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Risk Factors and Outcomes of Anemia in Pediatric Patients with Lower Respiratory Tract Infections

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Abstract

Anemia is a significant public health concern in pediatric populations, affecting millions of children worldwide. Understanding the risk factors and outcomes of anemia in pediatric patients with LRTI is crucial for developing effective prevention and treatment strategies. This study aims to investigate the risk factors and outcomes of anemia in pediatric patients with LRTI, providing valuable insights for healthcare professionals and policymakers. 374 pediatric patients (less than 18 years old) at Tobruk Medical Center who were diagnosed with LRTI between July 2022 and June 2023 had their medical records examined. The percentage of anemia was 49.7% (186/374), nearly half of the patients had anemia, with infants and toddlers having the greatest rates (30.5% and 14%, respectively). Significant risk factors were male sex ($p = 0.012$) and age ($p < 0.001$). The longest hospital stays and the greatest rates of intensive care unit admissions are linked to severe anemia (<8 g/dL) in LRTI patients ($p < 0.001$). Anemia is a common comorbidity in pediatric LRTI patients, particularly among young children and males. ICU admission rates and extended hospital stays are associated with severe anemia. Early detection and management are crucial to improve outcomes.

Keywords: Anemia, Lower Respiratory Tract Infection (LRTI), pediatric, ICU Admission, Risk Factors.

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عوامل الخطورة و مضاعفات فقر الدم لدى الأطفال المصابين بعدوى الجهاز التنفسي السفلي

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الملخص

فقر الدم هو مصدر قلق كبير للصحة العامة في فئات الأطفال، حيث يؤثر على ملايين الأطفال في جميع أنحاء العالم. إن فهم عوامل الخطر ونتائج فقر الدم لدى مرضى الأطفال المصابين بالتهابات الجهاز التنفسي السفلي أمر بالغ الأهمية لتطوير استراتيجيات فعالة للوقاية والعلاج. تهدف هذه الدراسة إلى التحقيق في عوامل الخطر ونتائج فقر الدم لدى مرضى الأطفال المصابين بالتهابات الجهاز التنفسي السفلي، وتوفير رؤى قيمة لمهنيي الرعاية الصحية وصناع السياسات. تم فحص السجلات الطبية لـ 374 مريضًا من الأطفال (أقل من 18 عامًا) في مركز طبرق الطبي والذين تم تشخيصهم بالتهابات الجهاز التنفسي السفلي بين يوليو 2022 ويونيو 2023. كانت نسبة فقر الدم 49.7٪ (374/186)، و كان ما يقرب من نصف المرضى يعانون من فقر الدم، وكان لدى الرضع والأطفال الصغار أعلى المعدلات (30.5٪ و 14٪ على التوالي). كانت عوامل الخطر المهمة هي الجنس الذكري ($p = 0.012$) والعمر ($p< 0.001$). ترتبط أطول فترات الإقامة في المستشفى وأعلى معدلات دخول وحدة العناية المركزة بفقر الدم الشديد (<8 جم / ديسيلتر) في مرضى التهاب الجهاز التنفسي السفلي ($p < 0.001$). فقر الدم هو مرض مصاحب شائع لدى مرضى التهاب الجهاز التنفسي السفلي عند الأطفال، وخاصة بين الأطفال الصغار والذكور. ترتبط معدلات دخول وحدة العناية المركزة والإقامة الطويلة في المستشفى بفقر الدم الشديد. يعد الاكتشاف المبكر والإدارة أمرًا بالغ الأهمية لتحسين النتائج.

