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The effect of rosemary essential oil inhalation on sleepiness and alertness of shift-working nurses: A randomized, controlled field trial

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ABSTRACT

Background: Sleepiness during the night shift is a common complaint of shift workers, including the nurses. This study investigated the effects of inhaled rosemary oil on sleepiness and alertness of shift-working nurses.
Methods: Eighty shift-working nurses were selected and assigned randomly into control (n = 40) and intervention (n = 40) groups. Both groups completed the Karolinska Sleep Questionnaire and Epworth Sleepiness Survey before the intervention. The intervention group received one drop of rosemary essential oil using a mask. The control group received a drop of distilled water instead, after which the questionnaires were completed for a second time.
Results: The sleepiness mean score in the intervention group reduced from 12.15 to 8.3, while it increased from 11.41 to 13.76 in the control group ($P < 0.001$). The alertness mean scores changed from 4.45 to 3.25 and from 4.41 to 5.34 in intervention and control groups, respectively ($P < 0.001$).
Conclusion: Rosemary aroma decreased sleepiness and increased alertness in shift-working nurses.

1. Introduction

Sleepiness during night shift is a common complaint among night shift workers [1], including nurses [2], which can lead to accidents and irreparable human and medical errors. Over 210,000 preventable deaths occur from medical mistakes in hospitals every year [3], a major cause of which is sleepiness and reduced alertness of the medical staff [4]. Sleep deprivation is embedded in night work, leading to sleepiness, poor quality performance, and possible errors [1] such that night-shift workers have, by far, a higher rate of errors than the other personnel [5]. An average level of sleepiness equals or overrides alcohol intoxication [4], while the severity of sleepiness increases gradually by the end of the night [2]. In one-fifth of shift workers, periods of micro sleep (involuntary sleep from 30 s to 3 min) occur during the night shift and may finally end in sleep [6] (see Fig. 1).

Two primary causes of sleepiness during shift work are deprivation from partial or complete sleep and circadian rhythm sleep disorders [4]. Due to long periods of alertness at night and reduced hours of sleep in 24 h, the frontal lobe of the brain, which is sensitive to insomnia, undergoes disorder (i.e., prefrontal theory) and reduces alertness – which is a product of correct performance of posterior parietal cortex and frontal lobe [7,8]. This leads to sleepiness and, subsequently, lower functioning of the person [9]. Circadian rhythm sleep disorders occur in workers whose work schedule is in regular sleep hours, whereby they experience severe sleepiness [4,10].

In his systematic review, Bonnefond et al. (2004) reported on measures taken to increase alertness and decrease sleepiness in shift workers – including the use of environmental stimuli (i.e., light, sound, music, ambient temperature change) and stimulants such as caffeine, nicotine, and amphetamines [10]. Consuming modafinils [10,11] and taking rest at work (between half an hour to 3 h) [12] are also found to be useful.

Aromatherapy is a convenient, non-invasive, and natural approach for olfactory stimulation [13]. Extracts (essential oil) made from different parts of a plant is used in aromatherapy, via release in the air (smelling) or massage [14]. When applied in massage therapy, essential oils have shown to have many favorable results [15], including improved knee pain [16]. Inhalation of essential oils can have calming and soothing effects, reduce stress, enhance memory [15], increase nurses' sleep quality after night shift [17], and reduce anxiety in dialysis patients [18].

The aromatic molecules reach the olfactory neurons by the nose and its axons synapses with the olfactory bulb. The received message is

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transmitted from there to the limbic system (amygdala and hippocampus) and to the cerebral cortex. The limbic system controls emotions, moods, and impulses [19].

The rosemary essence is among widely applied, stimulating essential oils that have a powerful and exhilarating fragrance. The main chemical components of rosemary oil are α-pinene, camphor, and 1-8-cineole. Containing copious amounts of α-pinene and especially 1–8 cineole [20], the essence increases heart rate, respiratory rate, and blood pressure, decreases alpha waves and increases beta waves in the brain, thus leading to enhanced alertness of the person [21].

