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Effectiveness of Lavender Aromatherapy to Reduce Headache in Patients with Traumatic Brain Injury

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ABSTRACT

Introduction: Headache is one of prevalent symptom among Traumatic Brain Injury (TBI) which can contribute to secondary headache namely Post Traumatic Headache (PTH). Patients with TBI may experience either acute or chronic headaches, which can interfere with everyday activities and even lower their quality of life. Consequently, simple and effective pain management is needed to overcome it
Objective: To determine the effectiveness of lavender aromatherapy to reduce headache intensity in mild TBI patients.
Method: A pre-experimental design with a one-group pretest-posttest design. The sample consists of 16 respondents who receive lavender aromatherapy for a duration of 30 minutes. Pain level was measured using the Numeric Rating Scale (NRS) pain scale. Data were analyzed using the Wilcoxon Signed Ranks Test at a significance level of $\alpha \leq 0,05$.
Results: The mean pain intensity prior to the implementation of lavender aromatherapy was 3.25, whereas the mean pain intensity following the implementation was 1.12. A significant difference in pain intensity was observed before and after the administration of lavender aromatherapy (p-value=0.000).
Conclusions: The use of lavender aromatherapy has been demonstrated to be an effective non-pharmacological therapy for headaches in patients with mild TBI.

Keywords : Aromatherapy Lavender, Headache, Traumatic Brain Injury

INTRODUCTION

Traumatic Brain Injury (TBI) is one of the main causes of death and disability in the globe. Road traffic injuries account for the majority of TBI, which affects 69 million people annually from all sources. The Southeast Asian and Western Pacific regions have the highest total disease burden (Dewan et al., 2019). Most road traffic deaths (92%) take place in nations with fewer resources (World Health Organization, 2023). All parts of the world are affected by TBI, but low and middle-income nations are particularly affected since they bear the greatest burden of trauma, accounting for almost 70% of all trauma-related deaths (Dewan et al., 2019).

TBI can result in temporary or permanent physical, cognitive, and psychosocial impairments (Khoiriyah et al., 2024; Perrin et al., 2022; Sameh et al., 2021). One of the most prevalent symptoms for TBI is a headache, which contributes significantly to the disease's burden (Sukraeny, 2019; Schwedt, 2021; Kraemer et al., 2022). According to studies, within a year after a traumatic brain injury, up to 90% of patients report having new or worsening headaches. An underlying head

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and/or neck injury is the cause of post-traumatic headache, a secondary headache disease. One of the most prevalent symptoms after a TBI is post-traumatic headache, which is also one of the most likely to last after the injury (Schwedt, 2021). Patients with mild TBI see a gradual alleviation of headaches over time. Nevertheless, the enhancement is minor and predominantly observed in those with less severe headache symptoms. Individuals with headaches are more susceptible to exacerbated headache features that significantly affect their quality of life (Flynn et al., 2023).

Headache management in TBI patients can be achieved by pharmaceutical and non-pharmacological approaches. Pharmacological therapy employs narcotic analgesics (morphine, codeine) and non-narcotic analgesics (aspirin, acetaminophen, ibuprofen). Non-pharmacological management employs relaxation techniques to alleviate muscle tension and anxiety, while distraction strategies mitigate pain by redirecting attention to alternative activities, such as watching television, listening to music or recitations, or engaging in aromatherapy (Ren et al., 2025).

Aromatherapy is a complimentary alternative therapy that can be utilized independently due to its straightforward application. Its numerous benefits for alleviating stress and enhancing sleep quality encompass affordability, accessibility, minimal time and space limitations, and rapid impacts. Aromatherapy involves inhalation, massage, and bathing with essential oils derived from fragrant plants. Aromatic molecules infiltrate the human body via the respiratory system and dermis; they influence the limbic system by modulating and altering the signals transmitted by the hypothalamus. All varieties of essential oils are applicable in aromatherapy. Lavender oil is among the most prevalent essential oils extensively utilized (Her & Cho, 2021).

Lavender (Lavandula angustifolia) oil, frequently utilized in fragrance, cosmetics, and medicines, contains two principal volatile constituents: linalool and linalyl acetate. Inhaled volatile chemicals exert quick effects through the limbic system, which is thought to account for their advantageous biological impacts. Numerous studies have demonstrated the efficacy of lavender aromatherapy (Her & Cho, 2021; Firooz et al., 2024; Ren et al., 2025). A comprehensive review and meta-analysis indicated that aromatherapy enhances sleep quality and alleviates stress, pain, anxiety, depression, and fatigue in adults and the elderly (Her & Cho, 2021). A systematic review and meta-analysis indicated that lavender oil aromatherapy effectively alleviated fatigue and anxiety in haemodialysis patients (Firooz et al., 2024). Consistent with that study, a comprehensive review and meta-analysis find that inhaled lavender aromatherapy considerably alleviates postoperative pain in adults (Ren et al., 2025).

