

Design of an Ergonomic Delivery Chair “Adjustable Midwife Chair” to Enhance Midwives’ Comfort and Work Efficiency

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Abstract. *Maternal and child health is a key indicator of a nation's well-being, with midwives playing a vital role in delivery services. This study aims to design an ergonomic delivery chair, the “Adjustable Midwife Chair,” to enhance the comfort and safety of midwives during childbirth assistance. A descriptive quantitative approach using the Quality Function Deployment (QFD) method was applied, involving 20 midwives as respondents. Results indicate that the most important attributes are sturdiness (4.8), frame supporting comfort (4.75), and automatic locking mechanism (4.7). The House of Quality (HOQ) analysis identified material quality (27.4%), additional functions (24.3%), and supporting facilities (21.2%) as top priorities. Anthropometric analysis produced dimensions suited to Indonesian women, including seat height 42–50 cm, width 50 cm, backrest height 55–70 cm, and inclination 90°–120°, promoting ergonomic posture and work comfort. The final design yields a durable, safe, and ergonomic delivery chair supporting improved midwifery care quality.*

Keywords: *delivery chair, ergonomics, Quality Function Deployment, anthropometry, midwife*

I. INTRODUCTION

Maternal and child health is one of the key indicators in determining the overall health status of a nation. One of the main components in improving maternal and child health is midwifery care, which plays a crucial role in reducing the maternal mortality rate (MMR) and infant mortality rate (IMR) (Ministry of Health of the Republic of Indonesia, 2022). Midwifery services not only include antenatal examinations but also encompass labor, postpartum care, and newborn care, all of which require professional competence and skill.

The childbirth process can take place in hospitals or at midwives’ private practices, which also provide antenatal to delivery care

(Sulistiyawati, 2020). Considering that several regions in Indonesia remain difficult to access by medical doctors, the government has implemented an equal distribution program for health personnel to reach remote areas. This program aims to ensure that communities, especially in rural regions, have access to adequate healthcare services through midwives and nurses (Ministry of Health of the Republic of Indonesia, 2021).

In South Kalimantan, particularly in Banjarmasin City, there are numerous independent midwifery practices that play an essential role in providing maternal healthcare services to local communities (South Kalimantan Provincial Health Office, 2023). Midwives provide holistic care ranging from antenatal examinations, delivery assistance, to postnatal services. According to the Banjarmasin City Health Office, there have been 59 registered and licensed independent midwifery practices since 2020 (Banjarmasin City Health Office, 2024). This number indicates that private midwifery practices remain a primary choice for maternal and neonatal healthcare services among the local population.

One example is the Independent Midwifery Practice of Winda Maolinda, M.Keb., MM., located on Jl. Veteran Komp. A. Yani 2, Pengambangan Sub-district, East Banjarmasin. When the birthing chair used by midwives does not fulfill ergonomic

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and comfort standards, mothers may experience pain, particularly in the waist and shoulders, both during and after childbirth. Based on an interview with Midwife Winda Maolinda, M.Keb., MM., it was revealed that midwives' discomfort is also influenced by the use of non-ergonomic birthing chairs, which creates barriers to providing optimal care. This situation highlights the need to develop an ergonomic "Adjustable Midwife Chair", designed to enhance comfort and safety for midwives during labor assistance.

Childbirth is a physiological process that requires adequate facilities, including a birthing chair that ensures the mother's comfort and facilitates midwives' performance. Recent research shows that the use of upright birthing chairs increases maternal comfort, accelerates the labor process, and poses no negative impact on the newborn (Hacivelioglu et al., 2023). A literature review also emphasizes that various maternal positions, such as sitting or upright, influence labor duration, perineal integrity, and maternal satisfaction (Sari & Wahyuningsih, 2025).

From a design perspective, ergonomic birthing chairs can minimize midwives' musculoskeletal strain and discomfort resulting from improper seating posture (Lirag & Santos, 2021). Furthermore, methodological approaches such as Quality Function Deployment (QFD) allow product designs to be more user-oriented and aligned with customer needs (Wang et al., 2024). The physical environment, including birthing furniture, also contributes significantly to mothers' comfort and sense of security during labor (Nilsson et al., 2022).

