary mechanisms (Malloggi *et al*, 2021). Linalool has sedative, anxiolytic, anticonvulsant and antidepressant effects by inhibiting glutamate binding (Hedigan *et al*, 2024) and by the increase in GABA that generates a parasympathomimetic effect, with a reduction in cortisol and systolic pressure (Lopes *et al*, 2021; Malloggi *et al*, 2021; Mendes *et al*, 2023; Pei *et al*, 2024; Rahmawati *et al*, 2022).

Linalyl acetate has a narcotic effect (Rahmawati *et al*, 2022) and progressive vascular contraction, relaxing the carotid artery (Lopes *et al*, 2021). In addition to these components, 1,8-cineole oxide inhibits acetylcholinesterase and increases locomotor activity, improves physical energy and mood in combination with camphor (Silva; Gouveia; Tescarollo, 2022). Both terpene-4-ol and α -terpineol have anti-inflammatory and antioxidant properties (Sweeney *et al*, 2025). The large number of phytochemicals in lavender oils, including linanol, linalin acetate, ocimene, lavandulyl acetate, farnesene, β -caryophyllene, 1,8-cineole oxide, and camphor, could explain the affective stimulation and relaxing effect (Silva *et al*, 2024; Silva; Gouveia; Tescarollo, 2022).

There is less evidence for copaiba oil in stress. A randomized clinical trial of copaiba oil inhalation in adults under high mental workload reduced heart rate, salivary cortisol, and beta waves in the left medial frontal region, consistent with body relaxation (Zhang *et al*, 2022). Most frequently found in copaiba oil, β -caryophyllene has local anesthetic activity, reducing nociception in arthritis in rats (Cardinelli *et al*, 2023; Pei *et al*, 2024) and acts on cannabinoid receptors CB2, contributing to systemic anti-inflammatory activity (Ferro *et al*, 2018; Nath; Kucukarslan, 2023; Pei *et al*, 2024; Silva *et al*, 2024).

Inhalation of β -caryophyllene with jojoba oil (1:1) reduced heart rate and frontal beta waves or alertness and increased delta and theta waves of relaxation and facial expressions of happiness, while linalool in the same proportion reduced systolic pressure, without changes in oxygen saturation and temperature (Pei *et al*, 2024). Alpha-humulene also has an anti-inflammatory role, related to body relief (Cardinelli *et al*, 2023). Combination of α -humulene, α -copaene, δ -cadinene, β -elemene and aromadendrene enhances the aromatic profile of copaiba oil, connecting with

affective stimulation (Silva *et al*, 2024; Silva; Gouveia; Tescarollo, 2022). Understanding phytocomplexes in essential oil helps to understand the significant and diverse biological activity (Sweeney *et al*, 2025). The positive results of copaiba oil make it a promising alternative to lavender for aromatherapy.

This unprecedented study reveals gaps in research on the association between mindfulness and aromatherapy, and copaiba oil in stress reduction. More evidence is needed, given the limited research with university students and the limited use of these techniques alone or in combination over the long term (Forini; Lima, 2025). Pharmacokinetic and pharmacodynamic in-depth studies are necessary for proper use by healthcare professionals and users, considering the mode of action, effects, contraindications, adverse effects, and safe dose of aromatherapy (Mendes *et al*, 2023). The social impact of the results can motivate the development of extracurricular activities (Murakami *et al*, 2024) or student support programs to mitigate the problem of university stress (Lyra; Nakai; Marques, 2010).

CONCLUSION

Mindfulness combined with aromatherapy suggests it is more beneficial than either modality alone for mitigating signs and symptoms of stress. Copaiba oil, as well as lavender, emerges as a promising aroma for more immediate effects. Despite favorable sensory data, long-term studies are needed to further explore preliminary physiological outcomes.

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