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Innovation in the development of a maternity warm massage belt for reducing back pain intensity in working pregnant women

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ABSTRACT

About 70% of pregnant women experience back pain, and working pregnant women are often very active. Persistent back pain can affect their quality of life, disrupt daily activities, lower work performance, and even cause trauma in future pregnancies. Currently, maternity belts do not include features such as back support, heating, massage, or an attractive design. This study aims to develop a maternity warm massage belt that can reduce the intensity of back pain. This research uses Research and Development (R&D) with three stages: analysis, development, and product testing. The quasi-experiment design includes a one-group pretest-posttest with 30 respondents selected through purposive sampling from July to September 2024 in the Puskesmas Sidomulyo area. In the first stage, feedback from 5 pregnant women indicated a desire for a belt with back support, heating, massage, and an appealing design. The second stage produced a maternity warm massage belt that met these expectations, with 92% of pregnant women finding it comfortable to use. The third stage of testing showed a reduction in back pain from 4,97 to 3, with a p-value of 0.000, indicating that the maternity warm massage belt effectively reduces back pain intensity. The maternity warm massage belt is effective in reducing back pain in pregnant women and could be an innovative product for further development.

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INTRODUCTION

Work-related musculoskeletal disorders, including musculoskeletal disorders, have become a serious concern that can affect workers' well-being and productivity (Heydari et al., 2022). According to the Central Bureau of Statistics (BPS), the number of female workers in Indonesia reached 52.74 million in 2022 (Badan Pusat Statistik, 2023). Women of childbearing age still have the potential for pregnancy (Nurlaela & Aryati, 2018). Pregnancy is a natural process but is also accompanied by physiological changes (Selvia, 2017). Back pain is the most common musculoskeletal disorder experienced by pregnant women, which can affect activity patterns and

postural characteristics (Nurlaela & Aryati, 2018). Back pain during pregnancy is caused by anatomical, hormonal, and stress-related changes. Anatomical changes occur because the spine bears an increasing burden to balance the body as the uterus and fetus grow (Selvia, 2017). Unresolved back pain can impact the quality of life of pregnant women by affecting daily activities, potentially reducing work performance, social life, and even interfering with household duties and leisure time(Arummega et al., 2022; Syafitasari et al., 2023). Research reports that back pain contributes to 30% to 70% of issues during pregnancy. Typically, back pain occurs in the second and third trimesters, but it can also occur during the first trimester (Berber & Satılmış, 2020; Heydari et al., 2023). Around 30% of pregnant women may stop at least one daily activity during pregnancy despite work demands (Fatmarizka et al., 2022). Another study in the city of Blantyre found that out of 249 pregnant women experiencing lower back pain, 24% were unable to walk more than 90 meters, 21% could not lift objects they previously could, 22% could not sit for more than 10 minutes, and 2% were unable to sit at all even posing a risk of miscarriage (Grahara & Setiawan, 2021; Manyozo et al., 2019).

Risk factors for workplace musculoskeletal disorders include poor posture, repetitive movements, heavy lifting, non-ergonomic workplace design, and physical fatigue (Heydari et al., 2022). Workers with physically demanding tasks (including prolonged sitting/standing) are at risk of developing musculoskeletal disorders. Many pregnant women face physical trauma risks at work, especially due to frequent bending in work activities (Sinclair et al., 2014). Preventive measures include workplace design improvements, task rotation to reduce pressure on specific body parts, and early recognition and management of musculoskeletal disorder symptoms (Goncharenko et al., 2020). Another study also recommends using a maternity belt to support the back and abdomen to minimize the use of pharmacological treatments, which may have side effects on both mother and fetus (Banning & Pollard, 2020).

An initial survey conducted by the author found that 9 out of 10 pregnant women in their second and third trimesters experienced lower back pain. Eight of these women reported that the pain was disruptive, hindering their activities, and that they used pharmacological medications to relieve the pain. Based on this data and the urgency of the issue, the author aims to develop an innovative solution called the Maternity Warm Massage Belt, a belt with adjustable temperature settings that provides a warm compress to the back area to help pregnant working women reduce the intensity of back pain.

