

Ergonomic Maternity Chair Heat Pillow Thermotherapy on the Labor Pain of First and Second Labor Stages

¹*Bilqis Ar-Rohman, ²Runjati, ³Djamaluddin Ramlan

¹Master of Applied Midwifery, Ministry of Health Polytechnic Semarang, Central Java, Indonesia

²Department of Midwifery, Ministry of Health Polytechnic Semarang, Central Java, Indonesia

³Department of Environmental Health, Ministry of Health Polytechnic Semarang, Central Java, Indonesia

*Corresponding Author's E-mail: bilqisarohman10@gmail.com

Abstract - Labor pain must be felt very uncomfortable in almost all women. If this is not handled, other problems will arise that can increase complications such as fatigue, anxiety, old partus until it has to lead to surgery. Efforts are needed to empower women and develop methods to reduce labor pain. Through the selection of labor positions vertically and heat therapy methods facilitated by ergonomic delivery chairs, heat pillow thermotherapy, it is expected to help reduce pain sensations so that labor can be made more comfortable for maternity mothers. In this analysis a comparison of the effect of ergonomic maternity chair heat pillow thermotherapy on the pain intensity and duration of labor pain of first and second labor stages. The Results of this study show that pain intensity score in second stages (4,60) was significantly lower than in first labor stages (4,95) ($p=0,000$). In addition, there was a statistical difference in the duration of pain between the first stage (23,20) seconds which was lower than the second labor stages (28,45) ($p=0,005$). The use of ergonomic maternity chair heat pillow thermotherapy chairs with a temperature of 38° C - 44° C for 30 minutes has an effect on reducing pain intensity and duration of labor pain of first and second labor stages.

Keywords: Ergonomic Maternity Chair, Heat Pillow Thermotherapy, Labor Pain.

I. INTRODUCTION

This labor process brings discomfort and malaise to all women, this is caused one of them by labor pain.⁽¹⁾ This discomfort stems from several factors, including physical fatigue, psychological impact, and other factors. If left untreated, this can lead to new problems such as excessive fatigue or running out of energy, which will eventually affect the duration of labor. Several other factors that play a role, such as the psychological condition of the mother and the position of labor, also affect the mother's health during labor.^{(2),(3)} Various efforts have been made to reduce maternal morbidity or mortality during childbirth. One of them is an initiative from the World Health Organization (WHO) that

develops evidence-based strategies to reduce maternal mortality through approaches that can end preventable material mortality (EPM). This approach involves comprehensively empowering women to ensure universal access to maternal health care during childbirth.⁽⁴⁾ In 2020, there were an estimated 287,000 deaths in women during pregnancy and childbirth worldwide, with 95% of these occurring in low- and middle-income countries.⁽⁵⁾ In 2021, Indonesia recorded 7,389 cases of maternal death, which is still dominated by several main causes of triple death and other causes of maternal death. The distribution of maternal deaths on the island of Java, especially in West Java, reached 1,204 cases in 2021.⁽⁶⁾ Similar things were recorded at the Garut Regency Health Office on the *Maternal Neonatal Death Notification* Application in 2022, with a total of 57 cases of maternal deaths.⁽⁷⁾ In Indonesia, maternal deaths often occur during childbirth and soon after. One of the complications that arise is if this condition is not treated properly at the time of labor, it can cause labor complications, such as old partus which occurs in 35% of cases. Complications that arose from prolonged partus included 31% experiencing excessive fatigue, 12% undergoing elective cesarean section, and 20-33% of women experiencing labor complications, with 45% experiencing severe pain and anxiety.⁽⁸⁾ Indonesian Basic Health Research (RISKESDAS) in 2018 reported that childbirth by *cesarean section* (SC) method in Indonesia reached 17.6% of the total number of deliveries.⁽⁹⁾ This shows that the prevalence of selecting the type of delivery by *cesarean sectio* method in Indonesia exceeds the ideal value set by the World Health Organization (WHO), which is around 10-15%.⁽¹⁰⁾

Some of the problems that arise include lack of bed ergonomics, ineffective labor position, difficulty in applying pressure when straining due to lack of energy, complaints of fatigue during labor, back aches, labor pain, and also aspects of discomfort for midwives who help labor while working or assist in the labor process. Alternative solutions are needed that can be adopted by midwives in monitoring women's reproductive cycles, especially during childbirth. One way this can be done is by empowering women during labor, which is

in line with the view that childbirth is a physiological process. One concrete step is to provide quality services and based on scientific evidence through the application of vertical or upright positions during labor. The consideration of using the vertical birthing position is in accordance with recommendations from the WHO issued in 1996, this approach is also in line with the physical principles of gravity that remain consistent.⁽¹¹⁾ The required position refers to the gravitational force of the earth, which involves aortocaval compression to help better promote intrauterine circulation and prevent ischemia in the uterus.⁽¹²⁾ This sitting labor position is facilitated by health workers through the use of ergonomic maternity chairs.^{(13), (14), (15), (16)}

Evidence related to ergonomic maternity chairs previously designed by Ministry of Health, Semarang Health Polytechnic "The Effect of Use of Ergonomic Childbirth Chair in the Period of Second Stage of Labor in Primipara" shows interesting results. In this study, it was found that the use of ergonomic maternity chairs significantly shortened the duration of labor by 35.4 minutes.⁽¹⁷⁾ Certainly, the development of innovations in maternity chair research has brought significant changes. From Birth Rite to AVE maternity beds, there has been an impressive evolution in the design and function of maternity chairs. The presence of technology and the advancement of the times have provided opportunities to continue to develop better maternity chair designs.⁽¹⁸⁾

Research in the Philippines shows that the use of maternity chairs is able to reduce the incidence of musculoskeletal disorders (MSDS) that are significant for healthcare workers and also provide greater comfort for patients.⁽¹⁹⁾ Other studies that have been conducted related to maternity chairs with the title "The Effect of the BC-MK15 Birth Chair on the Labor Pain Intensity in Multipara" in this study were applied by measuring the level of opening pain 4-5 cm and 7-9 cm significantly gave effective results on pain reduction, but different in the opening of 4 cm which was not significant in reducing pain.⁽²⁰⁾ This research will involve the development of ergonomic maternity chairs with the integration of heat temperature sensor components. Heat methods have been used before in a variety of contexts, such as heat therapy, warm compresses, thermal belts, and thermoforming.

