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# The Effect of Lavender Inhalation on Sleep Quality in Individuals with Coronary Heart Disease: A Randomized Controlled Study

# Koroner Kalp Hastalığına Sahip Bireylerde Kullanılan Lavanta İnhalasyonunun Uyku Kalitesi Üzerine Etkisi: Randomize Kontrollü Bir Çalışma

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## ABSTRACT

**Objective:** Sleep disorders frequently manifest in individuals with coronary heart disease (CHD). Evaluating sleep quality in these patients is crucial for devising effective healthcare interventions. This study aimed to assess the impact of long-term *home-based* lavender inhalation on sleep quality among individuals diagnosed with CHD.

**Materials and Methods:** A randomized controlled trial involving two groups was conducted in the cardiology clinics of a university hospital in 2023. Sixty-four patients (32 in the experimental group and 32 in the control group) were enrolled. Data collection utilized the Personal Information Form and the Pittsburgh Sleep Quality Index (PSQI). The experimental group received lavender oil inhalation for one month. The PSQI was administered to both groups at the study's commencement and conclusion (pre-test and post-test, respectively).

**Results:** A statistically significant difference was observed between the pretest and posttest PSQI scores in the experimental group (p=0.000). Furthermore, the posttest PSQI mean scores of the experimental group were found to be significantly lower than those of the control group (p=0.004).

**Conclusions:** Lavender inhalation demonstrated an enhancement in sleep quality among patients with CHD. To the best of our knowledge, this is the first randomized controlled study to evaluate sleep quality in CHD patients through a one-month lavender inhalation program conducted entirely at home. These findings contribute to the literature and are recommended for health practices. However, considering limitations such as its single-center design, it is important that the findings are supported by studies in broader populations and over longer durations.

**Keywords:** Aromatherapy, coronary heart diseases, lavender oil, sleep quality

## ÖZ

**Amaç:** Uyku bozuklukları, koroner kalp hastalığı (KKH) olan bireylerde sıkça görülmektedir. Bu hastalarda uyku kalitesinin değerlendirilmesi, etkili sağlık müdahalelerinin geliştirilmesi açısından önemlidir. Bu çalışmanın amacı, KKH tanısı konmuş bireylerde uzun süreli *ev temelli* lavanta inhalasyonunun uyku kalitesi üzerindeki etkisini değerlendirmektir.

**Materyal ve Metot:** Bu çalışma 2023 yılında bir üniversite hastanesinin kardiyoloji kliniklerinde iki gruplu, randomize kontrollü olarak yürütülmüştür. Çalışmaya 64 hasta katılmıştır (32 deney grubu, 32 kontrol grubu). Veri toplama aracı olarak Kişisel Bilgi Formu ve Pittsburgh Uyku Kalitesi İndeksi (PUKİ) kullanılmıştır. Deney grubuna bir ay boyunca lavanta yağı inhalasyonu uygulanmıştır. PUKİ, her iki gruba da çalışmanın başlangıcında ve sonunda (sırasıyla ön test ve son test) uygulanmıştır.

**Bulgular:** Deney grubunda ön test ve son test PUKİ puanları arasında istatistiksel olarak anlamlı bir fark gözlenmiştir (p=0.000). Ayrıca, deney grubunun son test PUKİ ortalama puanları, kontrol grubu puanlarından anlamlı derecede düşük bulunmuştur (p=0.004).

**Sonuç:** Lavanta inhalasyonun, KKH olan bireylerde uyku kalitesinde iyileşme sağladığı tespit edilmiştir. Bildiğimiz kadarıyla bu çalışma, tamamen evde uygulanan bir aylık lavanta inhalasyon programı aracılığıyla KKH hastalarında uyku kalitesini değerlendiren ilk randomize kontrollü çalışmadır. Bu bulgular literatüre katkıda bulunmakta ve sağlık uygulamaları için önerilmektedir. Ancak, çalışmanın tek merkezli olması gibi sınırlılıklar göz önüne alındığında, bulguların daha geniş popülasyonlarda ve uzun süreli çalışmalarla desteklenmesi önemlidir.