The previous findings indicate that lavender oil may potentially alleviate the intensity of headaches in TBI patients; however, this subject has yet to be investigated. The objective of this study was to examine the impact of lavender aromatherapy on pain intensity in TBI patients experiencing headaches.

MATERIALS AND METHODS

Study Design and Setting

This study used a pre-experimental design with a one-group pretest-posttest design. The study was conducted from January to March 2023 at RSD K.R.M.T Wongsonegoro Semarang.

Study Population and Sampling

The study population included patients with TBI who admitted at the RSUD K.R.M.T Wongsonegoro Semarang. The inclusion criteria were patients diagnosed with mild TBI, GCS score 14-15, headache with a pain score ≥ 3, aged 18-59 years, and not undergoing surgery. Patients

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with worsening conditions such as decreased level of consciousness or complications from other diseases were excluded from this study.

Intervention

In this study, participants received a single session of lavender aromatherapy intervention. Utilize lavender aromatherapy by combining 3 drops of lavender essential oil with 20ml of water in a diffuser for a duration of 30 minutes.

Measurement

The headache was measured by the pain scale using Numerical Rating Scale (NRS). The NRS is a unidimensional measure of pain intensity primarily used in adults. Although there are several variations, the 11-item form is the most widely used. A number 0–10, where 0 denotes no pain and 10 denotes the "worst pain imaginable" during the past 24 hours, is reported by patients assessed using the NRS. The NRS is still the most widely used instrument for assessing acute pain because it is easily accessible, simple to administer verbally, quick to complete (less than one minute), and has few translation issues (Robinson et al., 2024).

Data collection

Data collection was carried out after the patients met the inclusion criteria. The data collected included demographic data and patient medical history, namely age, gender, education level, occupation, cause of TBI, head CT scan, and analgesic use. Before and after lavender aromatherapy administration the patients was measured headache pain scale using NRS.

Statistical Analysis

The data obtained during the pre-test and post-test will be collected, tabulated and analyzed with a data normality test using Shapiro-Wilk which is obtained *p-value* ≤ 0.05. The difference in the pain mean score of the headache before and after the lavender aromatherapy intervention was analyzed using the Wilcoxon Signed Rank Test with a *p-value* ≤ 0.05.

Ethical Considerations

Ethical approval for this study was obtained from the Ethics Committee of RSD K.R.M.T Wongsonegoro Semarang, on January 25, 2023 (No. B/070/588/I/20223)

RESULTS

Total sixteen patients were included in this study. Half of the respondents, totaling 8 individuals (50.0%), are aged 18-24 years; 5 respondents (31.3%) are into the 25-39 years age range; and 3 respondents (18.7%) are aged 40-60 years. The majority of respondents are male as many as 14 respondents (87.5%). Regarding employment status, it is known that almost half of the respondents are private workers, totaling 7 respondents (43.75%), while an equal number of 7 respondents (43.75%) are students, and 2 respondents (12.5%) are unemployed. Based on the cause of mild head injuries, most occur due to traffic accidents, totaling 11 respondents (68.8%) and the least occurs due to experiencing physical violence is 1 respondent (6.3%). Most respondents did not receive supporting examinations, with 12 respondents (75.0%) not undergoing a CT scan of the head. The data characteristic of respondent can be seen in Table 1.

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Table 1: Frequency, Percentage, and Mean of Demographic and Health Status Characteristics of Study Participants (n = 16)

Items	n	%	Mean
Gender			
Male	14	87.5	
Female	2	12.5	
Age, year			28.18
(Minimum-Maximum=18-59)			
18 – 24 years	8	50	
25 – 39 years	5	31.3	
40 – 60 years	3	18.7	
Occupation			
Private employee	7	43.8	
Student	7	43.8	
No occupation	2	12.5	
Diagnostic Examination: Head CT Scan			
Yes	4	25	
No	12	75	
Cause of Injury			
Traffic Accident	11	68.8	
Falling	4	25	
Violence	1	6.3	

Regarding the pain scale of the headache, it is showed that the mean score of the pain scale of the headache in TBI patients before the intervention was 3.25 and the mean score of the pain scale after the intervention was 1.12. The difference in the mean pain scale before and after was 2.13 (p=0.000), so it can be concluded that there is a significant difference between the headache scale before and after the intervention treatment. That result shown at Table 2.