الكلمات المفتاحية: فقر الدم، عدوى الجهاز التنفسي السفلي (LRTI)، طب الأطفال، دخول وحدة العناية المركزة، عوامل الخطر

Introduction

Lower respiratory tract infections (LRTIs) are a leading cause of morbidity and mortality globally, particularly among pediatric populations (Lisa Frigati et al. 2024). These infections encompass various conditions, including pneumonia, bronchiolitis, and

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bronchitis, which affect the lungs and airways (Rodrigo Cavallazzi et al. 2022), (SaeidSafiri et al. 2022). LRTIs account for approximately 2.7 million deaths annually, with the majority occurring in developing countries. Anemia, marked by low hemoglobin (Hb) levels, significantly exacerbates disease severity and worsens outcomes in pediatric lower respiratory tract infection (LRTI) patients (Roma Kma et al. 2015, Dixita Tailor et al. 2023, Henish Shakya et al. 2018, Sheikh Quyoom, et al.2014). This multifaceted relationship involves: Pathophysiological Mechanisms: 1. Inflammation: Cytokine release and oxidative stress contribute to anemia (F Morceau et al. 2010). 2. Impaired Erythropoiesis: Reduced erythropoietin production and ineffective erythropoiesis (P Bhaskaram et al. 2003). 3. Oxidative Stress: Enhanced free radical production, damaging red blood cells (RBCs) (Emmanuel Ifeanyi et al. 2024). Contributing Factors: 1. Nutritional Deficiencies: Iron, vitamin B12, and folate deficiencies (Ola G. Behairy et al. 2018). 2. Chronic Diseases: Chronic kidney disease, HIV/AIDS, and malaria (S. Kent et al. 1994). 3. Genetic Disorders: Sickle cell disease, thalassemia, and glucose-6-phosphate dehydrogenase (G6PD) deficiency (ZaferKurugol et al. 2012). According to WHO criteria, for children aged 6–59 months, anemia is defined at Hb < 11.0 g/dL (10.0–10.9, 7.0–9.9, and < 7.0 g/dL correspond to mild, moderate and severe anemia, respectively. For children aged 5–11 years old, anemia is defined as Hb < 11.5 g/dL, in which 11.0–11.4, 8.0–10.9, and < 8.0 g/dL correspond to mild, moderate and severe anemia, respectively. for children aged 12 - 14 years old and for Girls > 14 years old anemia is defined as Hb< 12 g/dl , in which 11.0-11.9, 8.0-10.9 and < 8.0 g/dl correspond to mild, moderate and severe anemia, respectively. For boys > 14 years anemia defined Hb< 13g/dl, in which 11.0-12.9, 8.0-10. 9 and< 8.0 g/dl correspond to mild, moderate and severe anemia, respectively. Rationale for Study: Given the significant burden of anemia among pediatric LRTI patients, understanding itsrisk factors and outcomes is crucial. This knowledge will inform healthcare providers and policymakers in developing effective strategies for early detection, management, and prevention of anemia in pediatric LRTI patients.

Methods

Study Design: Retrospective cross-sectional study: Analyzed existing medical records of pediatric LRTI patients.

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Study Population: 1. Inclusion criteria: Pediatric patients (<18 years) diagnosed with LRTI. 2. Exclusion criteria: Patients with chronic diseases, congenital anomalies, or incomplete medical records. 3. Sample size: 374 patients.
Data Collection: 1. Medical records review: Extracted demographic, clinical, and laboratory data: 2. Anemia diagnosis: Based on WHO cutoff values.
Statistical Analysis: 1. SPSS version 26: Used for data analysis. 2. Descriptive statistics: Calculated means, standard deviations, and frequencies. 3. Chi-Square test: Compared categorical variables. 4. Independent Samples T-Test: Compared means. 5. Logistic Regression: Identified risk factors. 6. Spearman's Rank Correlation Coefficient: Assessed correlations. 7. Significance level: $p < 0.05$.