Based on previous research, researchers are interested in developing an ergonomic maternity chair with the addition of an adjustable temperature sensor component positioned in the lumbar sacral section, with the aim of helping reduce labor pain during the first and second periods. The tool to be developed is named "Ergonomic Maternity Chair Thermotherapy Heat Pillow". In this tool, there will be several

supporting electronic components. The advantage of this study lies in the analysis of previous research which showed that the current maternity chair is still manual and does not have an additional temperature component. This causes the application of heat to reduce labor pain in first stages and second stages has not been optimal. Six materials of several electronic components, the developed maternity chair will be connected to other components and power sources from PLN. In addition, the circuit will be equipped with a 16x32 LCD display to display controllable temperatures. This is what is an advantage in the research and development of this maternity chair. It is expected that the development of ergonomic maternity chairs with thermotherapy features can make a significant contribution in improving comfort and reducing pain for mothers during labor, especially in first and second labor stages.

II. MATERIALS PLANNED SYSTEM

2.1 Research and Development for Ergonomic Maternity Chair



Figure 1: Ergonomic Maternity Chair Images before Development

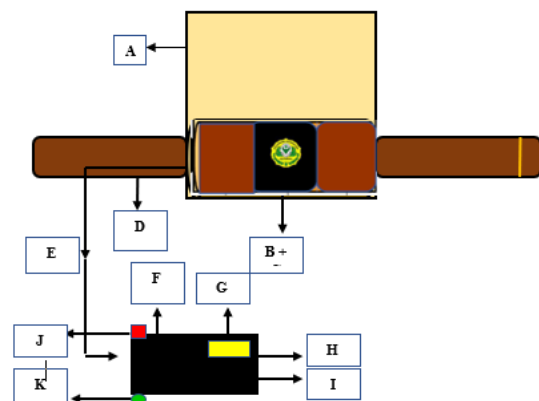


Figure 2: Range of Thermotherapy Systems for Ergonomic Maternity Chairs

Component Information:

- a) Ergonomic maternity chair
- b) Heating Element (Pc Air Heater Plate)
- c) DHT 11 Sensor
- d) Mini Fan (Jumper Cable, Heating Element Cable)
- e) Fan cable + connector to arduino UNO R3
- f) Arduino UNO R3
- g) LCD Display 1632
- h) Power Supply
- i) PCB Board (casing)
- j) Push button (on/off)
- k) Mini Fan Button

2.2 Hardware Components Required

a) Arduino UNO R3

Arduino is a microcontroller development board based on the ATmega328P chip, has 14 digital input / output pins and 6 analog input pins. Arduino supports microcontrollers that can be connected to a computer via a USB cable. The programming language used in this study is a C ++ program that can be used for serial communication. (21)



Figure 3: Arduino UNO R3

b) DHT 11 Sensor

The DHT11 sensor is a sensor with digital signal calibration that provides information about temperature and humidity. This sensor has very high stability. When used in conjunction with ATmega8 microcontroller capabilities. The size of this sensor is small, with low power consumption, and has a signal transmission range of up to 20 meters. This sensor has 4 pins arranged in a row. The quality of the data read by the sensor becomes more sensitive, with faster speed of reading the temperature and humidity of objects. In addition, the data read also has high resistance to interference.(22)

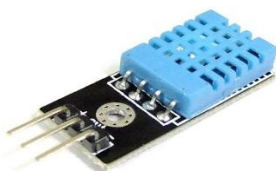


Figure 4: DHT 11 Sensors with 3 Pin

c) LCD 16x32

LCD (Liquid Crystal Display) is a collection of electronic components created with CMOS (Complementary Metal Oxide Semiconductor) technology. This technology allows LCD to transmit data from the back of the display to the front, or shift data from front to back with the goal of displaying characters, letters, numbers, and images. The LCD specifications of the 1632 model include 16 columns and 2 rows, are equipped with rear lighting (bottom light), the capacity to display 192 expandable characters, the ability to operate in 4 and 8 bit modes, as well as having a programmable character generator.(23)

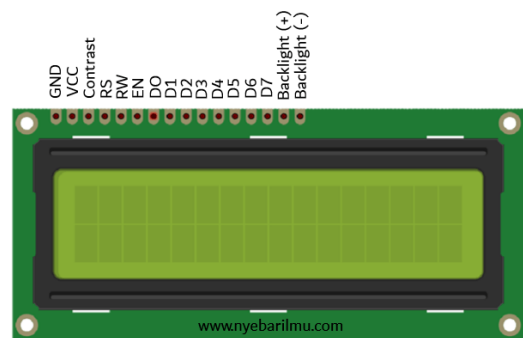


Figure 5: LCD 16x32

d) Elemen Pemanas

This electronic circuit serves to convert electrical energy into thermal energy. This circuit is intended to switch a substance from a low energy level to a high energy level. Electrical conductivity is consistently present in both raw materials and materials used as heating components of bearings. However, electrical conductors are often paired with materials that can increase the capacity of heat generated, such as insulating layers or ceramic coatings that coat them. This research uses Pc Air Heater Plat.(24)



Figure 6: PC Air Heater Plat

e) Power Supply

The power supply has a role as a source of electricity for other components. In this study, DC power supplies with electrical polarity were used that always remained at negative

values. This power supply serves to connect with PLN's electricity source, which is the main source of energy. As for this study, it uses a power supply with a power of 12 Volt 3 Amperes. (25)