As alertness and wakefulness of the brain correlate directly with cognitive performance [22], exposure to rosemary raises blood levels of 1-8-cineole and improves cognitive functions of the brain [20] and these can increase the levels of alertness and wakefulness of the brain. Quoting from Grahm, Sayorwan et al. state that exposure to rosemary fragrance can encourage dogs to stand and move about significantly more than when they are exposed to other fragrances. Hongratanaworakit (2009) reported that aromatherapy massage with rosemary oil made the participants more attentive, alert, vigorous, and cheerful [23].

Given the potentials of rosemary essential oil, it can be hypothesized that the application of the oil in nurses can result in reduced sleepiness and increased alertness. This, however, has not been investigated as far as the literature reveals. So, this study aimed to investigate the effects of rosemary essential oil on sleepiness and alertness of shift-working nurses.

2. Material and methods

2.1. Research design

A total of 80 nurses who had worked in rotating shifts for at least six continuous months and experienced sleepiness and lower alertness at

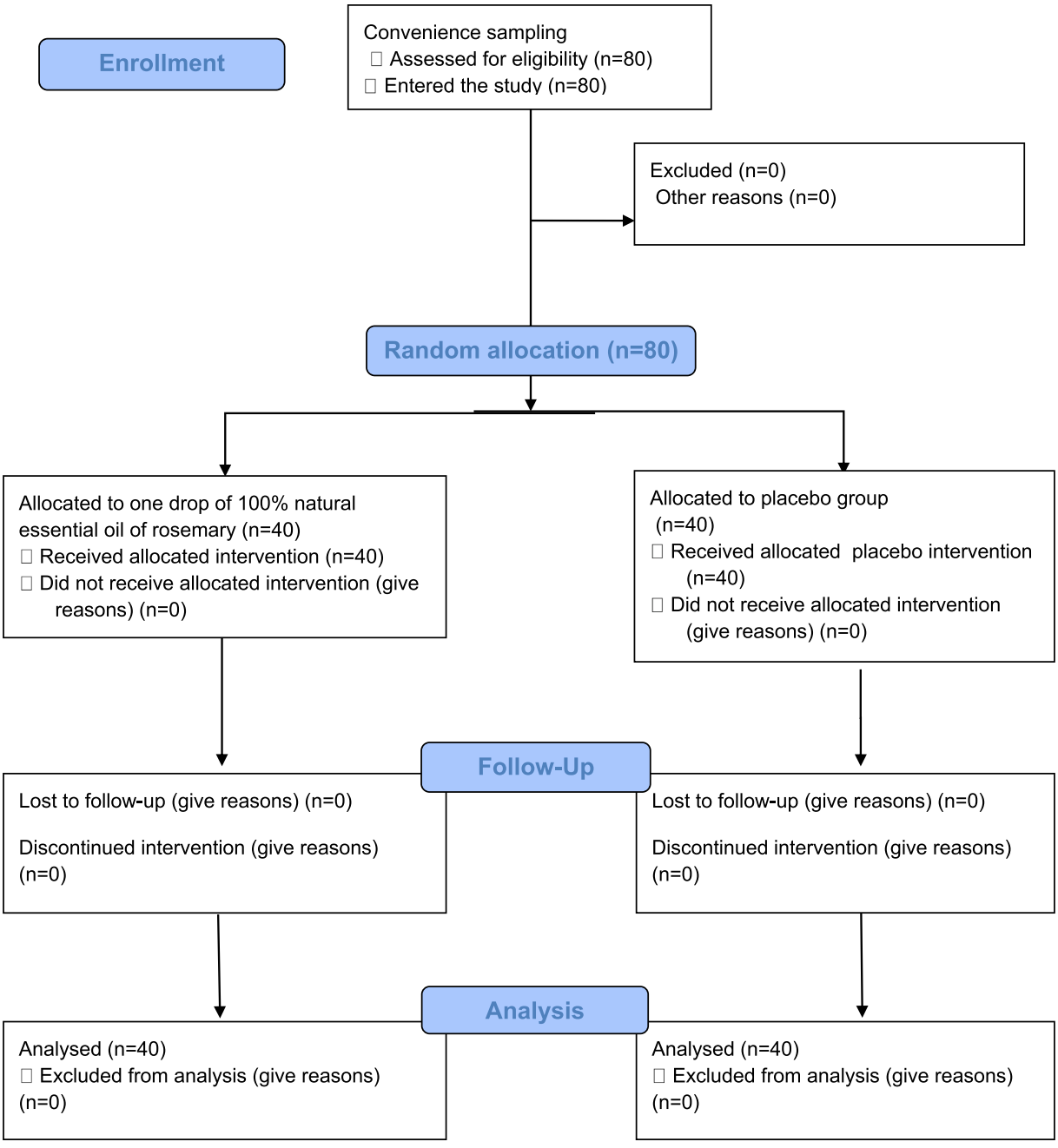

Fig. 1. Flowchart of participants through each stage of the study.

night shifts were selected by the convenience sampling method. They had at least six rotations of 12-h night shifts per month. The eligible nurses were randomly allocated to intervention and control groups.

The hour of the night shift in which the nurse had the highest sleepiness was asked and recorded. The essential oil used in this study was a 100% natural rosemary essential oil. This product is manufactured by Barij Essence Company of Kashan, Iran. The compounds in this essential oil are as follows: α-pinene, 1-8-cineole, beta-Pinene, Borneol, *p*-Cymene, D-Limonene, Campher, Camphen, and α-Terpineol.

In the intervention group, one drop of this essential oil was poured on gauze and fixed inside a simple mask (surgical mask). The participant would cover the mask on his/her nose easily. As for the control group, a drop of distilled water was used instead of rosemary [24].

2.2. Participants and interventions

There were 204 nurses working in the CCU, internal diseases, infectious diseases, heart, and angiography wards. A total of 145 shift-working nurses met the inclusion criteria and 80 of them entered the study using the convenience sampling method and randomly assigned to control (n = 40) and intervention (n = 40) groups.

