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The Effect of Aromatherapy on Sleep Quality Among Medical Students - A Randomized Controlled Trial

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Abstract

Aromatherapy inhalation has been proven to improve sleep quality and quantity, mostly in elderly and intensive care patients. Lavender oil (Lavandula angustifolia) has been reported to act on gamma aminobutyric acid (GABA) pathways, inhibiting binding at the GABA, a receptor channel with reversible inhibition of GABA-induced currents and an overall depressant effect on neurotransmission. This study was conducted to prove that aromatherapy inhalation, specifically lavender can improve sleep quality and quantity after a night of exposure, among medical students. A randomized controlled trial was conducted from August 2018 to September 2018. 50 participants were randomly assigned into 2 groups. 24 in control group and 26 in aromatherapy group. After dripping Lavender essential oil on the pillow of aromatherapy group, participants were given series of three questionnaires to test for sleep quality and quantity. Test scores of two groups were then compared and analysed using Epi Info™ 7th version. Subjective data (self-administered questionnaire) showed increased mean score in perceived sleep duration, sleep depth, latency, returning to sleep, awakening from sleep and sleep quality in intervention group. Aromatherapy increased clinical sleep duration, sleep depth, latency, returning to sleep, awakening from sleep and sleep quality. There is no significant effect in overnight usage of aromatherapy. Adverse effects such as disrupted sleep, headache and stuffiness of nose were reported by a minority of participants.

Keywords

Aromatherapy, Sleep, Students

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1. Introduction

Sleep stabilizes and enhances cognitive processes. Sleep is critical for memory consolidation, learning, decision making, and critical thinking [1-2]. Sleep deprivation has been shown to have a significant impact on mood, alertness, cognitive functions, and motor activity. These are important aspects in the life of medical students which is a typical group as medical studies are more demanding in terms of course content as well as working hours [3]. It has been reported that sleep quality affects medical student's physical and mental health, and consequently their working capacity [4]. The quality of sleep is a measure of both the quantitative and qualitative components of sleep. The quantitative component includes the duration of sleep while the qualitative component is a subjective measure of the depth and feeling of restfulness upon awakening [5]. A large survey study of Malaysian medical students revealed that daytime sleepiness occurred in 35.5% (as assessed by Epworth Sleepiness Scale Score [ESS] > 11), and poor sleep quality was reported by 16% [6].

Aromatherapy is the practice of using volatile plant oils, including essential oils, for psychological and physical well-

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being. Essential oils that are inhaled into the lungs offer both psychological and physical benefits [7]. Essential oils are a mixture of saturated and unsaturated hydrocarbons, alcohol, aldehydes, esters, ethers, ketones, oxides phenols and terpenes, which may produce characteristic odors [8]. The study of Goel et al, showed that aromatherapy improved the sleep quality of those who were suffering sleeplessness [9]. Research on aromatherapy use has mostly been limited by single oil choices and targeted to specific populations but is promising in its results to show that therapeutic-grade essential oils are efficacious at reducing pain, nausea, and anxiety in conjunction with standard care. [10-12]. Inhalation of essential oil (EO) involves both short application times and quick physical response in subjects, with EO components being detected in blood within 5 min and reaching maximum levels within 20 min. It is a non-invasive method that affects the brain directly, is a complementary and alternative medicine (CAM) therapy that is not restricted by time or place, is fast acting, and shows virtually no adverse effects [13]. Further, this method has an outstanding efficacy, as it spreads to the entire body through respiration to induce chemical reactions with enzymes, brings about enhanced psychological and physical relief effects [14], and can positively affect blood flow [15]. A sedative effect appears, at least in part, due to one of the major constituents of lavender oil, linalool, a monoterpene [16]. Lavender oil has been reported to act on gamma aminobutyric acid (GABA) pathways, inhibiting binding at the GABA, a receptor channel with reversible inhibition of GABA-induced currents and an overall depressant effect on neurotransmission [17]. Chemical compounds in essential oils can produce adverse effects when combined with medications. They may reduce the effectiveness of conventional drugs, or they may exacerbate health conditions in the individual. A person with high blood pressure, for example, should avoid stimulants, such as rosemary. Some compounds, such as fennel, aniseed, and sage act similarly to estrogen, so a person with an estrogen-dependent breast or ovarian tumor should avoid these. Some oils produce toxins which can cause damage to the liver, kidneys, and nervous system, especially if taken internally. Swallowing essential oils can be hazardous, and fatal in some cases. Aromatherapy can have side effects, but these are normally mild and do not last long. They include; nausea, headaches and allergic reactions. Use of aromatherapy by pregnant or nursing mothers has not been proven safe by research, so it is not recommended. During the first trimester of pregnancy, aromatherapy may pose a risk to the developing fetus. Women who are breastfeeding should avoid peppermint essential oil, as it may be expressed in breast milk. Essential oils derived from citrus may make the skin more sensitive to ultraviolet light, increasing the risk of sunburn. Some oils may affect the function of conventional medicines, so people who are using medications of any type should first check with a qualified pharmacist or doctor. [18]

