



THE EFFECTIVENESS OF BODY POSITIONING INTERVENTIONS ON RESPIRATORY PARAMETERS IN PEDIATRIC PNEUMONIA: A SYSTEMATIC REVIEW

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ABSTRACT

Pneumonia in children can cause impaired oxygenation and an increased respiratory rate. Body positioning is a simple nonpharmacological intervention with the potential to improve respiratory parameters. To analyze the effectiveness of body positioning interventions on respiratory parameters in pediatric patients with pneumonia. This study employed a systematic review design based on the PRISMA 2020 guidelines and the PICO framework. A literature search was conducted through PubMed, DOAJ, and Google Scholar for articles published between 2021 and 2026. A total of 859 articles were identified; 106 duplicates were removed, and 753 articles underwent title and abstract screening. Subsequently, 55 articles were sought for full-text retrieval, 13 articles were assessed for eligibility, and 8 studies met the inclusion criteria and were included in the analysis. Methodological quality was assessed using the Joanna Briggs Institute Critical Appraisal Tools according to each study design. Data were extracted and synthesized narratively because of study heterogeneity. The eight included studies examined various body positioning interventions, including lateral, prone, and semi-recumbent positions, which showed potential to improve SpO₂ and respiratory rate. Body positioning interventions have the potential to improve respiratory parameters in children with pneumonia.

Keywords: body positioning; oxygen saturation; pediatric pneumonia; respiratory parameters

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INTRODUCTION

Pneumonia remains a major cause of pediatric morbidity and mortality, primarily due to pulmonary inflammation and the accumulation of secretions that impair gas exchange. These pathological processes may lead to clinical manifestations such as tachypnea, dyspnea, and hypoxemia, making the optimization of respiratory parameters a key focus of patient management (World Health Organization, 2022). In addition to pharmacological therapy and oxygen administration, body positioning is a simple, feasible, and cost-effective nonpharmacological intervention that may support respiratory function in children. Physiologically, different positions, including supine, prone, lateral, and semi-recumbent positions, may influence respiratory responses by optimizing ventilation–perfusion distribution, promoting lung expansion, and facilitating secretion mobilization (Estela-Zape et al., 2025; Maria, 2022).

Recent evidence suggests that body positioning interventions may improve oxygenation in pediatric populations with respiratory disorders. A systematic review by Zape et al. (2025) examining prone positioning in children with hypoxemia reported improvements in oxygenation parameters and pulmonary function, although substantial variations were observed in intervention protocols, duration, and patient characteristics. In addition, a recent systematic review and meta-analysis by Al-Sofyani et al. (2026) involving pediatric patients with acute respiratory distress syndrome reported that prone positioning may improve oxygenation, although considerable heterogeneity

among studies remained. However, evidence regarding the effectiveness of body positioning specifically in children with pneumonia remains limited and inconsistent. Studies by Agustina et al. (2021) and other related pediatric respiratory studies suggest that the right lateral position may improve oxygen saturation and respiratory rate; however, the available evidence is primarily derived from studies with relatively small sample sizes. Meanwhile, recent reviews of prone positioning in pediatric respiratory disorders have generally focused on critically ill populations and acute respiratory distress, limiting the direct generalizability of their findings to children with pneumonia (Bhandari et al., 2022; Derebe et al., 2022).

Therefore, a synthesis of evidence is needed to specifically evaluate the effectiveness of various body positioning interventions on respiratory parameters in children with pneumonia. This study aimed to systematically review and synthesize the evidence regarding the effects of body positioning interventions on respiratory parameters, particularly oxygen saturation and respiratory rate, in pediatric patients with pneumonia. The findings are expected to provide an evidence-based foundation for the implementation of positioning interventions in pediatric clinical practice.

METHOD

This study employed a systematic review design conducted in accordance with the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.

Research Question (PICO)

The research question was developed using the PICO framework. The Population (P) comprised children aged 0–18 years diagnosed with pneumonia. The Intervention (I) included body positioning interventions, such as semi-recumbent/semi-Fowler, Fowler, lateral/right lateral, prone, and forward-leaning positions. The Comparison (C) consisted of standard positioning, the supine position, usual care, or a control group without a body positioning intervention, when available. The Outcomes (O) included respiratory parameters, primarily oxygen saturation (SpO₂) and respiratory rate, as well as other relevant respiratory parameters when reported.

