

Effect of Lavender Essential Oil Inhalation on Anxiety Level for Patients Undergoing Closed Magnetic Resonance Imaging

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ABSTRACT

Contents: Magnetic resonance imaging (MRI) is one of the medical diagnostic imaging techniques that can provoke or exaggerate anxiety in certain patients. It may sometimes lead to the cancellation of the MRI. The lavender essential oil has a long historical anxiolytic benefit.

Aim: This study aimed to examine the effect of lavender essential oil inhalation with a massage on anxiety level for patients undergoing closed magnetic resonance imaging.

Methods: A quasi-experimental research (study/control group) was used to achieve the aim of this study. The study conducted at Magnetic Resonance Imaging Unit in Main University Hospital, Alexandria, Egypt. A convenient sample of 100 patients divided into the study and control group (50 patients for each). Two tools were used in the present study. Those were structured interview questionnaire that elicited the patients' sociodemographic characteristics, and State-Trait Anxiety Inventory to identify the patients' anxiety levels.

Results: There were no statistically significant differences between both groups concerning the anxiety level before the MRI procedure ($\chi^2=2.041$, $P = 0.495$). While there were statistically significant differences between both groups concerning anxiety level post-MRI procedure and after receiving of interventions ($\chi^2 =35.135$, $P=0.000$), there was a highly statistically significant difference between anxiety level before and after receiving intervention in study group patients ($t= 77.059$, $P=0.000$).

Conclusion: Patients undergoing a closed magnetic resonance imaging who inhaled and massaged their hands with Lavender essential oil exhibited a reduced level of anxiety than the control group and compared to their preintervention level. The study recommended using the lavender essential oil, an inexpensive and noninvasive intervention in reducing MRI anxiety or other anxiety-producing procedures.

Keywords: Lavender essential oil, inhalation, anxiety, Closed Magnetic Resonance Imaging.

1. Introduction

Magnetic resonance imaging (MRI) is one of the medical diagnostic imaging techniques used in radiology to create a more detailed image of body organs and tissues that help in the diagnosis of patients. Most MRI machines are a large tube with a hole at both ends, and a magnet surrounds this tube. A combination of the MRI scanner's confining nature, the loud noise it generates and feeling uncontrollable can cause severe symptoms of anxiety (Rotunda, 2017).

Over 80 million MRI procedures are performed each year worldwide (Robinson et al., 2009; Enders et al., 2011). Approximately 2 million MRI procedures worldwide are aborted because of claustrophobia. MRI environment can be extremely distressing, making imaging challenging for radiologic technologists (Parmar et al., 2018). Consistently, Thomus (2017), reported that the MRI seem exaggerated anxiety-related reaction. It reportedly occurs 40% to 30% of patients undergoing MRI procedures. In contrast with Stanly et al. (2016), Dziuda et al. (2019) stated that as between 1 and 15% of all patients who scheduled for MRI suffer from anxiety and cannot be

imaged and require sedation to complete the scan.

Patients who undergo the closed tube MRI procedure are experiencing some level of anxiety, especially for those who have never had an examination. Besides, some of them have post-traumatic stress disorder (PTSD) and claustrophobia as well. PTSD is a serious psychological condition that can cause an extreme reaction during imaging and can make an MRI examination seem unbearable (Parmar et al., 2018). Usually, patients with severe anxiety level responses are sedated in most hospitals, wherever it offers a solution for patients who need to be scanned by MRI despite their fears or anxiety (Almutlaq, 2018).

Interacting with anxious or fearful patients is an everyday occurrence for MRI technical nurse. Since the MRI procedure can trigger a severe level of anxiety or fear, the radiology nurse has a vital role in assisting the patient before, during, and after the MRI procedure to decrease the patient's anxiety. Nursing interventions that reduce patient's anxiety or fear about the MRI procedure can be effective for patients who have PTSD or claustrophobia. Imaging professional nurses can implement many of them before the patient comes into the clinic, considering that each patient has different concerns, needs, expectations, perceptions, and feelings (Rotunda, 2017).

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Strategies such as providing information, the use of audiovisual systems, team training, and anxiety reduction protocols have all proved effective in reducing anxiety, fear, claustrophobia, and the need for sedation for people undergoing imaging (Munn & Jordan, 2012; Munn & Jordan, 2013; Munn & Jordan, 2014). Aromatherapy is one of the complementary therapies used to treat different diseases and symptoms (Sarris et al., 2012). It is a natural treatment utilizing essential oils as the primary therapeutic agents extracted from flowers, leaves, stalks, fruits, seeds, roots, and resins. Essential oils have various applications such as massage, inhalation, compresses, and baths (Vasquez & Garcia, 2017).

