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The effect of body position on cardiorespiratory status of premature infants: A systematic review

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Abstract

Background: Preterm infants are a group of infants with a high risk of various health problems, especially respiratory disorders that can affect their oxygenation status and cardiorespiratory function. Body positioning of preterm infants in the neonatal intensive care unit (NICU) is one of the important interventions that can affect lung function and hemodynamic stability
Purpose: To determine the effect of body position on cardiorespiratory status in preterm infants.
Method: This systematic review used the PICO search strategy. The data sources used came from 3 databases namely Pubmed, ProQuest, and ScientDirect. Based on the database, 4 articles were obtained that met the inclusion criteria. Inclusion criteria include respondents are premature infants < 37 weeks gestational age, articles used in the last 10 years (2016 to 2026) and use English.
Results: The study showed that position change interventions had a significant effect on the cardiorespiratory status of preterm infants. Pronation (prone) positioning and its variations, such as quarter prone positioning help maintain cardiorespiratory stability of preterm infants. However, there are certain indications and contraindications in the application of pronation position that need to be considered.
Conclusion: Pronation and semi pronation positions have been shown to increase lung expansion, oxygen saturation, and decrease respiratory frequency and pulse rate, thus helping to maintain cardiorespiratory stability of preterm infants.

Keyword: Body Position; Cardiorespiratory Status; NICU; Preterm Infants.

INTRODUCTION

Premature birth is a health issue that remains a global concern because it carries a high risk of neonatal morbidity and mortality. Premature infants born before 37 weeks of gestation are at high risk of organ dysfunction, particularly of the respiratory and cardiovascular systems. Immature lungs and insufficient surfactant production make them susceptible to conditions such as respiratory distress syndrome (RDS), apnea, and hypoxemia. To address these issues, non-pharmacological interventions such as body positioning have become an important part of neonatal care (Ballout, Foster, Kahale, & Badr, 2017; Darwish, Gibbons, Abdulrazzaq, Lei, Zhoe, Donnelly, Erkinger, Lentz, Stein, & Kresch, 2026; Hermansen & Mahajan, 2015).

Premature apnea is a condition in which breathing stops in babies born before 37 weeks of gestation, lasting more than approximately 15–20 seconds. This can occur with or without a decrease in blood oxygen levels (oxygen desaturation) or a decrease in heart rate (bradycardia). If the apnea episode lasts a long time or occurs repeatedly, it can interfere with blood and oxygen flow to body tissues, including the brain. This disruption of tissue perfusion has the potential to negatively impact the development of the infant's nervous system later in life.Therefore, the prevention

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and treatment of respiratory disorders is one of the main focuses in the care of premature infants in the neonatal unit. These efforts are usually carried out by providing respiratory support, either through invasive methods such as mechanical ventilation or non-invasive methods such as continuous positive airway pressure (CPAP). This approach aims to maintain the baby's respiratory stability, maintain adequate oxygen levels, and reduce the risk of complications that can affect the baby's long-term development (Brunherotti & Martinez, 2015; Richmond, Ring, Richmond, Rossouw, Ballard, & Birch, 2023; van der Burg, Miedema, de Jongh, Frerichs, & van Kaam, 2015; Rivas-Fernandez, i Figuls, Diez-Izquierdo, Escribano, & Balaguer, 2016; Güler, & Çalışır, 2020).

Premature infants often require respiratory support in the neonatal intensive care unit (NICU). Proper body positioning is essential to support hemodynamic stability and respiratory function in premature infants. Some recommended positions include prone (stomach down), quarter/semi-prone, lateral (side), and supine (back). The prone and quarter/semi-prone positions in particular have been shown to improve oxygenation and respiratory stability. Each position has advantages and disadvantages that need to be considered based on the individual condition of the infant. Therefore, it is important to routinely change the infant's position while paying attention to their behavioral responses and personal characteristics to ensure comfort and safety and support their physiological stability (Çakıcı & Mutlu, 2020; Mohamed, Elashry, & Mokbel, 2020; Ghorbani, Asadollahi, & Valizadeh, 2013; Gouna, Rakza, Kuissi, Pennaforte, Mur, & Storme, 2013).

