Open Access

Original Article

Effect of Positioning on Oxygen Saturation Among Neonates with Respiratory Distress

Kalsoom Shahnawaz Lashari, Shaista Gul Lashari, Abdul Hameed Radhan, Zamir Ahmed Qambrani, Khuda Bux Khoso, Farzana Shaikh

Department of Pediatrics, Liaquat University of Medical Health Sciences (LUMHS), Jamshoro, Pakistan

ABSTRACT

Objective: To determine the impact of the prone position versus the supine position on oxygen saturation (SpO2) in children with respiratory distress.

Study design: Qausi-experimental study

Place and Duration of Study: Department of Pediatrics, Liaquat University of Medical Health Sciences (LUMHS), Jamshoro, Pakistan, from Apr to Sep 2025.

Methodology: The study enrolled a sample size of 100 neonates, who were admitted to the neonatal intensive care unit (ICU) with respiratory distress. Following the initial stabilization, all the neonates were subjected to supplementary oxygen in both supine and prone positions. Demographic and clinical data were gathered. Statistical analysis was done through Statistical Package For Social Sciences (SPSS) version 27.00 with independent sample t-test to compare the mean SpO2 between positions where a p-value <0.05 was taken as significant.

Results: The infants in the prone positioning group gradually experienced an increase in mean SpO_2, which reached 95.02 ± 2.15% at 90 minutes, while the supine group's values stayed close to the baseline. A larger number of infants in prone position were able to get SpO_2 ≥92% starting from the 30-minute mark ($p < 0.001$), which proved that there was a continuous and statistically significant improvement in their oxygenation.

Conclusion: Prone position had a significant positive effect in terms of oxygen saturation in neonates with respiratory distress as compared to the supine posture.

Keywords: Infant; Oximetry; Oxygen Saturation; Prone Position; Respiratory Distress Syndrome

How to Cite This Article: *Lashari KS, Lashari SG, Radhan AH, Qambrani ZA, Khoso KB, Shaikh F. Effect of Positioning on Oxygen Saturation Among Neonates with Respiratory Distress. Pak Armed Forces Med J 2026; 76(Suppl-6): S1014-S1018. DOI: https://doi.org/10.51253/pafmj.v76i2.13976*

INTRODUCTION

Respiratory Distress Syndrome in Newborns (NRDS) is caused by the lack of pulmonary surfactant, characterized by the collapse of alveoli and decreased lung compliance, due to which infants experience breathing difficulties and respiratory failure, emerging within 4–12 hours after birth[1]. NRDS is still a major issue in preterm babies[2] leading to increased mortality in less developed countries[3]. Undiagnosed respiratory distress can very quickly lead to respiratory failure and cardiopulmonary arrest[4]. In infants with RDS, perfusion is affected by the process of hypoxia-induced vasoconstriction and changes in the blood vessels due to which pronated posture gives rise to a more even transpulmonary pressure and more favorable ventilation and perfusion, which leads to decreased shunting compared to the supine position[5]. Studies have highlighted that the prone posture contributes to the improvement of oxygen delivery through better movement of the diaphragm and increased negative pressure in the pleural cavity[6–7]. On the other hand, repositioning to the supine state has been connected to the fall in gas exchange[8]. Nevertheless, most of the studies conducted in the developed world focus on the use of the prone position in mechanically ventilated infants[9], but a local study from Pakistan observed a SpO_2 increase from 84.84 ± 4.20 in the supine position to 91.05 ± 3.29 after 2 hours of the prone position[10]. Thus, the aim of our research is to evaluate how different positions impact oxygen saturation in neonates suffering from respiratory distress as there is scant literature on the subject, especially from the local context. The identification of the ideal position will be of great help to the clinicians in terms of improving the outcomes with correct ventilation and oxygenation.

METHODOLOGY

A quasi-experimental study was carried out at the Children's Hospital and the Department of Pediatrics, Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro, Pakistan, for a duration of six months, from April 1, 2025, to September 30, 2025. Institutional ethics review committee approved the study and issued a protocol number No. LUMHS/REC/1090, dated: 10/09/25. The sample size

Correspondence: Dr Shaista Gul Lashari, Department of Pediatrics, Liaquat University of Medical Health Sciences, Jamshoro Pakistan
Received: 22 Oct 2025; revision received: 27 Jan 2026; accepted: 28 Jan 2026

was determined by assuming a power of 95% and a significance level of 5%, an average SpO_2 after two hours in supine (84.84 ± 4.20) and prone (91.05 ± 3.29) positions in infants with RDS with a correlation of 0.50, which resulted in an estimated sample size of 80, calculated with G*Power software.[11] The minimum required sample size was 80, however, a total of 100 neonates were recruited by applying a non-randomized consecutive sampling method.