A previous study done among self-reported sleep issues college students, who were exposed to lavender inhalation patch over 5 nights and their sleep quantity were accessed by Fitbit® tracker and their sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI). We conducted randomized controlled trial among health undergraduate medical students with no sleep disorder to examine whether aromatherapy via inhalation of essential oils, specifically lavender (*Lavandula angustifolia*) could improve sleep quality and to determine the effect of aromatherapy after a night of exposure. This randomized controlled trial will be observed overnight among medical students in Melaka Manipal Medical College (MMMC). We hypothesized that aromatherapy inhalation, specifically lavender can improve the sleep quality and quantity among medical students over a night.

2. Method

2.1. Study Design

We conducted a randomized controlled trial parallel design in order to determine whether aromatherapy via inhalation of essential oils, specifically lavender (*Lavandula angustifolia*) could improve sleep quality and to determine the effect of aromatherapy after a night of exposure among the students in Melaka Manipal Medical College (MMMC), Muar campus, Malaysia.

2.2. Study Setting and Study Population

This study was set in a private medical college in Muar, Johor, Malaysia, in which a student population of around 145 comprising a single batch of 4th year Bachelor of Medicine & Surgery (MBBS) students. The study was held from August, 2018 to September 2018.

2.3. Sample Size

Our sample size was based on the values of a previous research entitled, “Effect of Lavender Aromatherapy via Inhalation and Sleep Hygiene on Sleep in College Students with Self-reported Sleep Issues” (2014) by Angel Smith Lillehei at the University of Minnesota.

Difference in the mean(ժ)	: 11.1
Standard deviation(σ)	: 12.71
Alpha(α)	: 0.05
Power	: 0.8
Total (m)	: 1

Results obtained was 20 participants for each group.

However, our research required 22 participants for each group due to the 10% attrition.

Attrition = n1-Attrition%

=201-0.1

= 22.2 (Approximately 22 participants for each group)

We are planning a study of a continuous response variable from independent control and experimental subjects with 1 control(s) per experimental subject. In a previous study the response within each subject group was normally distributed with standard deviation 12.71. If the true difference in the experimental and control means is 11.1, we will need to study 20 experimental subjects and 20 control subjects to be able to reject the null hypothesis that the population means of the experimental and control groups are equal with probability (power) 0.8. The type 1 error probability associated with this test of this null hypothesis is 0.05.

2.4. Sampling

We used the non-probability sampling method to obtain the sample from our study population and choose by using criteria in Table 1. Hence, we asked for 44 volunteers from 145 students of Batch 37. 44 participants were randomized. 22 participants were randomized to experimental group and the remaining 22 were randomized to control group using the software Research Randomizer (https://www.randomizer.org) shown in Table 2. Method of randomization was block randomization. The experimental group were exposed to lavender oil overnight while the control group were not exposed to lavender oil overnight.

Table 1. Inclusion & Exclusion Criteria.

Inclusion Criteria	Exclusion criteria
Undergraduate medical students in Muar Campus	Using sleeping aids or medications.
Willing to give written informed consent	Known allergies to essential oils
	Suffering from sleep disorders
	Anosmic people
	Having acute illnesses (nasal congestion)
	Pregnant or lactating

Table 2. Sampling Results.

