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*Case Study*

# The application of nesting therapy on physiological changes (body temperature, respiratory rate, heart rate, and oxygen saturation) in low-birth-weight infants in the perinatology unit

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***Abstract***:
Infants with low birth weight (LBW) are at high risk of experiencing physiological adaptation disorders due to the immaturity of their organs, requiring close monitoring of physiological parameters such as body temperature, respiratory rate, heart rate, and oxygen saturation. Nesting therapy is one form of developmental care intervention aimed at stabilizing the baby's position and enhancing comfort to achieve stability in vital functions. This study aims to analyze the effect of nesting therapy on physiological changes in LBW infants in the Perinatology Unit of Dr. Soebandi General Hospital, Jember. The study design used a descriptive case study with a qualitative approach. The research subject was one LBW infant who met the inclusion criteria. Data collection was conducted through direct observation with measurements of physiological parameters before and after the administration of nesting therapy every 15 minutes over a one-hour period for three consecutive days. The results of the study showed positive changes in the infant's physiological parameters after nesting therapy was administered. Body temperature increased from 35.4°C to 36.3°C on the third day. Respiratory rate decreased from 75 breaths per minute to 58 breaths per minute. Heart rate decreased from 189 beats per minute to 122 beats per minute, and oxygen saturation increased from 94% to 99%. These findings indicate that nesting therapy is effective in helping to stabilize the physiological condition of LBW infants. The nesting position also makes the baby feel more comfortable, the baby's position is awake, the baby's sleep time is more effective, so that the baby's energy is used optimally in growth and development and can affect the baby's physiological functions. Given its non-invasive and safe nature, this therapy is recommended for routine application as part of the care of LBW infants in the perinatal unit.

***Keywords***:
infant low birth weight, infant physiological, nesting therapy

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## INTRODUCTION

Low Birth Weight (LBW) infants are infants born with a birth weight of less than 2500 grams, regardless of gestational age. The definition of Low Birth Weight (LBW) infants is infants with a birth

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weight of <2500 grams, regardless of gestational age. LBW can occur in preterm infants (≤ 37 weeks' gestational age) or in term infants (Intrauterine Growth Restriction) (Sapitri et al., 2023). The development of LBW infants is at risk of delay due to their weight being <2500 grams, resulting in significant physiological changes. Some of the physiological changes experienced by LBW infants include alterations in thermoregulation, respiration, cardiovascular function, gastrointestinal function, neurology, and immunology (Sumarni, 2023).

According to the WHO (2020), approximately 5 million neonatal deaths occur globally each year, with 98% of these deaths occurring in developing countries. Of the 4.5 million infant deaths, 7.5% occur in the first year of life. The global incidence of LBW is 15.5%, with an incidence of 1–8 cases per 1,000 live births and a case fatality rate (CFR) of 10–50% (Ramadhani & Maryatun, 2024). The infant mortality rate (IMR) in Indonesia remains very high compared to other ASEAN countries. The IMR in Indonesia is 4.6 times higher than in Malaysia, 1.3 times higher than in the Philippines, and 1.8 times higher than in Thailand (Sumiyati & Sari, 2024). Data from Kementrian Kesehatan RI (2023) shows that the main causes of infant mortality are respiratory and cardiac disorders (1%) and low birth weight (LBW) at 0.7%. In 2023, out of all newborns weighed across 38 provinces, 84.3% of infants had their birth weight measured, and 3.9% of them were classified as LBW. This figure has increased compared to 2022, when only 2.5% of infants were classified as LBW.

LBW infants who are born too early, lack nutrition, or suffer from a disease may face issues due to the immaturity of their various organ systems, making it difficult for them to adapt to the environment outside the uterus and leading to complex physiological changes in the body (Pratiwi et al., 2024). Babies with low birth weight have distinct anatomical and physiological characteristics. They have difficulty breathing because their lungs lack surfactant. Due to their weak muscles and underdeveloped brains, they require less effort to breathe naturally. Infants are more prone to heat loss due to their thin skin, large surface area, and low body fat content. Thin skin in infants can lead to heat loss or hypothermia and weight imbalance in LBW infants. To warm their bodies, cold infants require a significant number of calories (Ginting, Sari, et al., 2023).

