https://doi.org/10.29309/TPMJ/2026.33.03.10223 www.theprofesional.com

ORIGINAL ARTICLE

Incidence and risk stratification of pediatric acute respiratory distress syndrome in pediatric intensive care unit.

Muhammad Sami[1], Murtaza Ali Gowa[2], Hira Nawaz[3], Zaiba Anwar[4], Uzma Siddique[5], Ghazala Jamal[6]

ABSTRACT… Objective: To determine the incidence and risk stratification of pediatric acute respiratory distress syndrome (PARDS) in mechanically ventilated (MV) patients admitted at the pediatric intensive care unit (PICU). **Study Design:** Prospective Observational study. **Setting:** The PICU of National Institute of Child Health, Karachi, Pakistan. **Period:** April 2024 to March 2025. **Methods:** A total of 200 children aged 1 month to < 18 years admitted to the PICU with PARDS, and undergoing MV were included. Risk stratification was done on the basis of oxygenation index (OI) categorizing as mild (4 ≤ OI < 8), moderate (8 ≤ OI < 16), and severe (OI ≥ 16). Duration of MV, use of inotropes, PICU stay duration, and mortality were documented and compared with respect to PARDS severity using chi-square test, and Kruskal-Wallis test, taking p<0.05 as significant. **Results:** Among 200 children, 111 (55.5%) were female, and overall median age was 8.00 (IQR, 4.00–12.00) years. Regarding PARDS categorizations, 24 (12.0%) had mild, 82 (41.0%) moderate, and 94 (47.0%) severe PARDS. Inotropic support was required in 84 (42.0%) patients. Median duration of MV, and PICU stay were 8.00 (5.00–11.00), and 16.00 (12.00–23.00) days, respectively, increasing significantly with severity (p<0.001). Mortality was highest in severe PARDS (21.3%) compared to moderate (2.4%) and mild cases (4.2%) (p<0.001). **Conclusion:** The PALICC definition and stratification system for PARDS effectively categorize mechanically ventilated pediatric patients into distinct severity groups associated with clinically meaningful differences in ventilator requirements, PICU stay, and mortality.

Key words: Children, Inotropes, Mechanical Ventilation, Mortality, Oxygenation Index.

Article Citation: Sami M, Gowa MA, Nawaz H, Anwar Z, Siddique U, Jamal G. Incidence and risk stratification of pediatric acute respiratory distress syndrome in pediatric intensive care unit. Professional Med J 2026; 33(03):445-449. https://doi.org/10.29309/TPMJ/2026.33.03.10223

INTRODUCTION

Acute respiratory distress syndrome (ARDS) has been long known to clinicians since its early description.[1] Various guidelines had been published in the last three decades to define ARDS, but these were originally adult-derived criteria/definitions, which were then extrapolated for pediatric populations.[2,3] With time, it became apparent that pediatric-specific definitions were strongly needed. Due to numerous anatomic and physiologic differences between adults and children, like incomplete airway cartilage formation, greater increase in resistance with decrease in radius of airways, higher metabolic demand, or greater compliance, infants and children are more prone to serious illness with relatively small insults.[4] To overcome these hurdles, in 2015 a panel of 27 experts constituted the Pediatric Acute Lung Injury Consensus Conference (PALICC) and proposed new pediatric-specific definitions for ARDS.[5]

Wong et al demonstrated the PALICC criteria for stratification of PARDS into mild (23.9%), moderate (39.9%), and severe (36.2%) groups with overall mortality of 30.3%.[6] The largest international prospective study, Pediatric Acute Respiratory Distress Syndrome Incidence and Epidemiology (PARDIE)[7], found that PARDS affects 3% of PICU patients, and mortality exceeds 30% in those with severe hypoxemia. Gupta et al., estimated that the PALICC criteria showed a higher prevalence of PARDS (9.8%) as compared to the Berlin definition (4.2%).[8] Prasertsan et al observed the prevalence and outcome of PARDS according to the PALICC as 7.4% and the mortality rate as 51.1% in a PICU in Thailand.[9] In India, the incidence of PARDS was relatively higher (11.4%), with an overall mortality of 45.2%, as indicated by Bhart et al in their prospective observational study.[10]