One position that is often used is the prone position, which has been shown to increase oxygen saturation and stabilize cardiorespiratory function in premature infants. Research shows that the prone position can increase oxygen saturation from 89% to 96% in premature infants who use ventilators. In addition, this position also helps reduce breathing and heart rates, as well as improve the quality of sleep in infants. However, despite the widely reported benefits of the prone position, its application in clinical practice still varies. Therefore, it is important to further understand the effect of body position on cardiorespiratory status in premature infants to optimize care and improve the quality of life of infants (Çağlayan & Gözen, 2020; Oishi, Ohta, Hirose, Nakaya, Tsuchiya, Nakagawa, Kusakawa, Sato, Obonai, Nishida, & Yoda, 2018).

This study aims to examine the effect of body position, particularly pronation, on the cardiorespiratory status of premature infants. By understanding this relationship, it is hoped that it will contribute to the development of more effective care strategies for premature infants in neonatal intensive care units.

RESEARCH METHOD

This systematic review was compiled using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Eligibility criteria for this study were respondents with a gestational age <37 weeks. Literature sources were drawn from three databases: PubMed, ProQuest, and ScienceDirect. Articles used were limited to English-language, full-text literature published between 2016 and 2026.

The research question was formulated using the PICO framework: P (Population) is premature infants, I (Intervention) is body position, and O (Outcome) is cardiorespiratory status. The search strategy used keywords relevant to eligible research: "body position OR body positioning," AND "cardiorespiratory parameter OR Oxygen levels OR Hemodynamic," AND "preterm OR premature infants OR Neonatal prematurity OR premature newborn." The retrieved articles were then independently assessed based on title and abstract screening and full-text verification. Data was extracted using a structured data extraction table, including author names (publication year/country), study objectives, study design, and results.

A methodological quality assessment of the studies was conducted to minimize bias using the Joanna Briggs Institute's Critical Appraisal Tools. This systematic review used the JBI Critical Appraisal Tools, which were appropriate for the article's research design, specifically the Checklist for Randomized Controlled Trials for the RCT (Crossover) design.