The issues faced by infants with Low Birth Weight (LBW) are highly complex; therefore, to improve and enhance their health status, developmental care is implemented. One effective DC intervention is the use of nesting (Rhamelani & Kroirunnisa, 2024). Nesting is a care procedure that involves placing the infant in a flexed sleeping position within a rolled-up cloth/towel/swaddle made into a circular shape, resembling the environment inside the uterus. The purpose is to maintain a stable body posture, support the head in the midline position, and prevent sudden movements. The nesting method is beneficial for LBW infants as it aids in their physiological growth and behavior (Astuti et al., 2022). Additionally, proper sleeping positions protect the skin, improve sleep quality, stabilize heart rate and breathing, conserve energy, and make the baby feel safe and more relaxed (Alfiyanti et al., 2024).

The advantage of using nesting in neonates is to facilitate hand-to-hand and hand-to-mouth position patterns in neonates so that the flexion position is maintained. The flexion position can reduce stress because babies in the nesting position will feel like they are in their mother's womb. Additionally, nesting is designed to minimize movement in neonates, a form of energy conservation that improves comfort and hemodynamic stability in low-birth-weight babies (Pratama & Sulistyawati, 2022). Nurses can utilize nesting sustainably for low-birth-weight babies to maintain the normal stability of their physiological responses. Because the use of nesting affects the physiological

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changes of infants, namely changes in temperature, oxygen saturation, respiratory frequency and pulse frequency in LBW infants (Maimunatun et al., 2025). So the authors are interested in improving physiological changes in LBW babies by intervening with nesting.

## METHOD

This study employs a qualitative, descriptive case study design to evaluate the effect of nesting therapy on physiological changes in low-birthweight (LBW) infants. The population in this study was all LBW infants treated in the Perinatology Room of Dr. Soebandi Hospital in Jember. The sample was selected using a non-probability sampling approach with a purposive sampling method, where one infant was chosen based on specific inclusion and exclusion criteria. Inclusion criteria included infants weighing less than 2500 grams and parental consent, while exclusion criteria included infants with comorbidities such as congenital heart disease (CHD).

The intervention consisted of 1 hour of nesting therapy per day over three consecutive days, with monitoring of physiological parameters, including body temperature, respiratory rate, heart rate, and oxygen saturation. Measurements were taken before and after therapy at 15-minute intervals. This study was conducted in the Perinatology Unit of Dr. Soebandi General Hospital in Jember from October 24–26, 2024.

The instruments and tools used included nursing assessment forms, observation sheets, digital thermometers, stethoscopes, watches, and pulse oximeters. Data collection techniques involved direct observation, interviews with families, and recording of infants' physiological measurement results. Data analysis was conducted using descriptive qualitative methods based on the nursing process, which includes assessment, diagnosis, intervention, implementation, and evaluation. Interpretation was performed by comparing changes in physiological parameters before and after the intervention.

This study adhered to research ethics principles, including obtaining informed consent, maintaining patient data confidentiality, and upholding principles of fairness and benefit. The study was designed to ensure that it would not cause adverse effects on the infants, but rather to support physiological stability in a safe and non-invasive manner.

## RESULTS

### Body Temperature

Based on the results of body temperature measurements taken from the infant over three consecutive days, it was observed that the implementation of nesting therapy elicited varying responses. On the first and second days, body temperature after the intervention decreased compared to before the intervention, from 36.7°C to 36.3°C and 35.9°C, which may have been caused by the adaptation process or environmental factors. However, on the third day, there was a significant increase in body temperature, from 35.4°C to 36.3°C, after the intervention, indicating that nesting therapy is beginning to have a positive effect in helping to maintain the infant's body

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temperature stability. This suggests that the effects of nesting therapy may require time and consistency to work optimally.