The inclusion criteria for the study consisted of willingness to participate, signing the written consent form, having physical health, healthy olfactory system, and no allergies [13]. The health of the olfactory function was assessed by asking them. It was required for the participants not to be taking hypnotic and sedative medications (none of them had atopic diseases), nor to have a history of neurological and psychiatric disorders.

The conditions of the nurses at the testing night were as follows: not using stimulants and caffeine, perfumes, and aromatic substances by them [19]; having a normal shift (without much fatigue and severe stress); and having had a light dinner.

The researcher checked the study conditions and visited the nurses in their workplace at an hour when they felt most sleepy (i.e., around 2 a.m.). At first, the participants completed the Karolinska Sleep Scale (KSS) and Epworth Sleepiness Survey (ESS) under convenient circumstances in normal light and sound. Afterward, a drop of rosemary essential oil was poured on gauze and put inside a simple fabric mask (surgical mask), which was used by the participant on his/her face for 5–10 min during work [20]. The participants removed the mask after 10 min for 15 min to prevent the adaptation of the odor to the olfactory neurons [25]. This cycle continued for 2 h. At the end of the 2 h, the questionnaires were completed for a second time [26].

In their first use of the oil, the nurses were asked about how they found the rosemary essential oil; none of them described it as unpleasant. This procedure was performed in the control group using a drop of distilled water (as the placebo) on the mask, and the only difference between the control and intervention groups was the use of rosemary extract for the intervention group.

2.3. Outcomes

The tools used in this study consisted of a demographic characteristics form, the ESS [27], and the KSS, the latter of which was used to assess alertness [28,29]. Their validity and reliability have been confirmed [30].

The KSS is self-reported and completed on a 9-point Likert scale (from "extremely alert" to "extremely sleepy, fighting sleep") with the score ranging from 1 to 9, where 1 = very alert, 5 = neither sleepy nor alert, 7 = sleepy but no effort to remain awake, and 9 = very sleepy, with an effort to stay awake, fighting sleep [31]. Scores above 5 indicate decreased alertness. Its validity and reliability have been confirmed [29,32].