Table 2: Pain score of headache in TBI patients before and after aromatherapy (n = 16)

Variable	Mean (SD)	Median	Z	p value
Pain score pre intervention	3.25 (.577)	3.00	-3.189	0.000
Pain score post intervention	1.12 (.341)	1.00		

DISCUSSION

In recent years, there has been a significant rise in the utilization of complementary therapies among diverse global populations. This increasing tendency can be ascribed to multiple variables, such as the rising incidence of chronic illnesses, heightened patient awareness, and a demand for more comprehensive and individualized treatment methodologies. Complementary therapies are frequently employed in conjunction with conventional medical treatments to enhance overall well-being, mitigate symptoms, and reduce side effects linked to pharmacological interventions (Complementary, Alternative, or Integrative Health: What's In a Name? | NCCIH, n.d.). In accordance with these developments, this study investigated the pain-relieving benefits of lavender oil in TBI patients suffering from headaches.

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The results demonstrated that there is a significant difference in pain intensity before and after the administration of lavender aromatherapy (p-value=0.000). The pain intensity of the patients with mild TBI in this study according to the score is in mild categories. However, the headache in mild TBI patients need to be considered since there was evidence the headache in acute phase of TBI are risk factor for developing post-traumatic headache (Kraemer et al., 2022). Post-traumatic headache is prevalent and frequently persistent after mild traumatic brain injury. Various mechanisms for the onset and persistence of post-traumatic headache have been suggested, including neuro-inflammation, microglial proliferation, cellular injury resulting in disrupted homeostasis, axonal injury, impaired pain processing and modulation, and cortical spreading depression (Schwedt, 2021).

It is demonstrated that one-year post-injury, patients with post-traumatic headache following mild TBI were less likely to return to work (Schwedt, 2021). Furthermore, a study including headache patients with TBI over a five-year follow-up period revealed that individuals with TBI experienced more severe and frequent headaches compared to those without TBI. Headaches were correlated with diminished quality of life. Migraines, a kind of headache occurring after TBI especially in younger individuals, were correlated with increased headache severity and frequency over time (Flynn et al., 2023).

Individuals with mild TBI frequently endure pain and symptoms long after the initial injury. Insufficient understanding regarding pain and symptom management, along with competing obligations from job, school, and other duties, impeded their recovery (Portanova et al, 2021). Aromatherapy is a simple and safe adjunctive therapy for pain management in patients with mild TBI experiencing headaches.

Aromatherapy has been studied in many fields and shown to have numerous beneficial effects, including improved sleep quality and alleviates stress, pain, anxiety, depression, and fatigue in adults and the elderly (Her & Cho, 2021); fatigue and anxiety in haemodialysis patients (Firooz et al., 2024); reducing stress, insomnia, and anxiety in pregnant women (Vidal-García et al., 2024); reduced the quality, severity, and intensity of postherpetic pain (You et al., 2024); alleviates postoperative pain in adults (Ren et al., 2025).

The effects of aromatherapy lavender on pain can be explained by several possible mechanisms. Inhalation of 0.1% Lavender Essential Oil produces antinociceptive effects in mice experiencing complete Freund adjuvant (CFA)-induced inflammatory discomfort by activating connections from the anterior piriform cortex (aPir) to the insular cortex. This work illustrates a Lavender Essential Oil-responsive olfactory system circuit mechanism for mitigating inflammatory pain through aPir/IC neural connections, offering data to encourage the advancement of aroma-based therapies for pain relief (Yang et al., 2024).

This study has some limitations. The sample size of responders in this study was limited. The community of mild TBI patients is limited, necessitating an extensive duration to identify a substantial number of respondents.

CONCLUSIONS

Aromatherapy with lavender oil was found to reduce the headache intensity in mild TBI patients. These findings indicate that lavender oil may be useful in alleviating pain in patients with mild traumatic brain injury experiencing headaches. Furthermore, the inhalation of lavender essential oil by individuals with mild traumatic brain injury experiencing headaches has been suggested to serve as a non-pharmacological pain management strategy. Nonetheless, in light of the aforementioned limitations, further extensive studies are required to generalize the findings of the current research.

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Availability of data and materials
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Authors' contributions
The "Authors' Contributions" section details the specific roles of each author in conducting the research and preparing the manuscript. It enhances transparency, promotes accountability, and properly acknowledges each contributor's efforts.
Conceptualization, study design, and writing the first draft and framework: NS, DAK; Data collection: DAK and W; Data analysis: NS, DAK; Final approval: NS, DAK and W.

Conflict of Interest
There is no conflict of interest in this research.

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