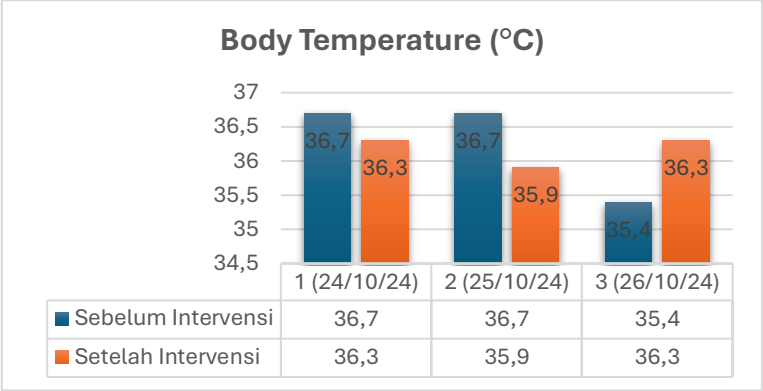


**Figure 1. Body Temperature Evaluation Chart**

## Respiratory Rate

Based on the respiratory rate graph (breaths per minute) over three consecutive days of observation, it is evident that the implementation of nesting therapy has an impact on the stability of the infant's respiratory pattern. On the first day (October 24, 2024), the respiratory rate increased from 48 to 53 breaths per minute following the intervention, indicating a slight increase in respiratory activity. However, on the second day (October 25, 2024), there was a significant decrease in respiratory rate, from 75 to 62 breaths per minute, after the intervention. On the third day (October 26, 2024), the respiratory rate also decreased, from 64 to 58 breaths per minute. This decrease indicates that nesting therapy plays a role in helping to lower the initially high respiratory rate to a more stable level and closer to the normal range. Overall, despite a slight increase on the first day, nesting therapy demonstrates effectiveness in lowering and stabilizing the infant's respiratory rate on subsequent days.

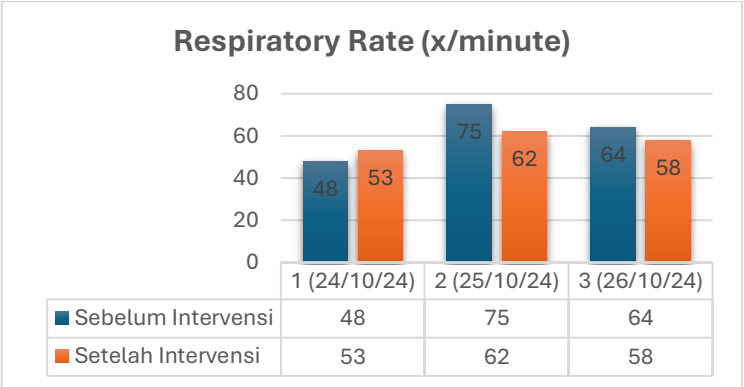


**Figure 2. Respiratory Rate Evaluation Chart**

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### Heart Rate

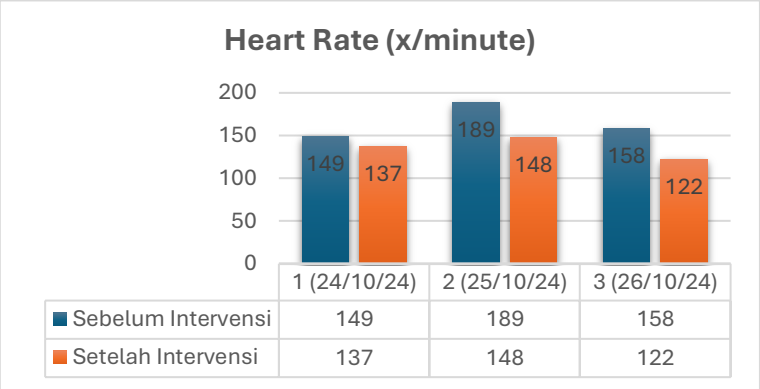


**Figure 3. Heart Rate Evaluation Chart**

Based on the heart rate frequency graph (x/minute) measured over three consecutive days, it is evident that the implementation of nesting therapy has a positive effect in reducing and stabilizing the baby's heart rate. On the first day (October 24, 2024), the heart rate decreased from 149 to 137 beats per minute after the intervention. A more significant decrease was observed on the second day (October 25, 2024), from 189 to 148 beats per minute, indicating a significant improvement in the baby's stress or discomfort levels. Similarly, on the third day (October 26, 2024), the heart rate before the intervention was 158 beats per minute and decreased to 122 beats per minute after the intervention. This downward trend indicates that nesting therapy can help reduce excessive sympathetic activity, thereby making the infant calmer and physiologically stable. Thus, it can be concluded that nesting therapy has a consistent effect on reducing heart rate over the three-day observation period.