1. MBBS, Postgraduate Trainee Pediatric Medicine, National Institute of Child Health, Karachi, Pakistan.
2. MBBS, FCPS (Padiatric Medicine), MRCPCH (UK), PCCM, Associate Professor Section Head Pediatric Intensive Care Unit, National Institute of Child Health, Karachi, Pakistan.
3. MBBS, FCPS (Pediatric Medicine), Consultant Pediatrician and Post-Fellow Critical Care Medicine, Pediatric Intensive Care Unit, National Institute of Child Health, Karachi, Pakistan.
4. MBBS, Postgraduate Trainee Pediatric Medicine, National Institute of Child Health, Karachi, Pakistan.
5. MBBS, FCPS (Pediatrics), Fellow Pediatric Intensive Care Unit, National Institute of Child Health, Karachi, Pakistan.
6. MBBS, MCPS (Pediatrics), Registrar Pediatric Intensive Care Unit, National Institute of Child Health, Karachi, Pakistan.
Correspondence Address:
Dr. Muhammad Sami
Department of Pediatric Medicine, National Institute of Child Health, Karachi, Pakistan.
drsami.1609@hotmail.com

Article received on:
14/10/2025
Accepted for publication:
20/12/2025

In Pakistan, there is a considerable lack of research exploring PARDS while some researchers have documented the frequency of PARDS to be as high as 15.3% in PICUs.[11] Although researchers used OSI as the labeling criteria for PARDS, invasive procedures are still in use for the assessment of oxygenation, which do not depict the actual burden of the disease among the local pediatric population. The current study was planned with the objective of estimating the incidence and risk stratification of PARDS in mechanically ventilated (MV) patients at PICU using the PALICC criteria.

METHODS

This prospective observational study was performed at the pediatric intensive care unit (PICU) of the National Institute of Child Health, Karachi, Pakistan, from April 2024 to March 2025, after obtaining approval from the Institutional Ethical Review Board (letter number: IERB-35/2023, dated: 14-12-2023). A sample size of 200 was calculated as per the WHO sample size calculator, taking the expected prevalence of RDS in the PICU as 15.3%[11], setting the confidence level at 95%, and the margin of error at 5%. Children aged between 1 month to < 18 years and admitted to the PICU due to ARDS defined in the PALICC were included. Only those who were mechanically ventilated were included. The exclusion criteria were patients with active perinatal disease or those with preparation/recovery from cardiac intervention. ARDS was labeled on the basis of hypoxemia caused by non-cardiogenic pulmonary edema developed acutely in the context of severe systemic illness. The partial pressure of oxygen (PaO_2) in the arterial blood <80 mm of Hg was considered hypoxemia. A non-probability consecutive sampling technique was followed for sample selection. Informed written consent from parents/caregivers of patients was obtained.

Cases meeting the eligibility criteria went through documentation of their demographics and clinical parameters. The history of the onset of symptoms of the patients was recorded. An X-ray chest was done for each patient and reviewed with a radiologist for the presence of infiltrates. Information regarding ventilator settings and the use of inotrope support was also gathered. Oxygenation index (OI) was calculated for all patients, and risk stratification was done on the basis of OI values, considering the PALICC. Risk stratification followed as mild (4 ≤ OI < 8), moderate (8 ≤ OI < 16), and severe (OI ≥ 16), calculated using mean airway pressure (MAP) X fraction of inspired oxygen (FiO_2) / PaO_2 X 100.[12] All the patients were followed for the disease outcome. A specifically predesigned proforma was utilized for the collection of relevant data.

Data were analyzed using IBM SPSS Statistics version 26.0. Categorical variables were summarized as frequencies and percentages, while continuous variables were presented as median and interquartile ranges (IQR) after assessing normality with the Shapiro-Wilk test. Comparisons across PARDS severity were performed using the Chi-square test for categorical variables, and the Kruskal-Wallis test for continuous variables, taking $p<0.05$ as significant. Survival analysis was conducted using Kaplan-Meier curves with log-rank (Mantel-Cox) test.

RESULTS

In a total of 200 mechanically ventilated children diagnosed with PARDS, 111 (55.5%) were female. The median (IQR) age was 8.00 (4.00-12.00) years. According to PALICC criteria, PARDS was classified into mild 24 (12.0%), moderate 82 (41.0%), and severe 94 (47.0%) categories. The male-to-female distribution was comparable across PALICC classification of PARDS ($p=0.955$) (Table 1). The median age was statistically similar among children of different PALICC categories ($p=0.797$). Median weight also did not significantly differ ($p=0.752$). Bilateral pulmonary infiltrates were significantly more frequent in moderate and severe PARDS compared to mild cases ($p=0.019$) (Table-I).