Literature Search Strategy

A systematic literature search was conducted using PubMed, the Directory of Open Access Journals (DOAJ), and Google Scholar. Articles published between 2021 and 2026 that were available as full-text and open-access publications were considered. The search strategy used a combination of keywords and the Boolean operators AND/OR, adapted to the characteristics of each database. The primary keywords included “pediatric pneumonia,” “children with pneumonia,” “body positioning,” “positioning intervention,” “prone position,” “lateral position,” “semi-Fowler,” “semi-recumbent,” “Fowler position,” “forward-leaning position,” “oxygen saturation,” “SpO₂,” and “respiratory rate.”

The general search strategy was formulated as follows:

(“Pediatric Pneumonia” OR “Children with Pneumonia”) AND (“Body Positioning” OR “Positioning Intervention” OR “Prone Position” OR “Lateral Position” OR “Semi-Fowler” OR “Semi-Recumbent” OR “Forward-Leaning”) AND (“Oxygen Saturation” OR “SpO₂” OR “Respiratory Rate”).

Inclusion and Exclusion Criteria

Studies were included if they met the following criteria: (1) involved children aged 0–18 years with pneumonia; (2) evaluated body positioning as the primary intervention or as a major component of a nursing intervention; (3) reported at least one respiratory parameter, particularly SpO₂ or respiratory rate; (4) used an experimental, quasi-experimental, randomized controlled trial, or relevant observational study design; (5) were published between 2021 and 2026; (6) were published in English or Indonesian; and (7) were available as full-text, open-access articles. Studies were excluded if they involved adult participants, animals, or in vitro models; were review articles,

editorials, letters to the editor, or conference abstracts; or did not evaluate a body positioning intervention or report relevant respiratory outcomes.

Study Selection

Study selection was conducted in several stages, including identification of records, removal of duplicate articles, title and abstract screening, full-text assessment, and identification of studies meeting the inclusion criteria. According to the PRISMA flow diagram, 859 records were initially identified, including 32 articles from PubMed, 83 from DOAJ, and 744 from Google Scholar.

After 106 duplicate records were removed, 753 articles underwent title and abstract screening. A total of 698 articles were excluded because they did not meet the scope of the review. Subsequently, 55 articles were sought for full-text retrieval; however, 42 reports could not be retrieved, leaving 13 articles for eligibility assessment. During the full-text assessment, articles were excluded if their study design was inappropriate, the intervention did not involve body positioning, or the full text was not available as an open-access publication. Ultimately, eight studies met the eligibility criteria and were included in the systematic review.

Study Quality Assessment

The methodological quality of the included studies was assessed using the Joanna Briggs Institute (JBI) Critical Appraisal Tools according to the design of each study. The appropriate JBI checklists for randomized controlled trials and quasi-experimental studies were applied based on the characteristics of each study design. Each assessment item was categorized as “Yes,” “No,” or “Unclear,” as appropriate.

The results of the quality assessment were used to evaluate the methodological quality and potential risk of bias of each included study during the evidence synthesis. Studies with lower methodological quality were interpreted cautiously when drawing conclusions.

Table 1.

Methodological Quality of Included Studies (JBI Critical Appraisal)													
Author (Year)	Study Design	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Yes Score	Quality
Agustina et al. (2021)	Quasi-experimental	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	9/10	High
Sundari & Rimbun (2021)	Quasi-experimental	Y	Y	N	Y	Y	U	Y	Y	Y	Y	8/10	Moderate–High
Danal et al. (2021)	Quasi-experimental	Y	Y	Y	Y	Y	U	Y	Y	Y	Y	9/10	High
Kaş Alay & Yıldız (2024a)	Randomized controlled trial (RCT)	Y	Y	Y	Y	Y	Y	Y	Y	Y	U	9/10	High
Nizar et al. (2024)	Observational study	Y	Y	Y	U	Y	Y	Y	Y	U		7/9	Moderate
Zata et al. (2026)	Pre-experimental	Y	Y	N	Y	Y	U	Y	Y	Y	Y	8/10	Moderate–High
Abd El-Monem El-Deeb et al. (2025)	Quasi-experimental	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	10/10	High
Zheng et al. (2024)	Quasi-experimental	Y	U	U	Y	Y	U	Y	U	U	U	5/10	Low–Moderate

Notes: Y = Yes (fulfilled); N = No (not fulfilled); U = Unclear (insufficient information); NA = Not Applicable.

