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Foot soak device to improve sleep quality for pregnant women

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ARTICLE INFO	ABSTRACT
<i>Article history:</i> Received Sep 20, 2024 Revised Sep 22, 2024 Accepted Sep 25, 2024 <i>Keywords:</i> Foot Soak Device Pregnant Mother Sleep Quality Third Trimester	The study explores the development of a Foot Soak Device to improve the sleep quality of pregnant women in their third trimester. Pregnant women often experience discomfort such as leg edema, back pain, and sleep disturbances due to increased fetal weight, shortness of breath, and fetal movements. Poor sleep quality can negatively impact health, weaken the immune system, and lead to complications like low birth weight in newborns. Existing foot soak devices lack key features such as temperature regulation, heating, and massage, prompting researchers to innovate a new foot soak device tailored to pregnant women. The research follows a Research and Development (R&D) method. It includes two stages: the first involves analysis and product development based on feedback from five third-trimester pregnant women, while the second stage tests the product's efficacy through a quasi-experimental design with a one group pretest-posttest involving 20 pregnant women, using purposive sampling. Results from the first stage highlighted the need for a foot soak with temperature control, a heater, and massage functionality. The developed device incorporated these features, and 90% of participants found the foot soaks comfortable. In the second phase, the analysis showed a significant effect of the foot soak on improving sleep quality ($p \leq 0.05$). The study concludes that midwives could implement this foot soak device as part of midwifery care to enhance the quality of life for pregnant women in the third trimester. <i>This is an open access article under the CC BY-NC license.</i> 

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INTRODUCTION

During pregnancy, there are many physiological and psychological adaptations, susceptible to all kinds of discomfort and stress resulting from changes in physiology and metabolic function (Syafitasari et al., 2023). Physiological changes include changes in the reproductive, cardiovascular, respiratory, kidney, skin, mucosa, skeletal, nervous, digestive, and endocrine systems (Zaenatushofi & Sulastri, 2019). In the third trimester of pregnancy, discomfort often occurs, including frequent urination in about 50%, vaginal discharge in 15%, sleep disturbances in 45%,

constipation in 40%, bloating in 30%, leg edema (swelling) in 20%, leg cramps in 10%, headaches in 20%, striae gravidarum 50% including hemorrhoids 60%, shortness of breath 60% and back pain 70% (Harismayanti et al., 2021).

Sleep quality in pregnant women is very important for the health of the mother and fetus. A study estimates that sleep disorders occur in 46-78% of pregnant women, with sleep quality decreasing towards the third trimester. Nearly 80% of pregnant women experience insomnia in the third trimester of pregnancy (Smyka et al., 2020). According to the World Health Organization (WHO) in 2021 globally there were around 145,000,000 pregnant women worldwide with an overall incidence of sleep disorders reaching 24.7% - 84.2% (WHO, 2021). In Indonesia, the prevalence of sleep disorders in pregnant women in 2022 was 63.4%. The main factors causing sleep quality disorders in pregnant women include anxiety about pregnancy, discomfort during pregnancy due to frequent urination, hypersalivation, snoring and cramps. Sleep disorders can cause hormonal imbalances in the body. Sleep disorders can increase the risk of diabetes mellitus (DM), increased blood pressure, and impaired fetal growth and development in the womb (Arthyka Palifiana & Wulandari, 2018). To overcome this disorder, pharmacological and non-pharmacological methods can be used. Pharmacological methods are common treatments for sleep disorders that aim to reduce anxiety and stress and calm the mind (Fitriana, 2020) (Kamagi & Sahar, 2021) (Ahmad et al., 2023) (Solehati et al., 2024) (Andas et al., 2024). However, this does not apply to pregnant women because it can increase the risk to the fetus and can affect fetal growth and development. Therefore, it is recommended to use the option of using non-pharmacological methods three times better, because there are no side effects compared to pharmacological methods. Non-pharmacological methods such as using relaxation techniques, music therapy, soaking feet in warm water can help improve sleep quality in pregnant women (Anasari et al., 2022), other non-pharmacological methods that can also be used are acupuncture, acupressure, massage or relaxation therapy, aerobic exercise but methods are needed that are used in further research to find out significant results in improving sleep quality in pregnant women (Hollenbach et al., 2013).