### Oxygen Saturation

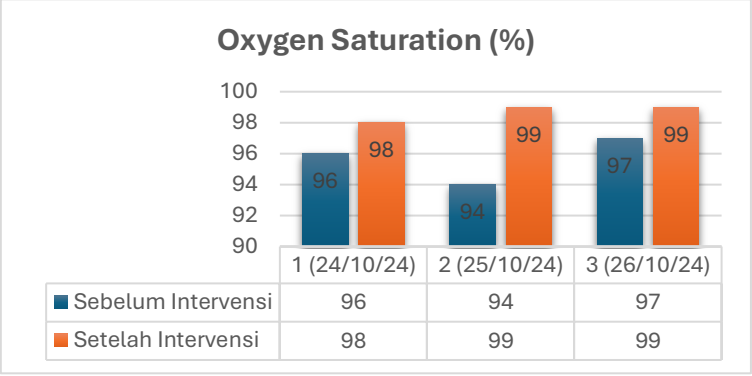


**Figure 4. Oxygen Saturation Evaluation Chart**

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Based on the oxygen saturation (%) graph measured over three consecutive days, the implementation of nesting therapy resulted in a consistent increase in oxygen levels in the baby's blood. On the first day (October 24, 2024), oxygen saturation increased from 96% before intervention to 98% after intervention. A larger increase occurred on the second day (October 25, 2024), from 94% to 99%, reflecting a significant improvement in oxygenation. On the third day (October 26, 2024), oxygen saturation increased from 97% to 99%. This trend indicates that nesting therapy contributes to enhancing the baby's comfort and physiological stability, thereby supporting efficient oxygen exchange. Overall, the nesting therapy intervention was effective in improving the baby's daily oxygen saturation levels during the observation period.

## DISCUSSION

### Body Temperature

Body temperature is a crucial physiological indicator in assessing the stability of thermoregulation in newborns, particularly premature infants or those with low birth weight (LBW), who have an immature body temperature regulation system. Under normal conditions, infants can maintain their body temperature within a range of 36.5°C to 37.5°C (Pratiwi et al., 2024). However, LBW infants are highly susceptible to hypothermia due to insufficiently developed subcutaneous fat layers, a relatively large body surface area compared to body mass and limited metabolic capacity to generate heat through non-shivering thermogenesis mechanisms (Alfiyanti et al., 2024). Therefore, interventions such as nesting therapy are important in helping to maintain their body temperature stability during care in the Perinatology unit.

Based on body temperature measurements of LBW infants receiving nesting therapy for three consecutive days, an interesting dynamic emerged. On the first day, the body temperature before intervention was recorded at 36.7°C and decreased to 36.3°C after nesting. A similar decrease occurred on the second day, from 36.7°C to 35.9°C. Although it initially appears that nesting therapy has not yet produced a temperature-raising effect, these results do not necessarily indicate intervention failure. Rather, this may be due to the infant's adaptation process to the new environment or potential suboptimal external environmental conditions (such as room temperature or airflow in the incubator). Interestingly, on the third day, the infants' body temperature increased significantly from 35.4°C to 36.3°C after undergoing nesting therapy, indicating that the intervention was beginning to show the expected thermal stabilization effect.

The body position in nesting resembles the fetal position in the womb, which helps the baby maintain a flexible posture, minimize heat loss, and enhance comfort (Maimunatun et al., 2025). In a study by Pratiwi et al (2024), it was explained that nesting provides comfort to babies, which affects their body temperature. The position given is a flexion sleeping position, which can increase motor activity, specifically involving hands grasping and hands to the mouth, and support self-regulation. In addition, the flexion position serves to prevent heat loss because it reduces the body surface's exposure to environmental temperatures. The circular body position also helps reduce exposure to the external environment and prevents unnecessary body movements that can increase energy expenditure (Suryani et al., 2023).

