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Anthropometric-Based Preliminary Design of an Ergonomic Breastfeeding Chair for Postpartum Mothers: A Descriptive Study

Mufdlilah[1], Reza Bintangdari Johan[2], Enny Fitriahadi[3], Yekti satriyandari[4]

[1,3,4]Faculty of Health Sciences, Midwifery Study Program, Universitas Aisyiyah Yogyakarta, Indonesia
[2]Diploma III of Midwifery Program, Faculty of Health Sciences, Universitas Borneo Tarakan, Indonesia
Corresponding author: mufdlilah@unisayogya.ac.id

ABSTRACT

Background: Breast milk is the best food for both containing nutrients needed by babies to grow and develop, therefore it is important to provide exclusive breastfeeding to newborns up to six months of age. However, incorrect breastfeeding positions and unsuitable breastfeeding chairs for breastfeeding mothers often cause pain and discomfort during or after breastfeeding. This condition can cause musculoskeletal disorders for mothers.
Purpose: This study aimed to apply anthropometric measurements of postpartum mothers to inform the preliminary design of an ergonomic breastfeeding chair.
Methods: The research method is descriptive study. The sample in this study consists of 30 postpartum mothers in the hospital. The instrument used in this study was an anthropometric measurement sheet which was carried out to measure the physical dimensions of the design. Data analysis used percentile value.
Results: The results of the study obtained were a prototype chair according to body dimensions with a chair width 52.61 cm (95^{th}), chair length 46.66 cm (5^{th}), backrest width 52.53 cm (95^{th}), seat back 83.83 cm (50^{th}), chair height 48.90 cm (50^{th}), armrest height 60.70 cm (50^{th}), and, armrest length 26.90 cm (50^{th}).
Conclusion: The dimensions of the chair can be used as a basis for designing a breastfeeding chair and are in accordance with ergonomic aspects. A comfortable and ergonomic breastfeeding chair can make it easier for mothers to adjust their position while breastfeeding their babies.

Keywords: *Model development; breastfeeding chair prototype; ergonomic; anthropometric; breastfeeding*

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BACKGROUND

Breastfeeding is the activity of giving breast milk to a child directly without using a pacifier or bottle. Every child has the right to receive breast milk from birth to six months of age and then continue until the age of two years. Breast milk is the best source of nutrition for babies that contains substances needed for growth and development (Shah et al., 2021). Breastfeeding can reduce stress and anxiety in mothers (Handayani et al., 2025). Breastfeeding can also affect the mother's mood, stress, and care (Castro et al., 2025).

Breastfeeding can provide various benefits for the mother's health, however, mothers must also pay attention to their position when breastfeeding so that they can get the benefits of breastfeeding perfectly. When breastfeeding, mothers tend to move their necks and backs forward, not leaning on the chair. In addition, mothers often bend over to breastfeed their babies so that this position puts pressure on the joints, ligaments, and muscles (Gumasing et al., 2019). Because of this action, incorrect positioning can cause pain in the lower back and neck. Breastfeeding mothers usually bend over for long periods; this can disrupt the mother's comfort and the breastfeeding process. To reduce this risk, an ergonomic and comfortable position is necessary.

Prolonged sitting while breastfeeding can also cause back pain, so a comfortable and ergonomic sitting position is needed by paying attention to lumbar support (Sharma & Roopa, 2024). Research conducted by Rani, et al, breastfeeding mothers who experience neck pain are 36.8% and lower back pain is 22.0% (Rani et al., 2019). There are seven criteria for the correct position when breastfeeding, namely a comfortable and relaxed position, sitting upright and supported by a good chair back, sitting position facing forward and flat lap, baby's neck straight or slightly bent back and body straight, baby's body facing the mother, baby's body is close to the mother's body and facing the mother's breast, and the mother supports the baby's entire body (Nduagubam et al., 2022).

Sitting is how most Indonesians breastfeed their babies. because it is more feasible. The same as the research of Prima, et al., most mothers prefer to breastfeed while sitting on a chair (Prima et al., 2020). Although practical, the chair facilities that exist so far for breastfeeding mothers are not ergonomic and cause discomfort. This condition can interfere with the process of breast milk production because the mother gets tired easily, has pain in the neck, back, and waist. Therefore, it is necessary to pay attention to ergonomics in designing chairs for breastfeeding mothers. Ergonomic chairs can reduce the risk of pain, soreness, and fatigue (Santhosh & Malavika, 2019). The mother can feel more comfortable and be able to breastfeed for longer if she adopts an ergonomic position.

