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The Effectiveness of a Combination of Lavender Aromatherapy and Sleep Hygiene in Improving Sleep Quality in Patients with Diabetes Mellitus: A Quasi Experimental Study

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Abstract: *Type 2 diabetes mellitus (T2DM) is often accompanied by sleep disturbances that can worsen glycemic control and increase the risk of complications. The combination of lavender aromatherapy and sleep hygiene is a non-pharmacological intervention that can potentially improve sleep quality in T2DM patients. This study aims to evaluate the effectiveness of lavender aromatherapy and sleep hygiene in improving sleep quality in T2DM patients. The study used a quasi-experimental design with a pre-test and post-test approach. The sample consisted of 15 inpatients with T2DM at PKU Muhammadiyah Gamping Hospital, who were selected using an accidental sampling method. Interventions included lavender aromatherapy inhalation and sleep hygiene implementation, including ablution, prayer, sleeping position, and lighting. Data were analyzed using paired t-tests to see changes in Pittsburgh Sleep Quality Index (PSQI) scores before and after the intervention. The mean PSQI score of the patients decreased significantly from 8.67 before the intervention to 5.40 after the intervention (p=0.001), indicating a significant improvement in sleep quality. The combination of lavender aromatherapy and sleep hygiene effectively improves sleep quality in T2DM patients. This intervention can be adopted in nursing practice to manage sleep disorders holistically.*

Keywords: *Type 2 diabetes mellitus (T2DM), Lavender aromatherapy, sleep hygiene, sleep quality*

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INTRODUCTION

Diabetes mellitus is a metabolic disease characterized by persistently elevated blood glucose levels (Westman, 2021). The number of people with diabetes is projected to increase to 643 million by 2023. Additionally, the International Diabetes Federation (IDF) reports that the number of people with diabetes in Indonesia is approximately 19.5 million (IDF, 2021). Diabetes mellitus is a disease characterized by high blood sugar levels (hyperglycemia) and metabolic disorders of carbohydrates, fats, and proteins associated with relative deficiency of insulin action or secretion (Sudayasa et al., 2020). Based on data from the International Diabetes Federation, it is estimated that 537 million people have diabetes, and this number is projected to reach 643 million by 2030, and 783 million by 2045. In addition, 541 million people are expected to have impaired glucose tolerance in 2021, it is also estimated that more than 6.7 million people aged 20-79 will die from diabetes-related causes in 2021 (IDF, 2021). One of the other common problems in diabetics is that 50% of diabetic patients with Restless Leg Syndrome have poor sleep quality. Diabetes mellitus is a very significant public health problem and is included in the four non-communicable diseases that are the main focus of action of world leaders. The

prevalence and number of cases of Diabetes Mellitus continues to increase every year (Ministry of Health, 2019).

Sleep disorders in DM patients are associated with symptoms felt nocturia, anxiety, depression, anxiety, and neuropathy (Darraj, 2023). This is supported by cross-sectional research conducted on type 2 DM patients which links type 2 DM with difficulty initiating sleep ($r = 0.29$, $p < 0.05$) and difficulty maintaining sleep ($r = 0.24$, $p < 0.05$). Sleeping less than 5 hours can increase the risk of death by 15%, besides sleeping less than 5 hours is associated with glucose intolerance and insulin resistance (Marjollet et al., 2015). Sleep disorders are increasingly common and impact both physical and mental health, and are considered an important component of overall health in modern society. These disorders can be triggered by various medical conditions, mental disorders, and chronic diseases such as diabetes and heart disease (Talih et al., 2016). Patients with sleep disorders often feel dissatisfied with the quality, duration, or amount of sleep they get. These sleep problems are also often experienced by people with diabetes, who often face difficulties falling asleep. Diabetes-related sleep disorders are a potentially life-threatening condition, with a growing prevalence (Modarresnia et al., 2018).