Research Randomizer Results:	
22 Sets of 2 Yes Numbers Per Set	
Range from 1 to 2 – No	
Set 1	1 2
Set 2	2 1
Set 3	2 1
Set 4	2 1
Set 5	2 1
Set 6	2 1
Set 7	2 1
Set 8	1 2
Set 9	2 1
Set 10	1 2
Set 11	1 2
Set 12	1 2
Set 13	1 2
Set 14	1 2
Set 15	2
Set 16	1 2
Set 17	1 2
Set 18	1 2
Set 19	2 1
Set 20	2 1
Set 21	1 2
Set 22	2 1

2.5. Data Collection

Study Procedure

Our study variables were sleep quantity, sleep quality and sleep hygiene. Firstly, we divided students into 2 groups, control and intervention groups. Each of the group consisted of 22 students. All participants were given informed consent form before we start giving intervention. The participants were also informed about the studies procedure and they can choose not to join or quit halfway during the study. Adverse effects of the studies were also informed. We gave questionnaires (Sleep Record, Sleep Hygiene and Richard-

Campbell Sleep Questionnaire) to all the subjects as a pre-test before the intervention to check the sleep quality on previous day. Students were informed to sleep at 11pm. For the intervention group, we dripped 1 drop (0.05ml) of Lavender essential oil (Lavandula angustifolia) in their room by using a plastic syringe before they sleep. All groups were informed to make themselves comfortable before sleep. Post test questionnaire (Sleep Record, Sleep Hygiene and Richard-Campbell Sleep Questionnaire) is given to the participants after the test.

Data collection instruments:

Sleep Hygiene Survey is a self-administered questionnaire given to asses routine sleep hygiene practices of the participants. The sleep hygiene practices assessed were:

1. going to bed and waking on a regular schedule
2. avoiding caffeine and nicotine late in the day
3. creating a good sleeping environment (e.g. wearing ear plugs and a sleep mask and avoiding screens and texting)
4. creating a relaxing bedtime routine (try to leave problems for wake time)
5. avoiding alcohol, large meals and beverages before bed
6. keeping up with school work, and exercising regularly.

This is similar to the NIH list of sleep hygiene practices (NIH 2009), with the exception of not including naps and exercise at bedtime which have been found to not impact sleep for adolescents and/or college students. In addition keeping up with school work and exercising regularly was added to the sleep hygiene list for this study population.

The sleep diary for this study was based on the National Sleep Foundation Sleep Diary (National Sleep Foundation, 2013) and inquired about the sleep quantity variables (number of minutes asleep, number of minutes in deep sleep, number of minutes in light sleep and number of minutes awakened) It also included questions on sleep quality, events affecting previous night's sleep, adverse effects from the essential oil, or sleep hygiene, and adherence to use of the oil. Sleep diaries are a standard means to collect quantitative sleep data and have been found to be more reliable than actigraphy (Levenson et al., 2013). The sleep diary questionnaire was completed in the morning following the night of lavender aromatherapy intervention.

Richards-Campbell Sleep questionnaire is a brief 5-item questionnaire used to evaluate perceived sleep depth, sleep latency (time to fall asleep), number of awakenings, efficiency (percentage of time awake), and sleep quality. Each RCSQ response was recorded on a 100mm visual analogue scale, with the highest score representing better sleep and the mean score of these 5-items, known as the "total score" representing the overall perception of sleep. Our questionnaire also included 3 additional items, evaluating perceived nighttime noise (range "0mm" for very quiet to 100mm for "very noisy"). Tiredness level at night is rated using the range 0mm for "very alert" and 100mm for "very tired". Stress level is rated using the range 0mm for "very stressed" and 100mm for "very relaxed".

Materials:

Lavender (Lavandula angustifolia) essential oil is a pure essential oil sealed in 15ml amber-coloured bottles. It is made in United States of America (USA) and manufactured by dōTERRA. It is indicated for aromatic or topical use. It has to be stored in a cool, dry place away from direct sunlight as it is light-sensitive. It is for external use only, avoid contact with eyes, inner ears, and sensitive areas. Caution has to be taken when used in pregnant women or person under doctor's care.