The ESS is a simple self-administered questionnaire that asks subjects to rate on a scale of 0–3 their usual chances of dozing off in each of eight different situations "in recent times" (0 = "would never doze" and 3 = "a high chance of dozing". The total ESS score ranges from 0 to 24, and a score more than 9 signifies sleepiness. The scale's validity and reliability have been confirmed [30].

2.4. Randomization

A simple random method was used for random allocation. Accordingly, from the list of recruited nurses (N = 80), they were randomly assigned to intervention and control groups.

2.5. Statistical methods

The data were analyzed in SPSS software (V. 15). Mann-Whitney *U* test was used to compare alertness mean scores before and after intervention as well as to compare score mean differences in intervention and control groups. The Independent *t*-test was also used to compare mean sleepiness scores and mean differences before and after the intervention in the two groups.

3. Results

Forty participants were in the intervention group and 40 in the control group.

A total of 35 (87.5%) nurses in the intervention group and 36 (87.8%) of those in the control group were female. In terms of age, 12 (30%) of those in the intervention group and 12 (29.3%) from those in the control group were 25 years or younger. Further, 15 (37.5%) of the nurses in the intervention group and 16 (39%) of the control group had a tenure of more than 5 years. The majority of the nurses in the intervention group (72.5%) and control group (78%) served in non-specialized wards, and 72.5% of the experimental group and 72.8% of the control group members had six night shifts per month. In addition, 45% of the nurses in the intervention group and 51% of the controls had not slept in the hours preceding the night shift (Table 1).

According to the results, there was no significant difference between the two groups in terms of gender, age, tenure, type of ward they served in, and the number of hours of sleep before starting night work.

As Table 2 shows, alertness mean scores in intervention and control

Table 1
Comparison of demographic characteristics between intervention and control groups.

Demographic data	Group		P-Value*
	Intervention(N = 40)	Control (N = 40)	
	Frequency (%)	Frequency (%)	
Gender			
Female	35(87.5)	34(85)	0.97
Male	5(12.5)	4(15)	
Tenure			
≤5 y	25(62.5)	24(60)	0.95
>5 y	15(37.5)	16(40)	
Ward			
General	29(72.5)	32(80)	0.56
Intensive	11(27.5)	8(20)	
Number of night shifts in month			
≤8 nights	29(72.5)	30(75)	0.99
>8 nights	11(27.5)	10(25)	
Number of slept hours before night shift			
0 h	18(45)	20(50)	0.78
1–2 h	18(45)	17(42.5)	
3-4	4(10)	3(7.5)	
Age(year)	Mean ± SD	Mean ± SD	P-Value**
	29.3 ± 5.7	29.5 ± 5.6	0.91

*P value is calculated by Chi-square test between group comparison.
**P value is calculated by Independent *t*-test between two group comparison.

Table 2
Comparison of alertness mean scores and mean score differences before and after intervention in intervention and control groups.

Stage	Group		P-Value*
	Intervention(N = 40)	Control (N = 41)	
	Mean ± SD	Mean ± SD	
Before intervention	4.45 ± 1.78	4.41 ± 1.76	0.96
After intervention	3.25 ± 1.21	5.34 ± 1.94	<0.001
Mean differences	1.20 ± 1.49	- 0.93 ± 1.75	<0.001

*P value is calculated by Mann-Whitney *U* Test between two group comparison.

Table 3
Comparison of sleepiness mean scores and mean score differences before and after intervention in intervention and control groups.

Stage	Group		P-Value*
	Intervention(N = 40)	Control (N = 41)	
	Mean ± SD	Mean ± SD	
Before intervention	12.15 ± 3.53	11.41 ± 4.37	0.41
After intervention	8.30 ± 3.94	13.76 ± 5.04	<0.001
Mean differences	3.85 ± 5.22	- 2.34 ± 3.06	<0.001

*P value is calculated by Independent *t*-test between two group comparison.

groups were not significantly different before the intervention (P = 0.96). After the intervention, however, the mean score in the intervention group was significantly lower than that of the control group (P < 0.001). In other words, the nurses in the intervention group were significantly more alert than those in the control group.

Mann-Whitney *U* test results showed that alertness mean differences before and after intervention in the intervention group were significantly higher than in the control group (P < 0.001).

