JOURNAL OF CLINICAL MEDICINE OF KAZAKHSTAN (E-ISSN 2313-1519)
Original Article DOI: https://doi.org/10.23950/jcmk/9651

The effect of the rose essential oil aroma on university students' learning and short-term memory: A randomized controlled trial

Elif Ok, Vildan Kocatepe, Vesile Ünver

Department of Nursing, School of Health Sciences, Acıbadem Mehmet Ali Aydinlar University, Istanbul, Turkey

Received: 2020-11-08
Accepted: 2020-01-05

J Clin Med Kaz 2021; 18(1):32-37

Corresponding author:
Elif Ok.
E-mail: elifok7@gmail.com;
ORCID: https://orcid.org/0000-0003-4342-4965

Abstract

Aim: This randomized controlled experimental study analyzes the effect of the rose essential oil aroma on university students' learning and recalling of information in short-term memory.

Material and methods: The study sample consisted of 131 students who had never attended hypoglycemia management education (first year), who had recently attended this education (sophomore), and who had attended this education a long time ago (third year). The experimental group was administered a pre-test before the education, and rose essential oil aroma was administered for all tests during and after the education. The control group only received the education and was administered the tests.

Results: No statistically significant differences were found between the pre-test and post-test mean scores of the experimental and control groups in third year students but the differences between the mean scores on the tests administered on the 7th and 30th days were statistically significant. A statistically significant difference was found between the post-test mean scores obtained by the experimental group students who had (second and third year) and had not (first year) attended this education on the 7th day.

Conclusion: This study found that the smell of rose extract did not affect immediate learning (working memory). However, it also indicated that people can remember previously learned information more easily when they repeat it using the essential oil of Rosa damascena. The study results suggest that students should review their studies between the 7th and 30th days after learning information in order to benefit from the effect of the odor of rose extract.

Key words: odor, rose essential aroma, learning, memory

Introduction

Essential oils extracted from herbs are commonly used in medicine for aromatherapy. The use of aromatic essential oils goes back to 5000 BCE. Aromatherapy is usually administered through inhalation because essential oils vaporize easily [1]. Many studies have shown the positive effects of pure essential oils on attention span [2], recall speed and quality [3], memory performance [4,5], short-term memory [6], image memory [7] in healthy individuals and on memory and moods in the cognitive disorders of dementia [8]. These effects occur due to the connections of the tractus olfactorius to the limbic system and the hypothalamus [9,10,11].

Johnson identified four potential mechanisms that can explain odor-dependent cognitive facilitation. The first concerns an odor-specific pharmacological mechanism, wherein volatile compounds enter the bloodstream following inhalation and affect neural activity. The second explanation is an epiphenomenal hedonically-driven mechanism, wherein effects on cognition are secondary to being in a better mood after being exposed to an odor. The third explanation is that odor effects are purely psychological, that a prior belief or expectation pertaining to the qualities of the odor underpins any benefits. The final explanation is a contextual or associative account: odors have specific effects because their presence is associated with a particular stimulus, mood or behavior [12].

The rose is a fragrant herb that belongs to the Rosaceae family, and it is among the most popular and most commonly used medicinal herbs in the world [13]. Rosa damascena (Isparta rose, oil rose) is grown in Region of Lakes in Turkey and is also used for medicine [14]. Some studies have analyzed the effect of rose oil odor on memory, recall and learning through animal experiments [15,16].

Rose oil has analgesic and antidepressant effects [13], and it also reduces headache and stress [14,17]. The effect of rose oil odor on physiological and psychological relaxation is due to the emergence of conditions that enable people to feel relaxed by reducing the oxyhemoglobin concentration in right prefrontal cortex [18]. Studies evaluating the effect of smelling rose extract on the memory of healthy individuals are limited in the literature [19]. Most previous studies have involved rose essential oil since it is safe [20]. Studies conducted with healthy individuals have reported that it has no adverse effects [13,20]. Shirazi et al. conducted a study with pregnant women and reported mild allergic rhinitis due to the topical use of rose oil [21]. Previous studies have reported that rose essential oil is safe for use to analyze the effect of its inhalation on healthy individuals' learning and memory [13,20,21].

Material and methods

This randomized controlled experimental study analyzes the effect of the rose essential oil aroma on university students' learning and recalling information in short-term memory.

