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Original Research

Effect of Using Medial Arch Support on Foot Pain (*Plantar Fasciitis*) in Pregnant Women

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ABSTRACT

Background: *Pregnancy is a natural process, but it often causes physical and psychological discomfort. One of the problems that can occur during pregnancy is foot pain, also known as plantar fasciitis, caused by inflammation of the plantar fascia and aggravated by increased body weight. A potential intervention for this problem is the use of medial arch support, an orthotic device designed to reduce pain by stabilizing the medial longitudinal arch of the foot.*

Methods: *This quantitative study used a quasi-experiment with a one-group pre-test and post-test design to examine the effect of medial arch support on foot pain in pregnant women. The study was conducted in Noborejo, Salatiga. The sampling technique used is purposive sampling and involved 20 pregnant women who often complained of foot pain in the 2-3 trimesters. Pain levels were measured using the Numeric Rating Scale (NRS) before and after a two-week intervention with medial arch support.*

Results: *The Wilcoxon test results indicate a significant reduction in foot pain ($p=0.000$, $p < 0.05$). The average pain score before the intervention was 7.9, which decreased to 4.5 after the use of medial arch support, reflecting a pain reduction of 43%. The average difference in pain level before and after the intervention was 3.4.*

Conclusion: *Medial arch support significantly reduces foot pain (plantar fasciitis) in pregnant women. This intervention offers a practical solution to reduce discomfort and improve the quality of health of pregnant women. Further studies are recommended to examine its long-term benefits and optimal application of medial arch support during pregnancy.*

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INTRODUCTION

Pregnancy is an important period in a woman's life, characterized by significant physical, hormonal, and psychological transformations. During pregnancy, women experience many changes in themselves, both physically and psychologically (Wulandari & Wantini, 2021). Physical discomfort is felt from the beginning during pregnancy. This process starts from conception, where the sperm cell fertilizes the egg, to childbirth after about 280 days or 40 weeks.

These adaptations occur gradually across the three trimesters of pregnancy and involve multiple body systems, including the musculoskeletal, cardiovascular, neurological, and metabolic systems. Each trimester of pregnancy has its unique features and challenges. During the initial stages of pregnancy, although external physical changes may not be prominent, the body undergoes significant internal adaptations. These include increased blood volume and hormonal fluctuations that affect cardiovascular and metabolic functions (Wulandari & Wantini, 2021).

Musculoskeletal changes also begin to manifest, notably through the increased mobility and elasticity of ligaments and joints due to elevated levels of relaxin, a hormone that facilitates the physiological preparation for fetal development and delivery (Fiat et al., 2022). In the second trimester, physical changes become more pronounced. The growing uterus causes a shift in the body's center of gravity, often resulting in alterations in posture and balance. There is also notable weight gain and structural changes in the musculoskeletal system.

These changes are commonly associated with musculoskeletal discomfort and muscle fatigue (Pascual & Langaker, 2023). During the third trimester, structural changes reach their peak. The rapid growth of the fetus exerts increased pressure on internal organs and further affects the musculoskeletal system. Research indicates significant alterations in foot structure, including reduced arch height and increased foot width, which may impair balance and mobility (Barczyk-Pawelec et al., 2021).

Several studies have identified various musculoskeletal problems frequently experienced by pregnant women, including back pain, leg cramps, and specifically plantar fasciitis. Plantar fasciitis commonly occurs in obese people and pregnant women, as excess weight puts strain on the fragile plantar fascia. Plantar fasciitis is an inflammation of the plantar fascia that often results from excessive pressure on the foot, especially during the third trimester of pregnancy. During pregnancy, there are changes in the biomechanics of the pregnant woman’s foot which can contribute to the risk of musculoskeletal disorders (Shmerling, 2023).

Contributing factors include increased body weight and increased stress on musculoskeletal structures during pregnancy. About 10 percent of women and those who are pregnant experience these complaints. One of the problems that can occur is overpronation of the foot. This happens when the foot arch flattens and tends to collapse inward. This can cause pain and discomfort in the heels when walking or even standing while supporting the body (Zangão et al., 2024).

Another problem is edema or swelling of the lower extremities. This condition often affects the foot during pregnancy. In addition, high pressure is exerted on the lower limbs, requiring proper footwear, orthoses, or massage to provide the necessary comfort (Fiat et al., 2022). To maintain foot health during pregnancy, especially when managing plantar fasciitis, it is essential to use orthotic devices that provide additional support and promote even distribution of body weight. Wearing footwear equipped with arch support can enhance proper blood circulation in the feet (Lerebourg et al., 2020).