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In addition, a study by Pratama & Sulistyawati (2022) stated that the body temperature of infants who are not given the right position such as nesting tends to decrease faster, especially within the first hour after birth or initial care. The nesting position can also help increase peripheral blood flow through postural comfort, which supports even distribution of body heat. The flexion position in nesting therapy can also facilitate the baby to increase muscle movement activity, which is directly proportional to the increase in metabolism, leading to an increase in body temperature.

The effectiveness of nesting also depends on various external factors such as incubator environmental temperature, the use of appropriate nesting cloth, and the accuracy of applying the infant's body position. Research by Azzahraa et al. (2022) shows that the positive effects of nesting therapy on body temperature are more optimal when performed consistently and accompanied by good environmental temperature monitoring.

Thus, although the positive effects are not immediately visible on the first and second days, the implementation of nesting therapy has been shown to begin stabilizing body temperature on the third day of observation. These results support the importance of using nesting therapy as a form of developmental care for low-birth-weight infants (LBW) to aid in physiological adaptation, particularly in maintaining stable body temperature.

**Respiratory Rate**

Respiratory rate is a vital indicator that is crucial in assessing the stability of the respiratory system and overall physiological condition in newborns, particularly those with low birth weight. In infants born prematurely, the respiratory system is not yet fully developed, making them highly susceptible to disorders such as tachypnea (rapid breathing), apnea (cessation of breathing), or irregular breathing (Ernawati et al., 2023). This respiratory instability often indicates discomfort, physiological stress, or immaturity of the central nervous system. Therefore, interventions are needed to support respiratory stability, one of which is through the provision of nesting therapy.

Based on data from the implementation of nesting therapy over three consecutive days, there was a significant change in the infant's respiratory rate parameters. On the first day (October 24, 2024), the respiratory rate before intervention was 48 breaths per minute and increased to 53 breaths per minute after intervention. Although there appears to be an increase, this can be understood as an initial adaptive response to the nesting position or mild stimulation that may occur when the infant is placed in this position. However, what is more interesting and meaningful is the result on the second and third days. On the second day (October 25, 2024), the respiratory rate decreased significantly from 75 to 62 breaths per minute. This decrease continued on the third day (October 26, 2024) from 64 to 58 breaths per minute. This trend indicates that nesting therapy can help reduce initially high or abnormal breathing rates to more stable levels closer to the normal physiological range.

The decrease in breathing frequency reflects the calming effect of the nesting position on the infant's autonomic nervous system. According to research by Afifah et al. (2025), infants placed in the nesting position tend to exhibit a decrease in sympathetic activity, resulting in a more regular and stable breathing frequency. A body position that resembles the fetal posture in utero also allows for more efficient lung expansion due to a more flexible sternum position and stable intra-abdominal

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pressure. In addition, postures that approximate natural physiological positions also reduce upper airway resistance, resulting in more efficient and energy-efficient breathing.

Similar findings were reported by Suriya et al (2024), who stated that administering nesting therapy for 3 days to LBW infants significantly reduced respiratory rate and improved infant sleep quality. The improved sleep quality resulting from increased comfort also contributed to a reduction in metabolic and respiratory activity in infants. Another study by Azzahraa et al (2022) also revealed that nesting not only improves respiratory rate but also reduces the incidence of apnea and supports ventilation stability in LBW infants.

Another study by Mahbubah et al. (2025) found that positioning using nesting can increase lung ventilation, reduce pressure on the heart, and enhance blood and oxygen flow throughout the body. Additionally, it can help improve the distribution of tidal volume throughout the lungs, thereby enhancing the effectiveness of ventilation. Nesting therapy is not only physically supportive but also has a psychological impact on the stability of the baby. When babies feel more comfortable, safe, and warm, the central nervous system works more efficiently in regulating vital functions, including respiration (Ramadhani & Maryatun, 2024). This confirms that non-pharmacological interventions, such as nesting, are important strategies in neonatal developmental care to support the gradual and effective physiological adaptation of infants.