Essential oils have many types of pharmacological effects. These effects include anti-microbial, sedative, analgesic, spasmolytic, and hormone-like effects of estrogen or steroids (Cho et al., 2013). Since different types of essential oils such as pure lavender, rose, mandarin, sweet orange, sandalwood, geranium have an anxiolytic function, aromatherapy was used to alleviate depression and anxiety. Therefore, safe and evidence-based complementary or alternative therapies may be valuable allies in patients with anxiety disorders (Vasquez & Garcia, 2017).

Lavender essential oil (LEO) has an extensive anecdotal history of anxiolytic benefit that has recently been supported by clinical efficacy studies. LEO is assumed to be anxiolytic, antidepressant, carminative (smooth-muscular relaxant), antibacterial, antifungal, analgesic, and beneficial immunomodulatory effects on wound healing (Silva et al., 2015; Malcolm & Tallian, 2017). Essential oils delivered via inhalation can have psychological effects because the olfactory bulb has limbic inputs associated with emotion and memory in the amygdala and hippocampus (Asquez & Garcia, 2017).

It is hypothesized that odor-induced emotional memory can, in some circumstances, be the etiological origin of situational anxiety (Imanishi et al., 2009; Malcolm & Tallian, 2017). Lavender is a plant commonly used in aromatherapy, with aromatic leaves at the top of the flowers and attractive bracts. Studies have shown that lavender aromatherapy inhalation effectively reduces depression, pain, and anxiety so the nurse can put it in her preparation for the patient before the MRI procedure instead of sedation to reduce anxiety (Malcolm & Tallian, 2017).

Aromatherapy studies face significant challenges for very comprehensive analysis. Many small, randomized aromatherapy trials have been conducted in medical settings that may provoke anxiety. State anxiety reduction has been identified in situations such as preoperative anxiety, removal of chest tubes, cosmetic procedures and stays in intensive care units (Barden et al., 2009; Cho et al., 2013; Franco et al., 2016; Grunebaum et al., 2011; Hasanzadeh et al., 2016). However, other similarly designed studies Bikmoradi et al., (2015); Dunn et al., (2008); Graham et al., (2003); Muzzarelli et al., (2006) in similar settings have failed to show benefit or have not demonstrated clear benefit.

A single observational pilot study Conrad and Adam

(2012) reported that postpartum women with anxiety showed decreased levels of anxiety using a rose/lavender oil blend over four weeks for 15 minutes twice weekly.

2. Significance of the Study

Magnetic resonance imaging (MRI) can cause high levels of anxiety in patients, especially those who are not adequately prepared to deal with their feeling of anxiety that was commonly experienced on MRI machines. They may have been instructed about the procedure and some of the physical sensations that they may encounter, but there is lacking use of alternative management to utilize when confronted with the occurrence of fear when immediately available. Therefore, nurses must implement some of the alternatives strategies in their practice to reduce anxiety and increase patient comfort rather than focusing on a sedating medication alone, which is usually associated with adverse effects such as respiratory depression (Rotunda, 2017).

No precise statistics of how many patients undergoing MRI annually in Egypt, but many clinical experiences with the MRI has revealed that the procedure may produce anxiety in some patients, to the extent that sometimes a patient may be unwilling to undergo the procedure. Only one Egyptian study is found in the literature that shedding light on the anxiety before MRI procedure using the State Traits Anxiety Inventory. The study indicated a moderate level of anxiety among the study and control group patients before MRI and a higher mean score after MRI for both groups. The study also reported that one-third of the studied patients reported severe anxiety after the procedure, and more than two-fifths of them reported moderate anxiety (Selim, 2001). Thus, the present study was conducted to examine whether aromatherapy with essential lavender oil as a non-pharmacological alternate can reduce anxiety levels in patients undergoing MRI procedures.

3. Aim of the study

This study aimed to examine the effect of lavender essential oil inhalation with a massage on anxiety level for patients undergoing closed magnetic resonance imaging.