**Anahtar Kelimeler:** Aromaterapi, koroner kalp hastalıkları, lavanta esansiyel yağı, uyku kalitesi

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## INTRODUCTION

It is estimated that approximately 17.9 million people in the world die each year due to coronary heart disease (CHD) and stroke, a figure anticipated to escalate to 23.3 million by 2030.[1] CHD significantly impacts quality of life, morbidity, and mortality. Sleep disorders frequently affect patients with CHD.[2]

Sleep, a complex biobehavioral phenomenon, profoundly affects psychological well-being, quality of life, morbidity, and mortality in chronic disease sufferers.[3] In individuals with sleep problems, the autonomic nervous system and hypothalamic-adrenocortical axis are activated, and immune functions are impaired. These issues also contribute to systemic inflammation, elevating the risk of metabolic syndrome, type 2 diabetes, hypertension, cardiovascular diseases, and premature mortality.[4] Sleep disruptions hinder tissue repair, cellular immunity, energy balance, endocrine, and metabolic functions vital for healing.[3,4]

Non-pharmacological methods, especially complementary alternative practices, are increasingly recommended.[5] In recent years, aromatherapy is one of the complementary therapies whose use has increased significantly due to its easy and effective use and cost savings.[5] Lavender, renowned for its anxiolytic, hypnotic, sedative, analgesic, and anticonvulsant properties, is a widely used aromatic herbal oil in aromatherapy.[6] It has also been reported to improve sleep quality and reduce pain and anxiety.[7,8]

Although various non-pharmacological methods have been studied to improve sleep in CHD patients,[9] to date there has been no randomized controlled trial evaluating the long-term effect of lavender inhalation performed entirely in the home environment. On the other hand, lavender oil inhalation studies, including a one-month home-based intervention, are available in the literature in different populations.[10]

However, this study addresses this gap by implementing a one-month home-based intervention that reflects a real and sustainable approach to self-care for individuals with CHD. Assessing sleep quality in these patients is crucial for planning effective healthcare interventions. Therefore, this study aimed to evaluate the impact of long-term home-based lavender inhalation on sleep quality among individuals diagnosed with CHD.

## MATERIALS AND METHODS

***Ethical Considerations:*** The study adhered to the principles outlined in the Helsinki Declaration. Approval was obtained from the Ethics Committee for Scientific Research and Publication of Isparta Applied Sciences University (Date: 12.01.2023, decision no: 131/07). Institutional approval to conduct the study was also obtained from the Chief Physician of Çukurova University Balcalı Hospital (E-59565534-010.01-679091). Prior to participation, all patients were duly informed about the study's objectives, emphasized the voluntary nature of their involvement, and assured of their right to withdraw at any point. Patients were explicitly notified that their participation or withdrawal would not influence their ongoing treatment and care. Informed consent was obtained from all of the participants. This study was registered in ClinicalTrials.gov under the registration number (ID: NCT05704946).

***Trial Design:*** This investigation followed a randomized controlled interventional design, adhering to the guidelines outlined in the Consolidated Standards of Reporting Trials (CONSORT).

***Participants and Sample Size:*** The population of the study encompassed patients diagnosed with CHD receiving treatment at the cardiology clinic of a university hospital in 2023. The sample was constituted of individuals aged 85 and below, literate, not hearing impaired, not having coagulation disorder, migraine, and chronic headaches, not allergic to lavender (Lavandula angustifolia), not receiving any sleep-related medical treatment and who agreed to participate. Patients who experienced asthma problems or allergic reactions related to inhalation, such as respiratory distress, cough, and nausea, or expressed a desire to withdraw from the study, were planned to be excluded from the study. However, no patient withdrew from the study due to these reasons (n=0). In this study, based on the research conducted by McDonnell & Newcomb, the number of samples for each group was calculated as 26 for the independent sample t-test with an effect size of 0.8, 5% margin of error and 80% power using the G*Power 3.1.9.7 programme.[11] Considering the possibility of data loss, the number of samples for each group was increased by 20%, and it was planned to include 32 patients for each group. One patient in the experimental group was lost to follow-up due to failure to communicate, and two patients in the control group were lost to follow-up because they refused to be a voluntary participant in the study. The study was completed with a total of 61 patients, 31 of whom were in the education group and 30 in the control group (Figure 1). A post-hoc power analysis determined this study's power to be 84% with an effect size of 0.77 and a margin of error of 0.05.