Thus, the reduction in respiratory rate on the second and third days after implementing nesting therapy in this study reinforces the evidence that nesting plays a role in stabilizing the baby's breathing pattern. This reduction is one of the positive indicators of the intervention's success in creating an environment that supports respiratory function and reduces the workload on the premature baby's respiratory system.

**Heart Rate**

Heart rate is one of the important vital parameters that reflect the infant's physiological response to the surrounding environment and the level of autonomic nervous system activity. A heart rate that is too high (tachycardia) or too low (bradycardia) in newborns, especially in premature or LBW infants, can be an indicator of physiological stress, pain, discomfort, or adaptation disorders (Nurpaijah & Setia Sari, 2021). Therefore, care interventions that can stabilize pulse frequency are a crucial aspect of neonatal care. One non-pharmacological approach that has proven effective in this regard is nesting therapy, which places the baby in a position resembling the position of the fetus in utero to create a sense of security, comfort, and support physiological stability.

Based on the results of the three-day implementation of nesting therapy, a consistent downward trend in pulse frequency was observed after the intervention. On the first day (October 24, 2024), the baby's pulse frequency dropped from 149 to 137 beats per minute. The second day showed a sharper decrease, from 189 to 148 beats per minute, and on the third day, the pulse rate decreased again from 158 to 122 beats per minute. This decrease not only indicates the calming effect of nesting therapy but also reflects the infant's adaptation process to the extrauterine environment, which is becoming more stable day by day.

This decrease in pulse frequency aligns with the findings of research by Ginting, Pasaribu, et al. (2023), which showed that premature infants receiving nesting therapy experienced a significant

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decrease in heart rate compared to those not receiving nesting therapy. This occurs because a comfortable and physiological body position can reduce excessive sensory stimuli and suppress the stress response. In the context of physiology, this can be attributed to a decrease in sympathetic nervous system activity and an increase in the dominance of parasympathetic nerves that play a role in calming the body.

In addition, a study by Sri Witartiningsih & Aniroh (2022) states that appropriate changes in infant body position, such as those used in nesting therapy, have a direct impact on hemodynamic stability, specifically heart rate. Placing the baby in a flexible lateral position, also known as the “fetal flexion” position, creates gentle pressure throughout the body that resembles the intrauterine environment, thereby providing a calming effect. This effect slows down the heart, which was originally beating rapidly due to environmental stress, to become more stable and energy-efficient.

Another study by Afifah et al. (2025) also revealed that the nesting position can stabilize or increase hemodynamics, because the nesting position makes the baby feel more comfortable, the baby's position is awake, the baby's sleep time is more effective, so that the baby's energy is used optimally in growth and development and nesting positioning can affect physiological functions, namely regular pulse, regular respiration, increased oxygen levels, reduced pain, risk of asphyxia. Reduced, quiet sleep duration increases, and neuromuscular maturity is achieved.

It should be noted that this decrease in pulse frequency that occurs during the implementation of nesting therapy is not a pathological indication, but rather a form of healthy and adaptive physiological adjustment. When the infant is comfortable, warm, and protected, metabolic load and systemic stress decrease, and the heart rate also drops to the normal range. This reflects the important role of nesting therapy as part of neonatal developmental care, which not only attends to clinical aspects but also considers the emotional and sensory needs of the baby (Sejati et al., 2025).

Thus, it can be concluded that nesting therapy has a significant effect in reducing and stabilizing the pulse frequency of LBW infants. This effect is progressive, with the best results usually seen after the intervention is carried out consistently for several days. Nesting can be used as a routine intervention in the Perinatology room to support the cardiovascular stability of infants naturally and non-invasively.

**Oxygen Saturation**

Oxygen saturation is one of the vital indicators that shows how well the baby's body, particularly the lungs and circulatory system, can exchange oxygen gas (Sapitri et al., 2023). In low-birth-weight (LBW) and premature infants, the level of oxygen saturation is often unstable because their vital organs, especially the respiratory and cardiovascular systems, are not yet fully developed. LBW infants also have immature lung tissue, low surfactant production, and suboptimal diaphragm function, resulting in inefficient oxygen exchange in the alveoli (Ginting, Sari, et al., 2023). Under these conditions, oxygen saturation easily decreases, especially when the baby is in a state of stress, anxiety, or apnea.