2.6. Data Analysis

Data collected in the questionnaire were exported to Microsoft Excel. All data were reviewed and analyzed using Epi Info™ version 7 from Centres for disease control and prevention website (CDC). The mean and standard deviation of Richards-Campbell Sleep Questionnaire scores were compared between the intervention and control groups. Proportions and frequency counts of categorical variables were calculated. Mean and standard deviation of the variables were reported. Unpaired-t test and Fischer-Exact test were used as the inferential statistics. Results were depicted using bar graphs and mean plots. Measure of association calculated is relative risk. Estimation of parameters using confidence interval (95% CI) and level of significance (5%).

2.7. Ethical Consideration

An informed consent form with all the important and relevant details of the study was given to the participants. The participants were given the option to participate in this study, and none were coerced into participating. Participants were notified that all data and information gained through the study would be kept confidential. The form also had a concise explanation about the study and its requirements. The participants were also told that they could chose to withdraw from the study whenever they needed to.

3. Results

Table 3. Baseline characteristics of participants.

Variables		Aromatherapy (n = 26) n(%)	Control (n = 24) n(%)	Total n(%)
Age (years)[a]		22.42 (0.95)	21.88 (0.95)	22.16 (0.98)
Gender	Male	5 (19.2)	9 (37.5%)	14 (28%)
	Female	21 (80.8)	15 (62.5%)	36 (72%)
Ethnicity	Malay	5 (19.2)	2 (8.3%)	7 (14%)
	Chinese	2 (7.8)	4 (16.7%)	6 (12%)
	Indian	19 (73.1)	9 (37.5%)	28 (56%)
	Others	0 (0)	9 (37.5%)	9 (18%)
Posting	Community Medicine	5 (19.2)	4 (16.7)	9 (18%)
	Medicine	1 (3.8)	7 (29.1)	8 (16%)
	Obstetrics and Gynaecology	4 (15.4)	3 (12.5)	7 (14%)
	Orthopaedics	8 (30.76)	3 (12.5)	11 (22%)
	Paediatrics	4 (15.4)	3 (12.5)	7 (14%)
	Surgery	4 (15.4)	4 (16.7)	8 (16%)
Sleep Hygiene Score (out of 16)[a]		5.27 (2.11)	4.96 (1.81)	5.12 (1.96)
Quietness Level (out of 100)[a]		85.96 (24.41)	87.08 (22.11)	86.5 (23.11)
Tiredness Level (out of 100)[a]		74.81 (24.35)	60.83 (21.20)	68.1 (23.73)
Relaxation Level (out of 100)[a]		69.04 (19.49)	54.17 (22.87)	61.9 (22.27)

[a]Mean (SD)

A total of 50 medical students have returned the questionnaire with a 100% response rate for the questionnaires. The demographic characteristics of the participants are listed in Table 3. A total of 51 respondents was sampled, with the majority of the participants were female (72%) and 56% of the participants were Indian with mean age of 22 (SD=0.98) years old. Most of the participants are currently in Orthopaedics posting (22%). The mean score for sleep hygiene is 5.27 (2.11) for intervention group and 4.96 (1.81) for control group. The sleeping environment for control group is quieter at 87.08 mean, compared to control group with 85.96 mean. Intervention group reported a tiredness level of 74.81, which was higher than the control group (60).

Table 4. Comparison of change in Sleep Quality score (after minus before) between intervention and control group.