RESEARCH METHOD

This research is a type of study that adopts the Research and Development (R&D) method. It consists of three stages: Stage I research, development, and Stage II research or product testing. Stage I is a descriptive study aimed at identifying the appropriate belt for pregnant women, especially those in the design profession, which primarily provides back support and massage features. Stage II is the development phase, in which the maternity warm massage belt is designed based on the findings from Stage I. The researcher designed the maternity warm massage belt in the form of a maternity corset, called the Maternity Warm Massage Belt, which is portable and includes straps to be worn over both shoulders for back support, warmth, and massage. It also has an on-off power button, eliminating the need to be connected to an external power source. The design validation test for this maternity warm massage belt was carried out by experts and users (5 pregnant women) to assess its feasibility before being used by respondents in the field. Stage III is the testing phase, which uses a quasi-experimental design in the form of a one-group pretest-posttest model. This design reveals the cause-and-effect relationship by involving a group of subjects, where the subjects are observed before the intervention and then observed again after the intervention. Data collection was done by analyzing the back pain levels of pregnant women using the Visual Analogue Scale (VAS) instrument. The maternity warm massage belt was applied for 15 minutes, after which the pain level was reanalyzed. The population used in this study was 30

pregnant working women in the Sidomulyo Public Health Center area, selected through purposive sampling with specific criteria: pregnant women in their third trimester, carrying a single fetus, with a normal body mass index, not taking pharmacological drugs, and without any other illnesses (systemic inflammation, sciatica, gynecological disorders, cardiovascular disease, tumors, including spinal fractures). Data analysis in this study was carried out using univariate and bivariate analyses with a sample t-test. This research has passed the ethical review with number 083//FB/KEPKSTIKesSaptaBakti/24.

RESULTS AND DISCUSSIONS

Result

The results of the first phase of the study, based on interviews with five pregnant working women, revealed that the existing belts lacked back support, temperature regulation, and massage features, and had an uncomfortable design. All respondents stated that an ideal maternity belt should include temperature regulation and massage features, as well as back support to facilitate use for pregnant women. During the development phase, the design and shape of the product were adjusted according to the respondents' preferences. The developed belt is equipped with temperature regulation, massage features, and back support, and is referred to as the maternity warm massage belt.

Figure 1. Front view

Figure 2. Back view

Table 1. Assessment of the technical electromedical expert validator on the maternity warm massage belt

No	Assessment Items	Mean(%)
1.	Safety	100
2.	Performance and functionality	100
3.	User friendliness	100
4.	Ergonomics and design	100
5.	Compliance with Medical Standards and Regulations	70
	Final Mean	85

Table 2. Assessment of the physiotherapy expert validator on the maternity warm massage belt

No	Assessment Items	Mean(%)
1.	Posture support functionality	80
2.	Feature functionality	70
3.	User comfort and fit	75
4.	Safety	80
5.	Adherence to therapy standards	75
	Final Mean	77

Table 3. Average value of user assessment results (working pregnant women)

No	Respondent	Assessment Items				Mean
		Ease of Use	Usefulness of the tool	Comfort	Design	
1	AY	85	85	100	100	92,5
2	DN	85	85	100	100	92.5
3	AS	75	85	100	100	90

4	JL	85	85	100	100	92,5
5	PP	85	85	100	100	92,5
				Total		460
				Final Mean		92

The evaluation of the maternity warm massage belt by experts has been categorized as excellent or highly feasible. The maternity warm massage belt is deemed applicable for pregnant women, with its development falling under the "feasible" category and considered effective if the usage score reaches at least 75%. After undergoing expert validation, the researcher conducted a product trial of the maternity warm massage belt using a quasi-experimental design, specifically a one-group pretest-posttest design. This method uncovers cause-and-effect relationships by involving a group of subjects observed both before and after the intervention. Data collection was carried out by analyzing the intensity of back pain in pregnant working women using the Visual Analog Scale (VAS) questionnaire, as shown in the following table:

Table 4. Overview of the back pain level in third-trimester pregnant women before being given the Maternity Warm Massage Belt in the working area of Sidomulyo Health Center in 2024

Back Pain	Before		Mean	SD	Min - Max	95% CI
	F	%	4,97	1,1,89	4 – 7	4,52-5,41
Mild	0	0,0				
Moderate	25	83,3				
Severe	5	16,7				
Total	30	100				

The analysis results show that before being given the maternity warm massage belt intervention, the majority of respondents experienced moderate back pain, with 25 respondents (83.3%) reporting such pain. The average back pain score among pregnant women was 4.97 (moderate pain), with a standard deviation of 1.189. The lowest pain level was 4 (moderate pain), and the highest pain level was 7 (severe pain). Based on the interval estimation, it can be concluded that there is a 95% confidence that the back pain level before the intervention is between 4.52 and 5.41 (moderate pain).