3.1. Research hypotheses

- Patients undergoing a closed magnetic resonance imaging who inhale and massage their hands with lavender essential oil will exhibit a reduced level of anxiety compared to the controls
- Patients undergoing a closed magnetic resonance imaging who inhale and massage their hands with lavender essential oil will exhibit a reduced level of anxiety compared to their preintervention level.

4. Subjects and Methods

4.1. Research design

The research design of this study was quasi-experimental research (study/control group). Quasi-experimental research is similar to experimental research in that there is the manipulation of an independent variable. It differs from experimental research because either there is

no control group, no random selection, no random assignment, and/or no active manipulation (*Abraham & MacDonald 2011*).

4.2. Research setting

This study was conducted at the Magnetic Resonance Imaging Unit in Main University Hospital, Alexandria, Egypt. This unit composes of four waiting rooms and 2 MRI rooms with one closed tube machine in each. Moreover, there are eight nursing staff and two technicians.

4.3. Subjects

This study's subjects were a convenient sample of patients admitted to the MRI unit at the setting mentioned above for six months. They were 100 adult patients undergoing closed MRI for different body parts. They were classified into two groups, 50 patients in each. Patients of both groups were matched as much as possible as regards age, gender, level of education, and marital status.

The patient's inclusion criteria were:

- Age ranges from 21- 60 years old and conscious.
- No previous experience with closed MRI machine.
- No allergic history of lavender smell.

Sample size calculation:

- Population size = 170 patients for 3 months.
- Expected frequency = 50%
- Acceptable error = 10%
- Confidence co-efficient = 95%
- Minimum sample size = 100 patients

4.4. Tools of the study

Two tools were used in the present study to fulfill its aim which including:

4.4.1. A Structured Interview Questionnaire

The researchers conceived and developed this tool to elicit patients' profiles regarding sociodemographic and clinical data as a patient's code, age, gender, educational level, marital status, duration of the procedure, and site of the procedure.

4.4.2. The State-Trait Anxiety Inventory (STAI)

State-Trait Anxiety Inventory designed by *Spielberger et al. (1970)*. The scale was translated and standardized for Egyptians by *Abdel Khalek (1984)* to measure the presence and severity of current anxiety symptoms and a generalized anxiety propensity. It is an individual type self-report, and self-administered questionnaire.

Within that measure, there are two subscales. First, the State Anxiety Scale (S-Anxiety) assesses the current state of anxiety by asking how respondents feel "right now," using items that quantify subjective feelings of fear, stress, nervousness, worry, and autonomic nervous system activation/arousal. Second, The Trait Anxiety Scale (T-Anxiety) evaluates relatively stable aspects of "proneness of anxiety," including the general state of calm, confidence, and security.

The STAI has 40 items, 20 items allocated for each of

the subscales S-Anxiety and T-Anxiety, e.g., I feel uncomfortable, feel tense, feel calm, and feel strained, and I feel nervous. Specific instructions are given for each of the subscales S-Anxiety and T-Anxiety. It took 10 minutes to be completed. Alpha coefficients tested internal consistency, and it was quite high, ranging from 0.86 to 0.95.

Scoring system

Item scores are added to obtain total test scores. Scoring was reversed for anxiety-absent items (19 items of the total 40). The scores range for each subtest is 20–80, the higher scores showing more significant anxiety. The state of patient's anxiety in the study and control group were judged as follows: Low anxiety (20-40), Moderate anxiety (41-60), and High anxiety (61-80).

4.5. Procedures

The study tools were examined for content and face validity by a panel of five experts from Medical-surgical and Mental Health Nursing Departments, Alexandria University, to elicit the completeness, clarity, relevance of the study tools. The necessary modifications were done to remove specific data, e.g., body mass index, chronic diseases, and medications taken by patients. The correlation coefficient estimated the reliability of the developed tool. It was 0.7 for the State Traits Anxiety Inventory.

An official letter is issued from the Dean of Faculty of Nursing, Alexandria University, to the hospital director of Main University Hospital, Alexandria, including the study aim and the procedures. Each participant has had written informed consent after explanation of the purpose of the study. Confidentiality and privacy were assured to each patient. A pilot study was conducted on ten patients to test the feasibility of the research process and the applicability of the developed tools. The patients included in the pilot study were included in the main study sample. Data collection was carried out in two phases:

Data collection related to the control group started before applying intervention to avoid contamination of the sample. Those patients received routine hospital care. Every patient met the study inclusion criteria was contacted to gain his/her agreement and cooperation to be included in the study. This meeting was done after an explanation of its purpose and assurance that his/her privacy and confidentiality would be maintained. Every patient was assessed by the researches to determine the anxiety level using the State-Trait Anxiety Inventory in the hospital waiting room of the MRI unit. The patient was then observed during the procedure by the researchers, then reassessed after finishing the procedure to determine the anxiety level using the State-Trait Anxiety Inventory.