Several studies on ergonomic chairs have been conducted. An ergonomic breastfeeding chair can enhance comfort, improve good posture, and reduce the risk of injury (Gumasing et al., 2019). Identify the design specifications of an ergonomic

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breastfeeding chair by measuring the anthropometry of breastfeeding mothers while seated This ergonomic breastfeeding chair has pedals and footrests that reduce hand pressure when you are holding your baby (Rahayu et al., 2024). Howover, no study exists on the initial design of ergonomic chairs that accounts for the anthropometric dimensions of postpartum mothers.

OBJECTIVE

This study aimed to apply anthropometric measurements of postpartum mothers to inform the preliminary design of an ergonomic breastfeeding chair.

METHODS

The design study was quantitative and descriptive, focusing solely on the physical characteristics and dimensions of the initial breastfeeding chair design as determined by anthropometric measurements. This study involves 30 postpartum mothers at the Ibu dan Anak Bantul Hospital Yogyakarta. The sample was taken through purposive sampling according to the inclusion criteria. Inclusion criteria consist of a history of normal delivery or cesarean section, postpartum on the second day, and being physically and mentally healthy. Meanwhile, the exclusion criteria are that the baby does not have any abnormalities or disabilities. This study took place from May to July 2021. Data collection was conducted by measuring the anthropometry of breastfeeding mothers, which included hip width, buttock-popliteal length, shoulder width, sitting height, popliteal height, sitting elbow height, and setting elbow length. This data was used as a reference in determining the dimensions of the chair parts were Chair width, chair length, backrest width, seat back, chair height, chair height, armrest height, and, armrest length.

The initial chair design uses anthropometric data, with postpartum mothers' body measurements taken using standard anthropometric measuring tools. All anthropometric measurements were taken in a sitting position while breastfeeding, and then their dimensions were measured. Anthropometric data underwent normality tests, data uniformity tests, data adequacy assessments, and percentile calculations. The normality test is used to determine whether the collected data is normally distributed or not, and the normality test is conducted using the Kolmogorov-Smirnov test with a p-value > 0.05, which means the data is normally distributed (Habibzadeh, 2024). Data homogeneity is conducted to determine whether the obtained data is already in a controlled state or not. Controlled data is data that falls within the Upper Control Limit (UCL) and Lower Control Limit (LCL) (Habibzadeh, 2024). Meanwhile, data sufficiency is used to determine whether the amount of data obtained meets the required number of observations by knowing the value of N'. S Next, the percentile calculation to show the percentage of the size, namely the 95th percentile, the 50th percentile, and the 5th

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percentile (Fitri et al., 2021). Normality, homogeneity, and sufficiency tests in anthropometric measurements aim to ensure that the collected data can be used to design ergonomic chairs suitable for various body sizes and enhance comfort. Analysis of anthropometric data using mean, minimum, maximum, standard deviation, 5th percentile, 50th percentile, and 95th percentile (Fitri et al., 2021). Tethics committee of Universitas 'Aisyiyah Yogyakarta has approved this study (No. 1847/KEP-UNISA/VII/2021).

RESULTS

Table 1. Normality Test of Postpartum Mothers Body Dimension

Dimension	N	Mean (cm)	SD	Kolmogorov-Smirnov Z	*P-value**
Hip width	30	46.63	3.63	1.090	0.186
Buttock-politeal length	30	52.40	3.49	0.615	0.844
Shoulder width	30	48.13	2.67	0.679	0.745
Sitting height	30	83.83	5.04	0.658	0.779
Popliteal height	30	48.90	2.19	1.057	0.214
Sitting elbow height	30	60.70	3.21	1.021	0.248
Sitting elbow length	30	26.90	2.01	1.131	0.155