Biomechanically, medial arch support plays a crucial role in alleviating plantar fasciitis symptoms by stabilizing the foot's structure and reducing strain on the plantar fascia (Buchanan et al., 2024). Recent studies have demonstrated the effectiveness of customized insoles with medial wedges in improving foot function and reducing pain associated with plantar fasciitis. For instance, a study by Thong-On and Harutaichun (2023) found that such insoles significantly decrease pain intensity and improved foot function over a three-month, as well as positively influenced lower extremity kinematics

during gait. These findings suggest that incorporating medial arch support into orthotic interventions can be a beneficial conservative treatment strategy for individuals suffering from plantar fasciitis.

Therefore, integrating biomechanically designed medial arch supports into footwear can be an effective approach to managing plantar fasciitis during pregnancy, aiding in pain reduction and enhancing overall foot mechanics. However, the existing literature often does not thoroughly explore the biomechanics of the bodies of pregnant women, especially in the community of Noborejo, Salatiga. This study also highlights the importance of tailoring health interventions to the specific needs of the population to achieve optimal outcomes.

Although there have been efforts to reduce plantar fasciitis in pregnant women, there is still a significant gap in the literature regarding the use of medial arch support as a primary intervention method in community settings. Previous research often tends to be limited to populations that do not reflect the everyday conditions of pregnant women in society. This study aims to fill this gap by identifying the effectiveness of medial arch support in reducing plantar fasciitis pain in pregnant women in Noborejo, Salatiga, as well as exploring its impact on the overall health quality of pregnant women.

This research will also explore the perceptions and experiences of pregnant women regarding the use of orthosis, providing deeper insights into how this intervention can be effectively adapted in different community contexts. By understanding the factors that influence acceptance and adherence to the use of medial arch support, it is hoped that more focused and sustainable intervention recommendations can be developed. This research aims to evaluate the impact of using medial arch support in reducing plantar fasciitis pain in pregnant women in Noborejo, Salatiga.

In addition, this research also aims to identify the factors that influence the success of this intervention and to explore the perceptions and experiences of pregnant women regarding the use of orthosis. In general, this research hypothesizes that the use of medial arch support will reduce the level of pain experienced by pregnant women due to plantar fasciitis, as well as improve mobility and the overall health quality of pregnant women. This study will also explore the factors that influence the success of the intervention using medial arch support, including psychosocial aspects and individual perceptions regarding the use of orthotics during pregnancy.

MATERIALS AND METHOD

This study uses a quantitative research method, with a one-group pre-test and post-test experimental design. This design involves measuring one group before and after the intervention to determine the effect of using medial arch support on foot pain (plantar fasciitis) in pregnant women in Noborejo Village, Salatiga. The research will be conducted over two weeks from April to May. The study was declared ethical approval by the Health Research Ethics Committee standards No. 1193/EA/F.XXIII.38/2024.

The research population is all pregnant women in the Noborejo sub-district, Salatiga, Central Java, Indonesia. Based on data from December to February 2022, there were 4.632 couples of childbearing age in the area, with 37 pregnant women. The sample was selected using purposive sampling techniques based on specific criteria for inclusion and exclusion. The inclusion criteria are (1) willing to cooperate and participate in the research program; (2) women in their 2-3 trimester of pregnancy; (3) experiencing foot pain (plantar fasciitis); and (4) not using other interventions to reduce foot pain. The exclusion criteria are (1) pregnant women in the first trimester; (2) not experiencing foot

pain; (3) using alternative methods to relieve foot pain; (4) special needs conditions; and (5) pregnant women who give birth during the research period.

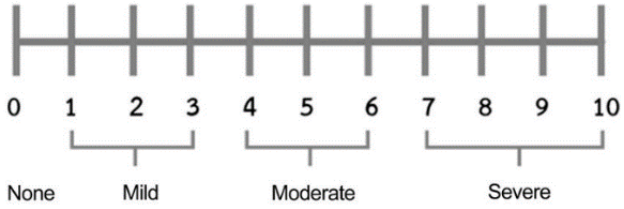
The inclusion of women in their second and third trimesters is based on the fact that plantar fasciitis tends to be more prevalent and symptomatic during the later stages of pregnancy due to increased body weight and pressure on the feet (Masłoń et al., 2022). Excluding women in the first trimester and those who use other pain relief methods helps reduce confounding factors that may influence the study results. Additionally, participants with special needs or who gave birth during the research period were excluded to maintain consistency in data collection and ensure participant safety.