Hypotheses of the study

H1: Students who attend Rose essential oil aroma interventions will have higher hypoglycemia management test scores than students in a control group.

Participants

The study population consisted of the students in their first (n=79), second (n=80) and third (n=65) years of study during the second semester of 2018-2019 academic year in the nursing department of X University in XXX. The students who met the inclusion criteria were randomly allocated into the groups using stratified sampling. They were categorized in three layers based on their academic year and success levels and were randomly allocated to the experimental and control groups. The students' success levels were determined by their grade point averages from the previous (2017-2018) academic year. The study sample consisted of 131 students, (experimental group=75) and (control group=56). Power analysis was performed using the G*Power (v3.1.7) program to determine the number of samples. Based on the previous study [22], it was calculated that in order to evaluate the effect of rose essential oil aroma on learning and short-term memory, there should be at least 23 people in the groups in order to obtain 95% power at the level of $\alpha = 0.05$. Considering that there might be losses during the study process, 37 students from 1st grade, 54 students from sophomore and 40 students from 3rd grade were included in the study (Figure 1).

The exclusion criteria were smoking, having a health problem that would affect the study (allergic rhinitis, respiratory tract infections, use of nasal medicines), having a head trauma, anosmia (loss of the sense of smell) and being allergic to aromatic odors. Before determining the groups, the students' anosmia and allergic to aromatic odors were questioned. Students' own statements were trusted.

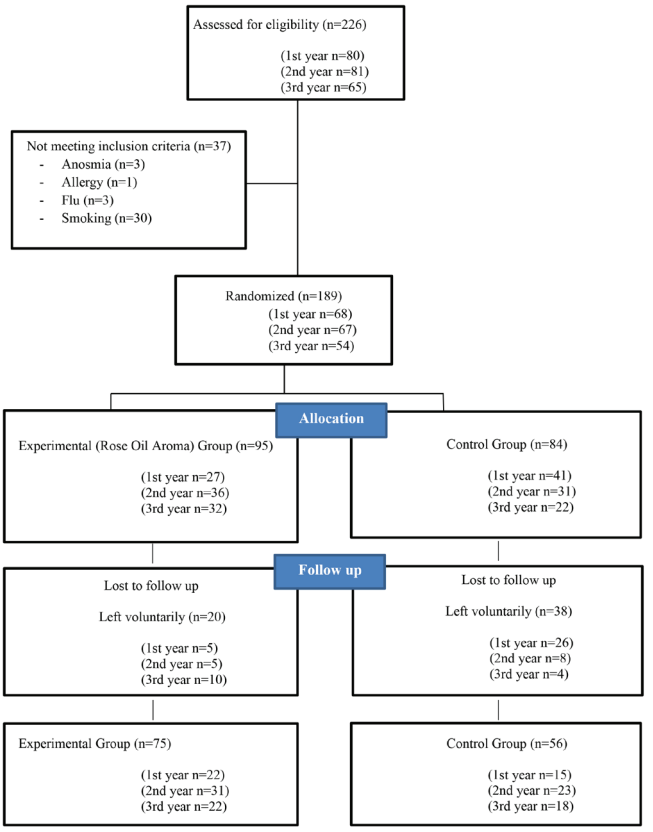

Figure 1. Study flowchart

Procedure

The students were randomly allocated to the experimental and control groups after stratification based on their year of study and grade point averages. The students included in the study were stratified according to their classes. Then, the students in each class were ranked from the highest to the lowest according to their grade-point average. Students were assigned to the experimental and control groups according to the randomization list prepared previously with the Excel program. The procedures were carried out on the same day for the experimental and control groups in standard-size classrooms by the researcher and an observer. In order to prevent researcher-induced bias in the study, hypoglycemia management tests were administered to the students by an observer who was not involved in the research. There was only one observer in this study. The students were told to have a full stomach before the procedures as it was considered to affect memory may negatively [23]. The education programs were planned according to the curriculum of the students. Some of the education programs were given in the morning, some in the afternoon. The subject of hypoglycemia management was selected to test the effect of smell on the students' learning and recall. This subject was selected because it is provided in the third semester in the curriculum. This made it possible to compare students who never took this course (first year), who recently took this course (sophomore) and who took this course a long time ago (third year).