Inclusion Criteria: Both male and female neonates, a gestational age of at least 32 weeks, and conforming to the operational definition of RDS were included in the study.

Exclusion Criteria: Babies with neonatal congenital defects, intrauterine growth retardation, neonates of mothers diagnosed with diabetes during pregnancy, and infants whose parents did not consent.

Data gathering activities began immediately after the Research Evaluation Unit of the College of Physicians and Surgeons Pakistan (CPSP) and the institutional ethical review committee gave their approvals. All infants who were suffering from RDS and were admitted to the neonatal intensive care unit (NICU) and who met inclusion criteria were included in the study. Written and informed consent was obtained from the parents before enrollment. All infants were given oxygen support through nasal prongs. Initially, two hours of respiratory support was provided in the supine position and oxygen saturation was monitored. Then, oxygen was given to the infants in the prone position for two more hours while oxygen saturation was checked. Those infants who worsened during the trial received emergency care immediately and were excluded if they did not complete follow-up in both positions. A predesigned data collection form was used to record demographic and clinical data such as gender, gestational age, birth weight, Apgar scores at 1 and 5 minutes, oxygen requirement, and oxygen saturation. All data was analysed by Statistical Package for Social Sciences (SPSS) version 27.00. Data was normally distributed as per Shapiro-Wilk>0.05. Continuous variables, such as gestational age, birth weight, Apgar scores, and SpO_2, were reported as mean ± standard deviation (SD), and categorical variables as counts and percentages. To compare the mean SpO_2 between the prone and supine groups at each time point, independent samples t-tests were conducted while Chi-square tests were used to evaluate the differences in categorical outcomes such as the proportion of infants reaching $SpO_2 \geq 92\%$ and *p*-value of ≤ 0.05 was deemed to indicate a statistically significant result. Additionally, trend analyses were carried out to detect the changes in SpO_2 over time. The entire analytical process was based on the valid cases only, which were free of missing or out-of-range values, thus guaranteeing the accuracy and dependability of the results.

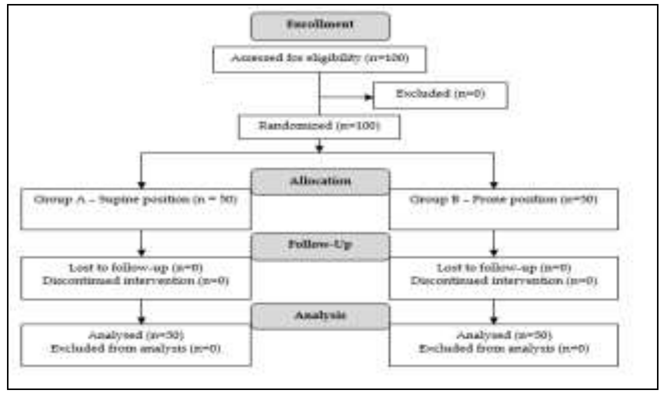

Figure: Patient Flow Diagram (n=100)

RESULTS

The research involved a sample of 100 neonates who were randomly divided into two groups, each with 50 babies, Group A being supine and Group B being prone. The overall sample consisted of 58.00% males and 42.00% females, but the gender distribution was not significantly different between the supine and prone groups (60.00% versus 56.00% males; p = 0.840). The mean gestational age of the study population was 33.06±2.41 weeks and was similar in both groups (32.70 ± 2.58 weeks in the supine group versus 33.42±2.20 weeks in the prone group; p = 0.139). The mean birth weight was also comparable across groups, with the supine group averaging 2.06 ± 0.50 kg and the prone group 2.04 ± 0.51 kg (p = 0.850). The average Apgar score at 1 minute for the whole cohort was 5.69 ± 1.20, with similar numbers in the supine and prone groups (5.56 ± 1.16 versus 5.82 ± 1.22; p = 0.279). At 5-minute intervals, the Apgar scores were also close in both groups (7.70 ± 0.79 in the supine and 7.80 ± 0.70 in the prone; p = 0.504). Concerning the leading reason for respiratory distress syndrome, the lack of surfactant was the most common cause, and it was seen in 85.00% of the neonates. The second reason was meconium aspiration (10.00%) and pneumonia (5.00%) and there was no significant difference in the distribution of the two groups' etiological factors (p = 0.900).