The sample consisted of 20 pregnant women who experienced foot pain (plantar fasciitis) in Noborejo District met the inclusion criteria during further screening and were willing to become research respondents. The purposive sampling method allowed the researcher to focus on individuals who were most likely to provide relevant and accurate data to evaluate the effectiveness of the intervention. The research variables are divided into two variables, namely independent variables and dependent variables. The independent variable in this study is the use of medial arch support. The use of *flexible medial arch support (FMAS)* made from *Ethylene Vinyl Acetate (EVA)* or soft foam was provided to the subjects for two weeks, except during bathing and sleeping.



Picture 1. *Flexible Medial Arch Support*

While the dependent variable is the level of foot pain (plantar fasciitis) experienced by pregnant women. The degree of foot pain is measured using a *Numeric Rating Scale (NRS)* score, which ranges from 0 (no pain) to 10 (severe pain).



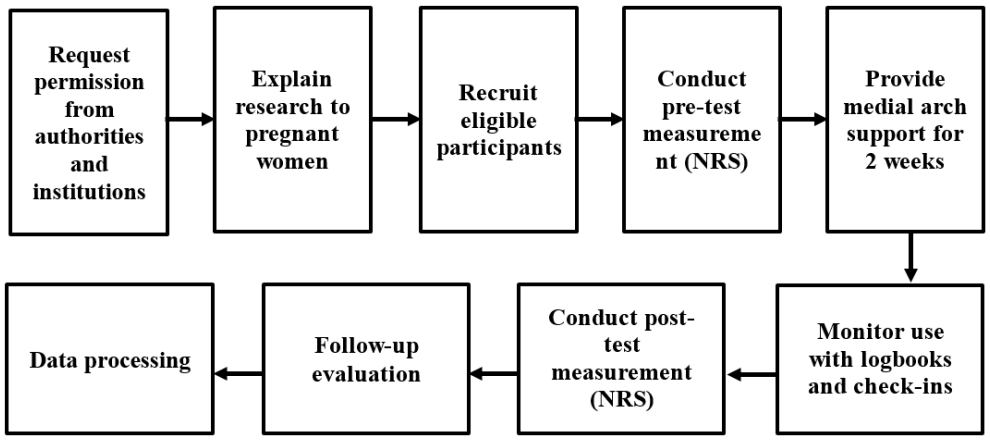
Picture 2. *Numeric Rating Scale (NRS)* (Zhao et al., 2020)

The data collection procedure includes the preparation stage of requesting permission from the relevant authorities and institutions, explaining to pregnant women the purpose, benefits, and procedures of the research, followed by the implementation stage of collecting data and selecting pregnant women who meet the inclusion criteria and are willing to participate. A pre-test measurement is conducted by assessing the initial pain level using the NRS. An intervention is then carried out by providing medial arch support and instructing the subjects to wear it continuously for two weeks during activities, except when bathing or sleeping.

To ensure adherence and accuracy of intervention use, the researcher monitors the actual use of medial arch support through weekly logbooks or checklists filled out by the

participants, along with periodic check-ins. This monitoring approach is designed to be simple and not burdensome, considering the physical condition and daily routines of pregnant women. After the two-week intervention, a post-test measurement is conducted using the NRS to assess the reduction in foot pain. Additionally, follow-up evaluations are conducted several weeks after the intervention period to assess the sustainability and long-term effects of medial arch support on plantar fasciitis symptoms among the participants.

Data processing using SPSS version 21. A normality test was conducted using the *Shapiro-Wilk test* to determine whether the data was normally distributed. Hypothesis testing by describing the characteristics of respondents such as age, weight, and occupation, and determining the effect of using *flexible medial arch support (FMAS)* on foot pain using the *Wilcoxon test*. The hypothesis is accepted if p-value < 0.05 and rejected if p-value > 0.05.



Picture 3. Flowchart of the research process

RESULTS

The research titled "Effect of Using Medial Arch Support on Foot Pain (Plantar Fasciitis) in Pregnant Women in Salatiga" was conducted from April to May, involving pregnant women experiencing foot pain (plantar fasciitis) in the Noborejo, Salatiga, who met the inclusion and exclusion criteria. The total number of pregnant women who met the inclusion and exclusion criteria was 20. The results of the research regarding the general characteristics of the research subjects are divided into characteristics based on the age of the pregnant mothers, gestational age, weight, and occupation.