Figure 7: Power Supply

2.3 Wiring Diagram

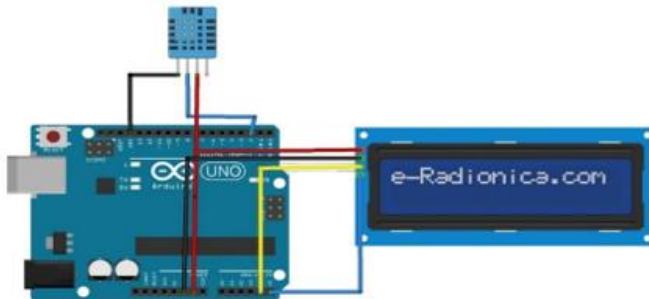


Figure 8: Wiring Diagram

2.4 Flow Chart

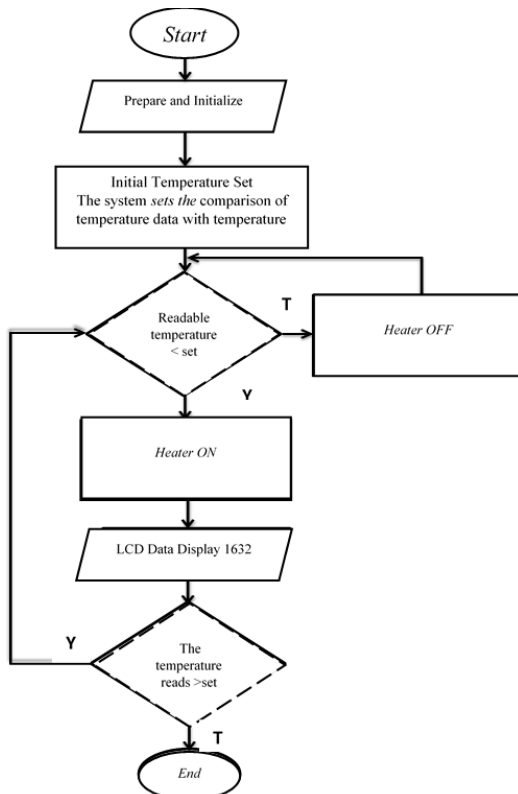


Figure 9: Flow Chart Development of Ergonomic Maternity Chair Thermotherapy Heat Pillow

- Heat pillows thermotherapy in ergonomic maternity chairs is used in maternity mothers during the active phase first to second labor stages, by placing the lumbar and sacral parts. When you first turn on the heating device on the pillow, there will be an initialization process or initial value given to the Arduino. Arduino UNO R3 and DHT 11 are used to detect temperature and control humidity, later will be able to be displayed through LCD Display 1632.
- After initialization, then the next step is the heating system will turn ON, we can monitor the heat level according to the patient's needs. After that, the temperature sensor will read the temperature level that will be generated on the LCD display. The use of this thermotherapy device will be connected to the PLN power source line. In this range, there is a mini fan to help neutralize excess temperatures in the thermoethy of the heat pillow.

2.5 Implementation and Result

- Figure 10 shows the circuit process on the Arduino and DHT 11 Sensor and the component device on the PCB board (Casing).
- Figure 11 is an ergonomic maternity chair after development.
- Figure 12 Ergonomic Maternity Chair Heat Pillow Thermotherapy after Development.
- Figure 13 Heat Pillow Thermotherapy.
- Figure 14 Delivery Process using Ergonomic Maternity Chair Heat Pillow Thermotherapy.

The tools that have been developed have passed the validation process from several experts such as electrical practitioners, obstetrics and gynecology doctors and midwives. To see the results of expert validation, we can see below:

Table 1: Expert Validity Test Results

| No | Validators | Number of Questions | Score Percentage | Interpretation |
|----|-------------------------------|---------------------|------------------|----------------|
| 1. | Electrical Engineering Expert | 16 | 90 % | Very Worth It* |
| 2. | Obstetrician & Gynaecologist | 9 | 93 % | Veru Worth It* |
| 3. | Midwife Expert | 9 | 93 % | Very Worth It* |

Based on the table 1, the validation value of 3 validators shows that the results of these electrical engineering experts are 90%, obstetrics and physiological specialists are 93% and midwife practitioners provide validation values of 93% the average assessment results from validators 92% show that the tool is included in the category of very feasible and safe, so

that this tool can be applied to maternity mothers at first stage and second labor stages.



Figure 10: Arduino UNO System Series, Snsor DHT 11 connected with several components on the PCB Board (Casing)

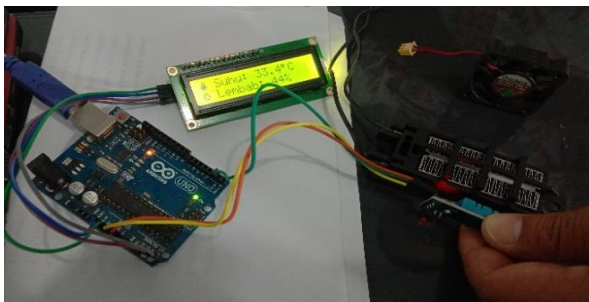


Figure 11: DHT 11 Temperature Sensor Test



Figure 12: Ergonomic Maternity Chair Heat Pillow Thermotherapy after Development



Figure 13: Thermotherapy Heat Pillow



Figure 14: Delivery Process using Ergonomic Maternity Chair Heat Pillow Thermotherapy

III. METHODOLOGY

This study used Type Research and Development (RnD) with Quasi Experimental Pretest-Posttest Design With Control Group. The study was conducted at Puskesmas Karangpawitan, Garut Regency - West Java, Indonesia. Conducted from May to June 2023. There are 2 groups in this study, namely the intervention group and the control group. The population in this study was primiparous and multiparous mothers aged <20 years, > 35 years and 20-35 years, gestational age 37-42 weeks with normal pregnancy, entry during the first active phase of labor, estimated fetal weight 2500-4000 grams, and HB >11 g / dL.

The sampling technique used in this study was simple random sampling. The number of respondents to the intervention group was 20 respondents and the control group amounted to 22 respondents. The intervention group was given the treatment of using an ergonomic maternity chair thermotherapy heat pillow, while the control group only used conventional beds and was not given any intervention. In this study, there was a drop out of 2 respondents in the intervention group due to obstetric pathology and respondents who withdrew in the research process.

The respondents' pain intensity scale was measured using the Numeric Rating Scale (NRS), while the duration of pain was measured using a Q & Q Stopwatch which was carried out simultaneously 4 times. In this study, two measurements were carried out both pretest and posttest, at the opening of the cervix 4-5 cm, once at the opening of 8-10 cm, and once during second labor stages or fetal expulsion phase. This intervention uses temperature settings ranging from 38°C - 44°C for 30 minutes. Thermotherapy of heat pillows in this ergonomic maternity chair is placed on the lumbar and sacral parts of maternity mothers.

3.1 Data Collection Tools

Survey was used for data collection. The questionnaires included a Numeric Rating Scala (NRS), Hamilton Anxiety Rating Scale (HARS).

3.2 Personal Information Form

- 1) Informed Consent.
- 2) Demographic characteristic.
- 3) Pregnancy and obstetric history.
- 4) Observation monitoring sheet of the use of ergonomic maternity chair heat pillow thermotherapy.