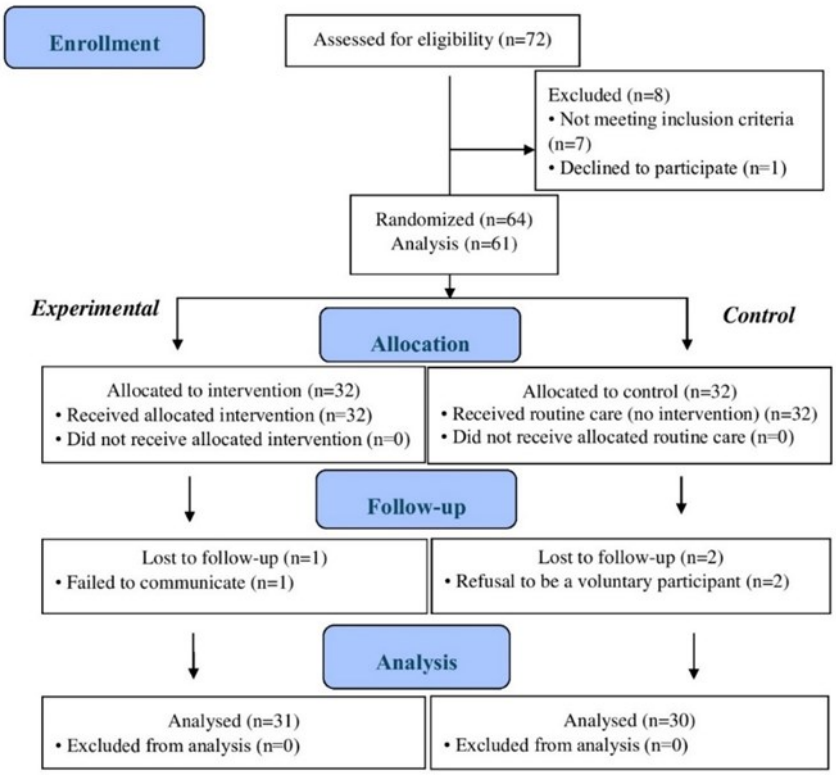


**Figure 1.** CONSORT flow diagram.

***Outcome Measures:*** Data collection for this study involved the utilization of two instruments: the Personal Information Form and the Pittsburgh Sleep Quality Index (PSQI).

The Personal Information Form, developed by the researchers, encompassed 10 queries pertaining to sociodemographic characteristics, specific health attributes, and medication usage associated with CHD.

The PSQI is a self-report scale developed by Buysse et al. for the assessment of sleep quality and sleep disturbance over the past month.[12] The validity and reliability of the PSQI were subsequently investigated by Ağargün et al.[13] PSQI comprises 24 questions designed. The first 19 questions are self-administered by the participants and cover subjective sleep quality, sleep duration, sleep latency, sleep disorders, habitual sleep efficiency, sleep medication use, and daytime dysfunction, making up 7 components in the index. PSQI scores of ≤5 indicate good sleep quality, while scores exceeding 5 indicate poor sleep quality. However, in this study, the Cronbach's alpha coefficient for the scale was determined to be 0.85.

