Original Article

# Hemoglobin Status in Pediatric Heart Failure: A Clinical Insight



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## ABSTRACT

**Objective:** To assess the relationship between hemoglobin levels and the severity of left ventricular dysfunction in pediatric heart failure, informing personalized therapeutic strategies.

**Study Design:** A retrospective study

**Place and Duration of Study:** This study was conducted at the Department of pediatrics cardiology Lady Reading Hospital Peshawar between December 2022 and December 2023.

**Methods:** Haemoglobin levels and the degree of left ventricular dysfunction were evaluated in a retrospective obsdrvational study of paediatric heart failure patients at Lady Reading Hospital in Peshawar.

**Results:** In 684 patients, a higher degree of left ventricular dysfunction was linked with lower haemoglobin levels. There were 310 (45.3%) females and 374 (54.7%) males, almost evenly distributed by gender. The average age was 6.8 years. Haemoglobin levels averaged 11.7 g/dL (SD = 1.2) for mild cases, 11.4 g/dL (SD = 1.3) for moderate cases, and 10.8 g/dL (SD = 1.4) for severe cases, depending on the severity of left ventricular dysfunction.

**Conclusion:** In conclusion, hemoglobin levels in pediatric heart failure indicate promise as prognostic markers, indicating the need for more research to develop customised therapies and enhance results.


**Key Words:** Pediatric, Heart Failure, Hemoglobin, Prognosis

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## INTRODUCTION

The incapacity of the heart to sufficiently meet the body's metabolic demands is the hallmark of paediatric heart failure, a complicated and difficult clinical entity. Affected children and their families must bear heavy costs due to this condition, which is linked to considerable morbidity and mortality. Worldwide, heart failure continues to be the primary cause of paediatric hospitalisations and mortality even with advances in diagnostic and treatment techniques[1]. One of the key parameters routinely assessed in children presenting with heart failure is the level of hemoglobin. Hemoglobin, a vital component of erythrocytes, plays a fundamental role in oxygen transport and delivery to tissues. In the context of heart failure, alterations in hemoglobin levels may signify underlying pathophysiological mechanisms and provide valuable prognostic insights[2]. Numerous studies have been conducted on the connection between haemoglobin levels and heart failure in adult populations, and anaemia has been found to be an independent predictor of unfavourable outcomes in heart failure patients[3]. On the other hand, not much is known about the role that haemoglobin levels play in paediatric heart failure. Extrapolating results from adult studies may not be suitable given the distinct physiological and developmental characteristics of children. It is crucial to understand the relationship between haemoglobin levels and paediatric heart failure for a number of reasons. To begin with, anaemia has the potential to aggravate the overall clinical condition and prognosis of heart failure by further impairing oxygen supply to essential organs[4]. In addition, changes in haemoglobin levels could indicate how severe and long-lasting a child's heart failure is, making them an important indicator for risk assessment and intervention choices[5]. Thus, the purpose of this study is to examine the haemoglobin levels in paediatric heart failure patients in order to clarify its possible significance as a prognostic marker and therapeutic target in this susceptible group. We hope to gain a better knowledge of the pathophysiology of paediatric heart failure and improve patient outcomes by conducting a thorough analysis of the link between haemoglobin levels and the condition.

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# METHODS

This retrospective study analysed data from hospital records of paediatric children who showed clinical indications of heart failure at Lady Reading Hospital Peshawar between December 2022 and December 2023. Approval from the Institutional Review Board (IRB) was secured before starting data collection. The diagnosis of heart failure was confirmed through echocardiographic results showing compromised left ventricular (LV) function. LV dysfunction was categorized as mild, moderate, or severe based on specific criteria:

- Mild LV Dysfunction: Ejection fraction (EF) between 40% and 54%.
- Moderate LV Dysfunction: Ejection fraction (EF) between 30% and 39%.
- Severe LV Dysfunction: Ejection fraction (EF) less than 30%.

All included patients had their haemoglobin (Hb) levels documented at the time of presentation. Standard laboratory methods were used to assess haemoglobin levels, and results were reported in grammes per deciliter, or g/dL. In this investigation, the haemoglobin levels measured during the first presentation were used for analysis.

**Statically analysis:** Descriptive statistics were utilised to compile the clinical and demographic features of the research population. Statistical analysis was carried out using the proper software (SPSS.23.0). Depending on the data distribution, continuous variables were given as mean ± standard deviation (SD) or median with interquartile range (IQR). Frequencies and percentages were used to summarise categorical variables.

Subgroup analyses were also carried out to investigate the relationship between haemoglobin levels and the degree of left ventricular dysfunction. ANOVA or Kruskal-Wallis tests for continuous variables and chi-square tests for categorical variables were among the relevant statistical tests used for doing comparative analyses.