Providing foot soaking therapy with warm water (Warm Hydrotherapy Feet) effective temperature is used at 38 °C -40 °C for 20 minutes which aims to vasodilate blood vessels which can result in smooth blood flow and result in muscles being able to relax so that it will reduce anxiety, increase blood circulation, reduce edema in the feet, can increase muscle relaxation, improve heart health, relax muscles, relieve stress and anxiety, relieve pain, increase capillary permeability, and provide warmth to the body (Rahayu et al., 2023).

Warm water foot soak technique by sitting on a chair in a relaxed manner and leaning back, Water temperature 38-40°C as much as 2 liters in a foot soak basin for 15 minutes then rinse with a towel and do it for 3 days (Rosyada et al., 2023). The warm water foot soak technique can produce a relaxed atmosphere that can increase serotonin production and then convert it into melatonin so that it causes drowsiness and can sleep well. The time to soak your feet in warm water is at night because at night the pineal gland begins to convert serotonin into melatonin. Melatonin produces at night then stimulates harmonious body functions (Febry Rahayu et al., 2023)

Based on Palifiana's 2018 research, Most pregnant women in the third trimester experience less than four types of discomfort in pregnancy (59.2%), most of the sleep quality of pregnant women in the third trimester is in the poor category (74.6%). There is a relationship between discomfort in pregnancy and the sleep quality of pregnant women in the third trimester (Arthyka Palifiana & Wulandari, 2018).

The occurrence of problems in the form of sleep disorders that are more often experienced by pregnant women can cause complications in their pregnancy which in this case will affect the fetus. This can also worsen the body's inflammatory response which causes excess cytokine production due to sleep disorders in pregnant women. A body condition that experiences excess

cytokines can interfere with the spinal arteries leading to the placenta, this can result in blood vessel disease and also increase the risk of premature birth (Febry Rahayu et al., 2023)

Based on the results of a study by Ahmed 2019, there is a relationship between maternal sleep quality and increased symptoms of depression and increased maternal blood glucose during pregnancy, therefore highlighting the need for intervention or tools as innovations to improve and restore sleep quality and sleep efficiency during pregnancy (Fauzia S et al., 2023)

The development of technology today greatly helps human work and activities. Based on the initial survey conducted by researchers, it was found that 9 out of 10 pregnant women in the 2nd and 3rd trimesters experienced sleep disorders. (Streatfeild et al., 2021) The 9 mothers stated that they felt uncomfortable with the sleep disorders they experienced during pregnancy and made their bodies tired quickly and had headaches in carrying out daily activities. Seeing the urgency of the problem, researchers had the idea to create an innovative foot soaker with an automatic water temperature detector and roller massage. This tool is very helpful for pregnant women to soak their feet without having to heat the water first and with the temperature detector used, the water temperature used is exactly the standard used for soaking feet and feeling the comfort of roller massage so that it relaxes the mother. It is hoped that after using this tool, the mother's sleep quality can improve. In this study, the assessment of sleep quality used the Pittsburgh Sleep Quality Index (PSQI) questionnaire.