***Data Collection:*** Data were collected in 2023. The study was carried out with two groups, control and experiment. Randomization occurred subsequent to interviews with willing participants who were informed about the study's objectives**.**

***Randomization and Blinding:*** Participants were allocated to the experimental (n = 32) and control (n = 32) groups using block randomization with a block size of 4 through the website (https://www.randomizer.org/). The random allocation sequence was concealed using closed envelopes to ensure blinding. The sequence and allocation details were securely managed by an independent nurse who was not involved in data collection or analysis. Participants were enrolled by the primary researcher, who was unaware of the allocation sequence. Throughout the study, participants were blinded to their group assignments, and the researchers responsible for outcome assessments were also blinded to the group allocations.

***Intervention:*** Participants were interviewed upon admission to the clinic, and written informed consent was obtained. They were then asked to complete the Personal Information Form and the PSQI questionnaire. Participants were instructed to use a chosen nickname when completing the questionnaire, which would be used for the final evaluation.

In this study, Rosense brand lavender oil (30 mL, Isparta lavender) produced from the Lavandula angustifolia species, which is the most widely utilized

and referenced species in the health field,[14] was used. In addition, lavender is known for its anxiolytic and sedative properties and has been shown to improve sleep quality.[6,7] It was preferred due to its potential positive effects on sleep problems commonly seen in CHD patients, its safe profile, and its potential to increase patient compliance.[8,11] Furthermore, a review of the literature indicates that it is frequently administered via the inhalation method.[9,10, 15,16] The selection and dosage of the oil were determined in consultation with a phytotherapy expert. The researcher provided detailed instructions on the lavender oil application technique. The patients were informed that they should apply two drops of lavender oil to the lower right side and two drops to the lower left side of their pillows approximately 20 to 30 minutes before going to sleep each night for one month following their discharge. For patients who utilized double pillows, they were specifically instructed to apply lavender oil to the pillow they slept on. In particular, lavender oil was applied to the underside of the pillow, thus preventing the patient from being disturbed by odor intensity or skin contact. Participants in the intervention group were encouraged to contact the researcher via a provided phone number if they had any questions or experienced any issues during the application period.

No intervention was applied to the control group, and they were instructed to maintain their normal sleep habits for one month. Both groups were contacted by the researcher every Friday to monitor progress. In the follow-up process for the experimental group, adherence to the lavender oil application was evaluated, and participants were encouraged to maintain compliance. The follow-up for the control group, on the other hand, aimed to confirm that participants sustained their existing sleep habits during the study period and ensured their continued participation. At the end of the fourth week, participants completed the PSQI questionnaire online using their chosen nicknames. Upon the completion of data collection, participants were thanked for their participation. To ensure ethical compliance, participants in the control group were provided with the same materials used in the experimental group after the study concluded, along with instructions on how to use the lavender oil in the same manner.

***Statistical Analysis:*** Statistical analyses for the study were conducted using IBM SPSS Statistics 24. Data normality was confirmed via skewness and kurtosis values; thus, parametric tests were employed. Data interpretation involved frequency tables and descriptive statistics for participant characteristics; the independent samples t-test for between-group comparisons; and the Paired Samples t-test for within-group pre-post PSQI comparisons. Additionally, a $\chi 2$ test was applied to compare categorical baseline variables and to explore associations between qualitative variables. A p-value $< 0.05$ was considered statistically significant.

## RESULTS

According to the descriptive characteristics of the groups, the mean age in the experimental group was 65.55 ± 10.54, while it was 67.07 ± 9.58 in the control group ($p = 0.559$). The duration of coronary heart disease was equal in both groups, with a mean of 7.00 years (experimental: ±6.31; control: ±6.70). In the experimental group, 15 patients (48.4%) were male and 16 (51.6%) were female, while in the control group, 18 patients (60.0%) were male and 12 (40.0%) were female ($p = 0.363$). Regarding education level, 12 patients in the experimental group had completed primary school, 12 had completed high school, and 7 had university degrees; in the control group, the corresponding numbers were 16, 10, and 4, respectively ($p = 0.459$). In terms of economic status, 24 patients in the experimental group and 26 in the control group reported having an income less than their expenses ($\chi^2 = 0.367$, $p = 0.544$). Concerning marital status, 19 patients in the experimental group were married, and 12 were single, whereas 22 patients in the control group were married, and 8 were single ($p = 0.316$). The presence of chronic diseases (excluding coronary heart disease) was reported by 23 patients in the experimental group and 27 in the control group ($p = 0.108$). Regarding smoking habits, 17 patients in the experimental group and 18 in the control group were non-smokers, while 10 patients in each group quit smoking ($p = 0.804$). As for exercise status, 9 patients in the experimental group and 10 in the control group reported engaging in regular physical activity ($p = 0.717$) (Table 1).