Data collection related to the study group: Every patient in the study group received interventions by the researches. Every patient who met the sample selection criteria was contacted to gain his/her agreement and cooperation. Explanation of the purpose and assurance of privacy and confidentiality had been done.

Every patient was assessed by the researcher to determine the anxiety level using the State-Trait Anxiety Inventory in the hospital waiting room before the MRI procedure. Before the MRI procedure, the researcher prepared the environment by spraying the MRI machine room with lavender oil.

The intervention included combined aromatherapy inhalation and massage. Lavender oil was purchased from the Faculty of Agriculture, and the oils were placed in a glass bottle of a dark color, light-proof, dropper. Three drops of lavender oil were dripped into a bowl after 200 ccs of boiled water were poured into a bowl. The patients were inhaled in the waiting room for 5 minutes from a distance of about 30 cm before entering the scanning MRI room. The patients were covered entirely with a cloth while the patients were told to shut their eyes and inhale deeply.

The researcher performed a gentle hand massage for patients' hands with ten drops of lavender oil for 10 minutes. The patient was then observed during the procedure by the researcher from outside through room screen then the patient was interviewed by the researcher on discharge to measure his/her anxiety level using the State trait Anxiety Inventory.

A comparison was made between two groups to determine the effect of lavender essential oil inhalation on anxiety levels for patients undergoing closed magnetic resonance imaging. Data collection was made over six months from the beginning of September 2019 to the end of February 2020.

4.6. Data analysis

Data was coded and transformed into a specially designed format to be suitable for computer feeding. Following data entry, checking, and verification processes were carried out to avoid errors of data entry. All statistical tests were completed using the Statistical Package for Social Sciences (SPSS) version 25 for windows. A 5 % level of significance was chosen where $p \leq 0.05$ was considered significant. The used tests were the Chi-square test used for finding the difference between categorical variables in both groups. Fisher's Exact test (FET) or Monte Carlo correction: Correction for chi-square when more than 20% of the cells have expected count less than 5. Pearson correlation was used to test the association between variables.

5. Results

Table 1 demonstrates patient sociodemographic characteristics. The results reveal a patients' mean age of 46.64 ± 4.84 years and 46.34 ± 5.86 years for the study and control groups, respectively. Concerning patients' gender, the highest percentages in both groups were female patients, 58.0%, and 68.0% for the study and control groups. As regards the patient's education, the highest percentages in both groups had secondary school education (40.0% and 34.0% for the study and control groups, respectively). About the patients' marital status, the highest percentage in both groups (60%) was married. There was

no statistically significant difference revealed between both groups regarding all sociodemographic characteristics

Table 2 represents a comparison between the study and control group regarding the MRI profile. Concerning the duration of the MRI procedure, the mean duration of the MRI procedure among the study group was 21.70 ± 6.27 , while in the control group, it was 20.00 ± 5.24 . About the MRI site, the highest percentages in both groups were knee MRI procedures, 28.0%, and 32.0% for the study and control groups, respectively. There was no statistically significant difference detected between both groups regarding their MRI profile.

Table 3 shows a comparison of the anxiety level between the study and control group. Concerning the pre-MRI anxiety level, most patients had moderate anxiety in the study group 96.0% and 100% of the study and control group, respectively. While post-MRI, all study group patients had low anxiety compared to 48.0% of control group patients had low anxiety levels, and 52% of them exhibit a moderate level of anxiety.

It can also be noted that there were no statistically significant differences between both groups concerning the anxiety level before the MRI procedure ($\chi^2 = 2.041$, $P = 0.495$). At the same time, there were statistically significant differences between the anxiety-level post-MRI procedures and after receiving interventions ($\chi^2 = 35.135$, $P = 0.000$).