Results

374 pediatric patients were diagnosed with LRTI in period between July 2022 and June 2023 aged from 0-18 years, were admitted in pediatric ward and PICU.Anemia was observed in 186patients 49.7% (186/374), nearly half of the patients had anemia. Table 1& Figure 1 show Age specific anemia percentage, Anemia was highest among infants (30.5%) and Toddlers (14%). Table 2 & Figure 2 show the distribution of anemia severity, mild anemia being the most common (58.6%). Table 3& Figure3 show the risk factors of anemia, Age: Infants and young children (P value<0.001)& male sex 114(61.3%) (P value =0.012) were significant risk factors for anemia. Table 4 shows the difference in ICU admission rates between Hb level categories is statistically significant ($p < 0.001$). Lower Hb levels significantly increase ICU admission risk and hospital stay duration. The difference in hospital stay durations between Hb level categories is statistically significant ($p < 0.01$). Severe anemia is associated with the highest ICU admission rates and longest hospital stays as seen in Figure4.

Table 1 presents Age-Specific Anemia percentage

Variable	Frequency	Percentage
Age Groups		
0-1 month	9	2.4
>1 month-1 year	112	30.5
>1-5 years	52	14
>5-12 years	12	3.2
>12 years	1	0.3

Age (mean ± SD) 3.5 ± 2.8

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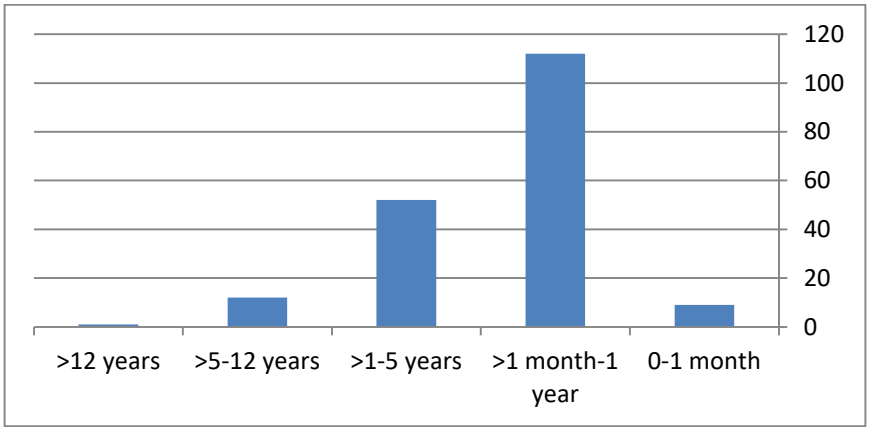

Figure 1: Age specific Anemia percentage

Table 2 the distribution of anemia severity.

Anemia Status	Frequency (n)	Percentage (%)
Anemic	186	49.7
Non-anemic	188	50.3
Mild Anemia	109	58.6
Moderate Anemia	68	36.6
Severe Anemia	9	4.8

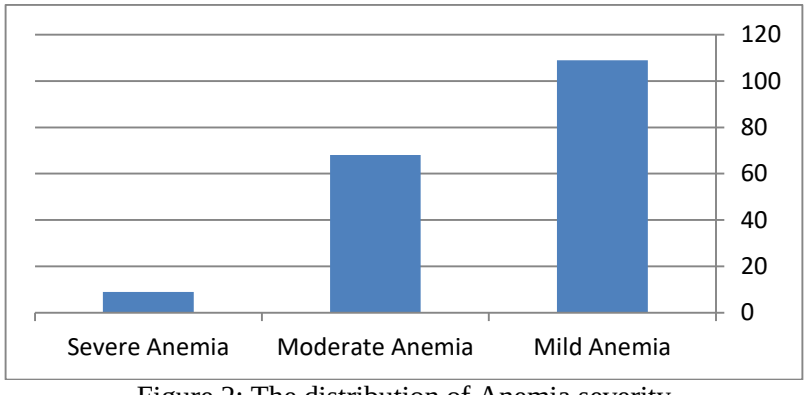

Figure 2: The distribution of Anemia severity

Table 3 the risk factors associated with anemia.