Intervention

Experimental Group

The students were administered the pre-test before the rose essential oil aroma. The rose essential oil aroma was administered using a diffuser in a classroom with a standard

volume of 735x721x283 cm3 10 minutes before the students entered the classroom (Martin & Chaudry, 2014). Three drops (150 microliters) of 100% pure rose (Rosa damascene) essential oil were added to 500 milliliters of water in the diffuser. When the students entered the classroom, the researcher taught hypoglycemia management for 30 minutes. Air conditioning and glass were not opened during the lesson. The aromatherapy continued while the researcher was teaching. Then the researchers took a 10-minute break and the students left the classroom. The classroom door was open during break. After the break, the students were asked questions along with aromatherapy (post-test). A test on hypoglycemia management was administered to the students after a week (7th day test) and a month (30th day test) along with aromatherapy. Each student took a lesson only once, accompanied by the scent of roses. In addition, aromatherapy was applied twice during the hypoglycemia management tests performed one week and one month later. The students in the experimental group received aromatherapy three times in total. After the first session, the experimental group students were asked to give feedback about whether they could smell the rose oil and the intensity of the smell. The amount of rose essential oil aroma was determined based on previous study [4]. During the administration, feedback was received from the students on whether they smell rose essential oil or not, whether it was disturbing or not. The students reported that they could smell the rose oil and that its intensity did not disturb them.

Control group

After administering the pre-test to the students, the researcher told taught hypoglycemia management in the classrooms with similar sizes without rose essential oil aroma. The students were asked questions about the subject after a 10-minute break (post-test). A test on hypoglycemia management was administered to the students after a week (7th day test) and a month (30th day test).

Instruments

The data collection tool has two sections. The first section includes questions about sociodemographic characteristics such as age, gender and year of study. The second includes 17 questions about the students' knowledge on "Hypoglycemia Management" prepared based on the literature [24,25]. The responses to these questions were yes, no, or undecided. The affirmative answers were given one point, and the other responses were given zero points. Hypoglycemia management questions consisted of 17 multiple choice questions. The prepared questionnaire was submitted to two expert opinions. Before the study was implemented, it was applied within the context of another course. It was decided by the students that the questions were understandable.

Ethical considerations

Ethical approval was obtained from the Medical Research Evaluation Committee of Acıbadem University on 1/10/2019 with approval number 2019-01/29. The permission of the institution was also obtained. The students' written and verbal consent was obtained.

Statistical Analysis

All statistical analyses were performed by SPSS 21 software (IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0, Armonk, NY, USA: IBM Corp.). The students' descriptive data were analyzed using mean values, standard deviations and percentages. The normally distributed quantitative variables were compared using the Student's t test, and the abnormally distributed quantitative variables were compared using the Mann-Whitney U test. The differences between multiple assessments of the same group were analyzed using the one-way variance analysis in repeated measurements. $p<0.05$ is taken as significance level.

Results

The study included 131 students: 37 students in the first year, 54 students in the sophomore, and 40 students in the third year. The students' mean age was 18.64±.64 year for the first year, 19.96±.84 year for the sophomore and 21.33±2.65 year for the third year. The number of female students was 35 (94.6%) in the first year, 48 (88.9%) in the sophomore and 37 (92.5%) in the third year.

The experimental and control groups' pre-test scores were similar ($p>.05$). No statistically significant differences were found between their mean scores on the 7th day test and the 30th day test ($p>.05$).

The decreases in the experimental and control groups' mean scores on the post-test, the 7th day test and the 30th day test were statistically significant ($p<.05$) (Table 1).

Table 1 A Comparison of the Experimental and Control Groups' Mean Scores by Year of Study