Variables	Mean (SD)		Mean Difference (95% CI)	t-statistics (df)	P-value
	Intervention	Control			
Time taken to fall asleep (minutes)	10.0 (24.46)	14.8 (36.70)	-4.8 (-12.75)	0.55 (48)	0.582
Total Duration of Sleep (minutes)	49.8 (110.87)	-6.9 (125.42)	56.7 (-123.88)	-1.70 (48)	0.096
Number of awakenings	0.3 (1.16)	0.7 (1.49)	-0.4 (-0.35)	1.07 (48)	0.291
Sleep depth	-1.0 (27.28)	-6.5 (24.74)	5.5 (-20.35)	-0.74 (48)	0.460
Sleep latency	-12.0 (25.62)	-13.8 (25.63)	1.8 (-16.41)	-0.25 (48)	0.802
Returning to Sleep	-1.7 (20.05)	-7.5 (16.81)	5.8 (-16.34)	-1.10 (48)	0.278
Awakening from Sleep	-2.5 (34.33)	-8.8 (21.58)	6.3 (-22.72)	-0.76 (48)	0.449
Sleep Quality	-3.5 (32.98)	-7.3 (31.03)	3.8 (-22.08)	-0.42 (48)	0.675

Table 4 shows the change score of sleep quality and quantity between intervention and control group.

The change score of the mean for time taken to fall asleep (minutes) in the intervention group (10.0) is lower compared to the control group (14.8) thus giving a mean difference of -4.8. There is no statistical significant difference in the time taken to fall asleep between intervention and control group (P value=0.582).

The change score of the mean for total duration of sleep (minutes) in the intervention group (49.8) is higher compared to the control group (-6.9), thus giving a mean difference of 56.7. There is no statistical significance in the total duration of sleep between intervention and control group (P-value=0.096).

The change score of the mean for the number of awakenings in the intervention group (0.3) is lesser compared to control group (0.7), thus giving a mean difference of -0.4. There is no statistical significance in the number of awakenings between intervention and control group (P-value=0.291).

The change score of the mean for sleep depth in the intervention group (-1.0) is higher compared to control group (-6.5), thus giving a mean difference of 5.5. There is no statistical significance in the sleep depth between intervention and control group (P-value=0.460).

The change score of the mean for sleep latency in the intervention group (-12.0) is higher compared to control group (-13.8), thus giving a mean difference of 1.8. There is no statistical significance between sleep latency in intervention and control group (P-value=0.802)

The change score of the mean for returning to sleep in the intervention group (-1.7) is higher compared to control group (-7.5), thus giving a mean difference of 5.8. There is no statistical significance in returning to sleep between intervention and control group (P-value=0.278).

The change score of the mean for awakening from sleep in the intervention group (-2.5) is higher compared to control group (-8.8), thus giving a mean difference of 6.3. There is no statistical significance in awakening of sleep between intervention and control group (P-value=0.449)

The change score of the mean for sleep quality in the intervention group (-3.5) is higher compared to control group (-7.3), thus giving a mean difference of 3.8. There is no statistical significance in the sleep quality between intervention and control group (P-value=0.675)

Table 5. Comparison of post-intervention Sleep Quality and Quantity between Intervention and Control Group.

Variables	Mean (SD)		Mean Difference (95% CI)	t-statistics (df)	P-value
	Intervention	Control			
Time taken to fall asleep (minutes)	23.0 (23.78)	27.0 (36.14)	-4.0 (-13.33)	0.47 (48)	0.641
Total Duration of Sleep (minutes)	405.0 (72.63)	424.4 (64.93)	-19.4 (-19.92)	0.99 (48)	0.427
Number of awakenings	0.6 (1.02)	1.2 (1.58)	-0.6 (-0.20)	1.48 (48)	0.146
Sleep depth	74.0 (19.08)	72.1 (17.75)	1.9 (-12.46)	-0.37 (48)	0.710
Sleep latency	64.4 (22.82)	61.6 (21.49)	2.8 (-15.60)	-0.47 (48)	0.639
Returning to Sleep	90.8 (16.23)	85.2 (18.03)	5.6 (-15.30)	-1.15 (48)	0.257
Awakening from Sleep	81.3 (18.42)	76.7 (19.32)	4.6 (-15.41)	-0.88 (48)	0.385
Sleep Quality	74.0 (21.54)	75.6 (20.61)	-1.6 (-22.08)	0.27 (48)	0.792

Interpretation:

In Table 5, the post intervention mean for time taken to fall asleep (minutes) in the intervention group (23.0) is lower compared to the control group (27.0) thus giving a mean difference of -4.0. There is no statistical significant difference in the time taken to fall asleep between intervention and control group (P value=0.641).