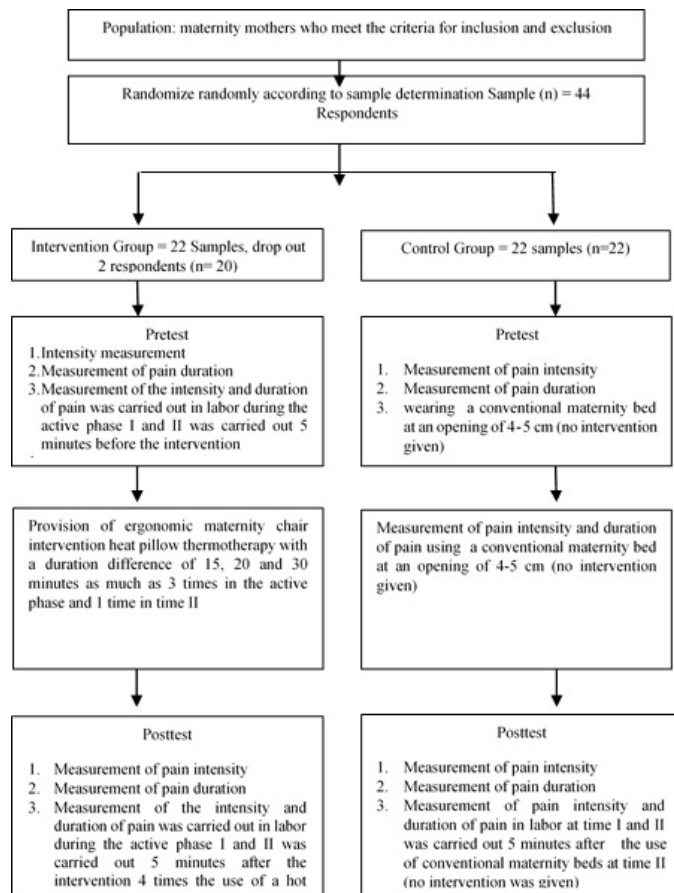


Figure 14: Flowchart of the research (CONSORT)

Table 1: Frequency Distribution of Respondents According to Maternal Characteristics

| Characteristic | Group | | | | Mean±SD | P |
|-----------------------------|---------------------|-----|----------------|------|------------|-------|
| | Intervention (n=20) | | Control (n=22) | | | |
| | n | % | n | % | | |
| Age | | | | | | |
| <20 and >35 Years | 4 | 20 | 6 | 27,2 | 26.79±6.60 | 0,302 |
| 20-35 Years | 16 | 80 | 16 | 72,8 | | |
| Total | 20 | 100 | 22 | 100 | | |
| Parity | | | | | | |
| Low parity (<2) | 9 | 45 | 11 | 50 | 1.76±0.82 | 0,930 |
| High parity (>2) | 11 | 55 | 11 | 50 | | |
| Total | 20 | 100 | 22 | 100 | | |
| Anxiety Level (HARS) | | | | | | |
| No Anxiety | 9 | 45 | 10 | 45,4 | 15.48±5.31 | 0,933 |
| Mild Anxiety | 6 | 30 | 6 | 27,3 | | |
| Moderate Anxiety | 5 | 25 | 6 | 27,3 | | |
| Total | 20 | 100 | 22 | 100 | | |

*Leven's Test Statistic

3.3 Ethical Considerations

This research has been approved by the Health Research Ethics Committee Ministry of Health, Semarang Health Polytechnic (No.0601/EA/KEPK/2023). The maternity women who agreed to participate in the study were informed about the purpose and procedure of the study. It was explained to the participants that the intervention posed no risk to the maternity mother and baby. Participants were also informed that all identifiable information would be kept confidential. Participants can leave the study at any time. Written consent and voluntary information forms are obtained from all participants.

3.4 Data Analysis

Analysis of Leven's Test data to determine differences between groups in terms of socio demographic and obstetric characteristics of maternity mothers. The Skewness test is used to assess the normality of data. In the group, significant differences between pain levels and duration of pain during cervical dilatasi other stages of labor were determined using the paired t test. To see the changes in each group using the Independent T test.

3.5 Research limitations and Future Scope

- 1) This research still uses PLN's electricity source as the main source of electrical resources.
- 2) There is limited data information to avoid errors from tools that are still in prototype form.
- 3) The use of this development tool needs to be socialized to the family so that it can be used independently.
- 4) There is still selective loss to follow up with the presence of research subjects who are missing due to pathological problems in labor.

- 5) More specific sample numbers become difficult to obtain.
- 6) There are several components of improvement in the material and design of the hang drip frame on the arms and legs, handrail material, and positions that can be adjusted by adjusting the speed of forward settings.
- 7) The temperature system needs to be changed to a close loop or automatic system for ease of use.
- 8) The desired temperature setting has not been done automatically.

IV. RESULTS AND DISCUSSION

Table 2: Differences in pain intensity during first and second labor stage before and after the use of the ergonomic maternity chair heat pillow thermotherapy for 30 minutes in the intervention group and control group

| Pain Intensity | Group | | P |
|----------------|--------------------------------|---------------------------|-------|
| | Intervention Group n = (20) | Control Group n = (22) | |
| | Mean±SD | Mean±SD | |
| First Stage | | | |
| Pre | 5,55±1,47 | 6,59±0,80 | 0,338 |
| Post | 4,95±1,15 | 7,50±0,67 | 0,001 |
| Δ | -0,60±1,23 | 0,91±0,97 | |
| Second Stage | | | |
| Pre | 5,55±1,47 | 6,59±0,80 | 0,338 |
| Post | 4,60±1,43 | 7,45±0,91 | 0,000 |
| Δ | -0,95±1,53 | 0,86±0,89 | |

*Independent Test

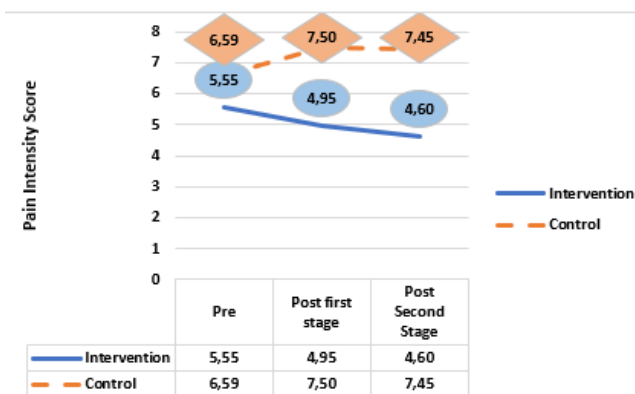


Figure 15: Changes in Labor Pain Intensity first stage and second labor stages after the use of ergonomic maternity chair heat pillow thermotherapy

In the intervention group, In the first stage, before the intervention, the pain intensity score was 5.55. After that, there was a decrease in the pain intensity score to 4.95. In second stage, the use of ergonomic maternity chairs with heat pillow thermotherapy had a significant impact. The pain intensity score before the intervention was 5.55, and after the intervention, the score decreased to 4.60. This showed a significant reduction in pain intensity after the intervention at second labor stages.