However, most previous studies have focused mainly on maternal comfort or birthing positions, while research that integrates ergonomic considerations for midwives with user-centered design remains limited. Therefore, this study is essential to develop a birthing chair design that not only enhances maternal comfort but also supports midwives' efficiency and health through an ergonomic and participatory design approach.

Based on this background, the research question is: how can an ergonomic "Adjustable

Midwife Chair" be designed to support midwives' comfort and safety during childbirth? The objective of this study is to develop an ergonomic birthing chair design based on user needs, considering both the mother and the midwife, by applying the Quality Function Deployment (QFD) method and local anthropometric data. The results are expected to contribute to improving the quality of midwifery services, particularly in ergonomic delivery facilities, and serve as a recommendation for medical equipment developers and related institutions in promoting more comfortable, safe, and sustainable birthing environments.

II. RESEARCH METHOD

Research Type and Design

This study is a descriptive research employing a quantitative approach using the Quality Function Deployment (QFD) method. The QFD method was chosen to translate user needs (midwives) into the technical specifications of an ergonomic birthing chair, namely the "Adjustable Midwife Chair." The QFD analysis was conducted through the construction of a House of Quality (HOQ), which serves as a tool for identifying and prioritizing user requirements. The results of the HOQ analysis were then used as the foundation for designing the chair using AutoCAD and Fusion 360 software, ensuring that the final product adheres to ergonomic principles and meets the midwives' functional needs.

Research Location and Period

This research was conducted at the Independent Midwifery Practice of Winda Maolinda, M.Keb., MM., located at Jl. Veteran Komplek Ahmad Yani, Pengambangan Sub-district, East Banjarmasin, South Kalimantan, Indonesia. The location was selected due to its active midwifery services and the availability of birthing facilities relevant to the study. The research was carried out from May to July 2025, covering stages of data collection, needs analysis, and product design development.

Population and Sample

The population of this study consisted of all midwives operating independent practices in

Banjarmasin City. The research sample was determined using purposive sampling, selecting respondents based on specific criteria relevant to the research objectives. The criteria included midwives who actively run independent practices and have experience using birthing chairs during service. Based on these criteria, a total of 20 midwives were selected as research respondents.

Research Instruments

The instruments used in this study included:

1. An online questionnaire (Google Form) containing questions related to midwives' needs for birthing chairs.
2. A Level of Importance Table to measure how important each attribute of the birthing chair is for midwives.
3. A Level of Satisfaction Table to assess midwives' satisfaction with the birthing chairs currently in use.
4. A Technical Characteristics Table to translate user needs into technical design aspects.
5. The House of Quality (HOQ) as part of the QFD analysis to determine priority needs.
6. AutoCAD and Fusion 360 software as tools for designing an ergonomic birthing chair.

Data Collection Techniques

Primary data were collected through questionnaires distributed to 20 midwife respondents. The questionnaire covered aspects such as comfort, safety, ergonomic requirements, and chair functionality. In addition, short interviews were conducted with several respondents to strengthen the quantitative findings and provide contextual understanding.

Data Analysis Techniques

1. The data analysis was carried out through the following stages:
2. Recapitulating questionnaire results to identify midwives' needs.
3. Compiling Level of Importance and Level of Satisfaction Tables for each chair attribute.
4. Translating user needs into the Technical Characteristics Table.

5. Constructing the House of Quality (HOQ) using the QFD method to determine the primary priorities.
6. Conducting anthropometric analysis to determine chair dimensions suitable for Indonesian women using the 5th, 50th, and 95th percentiles.
7. Designing the ergonomic birthing chair using AutoCAD and Fusion 360 based on QFD and anthropometric analysis results.

Research Output

The output of this study is the design of an ergonomic, durable, and functional "Adjustable Midwife Chair" that meets midwives' needs during childbirth assistance. The final product consists of 2D and 3D design drawings developed using AutoCAD and Fusion 360, representing a model that supports comfort, safety, and ergonomic efficiency in midwifery practice.