Table 1. Characteristics of subjects in research (n = 20 pregnant women)

Subject Characteristics	n	Percentage (%)
Age of Pregnant Women		
20-30 years old	9	45
31-40 years old	10	50
41-45 years old	1	5
Total	**20**	**100**
Trimester of Pregnancy		
II	6	30
III	14	70
Total	**20**	**100**

Subject Characteristics	n	Percentage (%)
Body weight (kg)		
60-70	12	60
71-80	7	35
81-90	1	5
Total	**20**	**100**
Occupation		
Civic Servant	4	20
Private Worker	12	60
Self-employed	2	10
Housewife	2	10
Total	**20**	**100**

The table presents the demographic and physical characteristics of the pregnant women participating in the study. The participants' ages range from a minimum of 20 years to a maximum of 45 years, with the majority aged between 31–40 years. Most participants are in their third trimester of pregnancy. In terms of body weight, the lowest recorded range is 60–70 kg, while the highest is 81–90 kg. Regarding occupation, the majority of participants are private workers, followed by civil servants, self-employed individuals, and housewives.

These characteristics represent factors that may potentially influence the outcomes of the study, particularly in relation to the experience of foot pain (plantar fasciitis) and the effectiveness of medial arch support during pregnancy. The data on the results of measuring the degree of pain before being given the intervention treatment and after being given the medial arch support intervention treatment are as follows:

Table 2. Pain Measurement Before and After Treatment (n = 20 pregnant women)

Variable	Min	Max	Mean± Standar deviation
Pain			
Pre-test	6	9	7.9±0.852
Post-test	3	6	4.5±1.100

The results of measuring pain levels using the NRS before the application of medial arch support showed an average score of 7.9, while after the application, the average score was 4.5. The difference in average scores before and after the application of FMAS was 3.4, resulting in a pain reduction value of 43%. This indicates that after the intervention, the subjects experienced a decrease in foot pain levels (plantar fasciitis).

The normality test in this study was conducted using the Shapiro-Wilk test. The Shapiro-Wilk test was used because the number of subjects was less than 50. Results on the data normality test for Pre-test and Post-test, significant results were obtained for the pre-test *p-value* of 0.011 and the post-test *p-value* of 0.010 so it can mean that the data is not normally distributed because the p-value < 0.05. So hypothesis testing is done using a nonparametric analysis test, namely the Wilcoxon test.

Hypothesis testing is used to determine whether or not there is an effect before and after using medial arch support on foot pain (plantar fasciitis) in pregnant women in Noborejo Salatiga Village. This study used the Wilcoxon hypothesis test because the

results of the normality test were not normally distributed. The following is a table of results from the Wilcoxon hypothesis test:

Table 3. Results of the Wilcoxon Signed Ranks Test Hypothesis Test (n = 20 pregnant women)

Variable		n
Pain		
Pretest-Posttest	*Asymp. Sig. (2-tailed)*	≤0.001

Based on the table above, the results of the pre-test - post-test hypothesis test on the NRS assessment using the Wilcoxon test showed a p-value of ≤0.001 (p<0.05), so the results can explain that there is an effect of using FMAS on foot pain (plantar fasciitis) in pregnant women. With this, the hypothesis of this study is accepted because there is an effect of using FMAS on foot pain (plantar fasciitis) in pregnant women.

DISCUSSION

This study aims to evaluate the effect of using Flexible Medial Arch Support (FMAS) on foot pain (plantar fasciitis) in pregnant women in Noborejo Village, Salatiga. This study selected 20 pregnant women with an age range of 22-41 years and a weight range of 60-90 kg. Pain levels before and after the intervention were measured using the Numeric Rating Scale (NRS), and the results showed a significant reduction in pain with an average decrease of 3.4 points.

Statistical analysis using the Wilcoxon test yielded a p-value of 0.000, indicating a significant effect of FMAS on reducing plantar fasciitis pain. The significant decrease in pain demonstrates that FMAS can effectively distribute pressure more evenly across the foot, particularly reducing stress on the plantar fascia and improving foot stability. By the research of Sutanto and Sidarta (2022) conducted research on 68 subject data in Tangerang Private Hospital and obtained the results of 81.1% of women with excessive body mass index (BMI) suffering from plantar fascitis showed that there was a relationship between BMI and plantar fasciitis pain aged 20-50 years (p=0.049).

Biomechanically, this is supported by the fact that overweight individuals experience changes in the plantar fascia due to prolonged weight-bearing on the heel area, which leads to reduced cushioning and structural support in the midfoot. These changes occur due to long-term exposure to body weight in the heel area of the foot which causes a decrease in cushioning protective capacity and tissue support in the foot area. Most of the respondents work as factory employees who stand for a long time during work.

Research by Khired et al. (2022) states that plantar fasciitis is a common and disabling condition with a considerable impact on a person's quality of life. Work that requires walking or standing for long hours and gastrocnemius muscle tension are the main risk factors for plantar fasciitis. The findings of this study support the initial hypothesis that FMAS use for two weeks significantly reduces plantar fasciitis-related pain in pregnant women.