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RESEARCH RESULTS

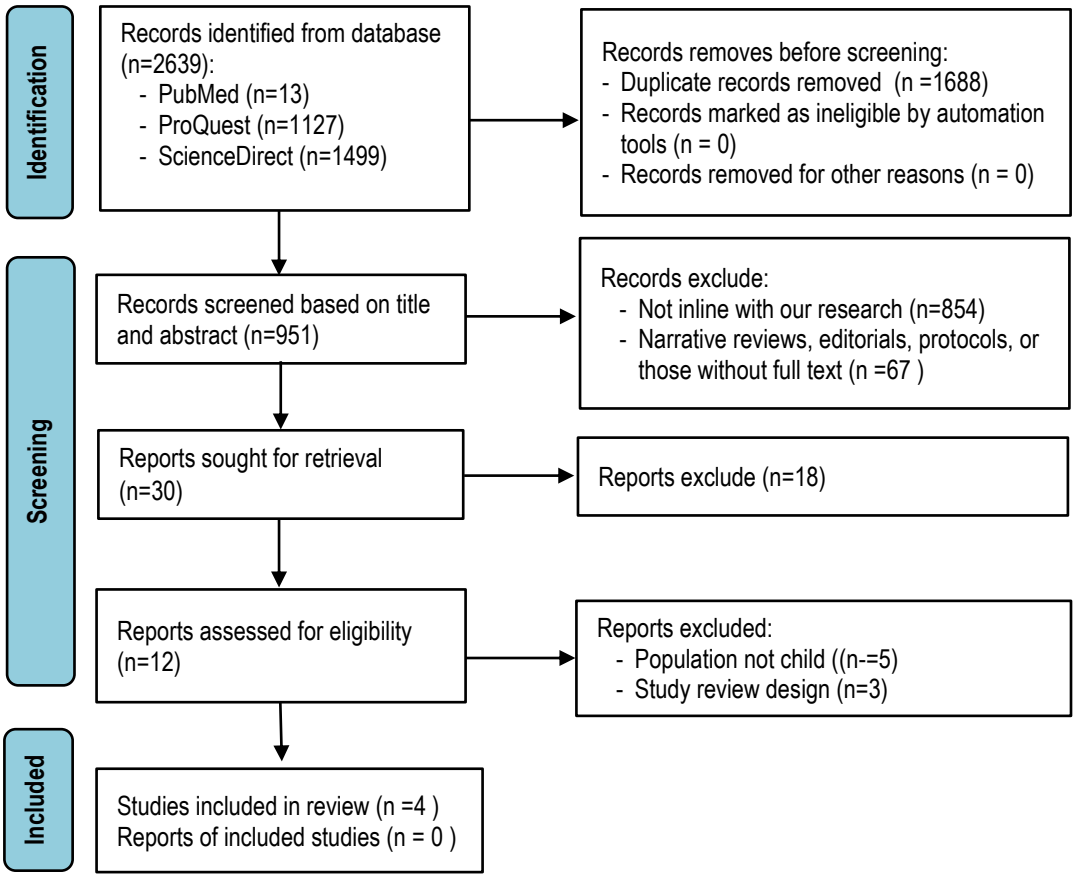

Figure PRISMA Flow Diagram

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Table Characteristics of the Included Studies

(Authors, Year) Country	Purpose	Design study	Sample	Results
(Yin et al., 2016) (Taiwan)	To determine the effect of three sleeping positions (supine, lateral, and semi prone) on physiological parameters (heart rate/HR, respiratory rate/RR, and oxygen saturation/SpO2) in premature infants receiving Nasal Continuous Positive Airway Pressure (NCPAP) therapy.	RCT (Crossover)	47 premature infants with gestational ages between 26-35 weeks	The results showed a significant difference in the mean RR, where the lateral position caused an increase in RR compared to the supine position (p = 0.040). In addition, RR variability was statistically lower in the semiprone position compared to other positions (OR = 0.68; 95% CI 0.51–0.89), which can be concluded that RR is more stable in the semiprone position.
(Çakıcı & Mutlu, 2020) (Turkey)	To investigate the effects of four body positions (supine, prone, left lateral, right lateral) on cardiorespiratory stabilization of preterm infants receiving Nasal Continuous Positive Airway Pressure (NCPAP).	RCT (Crossover)	20 premature infants receiving NCPAP therapy	The results showed that there was no statistically significant difference between heart rate (p = 0.83), respiratory rate (p = 0.90), and oxygen saturation (p = 0.15) with the infant's body position. Four positions (prone, supine, right lateral, and left lateral) performed on premature infants did not affect their cardiorespiratory stabilization.
(Çağlayan & Gözen, 2020) (Turkey)	To compare the effects of supine flexion position (SFP) and prone flexion position (PFP) on heart rate (HR) and oxygen saturation (SPO2).	RCT (Crossover)	438 premature babies in the NICU of a hospital	The results showed that the HR of infants in the supine position was lower than in the prone position in the first 1 and 2 hours. The SpO2 of infants in the supine position decreased immediately after positioning, and this decrease was statistically significant. In contrast, the SpO2 in the PFP did not change much at 0, 1, and 2 hours, and there was no significant difference.
(Richmond, et al., 2023) (Australia)	To compare the effects of infant positioning interventions on respiratory events and oximetry parameters in spontaneously breathing premature infants born < 32 weeks admitted to a neonatal unit.	RCT (Crossover)	68 premature infants (gestational age < 32 weeks) from a tertiary neonatal unit	The results showed that the propped/prone position significantly reduced the incidence and increased the percentage of time SpO2 < 80% and ≥88% compared to the other two conditions (all P < 0.001).