Data Extraction and Synthesis

Data from each article were extracted using a standardized form, including author name(s) and publication year, study country, study design, sample size, respondent characteristics, pneumonia

type, type and duration of body positioning intervention, comparison group, measured respiratory parameters, measurement instruments, SpO₂ values, respiratory rate, statistical analysis results, and methodological quality of the study. The data were then presented in tabular form and analyzed using narrative synthesis. Narrative synthesis was chosen due to heterogeneity in body positioning types, patient characteristics, study designs, intervention durations, measurement methods, and outcome reporting, which precluded a consistent quantitative meta-analysis.

RESULT

Study Characteristics

Articles were selected based on PRISMA 2020 guidelines evaluating the effectiveness of various body positioning interventions on SpO₂ and respiratory rate in pediatric pneumonia patients. Literature was searched through PubMed, DOAJ, and Google Scholar for publications from 2021 to 2026. Studies were screened using the PICO framework, and their methodological quality was evaluated using the JBI Critical Appraisal Tools. Data regarding study characteristics, position types, comparison groups, and changes in SpO₂ and respiratory rate were extracted and synthesized narratively to determine the effectiveness of body positioning interventions in children with pneumonia.

Study Selection Process Following PRISMA 2020

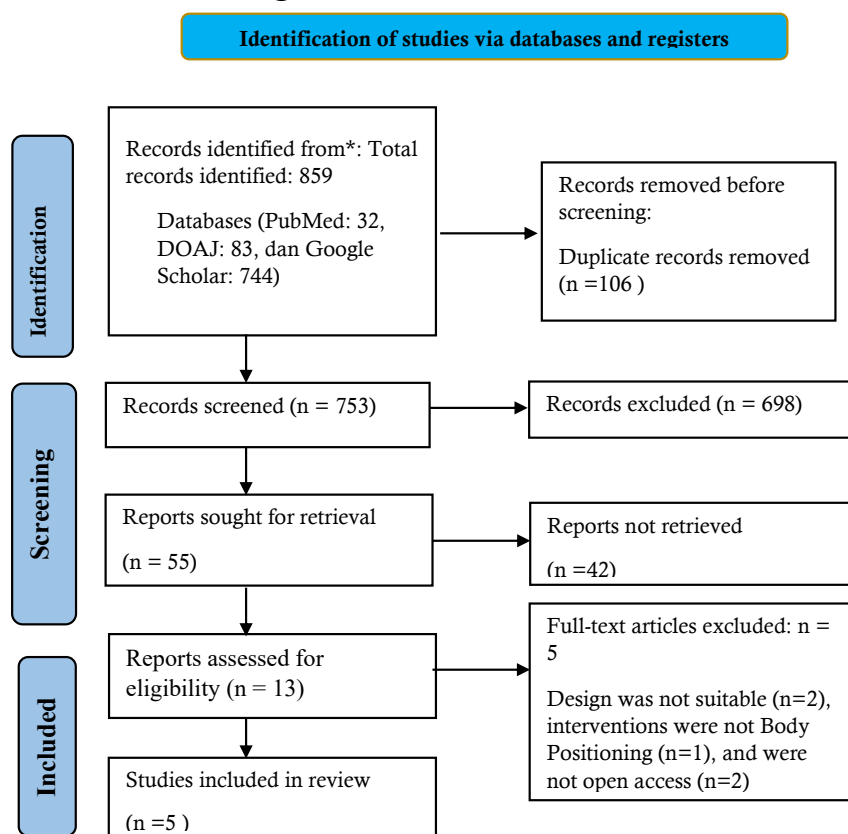


Figure 1. PRISMA Flow Diagram of Study Selection Process
Table 1.

Data Extraction From Included Studies (n = 8)

No.	Author, Year	Title	Intervention/Position	Respiratory Outcome	Study Design	Country
1	Agustina et al. (2021)	Right lateral position can improving oxygen saturation and respiratory rate on under-five children with pneumonia	Right lateral	SpO ₂ and respiratory rate	Quasi-experimental, pre-posttest with control group, n=32	Indonesia