This supports the objective of evaluating FMAS as an effective intervention for pain management during pregnancy. The reduction in pain is also consistent with findings from Yar (2022) which also found that the usage of orthoses in pregnancy can have a significant and positive role in uplifting the discomforts and pains. It is also suggested that orthosis can be prescribed during pregnancy, which can be a cost-effective and adequate means of intervention as it is identified that a handful of discomforts originate from biomechanical aspects and can be rectified by orthoses.

Theoretically, FMAS serves as an additional support mechanism for the medial longitudinal arch of the foot. It helps reduce pressure in the medial midfoot area, thereby relieving the load borne by the plantar fascia and promoting proper foot alignment. Research by Peng et al. (2022) demonstrated that orthotic devices with medial arch support help maintain the medial longitudinal arch, increase arch height, and promote more balanced pressure distribution during standing and walking.

These biomechanical improvements reduce peak plantar pressure and contribute to enhanced foot function. Pregnancy itself induces substantial physiological and biomechanical changes, such as increased body weight and anterior displacement of the body's center of gravity. These changes increase the load on the foot, especially the plantar fascia, which often results in pain. As stated by Alcahuz-Griñan et al. (2021) during pregnancy, weight gain overloads the knees, ankles, and feet, which increases pressure in the midfoot area.

During the second and, especially, the third trimester of pregnancy, the eversion of the ankle decreases, which heightens the anterior inclination of the pelvis and the external rotation of the hip. All phases of gait increase in duration and decrease in speed, altering stability and heightening the risk of falls. This can worsen the condition of plantar fasciitis. Medial arch support can also help improve walking patterns; the foot will not experience excessive pronation (inward rotation) or supination (outward rotation).

The use of medial arch support increases comfort by reducing pain and supporting the foot optimally, reduces foot fatigue that often occurs during pregnancy so that it feels more comfortable during activities, and improves the quality of life of pregnant women who can undergo daily activities better and enjoy pregnancy better. The study by Yar (2022) also supports these findings, indicating that consistently using arch support decreases foot discomfort during pregnancy. However, this study has some limitations. First, the relatively small number of subjects may limit the generalizability of the study.

Second, the researcher was unable to monitor the respondents' compliance in using the medial arch support every day, which might affect the level of comfort and effectiveness of daily activities that could affect the results of the study. For future research, it is recommended to use a larger sample and extend the monitoring period to ensure respondents' compliance. Further research can also explore the long-term effects of using FMAS on plantar fasciitis pain during and after pregnancy.

In conclusion, this study supports the hypothesis that the use of FMAS significantly reduces foot pain (plantar fasciitis) in pregnant women. By supporting the medial arch of the foot, reducing tension on the plantar fascia, and improving foot mechanics and walking patterns. This study shows that the use of FMAS can be an effective and simple intervention to reduce plantar fasciitis pain in pregnant women, improving their comfort and quality of life. This study has important practical implications for pain management in pregnant women, especially for those with plantar fasciitis.

CONCLUSION

Based on the results of a study conducted in Salatiga involving 20 pregnant women who frequently experienced foot pain (plantar fasciitis), the use of flexible medial arch support (FMAS) over a two-week was found to reduce pain complaints as measured by the Numeric Rating Scale (NRS). This supports the effectiveness of FMAS as a biomechanical intervention in helping manage plantar fasciitis during pregnancy. The flexible medial arch support works by providing structural reinforcement to the medial longitudinal arch of the foot, which helps redistribute pressure, enhance foot stability, and

reduce strain on the plantar fascia—a mechanism particularly beneficial during pregnancy when body weight and hormonal changes increase the risk of foot discomfort.

This study aligns with previous research and supports the hypothesis that proper foot support mechanisms can help reduce pain and improve comfort in pregnant women. Given the ongoing physical changes throughout pregnancy, consistent use of FMAS is important to provide continuous support. Suggestions for future research can expand the sample size, and study time and ensure consistent compliance with the protocol for using FMAS to strengthen the strength of the conclusions in this study.

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DECLARATION OF USE OF AI IN SCIENTIFIC WRITING

The authors declare that the use of artificial intelligence (AI) tools in the preparation of this manuscript, if any, has been disclosed transparently, including the name of the tool, its purpose, and the extent of its use. The authors take full responsibility for the accuracy, originality, integrity, and final content of the manuscript.

CONFLICT OF INTERESTS

The authors declare that there are no conflicts of interest that could have influenced the research, interpretation of the results, or publication of this manuscript.

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