III. RESULT AND DISCUSSION

Results of the Importance Level (Needs) Assessment of Midwives toward the "Adjustable Midwife Chair"

This section presents the research findings on the importance level (needs) of midwives regarding the "Adjustable Midwife Chair," obtained through questionnaires distributed to research respondents. The analysis aims to identify chair attributes considered most essential by midwives in supporting comfort during childbirth assistance. Figure 1 illustrates the **Importance Level (Needs) of Midwives toward the "Adjustable Midwife Chair."

Based on the analysis using the lollipop chart, a clearer picture was obtained regarding the ranking of consumer importance levels for the attributes of the "Adjustable Midwife Chair." The results show that the attributes with the highest importance scores are sturdy structure (4.8), followed by a frame that supports comfort (4.75), automatic locking mechanism (4.7), strong chair design (4.65), and comfortable size (4.6). These findings emphasize that consumers highly prioritize aspects of stability, safety, and basic

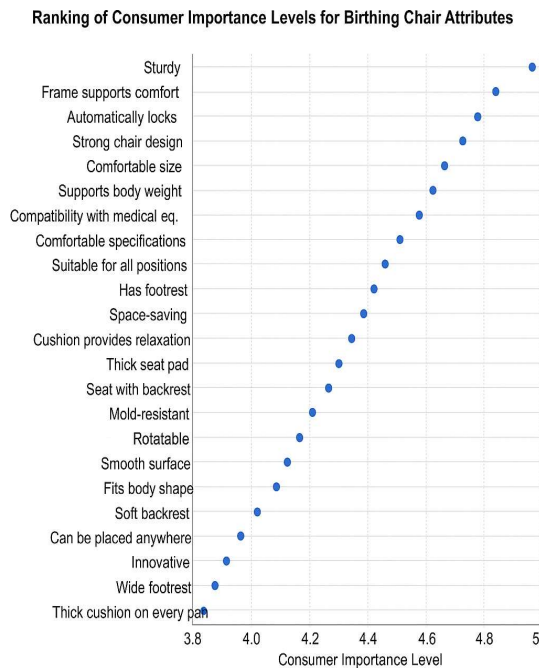


Figure 1. Importance Level (Needs) of Midwives toward the "Adjustable Midwife Chair"

comfort in choosing a delivery chair. These factors are crucial because the chair is used in critical situations, requiring guaranteed safety and product durability.

Furthermore, attributes with moderate importance levels fall within the score range of 4.3–4.55. These include compatibility with medical equipment, load-bearing capacity, comfortable size specifications, ability to be used in various positions, presence of footrests, and additional comfort features such as thick cushions and soft padding. This indicates that consumers also value flexibility and added comfort as supporting factors, although these are rated slightly lower than strength and safety factors.

On the other hand, several attributes occupy the lowest ranks with scores below 4.1, including trendy design, foldability, aesthetics, and natural color. This shows that aesthetic and visual design aspects are not the main priorities for consumers. Consumers tend to emphasize functionality, safety, and comfort over external appearance.

Overall, the results of this study reveal that consumers tend to prioritize functional and essential attributes, particularly those related to

safety, strength, and basic comfort of the delivery chair. The implication of these findings is that the development of delivery chair products should focus on improving material quality, structural strength, secure locking mechanisms, and basic user comfort. Aesthetic aspects may still be considered but should serve as an added value rather than a primary factor in consumer decision-making.

Calculation of Midwives' Satisfaction Level with the Delivery Chair

Based on the results of the Pareto Chart analysis of 29 adjustable delivery chair attributes, it was observed that the distribution of consumer satisfaction levels follows the Pareto principle (80/20 rule), where a small number of attributes contribute a large proportion to the overall satisfaction level. The Pareto Chart is shown in Figure 2.

Attributes with the highest scores—such as "sturdy" (4.8), "frame supporting comfort" (4.75), "automatic locking mechanism" (4.7), and "strong chair design" (4.65)—provide the most significant contribution to the total satisfaction score. When combined with other attributes such as "comfortable size" (4.6) and "compatibility with medical equipment" (4.55), approximately 20–25% of the top attributes account for more than 80% of the cumulative satisfaction contribution.

This finding indicates that durability, safety, and functional comfort are the dominant factors influencing user preferences. Conversely, lower-valued attributes such as "natural color" (3.8), "aesthetic appeal" (3.85), and "foldable feature" (3.9) contribute minimally to the overall satisfaction, suggesting that visual and aesthetic factors are secondary priorities for consumers.