* Test distribution is normal *p-value* >0.05; SD = Std. Deviation

This study involves 30 postpartum mothers on the second day. Anthropometrically measured postpartum mothers to determine the initial dimensions for the breastfeeding chair design. The dimensions measured are hip width, buttock-popliteal length, shoulder width, sitting height, popliteal height, sitting elbow height, and sitting elbow length. To design the chair, the mean value measurement provides a measure of the data's central tendency. Each dimension has been measured with the following mean values are hip width (46.63 cm), buttock-popliteal length (52.40 cm), shoulder width (48.13 cm), sitting height (83.83 cm), popliteal height (48.90 cm), sitting elbow height (60.70 cm), and sitting elbow length (26.90 cm). The standard deviation was calculated to provide a measure of the dispersion of the average data. The standard deviation values are hip width (3.63 cm), buttock-popliteal length (3.49 cm), shoulder width (2.67 cm), sitting height (5.04 cm), popliteal height (2.19 cm), sitting elbow height (3.21 cm), and sitting elbow length (2.01 cm). The mean and standard deviation are required to determine the dimensions of body measurements and to provide the foundation for normalcy tests when designing ergonomic chairs. The results show that all dimensions are normally distributed (P-value > 0.05). This means that all postpartum mothers have body sizes close to the (table 1).

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Table 2. Results of Data Homogeneity Test and Data Sufficiency from Respondent's Anthropometric Data

Dimensions	N	Mean	SD	Min	Max	LCL	UCL	N'	Data Testing	
Hip width	30	46.63	3.63	41	53	39.36	53.90	9.39	Homogeneous	Sufficient
Buttock-politeal length	30	52.40	3.49	47	58	45.42	59.38	6.86	Homogeneous	Sufficient
Shoulder width	30	48.13	2.67	43	52	42.78	53.48	4.78	Homogeneous	Sufficient
Sitting height	30	83.83	5.04	74	97	73.76	93.91	5.59	Homogeneous	Sufficient
Popliteal height	30	48.90	2.19	46	55	44.53	53.27	3.09	Homogeneous	Sufficient
Sitting elbow height	30	60.70	3.21	54	69	54.29	67.21	4.31	Homogeneous	Sufficient
Sitting elbow length	30	26.90	2.01	24	30	22.89	30.91	8.60	Homogeneous	Sufficient

* LCL = Lower Control Limit; UCL = Upper Control Limit

The next step involved measuring all dimensions to ensure homogeneity and data sufficiency. Homogeneity helps in determining whether data points are within control limits. Every anthropometric dimension that has been assessed has consistent data and is within normal control ranges, with each measurement falling between the upper and lower control limits. Moreover, a data sufficiency test was conducted; for each dimension, the number of data N is greater than the number of data N' (30 > N'), so all data are declared sufficient (Table 2). Thus, it is suitable for further analysis, namely percentile calculation. The percentile sizes used are the 5th for the lower percentile, the 50th for the average percentile, and the 95th for the upper percentile.

Table 3. Percentile Calculation of Postpartum Mother Body Dimension

Dimensions	Explanation	Percentile		
		5^{th} (cm)	50^{th}(cm)	95^{th}(cm)
Hip width	Chair width	40.66	46.63	52.61
Buttock-politeal length	Chair length	46.66	52.4	58.14
Shoulder width	Backrest width	43.73	48.13	52.53
Sitting height	Seat back	75.54	83.83	92.12
Popliteal height	Chair height	45.30	48.90	52.50
Sitting elbow height	Armrest height	55.42	60.70	65.98
Sitting elbow length	Armrest length.	23.60	26.90	30.2

Determination to provide comfort levels for your Chair users, it is necessary to add percentiles to each seat dimension (Table 3) :

a. Chair width

The width of the seat was determined by the dimensions Hip width. Hip width measured from the outer right hip to the outer left hip in an upright sitting

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condition. The 95th used was 52.61 cm. It was expected that the dimensions can accommodate breastfeeding mothers with the largest hip size so that all parts of the hip can be accommodated and feel comfortable.

b. Chair length

The length of the chair was determined by the dimensions of the buttock-popliteal depth.The buttock-popliteal depth was measured from the inner knee to the buttocks horizontally in an upright sitting position (Afshariani et al., 2019), These dimensions were mostly for designing chairs including KORSIMU. The 5th used was 46.66 cm. It was expected to be able to accommodate breastfeeding mothers with both calves attached to the surface of the chair to the inside of the knee in a comfortable condition.

c. Backrest width

The width of the seatback was determined by the dimensions of the shoulder width. Shoulder width measured from the outermost side of the right arm to the outer part of the left arm in sitting or standing upright conditions. The percentile used was 95th (52.53 cm). It was expected that the dimensions can accommodate breastfeeding mothers with the largest new size so that all dimensions of the population can be accommodated and feel comfortable.

d. Seat back

The seat back was determined by the dimensions of the sitting hight. The sitting hight measured from the buttocks to the very tip of the head in an upright sitting position. The 50th used was 83.83 cm. It was expected that breastfeeding mothers can accommodate from the back to the head, both small and medium dimensions.