No.	Author, Year	Title	Intervention/Position	Respiratory Outcome	Study Design	Country
2	Sundari & Rimbun (2021)	Pengaruh Posisi Prone pada Balita dengan Pneumonia terhadap Peningkatan Saturasi Oksigen di Ruang PICU RSAB Harapan Kita Jakarta	Prone	SpO ₂	Quasi-experimental, pre-posttest without control, n=15	Indonesia
3	Danal et al. (2021)	Pengaruh Pemberian Posisi Lateral terhadap Saturasi Oksigen dan Frekuensi Pernapasan pada Anak dengan Gangguan Pemenuhan Kebutuhan Oksigenasi	Lateral	SpO ₂ and respiratory rate	Quasi-experimental, n=36	Indonesia
4	Kaş Alay & Yıldız (2024)	Comparison of Forward-Leaning and Fowler Position: Effects on Vital Signs, Pain, and Anxiety Scores in Children With Asthma Exacerbations	Forward-leaning vs. Fowler	SpO ₂ and respiratory rate	Randomized controlled trial, n=86	Turkey
5	Nizar et al. (2024)	Is Prone Positioning Worth the Turn in Pediatrics? Unraveling the Oxygenation Mystery in Ventilated Patients with PNEUMONIA	Prone	Oxygenation index, OSI, SF ratio, PF ratio	Observational study, n=13	India
6	Zata et al. (2026)	Aplikasi Posisi Semi Recumbent terhadap Saturasi Oksigen dan Tingkat Kenyamanan pada Anak dengan Pneumonia	Semi-recumbent	SpO ₂ and comfort	Pre-experimental, one-group pretest-posttest, n=12	Indonesia
7	Abd El-Monem El-Deeb et al. (2025)	Effect of Self-Prone on Respiratory Functions, Pneumonia Severity, and Mortality Risk Among Patients Diagnosed With Community-Acquired Pneumonia: A Nursing-Based Quasi-	Self-prone	Respiratory rate, SpO ₂ , O ₂ requirements, respiratory function	Quasi-experimental, pretest-posttest with control group, n=128	Egypt

No.	Author, Year	Title	Intervention/Position	Respiratory Outcome	Study Design	Country
Experimental Study						
8	zheng et al. (2024)	Effect of high-flow nasal cannula oxygen therapy with awake prone position ventilation vs. supine position ventilation in patients with severe pneumonia: a quasi-experimental study	Awake prone vs. supine	Oxygenation/respiratory parameters	Quasi-experimental, n=120	China

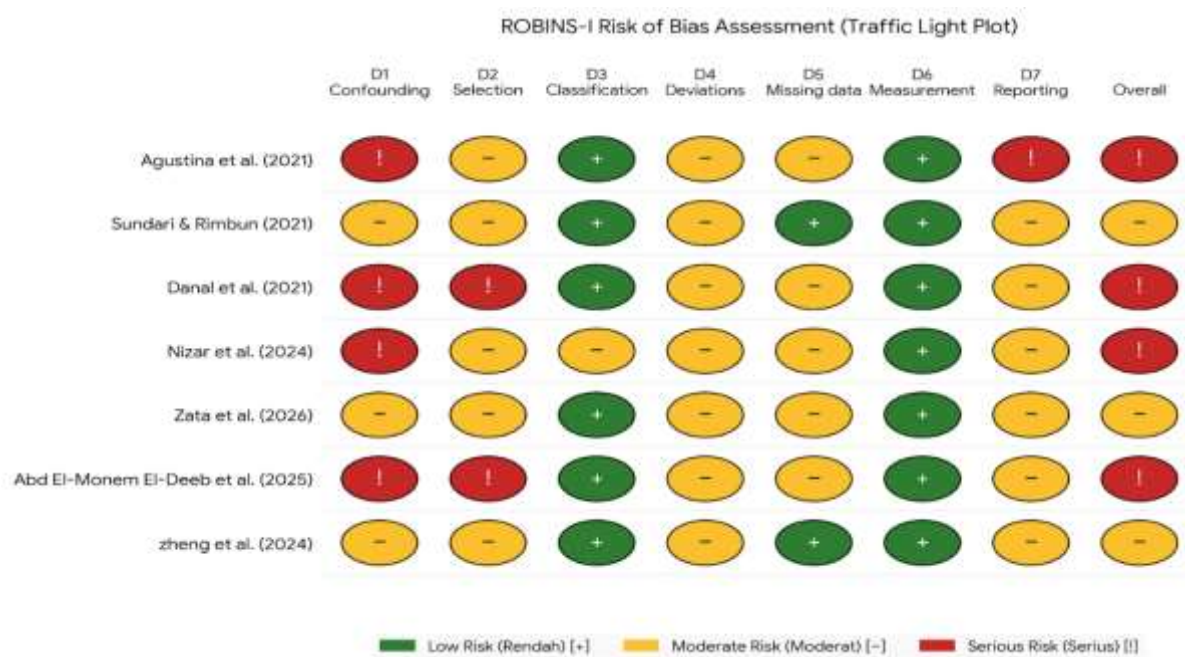


Figure 1. Risk of Bias Traffic Light Plot

The traffic light plot above displays the results of the risk of bias assessment conducted using the ROBINS-I tool for seven non-randomized studies. Overall, the assessment indicates that four studies (Agustina et al., Danal et al., Nizar et al., and Abd El-Monem El-Deeb et al.) carried a serious risk of bias, whereas the remaining three studies (Sundari & Rimbun, Zata et al., and Zheng et al.) were classified as having a moderate risk.