According to Table 3, the mean sleepiness score of the nurses in the intervention and control groups were not significantly different before the intervention (P = 0.41). However, the mean score of sleepiness after the intervention was significantly lower in the intervention group than in the control group (P < 0.001). The mean sleepiness score changes were significantly higher in the intervention group than in the control group (P < 0.001).

4. Discussion

The present study investigated the influence of rosemary essential oil on sleepiness and alertness of shift-working nurses. According to the results, inhaled rosemary oil had a positive effect on decreasing sleepiness and increasing alertness such that the nurses in the intervention group were more alert and less sleepy than those in the control group because of aromatherapy with rosemary essential oil.

After inhaling rosemary essential oil, the participants of the intervention group reported greater alertness than before intervention or the control group. Sayorvan et al. (2013) showed that the scent of rosemary generates beta waves and thus enhances alertness. By raising the respiratory rate, heart rate, and blood pressure, it stimulates the autonomic nervous system, hence increased alertness. Quoting from Nakagawa, Sayorvan et al. (2013) maintain that the important 1-8-cineole available in rosemary essence improves beta waves in the brain.

Moss et al. as quoted by Orhan, maintain that the two main ingredients in rosemary essential oil, i.e., 1–8 cineole (44.4%) and α-pinene (12.6%), exert cholinergic effects on a person by inhibiting BChE and AChE enzymes. As mentioned by Watson et al. (2010; sleep Med Clin) acetylcholine neurotransmission mediated by 5 subtype (M1-M5) of the muscarinic receptor that M2 plays a key role in the REM sleep generation [33].

Hongratanaworakit (2009) also showed that rosemary aroma used along with massage increase the heart rate, respiratory rate, and blood pressure by stimulating the sympathetic system, exerting stimulating effects on individuals, and thus making people happier and more cheerful [23]. Brain waves and autonomic system parameters (i.e., blood pressure, heart rate, respiratory rate, and skin temperature) are indicators of the arousal level of the nervous system [21].

The results of Moss et al.'s study (2012), similar to the current study, suggest improved cognitive function of the brain after inhaling rosemary aroma. Moss et al. showed that rosemary aroma raises blood 1-8-cineole levels, hence improved cognitive functions of the brain. They also demonstrated that the longer an individual's exposure to this aroma, the greater the effect. As the brain's levels of alertness and arousal are directly associated with its cognitive function [22,34], therefore, the participants reported significant freshness and increased alertness.

In the present study, after inhaling rosemary essential oil, the participants of the intervention group reported less sleepiness than before intervention or the control group. Sayorwan et al. also showed that rosemary aroma could decrease sleepiness by reducing alpha waves. Studying mood and arousal physiology of people, Sumegi concluded that rosemary aroma has stimulating effects given the increase it brings about in the heart rate, which is a significant indicator of arousal.

Diego's study also showed that the scent of rosemary reduces alpha waves and leaves stimulant effects on the individual [35], and decreased alpha power may be related to an increased level of alertness [21]. The rosemary essential oil led to improved alertness of nurses, given the stimulatory effects of rosemary on the reduction of alpha waves.

5. Conclusion

Rosemary essential oil inhalation is an easy and natural procedure. In the present study, inhalation of stimulating and robust scent of rosemary reduced drowsiness and increased alertness in the staff nurses during the night shift without causing any specific complication,. Evidently, reducing these traits, including the nurses, can prevent dangerous events and medical errors.

5.1. Limitations

The major limitation of the study is the absence of a crossover design as well as the lack of a real blind control (Oil has an odor that is clearly distinguishable from water used as the control substance). The alerting action of such intervention can be attributed to the placebo effect. Moreover, given that the aromatherapy is accompanied by the aroma, here that of rosemary, blinding cannot happen. Therefore, non-blindness is a further limitation of the current study.

CRediT authorship contribution statement

Ahmad Nasiri: Conceptualization, Methodology, Formal analysis, Writing - review & editing, Project administration. **Masoomeh Mo'tamed Boroomand:** Methodology, Investigation, Data curation, Writing - original draft.