RESEARCH METHOD

The occurrence of problems in the form of sleep disorders that are more often experienced by pregnant women can cause complications in their pregnancy which in this case will affect the fetus. This can also worsen the body's inflammatory response which causes excess cytokine production due to sleep disorders in pregnant women. A body condition that experiences excess cytokines can interfere with the spinal arteries leading to the placenta, this can result in blood vessel disease and also increase the risk of premature birth (Febry Rahayu et al., 2023) Based on the results of a study by Ahmed 2019, there is a relationship between maternal sleep quality and increased symptoms of depression and increased maternal blood glucose during pregnancy, therefore highlighting the need for intervention or tools as innovations to improve and restore sleep quality and sleep efficiency during pregnancy (Fauzia S et al., 2023) The development of technology today greatly helps human work and activities (Streatfeild et al., 2021). Based on the initial survey conducted by researchers, it was found that 9 out of 10 pregnant women in the 2nd and 3rd trimesters experienced sleep disorders. The 9 mothers stated that they felt uncomfortable with the sleep disorders they experienced during pregnancy and made their bodies tired quickly and had headaches in carrying out daily activities. Seeing the urgency of the problem, researchers had the idea to create an innovative foot soaker with an automatic water temperature detector and roller massage. This tool is very helpful for pregnant women to soak their feet without having to heat the water first and with the temperature detector used, the water temperature used is exactly the standard used for soaking feet and feeling the comfort of roller massage so that it relaxes the mother. It is hoped that after using this tool, the mother's sleep quality can improve. In this study, the assessment of sleep quality used the Pittsburgh Sleep Quality Index (PSQI) questionnaire.

RESULTS AND DISCUSSIONS

Result

Phase 1 research obtained results, from interviews conducted with 6 pregnant women stated that existing foot soaks do not have a temperature regulator which makes pregnant women difficult. All respondents stated that a good foot soak is one that has a temperature regulator that makes it easier for pregnant women to use.

At the development stage, the design and shape of the product were obtained according to market demand. The developed foot soak is equipped with features that are automatically connected to electricity, there is a temperature control feature and there is a roller massage so that it can make it easier for mothers to soak their feet without having to heat and determine the water temperature manually.



Figure 1. Water temperature manually

Table 1. Electrical technical expert validator's assessment of foot soak

No	Assessment Items	Average value (%)
1.	Safety	90
2.	Performance and functionality	100
3.	User friendliness	100
4.	Ergonomics and design	100
5.	Compliance with Medical Standards and Regulations	80
Expert Validator Average Final Score		85

Table 2. Expert physiotherapist validator assessment of foot soak

No	Assessment Items	Average value (%)
1.	Posture support functionality	80
2.	Feature functionality	70
3.	User comfort and fit	75
4.	Safety	80
5.	Adherence to therapy standards	75
Average Value of expert validators		76

Table 3. Average value of user rating results

No	Respondent	Assessment Items				Number
		A	B	C	D	
1	HL	85	85	100	100	92,5
2	SW	85	85	100	100	92,5
3	DS	75	85	100	100	90
4	LN	85	85	100	100	92,5
5	TS	85	85	100	100	92,5
Total						460
Average Score						92

The assessment of foot soak by experts has been categorized as very good or very feasible. After going through expert validation assessment, researchers conducted a trial stage of the foot

soak product with a quasi-experimental design in the form of a one group pretest-posttest design, namely revealing a causal relationship by involving a group of subjects, where the group of subjects was observed before the intervention, then observed again after the intervention. Data collection was carried out by researchers analyzing the sleep quality of pregnant women using the Pittsburgh Sleep Quality Index (PSQI) questionnaire.

Table 4. Overview of sleep quality of pregnant women in the third trimester before being given foot soak in the Sukamerindu Health Center work area in 2024

Sleep Quality	Before		Mean	SD	Min - Max	95 % CI
	f	%				
Very Good	0	0	1,43	2,66	11 - 13	5,61 - 6,07
Good	0	0				
Very Poor	16	71,3				
Poor	4	28,7				
Total	20	100				

The results of the analysis show that before being given the maternity warm massage belt intervention, most respondents experienced poor sleep quality, namely 20 respondents (71.3%) with an average score of sleep quality experienced by pregnant women of 28.7 (poor), with a standard deviation of 2.66.

Table 5. Overview of the level of sleep quality of pregnant women in the third trimester after being given foot soak in the Sukamerindu Health Center work area in 2024.