Table-I: Baseline Characteristics of the Study Participants (n=100)

Characteristic	Total Sample (N = 100)	Group A: Supine (n = 50)	Group B: Prone (n = 50)	p-value
Gender, n (%)				0.840
Male	58(58.00%)	30(60.00%)	28(56.00%)	
Female	42(42.00%)	20(40.00%)	22(44.00%)	
Gestational Age (weeks)				0.139
Mean ± SD	33.06 ± 2.41	32.70 ± 2.58	33.42 ± 2.20	
Range	28–36	28–36	29–36	
Birth Weight (kg)				0.850
Mean ± SD	2.05 ± 0.50	2.06 ± 0.50	2.04 ± 0.51	
Range	1.10–3.80	1.20–3.80	1.10–3.50	
Apgar (1 min)				0.279
Mean ± SD	5.69 ± 1.20	5.56 ± 1.16	5.82 ± 1.22	
Apgar (5 min)				0.504
Mean ± SD	7.75 ± 0.74	7.70 ± 0.79	7.80 ± 0.70	
Primary Cause of RDS, n (%)				0.900
Surfactant Deficiency	85(85.00%)	43(86.00%)	42(84.00%)	
Meconium Aspiration	10(10.00%)	5(10.00%)	5(10.00%)	
Pneumonia	5(5.00%)	2(4.00%)	3(6.00%)	

SD = Standard Deviation;
p-value from Chi-square test for categories and independent sample t-test for continuous variables

Table-II: Statistical Comparison of Mean SpO_2 Between Supine and Prone Positioning (n=100)

Time Point	Prone (n = 50) Mean ± SD	Supine (n = 50) Mean ± SD	p-value
Baseline	88.26 ± 3.45	89.00 ± 3.61	0.298
15 minutes	91.38 ± 2.64	89.16 ± 2.98	<0.001
30 minutes	93.54 ± 2.57	89.52 ± 2.76	<0.001
45 minutes	94.20 ± 1.78	88.92 ± 3.08	<0.001
60 minutes	94.80 ± 2.21	90.40 ± 3.07	<0.001
75 minutes	94.58 ± 2.09	90.48 ± 2.87	<0.001
90 minutes	95.02 ± 2.15	90.24 ± 2.97	<0.001
105 minutes	94.26 ± 2.47	90.28 ± 3.46	<0.001
120 minutes	93.46 ± 1.92	90.08 ± 2.99	<0.001

Table-III: Frequency of Neonates Achieving Target SpO_2 (≥92%) by Position (n=100)

Category (SpO_2 ≥92%)	Prone n(%)	Supine n (%)	p-value
Baseline	6 (12.00)	11 (22.00)	0.183
15 minutes	20 (40.00)	12 (24.00)	0.086
30 minutes	38 (76.00)	13 (26.00)	<0.001
45 minutes	47 (94.00)	8 (16.00)	<0.001
60 minutes	49 (98.00)	16 (32.00)	<0.001
75 minutes	48 (96.00)	19 (38.00)	<0.001
90 minutes	46 (92.00)	17 (34.00)	<0.001
105 minutes	42 (84.00)	20 (40.00)	<0.001
120 minutes	42 (84.00)	16 (32.00)	<0.001

Both groups had similar mean baseline SpO_2, which was measured at 88.26 ± 3.45% for the prone group and 89.00 ± 3.61% for the supine group. After the intervention, the prone group experienced a steady increase in oxygen saturation, as indicated by the mean SpO_2 values of 91.38 ± 2.64% at 15 minutes, 93.54 ± 2.57% at 30 minutes, and 95.02 ± 2.15% at 90 minutes, with then a slight decline at 105 and 120 minutes (94.26 ± 2.47% and 93.46 ± 1.92%, respectively). On the other hand, the supine group did not show any significant change in SpO_2 over the period, and the mean values were around the baseline, ranging from 88.92 ± 3.08% to 90.48 ± 2.87% during all observation intervals. To sum up, the whole group was able to gradually increase the mean SpO_2 from 88.63 ± 3.54% at the beginning to 92.63 ± 3.52% after 90 minutes, after which a slight decrease occurred at 120 minutes (91.77 ± 3.02%), thus showing a more pronounced and sustained improvement in oxygenation among the prone patients. Initially, the average SpO_2 levels were similar in both prone and supine groups (88.26 ± 3.45% versus 89.00 ± 3.61%; p = 0.298). Nevertheless, starting from 15 minutes, the prone group consistently showed significantly(p-value<0.001) better oxygen saturation than the supine group at all the following measurement points. The study showed that from 30 minutes onward, neonates in the prone group demonstrated a higher success rate of achieving SpO_2 levels above 92% which continued to show benefits throughout the entire observation period. The advantage of prone positioning was still evident at 105 minutes (94.26 ± 2.47% versus 90.28 ± 3.46%; $p < 0.001$) and 120 minutes (93.46 ± 1.92% versus 90.08 ± 2.99%; $p < 0.001$), thus confirming that the prone position was significantly and continuously improving oxygenation.