In patients with chronic conditions such as diabetes mellitus, it is very important to have quality sleep. However, in the general population, 53.4% of patients with diabetes experience poor sleep quality compared to 29% of patients with diabetes (Sokwalla et al., 2017). Patients with diabetes mellitus have been reported to experience higher sleepiness on every day and experience adverse obstructive sleep apnea (Lou et al., 2015; Osonoi et al., 2015). Sleep quality can be influenced by several factors, namely physical state, psychological stress, drugs, exercise and fatigue, nutrition and calorie intake, environment, and motivation. Some studies explain that very short (5 hours/night) or very long (9 hours/night) sleep duration can increase the risk of diabetes, the results of the study show that poor sleep quality can affect glucose metabolism, reduce insulin sensitivity, and increase insulin resistance (Lin et al., 2019).

Diabetes Mellitus control can be done with additional interventions in the form of maintaining good sleep quality which serves to control blood sugar levels in diabetics (Bellon et al., 2021). Sleep disturbances in diabetics will reduce their sleep quality. Sleep quality can be seen from the duration of sleep, the time it takes to be able to sleep how many times you wake up, and the depth of sleep (Khalil et al., 2020). Poor sleep quality is closely related to poor glycemic control levels, so improving sleep quality in diabetic patients can lead to better glycemic control and improve quality of life (Tsai et al., 2012).

Research conducted by Febriana stated that respondents experienced 1 sleep disturbance in one month. The sleeping pills subscale is how often respondents use medication to help them fall asleep. The average of this subscale shows that few respondents used medication to help sleep with a frequency of less than once a week in the past month (mean 0.16, SD = 0.49) (Febriani, 2024). research conducted by Andriani et al (2023) stated that more than half of the respondents (64.1%) experienced poor sleep quality

Research by Azharuddin et al (2020) shows that short sleep is significantly associated with higher HbA1c levels or worse glycemic control, whereas, good sleep quality significantly reduces HbA1c levels. There are several ways to improve sleep quality, namely with pharmacological and non-pharmacological therapies. Non-pharmacological therapy, one of the strategies that aims to improve sleep quality and can be carried out independently by nurses is the provision of aromatherapy and the application of sleep hygiene.

One of the aromatherapy that can be used to improve the quality of sleep of Diabetes Mellitus patients is lavender which mostly contains linalool and linalool acetate around 30-60% of the total weight of the oil, where linalool is a content that is known to have a relaxing effect (Maharianingsih et al., 2020). Lavender aromatherapy can reduce anxiety levels and provide a more relaxed feeling because

when inhaling lavender aromatherapy, chemical components will enter the limbic system in the brain. The limbic system is the center of pain, pleasure, anger, fear, depression, and various other emotions.

The application of sleep hygiene effectively improves the sleep quality of DM patients, this is supported by Chung et al (2018) Sleep hygiene education as a treatment of insomnia: a systematic review and meta-analysis with the results of sleep hygiene improving sleep quality. The research was also conducted by Lucena et al (2021) with the title Effect of a lavender essential oil and sleep hygiene protocol on insomnia in postmenopausal women: A pilot randomized clinical trial. With the results of lavender aromatherapy and sleep, hygiene improves sleep quality. Sleep hygiene to be applied is the development of bedtime rituals, namely ablution, prayer, and body position when going to bed, adjusting the bed, and lighting.

Research conducted by Monika et al (2021) "The Effect of Ablution Before Bedtime on Sleep Quality in Hypertensive Patients", shows that ablution therapy is effective in improving the patient's sleep quality. Ablution can also protect against shaitan interference when someone is asleep (one of which is in the form of nightmares). So perfect that Islam regulates all Muslim activities in their daily lives, including sleep activities (Chusnan et al., 2021).

A review of the literature conducted by Vitani et al (2020) on spiritual therapy in patients with type 2 diabetes millets that spiritual therapy serenity prayer and remembrance therapy have benefits including improving quality of life, reducing levels of stress, depression, anxiety, and remembrance that can normalize blood sugar, make life feel more peaceful, calm, and peaceful.