Table 4 shows the mean anxiety score for both studied groups before and after MRI, that in the study group the mean \pm SD of anxiety level before performing MRI was 44.96 ± 1.94 while after inhalation of lavender oil and performing MRI, it was 33.02 ± 2.10 with a highly statistically significant difference between anxiety level before and after receiving interventions ($t = 77.059$, $P = 0.000$). On the other hand, the control group had a mean \pm SD of anxiety level before performing MRI was 45.30 ± 2.04 while after performing MRI, it was 41.88 ± 2.63 with a highly statistically significant difference between anxiety level before and after the procedure (24.910 , $P = 0.000$).

It can also be noted that there were no statistically significant differences between both groups concerning mean anxiety before receiving interventions ($t = -0.852$, $P = 0.396$). At the same time, there was a highly statistically significant reduction of anxiety mean score in the study group compared to the control group after receiving the lavender oil inhalation ($t = -18.561$, $P = 0.000$). Regarding the mean difference in the study group between the anxiety level before and after receiving interventions, it was (-11.94 ± 1.09) while in the control group it was (-3.42 ± 0.97) . Furthermore, the difference between both groups was highly statistically significant ($t = -41.156$, $P = 0.000$).

Table 5 represents the association between anxiety level and patients' gender. Regarding the study group, most patients had a moderate level of anxiety (96.6%) among female patients before the intervention. In comparison, all female patients (100%) had low anxiety levels after receiving lavender oil inhalation (LOI) post-MRI. There

was no association between study group patients' gender and anxiety level before and after MRI procedure ($\chi^2 = 2.041$ $P = 0.495$)

On the other hand, the control group, all-female and male patients had moderate anxiety levels before the MRI procedure, while 55.9% of female patients moderate anxiety after the MRI procedure. There was no association between control group patients' gender and anxiety levels before the MRI procedure and after the MRI procedure ($\chi^2 = 0.642$, $P = 0.547$).

Table 6 indicates the correlation between the anxiety level post-procedure after using the LOI and the MRI procedure duration. There was a strong inverse statistically significant correlation between the anxiety scores after receiving inhalation of lavender oil and the duration of the procedure in the study group ($r = -0.312$, $P = 0.028$). At the same time, there was no statistically significant correlation in the control group ($r = -0.110$, $P = 0.445$).

Table (1): Comparison of patients in the study and control groups concerning their sociodemographic characteristics.

Sociodemographic characteristics	Study Group (n=50)		Control Group (n=50)		Significance test	p-value
	(N)	(%)	(N)	(%)		
Age (Mean±SD)	46.64 ± 4.84		46.34 ± 5.86		T = 0.279	0.781
Gender						
Male	21	42.0	16	32.0	$\chi^2 = 1.07$	0.408
Female	29	58.0	34	68.0		
Educational Level						
Cannot read and write	11	22.0	9	18.0	FET= 4.93	0.291
Primary	4	8.0	9	18.0		
Preparatory	6	12.0	2	4.0		
Secondary	20	40.0	17	34.0		
University	9	18.0	13	26.0		
Marital status						
Single	19	38.0	19	38.0	FET=0.258	1.000
Married	30	60.0	30	60.0		
Widow	1	2.0	1	2.0		

Table (2): Comparison between the study and control group patient regarding the MRI profile.

MRI profile	Study Group (n=50)		Control Group (n=50)		Significance test	p-value
	(N)	(%)	(N)	(%)		
Duration of MRI procedure						
<20 minutes	30	60.0	39	78.0	$\chi^2 = 3.787$	0.083
20-30 minutes	20	40.0	11	22.0		
Mean ± SD	21.70 ± 6.27		20.00 ± 5.24		T = 1.469	0.145
MRI Procedure						
Pelvis	7	14.0	7	14.0	$\chi^2 = 0.466$	0.979
Abdomen	12	8.0	11	18.0		
Head	7	14.0	8	16.0		
Knee	14	28.0	16	32.0		
Foot	10	20.0	8	16.0		

Table (3): Comparison of anxiety levels before and after MRI procedure among study and control groups.

Anxiety Level*	Pre -MRI				Post-MRI			
	Study Group		Control Group		Study Group		Control Group	
	N	%	N	%	N	%	N	%
Low anxiety	2	4.0	0	0.0	50	100	24	48.0
Moderate anxiety	48	96.0	50	100.0	0	0	26	52.0
Test	$\chi^2 = 2.041$		P = 0.495		$\chi^2 = 35.135$		P = 0.000	

* no one of the patients in study or control group had a severe level of anxiety

Table (4): Comparison of mean anxiety scores among study and control groups before and after MRI and between both groups.