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References

[1] K. Sadeghniiat-Haghighi, Z. Yazdi, H. Jahanihashemi, O. Aminian, The effect of bright light on sleepiness among rapid-rotating 12-hour shift workers, Scand. J. Work. Environ. Health 37 (1) (2011) 77.
[2] J. Geiger-Brown, V. Rogers, A. Trinkoff, R. Kane, R. Bausell, S. Scharf, Sleep, sleepiness, fatigue, and performance of 12-hour-shift nurses, Chronobiol. Int. 29 (2) (2012) 211–219.
[3] J.T. James, A new, evidence-based estimate of patient harms associated with hospital care, J. Patient Saf. 9 (3) (2013) 122–128.

[4] K. Ker, P. Edwards, L. Felix, K. Blackhall, I. Roberts, Caffeine for the prevention of injuries and errors in shift workers, Cochrane Database Syst. Rev. (5) (2009). CD008508-CD008508.
[5] A.E. Rogers, The Effects of Fatigue and Sleepiness on Nurse Performance and Patient Safety, 2008.
[6] M. Tippins, L. Stroh, Shiftwork: factors impacting workers biological and family well-being, J. Appl. Bus. Res. 7 (4) (2011) 131–135.
[7] M. Thomas, H. Sing, G. Belenky, H. Holcomb, H. Mayberg, R. Dannals, H. Wagner jr, D. Thorne, K. Popp, L. Rowland, Neural basis of alertness and cognitive performance impairments during sleepiness. I. Effects of 24 h of sleep deprivation on waking human regional brain activity, J. Sleep Res. 9 (2000) 335–352.
[8] P.B.N. Liberalesso, K.F.K. D'Andrea, M.L. Cordeiro, B.S. Zeigelboim, J.M. Marques, A.L. Jurkiewicz, Effects of sleep deprivation on central auditory processing, BMC Neurosci. 13 (1) (2012) 1.
[9] J. Lo, J. Groeger, N. Santhi, E. Arbon, A. Lazar, S. Hasan, M. von Schantz, S. Archer, D. Dijk, Effects of partial and acute total sleep deprivation on performance across cognitive domains, individuals and circadian phase, PloS One 7 (9) (2012), e45987.
[10] A. Bonnefond, P. Tassi, J. Roge, A. Muzet, A critical review of techniques aiming at enhancing and sustaining worker's alertness during the night shift, Ind. Health 42 (1) (2004) 1–14.
[11] N.J. Wesensten, Effects of modafinil on cognitive performance and alertness during sleep deprivation, Curr. Pharmaceut. Des. 12 (20) (2006) 2457–2471.
[12] M. Purnell, A.M. Feyer, G. Herbison, The impact of a nap opportunity during the night shift on the performance and alertness of 12-h shift workers, J. Sleep Res. 11 (3) (2002) 219–227.
[13] M.C. Chen, S.H. Fang, L. Fang, The effects of aromatherapy in relieving symptoms related to job stress among nurses, Int. J. Nurs. Pract. 21 (1) (2015) 87–93.
[14] B. Cooke, E. Ernst, Aromatherapy: a systematic review, Br. J. Gen. Pract.: J. Roy. Coll. Gen. Pract. 50 (455) (2000) 493–496.
[15] B. Ali, N.A. Al-Wabel, S. Shams, A. Ahamad, S.A. Khan, F. Anwar, Essential oils used in aromatherapy: a systemic review, Asian Pacific Journal of Tropical Biomedicine 5 (8) (2015) 601–611.
[16] A. Nasiri, M.A. Mahmodi, Z. Nobakht, Effect of aromatherapy massage with lavender essential oil on pain in patients with osteoarthritis of the knee: a randomized controlled clinical trial, Compl. Ther. Clin. Pract. 25 (2016) 75–80.
[17] W. Kim, M.-H. Hur, Inhalation effects of aroma essential oil on quality of sleep for shift nurses after night work, Journal of Korean Academy of Nursing 46 (6) (2016) 769–779.