At baseline, patients getting SpO_2 ≥92% was similar in the prone and supine groups (12.00% versus 22.00%; p = 0.183). After 15 minutes, more patients in the prone group reached SpO_2 ≥92% than the supine group, but this was not significant (40.00% versus 24.00%; p = 0.086). Starting from 30 minutes, a large part of patients in the prone position got good oxygenation which caused a significantly greater number of neonates with SpO2 ≥92% to remain in this condition since it was realized after 30 minutes onwards. This benefit was retained during the entire observation period ($p < 0.001$), thus confirming the maintenance of a significant oxygenation benefit via prone positioning over time statistically.

DISCUSSSION

Our findings are well entrenched in the established physiology of respiration as there is a general agreement among a wide variety of studies that the prone position enhances ventilation-perfusion (V/Q) matching in a variety of mechanisms[12]. These are: a decreased cardiac impedance of the lungs, a more uniform distribution of pleural pressure, increased diaphragmatic function because of anterior movement of the abdominal walls, and better clearance of pulmonary fluids[13,14]. Our results indicate that prone positioning is a natural maneuver to recruit the lung in neonates with RDS who possess low lung compliance and functional residual capacity (FRC). Our average SpO_2 shows an improvement in the range of +2.22% to +5.28%, with the maximum difference at 45 minutes (+5.28%). These findings are similar to and even stronger than another research, where mean SpO_2 improved by +3.20 in preterm infants.[15] We found a larger improvement with a sustained average of ~+4.0 to +4.6 and peak difference of +5.28% at 45 minutes, likely due to the lower baseline SpO_2 of our cohort (88.4%), which implies that the more ailing the baby, the higher the possible absolute advantage of optimum positioning. A more recent study also reported a statistically significant increment of SpO 2 between 90.76 (supine) and 95.24 (prone) in preterm infants,[16] which is +4.48, nearly identical to the effect size we observed. We noted in our categorical analysis that, from 30 minutes of prone, a substantially greater percentage of neonates ($p < 0.001$) were above SpO_2 ≥92% and over 90% of neonates at 45 minutes maintained that cut-off (compared to 16% in supine), substantiated by the results of another study which indicated that a much greater proportion of neonates in the prone position maintained SpO 2 within a target range (95-99) of (99-98).[17] The maximum benefit in our study was at 45 minutes of prone positioning and lasted to 120 minutes, while other studies have found the maximum benefit to be at 60 minutes.[18,19] This minor discrepancy in the time to peak effect may be due to differences in the severity of RDS, gestational age distributions in the samples of the studies, or even the definition of respiratory distress.

LIMITATIONS OF STUDY

This study was carried out at one center, which could be a limitation of generalizability. Even though the baseline characteristics were similar, a randomized crossover design (each neonate is his/her control in both positions in randomized order) would further remove any possible inter-individual confounding. Moreover, we paid attention to short-term physical results. This should form the basis of future studies to examine the effects of positional therapy in the long term on such outcomes as the oxygen dependency duration, bronchopulmonary dysplasia occurrence rates, and the duration of hospitalization.

CONCLUSION

Prone positioning was considerably more effective than the supine position in oxygen saturation in neonates with respiratory distress, making it an easy, economical, and statistically significant intervention in improving hypoxemia in the case of respiratory distress in neonates.

Conflict of Interest: None.

Funding Source: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

KSL & SGL: Data acquisition, data analysis, critical review, approval of the final version to be published.