Thus, the Pareto Chart indicates that product development strategies should focus on optimizing the key high-value attributes—namely strength, safety, and structural comfort—since improvements in these aspects will have the greatest impact on perceived quality and user satisfaction. Attributes with lower importance levels may still be considered as added value, rather than the main focus of innovation.

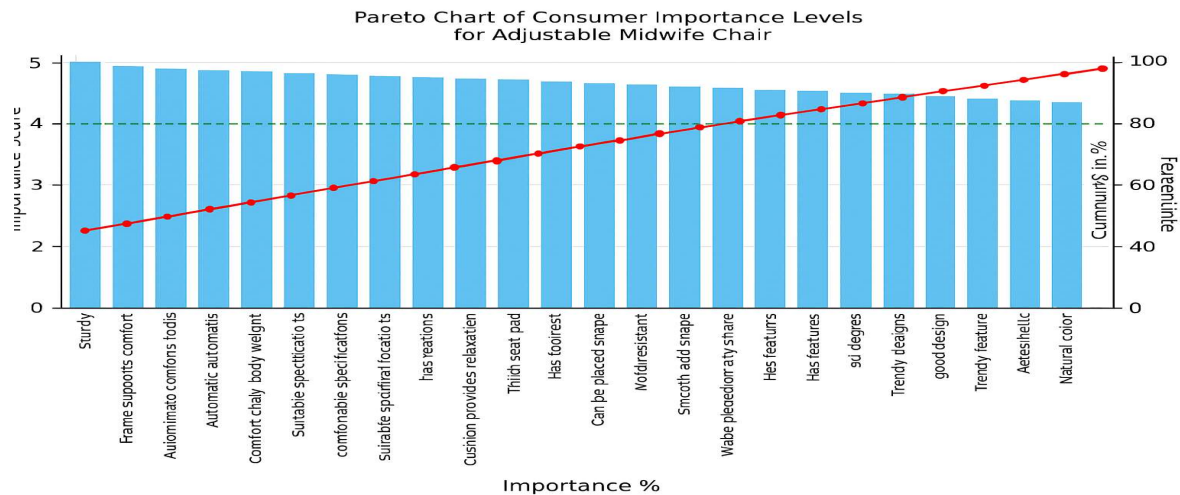


Figure 2. Pareto Chart of Consumer Importance Levels of Adjustable Midwife Chair

House of Quality (HOQ) Analysis

Through the House of Quality (HOQ) analysis, a clear overview of consumer priority needs in the design of the Adjustable Midwife Chair was obtained. The analysis results show that the chair material quality ranks highest with a score of 645.03 or 27.4% weight, making it the most crucial factor due to its direct relationship with safety, comfort, and durability.

Furthermore, consumers also place significant emphasis on additional functions (24.3%) and supporting facilities (21.2%), reflecting the need for flexibility and ease of use. Meanwhile, chair design (19.5%) and anthropometry (8.4%) remain important considerations, although their contribution is relatively smaller.

These findings affirm that fulfilling material quality and core functional aspects of the delivery chair will have the greatest impact on user satisfaction.

Product Development Analysis

The visualization results using the radar chart illustrate the differences in contribution among

the levels of technical difficulty, consumer importance, and estimated cost in designing the Adjustable Midwife Chair.

First, the chair design and additional facilities aspects occupy the most dominant positions on the technical difficulty indicator (highest score of 5) while also showing high estimated costs (26). This indicates that developing these two aspects requires more complex technical efforts and significant financial investment. However, both also rank relatively high in terms of importance (20–21), making them still worth prioritizing despite demanding greater resources.

Second, the material quality aspect stands out on the importance indicator (27), making it the top priority from the user's perspective. Interestingly, material quality only ranks at a moderate level of difficulty (3) and moderate cost (16), suggesting that this aspect is relatively easier to achieve efficiently. This finding reinforces the argument that development efforts should primarily focus on selecting safe, durable, and comfortable materials, as this can meet user needs without imposing excessive costs.