Group	Anxiety before MRI	Anxiety level after MRI	Paired t-test	p-value	Mean anxiety difference score
	Mean ± SD	Mean ± SD			
Study Group	44.96 ± 1.94	33.02 ± 2.10	77.059	0.000	- 11.94 ± 1.095
Control Group	45.30 ± 2.04	41.88 ± 2.63	24.910	0.000	-3.4200 ± .97080
Test/p	t = -0.852, P = 0.396		t = -18.561, P = 0.000		t = - 41.156, P = 0.000

Table (5): Association between the anxiety level before and after using lavender oil and participants' gender among study and control groups.

Anxiety Level	Study Group (n=50)								Control Group (n=50)							
	Pre -MRI				post MRI				Pre -MRI				post MRI			
	Male		Female		Male		Female		Male		Female		Male		Female	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
	21	42	29	58	21	42.0	29	58.0	16	32.0	34	68.0	16	32.0	34	68.0
Low anxiety	1	4.8	1	3.4	21	100	29	100	0	0	0	0	9	66.3	15	44.1
Moderate anxiety	20	95.2	28	96.6	0	0.0	0	0.0	16	100	34	100	7	43.8	19	55.9
Total	21	100	29	100	21	100	29	100	16	100	34	100	16	100	34	100
Test	$\chi^2 = 0.055$ P = 1.000								$\chi^2 = 0.642$ P = 0.547							

Table (6): Correlation between the anxiety scores after using lavender oil and duration of MRI procedure among study and control groups.

Parameter	Anxiety level post-procedure		
	Study group (n=50)	Control group (n=50)	Total Sample (n=100)
Duration of MRI procedure	r = - 0.312 p = 0.028	r = -0.110 p = 0.445	$\tau = - 0.225$ p = 0.025

6. Discussion

Complementary and alternative drug therapies are safer than pharmacological approaches and have fewer adverse effects. Aromatherapy is a natural method of treatment using the chemical structure and the effects of essential oils. The use of aromatherapy has increased considerably compared with other medical approaches (Fayazi et al., 2011). Inhalation aromatherapy is a method used in the inhalation of essential oils (Hur et al., 2012) and can decrease pain, anxiety, depression, and improve the vital signs (Kim et al., 2011; Lee & Hwang, 2011; Boehm et al., 2012). Therefore, this study aimed to examine the effect of lavender essential oil inhalation with a massage on anxiety level for patients undergoing closed magnetic resonance imaging.

Two matched groups were recruited in this study conveniently. Regarding the sociodemographic characteristics of studied patients, this study revealed that the mean age of the study and control groups was 46.64±4.84; 46.34±5.86, respectively. Concerning patients' gender, the highest percentages in both groups were female patients. This study's results are similar to the finding of Sleim (2001), who study the "effect of pre-instruction on anxiety levels of patients undergoing magnetic resonance imaging examination" and found a sample mean age of 44.5±6.46 years. In a similar study, Seif et al. (2014), studied the "effect of lavender essential oil on anxiety level in patients undergoing coronary artery bypass graft surgery" and reported contradicting findings of male predominance, mean age of 65.63±10.81, most of their patients were non-educated and married. This difference could be due to a different sample of patients with coronary artery bypass graft surgery.

About the MRI site, the results of this study found that the highest percentages in both groups were frequently a knee MRI. These results contradict Debnam (2017), who

stated that MRI in the brain and spinal cord imaging test most commonly used compared to other body parts.

Regarding the level of anxiety of patients before and after MRI procedure in study and control groups, the results of the present study reveal that most of the patients in study and control groups had moderate anxiety before MRI with a non-significant difference between both groups. In contrast, post-MRI, all study group patients had a low anxiety level compared to less than half of the control group, who shows more than half of the control group had moderate anxiety with a statistically significant difference between both groups. This finding might be due to the inhalation of lavender essential oil decreases anxiety among the study group as the lavender essential oil is documented in many studies to reduce anxiety (Malcolm & Tallian, 2017; Buch & von Fraunhofer, 2019; Wong, 2020). Malcolm and Tallian (2017); Chioca et al. (2013) reported a mechanism of action of LEO related to inhibition of voltage-gated calcium channels (VGCCs), reduction of 5HT_{1A} receptor activity, and increased parasympathetic tone.