e. Chair height

The seat height was determined by the dimensions Popliteal height. The popliteal height was measured from the floor surface to the deepest part of the knee in an upright sitting condition. These dimensions were mostly for designing chairs including KORSIMU. The 50th used was 48.90 cm. It was expected that the dimensions can accommodate breastfeeding mothers with both calves attached to the surface of the chair to the inside of the knee in comfortable conditions.

f. Armrest height

Armrest height was determined by the dimensions sitting elbow height.The sitting elbow height was measured from the top of the floor to the bottom of the hand in an upright sitting position. The 50th used was 60.70 cm. It was expected to be able to accommodate breastfeeding mothers with free hands resting in an upright sitting position. The armrest is not high, this causes the

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shoulders to lift causing pain in the shoulders and neck (Santhosh & Malavika, 2019).

g. Armrest length.

The length of the seat armrest was determined by the dimensions of the sitting elbow length. Sitting elbow length was measured from wrist to elbow, in sitting or standing upright conditions. The 50th used was 26.90 cm. It was expected that the dimensions can accommodate breastfeeding mothers with the largest new size so that all dimensions of the population can be accommodated and feel comfortable.

Tabel 4. Breastfeeding Chair (KORSIMU) Measurement

Dimensions	Explanation	Percentile	Size (Cm)
Hip width	Chair width	95th	52.61
Buttock-politeal length	Chair length	5th	46.66
Shoulder width	Backrest width	95th	52.53
Sitting height	Seat back	50th	83.83
Popliteal height	Chair height	50th	48.90
Sitting elbow height	Armrest height	50th	60.70
Sitting elbow length	Armrest length.	50th	26.90

Table 4, The results of the percentile calculations are that the chair design uses the specified dimensions, where chair width is 52.61 cm (95th), chair length is 46.66 cm (5th), backrest width is 52.53 cm (95th), seat back is 83.83 cm (50th), chair height is 48.90 cm (50th), armrest height is 60.70 cm (50th), and armrest length is 26.90 cm (50th). These anthropometric dimension measurements can be used to design breastfeeding chairs.

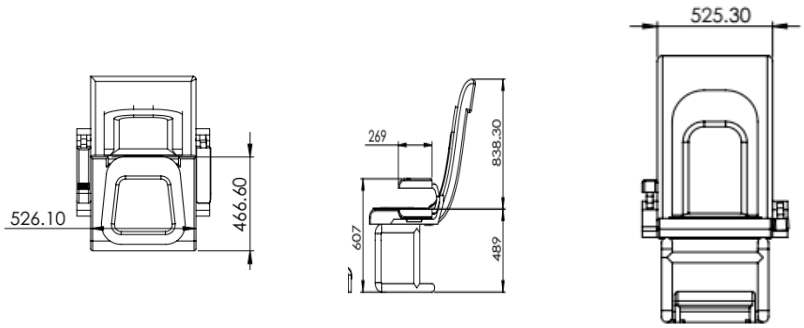

Figure 1. Preliminary Design of an Ergonomic Breastfeeding Chair

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DISCUSSION

An ergonomic breastfeeding position can affect the breastfeeding process. The design of an ergonomic chair must consider the anatomical and biological perspectives of the breastfeeding process (Santhosh & Malavika, 2019). The process of breastfeeding is an important part of a baby's life, providing the necessary nutrition for the baby's growth and development. Breastfeeding is the process of providing breast milk to a baby directly through the breast. (Kalarikkal & Pfleghaar, 2023). However, problems when the mother is about to start breastfeeding and during breastfeeding, causing the failure of breastfeeding is mothers feel that breast milk production is lacking. Feelings of perceived insufficient milk are the condition of mothers who feel that their milk is not sufficient for the needs of their babies (Santhosh & Malavika, 2019).

Another common complaint among breastfeeding mothers is discomfort in the neck, shoulders, elbows, wrists, and back due to poor posture. The cross-cradle hold is the most commonly used position while breastfeeding, and this is related to the discomfort that often arises (Irfan et al., 2023). Breastfeeding in a sitting position can put pressure on the back and neck muscles, with chair height not matching body posture and feet not placed on the floor and not flat. So that sitting upright and using supports in the arm or back and leg areas can provide balance and comfort for the mother (Afshariani et al., 2019). An ergonomic position while breastfeeding can enhance the mother's comfort and help her increase the duration of breastfeeding Sharma & Roopa, (2024) therefore, an ergonomic chair that considers the body's anthropometric dimensions is needed to assist the mother in a sitting position, providing comfort and reducing the risk of pain and injury during or after breastfeeding.