The main problem that can be concluded from the report is that sleep disturbances are often experienced by patients with type 2 diabetes mellitus, which can affect glycemic control and overall health. The problem of sleep disturbance in patients with type 2 diabetes mellitus requires effective non-pharmacological intervention approaches, such as a combination of lavender aromatherapy and sleep hygiene. The purpose of the study is to determine the effectiveness of lavender aromatherapy and sleep hygiene to improve the sleep quality of patients with type 2 diabetes mellitus.

METHODS

The study used a quasi-experimental design with a pre-test and post-test approach without a control group. The study population was inpatients with T2DM who experienced sleep disorders. The target population was inpatients with type 2 diabetes mellitus with sleep disorders at PKU Muhammadiyah Gamping Hospital. The sample was calculated using G*Power software with: Effect size: 1.103 (based on previous studies), α (alpha): 0.05, Power: 0.8. The calculation resulted in 15 samples per group. The sampling method was accidental sampling. The sample size was calculated using G*Power with the effectiveness of the intervention measured at α=0.05 and power=0.8. The total sample size used was 15 patients with type 2 diabetes mellitus with complaints of sleep disorders." A sample of 15 patients was selected using an accidental sampling technique based on inclusion and exclusion criteria. Inclusion criteria: (1) Pittsburgh Sleep Quality Index (PSQI) score >5, (2) prefer lavender aromatherapy, (3) able to perform ablution or tayamum, (4) not using other complementary therapies, and (5) willing to participate. Exclusion criteria: patients with psychological disorders or allergies to lavender aromatherapy. The intervention was conducted for 12 days, including 1) Lavender aromatherapy was administered by dripping three drops of essential oil on the gauze placed 20 cm from the patient's nose. 2) Sleep hygiene, including ablution before bedtime, prayer, sleeping position on the right side, and dim lighting. Sleep quality was measured using PSQI before and after the intervention. The paired t-test was used to analyze changes in PSQI scores with a significance level of $p<0.05$. research flow in this report:

1. Screening of patients based on inclusion and exclusion criteria.
2. Randomization or group allocation.
3. Intervention delivery (lavender aromatherapy and sleep hygiene).
4. Measurement of sleep quality before and after intervention with PSQI.

Aromatherapy details: Aromatherapy using lavender essential oil containing 30-60% linalool. The application method is inhalation through a diffuser, given for 6-7 hours before bedtime for 4 weeks.

Subject Allocation: Subjects were selected based on inclusion/exclusion criteria. There is no mention of a randomization method, but it should be explained if blinding is used.

RESULTS

a. Respondent Characteristics

Data on the characteristics of respondents in this study include age, gender, diabetes mellitus drug consumption, occupation, and length of diabetes mellitus. The descriptive characteristics of respondents are shown in Table 1.

Table 1. Respondent Characteristics

Demographic data	Frequency (f)	Percentage (%)
Age		
40-49 years	2	13.3
50-59 years	8	53.3
60-69 years		26.7
>69 years	1	6.7
Gender		
Male	6	40
Female	9	60
Duration of DM		
5-8 years	6	40
8-12 years	9	60
Current blood Sugar		
150 -200	2	13.3
201-300	5	33.3
301-400	7	46.76
>400	1	6
Take medicine		
Regular	6	40
Irregular	9	60

The results of this study showed that the age of most respondents was ≥ 50 - 59 years as many as 8 or 53.3%. The most common gender is female as many as 9 or 60%. The majority of temporary blood sugar is 301-400 g/dl. The length of time the elderly suffer from diabetes in the elderly have all suffered for 8 - 12 years as many as 9 or 60%. Taking DM medication is mostly irregular as many as 9 or 60%.

b. Analysis Results

The results of data analysis in the study to see the difference in sleep quality before the application and after the application of the Lavender Aromatherapy and Sleep Hygiene Combination. A description of the results of the data analysis is shown in Table 2.