In the Control group, In first stage, before the intervention, the pain intensity score was 6.59. After that, there was an increase in the pain intensity score to 7.50. This showed that in the control group, pain intensity tended to increase after delivery at no. However, in second stage, after the intervention was carried out, there was a decrease in pain intensity score to 7.45. Although there was still an improvement from the pre-intervention score, this decrease may indicate that the change in second labor stages was not as strong as in the intervention group.

Table 3: Differences in Duration of Pain during First and Second Labor Stage Before and After Using the Ergonomic Maternity Chair Heat Pillow Thermotherapy for 30 Minutes in the Intervention Group and Control Group

| Duration of Pain | Group | | P |
|------------------|--------------------------------|---------------------------|-------|
| | Intervention Group n = (20) | Control Group n = (22) | |
| | Mean±SD | Mean±SD | |
| First Stage | | | |
| Pre | 23,35±8,46 | 27,95±5,29 | 0,016 |
| Post | 23,20±6,55 | 28,45±5,01 | 0,005 |
| Δ | -0,15±6,90 | 2,41±5,98 | |
| Second Stage | | | |
| Pre | 23,25±8,46 | 27,95±5,29 | 0,016 |
| Post | 24,05±4,47 | 18,86±5,95 | 0,001 |
| Δ | 0,70±6,81 | 2,82±4,66 | |

*Independent Test

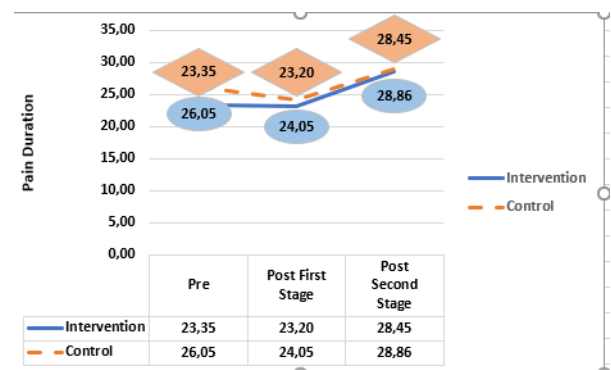


Figure 16: Changes in the Duration of Labor Pain first stage and second labor stages after the use of ergonomic maternity chair heat pillow thermotherapy

In the intervention group, before the treatment was given, the duration of pain at first stage was 23.35 seconds, after the treatment was done at time I, there was a decrease in the duration of pain to 23.20 seconds. This showed a slight decrease in the duration of pain after the intervention at first stages. At second labor stage, before the treatment was done, the duration of pain was 23.35 seconds. After treatment was carried out at second labor stages, there was an increase in the duration of pain to 28.45 seconds. This suggests that such interventions may not be successful in reducing the duration of

pain in second stage; conversely, there was a significant increase in the duration of pain after the intervention.

In the control group, before treatment was performed at first stage, the duration of pain was 26.05 seconds. After the treatment was carried out at first stage, there was a decrease in the duration of pain to 24.05 seconds. This showed that in the control group there was also a decrease in the duration of pain after the intervention at first stage. At second labor stages, before the treatment was carried out, the duration of pain was 26.05 seconds. After treatment was carried out at second stage, there was an increase in the duration of pain to 28.86 seconds. This showed that in the control group, there was a significant increase in the duration of pain after the intervention at second labor stages.

4.1 Discussion

The Effect of Ergonomic Maternity Chair Heat Pillow Thermotherapy on the Intensity of Labor Pain first stage and second labor stages

Each labor process will be very different in the level of pain, ranging from the most pleasant to unbearable. At first stage, the pain felt can be caused by increased uterine contractions, and this pain can be triggered by stimulation at nerve locations such as L1, T12, T11, and T10. This relates to the physical changes that occur in the mother's body as the uterus contracts to help open the cervix. At second labor stages greater pain may occur due to continued uterine contractions, increased segment distention (uterine growth and decreased baby through the birth canal), as well as tissue tears. Somatic nerves in the sacral section (S2, S3, and S4) are involved in sending pain sensations from the perineum and birth canal.⁽²⁶⁾

High levels of pain during labor can have complex effects on the mother. In addition to causing strong physical pain, unresolved pain can also have emotional and psychological impacts. Fear and anxiety can increase stress and interfere with labor.⁽²⁷⁾ Psychological disorders should be managed properly so as not to interfere with the labor process.⁽²⁸⁾ Actions to reduce the intensity and duration of pain during labor, especially during time I and time II, can involve diverse approaches, including empowerment in labor and the use of complementary therapies, one of which is by applying the vertical maternity position recommended by WHO and the use of complementary therapy as a non-pharmacological therapy in the form of heat pillows that are regulated to reduce pain in the form of lumbar and sacral parts. This is in accordance with the gate theory of pain transmission which states that in this case we can close the gate of pain transmission, one of which is through non-pharmacological methods.⁽²⁹⁾ This hot pillow thermotherapy provides relaxation and soothes the spinal cord

in reducing pain. The thermotherapy of this pillow has been combined with an ergonomic maternity chair that has been developed into appropriate technology.

However, in this study, statistically the results of the Numeric Rating Scale (NRS) measurement that decreased pain intensity in the first stage of labor and the second stage of labor showed a significant difference using the ergonomic labor rate of heat pillow thermotherapy in the second stage of labor. This is supported by research related to the effect of ergonomic labor chairs on the duration of labor when II in primiparous mothers, the use of ergonomic maternity chairs makes the time of the second labor stage shorter.⁽¹⁷⁾

This study is in line with research on the position of labor through the BC-MK 15 maternity chair by showing the effect of changes in labor pain intensity at the opening of 10 cm.⁽²⁰⁾ Other studies on the use of other maternity chairs help reduce pain intensity, also help reduce the incidence of musculoskeletal disorder (MSDS) for healthcare workers and provide more comfort value for patients who use them.⁽¹⁹⁾