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DISCUSSION

The results of these five research articles demonstrate a strong correlation regarding the importance of body positioning to support physiological stability and comfort of premature infants in the Neonatal Intensive Care Unit (NICU). Body positioning has distinct effects on physiological parameters and comfort of premature infants, particularly on the cardiorespiratory system (Brunherotti, Martinez, & Martinez, 2014; Çakıcı & Mutlu, 2020; Hough, Johnston, Brauer, Woodgate, & Schibler, 2013).

Body positioning is a crucial non-pharmacological intervention in the clinical management of premature infants in the NICU. Consistently, the prone position and its variations, such as semi-prone and propped-prone, have shown significant benefits compared to the supine position in terms of oxygenation stability. Research in Istanbul-Turkey showed that the prone position improves oxygen saturation due to optimized chest wall mechanics and increased lung volume (Çağlayan & Gözen, 2020). This finding is supported by research rom an Australian tertiary neonatal unit found that modifying the propped and prone positions effectively reduced the incidence of apnea, bradycardia, and oxygen desaturation compared to the flat supine position, suggesting that this position provides better mechanical support for spontaneously breathing preterm infants (Richmond et al., 2023). In terms of cardiovascular stability, there were interesting findings regarding respiratory and heart rate variability. Research in Taiwan showed that the semi-prone position provided better respiratory rate stability (lower variability) in preterm infants using Nasal CPAP compared to the lateral and supine positions (Yin, Yuh, Liaw, Chen, & Wang, 2016). This research is also supported by research in Assiut University Children Hospital, which showed that the semi-prone position was most effective in improving heart rate (HR), respiratory rate (RR), and significantly increasing oxygen saturation compared to the right lateral and supine positions (Hassan, Mohamed, & Mohamed, 2020).

While Çakıcı & Mutlu (2020) found no significant differences in heart rate among four positions (supine, prone, right lateral, and left lateral), another study noted a slight increase in heart rate in the prone flexion position. This indicates that although the prone position is highly beneficial for the respiratory system, its effect on cardiac workload may be influenced by other factors such as comfort level or the duration of stabilization after position change. These findings align with several previous studies that have shown that both the prone and semi-prone positions can improve synchronized thoracoabdominal movements and improve respiratory mechanics. These positions are also known to reduce apnea and increase pulmonary ventilation. This can be explained physiologically, as the semi-prone position allows for more even ventilation distribution and increases functional residual capacity, thus supporting respiratory stability in preterm infants (Yin et al., 2016).

The prone position has been shown to produce significantly higher arterial oxygen saturation values than the supine position in infants with respiratory distress. This is supported by findings that the prone position improves oxygenation through better chest wall movement and increased lung volume and can improve oxygenation without significantly affecting hemodynamic stability (Cheraghi, kiani Mahabadi, Sadeghian, Tapak, & Basiri, 2020; King & Norton, 2017; Richmond et al., 2023). Prone positioning in extremely preterm infants reduced the frequency and duration of bradycardias and desaturations. In very preterm infants, prone positioning only reduced the frequency of desaturations (Shepherd, Yiallourou, Odoi, Yeomans, Willis, Horne, & Wong, 2020).

The prone position significantly reduces respiratory rate (RR) and heart rate (HR) compared to the supine position. This decrease indicates a reduction in tachypnea and tachycardia, resulting in more stable and calm premature infants. The advantage of the prone position is thought to be due to reduced pressure on the abdominal organs on the diaphragm.

CONCLUSION

Body position can significantly influence cardiorespiratory stability in premature infants. The prone position (or its variations such as semi-prone and propped-prone) is highly recommended for premature infants because it can increase oxygen saturation, stabilize respiratory rate and heart rate, and provide comfort. The supine and side-lying positions are more frequently associated with bradycardia and oxygen desaturation. Prone

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positioning intervention significantly reduced respiratory events and improved oximetry profiles in spontaneously breathing premature infants compared with the supine position. These results support the use of this position as part of neonatal care, especially for premature infants with recurrent respiratory problems. These findings are important for clinical practice and should be carried out under supervision because it can carry the risk of SIDS (Sudden Infant Death Syndrome), so the implementation of the prone position at home must consider this risk. Therefore, position selection should be individualized, considering the clinical condition and stability needs of each premature infant.

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