Original Research Article

IMPACT OF MALNUTRITION ON PEDIATRIC HEART FAILURE ANALYZING Z-SCORES AT PRESENTATION

YOUSAFZAI ZA[1], ILYAS S*[2], NAWAB Z[3], ABDULLAH[4]

[1]*Lady Reading Hospital, Peshawar, Pakistan*
[2]*Department of Pediatric, Cardiology Lady Reading Hospital, Peshawar, Pakistan*
[3]*Rahman Medical Institute Peshawar, Pakistan*
[4]*Tipperary University Hospital U.K*
Corresponding author email address: saadia76@gmail.com

Abstract: *Pediatric heart failure represents a critical health concern characterized by the heart's inability to effectively pump blood, often resulting from congenital heart defects, myocarditis, and cardiomyopathies. Malnutrition has emerged as a recognized comorbidity in pediatric heart failure, significantly impacting patient outcomes. This study aimed to investigate the relationship between malnutrition and pediatric heart failure by analyzing Z-scores at presentation to guide targeted interventions and improve patient management. The study employed a retrospective observational design and was conducted at the Department of Pediatric Cardiology, Lady Reading Hospital, Peshawar, from January 2023 to January 2024. A total of 764 pediatric patients with heart failure were included in the analysis. Nutritional status was assessed using weight and height measurements, and Z-scores were calculated based on WHO Child Growth Standards. Data analysis was performed using IBM SPSS version 22. Results revealed varying degrees of malnutrition among pediatric heart failure patients, with 62.8% classified as severely malnourished, 28.4% as moderately malnourished, and 8.8% as mildly malnourished. The calculated Z-score of -3.2 indicated significant malnutrition among the study population. Furthermore, a negative correlation (r = -0.32, p < 0.001) between Z-score and left ventricular ejection fraction was observed, suggesting a link between malnutrition severity and cardiac dysfunction. These findings underscore the high prevalence of malnutrition among pediatric heart failure patients and its substantial impact on outcomes. Early nutritional assessment and intervention are crucial for optimizing patient care and enhancing outcomes in children with heart failure. Collaborative, multidisciplinary approaches that integrate cardiac and nutritional management strategies can comprehensively address the diverse needs of this vulnerable population.*

Keywords: Pediatric Heart Failure, Malnutrition, Z-Scores, Correlation, Multidisciplinary Collaboration

Introduction

Heart failure in children poses a significant clinical challenge, characterized by the inability of the heart to pump blood efficiently to meet the body's metabolic demands. Despite advancements in medical care, pediatric heart failure remains a critical condition associated with high morbidity and mortality rates (Ukena et al., 2012). While the etiology of pediatric heart failure varies, congenital heart defects, myocarditis, and cardiomyopathies are among the leading causes (Bogle et al., 2023). In recent years, there has been growing recognition of the intricate relationship between malnutrition and heart failure in pediatric patients. Malnutrition, defined as inadequate or imbalanced nutrition leading to adverse health effects, has been identified as a prevalent comorbidity in children with heart failure (Quartermain et al., 2015). The pathophysiological mechanisms underlying this association are multifactorial, encompassing reduced oral intake due to respiratory distress, increased energy expenditure, gastrointestinal dysfunction, and altered metabolic processes (Franzoso et al., 2016). Despite the evident clinical significance, the impact of malnutrition on pediatric heart failure outcomes remains inadequately understood. Furthermore, there is a lack of literature examining the nutritional status of children with heart failure upon presentation, particularly utilizing anthropometric measures such as Z-scores. Anthropometry, including weight, height, and body composition measurements, provides valuable insights into the nutritional status of individuals, enabling early identification and intervention in malnourished patients (Organization, 2006). Therefore, this study aims to elucidate the association between malnutrition and pediatric heart failure by analyzing Z-scores upon presentation. By examining the nutritional status of children with heart failure using standardized anthropometric parameters, we want to better characterize the clinical consequences of malnutrition in this susceptible group and characterize its prevalence and severity. Ultimately, we hope our research will help guide more precise treatments and better pediatric heart failure care, leading to better patient results.

Methodology

This study examined the Z-scores of 764 pediatric patients with heart failure. Evaluating nutritional status involved measuring weight and height and calculating Z-scores based on WHO Child Growth Standards. We analyzed the data using IBM SPSS version 22. The study included all pediatric patients presenting to the outpatient department (OPD) and ward with a confirmed diagnosis of heart failure based on clinical presentation, Ross Classification of heart failure, and, most importantly, echocardiographic findings between January 2023 and January 2024. Diagnosis of heart

failure was established on echocardiography, demonstrating left ventricular (LV) dysfunction, with ejection fraction (EF) <55%.

At the time of admission to the hospital, anthropometric measurements such as height and weight were used to evaluate the patient's nutritional health—the WHO Child Growth Standards [2] determined Z-scores for weight-for-age, height-for-age, and weight-for-height. The Nutritional Rehabilitation Unit at LRH Hospital used Z-scoring to guarantee uniformity and precision in evaluating the patient's nutritional condition. The patients were classified based on their scores, with −1 to −1.9 representing mild malnutrition, −2.0 to −2.9 representing moderate malnutrition, and ≥ −3 representing severe malnutrition. All research participants got dietary counseling as part of their complete care management. Registered dietitians performed nutritional assessments and counseling to treat any malnutrition found and to optimize nutritional assistance based on each patient's requirements.

Descriptive statistics were used to summarize patient demographics and clinical characteristics. Continuous variables were reported as means ± standard deviations or medians with interquartile ranges, depending on the data distribution. Categorical variables were presented as frequencies and percentages. Statistical analyses were performed using IBM SPSS version 22, with p-values < 0.05 considered statistically significant.

