

## *The Effect of Orange Essential Oil Aromatherapy on Sleep Quality in Hospitalized Children*

Mahla Salarfard<sup>1</sup>, Bahare Zarei<sup>2</sup>, Zahra Younesi<sup>3</sup>, Asma Nikkhah Bidokhti<sup>4</sup>, Fatemeh Taheri Bojd<sup>5</sup>

<sup>1</sup>Instructor, Department of Midwifery, School of Nursing and Midwifery, Birjand University of Medical Sciences, Birjand, Iran

<sup>2</sup>PhD Student in Nursing, School of Nursing and Midwifery, Isfahan University of Medical Sciences, Isfahan, Iran

<sup>3</sup>Instructor, Department of Nursing, Birjand University of Medical Sciences, Birjand, Iran

<sup>4</sup>Instructor, Department of Nursing, Qaen school of Nursing and Midwifery, Birjand University of Medical Sciences, Birjand, Iran

<sup>5</sup>Professor, Department of Pediatrics, School of Medicine, Birjand University of Medical Sciences, Birjand, Iran

**\*Corresponding Author Address:** Qain School of Nursing and Midwifery, 17 Shahrivar Square, Qain, South Khorasan, Iran

**Tel:** 0098-9336416787

**Email:** asmanikkhah52@gmail.com

**Received:** 31 Jan 2022

**Accepted:** 25 Feb 2023

### **Abstract**

**Background:** Sleep disorders are common among hospitalized children. Aromatherapy is one of the interventions with demonstrated effectiveness in improving sleep quality.

**Objectives:** This study was conducted to investigate the effect of orange essential oil inhalation on the sleep quality of hospitalized children.

**Methods:** This semi-experimental study was conducted on 70 children admitted to Valiasr Hospital in Birjand selected by the convenience sampling method and then randomly assigned to two groups of orange essential oil receivers and the control group. In the intervention group, aromatherapy was performed every day for three days in three shifts (10 am, 4 pm, and at the usual bedtime). The researcher completed the BEARS sleep quality questionnaire at the beginning and end of the intervention period. Data analysis was conducted utilizing SPSS version 16 statistical software and chi-square, Mann-Whitney, paired t-test, McNemar, and t-test.

**Results:** There was no statistically significant difference in the demographic characteristics of the children in the two groups ( $p>0.05$ ). The results showed no significant difference between the two study groups before the intervention regarding different sleep quality domains ( $p<0.05$ ). After the intervention, there was a significant difference between the two studied groups in the domains of difficulty in falling asleep, waking up during the night, and disturbance in the regularity and duration of sleep ( $p<0.05$ ), and the intervention group had better scores than the control group.

**Conclusion:** The present demonstrated that inhalation of orange essential oil had a favorable effect on the sleep quality of hospitalized children. This intervention can be introduced and implemented as an effective method to improve the sleep quality of hospitalized children.

**Keywords:** aromatherapy, orange essential oils, child, sleep quality

### **Introduction**

Due to their underdeveloped immune systems, children are vulnerable to various diseases and injuries. Many children experience hospitalization at least once during their childhood [1]. Evidence shows that approximately 30% of children are

hospitalized at least once during their childhood, and approximately 5% are hospitalized several times [2]. Hospitalization can have a significant impact on a child's life. Hospitalized children meet strangers in an unfamiliar environment and experience traumatizing events such as painful

procedures, and most of them view illness and hospitalization as a punishment [3]. Fear and sleep disorders are the most common response of children to hospitalization, which lead to adverse outcomes such as prolonged recovery time, pain, infection, and the need for sedatives [4].

Sleep is a dynamic and organized biological process during which a person regains his strength and refreshes. Therefore, the quality and quantity of sleep can significantly affect daily life. Numerous pieces of research have shown that sleep stimulates growth hormone secretion and promotes children's development and weight gain, which are particularly important in childhood [5]. Any physical condition leading to significant pain, discomfort, and metabolic disorders can negatively affect the quality and quantity of sleep [6]. In the hospital, in addition to the disease and its complications, long-term treatment and the behavior of the staff can lead to sleep disorders.

Consequently, these children may suffer from fatigue, disturbed memory and learning, increased stress and anxiety, and reduced quality of daily life [7]. Approximately 20 to 30 percent of children and adolescents in the community experience sleep disturbances and disorders. Although the prevalence of sleep disorders in hospitalized children is not well elucidated, there is evidence that hospitalized children have inadequate sleep or sleep disorders [8]. In a descriptive study on hospitalized children between 3 and 8 years, these children slept 20 to 25% less than their expected sleep time due to falling asleep late or rising early in the morning [9].