RoB 2 Assessment Traffic Light Plot
Kaş Alay & Yıldız (2024)



Figure 2. RoB 2 (Risk of Bias 2)

The primary threat of bias across this group of studies stemmed from Domain 1 (Confounding) and Domain 2 (Selection of participants), both of which were dominated by moderate to serious risk ratings. Conversely, methodological performance was strongest in Domain 6 (Measurement of outcomes), where all studies achieved a low risk of bias, as well as Domain 3 (Classification of interventions), which was assessed as low risk across nearly all studies.

The RoB 2 traffic light plot for the study by Kaş Alay & Yıldız (2024) indicates generally good methodological quality, with the first four domains evaluated as having a low risk of bias, including the randomization process (D1), deviations from intended interventions (D2), missing outcome data (D3), and measurement of the outcome (D4). However, there were "some concerns" in Domain 5 regarding the selection of the reported result (D5), which ultimately led to the overall risk of bias assessment being categorized as having "some concerns."

DISCUSSION

The results of this systematic review indicate that body positioning interventions have the potential to serve as non-pharmacological nursing interventions that can improve respiratory parameters in children with pneumonia, particularly oxygen saturation (SpO₂) and respiratory rate. Pediatric pneumonia can cause ventilation and oxygenation impairments due to inflammatory processes, secretion accumulation, and ventilation-perfusion mismatch. Consequently, body positioning modifications can be utilized to help optimize lung expansion, maintain airway patency, and improve ventilation distribution. The most direct evidence in this review comes from the studies by Agustina et al. (2021), Sundari and Rimbun (2021), and Zata et al. (2026), all of which specifically involved pediatric patients with pneumonia.

Agustina et al. (2021) demonstrated that the right lateral position had a significant effect on SpO₂ and respiratory rate in 32 children with pneumonia. Utilizing a quasi-experimental pretest-posttest design with a control group, the study revealed significant differences in both SpO₂ and respiratory rate before and after right lateral positioning ($p = 0.000$). These findings suggest that the right lateral position can help increase oxygenation while stabilizing respiratory patterns in pediatric pneumonia patients. Physiologically, the lateral position can influence ventilation-perfusion distribution and assist in maintaining airway patency, thereby facilitating more optimal gas exchange. The strength of this study lies in its inclusion of a control group and the measurement of two respiratory parameters directly relevant to pediatric pneumonia.

These findings are further supported by Danal et al. (2021), who investigated 36 children with impaired oxygenation needs in a pediatric infectious disease ward. This quasi-experimental study compared a group placed in the lateral position with a group receiving standard hospital care. The results showed significant differences in SpO₂ and respiratory rate before and after the lateral positioning intervention. Although the study did not exclusively restrict its sample to a diagnosis of pneumonia, the setting in a pediatric infectious ward and the outcomes measured lend support to the application of positional modifications to improve oxygenation and respiratory patterns in pediatric patients with respiratory distress. Thus, the lateral position can be viewed as a promising, simple nursing intervention to support respiratory stabilization in children with pneumonia.

Regarding the prone position, Sundari and Rimbun (2021) directly evaluated 15 toddlers with pneumonia treated in the PICU. Their quasi-experimental study, using a pretest-posttest design without a control group, showed a significant increase in SpO₂ following prone positioning ($p = 0.000$). These results indicate that shifting to a prone position can enhance oxygenation in pediatric pneumonia. Physiologically, prone positioning improves lung ventilation-perfusion distribution and reduces ventilation-perfusion mismatch in impaired lung regions. Nevertheless, caution is warranted in interpreting these results, as the study lacked a control group and had a relatively small sample

size. Therefore, the increase in SpO₂ cannot be completely isolated from the effects of standard medical therapy or natural clinical progression during hospitalization.

Recent evidence from Zata et al. (2026) provides additional support for the use of the semi-recumbent position in children with pneumonia. Their pre-experimental one-group pretest-posttest study involving 12 children demonstrated that the mean SpO₂ increased from 94.75% before the intervention to 96.50% after semi-recumbent positioning ($p = 0.002$). Beyond oxygenation improvement, the study also reported an increase in patient comfort. This finding is notable because the semi-recumbent position is relatively simple to implement in pediatric patients with respiratory distress and does not require specialized equipment. However, because the study utilized a single group without a control arm and was limited to 12 children, these results should be viewed as preliminary evidence regarding the effectiveness of the semi-recumbent position rather than robust causal evidence.