	1. Year			2. Year			3. Year		
Score	Experimental $\bar{X}$±SD (n=22)	Control $\bar{X}$±SD (n=15)	Statistical test / p	Experimental $\bar{X}$±SD (n=31)	Control $\bar{X}$±SD (n=23)	Statistical test / p	Experimental $\bar{X}$±SD (n=22)	Control $\bar{X}$±SD (n=18)	Statistical test / p
Pre-test	5.50±3.87	7.73±2.34	[1]U=106.000 p=.066	10.70±2.16	10.43±1.90	[1]U=319.000 p=.504	9.36±1.81	8.94±2.80	[1]U=177.500 p=.571
Post-test	14.90±1.15	14.53±1.51	[1]U=140.000 p=.422	15.23±1.26	15.35±.88	[1]U=343.000 p=.806	14.91±1.20	14.05±1.62	[1]U=140,000 p=.104
7th Day Test	13.54±1.77	13.40±1.40	[1]U=154.000 p=.729	14.41±1.31	14.35±1.33	[1]U=337.000 p=.726	14.50±1.41	13.06±1.35	[1]U=90.500 p=.003
30th Day Test	13.31±1.75	13.07±1.33	[1]U=149.500 p=.625	13.77±1.20	13.56±1.83	[1]U=354.500 p=.971	13.77±1.34	12.72±1.49	[1]U=127.500 p=.048
Statistical test	[2]F =48.724	[2]F =35.459		[2]F =37.888	[2]F =35.522		[2]F =66.158	[2]F =20.67	
p	p=.001	p=.001		p=.001	p=.001		p=.001	p=.001	

1 U=Mann-Whitney U test
2 F=General linear model test

Table 2 A Comparison of the Mean Scores of the Experimental and Control Group Students Who Had and Had Not Attended the "Hypoglycemia Management" Education by Year of Study

Attending the Education	**Had Not Attended Hypoglycemia Management Education (1st Year)**	**Had Attended Hypoglycemia Management Education (2nd and 3rd Year)**		**Had Not Attended Hypoglycemia Management Education (1st Year)**	**Had Attended Hypoglycemia Management Education (2nd and 3rd Year)**	
Score	Experimental $\bar{X}$±SD (n=22)	Experimental $\bar{X}$±SD (n=53)	Statistical test / p	Control $\bar{X}$±SD (n=15)	Control $\bar{X}$±SD (n=53)	Statistical test / p
Pre-test	5.50±3.87	10.15±2.11	[1]U=-4.599 p=.001*	7.73±2.34	9.78±2.42	[1]U=-2.733 p=.006
Post-test	14.90±1.15	15.09±1.16	[1]U=-.391 p=.695	14.53±1.51	14.781±1.41	[1]U=-.634 p=.526
7th Day Test	13.54±1.77	14.45±1.33	[1]U=-2.103 p=.035*	13.40±1.40	13.781±1.474	[1]U=-.824 p=.410
30th Day Test	13.31±1.75	13.77±1.25	[1]U=.1,028 p=.304	13.07±1.33	13.195±1.721	[1]U=-.597 p=.550

1 Mann-Whitney U test
*p<.05

No statistically significant differences were found between the first-year and second-year students' mean scores on the 7th day test and the 30th day test (p>.05) No statistically significant differences were found between the pre-test and post-test mean scores of the experimental and control groups. The difference between their mean scores on the 7th and 30th day tests was statistically significant (p<.05) (Table 1).

The difference between the mean pre-test scores of the experimental group students who had not attended hypoglycemia management education (first year) and those who had (second and third year) was statistically significant (U=-4.599; p<.05), and they obtained similar mean post-test scores (p>.05) (Table 2).

A statistically significant difference was found between the experimental group students' mean scores on the 7th day test depending on whether or not that had attended hypoglycemia management education (U=-2.103; p<.05) (Table 2).

No statistically significant differences were found between the mean scores of the control group students who had not attended hypoglycemia management education (first year) and those who had (second and third year) on the post-test, the 7th day test and the 30th day test (p>.05).

Discussion

The effects of odor on memory and the hints it provides for remembering have been discussed for a long time. Studies of odor have indicated that different oils affect attention span, recall speed and quality [2,3,4], short-term memory [7] and image memory [6].

Results in our study (Table 2) show that reviewing previously learned information along with the rose essential oil aroma allows people to recall it more easily. According to table 1 only the experimental group third year students obtained significantly higher scores on the 7th and 30th day tests. This can be explained by the fact that the third-year students' review of the information they learned about three semesters ago along with the rose essential oil aroma may have facilitated their remembering.