[18] F. Barati, A. Nasiri, N. Akbari, G. Sharifzadeh, The effect of aromatherapy on anxiety in patients, Nephro-Urol. Mon. 8 (5) (2016).
[19] L. Sumegi, Differential Effects of Lavender and Rosemary on Arousal and Cognitive Performance, Carleton University Ottawa, Canada©, 2011, 2007.
[20] M. Moss, L. Oliver, Plasma 1, 8-cineole correlates with cognitive performance following exposure to rosemary essential oil aroma, Therapeutic advances in psychopharmacology 2 (3) (2012) 103–113.
[21] W. Sayorwan, N. Ruangrungsi, T. Piriyapunyporn, T. Hongratanaworakit, N. Kotchabhakdi, V. Siripornpanich, Effects of inhaled rosemary oil on subjective feelings and activities of the nervous system, Sci. Pharm. 81 (2) (2013) 531.
[22] M. Moss, J. Cook, K. Wesnes, P. Duckett, Aromas of rosemary and lavender essential oils differentially affect cognition and mood in healthy adults, Int. J. Neurosci. 113 (1) (2003) 15–38.
[23] T. Hongratanaworakit, Simultaneous aromatherapy massage with rosemary oil on humans, Sci. Pharm. 77 (2) (2009) 375.
[24] L.A. Anderson, J.B. Gross, Aromatherapy with peppermint, isopropyl alcohol, or placebo is equally effective in relieving postoperative nausea, J. PeriAnesthesia Nurs. 19 (1) (2004) 29–35.
[25] P.R. Zoladz, B. Raudenbush, Cognitive enhancement through stimulation of the chemical senses, N. Am. J. Psychol. 7 (1) (2005) 125–140.
[26] B. Raudenbush, R. Grayhem, T. Sears, I. Wilson, Effects of peppermint and cinnamon odor administration on simulated driving alertness, mood and workload, N. Am. J. Psychol. 11 (2) (2009).
[27] V. Gumenyuk, T. Roth, C.L. Drake, Circadian phase, sleepiness, and light exposure assessment in night workers with and without shift work disorder, Chronobiol. Int. 29 (7) (2012) 928–936.
[28] S.M. Wehrens, S.M. Hampton, M. Kerkhofs, D.J. Skene, Mood, alertness, and performance in response to sleep deprivation and recovery sleep in experienced shiftworkers versus non-shiftworkers, Chronobiol. Int. 29 (5) (2012) 537–548.
[29] K. Kaida, M. Takahashi, T. Åkerstedt, A. Nakata, Y. Otsuka, T. Haratani, K. Fukasawa, Validation of the Karolinska sleepiness scale against performance and EEG variables, Clin. Neurophysiol. 117 (7) (2006) 1574–1581.
[30] K. Sadeghniiat Haghighi, A. Montazeri, A. Khajeh Mehrizi, O. Aminian, A. Rahimi Golkhandan, M. Saraei, M. Sedaghat, The Epworth Sleepiness Scale: translation and validation study of the Iranian version, Sleep Breath. 1-8.
[31] T. Åkerstedt, B. Peters, A. Anund, G. Kecklund, Impaired alertness and performance driving home from the night shift: a driving simulator study, J. Sleep Res. 14 (1) (2005) 17–20.
[32] A. Subasi, Automatic recognition of alertness level from EEG by using neural network and wavelet coefficients, Expert Syst. Appl. 28 (4) (2005) 701–711.
[33] C.J. Watson, H.A. Baghdoyan, R. Lydic, Neuropharmacology of sleep and wakefulness, Sleep medicine clinics 5 (4) (2010) 513–528.
[34] H.J. Moller, G.M. Devins, J. Shen, C.M. Shapiro, Sleepiness is not the inverse of alertness: evidence from four sleep disorder patient groups, Exp. Brain Res. 173 (2) (2006) 258–266.
[35] M.A. Diego, N.A. Jones, T. Field, M. Hernandez-Reif, S. Schanberg, C. Kuhn, M. Galamaga, V. McAdam, R. Galamaga, Aromatherapy positively affects mood, EEG patterns of alertness and math computations, Int. J. Neurosci. 96 (3–4) (1998) 217–224.