This can be caused by several influencing factors, such as maternal strength factors, psychological, and labor position that still make the mother comfortable⁽³⁰⁾ In addition, this study showed that the heat pillow thermotherapy ergonomic maternity chair provided a sense of security and comfort when used, which was tested both in the supine position, 45° and 60° C. On average, patients said they were more dominant, comfortable when they are in the position of 45° - 60°. The mobilization technique referred to in this study is a vertical position that focuses on the buttocks, knees such as half sitting, sitting by avoiding the supine position. In accordance with the WHO recommendations of 1996 which recommend vertical positions. One is through the sitting position, which facilitates the advancement of energy in straining and helps the mother and baby for some physiological things.^{(31),(32)} This position allows for a more e-arth gravitational role as well as less autovagal compression and helps reduce less pain, shorter interventions and efficient thrusts in straining. It facilitates dilated fetal and structural accommodation. Position the semi fowler at an angle of 45°-60° to avoid supine position and this position is considered most important during labor.⁽³³⁾

The upright position applied in this study helped make it easier to push the fetal head downward more easily with a widened accommodation structure. This is supported by research on pelvimetric measurements using sagittal outlet MRI and a larger interspinous diameter compared to the supine position. Seeing that other supporting research around this ergonomic maternity chair already has supporting facts that maternity chairs can help reduce the intensity of pain in labor. To develop the function of the maternity chair, in this

study has been developed by adding electronic components to help reduce pain with flexible use by combining it with non-pharmacological methods such as heat therapy.

This heat pillow thermotherapy is made with a temperature rule of 38°-44°C, it follows the principle according to the theory that heat therapy if applied to skin receptors will cause relaxation and pleasant to access the spinal cord in reducing pain.⁽³⁴⁾ This is seen from the aspect of Vander's theory which states that the body can allow small temperature changes, but if there is a temperature deviation of 4-5 ° C, it will usually occur in the nervous system, if the normal temperature is 36.5 ° C-37.5 ° C the maximum will only reach 43 ° C. this if given excessive temperature will cause damage to cellular structures, necrosis can cause *heat stroke* at core body temperature, and this will trigger more cell death.⁽³⁵⁾ The effect of stimulating skin and tissue receptors in suppressing pain through the theory of gate control anchovies. The application of heat therapy if applied correctly will not cause negative effects, even reduce pain and increase maternal satisfaction⁽³⁶⁾ Human body temperature has a balance of 36.5 ° C – 37.5 ° C and critical human temperature is critical which reaches 41.6° C to 42° C. (37)(38) Cells normal tissue temperature is 40°C, but at extreme temperatures (49-50°C), the overall structure deteriorates and cell necrosis occurs, which can occur within minutes or even hours.

The temperature regulation applied in this study has been in line with Vander's theory which states that deviations occurring 4-5 ° C still have different safe values if more than 4-5 ° C then nervous disorders will occur⁽³⁹⁾ The use of thermotherapy thickness of heat pillows used is in line with the theory that direct contact of hot media with skin should be > 2cm thickness. This is so that there is no hot effect that causes skin irritation, inflammation, ulceration or burns. The application of this heat method has been applied in accordance with security principles and theoretical studies and other supporting research.⁽³⁵⁾

This is in line with previous research on the effect of heat on the back and abdomen and cold on the perineum to reduce labor pain, that the intervention had significant differences in both the opening phase and release phase, but no significant difference in the third phase. In his studies did not show abnormal conditions in the fetus⁽⁴⁰⁾ Other supporting research through research on the use of thermal belts at pad temperatures of 38°-39°C for 30 minutes, can reduce pain.⁽¹⁶⁾ That the use of thermal belts in the lumbar and suprapubic regions, as well as the combination of cooling sensations for 10 minutes, showed changes. A literature review mentions that hot water pads applied temperature (38°-40°C).⁽³¹⁾

This is in contrast to massage research and heat application in pain and comfort which provides a thermoforming method of heat intervention with the application of pre-wrapped using a towel to protect the mother from the direct influence of hot surfaces. Massage in his research leads to heat formation, and muscle stiffness that increases body flow also reduces the transmission of impulses to the brain through the release of endorphins to block the gates of pain transmission.⁽¹⁵⁾ Another study that applied heat therapy was by giving hot herbal compression in the style of traditional Thai medicine methods given to respondents starting from the opening of 4-5 cm in the first stage of the active phase for 20 minutes at the sacrum point was able to provide results in reducing pain in labor from the first stage of the active phase to the complete opening of the cervix.⁽⁴¹⁾

In contrast to a literature review and meta-analysis that heat therapy only reduces the intensity of pain in the first phase of labor. Other studies related to warm compresses in the sacral lumbo region for 15-20 minutes have so far shown positive. Several studies and literature reviews and meta-analyses related to heat application for labor pain reduction showed no reports of negative effects caused by mother and fetus⁽⁴²⁾ Based on a literature review of some of the studies above, this study proves that the application of thermotherapy methods or heat therapy has advantages or advantages in providing pain reduction effects in labor. In addition to having a positive or good influence in reducing labor pain, thermotherapy methods combined with ergonomic maternity chairs can also help mothers through empowerment in the labor process through the application of vertical labor positions facilitated by ergonomic delivery chairs, hot pillow thermotherapy so that mothers feel more confident and ready to face the labor process.

The Effect of Ergonomic Maternity Chair Heat Pillow Thermotherapy on the Duration of Labor Pain First Stage and Second Labor Stages

The stage of labor that occurs at first stage is caused by uterine contractions and dilation of the cervix until complete opening followed by a decrease in the lowest part of the fetus which makes pain will increase. In monitoring the duration, the strength of uterine contractions. Usually contractions will occur every 10 minutes, and usually occur 15-20 minutes.⁽⁴³⁾ The phase of first stage is divided into two, namely the latent phase and the active phase; this latent phase takes time that will be tiring in maternity, as well as in the active phase of labor characterized by an increase in the frequency of uterine contraction duration.

Based on this study, the intervention of ergonomic maternity chair heat pillow thermotherapy with a temperature

of 38 °-44 ° C for 30 minutes given in labor when I had an influence on the duration of pain felt at first stage. Before the intervention, the average duration of pain in the intervention group was 23.35 seconds and the control group was 27.95 seconds and after the intervention in the intervention group decreased the duration of pain by 23.20 seconds and the control group experienced an increase of 28.45 seconds. The difference in the average pain intensity score before and after the intervention was -0.15 ± 6.90 in the intervention group and the decrease in the score in the control group by 2.41 ± 5.98 . The results of the *independent test* analysis showed a significant difference at first labor stages.