Studies evaluating the effect of smelling rose extract on the memory of healthy individuals are limited in the literature. The study of Neumann et al. (2020) was conducted with 6th grade students, consisting of 54 people, aged 11-12. In the study, the students were divided into 4 groups and the effect of smelling rose extract on memory was examined. The evaluation was made with the word tests of a new language that the students started learning 1 year ago. As a result of the study, it was determined that the highest effect size regarding recall was in the group exposed to rose scent while working at home, during sleep and during the post-test. However, it was reported in the study that conditions outside the school environment could not be controlled [19]. Although rose scent was not applied outside the school environment in our study, the results are similar.

In the study examining the effect of Rosa damascene supplementation with aerobic exercise on memory in obese women, a significant improvement was reported in the memory performance of the experimental group compared to the control group [26].

Rosa damascena extract has been reported to significantly reduce dementia patients' cognitive impairment [8].

Rosa damascena ethanol extract was shown to have protective effects on memory performance of rats subjected to scopolamine induced amnesia. This was explained by rose extract's antioxidant effect [27].

The present study found that the rose essential oil aroma affected the memories of healthy individuals. This finding is similar to the findings of the studies that reported the positive effects of Rosa damascene on memory.

Specific aromatherapy oils, that act on the limbic system or primitive brain and are thought to enhance memory and decrease emotional anxiety [11], may enhance a person's ability to concentrate and focus and may also decrease feelings of anxiety and stress in the person.

In the study of Fernandez et al. (2018) the effect of lavender aromatherapy on anxiety, concentration and memory in junior nursing students was examined. As a result of the study, it was reported that lavender aromatherapy decreased the anxiety level of nursing students and increased their concentration and memory [22]. In addition, studies have shown that aromatherapy of lemon [28] and lavender [29] reduces cognitive test anxiety in nursing students.

Filiptsova et al. (2018) reported that the essential oils such as rosemary and lavender significantly increased subjects' image memory compared to a control group [7]. Filiptsova et al. (2017) found that rosemary essential oil positively affected people's short-term memory, while ylang ylang essential oil affected it negatively [6].

Hawiset et al. (2016) reported that orange essential oil aromatherapy had positive effects on memory and calming of people in healthy young adult women [30].

Sulung and Aulia (2018) reported that rosemary aromatherapy improves short-term memory in elderly individuals [31].

Yıldırım et al. (2020) showed that both rosmary-lemon and lavender aromatherapy increased cognitive performance in older adults staying in nursing homes [32].

Kato et al. (2012) analyzed the effects of the intermittent release of smells on cognitive motor performance and brain function during mental fatigue and found that smell was an effective means of maintaining the attention and reducing reaction times while performing a long-term task [2].

Martin and Chaudry (2014) reported that exposure to pleasant odors such as lemon had a positive effect on working memory, while exposure to bad odors such as machine oil reduced performance [4].

Studies with essences obtained from different aromatic plants other than Rosa damascene show that aromatherapy increases various aspects of memory or cognitive performance. Although the types of aromatherapy used in studies differ, the findings obtained in terms of positive effects on memory are similar to our study.

Conclusion

This study aimed to analyze the effect of the rose essential oil aroma on learning and recalling information in working and short-term memory. It found no statistically significant difference between the experimental and control groups regarding the effects of the rose essential oil aroma on immediate learning (working memory). However, it found that people can remember previously learned information more easily when they review it while smelling the essential oil of Rosa damascena. It is not clear whether this difference was caused by the smell of rose extract or the relationship between smell and learning. Comprehensive studies are needed on this subject.

Limitations

A limitation of this study was that it was conducted in only one institution. Another limitation is that it only tested the students' cognitive memory and not to evaluate the anxiety level of the students.

Disclosures: There is no conflict of interest for all authors.

Acknowledgements: Thanks to all participants who allowed us to collect the data.