Regarding drug use, no statistically significant differences were found between the experimental and control groups in terms of anticoagulant use (80.6% vs 80.0%, p=0.949), beta-blocker uses (74.2% vs 66.7%, p=0.519), diuretic use (71.0% vs 63.3%, p=0.525), ACE inhibitor use (67.7% vs 56.7%, p=0.372), cardiac vasodilator use (61.3% vs. 56.7%, p=0.714), statin use (51.6% vs. 53.3%, p=0.893), and cardiac glycoside use (22.6% vs. 6.7%, p=0.80) (Table 2).

The pre-test and post-test PSQI scores within the control group showed no statistically significant difference (p=0.089). However, within the experimental group, there was a significant difference was observed between pre-test and post-test PSQI scores (p=0.000). Notably, the post-test mean scores for the experimental group were lower than their pre-test scores. During the pre-test, no statistically significant difference between groups was observed in mean scores (p=0.491). However, during the post-

**Table 1.** Comparison of descriptive characteristics of the patients.

| | | Experimental Group (n=31) | Control Group (n=30) | Test |
|---|---|---|---|---|
| **Age,** mean±SD [Min-Max] | | 65.55±10.54 [44-85] | 67.07±9.58 [48-85] | t=-0.588[a] p=0.559 |
| **CHD duration (year),** mean±SD [Min-Max] | | 7.00±6.31 [1-20] | 7.00±6.70 [1-21] | t=-0.420[a] p=0.676 |
| **Sex, n (%)** | Male | 15 (48.4) | 18 (60.0) | $\chi^2$=0.828[b] |
| | Female | 16 (51.6) | 12 (40.0) | p=0.363 |
| **Education level, n (%)** | Primary school | 12 (38.7) | 16 (53.3) | $\chi^2$=1.555[b] |
| | High school | 12 (38.7) | 10 (33.3) | p=0.459 |
| | University | 7 (22.6) | 4 (13.3) | |
| **Economic situation, n (%)** | Income less than expenses | 24 (77.4) | 26 (86.7) | $\chi^2$=0.367[b] |
| | Income equal to expenses | 7 (22.6) | 4 (13.3) | p=0.544 |
| **Marital status, n (%)** | Married | 19 (61.3) | 22 (73.3) | $\chi^2$=1.003[b] |
| | Single | 12 (38.7) | 8 (26.7) | p=0.316 |
| **Chronic disease (excluding CHD), n (%)** | Yes | 23 (74.2) | 27 (90.0) | $\chi^2$=2.577[b] |
| | No | 8 (25.8) | 3 (10.0) | p=0.108 |
| **Smoking usage status, n (%)** | Yes | 4 (12.9) | 2 (6.7) | $\chi^2$=0.702[b] |
| | No | 17 (54.8) | 18 (60.0) | p=0.804 |
| | Quit smoking | 10 (32.3) | 10 (33.3) | |
| **Exercise status, n (%)** | Yes | 9 (29.0) | 10 (33.3) | $\chi^2$=0.132[b] |
| | No | 22 (71.0) | 20 (66.7) | p=0.717 |

CHD: Coronary Heart Disease; SD: Standard Deviation; a: Independent Sample-t; b: Pearson-$\chi^2$