This same thing occurred differences in labor in time II, the use of stopwatch measurements in measuring pain duration in second stage. Before the intervention, the average duration of pain in the intervention group was 23.25 seconds and the control group was 27.95 seconds and after the intervention in the intervention group experienced a decrease in pain duration by 24.05 seconds and the control group experienced a decrease in pain duration by an average of 18.86 seconds. The difference in the average duration of pain before and after the intervention was 0.70 ± 6.81 in the intervention group and the decrease in scores in the control group by 2.82 ± 4.66 . The results of the *independent test* analysis showed a significant difference in second labor stages.

When entering the active phase, contractions last 45-90 seconds with an average of 60 seconds. The frequency and duration of uterine contractions will increase gradually, and are said to be adequate if they occur $\geq 3x$ within 10 minutes and last for 40 seconds⁽⁴³⁾. At time II his coordinated, strong, fast and long, interval 3-4 minutes. His strength at the end of the first time or the beginning of the second time has amplitude of 60 mmHg, the duration ranges from 60-90 seconds.

This study has been in line with the theory that contractions in labor will increase over time, but this study shows that this ergonomic maternity chair thermotherapy heat pillow intervention helps maternity mothers reduce half of the full duration during contractions to experience longer relaxation because it appears that the duration of pain felt is only half of the full duration during contractions. In this pain duration study, there is no gap between the theory and the findings obtained in the research field.

V. CONCLUSION

This study has proven that the use of ergonomic maternity chairs with heat pillow thermotherapy has an influence on the intensity of labor pain, and the results show higher effectiveness at second labor stages. In addition, this study provides new evidence that the use of the chair is more

effective in shortening the duration of labor pain at first labor stage by providing heat temperatures between 38° C to 44° C for 30 minutes.

CONFLICT OF INTEREST

The author stated that there was no conflict of interest during the research.

ACKNOWLEDGEMENT

As part of the award, I would like to thank you, many special thanks to all the families, lecturers, experts, midwives, obstetrics and gynecology doctors, electrical practitioners, and everyone who helped complete this research study.

REFERENCES

- [1] Astuti T, Bangsawan M. Aplikasi Relaksasi Nafas dalam terhadap Nyeri dan Lamanya Persalinan Kala I Ibu Bersalin di Rumah Bersalin Kota Bandar Lampung. *Jurnal Ilmiah Keperawatan Sai Betik*. 2019;15(1):59. <http://dx.doi.org/10.26630/jkep.v15i1.1359>
- [2] Sulfiyanti, Indryani, Deasy H.P., Samsider S, Meda Y, Hasliana H, Ismawati, Marlynda H.N.S, Pebri W.P, Wahyuni, Julietta H. Dina D.A, Agung M.V.P FN. *Asuhan Kebidanan Pada Persalinan*. Sumatera Utara: Yayasan Kita Menulis; 2020.
- [3] Huang J, Zang Y, Ren LH, Li FJ, Lu H. A review and comparison of common maternal positions during the second-stage of labor. *International Journal of Nursing Science* 2019;6(4):460–7. <https://doi.org/10.1016/j.ijnss.2019.06.007>
- [4] World Health Organization. Strategies toward ending preventable maternal mortality (EPMM). 2015;6736 2013:1–4.
- [5] World Health Organization .2023. <https://www.who.int/news-room/fact-sheets/detail/maternal-mortality>
- [6] Kemenkes RI. *Profil Kesehatan Indonesia*. 2021. Kementerian Kesehatan Republik Indonesia.
- [7] Keluarga SK. *Angka Kematian Ibu Tahun 2022 "Maternal Neonatal Death Nitification*. Garut; 2022.
- [8] Badan Pusat Statistik. *Survei Demografi Dan Kesehatan : Kesehatan Reproduksi Remaja 2017*. In Badan Kependudukan dan Keluarga Berencana. Survei Demografi Dan Kesehatan .2017;271. <http://www.dhsprogram.com>.
- [9] Kemenkes RI. *Riset Kesehatan Dasar (Riskesdas)* Badan Penelitian dan Pengembangan Kementerian Kesehatan Republik Indonesia. 2018.
- [10] Cole SK. Cæsarean Section Rates. *Lancet*. 1980;315(8168):606.
- [11] Suryani S. Penggunaan Konsep Fisika dalam