Also, Baldinger et al. (2014) reported that after administering LEO for eight weeks in a randomized, blind, placebo-controlled crossover test on 17 healthy human volunteers, brain changes observed by positron emission tomography, and magnetic resonance imaging scans. They showed an anxiolytic effect of LEO. Besides, the investigators concentrated on the inhibitory 5HT_{1A} receptor due to increased activity of this receptor being highlighted in previous neuroimaging studies in anxiety pathophysiology (Akimova et al., 2009; Stanly et al., 2016).

In addition to the central effects, lavender oil appears to have peripheral effects, which can be an essential addition to its action mechanism. Lavender oil has demonstrated increased parasympathetic function and decreased hemodynamic parameters for rats, dogs, and humans (Cha et al., 2010; Hur et al., 2007; Komiya et al., 2009; Sayorwan et al., 2012; Shen et al., 2005). This

finding may be evidenced in this study as the researcher performs gentle hand massage with ten drops of lavender oil on the patient's hand for 10 minutes. These findings are supporting the first research hypothesis.

One of the notable findings of this study is the statistically significant reduction in study group anxiety mean score post-intervention compared to preintervention, which further supports the evidence extracted from the current research regarding the effect of LEO. *Karan (2019)*, supported these findings when investigating the effect of handheld inhalers containing LEO on the patient's anxiety and stated that the use of lavender aromatherapy reduced anxiety by 10% to 20% during MRI procedures. These findings are supporting the second research hypothesis.

On the other hand, a statistically significant difference between pre and post anxiety mean scores were also revealed among the control group. This finding may be referred to that post-MRI, it was expected that even the anxious patients become relaxed as they finish an anxiety-provoking procedure. The second rationale was related to the study tool itself STAI, as the S-Anxiety scale tends to detect transitory states (*Spielberger, 1983*). *Spielberger* also reported test-retest reliability coefficients on initial development ranged from 0.31 to 0.86, with intervals ranging from 1 hour to 104 days (*Julian, 2011*). However, the study group's improvement compared to the control group was further confirmed by a statistically significant difference between the mean anxiety difference scores.

This finding is similar to *Karan (2019)*, who found that patients exposed to the scent of lavender are experienced significantly lower anxiety, reduce stress, and pain among patients undergoing oral surgery. In contrast, the results of this study contradicted with *Stanly et al. (2016)*, who showed that participants' positive ratings of the smell pleasantness were associated with a reduced likelihood of experiencing anxiety ($p = 0.13$). However, the results were not statistically significant. This contradicting finding might be because most of their patients did not experience significant anxiety during MRI.

The present study showed no association between patients' gender and anxiety levels before and after the MRI procedure in both studied groups. These findings are supported by *Parmar et al. (2018)*, who reported that although the female had a higher percentage level of anxiety, there were no significant differences in patient experience anxiety when comparing female and male cases in both groups. This result was contradicted *Malcolm & Tallian (2017)*, who reported that females who have had MRI are twice as likely as males to have an anxiety disorder.

Regarding the correlation between the anxiety scores after MRI and the duration of the procedure, there was a strong inverse statistically significant correlation between the anxiety scores after receiving inhalation of lavender oil and the length of procedure in the study group, while there was no statistically significant correlation in the control group. This finding may be explained as the patient tenable with the anxiolytic effect of LEO that given before MRI and sprayed in the MRI room environment, so the

prolonged duration did not increase the patients' anxiety level. This result indicated that the essential oil of lavender might have a long-lasting effect due to lavender oil's influence on the nervous system. Also, lavender oil inhalation decreases the autonomic arousal. *Landelle et al. (2008)* reported a duration of six-hour for recovery from a poisonous state of LEO, which may be a subject for further studies.

7. Conclusion

Patients who were undergoing a closed magnetic resonance imaging who inhaled and massaged their hands with lavender essential oil exhibited a reduced level of anxiety compared to the control group and compared to their preintervention level.

8. Recommendations

- Continuing nursing staff education through an in-service training program to enhance their knowledge and skills on alternative therapies rather than administering sedatives.
- Using lavender oil is inexpensive and non-invasive intervention in reducing MRI anxiety or other anxiety-producing procedures.
- Investigate the effect of aromatherapy with lavender oil and other essential oils on other diagnostic or management methods in future studies.
- Inhalation of lavender oil can be prospectively considered in future studies for its potential sedative characteristics in patients undergoing surgical procedures performed under local anesthesia.

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