**Table 2.** Comparison of drugs used by patients for CHD.

| | | Experimental Group (n=31) | Control Group (n=30) | Test |
|---|---|---|---|---|
| **Anticoagulant, n (%)** | Yes | 25 (80.6) | 24 (80.0) | $\chi^2$=0.004[a] |
| | No | 6 (19.4) | 6 (20.0) | p=0.949 |
| **Beta Blocker, n (%)** | Yes | 23 (74.2) | 20 (66.7) | $\chi^2$=0.415[a] |
| | No | 8 (25.8) | 10 (33.3) | p=0.519 |
| **Diuretic, n (%)** | Yes | 22 (71.0) | 19 (63.3) | $\chi^2$=0.403[a] |
| | No | 9 (29.0) | 11 (36.7) | p=0.525 |
| **ACE Inhibitor, n (%)** | Yes | 21 (67.7) | 17 (56.7) | $\chi^2$=0.796[a] |
| | No | 10 (32.3) | 13 (43.3) | p=0.372 |
| **Cardiac Vasodilator, n (%)** | Yes | 19 (61.3) | 17 (56.7) | $\chi^2$=0.135[a] |
| | No | 12 (38.7) | 13 (43.3) | p=0.714 |
| **Statins, n (%)** | Yes | 16 (51.6) | 16 (53.3) | $\chi^2$=0.018[a] |
| | No | 15 (48.4) | 14 (46.7) | p=0.893 |
| **Cardiac Glycoside, n (%)** | Yes | 7 (22.6) | 2 (6.7) | $\chi^2$=3.070[a] |
| | No | 24 (77.4) | 28 (93.3) | p=0.80 |

ACE: Angiotensin Converting Enzyme, [a]: Independent Sample-t; [b]: Pearson-$\chi^2$.

test, a significant difference was observed in mean PSQI scores between the groups (p=0.004). Specifically, the experimental group exhibited a notably lower post-test mean score compared to the control group (Table 3).

**Table 3.** Comparison of the PSQI score averages of the groups.

| PSQI | Experimental Group (n=31) | Control Group (n=30) | Test |
|---|---|---|---|
| **Pre-test,** mean±SD [Min-Max] | 12.81±4.02 [6-19] | 12.03±4.67 [5-21] | t=0.694[a] p=0.491 |
| **Post-test,** mean±SD [Min-Max] | 7.52±3.80 [3-17] | 10.83±4.77 [3-20] | t=-3.008[a] **p=0.004** |
| **Test** | t=6.385[b] **p=0.000** | t=1.759[b] p=0.089 | |

PSQI: Pittsburgh Sleep Quality Index; SD: Standard Deviation; a: Independent Sample-t; b: Pearson-$\chi^2$.

## DISCUSSION AND CONCLUSION

Sleep disorders are addressed through a variety of approaches, encompassing both pharmacological and non-pharmacological methods. However, although pharmacologic treatments can significantly improve sleep quality, they may have side effects and may cause addiction.[15] Therefore, it is important that non-pharmacologic methods are safer.

The investigation aimed at exploring the impact of aromatherapy on the sleep quality of individuals with coronary heart disease revealed a notable enhancement in sleep quality among patients undergoing aromatherapy inhalation. Davari et al. reported findings congruent with the present study, noting an augmentation in sleep quality following aromatherapy among cardiac patients.[15] Likewise, Emami-Sigaroudi et al. observed the efficacy of aromatherapy involving lavender essential oil in averting sleep disorders.[8] Lavender essential oil operates on the limbic system, stimulating the production of γ-aminobutyric acid, particularly within the amygdala, thereby promoting sleep initiation. Moreover, its tranquilizing properties facilitate sleep by suppressing the release of acetylcholine.[16] Polonini et al. demonstrated that the daily intranasal administration of an essential oil blend comprising lavender and fennel prior to sleep resulted in a notable reduction in salivary cortisol levels and an improvement in sleep quality.[17] Her and Cho conducted a systematic review demonstrating that aromatherapy significantly improves sleep quality in adults and older individuals, with additional benefits such as reduced stress, pain, anxiety, depression, and fatigue.[18] In a clinical trial conducted by Mahdavikian et al., evaluating lavender aromatherapy's effectiveness over seven days in 105 cardiac care unit patients, significant positive effects on sleep quality were observed within the experimental group when compared to the control group.[19]