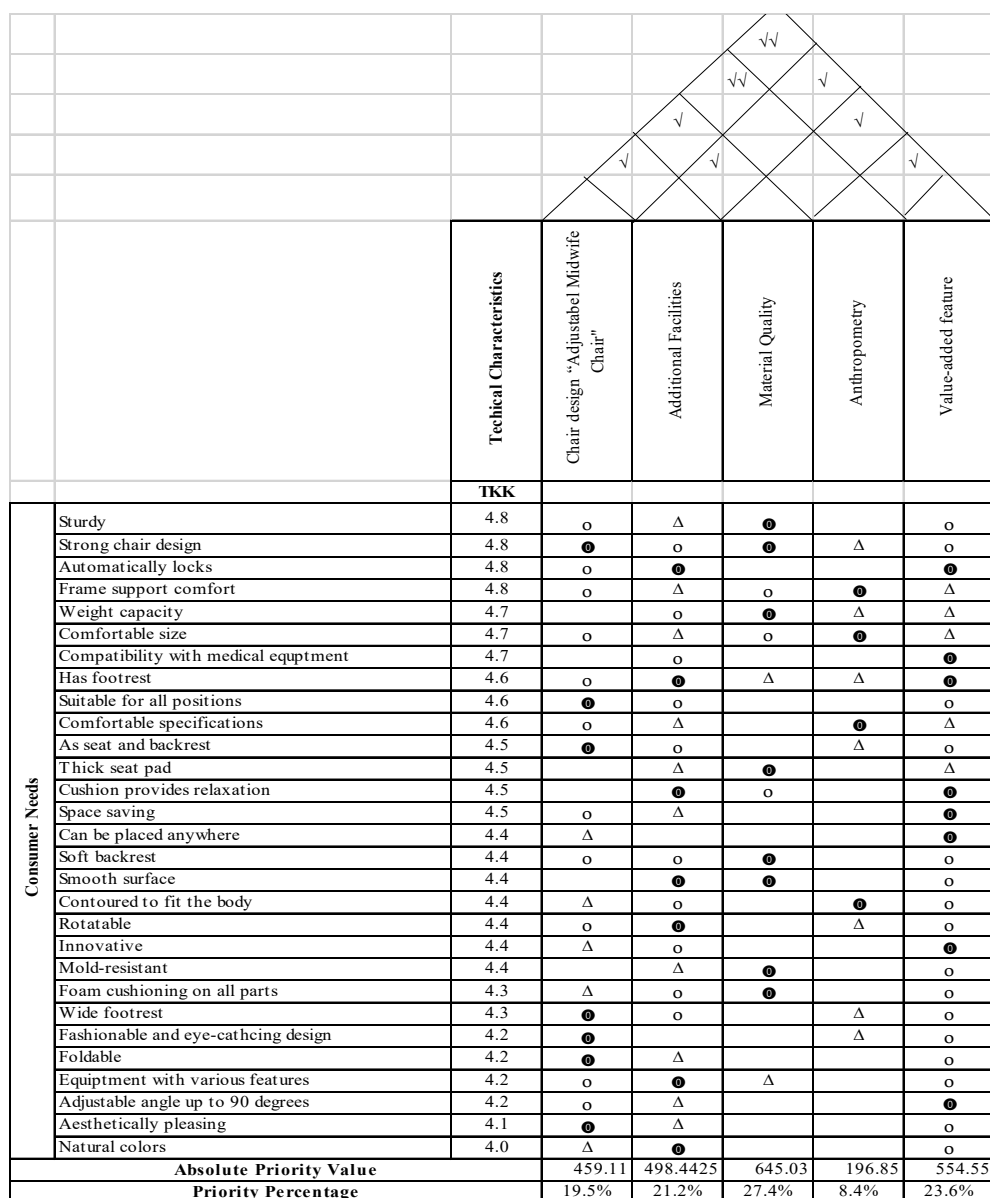


Figure 3. House Quality of the Ergonomic “Adjustable Midwife Chair”

Next, additional functions carry a fairly high importance score (24) with moderate levels of technical difficulty and cost (3 and 16). This suggests opportunities for feature innovation without significant financial risk. Conversely, anthropometric aspects show the lowest importance score (8), despite having low cost and difficulty (16 and 3). Nevertheless, this aspect remains crucial to ensure that the chair fits the body characteristics of birthing mothers and therefore must not be neglected in ergonomic design. Figure 3 shows the Radar Chart of the

Characteristics of the Delivery Chair (Adjustable Midwife Chair) as presented at Figure 4.