Anthropometry is a branch of ergonomics related to the measurement of human body dimensions that can be used as a basis for designing ergonomic facilities. Anthropometry essentially pertains to the dimensions of human body functions, including linear measurements, weight, volume, range of motion, and others (Prasetiyo & Budiyanto, 2020). The results of ergonomic anthropometric measurements can help create comfort, safety, well-being, and suitability and reduce musculoskeletal disorders (Silviana et al., 2022). Ergonomically, anthropometry is used as a basis for preparing a space to provide comfort (Hutabarat et al., 2023). Anthropometric measurements are conducted to assess the size, shape, and composition of the human body. Designing chairs using anthropometric and ergonomic approaches can improve work efficiency, minimize lower back pain, and reduce musculoskeletal disorders (Fitrianto et al., 2025).

Results of the study of the anthropometric measurements used are based on the 5th to 95th percentile values, with the anthropometric dimensions being chair width, chair length, backrest width, seat back, chair height, chair height, armrest height, and armrest length (table 4), relevant and can be used as initial design measurements for a chair for

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mothers when breastfeeding their babies in a sitting position. Same as the research Gumasing, et al., The size of the chair from an anthropometric aspect must be considered, including hands, feet, soles, back, and waist, to assess stability because this is a determinant of the success of an ergonomic chair design (Gumasing et al., 2019). The anthropometric dimensions measured are bench surface height, bench depth and width, backrest width and height, backrest angle, desk height, desk depth, width, and desk angle (Silviana et al., 2022).

The design of this chair also includes armrests and a backrest (Figure 1). Primagung's research on armrests, adjustable footrests, head support cushions for babies, headrests, foam cushions, adjustable backrest angles, and wheels are important features in designing an ergonomic breastfeeding chair to meet the needs of breastfeeding mothers (Prima et al., 2020). Moreover, the position of the neck, back, arm support with a pillow, and footrest are very important during breastfeeding (Widiastuti et al., 2020). Therefore, each dimension must be adjusted to the condition and sitting posture while breastfeeding. This study also takes body posture into account. The chair is designed to maintain a neutral position while the mother is breastfeeding. Neutral posture is a position where the body is aligned and balanced, maintaining the joints in harmony while sitting or standing. During breastfeeding, this neutral position allows the mother to keep her position close to the center of gravity, thereby minimizing the risk of discomfort and pain during or after breastfeeding.

Body posture is greatly influenced by the design and dimensions of the chair, so it is necessary to pay attention to appropriate anthropometric measurements to produce an ergonomic chair (Mohamaddan et al., 2022). An ergonomic chair is highly needed for mothers when breastfeeding their babies in a sitting position to enhance comfort and support for the mother during breastfeeding, thereby reducing back pain caused by prolonged breastfeeding in a sitting position (Santhosh & Malavika M D, 2019). Therefore, anthropometric dimension measurements are used to determine the appropriate size of the chair parts to provide comfort while breastfeeding and assist the mother in the breastfeeding process. However, the limitations in this study highlight the need for further development of the breastfeeding chair design by involving a larger sample size and longer observation and clinical testing periods to refine the chair design.

CONCLUSION

Postpartum breastfeeding mothers and women who have undergone cesarean section have different sizes and shapes, namely small, medium, and large based on the average percentile. The results of this study obtained a chair prototype according to the standard size required for the comfort of breastfeeding mothers by considering ergonomic aspects. The chair prototype fits the body dimensions with a Chair width 52.61 cm (95^{th}),

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chair length 46.66 cm (5th), backrest width 52.53 cm (95th), seat back 83.83 cm (50th), chair height 48.90 cm (50th), armrest height 60.70 cm (50th), and, armrest length 26.90 cm (50th). The backrest is adjusted to the width of the head to prevent back and waist fatigue for comfort, and the armrest chair is adjusted to prevent fatigue when holding the baby while breastfeeding so that the baby does not fall. The ergonomic parameters in this study can be used to design an ergonomic breastfeeding chair to improve comfort, reduce back pain issues, and alleviate musculoskeletal disorders while breastfeeding in a sitting position.

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