Evidence concerning the forward-leaning position in children provides an important physiological rationale for developing interventions in pneumonia, even though the available study was not conducted in a pneumonia population. Kaş Alay and Yıldız (2024) conducted a randomized controlled trial involving 86 children with asthma exacerbations, comparing the forward-leaning position to Fowler's position during nebulization. Their results showed that the increase in SpO₂ was significantly greater in the forward-leaning group compared to the Fowler group ($3.2 \pm 1.5\%$ vs. $2.3 \pm 1.9\%$; $p = 0.01$), while the reduction in respiratory rate was also greater in the forward-leaning group (-6.0 ± 1.7 vs. -3.2 ± 1.8 breaths/min; $p < 0.001$). Although the participants were diagnosed with asthma rather than pneumonia, these findings suggest that adopting a forward-leaning position during inhalation therapy can yield benefits for oxygenation and ventilation in pediatric patients with respiratory distress.

Findings in adult pneumonia also offer supplementary support for positioning mechanisms; however, these must be considered indirect evidence for the pediatric population. El-Deeb et al. (2025) conducted a quasi-experimental study on 128 patients with community-acquired pneumonia and found that self-proning improved respiratory rate, SpO₂, supplemental oxygen requirements, and several parameters of respiratory function compared to the control group. The study also demonstrated a reduction in pneumonia severity scores in the intervention group. These results reinforce the likelihood that positional changes can enhance oxygenation through ventilation-perfusion optimization; however, direct extrapolation to pediatric populations should be made cautiously due to differences in physiological characteristics and clinical responses between children and adults.

Similarly, Zheng et al. (2024) reported that combining high-flow nasal cannula (HFNC) with awake prone position ventilation in patients with severe pneumonia yielded a higher treatment success rate compared to HFNC with supine position ventilation (90.0% vs. 76.7% ; $p = 0.040$) and shortened the length of stay. However, changes in the oxygenation index over time showed no significant differences between the two groups ($p = 0.604$). Additionally, because this study was published as a conference abstract without full-text availability, its findings should be regarded as supporting evidence with reporting limitations.

The study by Nizar et al. (2024) provides supplementary evidence regarding prone positioning in pediatric patients with acute respiratory distress syndrome (PARDS), focusing on oxygenation parameters such as the oxygenation index, oxygen saturation index, SF ratio, and PF ratio. However, that study was observational and conducted in children with PARDS rather than specifically pneumonia. Therefore, its results are better suited to elucidating the mechanisms and potential benefits of prone positioning in severe oxygenation impairment in children, rather than serving as direct evidence for positional effectiveness in pediatric pneumonia.

Overall, the findings of this systematic review highlight a consistent pattern: body positioning modifications can confer benefits to oxygenation and respiratory parameters in pediatric pneumonia, although the strength of the evidence varies. The most direct evidence supports the benefits of right lateral, prone, and semi-recumbent positioning on SpO₂, whereas evidence regarding the forward-leaning position in children stems primarily from studies on asthma exacerbations during nebulization. Thus, the forward-leaning position possesses a promising physiological basis and pediatric evidence, but a research gap remains regarding its specific application in children with pneumonia.

This gap is particularly important because most available pediatric pneumonia studies evaluate a single body position in isolation, such as lateral, prone, or semi-recumbent. Very few studies have specifically evaluated the combination of nebulizer therapy with the forward-leaning position in pediatric pneumonia patients while simultaneously measuring changes in SpO₂ and respiratory rate. Consequently, investigating the effectiveness of combining nebulizer therapy with forward-leaning positioning in children with pneumonia has strong scientific relevance and holds potential to contribute to the development of non-pharmacological nursing interventions that are simple, safe, and easily implemented to fulfill oxygenation needs in pediatric care.

CONCLUSION

Based on the results of this systematic review, body positioning interventions show potential effectiveness as non-pharmacological nursing strategies to improve respiratory parameters in pediatric patients with pneumonia. Right lateral, lateral, prone, and semi-recumbent positions demonstrated a tendency to improve oxygen saturation (SpO₂) and/or reduce respiratory rate. However, the available evidence remains limited due to variations in study designs, sample sizes, positioning types, and measurement methods.

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