Sleep Quality	Before		Mean	SD	Min - Max	95 % CI
	f	%				
Very Good	17	89,2	4,5	5.79	9 - 16	5,958 - 7,169
Good	3	10, 8				
Very Poor	0	0,00				
Poor	0	0				
Total	20	100				

The results of the analysis show that after being given a foot soak intervention, the majority of respondents experienced good sleep quality, namely 17 respondents (89.2%).

Table 6. Effect of foot soak on sleep quality of pregnant women in the third trimester in the Sukamerindu Health Center work area in 2024.

Variable	Mean	SD	SE	P	N
Sleep quality Before being given foot soak	4,91	0,623	0,1023		
Sleep quality After being given foot soak	3,53	0,762	0,1247	0,000	20

The results of the analysis showed that the average sleep quality before being given a foot soak was 4.91 (bad) with a standard deviation of 0.623. In the second measurement (after the foot soak), the average pain level was 3.53 (good) with a standard deviation of 0.762. The average difference between the pre-test and post-test sleep quality was 1.247 with a standard deviation of 0.762. The results of the statistical test obtained a p-value of 0.000, so it can be concluded that there is foot soak on the sleep quality of pregnant women in the third trimester at the Puskesmas in the Sukamerindu Puskesmas work area in 2024.

Discussion

One of the electronic devices to improve the comfort of pregnant women's sleep quality (Ismiyati & Faruq, 2020) (Putri & Nur, 2021) (Pondaang et al., 2023) (ARUM, 2024) (Hayati et al., 2024). Foot soak aims to vasodilate blood vessels which can result in smooth blood flow and result in muscles being able to relax so that it will reduce anxiety, increase blood circulation, reduce

edema in the legs, can increase muscle relaxation, improve heart health, relax muscles, relieve stress and anxiety, relieve pain, increase capillary permeability, and provide warmth to the body (Febry Rahayu et al., 2023).

Foot soaks developed by researchers have proven to be more practical and effective because they are equipped with features that are automatically connected to electricity, there are temperature settings, and there is a roller massage (Anshory et al., 2022)(Lestari, 2021)(Mahendra et al., 2024). The assessment of foot soaks by experts has been categorized as very good or very feasible. Based on the results of the analysis, foot soaks have been proven to have an effect on improving sleep quality in pregnant women. This is in accordance with the research of Wibowo & Purnamasari (2019) explaining that the quality of sleep of the elderly before warm foot soak therapy who experienced poor sleep quality was 10 people (66.7%) and good sleep quality was 5 people (33.4). Then after the application of warm water foot soak therapy for 15 minutes using a temperature of 40°C for 5 consecutive days showed data on poor sleep quality of 5 people (33.4) and good sleep quality of 10 people (66.7%) so that it can be concluded that there is effectiveness of warm water foot soak therapy. Soaking feet in warm water has benefits to help vasodilation of blood vessels and smooth blood circulation. In addition, in the endocrine system, soaking feet in warm water can stimulate increased hormone secretion in the body, namely the hormone serotonin which is then converted into the hormone melatonin (a hormone that causes relaxation and drowsiness) (Wibowo & Purnamasari, 2019). Soaking in warm water can relax the nerves in the body that were initially tense and can smooth blood flow, so that the quality of sleep in the elderly can improve. From the results of the study, there was an increase in sleep quality in the elderly after soaking feet using warm water. It was proven that there was an effect after being given warm water foot soak therapy in improving the quality of sleep in the elderly, and the elderly's response said they felt relaxed when given therapy. The warm sensation that directly touches the skin that contains many blood vessels provides a relaxing effect, causing relaxation. Warm water provides a sedative effect that can stimulate sleep (Roufuddin & Syaifuddin, 2021).

CONCLUSION

Based on the results of research and development that has been carried out, Development research was carried out to produce a new product in the form of a foot soak to improve the quality of sleep for pregnant women. The results of the electromedical expert test to measure the quality of the suitability of the foot soak obtained a very feasible category. There is an effect of foot soak on the quality of sleep for pregnant women. The development of foot soak does not stop here, it is necessary to develop and measure other variables so that the perfect foot soak is obtained to undergo a quality pregnancy.

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