The post intervention mean for total duration of sleep (minutes) in the intervention group (405.0) is lower compared to the control group (424.4), thus giving a mean difference of -19.4. There is no statistical significance in the total duration of sleep between intervention and control group (P-value=0.427).

The post intervention mean for the number of awakenings in the intervention group (0.6) is lesser compared to control group (1.2), thus giving a mean difference of -0.6. There is no statistical significance in the number of awakenings between intervention and control group (P-value=0.146).

The post intervention mean for sleep depth in the intervention group (74.0) is higher compared to control group (72.1), thus giving a mean difference of 1.9. There is no statistical significance in the sleep depth between intervention and control group (P-value=0.710).

The post intervention mean for sleep latency in the intervention group (64.4) is higher compared to control group (61.6), thus giving a mean difference of 2.8. There is no statistical significance between sleep latency in intervention and control group (P-value=0.639)

The post intervention mean for returning to sleep in the intervention group (90.8) is higher compared to control group (85.2), thus giving a mean difference of 5.6. There is no statistical significance in returning to sleep between intervention and control group (P-value=0.257).

The post intervention mean for awakening from sleep in the intervention group (81.3) is higher compared to control group (76.7), thus giving a mean difference of 4.6. There is no statistical significance in awakening of sleep between intervention and control group (P-value=0.385)

The post intervention mean for sleep quality in the intervention group (74.0) is lower compared to control group (75.6), thus giving a mean difference of -1.6. There is no statistical significance in the sleep quality between intervention and control group (P-value=0.792).

Table 6. Association between aromatherapy and feeling refreshed after sleep via Fischer-Exact test.

Feeling n(%)	Intervention group	Control group	DF	P-value
Fatigue	6 (23.08)	4 (16.67)		
Somewhat refreshed	10 (38.46)	10 (41.67)	2	0.871
Refreshed	10 (38.46)	10 (41.67)		

Among intervention in Table 6, 23.08% of participants reported fatigue, 38.46% reported somewhat refreshed and 38.46% reported refreshed. Among controls, 16.67% of participants reported fatigue, 41.67% reported somewhat refreshed and 41.67% reported refreshed. There is no significant difference of fatigue, somewhat refreshed and refreshed between aromatherapy and control group (P-value = 0.871).

Table 7. Adverse reactions among Aromatherapy.

Adverse reaction	n (%)
Sleep disrupted by strong smell	3 (11.54)
Headache	2 (7.69)
Stuffiness of nose	1 (3.85)
Nausea	0 (0)
Itchiness of throat	0 (0)
Itchiness of nose	0 (0)

Table 7 shows the adverse reactions among aromatherapy group. Among 26 participants, three (11.54%) person find the strong smell of lavender irritating and disruptive to their sleep, two person experienced headache (7.69%), and one participant experienced stuffiness of nose (3.85%) after exposure to aromatherapy.

4. Discussion

Sleep is undoubtedly one of the most essential requirements for the human body to function properly [19]. Sleep is necessary to maintain physical appearance, bolster energy levels, and ensure overall well-being; lack of sleep has a strong adverse impact on physical and mental functioning [20]. Research shows that inadequate sleep affects hemostatic and nerve functions, as well as mood. Even the effects of moderate sleep loss on life and health quality can be similar to sleep deprivation [21].

The objective of our study is to examine whether aromatherapy via inhalation of essential oils, specifically lavender could improve sleep quality and to determine the effect of aromatherapy after a night of exposure. From our study, we found that time taken to fall asleep and number of awakenings is less in intervention group compared to control group. Aromatherapy has increased the total perceived duration of sleep. Sleep depth, latency, returning to sleep, awakening from sleep and sleep quality are increased in intervention group compared to control group.