Inotropes were used among 84 (42.0%) children during PICU stay. Mortality was reported in 23 (11.5%) cases. The median duration of MV, and PICU stay were 8.00 (5.00-11.00) days, and 16.00 (12.00-23.00) days, respectively. The median duration of MV progressively increased with PARDS severity ($p<0.001$). The requirement for inotropic support was significantly higher in severe PARDS ($p<0.001$). The median PICU stay increased with severity, from 8.00 days (IQR, 7.00–9.75) in mild to 14.00 days (IQR, 12.00–17.25) in moderate,

and 23.00 days (IQR, 15.00–24.25) in severe cases (p<0.001). Mortality was significantly higher in severe PARDS (21.3%) compared to moderate (2.4%) or mild (4.2%) (p<0.001). Table-II is showing comparison of various outcomes according to PARDS as per PALICC classification.

The Kaplan-Meier survival analysis demonstrated a significant difference in cumulative survival across severity groups (log-rank test, p=0.011), with the lowest survival observed among patients with severe PARDS (Figure-1).

DISCUSSION

This study demonstrated that according to PALICC classification, severe PARDS was the most common category (47%), followed by moderate (41%) and mild (12%) cases. Judith et al.[6] reported an approximately balanced distribution among mild (27.3%), moderate (36.4%), and severe (36.4%) PARDS in their prospective study, although the proportion of mild PARDS was comparatively higher than that observed in the present cohort.

FIGURE-1

Survival analysis with respect to pediatric acute respiratory distress syndrome severity

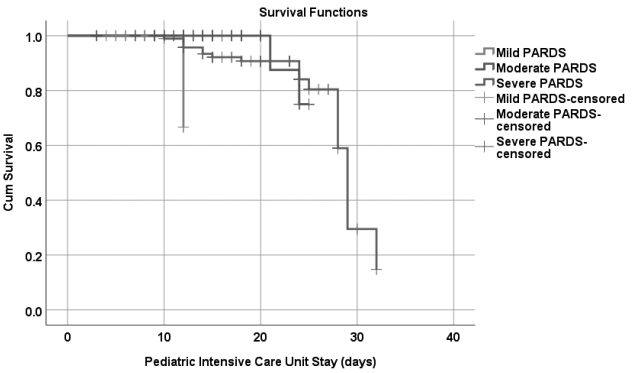

TABLE-I

Characteristics of children according to PARDS classification

Characteristics		Total (%) Mild (n=24)	Severity of PARDS		P-Value
			Moderate (n=82)	Severe (n=94)	
Gender	Male	89 (44.5%)	14 (58.3%)	45 (54.9%)	52 (55.3%)	0.955*
	Female	111 (55.5%)	10 (41.7%)	37 (45.1%)	42 (44.7%)	
Age (years)#		8.00 (4.00-12.00)	8.00 (4.00-12.00)	8.50 (3.75-13.00)	8.00 (4.00-12.00)	0.797^
Weight (kg)#		23.36 (12.00-35.00)	20.50 (9.75-35.75)	23.00 (11.2-35.00)	24.00 (12.00-35.00)	0.752^
Radiological findings	Bilateral	144 (72.0%)	12 (50.0%)	58 (70.7%)	74 (78.7%)	0.019*
	Unilateral	56 (28.0%)	12 (50.0%)	24 (29.3%)	20 (21.3%)	

Kg: kilogram; PARDS: pediatric acute respiratory distress syndrome;
*Chi-square test applied; ^Kruskal-Wallis test applied
#Presented as median and interquartile range

TABLE-II

Comparison of outcomes according to PARDC classification

Outcomes	Total	Severity of PARDS			P- value
		Mild (n=24)	Moderate (n=82)	Severe (n=94)	
Duration of mechanical ventilation (days)#	8.00 (5.00-11.00)	4.00 (2.00-5.00)	7.50 (5.00-9.00)	9.50 (6.00-13.00)	<0.001^
Use of inotropes	84 (42.0%)	4 (16.7%)	24 (29.3%)	56 (59.6%)	<0.001*
Duration of PICU stay (days)#	16.00 (12.00-23.00)	8.00 (7.00-9.75)	14.00 (12.00-17.25)	23.00 (15.00-24.25)	<0.001^
Mortality	23 (11.5%)	1 (4.2%)	2 (2.4%)	20 (21.3%)	<0.001*

PARDS: pediatric acute respiratory distress syndrome
*Chi-square test applied; ^Kruskal-Wallis test applied
#Presented as median and interquartile range

Wong et al.[6], in a multicenter study across Asia, found that 23.9%, 39.9%, and 36.2% of patients had mild, moderate, and severe PARDS, respectively, aligning closely with the current findings where moderate and severe cases predominated. The higher proportion of severe PARDS cases in the present study may be attributed to referral bias, as NICH serves as a tertiary referral center receiving critically ill patients from across the region, many of whom present late in their disease course.