Risk Factors	Anemic (n)	Non-anemic (n)	p-value
Age	2.8 ± 2.5	4.1 ± 2.9	<0.001
Male Sex	114 (61.3%)	92 (48.9%)	0.012

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Table 4 ICU admission and Hospital stay duration by Hb level

Category	ICU admission %	Hospital stay(days)	ICU stay (days)
Normal	5.1%	2	1-2
Mild	15.6%	3-4	2-3
Moderate	30.4%	5-6	3-5
Severe	51.1%	8-10	5-7

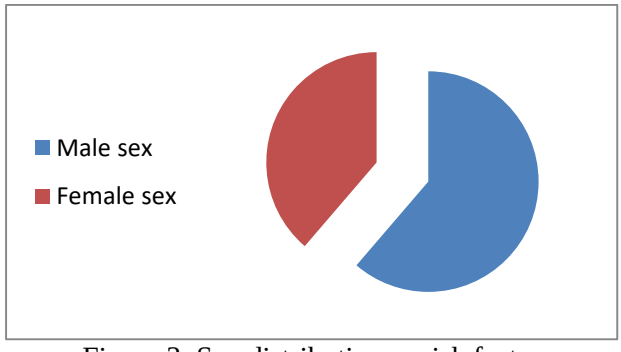

Figure 3: Sex distribution as risk factor

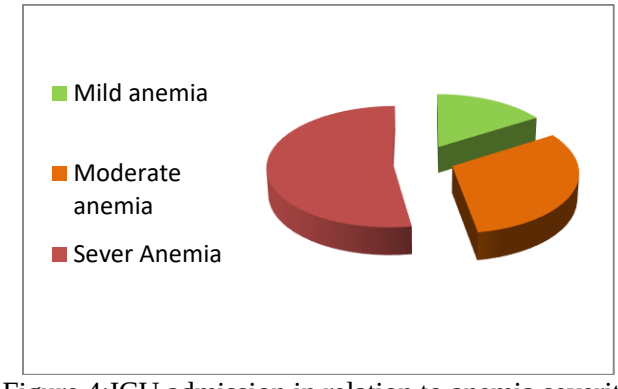

Figure 4:ICU admission in relation to anemia severity

Discussion

This retrospective cross-sectional study elucidates the complex interplay between anemia, age and disease severity in pediatric lower respiratory tract infection (LRTI) patients. Our findings corroborate existing literature, providing valuable insights for clinicians and researchers.Anemia was present in nearly half (49.7%) of pediatric LRTI patients, with mild anemia accounting for the majority (58.6%). This result is consistent with earlier findings (Gobinaath, et al. 2020 and Gajanan, et al. 2023). The

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frequency of anemia highlights its importance in the treatment of pediatric LRTI. Anemia was peaked among infants (30.5%) and toddlers (14%), echoing findings by Amanuel 2021, Ushani, et al. 2023 & Innocent B, et al. 2023. Younger children's immature immune systems and limited respiratory reserve render them susceptible to anemia's detrimental effects. Age and male sex significantly increased anemia risk, consistent with Marol, et al. 2020 & Henedina, et al. 2012. Anemia severity predicted ICU admission rates (51.1% for severe anemia) and hospital stay durations (8-10 days for severe anemia), mirroring findings by Manisha S, et al. 2020, Abhin S, et al. 2023 & Shereen A. 2024. Early anemia detection and management are crucial to mitigate these adverse outcomes.

Conclusion

In children with lower respiratory tract infections (LRTI), this retrospective cross-sectional study conducted at Tobruk Medical Center showed a strong correlation between anemia and unfavorable outcomes. Important conclusions include:Anemia is a common comorbidity in pediatric LRTI patients with Infants and toddlers were disproportionately affected, male sex and age raise the risk of anemia.Prolonged hospital stays and ICU admission rates are associated with severe anemic outcomes. These results are consistent with earlier studies that highlight the significance of early anemia detection and treatment. Results may be enhanced by the use of focused therapies, dietary assistance, and routine hemoglobin testing.

Clinical Implications

1. Regular hemoglobin monitoring.
2. Age-targeted interventions.
3. Nutritional support.
4. Prompt anemia identification and treatment.

Limitations

1. Retrospective design.
2. Single-center setting.

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