However, conflicting results exist regarding the effectiveness of aromatherapy in this context. Otaghi et al. conducted a clinical study among patients in a cardiac care unit, all of whom were candidates for angiography. They administered lavender essential oil four times (every 8 hours, starting 24 hours before angiography) but found no notable difference in sleep quality between the intervention and control groups.[20] Furthermore, another study involving 150 cardiac patients demonstrated that aromatherapy massage using lavender oil did not yield a significant difference in sleep quality compared to routine massage over 7 days.[21] These discrepancies in the efficacy of lavender oil in enhancing sleep among individuals with cardiovascular diseases might arise from variations in study duration and the specific interventions employed. While some studies did not observe significant effects of lavender inhalation,[20,21] this study demonstrated significant improvements in sleep quality with the extended one-month home-based intervention.

Overall, the comprehensive review by Luo and Jiang on aromatherapy studies provided encouraging evidence supporting the efficacy of lavender in addressing sleep disorders across diverse populations and medical conditions.[22] However, they underscored the necessity for additional clinical trials employing robust methodologies and extended intervention durations. Such trials are crucial for forming more evidence-based conclusions regarding the impact of lavender on sleep-related issues and for delving deeper into its mechanisms of action.

In conclusion, it can be said that lavender inhalation improves sleep quality in patients with CHD. Unlike previous studies limited to clinical or short-term applications,[9] this study uniquely implemented a monthly lavender inhalation protocol in the home environment of patients in this population. This design not only increases ecological validity but also provides insights into complementary therapies applicable in routine daily life. Lavender is one of the most commonly used herbs for patients with sleep disorders. There are various application techniques, with inhalation being the most preferred. The mechanisms likely involve lavender's known anxiolytic and sedative properties, potentially mediated through the central nervous system. Given its non-invasive, cost-effective, and easily applicable nature, alongside its suitability for cardiac patients, lavender essential oil serves as a promising, independent healthcare intervention. Healthcare professionals can consider incorporating lavender inhalation into patient education as a simple approach to improving sleep quality in CHD patients. However, the generalizability of these findings is limited by the study's sample, which included only patients discharged from a single clinic within a university hospital. Additionally, the assessment of patients' sleep quality was confined to the scale's items, representing a further limitation. Future studies should explore the effects of lavender inhalation over extended periods and its potential impact on long-term cardiovascular outcomes.

***Ethics Committee Approval:*** The study adhered to the principles outlined in the Helsinki Declaration. Approval was obtained from the Ethics Committee for Scientific Research and Publication of Isparta Applied Sciences University (Date: 12.01.2023, decision no: 131/07). Institutional approval to conduct the study was also obtained from the Chief Physician of Çukurova University Balcalı Hospital (E-59565534-010.01-679091). Prior to participation, all patients were duly informed about the study's objectives, emphasized the voluntary nature of their invol-

vement, and assured of their right to withdraw at any point. Patients were explicitly notified that their participation or withdrawal would not influence their ongoing treatment and care. Informed consent was obtained from all of the participants. This study was registered in ClinicalTrials.gov under the registration number (ID: NCT05704946).

***Conflict of Interest:*** No conflict of interest was declared by the authors.

***Author Contributions:*** Concept – EG, SDD, SA; Supervision – SA; Materials – EG; Data Collection and Processing – EG; Analysis and Interpretation – SDD; Writing – EG, SDD, SA.

***Peer-review:*** Externally peer-reviewed.

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***Other Information:*** This study was presented at the International Health Services Congress. The congress took place on November 21-22, 2023, at Toros University in Mersin, Türkiye.

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