Mortality in the current study was 11.5%, which increased significantly with PARDS severity, reaching 21.3% among severe cases. This graded increase in mortality with disease severity is consistent with the survival curves and outcomes described by Khemani et al.[7], where severe PARDS was associated with a mortality rate of approximately 33%. Ju-Ming et al. reported a 30.3% overall PICU mortality rate among PARDS patients, and a 100-day mortality of 39.7%, with risk increasing progressively from mild to severe PARDS.[2] These data affirm the prognostic validity of the PALICC stratification system, as higher OI thresholds correspond to worsened outcomes.[14,15]

The association between bilateral infiltrates and worse outcomes observed in this study is corroborated by findings from Rudolph et al.[16], who demonstrated significantly increased mortality among patients with bilateral consolidations (26.3% versus 9.3% for unilateral disease, p=0.025). In this study, bilateral infiltrates were present in 72% of cases and were significantly more prevalent in moderate and severe disease (p=0.019). These finding reinforce the importance of incorporating radiological assessment into early risk stratification protocols in suspected PARDS.[17]

This study found that duration of MV, and PICU stay increased significantly with respect to PARDS severity. Judith et al.[13], demonstrated that time to resolution of oxygenation defect progressively lengthened from mild to severe PARDS (p<0.001). The duration of PICU stay emphasizes the substantial resource burden posed by severe PARDS.[18] The findings from Liang et al.[19], highlight the importance of using dynamic OI measurements to refine prognostication. Liang et al.[19], documented that the worst OI within 72 hours after diagnosis better stratified outcomes, with mortality rates closely aligned to severity definitions. Dynamic assessment offers a practical and valuable tool for clinicians in resource-limited settings where advanced biomarkers or imaging modalities may not be readily available.[20]

The single-center nature of the study may limit generalizability. The study design did not allow for longitudinal reassessment of oxygenation indices. The study did not collect detailed comorbidity data, nutritional status, or severity of illness scores such as PRISM III or PELOD-2. The recent PALICC-2 guidelines have emphasized not only refining diagnostic criteria but also addressing the morbidity burden and resource limitations globally.[21]

CONCLUSION

The PALICC stratification system for PARDS effectively categorize MV pediatric patients into distinct severity groups associated with clinically meaningful differences in ventilator requirements, PICU stay, and mortality. Severe PARDS remains a major clinical challenge with significant resource utilization and mortality. Early identification and aggressive management of moderate and severe cases are critical.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

SOURCE OF FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Ashbaugh DG, Bigelow DB, Petty TL, Levine BE. **Acute respiratory distress in adults.** Lancet. 1967; 2(7511):319-23.
2. Bernard GR, Artigas A, Brigham KL, Carlet J, Falke K, Hudson L, et al. **The American-European Consensus Conference on ARDS. Definitions, mechanisms, relevant outcomes, and clinical trial coordination.** Am J Respir Crit Care Med. 1994; 149(3 Pt 1):818-24.
3. ARDS Definition Task Force, Ranieri VM, Rubenfeld GD, Thompson BT, Ferguson ND, Caldwell E, et al. **Acute respiratory distress syndrome: The Berlin Definition.** JAMA. 2012; 307(23):2526-33.
4. Cheifetz IM. **Year in Review 2015: Pediatric ARDS.** Respir Care. 2016; 61(7):980-85.