Table. 5 Overview of the back pain level in third-trimester pregnant women After being given the Maternity Warm Massage Belt in the working area of Sidomulyo Health Center in 2024

Back Pain	After		Mean	SD	Min - Max	95% CI
	F	%	3	1,017	1-5	2,62-3,38
Mild	19	63,3				
Moderate	11	36,7				
Severe	0	0				
Total	30	100				

The analysis results show that after the maternity warm massage belt intervention, the majority of respondents experienced mild back pain, with 19 respondents (63.3%) reporting this, and none (0%) experienced severe back pain. The average back pain score among pregnant women was 3 (mild pain), with a standard deviation of 1.017. The lowest pain level was 1 (mild pain), and the highest pain level was 5 (moderate pain). Based on the interval estimation, it can be concluded that there is a 95% confidence that the back pain level after the intervention is between 2.62 (mild pain) and 3.38 (moderate pain).

Table 6. The Effect of the Maternity Warm Massage Belt on Back Pain Levels in Working Pregnant Women in the Working Area of Sidomulyo Health Center in 2024.

Variable	Mean	SD	Z	P	N
Pain Before Receiving the Maternity Warm Massage Belt	4,97	1,189	4,784	0,000	30
Pain after Receiving the Maternity	3	1,017			

Variable	Mean	SD	Z	P	N
Warm Massage Belt					

The analysis results show that the average pain level before being given the maternity warm massage belt was 4.97 (moderate pain) with a standard deviation of 1.189. In the second measurement (after the maternity warm massage belt was applied), the average pain level was 3 (mild pain) with a standard deviation of 1.017. The statistical test results showed a p-value of 0.000, indicating that there is a significant effect of the warm massage belt on the back pain intensity of pregnant working women at Sidomulyo Health Center in 2024.

Discussion

One of the tools to improve the quality of life for pregnant working women is a maternity belt. The maternity warm massage belt is designed to support the back of pregnant women, stimulate endorphin hormone release, and promote vasodilation of blood vessels, which enhances blood flow, leading to muscle relaxation. This reduces anxiety, improves blood circulation, and enhances muscle relaxation (Morino et al., 2019). The maternity warm massage belt developed by the researchers has proven to be more practical and effective as it is equipped with back support, temperature regulation, and massage features. Expert evaluations have categorized the maternity warm massage belt as excellent or highly feasible. Based on the analysis, the average pain level before the intervention was moderate. Interval estimation concludes with 95% confidence that the pain level before the intervention was between 4,52-5,41. Back pain in pregnant women is part of the adaptation process during pregnancy. This pain generally increases as pregnancy progresses due to shifts in the center of gravity and changes in posture caused by the growing uterus. If posture is not well maintained, increased lumbar lordosis can occur, causing back muscles to become tense and painful. This condition peaks between weeks 24 and 28, just before the abdomen reaches its maximum size (Gozali et al., 2020). Additionally, during pregnancy, women gain an average of 11 to 12 kg, and hormonal and biomechanical changes make them more susceptible to various musculoskeletal issues, including back pain (Saxena et al., 2019). According to (Wulandari & Wantini, 2021), 46% of women often experience back pain, and 42.90% of pregnant women frequently experience pain in the lower back area, which may start in the early trimester and peak in the second and third trimesters.

In general, back pain is the most common complaint, with a prevalence reaching 49%. About 80-90% of pregnant women with back pain report not taking any measures to address the symptoms, resulting in only 10-20% seeking medical care (Bryndal et al., 2020; Segita & Rusfah, 2023). Factors influencing back pain include the gestational age when pain first appears. Back pain typically occurs around week 27, with some reports indicating it first appears between weeks 20-28 (Bryndal et al., 2020). Maternal age also affects back pain, with lower back pain commonly experienced by women aged 20-24 and peaking after age 40 (Sukeksi et al., 2018). Additionally, multiparous and grand multiparous women experience more back pain due to weakened muscles that cannot adequately support the enlarging uterus (Fithriyah et al., 2020). Other factors influencing back pain during pregnancy include a history of back pain in previous pregnancies or past back issues, trauma leading to back or pelvic injuries, stress, and physical strain at work (Manyozo et al., 2019).

Back pain during pregnancy can hinder women from returning to work, having significant social impacts. In the Netherlands, one in fifty female workers on sick leave does so for pregnancy-related reasons, and over 25% of young women receiving disability pensions experience this condition after pregnancy and childbirth (Wiezer et al., 2020). Persistent back pain can lead to prolonged discomfort, increased risk of postpartum back pain, and chronic pain that is more challenging to treat or resolve, potentially recurring in future pregnancies. Lower back pain can negatively impact the quality of life for pregnant women by interfering with daily physical activities, such as difficulty standing after sitting, sitting or standing for too long, or moving objects

around (Salari et al., 2023). This is supported by research showing that 45.7% of respondents report that back pain affects daily activities, causing physical limitations that impact functional status and quality of life (Berber & Satılmış, 2020).