Nowadays, non-pharmacological methods of improving sleep have attracted nurses' attention, and patients are willing to experience them. These interventions are practical, simple, low-risk, and do not require a specific time or expensive equipment [10]. One example of non-pharmacological interventions in improving the quality of children's sleep is music therapy and storytelling, which are documented to be effective by a study by Anggerainy et al. (2019) [11]. On the contrary, in Valizadeh et al.'s study (2022), storytelling did not affect anxiety, heart rate, and sleep onset time of hospitalized children with fractures [12].

Aromatherapy is a complementary medicine approach that uses volatile oils, including essences, for physical and mental therapeutic purposes [13]. Orange essential oil is widely used in aromatherapy. Orange is a tree plant that belongs to the Citrus genus, which is grown in different regions of the north and south of Iran and has medical applications in colds, liver and gall bladder disorders, rheumatism, mental stress, and digestive disorders [14]. Several clinical studies have demonstrated the positive effects of inhaling this essential oil on insomnia, with no report of side effects hitherto [15,16]. A study by Lee et al. (2011) demonstrated that aromatherapy reduced sleep disorders and fatigue and increased sleep satisfaction in hemodialysis patients [16].

Considering the importance of research in the field of herbal medicines and the adverse effects of sleep disorders on hospitalized children, such as fatigue, despair, withdrawal of treatment, and reduced growth and development, this area is one of the country's medical research priorities [17]. As nurses play an essential role in providing children's these physiological needs and implementing non-pharmacological treatments, this research was conducted to investigate the effect of orange essential oil aromatherapy on the sleep quality of hospitalized children.

### Methods

This semi-experimental study, which had two parallel groups, was part of a project approved by Birjand University of Medical Sciences designed to investigate the effect of orange essential oil aroma therapy on the anxiety and sleep quality of hospitalized children. After the approval of the ethics committee of Birjand University of Medical Sciences (with the registration code IR.BUMS.REC.1399.026), the study was conducted from July to December 2019 on 70 children admitted to Valiasr Hospital in Birjand. The sample size was calculated based on a survey by Jalil-ul-Qadr et al. (2022) [18] according to the formula of comparing two averages, considering the mean ( $m_1=8.97$  and  $m_2=7.80$ ) and standard deviation ( $s_1=1.45$  and  $s_2=1.49$ ). The sleep disturbance subscale of the two studied groups of children was based on a confidence interval of 95% and a test power of 90%. Therefore, the number of required samples for each group was estimated to be 33, and considering a sample drop

of 5%, the sample size was calculated as 35 for each group.

Children in the age range of 6 to 12 years hospitalized with sleep disorders due to common colds and pneumonia were evaluated by the BEARS questionnaire, and children with at least two positive areas out of the five were included. Children receiving anti-anxiety drugs and those with a history of mental illness, allergic rhinitis, and chronic diseases such as diabetes, epilepsy, and hematology disorders were excluded. Moreover, the child's or parents' unwillingness to continue the study and any unpredicted incident were considered exclusion criteria.

Convenience sampling method was utilized. Then, based on a random sequence using SPSS software, the children were allocated to either the orange essential oil aromatherapy or the control group. During the random allocation process, if a child from the control group was placed next to a child from the intervention group, the lot was conducted again so that at the end of the random allocation, no children from the control and intervention groups were together. In the present study, the data collection tool included a demographic information questionnaire and the BEARS sleep questionnaire. The demographic information questionnaire included age, gender, parents' education, and hospitalization period. The instrument used for evaluating sleep quality was the BEARS sleep questionnaire. This questionnaire is a screening tool designed by Brown University School of Medicine researchers to assess the most common sleep issues in toddlers, preschoolers, and school-aged children. This questionnaire includes 17 scored questions in 5 main sleep subscales, including sleep initiation problems, excessive sleepiness during the day, waking up during the night, insufficient sleep duration, and snoring. A score of zero is considered good sleep quality, and a score of 1-8 is considered poor sleep quality. This instrument has also been validated in Iran by Mohammadi et

al. (2008) with Cronbach's alpha coefficient of 0.80, which was considered acceptable [18]. The scale's reliability was confirmed for this study with a Cronbach's alpha coefficient of 0.84.

The purpose of the study and the methods were explained, and it was emphasized that the information would remain confidential. After obtaining written consent from the parents, the BEARS sleep quality and demographic information questionnaires were completed by the researcher. Having met the inclusion criteria, the children were randomly assigned to two intervention and control groups. In the intervention group, aromatherapy was conducted every day for three days at three times of the day (10 am, 4 pm, and at night before bedtime). Two drops of orange essential oil made by Gorgan Essential Oil Company with the main ingredients of limonene (96.5%), betapinene (0.37%), alphapinene (0.3%), and myrcene (0.2%) were put on a sterile gauze using a dropper. This gas was kept at a 5 cm distance from the child's nose in an open box, and the child was asked to breathe deeply for two minutes. At the end of the intervention, the researcher completed the sleep quality questionnaire. The intervention method at night was putting the impregnated gauze under the pillow's outer layer. No intervention was made for the control group.