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

References

1. Mary S. The Art of Aromatherapy in Nursing Practice. *Int. J. Psychiatr. Nurs.* 2019; 5(1):88-91. https://doi.org/10.5958/2395-180X.2019.00018.5
2. Kato Y, Endo H, Kobayakawa T, Kato K, Kitazaki S. Effects of Intermittent Odours on Cognitive-Motor Performance and Brain Functioning During Mental Fatigue. *Ergonomics.* 2012; 55(1):1-11. https://doi.org/10.1080/00140139.2011.633175
3. Moss M, Cook J, Wesnes K, Ducked P. Aromas of Rosemary and Lavender Essential Oils Differently Affect Cognition and Mood in Healthy Adults. *Int. J. Neurosci*. 2003; 113(1):15-38. https://doi.org/10.1080/00207450390161903
4. Martin GN, Chaudry A. Working Memory Performance and Exposure to Pleasant and Unpleasant Ambient Odor: Is Spatial Span Special? Int. *J. Neurosci.* 2014; 124(11):806-811. https://doi.org/10.3109/00207454.2014.890619
5. Tildesley NTJ, Kennedy DO, Perry EK, Ballard CG, Savelev S. Wesnes, KA, Scholey AB. Salvia lavandulaefolia (Spanish Sage) Enhances Memory in Healthy Young Volunteers. *Pharmacol Biochem Behav.* 2003; 75(3):669-674. https://doi.org/10.1016/S0091-3057(03)00122-9
6. Filiptsova OV, Gazzavi-Rogozina LV, Timoshyna IA, Naboka OI, Dyomina YeV, Ochkur AV. The Essential Oil of Rosemary and Its Effect on the Human Image and Numerical Short-Term Memory. *Egyptian Journal of Basic and Applied Sciences.* 2017; 4:107–111. https://doi.org/10.1016/j.ejbas.2017.04.002
7. Filiptsova OV, Gazzavi-Rogozina LV, Timoshyna IA, Naboka OI, Dyomina YeV, Ochkur AV. The Effect of the Essential Oils of Lavender and Rosemary on the Human Short-Term Memory. *Alexandria J. Med.* 2018; 54:41–44. https://doi.org/10.1016/j.ajme.2017.05.004
8. Esfandiary E, Abdolali Z, Omranifard V, Ghanadian M, Sararoud RB, Karimipour M, Mahaki B, Dabiri S. Novel Effects of Rosa damascena Extract on Patients with Neurocognitive Disorder and Depression: A Clinical Trial Study. *Int J Prev Med*. 2008; 9:57. https://doi.org/10.4103/ijpvm.IJPVM_199_17
9. Broughan C. Odours, Emotions, and Cognition- How Odours May Affect Cognitive Performance. *Int J Aromatherapy*. 2002; 12:92-98. https://doi.org/10.1016/S0962-4562(02)00033-4
10. Carvalho-Freitas MI, Costa M. Anxiolytic and Sedative Effects of Extracts and Essential Oil from Citrus Aurantium L. *Biol Pharm Bull.* 2002; 25:1629-1633. https://doi.org/10.1248/bpb.25.1629
11. Savic, I, Berglund H, Gulyas B, Roland P. Smelling of Odorous Sex Hormone-like Compounds Causes Sex-Differantiated Hypothalamic Activations in Humans. *Neuron.* 2001; 31:661-668.
12. Johnson AJ. Cognitive Facilitation Following Intentional Odor Exposure. *Sensors.* 2011; 11:5469-5488. https://doi.org/10.3390/s110505469
13. Mohebitabar S, Shirazi M, Bioos S, Rahimi R, Malekshahi F, Nejatbakhsh F. Therapeutic Efficacy of Rose Oil: A Comprehensive Review of Clinical Evidence. *Avicenna J Phytomed.* 2017; 7(3):206–213.
14. Özçelik H, Korkmaz M. Roses of Türkiye with Various Aspects [in Turkish]. *SDU Journal of Science (E-Journal)*. 2015; 10(2):1-26.
15. Martin C, Gervais R, Messaoudi B, Ravel N. Learning-Induced Oscillatory Activities Correlated to Odour Recognition: A Network Activity. *Eur J Neurosci.* 2006; 23:1801-1810. https://doi.org/10.1111/j.1460-9568.2006.04711.x
16. Rezvani-Kamran A, Salehi I, Shahidi S, Zarei M, Moradkhani S, Komaki A. Effects of the Hydroalcoholic Extract of Rosa Damascena on Learning and Memory in Male Rats Consuming a High-Fat Diet. *Pharmaceutical Biology.* 2017; 55(1):2065–2073. https://doi.org/10.1080/13880209.2017.1362010