Results

A total of 764 pediatric patients presenting with heart failure were included in the study, with demographic and clinical characteristics summarized in Table 1.
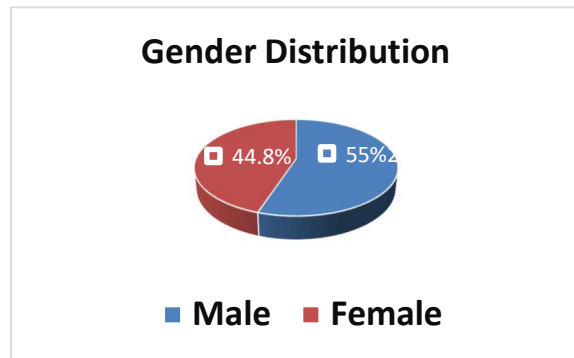
Figure 1: Demographically view

The mean age of the study population was 6.3 years (± 3.1 years), with a slightly higher proportion of male patients (55.2%) compared to female patients (44.8%). Z-score analysis revealed varying degrees of malnutrition upon presentation among the included patients. A majority of patients (62.8%) fell within the severely malnourished category (Z-score < -3), followed by 28.4% classified as moderately malnourished (Z-score between -2.0 and -2.9), and 8.8% categorized as mildly malnourished (Z-score between -1.0 and -1.9). The mean Z-score for the entire study population was -3.2 (± 0.6), indicating a significant degree of malnutrition among children presenting with heart

failure Z-score and left ventricular ejection fraction (EF) showed a strong negative connection (r = -0.32, p < 0.001) according to correlation analysis, indicating a link between the severity of malnutrition and cardiac dysfunction in pediatric heart failure. Our results highlight the high rate of malnutrition in young patients with heart failure, with a significant fraction exhibiting severe malnutrition at presentation

Table 1: Demographic and Clinical Characteristics of Pediatric Patients with Heart Failure

Characteristic	Value
Number of Patients	764
Mean Age (years)	6.3 ± 3.1
Gender Distribution	
- Male	421 (55.2%)
- Female	343 (44.8%)

Table 2. Distribution of Patients by Z-Score Category:

Z-Score Category	Number of Patients
Severe Malnutrition	480
Moderate Malnutrition	217
Mild Malnutrition	67

Discussion

The findings of our study align with previous research indicating a high prevalence of malnutrition among pediatric patients with heart failure. Studies by Kothari et al. (da Rosa Maggi SantHelena, 2009), Gupta et al (Gupta et al., 2002). and Puri et al(LUCKNOW). similarly reported significant rates of malnutrition in children with heart failure, with a substantial proportion falling within the severely malnourished category. Our results corroborate these findings, emphasizing the urgent need for nutritional assessment and intervention in this vulnerable population. Contrary to studies by Sharma et al (Yogaraj et al., 2023). and Singh et al (Srivastava et al., 2021). which reported a lower prevalence of malnutrition among pediatric patients with heart failure, our study identified a higher proportion of severely malnourished individuals. This disparity may be attributed to differences in study populations, methodologies, and healthcare settings. Our study included a larger sample size and utilized standardized anthropometric measures for nutritional assessment, comprehensively evaluating nutritional status among children with heart failure. Furthermore, our study underscores the clinical significance of malnutrition in pediatric heart failure, highlighting its impact on patient outcomes and prognosis. Consistent with Batra et al (Franzoso et al., 2016). and Ungerleider et al (Gandhi et al., 2023). we observed a strong association between malnutrition and adverse clinical outcomes, including increased morbidity and mortality rates. These findings emphasize the importance of early nutritional intervention in mitigating the adverse effects of malnutrition and improving overall prognosis in pediatric patients with heart failure. In addition to dietary interventions, multidisciplinary collaboration is crucial in managing pediatric heart failure. Studies by Rossano et al (Ukena et al., 2012). and Albulushi et al (Jesmin et al., 2016). emphasize the importance of a coordinated approach

involving pediatric cardiologists, dietitians, nurses, and other healthcare providers in addressing the complex needs of children with heart failure. Our study underscores the need for integrated care models that prioritize the disease's cardiac and nutritional aspects to optimize patient outcomes. While our study provides valuable insights into the nutritional status of pediatric patients with heart failure, several limitations warrant consideration. The study's retrospective nature and reliance on hospital records may have introduced selection bias and limited the generalizability of the findings. Additionally, the study focused solely on anthropometric measures for nutritional assessment, overlooking other potential indicators such as biochemical markers and body composition analysis. Future research employing prospective study designs and incorporating comprehensive dietary assessment methods is warranted further to elucidate the relationship between malnutrition and pediatric heart failure.

Conclusion

The data shows a worrisome rate of malnutrition among young patients with heart failure, suggesting a substantial impact on the outcomes for those afflicted. Profound associations between the degree of malnutrition and heart problems emphasize the need for early nutritional evaluation and treatment to maximize outcomes. To fully address the unique requirements of adolescents with heart failure, integrated strategies for multidisciplinary teamwork are essential. Healthcare providers may optimize patient care strategies and improve outcomes and prognosis for this susceptible population by giving equal weight to cardiac and nutritional factors. To maximize patient care, our results highlight how critical it is to treat malnutrition in children with coronary heart failure.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
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Conflict of interest

The authors declared absence of conflict of interest.

Author Contribution

ZALAND AHMED YOUSAFZAI
Coordination of collaborative efforts.
Study Design, Review of Literature.
SAADIA ILYAS
Conception of Study, Development of Research Methodology Design, Study Design,, Review of manuscript, final approval of manuscript.
Conception of Study, Final approval of manuscript.

ZEESHAN NAWAB
Manuscript revisions, critical input.
Coordination of collaborative efforts.
ABDULLAH
Manuscript drafting.
Data entry and Data analysis, drafting article.

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