Table 2. Analysis Results

	Median (Min – Max)	p-value
Sleep Quality before Implementation	8.67	**0.001**
Sleep quality after implementation	5.40	

*Significant with $p < 0.05$

Based on the study's results, the mean Pittsburgh Sleep Quality Index (PSQI) score significantly decreased from 8.67 (Pre) to 5.40 (Post) after the application of a combination of lavender aromatherapy and sleep hygiene. This indicates that the intervention successfully improved the sleep quality of patients with type 2 diabetes mellitus significantly (p=0.001).

DISCUSSION

Based on the results of the analysis, shows that there is a difference or there is an influence between the quality of sleep before and after the application, namely the data obtained a p-value of 0.001 which is statistically significant. Based on the results of the analysis conducted on the implementation of combined therapy aromatherapy therapy and sleep hygiene in type 2 diabetes mellitus respondents, the quality of sleep decreased from an average value of 8.86 to 5.40. Research results in One of the complementary therapies that can be given is lavender aroma therapy lavender essential oil by dripping on the right side of the pillow for 2 weeks Malloggi et al (2022) then given by inhaling 3 drops of lavender essential oil on a linen cloth slowly for 5 minutes (Nasiri Lari et al., 2020).

According to Rahmadhani (2022) there are several things that happen after giving lavender aroma therapy, namely effective as a sedative that functions to calm the central nervous system which can help overcome insomnia, especially stress, anxiety, anxiety, tension and depression. According to Susiyanti & Dharmayanti (2023) the main content in lavender oil is linalool acetate oil which is able to relax and relax the nervous system and tense muscles. So it can be used in stress management. Aromatherapy is a method that uses essential oils and can affect a person's emotions. Lavender essential oil aroma therapy is one of the safest oils as well and has strong antiseptic power, and anti-depression with a sweet-smelling, floral, very herbal aroma so it is widely used as the most popular aroma therapy that has many properties (Buckner et al., 2018).

According to the results of research from Ariska & Faridah (2020) interventions that have been given by means of lavender aromatherapy which can be inhaled with 3 drops of lavender essential oil on linen cloth (two layers of linen cloth about 12 cm) and smell it rhythmically and slowly for 5 minutes at bedtime. The results showed that the average age of respondents was 56 years as many as 31 respondents 59.6% there were better results on sleep quality significantly $P < 0.001$ in group 1 and $P < 0.05$ in group 2 but there were no significant differences in fasting blood sugar serum levels and anthropometric results $P > 0.05$). In research conducted by Hatami et al (2017) as many as 31 respondents aged 40-65 years were given 3% lavender and ylang-ylang aromatherapy intervention for 2 weeks. Given by inhalation, respondents were asked to wear a necklace containing aromatherapy for 3-6 hours with a necklace designed 20 cm from the nose, and massage once a day before bed or before bathing for 15-20 minutes for 1 week there were significant results on sleep quality $P < 0.001$. Based on research conducted by X, it is stated that aromatherapy can improve sleep quality, especially in adults who have diabetes. Aromatherapy can have a better impact on sleep quality if used regularly and continuously (Salamung & Elmiyanti, 2023).

Based on the results of the analysis, it shows that there is a difference or there is an influence between the quality of sleep hygiene is an activity carried out before resting/sleeping at night. The first is ablution. Wudhu is linguistically derived from the word al-wadha'ah which means clean and bright. According to Shara', wudhu is washing, megalin, and cleaning and wiping parts of the body using water on each part of the members of wudhu to remove minor impurities as a valid condition for performing prayer. Wudhu can also be interpreted as the activity of washing certain parts of the body with the intention of cleaning and purifying. Which is determined by sharing the parts of the human body. Unconsciously, Muslims have underestimated the sunnah of ablution before bed which has many benefits.