5. Pediatric Acute Lung Injury Consensus Conference Group. **Pediatric acute respiratory distress syndrome: consensus recommendations from the Pediatric Acute Lung Injury Consensus Conference.** Pediatr Crit Care Med. 2015; 16(5):428-39.
6. Wong JJ, Phan HP, Phumeetham S, Ong JSM, Chor YK, Qian S, et al. **Risk stratification in pediatric acute respiratory distress syndrome: A multicenter observational study.** Crit Care Med. 2017; 45(11):1820-28.
7. Khemani RG, Smith L, Lopez-Fernandez YM, Kwok J, Morzov R, Klein MJ, et al. **Paediatric acute respiratory distress syndrome incidence and epidemiology (PARDIE): An international, observational study** [published correction appears in Lancet Respir Med. 2019 Feb; 7(2):e9. doi: 10.1016/S2213-2600(18)30475-2.] [published correction appears in Lancet Respir Med. 2019;7(3):e12. doi: 10.1016/S2213-2600(19)30032-3.]. Lancet Respir Med. 2019; 7(2):115-128.
8. Gupta S, Sankar J, Lodha R, Kabra SK. **Comparison of prevalence and outcomes of pediatric acute respiratory distress syndrome using pediatric acute lung injury consensus conference criteria and berlin definition.** Front Pediatr. 2018; 6:93.
9. Prasertsan P, Anuntaseree W, Ruangnapa K, Saelim K, Geater A. **Severity and mortality predictors of pediatric acute respiratory distress syndrome according to the pediatric acute lung injury consensus conference definition.** Pediatr Crit Care Med. 2019; 20(10):e464-e472.
10. Yadav B, Bansal A, Jayashree M. **Clinical profile and predictors of outcome of pediatric acute respiratory distress syndrome in a PICU: A prospective observational study.** Pediatr Crit Care Med. 2019; 20(6):e263-e273.
11. Ahmed R, Azim A, Nangialay A, Haque A, Jurair H. **Frequency of pediatric acute respiratory distress syndrome based on oxygen saturation index in pediatric intensive care unit of a developing country.** Cureus. 2019; 11(12):e6444.
12. Yehya N, Thomas NJ, Khemani RG. **Risk stratification using oxygenation in the first 24 hours of pediatric acute respiratory distress syndrome.** Crit Care Med. 2018; 46(4):619-24.
13. Judith WJM, Tan HL, Sultana R, Ma YJ, Aguilan A, Lee SW, et al. **The longitudinal course of pediatric acute respiratory distress syndrome and its time to resolution: A prospective observational study.** Front Pediatr. 2022; 10:993175.
14. Kneyber MCJ, Khemani RG, Bhalla A, Blokpoel RGT, Cruces P, Dahmer MK, et al. **Understanding clinical and biological heterogeneity to advance precision medicine in paediatric acute respiratory distress syndrome.** Lancet Respir Med. 2023; 11(2):197-212.
15. Bhalla A, Baudin F, Takeuchi M, Cruces P. **Second Pediatric Acute Lung Injury Consensus Conference (PALICC-2) of the Pediatric Acute Lung Injury and Sepsis Investigators (PALISI) Network. Monitoring in pediatric acute respiratory distress syndrome: From the second pediatric acute lung injury consensus conference.** Pediatr Crit Care Med. 2023; 24(12 Suppl 2):S112-S123.
16. Rudolph M, van Dijk J, de Jager P, Dijkstra SK, Burgerhof JGM, et al. **Performance of acute respiratory distress syndrome definitions in a high acuity paediatric intensive care unit.** Respir Res. 2021; 22(1):256.
17. Jabaudon M, Audard J, Pereira B, Jaber S, Lefrant JY, Blondonnet R, et al. **Early changes over time in the radiographic assessment of lung edema score are associated with survival in ARDS.** Chest. 2020; 158(6):2394-2403.
18. Pujari CG, Lalitha AV, Raj JM, Kavilapurapu A. **Epidemiology of acute respiratory distress syndrome in pediatric intensive care unit: Single-center experience.** Indian J Crit Care Med. 2022; 26(8):949-55.
19. Zhou L, Li S, Tang T, Yuan X, Tan L. **A single-center PICU present status survey of pediatric sepsis-related acute respiratory distress syndrome.** Pediatr Pulmonol. 2022; 57(9):2003-2011.
20. Matthay MA, Arabi Y, Arroliga AC, Bernard G, Bersten AD, Brochard LJ, et al. **A new global definition of acute respiratory distress syndrome.** Am J Respir Crit Care Med. 2024; 209(1):37-47.
21. Emeriaud G, López-Fernández YM, Iyer NP, Bembea MM, Agulnik A, Barbaro RP, et al. **Executive summary of the second international guidelines for the diagnosis and management of Pediatric Acute Respiratory Distress Syndrome (PALICC-2).** Pediatr Crit Care Med. 2023; 24(2):143-68.

AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Muhammad Sami:** Data collection, drafting.
2	**Murtaza Ali Gowa:** Study concept.
3	**Hira Nawaz:** Proof reading, Critical revisions.
4	**Zaiba Anwar:** Data analysis.
5	**Uzma Siddique:** Data collection.
6	**Ghazala Jamal:** Critical revision, data analysis.