Overall, the radar chart demonstrates a trade-off between importance, cost, and difficulty. The most effective design strategy is to focus on material quality as the top priority, given its high importance but moderate cost and difficulty. Subsequently, chair design and additional features can be developed gradually while considering budget constraints and technical complexity.

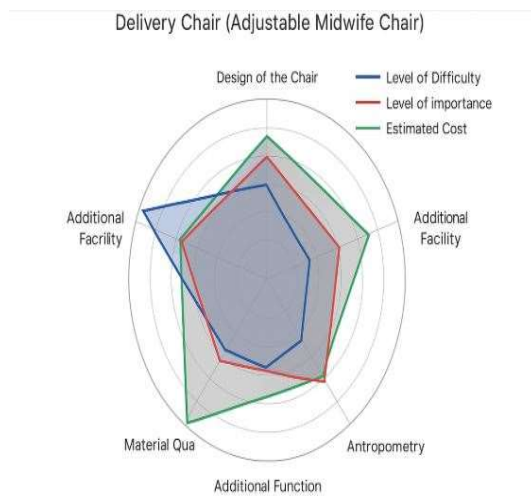


Figure 4. Radar Chart of the Characteristics of the Birthing Chair (Adjustable Midwife Chair)

Anthropometric Analysis

The anthropometric analysis of the Adjustable Midwife Chair design indicates that its dimensions have been adapted to the body characteristics of Indonesian women, ensuring ergonomic compliance. Table 1 shows the Anthropometric Analysis of the Adjustable Midwife Chair Delivery Chair.

The chair backrest, with a height range of 55–70 cm, provides optimal support for the back up to the scapular area, while the adjustable recline angle of 90°–120° allows for variations in body position according to the stage of labor. The addition of armrests at a height of 18–25 cm serves as support for the arms, reducing strain on the shoulder and upper back muscles. A footrest with a depth of 20–30 cm also supports an

ergonomic posture, particularly when the mother chooses a semi-squatting position. From a material perspective, the chair uses soft foam padding covered with antibacterial synthetic leather, designed to enhance comfort while maintaining hygiene in the delivery environment. Therefore, the design of this delivery chair can be categorized as compliant with anthropometric and ergonomic standards, expected to minimize fatigue, improve comfort, and support the effectiveness of the birthing process.

The Figure 5 shows the design result of the Adjustable Midwife Chair Delivery Chair.

The research findings indicate that the attributes most prioritized by midwives in using the delivery chair are chair strength (mean = 4.8), followed by frame comfort (mean = 4.75) and automatic locking mechanism (mean = 4.7). These attributes demonstrate that users place higher importance on stability, safety, and fundamental comfort rather than aesthetic or visual aspects. This aligns with the midwifery work context, which demands high safety and efficiency during labor, where the chair serves as a primary support tool for the mother's position and the midwife's comfort.

Through House of Quality (HOQ) analysis, the results show that material quality holds the highest weight at 27.4%, followed by additional functions (24.3%), supporting facilities (21.2%), chair design (19.5%), and anthropometry (8.4%). These findings suggest that the quality of materials and main functions of the chair contribute most significantly to user satisfaction. Strong, durable, and comfortable materials are considered crucial in supporting the midwife's

Table 1. Anthropometric Analysis of Midwife Chair

<i>Chair Component</i>	<i>Size (cm)</i>	<i>Adjustment Range</i>	<i>Functional Description</i>
<i>Seat Height</i>	45	42 – 50	<i>Adjusts to the mother's height during childbirth</i>
<i>Seat Depth</i>	45	Fixed	<i>Designed based on the average anthropometry of Indonesian women</i>
<i>Seat Width</i>	50	45 – 55	<i>Provides more comfortable movement space</i>
<i>Backrest Height</i>	60	55 – 70	<i>Supports the mother's back during delivery</i>
<i>Armrest Height</i>	20	18 – 25	<i>Serves as an arm support for comfort</i>
<i>Footrest</i>	25 (depth), 10 (height)	20 – 30 (depth)	<i>Helps maintain an ergonomic leg position</i>
<i>Backrest Inclination</i>	–	90° – 120°	<i>Adjustable according to the stage of labor</i>



Figure 5. Ergonomic Adjustable Midwife Chair

work safety and the mother's comfort during labor.