- Pertimbangan untuk menentukan Posisi Persalinan. J Fis dan Apl. 2013;9(3):116.
doi : 10.12962/j24604682.v9i3.85
- [12] Astuti, Titi Y mashaurani. Pengaruh Posisi Tegak (Upright) Terhadap Rasa Nyeri dan Lamanya Kala I Persalinan Ibu Primipara. *Jurnal Ilmiah Keperawatan Sei Betik*. 2015;IX(1):87–94.
- [13] Türkmen H, Oran NT. Massage and heat application on labor pain and comfort: A quasi-randomized controlled experimental study. *Explore*. 2021;17(5):438–45. <https://doi.org/10.1016/j.explore.2020.08.002>
- [14] Farahmand M, Khooshab E, Hasanzadeh F, Amooee S, Akbarzadeh M. The effect of warm compress Bi-stage on pain strength in labor stages and after delivery. *International Journal Women's Health and Reproduction Science*. 2020;8(1):46–52.
doi : 10.15296/ijwhr.2020.06
- [15] Kaur J, Sheoran P, Kaur S, Sarin J. Effectiveness of Warm Compression on Lumbo-Sacral Region in Terms of Labour Pain Intensity and Labour Outcomes among Nulliparous: an Interventional Study. *Journal Caring Science*. 2020;9(1):9–12.
doi: 10.34172/jcs.2020.002
- [16] Tarrats L, Paez I, Navarri I, Cabrera S, Puig M, Alonso S. Heat application on lumbar and suprapubic pain during the onset of labour using a new abdominal two-pocket belt: a randomized controlled trial. *Gynecology and Obstetrics*. 2019;9(9):1–5.
doi: 10.24015/2161-0932/9.511
- [17] Rusmini S. The Effect of Use of Ergonomic Childbirth Chair in the Period of Second Stage of Labor in Primipara. *International Conference Handling Non-Communicable Disease (ICHNCDs)*. 2019;p-67.
- [18] Thies-Lagergren L, Kvist LJ, Christensson K, Hildingsson I. Striving for scientific stringency: A re-analysis of a randomised controlled trial considering first-time mothers' obstetric outcomes in relation to birth position. *BMC Pregnancy Childbirth*. 2012;12. <https://doi.org/10.1186/1471-2393-12-135>
- [19] Borres RD, Javier AK. An ergonomic design of birthing chair for public maternity hospitals in the Philippines. *Proceedings of the International Conference on Industrial Engineering and Operations Management*. 2019;2019(3):2463–9. <https://doi.org/10.3390/app13053003>
- [20] Purnama Y, Mose JC, Herman H. The Effect of the BC-MK15 Birth Chair on the Labor Pain Intensity in Multipara. *Global Medical and Health Communication*. 2018;6(3):155–61. <https://doi.org/10.29313/gmhc.v6i3.2841>
- [21] Qayoom F, Balaji N, Gurukiran S, Sourabh SN. Hand Gesture Vocaliser for Deaf. *International Journal of Innovative Science and Research Technology*. 2022;7(7):706–11. <https://doi.org/10.5281/zenodo.6965367>
- [22] Hadi S, Labib RPM, Widayaka PD. Perbandingan Akurasi Pengukuran Sensor LM35 dan Sensor DHT11 untuk Monitoring Suhu Berbasis Internet of Things. *Satuan Tulisan Riset dan Inovasi Teknologi (STRING)*. (2022) ;6(3):269. doi:10.30998/string.v6i3.11534.
- [23] Hsu WL, Jhuang JY, Huang CS, Liang CK, Shiau YC. Application of Internet of Things in a kitchen fire prevention system. *Applied Sciences*. 2019;9(17). <https://doi.org/10.3390/app9173520>.
- [24] Meriadi, Meliala S, Muhammad. Menggunakan Pemanas Listrik. *Jurnal Energi Elektro*. 2018;7:47–53. doi :10.24036/jtein.v1i2.53
- [25] Putra GSA, Nabila A, Pulungan AB. Power Supply Variabel Berbasis Arduino. *Jurnal Teknik Elektro Indonesia (JTEIN)*. 2020;1(2):139–43. doi: 10.24036/jtein.v1i2.53
- [26] Yuliatun. *Buku Pijat Effleurage*. Jakarta: EGC; 2008.
- [27] Efektifitas Massage Effleurage dan Massage Counterpressure Terhadap Penurunan Nyeri Persalinan. 2017;9(1):19–25.
- [28] Sari N, Runjati, Fatmasari D, Pujiyanto TI. Practices of Counter Pressure and Birth Ball Exercise Combination to Increase β -Endorphin Hormone Levels in Labor Pain. 2020;27(ICoSHEET 2019):314–7. *International Conference on Science, Health, Economics, Education and Technology (ICoSHEET)*. doi: 10.2991/ahsr.k.200723.079
- [29] Arro CD. Harnessing The Power Of Gate Control: Intervention For Procedural Pain and Anxiety. *International Journal of Whole Person Care*. 2022;9(1)
- [30] Carquillat P, Boulvain M, Guittier MJ. How does delivery method influence factors that contribute to women's childbirth experiences? *Midwifery*. 2016;43(September):21–8. <http://dx.doi.org/10.1016/j.midw.2016.10.002>
- [31] Gizzo S, Di Gangi S, Noventa M, Bacile V, Zambon A, Nardelli GB. Women's choice of positions during labour: Return to the past or a modern way to give birth? A cohort study in Italy. *Biomed Research International*. 2014;2014. <http://dx.doi.org/10.1155/2014/638093>
- [32] Lawrence A, Lewis L, Hofmeyr GJ SC. Maternal positions and mobility during first stage labour. *Cochrane Database Systematic Review*; 2013. 9;(10). doi : 10.1002/14651858.CD003934.pub4
- [33] RJ A. Parturitional posture and related birth behavior. *Acta Obstetrica et Gynecologica Scandinavia*; 1976. 55:3-25. doi: 10.3109/00016347609156455
- [34] Fitria CTN, Runjati R, Patriajati S, Anwar C.

- Innovation relaxation belts to reduce labor pain intensity and increase β -endorphine levels. *Medisains*. 2020;18(2):69.
<https://doi.org/10.30595/medisains.v18i2.7994>.
- [35] Sheremata WA BJ. Persistent neurological deficit precipitated by hot bath test in multiple sclerosis. *JAMA*; 1983. 249 p.
- [36] Ganji Z, Shirvani MA, Rezaei-Abhari F, Danesh M. The effect of intermittent local heat and cold on labor pain and child birth outcome. *Iranian Journal of Nursing and Midwifery Research*. 2013;18(4):298–303.
- [37] Sakaguchi Y, Stephens LC, Makino M, Kaneko T, Strebel FR, Danhauser LL, Jenkins GN BJ. Apoptosis in Tumors And Normal Tissues Induced By Whole Body Hyperthermia in Rats. *Cancer res*. 1995;15;55(22):
- [38] Polla BS, Bachelet M, Elia G SM. Stress proteins in inflammation. *Annals of the New York Academy of Science*. 1998; 30;851:75-84.
- [39] Vander, Arthur J, James H. Sherman DSL. Human physiology : the mechanism of body function. 4th ed. New York: *McGraw-Hill Education*; 1986. 792 p.
- [40] Yazdkhasti M, Hanjani SM, Tourzani ZM. The effect of localized heat and cold therapy on pain intensity, duration of phases of labor, and birth outcomes among primiparous females: A randomized, controlled trial. *Shiraz E-Medical Journal*. 2018;19(8).
<https://doi.org/10.5812/semj.65501>
- [41] Larasati S, Pramono N, Ramlan D. Hot herbal compresses as therapy for reducing labor pain levels in the first stage of active phase in primigravida. *Majalah Obstetri Ginekologi*. 2022;30(1):36–41.
doi: 10.20473/mog.v30i12022.36-41
- [42] Akbarzadeh M, Nematollahi A, Farahmand M, Amooee S. The Effect of Two-Stage Warm Compress on the Pain Duration of First and Second Labor Stages and Apgar Score in Primi Gravida Women: a Randomized Clinical Trial. *Journal of Caring Science*. 2018;7(1):21–6.
<http://dx.doi.org/10.15171/jcs.2018.004>
- [43] Alam HS. *Upaya Mengurangi Nyeri Persalinan dengan Metode Akupresur*. Cijerah, Kota Bandung-Jawa Barat: Media Sains Indonesia; 2020.

Citation of this Article:

Bilqis Ar-Rohman, Runjati, Djamaluddin Ramlan, “Ergonomic Maternity Chair Heat Pillow Thermotherapy on the Labor Pain of First and Second Labor Stages” Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 7, Issue 8, pp 184-195, August 2023. Article DOI <https://doi.org/10.47001/IRJIET/2023.708024>