AHR & ZAQ: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

KBK & FS: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCE

1. Legesse BT, Wondie WT, Mekonen WM, Mekonnin GB. Predictors of mortality among neonates admitted with hypothermia and respiratory distress syndrome at West Oromia tertiary hospitals, retrospective follow-up study, 2023. J Neonatal Nurs. 2025; 31(3): 101673. https://doi.org/10.1016/j.jnn.2025.101673
2. Stylianou-Riga P, Boutsikou T, Kouis P, Kinni P, Krokou M, Ioannou A, et al. Maternal and neonatal risk factors for neonatal respiratory distress syndrome in term neonates in Cyprus: a prospective case-control study. Ital J Pediatr. 2021; 47(1): 129. https://doi.org/10.1186/s13052-021-01086-5
3. Chen IL, Chen HL. New developments in neonatal respiratory management. Pediatr Neonatol. 2022; 63(4): 341-347. https://doi.org/10.1016/j.pedneo.2022.03.003
4. Dyess N, Kinsella JP, Parker TA. Acute neonatal respiratory disorders. In: Gleason CA, Devaskar SU, editors. Avery's diseases of the newborn. 11th ed. Philadelphia: Elsevier; 2024. p. 594-613. https://doi.org/10.1016/B978-0-323-82823-9.00042-8
5. Poets CF, Lim K, Cramer S, Marshall A, Gale T, Dargaville PA. Oxygenation and intermittent hypoxia in supine vs prone position in very preterm infants. Acta Paediatr. 2020; 109(8): 1677-1678. https://doi.org/10.1111/apa.15353
6. Yang S, Sun Q, Yuan X, Wang J, Wang H, Hu W, et al. Effect of prone position on ventilation-perfusion matching in patients with moderate to severe ARDS with different clinical phenotypes. Respir Res. 2025; 26(1): 70. https://doi.org/10.1186/s12931-025-03154-4
7. Guérin C. Prone ventilation in acute respiratory distress syndrome. Eur Respir Rev. 2014; 23(132): 249-257. doi: https://doi.org/10.1183/09059180.00001114
8. La Vita CJ, De Santis Santiago RR. Prone position: a strategy in expansion? Respir Care. 2021; 66(5): 884-885. https://doi.org/10.4187/respcare.09131
9. Qin W, Mao L, Shen Y, Zhao L. Prone position in the mechanical ventilation of acute respiratory distress syndrome children: a systematic review and meta-analysis. Front Pediatr. 2024; 12: 1293453. https://doi.org/10.3389/fped.2024.1293453
10. Daas H, Shaikh SKN. Effect of prone versus supine position on oxygen saturation in patients with respiratory distress in neonates. Pak J Med Sci. 2011; 27(5): 1098-1101.
11. Fridrich P, Krafft P, Hochleuthner H, Mauritz W. The effects of long-term prone positioning in patients with trauma-induced

adult respiratory distress syndrome. Anesth Analg. 1996; 83(6): 1206-1211. https://doi.org/10.1097/00000539-199612000-00013

12. Chacko J, Pawar S, Seppelt I, Brar G. Prone ventilation in acute respiratory distress syndrome. In: Kulkarni RL, Dixit SB, Kulkarni AP, editors. Controversies in critical care. Springer Nature; 2023. p. 47-54. https://doi.org/10.1007/978-981-19-9940-6_6
13. Amiri B, Zemková E. Diaphragmatic breathing exercises in recovery from fatigue-induced changes in spinal mobility and postural stability: a study protocol. Front Physiol. 2023; 14: 1251978. https://doi.org/10.3389/fphys.2023.1251978
14. Inoue R, Nagamine Y, Ohtsuka M, Goto T. Association between diaphragmatic dysfunction after adult cardiovascular surgery and prognosis of mechanical ventilation: a retrospective cohort study. J Cardiothorac Vasc Anesth. 2024; 38(3): 701-707. https://doi.org/10.1053/j.jvca.2023.10.024
15. Kaltsogianni O, Jenkinson A, Harris C, Jeffreys E, Sikdar O, Greenough A, et al. Closed-loop automated oxygen control in late preterm and term, ventilated infants: a randomised controlled trial. Acta Paediatr. 2025; 114(6): 1222-1228. https://doi.org/10.1111/apa.17549
16. Castro ES, Bacil LF, Almeida FL, Andreazza MG, Alves RA, Valderramas SR. Premature newborn positionings and physiologic parameters: a randomized clinical study. Fisioter Mov. 2023; 36: e36121. https://doi.org/10.1590/fm.2023.36.121.en
17. Hassan MHM, El-Sakka ASE, Ahmed DAH, Alhassanin AHAS. Cardiorespiratory assessment of preterm and near term neonates on nasal continuous positive airway pressure (CPAP) in different body positions. QJM. 2024; 117(Suppl 2): hcae175.760. https://doi.org/10.1093/qjmed/hcae175.760
18. Shamkhi HAH, Shawq AH. Positioning preterm newborns for cardiorespiratory stability: a global insight. Acad Open. 2024; 9(2): e24090204. https://doi.org/10.21070/acopen.9.2024.9063
19. Susanthy M, Rustina Y. Efektivitas posisi prone dibandingkan posisi supine terhadap fungsi fisiologis bayi prematur. J Telenursing. 2022; 4(1): 243-251. https://doi.org/10.31539/joting.v4i1.3376

....