A previous study concluded that the sleep quality and quantity in the group that was exposed to lavender essential oil was better compared to the control group. They had used Fitbit One fitness band, which is an objective data. Fitbit estimates your sleep stages using a combination of your movement and heart-rate patterns. When you haven't moved for about an hour, your tracker or watch assumes that you're asleep. Additional data—such as the length of time your movements are indicative of sleep behavior (such as rolling over, etc.)—help confirm that you're asleep. While you're sleeping, your device tracks the beat-to-beat changes in your heart rate, known as heart rate variability (HRV), which fluctuate as you transition between light sleep, deep sleep, and REM sleep stages [22]. The previous study also did double-blinding by giving the intervention group a lavender patch and a blank patch to the control group and the Pittsburgh Sleep Quality Index (PSQI) to assess sleep quality and quantity, and Patient-Reported Outcomes Measurement Information System (PROMIS$^{TM)}$ Sleep Disturbance Survey to assess sleep quality and Self-Assessment of Change Survey (SAC) to assess dimensions of wellbeing. According to their study, a minimum of 5 days of exposure to aromatherapy inhalation is significant to change a person's sleep quality [23]. Another research done demonstrated that aromatherapy, which was administered over two days, reduced stress and improved sleep quality in ICU patients [24]. In our study, subjective assessment of sleep quality revealed that aromatherapy produces better sleep quality. However, our findings were not statistically significant.

There are a few limitations in this study. This includes the duration of exposure to aromatherapy. This study involved an overnight exposure of the medical students to the aromatherapy inhalation, which is not sufficient to make changes in the participants' sleep quality. The presence of unfamiliar strong scent of the aromatherapy, lavender, also adversely affected the participants who were not used to the scent. In this study, only hostelites are sampled because their sleeping condition and environment are the same in terms of mattress, bed size, etc. We also had difficulty in finding participants during the weekends when the hostels are mostly empty due to the students returning to their hometown. Blinding was not done in our study because we used scented essential oil and the subjects would eventually know which group they belong to due to the smell. Lastly, we had difficulty getting the participants to comply with our advices such as not taking a nap or drinking caffeine before bed. The participants who were used to sleeping late had difficulty falling asleep at the stipulated time which was 11pm.

Future researchers are recommended to use polysomnography or sleep study, a test used to diagnose sleep disorders. Polysomnography records your brain waves, the oxygen level in your blood, heart rate and breathing, as well as eye and leg movements during the study. It monitors sleep stages and cycles to identify if or when your sleep patterns are disrupted and why [25]. Increasing duration of study and sample size is recommended as it would help in improving the results as well. Other therapeutic uses of aromatherapy, which includes immediate reduction in pain, as well as changing physiological parameters such as pulse, blood pressure, skin temperature, and brain activity [26] can also be explored in further researches. Essential oils can be inhaled, massaged onto the skin, diffused into the air, applied as a compress, or placed in a bath for soaking [27]. The safety and efficacy of different route of administration (topical, inhalation) of aromatherapy can also be assessed.

There are hundreds of essential oils that provoke different responses in people. Some of the odorants that have been prescribed to cause certain healing reactions include: sweet marjoram (to calm, sedate, and relieve an assortment of negative emotions like irritability, loneliness, and anxiety); sandalwood (also used to sedate, relax, and aid in treating depression, anxiety, and insomnia); and clary sage (to uplift, help relieve anxiety and depression, aid in fatigue, and calm irritable children) [28]. Future researches can investigate the effects of different types of aroma on the physiology of human beings.

5. Conclusion

This randomized controlled trial examined the effect of aromatherapy on sleep quality among medical students. From our study we found that time taken to fall asleep and number of awakenings is less in intervention group compared to control group. Aromatherapy has increased the total perceived duration of sleep. Sleep depth, latency, returning to sleep, awakening from sleep and sleep quality are increased in intervention group compared to control group. In conclusion, aromatherapy increased sleep duration, sleep depth, latency, returning to sleep, awakening from sleep and sleep quality. However, our data was not statistically significant. Our findings were consistent with another study which showed that lavender aromatherapy has no statistically significant effect on sleep quality in candidates for angiography hospitalized in the coronary care unit (CCU) [29]. In the assessment of Lytle et al. of the effect of lavender essential oil in sleep quality patients in the CCU using the Richards-Campbell Sleep Questionnaire, the average sleep score in the intervention group was higher than in the control group and sleep quality improved, but the difference between the scores on the test scale were not statistically significant [30].

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