This research aligns with the findings of Hacivelioglu et al. (2023), who stated that the use of an upright birthing chair can improve maternal comfort and accelerate labor without causing negative effects on the baby. Furthermore, Ahmar et al. (2025) emphasized that variations in birthing positions, such as sitting or upright, significantly affect labor duration, perineal integrity, and maternal satisfaction. Therefore, a chair with adjustable height and backrest angles can provide optimal flexibility for midwives in positioning mothers according to the stage of labor.

From an ergonomic perspective, the findings support the studies of Lirag and Santos (2021) and Borres and Javier (2019), which stated that non-ergonomic chair designs can cause musculoskeletal disorders, particularly in the back, shoulders, and neck areas. In this study, the chair design considered the anthropometric dimensions of Indonesian women to match local user proportions. The main dimensions established include seat height (42–50 cm), seat depth (45 cm), seat width (50 cm), backrest height (55–70 cm), and backrest recline angle (90°–120°). These dimensions are based on the 5th, 50th, and 95th percentiles, enabling the chair to accommodate most body size variations and uphold ergonomic principles.

Anthropometric analysis also shows that the chair design meets the principles of working comfort, with an adjustable backrest to fit body posture and a footrest that helps maintain balance for the mother. These findings are consistent with Oyama et al. (2022), who

highlighted the importance of body pressure distribution and pelvic positioning in preventing work fatigue in professions involving prolonged sitting. Additionally, the Chair Design and Human Factors Study (2023) explained that alignment between user height and chair dimensions reduces muscle strain and enhances postural efficiency.

From a methodological perspective, applying Quality Function Deployment (QFD) in this research proved effective in translating user needs (midwives) into technical product characteristics. This approach, also used by Wang et al. (2024) and Liu et al. (2023) in ergonomics-based product development, emphasizes the importance of the voice of the customer in determining design priorities. Thus, the QFD approach in this study successfully produced a delivery chair design that is user-centered and balances functionality, safety, and comfort.

Overall, the results indicate that the development of the "Adjustable Midwife Chair" has the potential to enhance the quality of midwifery services by improving both midwives' working comfort and mothers' birthing comfort. The chair is designed not only as a functional tool but also as an ergonomic support system that promotes movement efficiency and labor safety. The practical implications of this study suggest that delivery chair design should focus on improving material quality, position adjustability, and anthropometric compatibility. Therefore, this product can serve as a recommendation for medical device developers, midwifery education institutions, and healthcare facilities to create ergonomic, safe, and sustainable medical equipment.

IV. CONCLUSION

The design of the "Adjustable Midwife Chair", developed through the integration of QFD, anthropometry, and ergonomics, demonstrates that material quality, additional functions, and supporting facilities are the primary priorities based on user needs. Meanwhile, the chair dimensions were adapted to fit Indonesian women's body proportions (seat height: 42–50 cm; seat width: 50 cm; backrest height: 55–70 cm; recline angle: 90°–120°). These adjustments enhance comfort, positional flexibility, and reduce muscle fatigue. The findings align with previous studies highlighting the importance of anthropometric-based design to improve comfort, safety, and body efficiency, making this chair a potential ergonomic solution to support smoother delivery processes.

Future research is recommended to conduct field testing to evaluate the comfort and safety of the chair for mothers during labor, as well as to develop designs integrating medical technologies such as position sensors, more durable antibacterial materials, and flexible modular structures. Additionally, expanding anthropometric data will allow for more universal usability, ensuring that the product is not only ergonomic but also innovative, hygienic, and aligned with the needs of modern midwifery practice. Top of Form

V. ACKNOWLEDGE

The author would like to express sincere gratitude to the research team, as well as to Sari Mulia University for funding support through this internal grant, and to the Indah Banjarmasin Foundation for their contribution and assistance.

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