# RESULTS

This study comprised a total of 684 paediatric patients who were diagnosed with heart failure. The study population's mean age was 6.8 ± 3.2 years, with 45.5% female and 54.5% male participants. This indicates a little male predominance. At presentation, the average haemoglobin (Hb) level was 11.2 ± 1.5 g/dL, according to the results. Following evaluation by echocardiography, patients were categorised according to the degree of left ventricular (LV) dysfunction. There were 238 patients (34.8%) with mild LV dysfunction, 309 patients (45.1%) with moderate LV dysfunction, and 137 patients (20.1%) with severe LV dysfunction out of the overall cohort. To evaluate the relationship between haemoglobin levels and the degree of left ventricular dysfunction, subgroup analysis was performed. Among patients with different degrees of left ventricular dysfunction, the mean haemoglobin levels varied significantly ($p < 0.001$), according to the results. Namely, mean haemoglobin levels were lower in patients with severe LV failure than in patients with mild or moderate dysfunction (Table 1).

**Table No. 1. Gender distribution and mean age of the study population**

| Gender | Number of Patients | Percentage (%) |
|---|---|---|
| Male | 374 | 54.7 |
| Female | 310 | 45.3 |

Mean Age: 6.8 years (Standard Deviation: 3.2 years)

**Table No. 2: Mean Hemoglobin Levels Across Severity of LV Dysfunction**

| LV Dysfunction Severity | Mean Hb Level (g/dL) | Standard Deviation |
|---|---|---|
| Mild | 11.7 | 1.2 |
| Moderate | 11.4 | 1.3 |
| Severe | 10.8 | 1.4 |

Moreover, haemoglobin levels considerably ($p < 0.001$) varied in the distribution of patients among LV dysfunction categories. The distribution of patients by haemoglobin levels and severity of left ventricular failure is shown in Table 2.

**Table No. 3: Distribution of Patients by LV Dysfunction Severity and Hemoglobin Levels**

| LV Dysfunction Severity | Hemoglobin Level (g/dL) | Number of Patients | Percentage (%) |
|---|---|---|---|
| Mild | < 11 | 72 | 30.3 |
| | 11 - 12 | 134 | 56.3 |
| | > 12 | 32 | 13.4 |
| Moderate | < 11 | 98 | 31.7 |
| | 11 - 12 | 168 | 54.3 |
| | > 12 | 43 | 13.9 |
| Severe | < 11 | 60 | 43.8 |
| | 11 - 12 | 62 | 45.3 |
| | > 12 | 15 | 10.9 |

# DISCUSSION

The incapacity of the heart to efficiently pump blood to meet the body's metabolic needs is the hallmark of paediatric heart failure, a complicated and multifaceted illness. It can result from a number of aetiologies, including infections, hypertension, congenital cardiac abnormalities, cardiomyopathies, and myocarditis. Despite advancements in diagnosis and management, pediatric heart failure remains a significant cause of morbidity and mortality in children[6]. Congenital heart defects, such as ventricular septal defects (VSDs) and atrial septal defects (ASDs), represent common underlying etiologies of pediatric heart failure[7]. Furthermore, cardiomyopathies including hypertrophic cardiomyopathy (HCM) and dilated cardiomyopathy

(DCM), which decrease cardiac function and cause heart failure in infants, may be influenced by hereditary factors[8]. Understanding the diverse etiologies of pediatric heart failure is essential for accurate diagnosis, risk stratification, and targeted therapeutic interventions. Anemia, a prevalent comorbidity in heart failure patients, has been implicated in disease progression and adverse outcomes. The prognostic relevance of anaemia in heart failure has been highlighted by studies in adult heart failure cohorts that have consistently shown a relationship between lower haemoglobin levels and greater mortality rates[9,10]. Additionally, treatments for anaemia, like iron supplements or blood transfusions, have improved clinical outcomes in adult heart failure patients in a promising way[11,12]. Our research contributes to the increasing amount of data that indicates haemoglobin levels have a significant prognostic role in paediatric heart failure. Consistent with findings from adult heart failure cohorts, we observed a significant association between reduced hemoglobin levels and more severe left ventricular (LV) dysfunction in pediatric patients. These results suggest that anemia may serve as a valuable marker of disease severity and prognosis in both pediatric and adult heart failure populations[13,14]. Moreover, our study underlines the necessity of thorough risk stratification methodologies in juvenile heart failure care. By incorporating hemoglobin assessment into clinical evaluations, doctors can better identify high-risk patients who may benefit from enhanced treatment approaches, such as iron supplementation or transfusion therapy. More research in paediatric heart failure cohorts is necessary to fully understand the potential contribution of these therapies to better outcomes[15]. Our research concludes by highlighting the importance of haemoglobin levels as a possible prognostic indicator in children with heart failure. Subsequent investigations need to concentrate on clarifying the fundamental processes that associate the advancement of heart failure in youngsters with anaemia and investigating focused treatments to enhance results in this susceptible group.

# CONCLUSION

In conclusion, hemoglobin levels in pediatric heart failure indicate promise as prognostic markers, indicating the need for more research to develop customised therapies and enhance results.

**Author's Contribution:**

| | |
|---|---|
| Concept & Design of Study: | Saadia Ilyas |
| Drafting: | Ijaz Hussain, Zaland Ahmed Yousafzai |
| Data Analysis: | Uroosa Shamshad, Muhammad Bilal |
| Revisiting Critically: | Saadia Ilyas, Ijaz Hussain |
| Final Approval of version: | Saadia Ilyas |

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

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