17. Özçelik H, Muca B, Özavcı AGM. The Effects of Flowers and Oil of the Isparta Oil Rose (Rosa × damascena Mill.) on Headaches Caused by Stress in the Patients of Neurology and Psychology [in Turkish]. *Biyoloji Bilimleri Araştırma Dergisi*. 2011; 4(2):99-105.
18. Igarashi M, Ikei H, Song C, Miyazaki Y. Effects of Olfactory Stimulation with Rose and Orange Oil on Prefrontal Cortex Activity. Complement Ther Med. 2014; 22:1027-1031. https://doi.org/10.1016/j.ctim.2014.09.003
19. Neumann F, Oberhauser V, Kornmeier J. How odor cues help to optimize learning during ~~s~~leep in a real ~~l~~ife-setting. *Sci. Rep*. 2020; 10(1):1-8. https://doi.org/10.1038/s41598-020-57613-7
20. Nayebi N, Khalilib N, Kamalinejadc M, Emtiazya MA. Systematic Review of the Efficacy and Safety Of Rosa Damascena Mill. with an Overview on Its Phytopharmacological Properties. Complement Ther Med. 2017; 34:129-40. https://doi.org/10.1016/j.ctim.2017.08.014
21. Shirazi M, Mohebitabar S, Bioos S, Yekaninejad MS, Rahimi R, Shahpiri Z et al. The Effect of Topical Rosa Damascena (Rose) Oil on Pregnancy-Related Low Back Pain a Randomized Controlled Clinical Trial. *J Evidence-Based Complement Alternat Med*. 2017; 22(1):120-126. https://doi.org/10.1177/2156587216654601
22. Fernandez MLF, Ferrer MVP, Flores KAB, Florido AIA, Foronda KIL. The Effect of Lavender Aromatherapy to Junior Nursing Students' Anxiety, Concentration and Memory Retention. *Int Arch Nurs Health Care.* 2018:102.
23. Tyng Chai M, Amin HU, Saad MN, & Malik AS. The influences of emotion on learning and memory. Front. *Psychol.* 2017; 8:1454. https://doi.org/10.3389/fpsyg.2017.01454
24. The Society of Endocrinology and Metabolism of Turkey (SEMT) Diabetes Mellitus Working Group. Clinical Practice Guideline for Diagnosis, Treatment and Follow-up of Diabetes Mellitus and Its Complications – 2019. English Version of the 12th Edition. Ankara: BAYT Bilimsel Araştırmalar Basın Yayın ve Tanıtım Ltd. Şti, 2019; 15-64.
25. American Diabetes Association (ADA). Diabetes Care. 2019; 42(1):61-70. https://doi.org/10.2337/dc19-S006
26. Razipour M, Irandoust K, Taheri M. Effect of aerobic training and Rosa damascene supplement on the memory of obese women. Int. Arch. Health Sci. 2019; 6(3):136. https://doi.org/10.4103/iahs.iahs_6_19
27. Mohammadpour T, Hosseini M, Asieh A, Karami R, Sadeghnia HR, Soukhtanloo M, Vafaee F. Protection Against Brain Tissues Oxidative Damage as a Possible Mechanism for the Beneficial Effects of Rosa Damascena Hydroalcoholic Extract on Scopolamine Induced Memory Impairment in Rats. *Nutr. Neurosci.* 2015; 18(7):329-336. https://doi.org/10.1179/1476830514Y.0000000137
28. Kavurmacı M, Küçükoğlu S, Tan M. Effectiveness of aromatherapy in reducing test anxiety among nursing students. *Indian J. Tradit. Knowl.* 2015; 1(1):52-56.
29. Johnson CE. Effect of aromatherapy on cognitive test anxiety among nursing students. *J Altern Complement Med*. 2014; 20(2):84-87. https://doi.org/10.1089/act.2014.20207
30. Hawiset T, Sriraksa N, Somwang P, Inkeaw P. Effect of orange essential oil inhalation on mood and memory in females humans. *J Physiol Biomed Sci.* 2016; 29(1):5-11.
31. Sulung N, Aulia FF. Effect of Rosemary Aromatherapy (Rosmarinus Officinalis) To Memory of Short-Term Memory in Elderly. *Jurnal Endurance.* 2018; 3(2):247-252.
32. Yildirim TA, Kitis Y. The Effect of Aromatherapy Application on Cognitive Functions and Daytime Sleepiness in Older Adults Living in a Nursing Home. *HOLIST NURS PRACT.* 2020; 34(2):83-90. https://doi.org/10.1097/HNP.0000000000000371