Based on the measurement results for three days of nesting therapy implementation, it appears that this therapy has a consistent and progressive impact on improving infant oxygen saturation. On the first day (October 24, 2024), oxygen saturation increased from 96% before intervention to 98%

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after nesting therapy. On the second day (October 25, 2024), a greater increase occurred from 94% to 99%, and this result remained consistent on the third day (October 26, 2024), with saturation rising from 97% to 99%. This improvement suggests that nesting therapy significantly contributes to helping infants achieve optimal oxygenation stability during the perinatal phase.

The increase in oxygen saturation in infants receiving nesting therapy can be physiologically explained from two aspects. First, the body position that resembles the fetal position (flexion posture) in nesting increases respiratory efficiency. According to Pratiwi et al. (2024), infants in a physiological position tend to have better chest expansion, lower airway resistance, and more efficient lung ventilation, resulting in increased oxygen distribution to tissues. Secondly, the comfort effect of nesting helps infants to calm down and reduce agitation. Babies who are calm and feel safe will experience a decrease in metabolic activity and oxygen demand, allowing blood oxygen levels to be maintained at a stable level. Nesting helps maintain the baby's position by reducing the pressure on the lungs generated by the heart and maximizing lung function. Therefore, nesting supports improved oxygen saturation by ensuring the infant remains in a position that is optimal for lung function (Desy Fitriana Putri & Rahmah, 2024).

Furthermore, research by Cahyaningrum et al (2025) revealed that the position of the baby's body during sleep has a direct impact on the incidence of hypoxemia (decreased blood oxygen levels). In this case, the nesting position that facilitates physiological posture helps improve respiratory mechanics, reduces excessive intra-abdominal pressure on the diaphragm, and increases the tidal volume of the lungs. This is the basis why oxygen saturation in LBW infants tends to be higher after receiving appropriate positional interventions. Nesting also facilitates the baby's adaptation to the environment, reducing stress and increasing comfort, which in turn stabilizes the baby's oxygen saturation (Melania Fitri Astuti et al., 2022).

The comfort created by nesting also helps the baby achieve a state of quiet sleep, a deep sleep phase characterized by stable breathing, heart rate, and oxygen saturation. In this phase, the body's oxygen demand is lower, and the body is more focused on the recovery process and the development of vital organ systems (Desy Fitriana Putri & Rahmah, 2024). Therefore, nesting intervention is highly recommended to be provided consistently, especially for LBW infants who need help in maintaining internal homeostasis.

Considering the observation of a progressive and steady increase in oxygen saturation over the three days of nesting therapy implementation, it can be concluded that nesting has a major role in supporting the respiratory and circulatory functions of preterm infants. This intervention is proven to be effective, non-invasive, and easy to implement in the neonatal intensive care unit as part of a developmental care approach centered on infant comfort.

## CONCLUSION

Based on the results of implementing nesting therapy for three consecutive days in infants with low birth weight (LBW), it can be concluded that this intervention has a positive effect on the physiological stability of infants, including body temperature, respiratory rate, pulse rate, and oxygen saturation.

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On the first and second days, the baby's body temperature decreased from 36.7°C to 36.3°C and from 36.7°C to 35.9°C after nesting therapy. However, on the third day, the body temperature increased significantly from 35.4°C to 36.3°C, indicating a positive effect after adaptation. The infant's breathing frequency increased from 48 to 53 times per minute on the first day but decreased to 62 times per minute on the second day and to 58 times/minute on the third day. This decrease indicates an increase in respiratory stability after nesting therapy. There was a gradual decrease in pulse rate: on the first day, from 149 to 137 beats/min, on the second day, from 189 to 148 beats/min, and on the third day, from 158 to 122 beats/min. This decrease reflects the infant's positive response to comfort and a decrease in stress due to nesting. The infant's oxygen saturation increased each day: from 96% to 98% (first day), from 94% to 99% (second day), and from 97% to 99% (third day). This indicates an increase in oxygenation efficiency thanks to a body position that favors optimal breathing.

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