These benefits are not only spiritual but also physical benefits that will be obtained by performing ablution before bed. Many traditions speak of the virtues of ablution and are supported by specialized research on the benefits for Muslims. Therefore, this recommendation is a very good sunnah for the Muslim community to do. As is well known, ablution is very influential for health, because ablution is not just for physically cleaning the limbs. However, the movements in ablution can provide relaxation

to our tired muscles. The coolness of the water in each wash of ablution will clean ourselves and get fresher and lighter so that the body will relax again. Speaking of Health the Prophet in his hadith has given deep attention to the problem of human health, namely the health of the body and soul. It can be understood how important ablution is in so many practices that if you are going to do it, you must do ablution first, such as ablution before going to bed. In addition, it contains a lot of wisdom, which can raise a person's degree before Allah SWT, prevent skin cancer, can reduce and eliminate anxiety, depression, and stress, which makes the mind relax and the body not feel tired. So if someone does ablution activities then indirectly do therapy for his health. And spiritually, ablution will be a reminder to always worship Allah SWT and eliminate laziness. One of them is Prof. Leopold Werner von Ehrenfels, a psychiatrist and neurologist. He found that ablution can stimulate nerve centers in the human body. Because of the harmony of water with ablution and nerve points, the body's condition will always be healthy.

Ablution is also a very effective protection for the outer skin layer from microbial attacks that will enter the body, thus minimizing the occurrence of various diseases. According to Dr. Magomedov, assistant at the Institute of General Hygiene and Ecology. Ablution can stimulate and stimulate natural body rhythms, especially at biological points. For a person who performs ablution, there are 61 and 65 reflection points which are the parts that are exposed to the wash of ablution water. These points are nerves associated with the organs of the human body that can often cause dangerous diseases, such as kidney, heart, lung, high blood pressure, and cancer. With this reflection, it will then bring good changes to one's health condition. For this reason, when someone often performs ablutions, indirectly that person is doing reflection therapy which is very beneficial and has a significant effect on human health.

It is recommended to sleep facing right. The Prophet recommends that the best sleeping position is resting on the right side of the body or facing right. The Prophet likes to do things with the right limbs because sleeping on the right side is faster than waking up. Sleeping on the right side will make the position of the heart hang in the right position so that it will not complicate blood circulation. Sleeping on the right side and then bending his legs slightly is the most ideal sleep and provides the relaxation needed for the body and soul. In addition, Ibn al-Qayyim also explained that the Prophet slept lying on his right side and he placed his right hand under his right cheek. Praying before going to sleep from the above hadith is the last recommended recitation of prayer. Prayers and dhikr to Allah SWT, are brought repeatedly until the patient falls asleep.

Based on the results of the analysis conducted on the application of combined therapy of aromatherapy and sleep hygiene therapy, the p-value data is 0.001 which is statistically significant. Selection bias may occur due to the incidental sampling method. A possible solution to minimize bias is to control for external variables.

CONCLUSION

The combination of lavender aromatherapy and sleep hygiene is effective in improving the sleep quality of T2DM patients. This intervention can be integrated into nursing care as a non-pharmacological approach to managing sleep disorders in diabetic patients. This study was based on a population of diabetes mellitus patients at PKU Muhammadiyah Gamping Hospital. The results may not be fully applicable to patients in other places with different characteristics.

DATA AVAILABILITY

Data are available upon request to the authors to support patient privacy.

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ETHICAL STATEMENT

The ethical statement for this study is No. 123/KEP-PKU/V/2024 from ITS PKU Muhammadiyah Surakarta Ethical Committee.

AUTHOR CONTRIBUTIONS

Yuli Widyastuti (YW) ,Fitrian Rayasari (FY), Dewi Anggraini (DA), Wati Jumaiyah (WJ), Ita Indraswati (ITA).
YW: Conceptualization, Methodology, Data curation, Writing- Original draft preparation.
FY, DA, WJ: Methodology, Writing- Original draft preparation.
ITA: Visualization, Writing- Reviewing and Editing.
All authors approved the final version of the manuscript.

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CONFLICT OF INTEREST

There is no conflict of interest in this study

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