The normal distribution of quantitative variables was investigated by the Kolmogorov-Smirnov test. Data analysis was done using SPSS version 16 statistical software and chi-square, Mann-Whitney, paired t-test, and McNemar t-test. A significance level of less than 0.05 was considered.

## Results

A total of 70 hospitalized children participated in this research, and 35 children were included in each group. The socio-cognitive characteristics of the studied children are demonstrated in Table 1.

*Table 1: Comparison of Demographic Characteristics in Children of two Study Groups*

Group	Variable	Control	Intervention	P-value
Qualitative variables		Number (%)	Number (%)	
Gender	Female	(48.6) 17	(45.7) 16	0.631*
	Male	(51.4) 18	(54.3) 19	
Father's education	Illiterate and primary school	(31.4) 11	(28.6) 10	0.642*
	High school	(37.1) 13	(40) 14	
	Academic education	(31.4) 11	(31.4) 11	
Mother's education	Illiterate and primary school	(34.3) 12	(40) 14	0.540*
	High school	(40) 14	(31.4) 11	
	Academic education	(25.7) 9	(28.6) 10	
Quantitative variables		Mean $\pm$ SD	Mean $\pm$ SD	
Children's age		9.02 $\pm$ 1.48	8.31 $\pm$ 1.23	0.058**
Duration of Hospitalization		4.65 $\pm$ 1.23	4.62 $\pm$ 0.77	0.771**

\*Chi-square test

\*\*Mann-Whitney-U test

The chi-square test demonstrated that before the intervention, there was no significant difference

between the two groups in terms of different sleep quality subscales. ( $p < 0.05$ ) (Table 2).

*Table 2: Comparison of the Percentage and Frequency of Sleep Quality Problems in Children of the two Study Groups Before the Intervention*

Sleep quality subscales	Difficulty	No		Yes		Chi-square test result	
		Group	Number	%	Number	%	$\chi^2$ P
Difficulty in falling asleep	Control	13	37.1	22	62.9	2.05	0.15
		Intervention	15	42.9	20	57.1	
Severe drowsiness in daytime	Control	20	57.1	15	42.9	0.91	0.33
		Intervention	19	54.3	16	45.7	
Awakening in night	Control	12	34.3	23	65.7	1.42	0.23
		Intervention	18	51.4	17	48.6	
Difficulty in sleep duration and regulation	Control	19	54.3	16	45.7	0.91	0.33
		Intervention	20	57.1	15	42.9	
Snoring	Control	21	60	14	40	0.51	0.47
		Intervention	18	51.4	17	48/6	

The results of the Chi-square test indicated that after the intervention, there was a significant difference between the two study groups in the areas of falling asleep, waking up during the

night, and defect in regularity and duration of sleep ( $p < 0.05$ ), and the intervention group scored better than the control group (Table 3).

**Table 3: Comparison of the Percentage and Frequency of Sleep Quality Problems in Children of the two Study Groups After the Intervention**

Quality of sleep subscales	Difficulty Group	No		Yes		Chi-square test result	
		Number	%	Number	%	$\chi^2$	P
Difficulty in falling asleep	Control	14	40	21	60	5.71	0.01
	Intervention	30	85.7	5	14.3		
Daytime drowsiness	Control	17	48.6	18	51.4	0.05	0.81
	Intervention	21	60	14	40		
Midnight awakening	Control	13	37.1	22	62.9	4.62	0.03
	Intervention	29	82.9	6	17.1		
Difficulty in the regularity and duration of sleep	Control	18	51.4	17	48.6	4.85	0.03
	Intervention	26	74.3	9	25.7		
Snoring	Control	23	65.7	12	34.3	2.05	0.15
	Intervention	20	57.1	15	42.9		

The results of the McNemar test indicated that the scores of the sleep quality areas in the control group before and after the intervention did not have a statistically significant difference ( $p>0.05$ ). However, in terms of the scores of the areas of the

time of falling asleep, waking up during the night, and difficulty in the regulation and duration of sleep, there was a significant difference in the intervention group before and after the intervention ( $p<0.001$ ) (Table 4)