The results of this study show that the majority of respondents who were given the maternity warm massage belt intervention experienced mild back pain, with 19 respondents (63.3%) reporting this, and none (0%) experiencing severe back pain. The average back pain score among pregnant women was 3 (mild pain), with a standard deviation of 1.017. The lowest pain level was 1 (mild pain), and the highest was 5 (moderate pain). Based on the interval estimation, it can be concluded with 95% confidence that the pain level after the intervention was between 2.62 (mild pain) and 3.38 (moderate pain). The statistical test also showed a p-value of <0.05, indicating that the maternity warm massage belt had an effect on the back pain levels of pregnant working women in the Sidomulyo Health Center area in 2024.

As pregnancy progresses, a woman's body adjusts to the increasing weight of the uterus. The shoulders tend to be pulled back due to the enlarging abdomen, and to maintain balance, the spinal curve becomes more pronounced. The joints in the pelvic area also become more relaxed, often leading to back pain, especially after fatigue, bending, or lifting (Saudia & Sari, 2022). Additionally, hormonal changes, such as increased levels of relaxin, have been shown to increase ligament laxity in the pubic area. This causes symphysis widening during pregnancy, but pelvic joint laxity can also reduce pelvic stability and negatively affect posture stability (Bey et al., 2018).

The use of abdominal support belts, which extend to the pelvis and fit the waist shape, aims to limit movement in the waist area and strengthen abdominal muscles. This helps maintain lumbar stability and can reduce back pain in pregnant women. Pregnancy support belts are elastic belts worn under the abdomen with back support, often recommended to prevent and alleviate back pain during pregnancy. These belts are readily available and commonly used to reduce fatigue, pressure, and back tension, as well as to help prevent or relieve back pain and improve posture (Rodriguez & Troynikov, 2019). This is supported by research indicating that abdominal supports keep the spine, waist muscles, and abdominal muscles in an upright position, counteracting gravity to maintain balance. Supports also help maintain the natural curve of the lower back while limiting lateral, oblique, and rotational movements. Other studies (Huang et al., 2019) have shown that using a support belt has a positive impact on support during pregnancy and significantly reduces lower back pain. These changes are observed after using a pelvic support belt for [intervention duration]. The results support the use of pelvic support belts as an essential part of managing lower back pain during pregnancy. Additionally, according to (Heydari et al., 2023), the use of pregnancy belts positively impacts the quality of life for pregnant women experiencing back pain, reducing sacroiliac joint pain and improving physical health, vitality, and mental well-being (reducing stress due to pain), thereby enhancing physical activity at work.

The Maternity Warm Massage Belt features both a massage and heating function. The differences observed before and after using the Maternity Warm Massage Belt are attributed to the relaxation effect, which can reduce or eliminate pain and improve blood circulation. The heat produced causes vasodilation and physiological changes, contributing to increased blood flow and reduced pain. The body's response to heat is utilized as a therapeutic method to alleviate pain. The therapeutic effects of warm compresses can also help reduce muscle spasms and decrease joint stiffness. Additionally, combining massage a non-pharmacological therapy to reduce back pain in pregnant women helps relieve muscle tension and pain, improve mobility, and enhance blood circulation (Novelia & Anisah, 2021).During massage, endorphins are released in response to the body's needs, blocking pain receptors in the brain. Proper massage stimulation can easily activate the nervous system to release endorphins. This is supported by research showing that regular massage can be used during pregnancy to reduce stress and various pregnancy-related discomforts. Massage during pregnancy has been shown to alleviate leg and back pain, symptoms

of depression and anxiety, reduce cortisol levels, and have positive effects on immune function, thus improving the quality of life for pregnant women (Mueller & Grunwald, 2021).

CONCLUSION

Based on the research results, the Maternity Warm Massage Belt is deemed effective, with a validation score of 85% from Electromedical Engineering Experts, 77% from Physiotherapy Experts, and 92% from user validity. The trial results for back pain in working pregnant women in the Sidomulyo Health Center area can be summarized as follows: Before the intervention with the Maternity Warm Massage Belt, the average pain level was 4,97 (moderate pain). After the intervention, the average pain level was 3 (mild pain). The analysis indicates that the Maternity Warm Massage Belt has an impact on reducing back pain in working pregnant women, with a p-value of 0.000 ($p < 0.05$).

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