**Table 4: Comparing the Scores of the Sleep Quality Domains Before and After the Intervention in the two Study Groups**

Quality of sleep subscales	Difficulty  Group	Before intervention				After intervention				The result of the McNemar test  P
		No		Yes		No		Yes		
		Number	%	Number	%	Number	%	Number	%	
	Difficulty in falling asleep	Control	13	37.1	22	62.9	14	40	21	60
Intervention		15	42.9	20	57.1	30	85.7	5	14.3	<0.001
Drowsiness during daytime	Control	20	57.1	15	42.9	17	48.6	18	51.4	0.500
	Intervention	19	54.3	16	45.7	21	60	14	40	0.250
Awakening during sleep	Control	12	34.3	23	65.7	13	37.1	22	62.9	0.687
	Intervention	18	51.4	17	48.6	29	82.9	6	17.1	<0.001
Difficulty in regulation and duration of sleep	Control	19	54.3	16	45.7	18	51.4	17	48.6	0.501
	Intervention	20	57.1	15	42.9	26	74.3	9	25.7	<0.001
Snoring	Control	21	60	14	40	23	65.7	12	34.3	0.970
	Intervention	18	51.4	17	48.6	20	57.1	15	42.9	0.500

## Discussion

In this study, the effect of inhalation of orange essential oil on the sleep quality of hospitalized children was investigated. The results demonstrated that in the intervention group, there was a significant improvement in sleep quality scores in the areas of difficulty in falling asleep, waking up during the night, and regularity and duration of sleep disturbances after aromatherapy compared to the control group, which indicates

the positive effect of the intervention. In other words, the intervention improved the children's quality of sleep. In 2014, Zamanjani et al. conducted a study to investigate the effect of orange scent on the sleep quality of school-aged children with acute lymphoblastic leukemia and reported the average sleep quality score after the intervention in the intervention group was significantly higher than before [6].

The findings of Momeni et al.'s research in 2010 demonstrated that after aromatherapy with lavender, the average sleep quality scores in both intervention and control groups were different compared to before aromatherapy [19]. In the study of Lee et al. in 2012, aromatherapy with a combination of orange and lavender essential oils effectively alleviated sleep disorders in dialysis patients [16]. In 2016, Mirghforvand et al. stated that orange extract effectively promotes mothers' sleep quality [20]. Moreover, in the study of Lehrner et al. in 2005, the scent of orange in a dental office reduced anxiety and improved mood in female patients waiting for dental treatment [21]. The results of the studies above were consistent with the results of the present study.

However, the present study's results differed from Williams' study, which investigated the effect of aromatherapy on the sleep quality of autistic children [22]. This discrepancy may be related to the diseases of the children (colds and pneumonia versus autism and learning problems) and the small sample size (12 children).

In a study by Fesmer et al. (2012), which was conducted to determine the effect of aromatherapy with lavender essential oil on the quality of sleep of patients hospitalized in the CCU, no significant difference was observed [23]. This may be attributed to the short duration of the study (one night), the different amounts and types of essential oil used (one drop), and the age of the participants (adults).

According to the literature, the orange extract contains linalyl acetate and linalool compounds. Linalool has a sedative effect on the central nervous system through the GABA receptor. Moreover, linalool acetate has narcotic-like effects. Flavonoids also act as benzodiazepine receptor agonists and have sedative properties [20,24]. These findings seem to justify the outcome of the current research. Daily stress and anxiety lead to sleep delay, and reduced stress and anxiety facilitate falling asleep; and as a result, sleep delay decreases, and vice versa [25]. In a review study entitled the potential anti-anxiety and sedative effects of herbal compounds, Kuponiyi demonstrated that orange essential oil has anti-anxiety and sedative properties [26]. Therefore, it seems that orange, due to its calming and anti-anxiety compounds, improves sleep

quality by reducing anxiety and inducing relaxation.

One of the limitations of this research was using a questionnaire to evaluate sleep quality, which may be less reliable than objective methods such as plethysmography. Another limitation of this study was that other uncontrollable variables could have influenced the quality of sleep. The defective blinding procedure also could have distorted our outcomes.

### Conclusion

In conclusion, the present study's findings demonstrated that the inhalation of orange extracts has a favorable effect on the sleep quality of hospitalized children, and the inhalation of its essential oil can improve sleep quality. Considering the favorable effects of orange essential oil inhalation, this non-pharmacological intervention can improve hospitalized children's sleep quality. This approach is highly recommended due to its easy use and affordability.

### Acknowledgments

This article is extracted from a research project (code no=5250) approved by the ethics committee of Birjand University of Medical Sciences (with the registration code IR.BUMS.REC.1399.026). We would like to thank all those who participated in this study.

### Conflict of interest

The authors reported no conflict of interest.

### Funding

This study was financially supported by the Birjand University of Medical Sciences.

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