Prevalence of Comorbidities Linked to Integrated Management of Childhood Illness Among Children with Diarrhea

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Abstract

Objective: This study aims to assess the prevalence of various comorbidities related to the Integrated Management of Childhood Illness (IMCI) among children presenting with diarrhea.

Material and Methods: A descriptive cross-sectional study was conducted at the Department of Pediatrics, Services Hospital Lahore (Ref No. IRB/2024/1410/SIMS dated 22.08.2024). A total of 383 children aged 1-5 years who presented with diarrhea were included using a non-probability consecutive sampling method. Diarrhea was defined as the passage of three or more loose stools per day. The prevalence of IMCI-related comorbidities including malnutrition, anemia, rickets, ear infections, and worm infestations was assessed through clinical evaluation and laboratory tests. Data on demographic characteristics, breastfeeding and weaning practices, vaccination status, and medical history were collected. Chi-square tests were used to determine associations between comorbidities and diarrhea prevalence, with significance set at $p \le 0.05$.

Results: The study revealed a high prevalence of malnutrition (54.6%), anemia (55.9%), and rickets (30.8%) among the children with diarrhea. Significant associations were observed between malnutrition, anemia, and rickets (p < 0.001) with diarrhea prevalence. Ear infections were less common (4.17%) but still showed a significant association (p = 0.049). Worm infestations, however, did not show a significant relationship with diarrhea (p = 0.79).

Conclusion: Malnutrition, anemia, and rickets are strongly associated with diarrhea in children under five, underscoring the need for integrated nutritional interventions. Addressing these comorbidities through early detection, prevention, and targeted healthcare interventions can significantly improve child health outcomes.

Keywords: Diarrhea, Malnutrition, Anemia, Rickets, Integrated Management of Childhood Illness, Pediatrics.

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Introduction

Childhood diarrhea remains a critical public health issue in low- and middle-income countries, leading to significant mortality among

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children under five, with approximately 0.5 million deaths annually and 1.7 billion cases globally.¹ UNICEF (2021) reported that of the 5 million deaths of children under five worldwide, around 30% were caused by infectious diseases, often presenting with diarrhea and fever.² To address such challenges, UNICEF and WHO introduced the Integrated Management of Childhood Illnesses (IMCI), a strategy targeting major childhood diseases like acute respiratory infections, diarrhea, measles, malaria, and malnutrition, which collectively account for over 70% of child mortality in resource-limited settings.³

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IMCI emphasizes clinical assessment and disease classification without laboratory reliance, addressing preventable conditions that significantly affect child health.⁴ In Pakistan, childhood illnesses are exacerbated by poor living conditions, limited healthcare access, malnutrition, and infectious disease exposure. Common comorbidities in children under five include anemia (55.8%), rickets (19.6%), malnutrition (69.5%), worm infestations (15.9%), and inadequate weaning and breastfeeding practices (49%).⁵ IMCI's holistic approach focuses on treatment and prevention, aiming to reduce mortality, disability, and disease severity. The rationale of this study is to determine the prevalence of IMCI-related comorbidities in children under five with diarrhea, providing critical evidence for policymakers to improve healthcare delivery, develop targeted interventions, and enhance child health outcomes in Pakistan.

Material and Methods

A descriptive cross-sectional study was conducted in the Department of Pediatrics at Services Hospital Lahore after obtaining IRB approval (Ref No. IRB/2024/1410/SIMS dated 22.08.2024). Using a non-probability consecutive sampling method, 383 children aged 1-5 years presenting with diarrhea were included. Diarrhea was defined as the passage of three or more loose or liquid stools per day.⁶ IMCIrelated complications assessed included malnutrition, anemia, rickets, worm infestation, and ear infections. Malnutrition was classified using Gomez criteria,⁷ with degrees ranging from mild (76–90% of expected weight) to severe (<60%). Anemia was identified through clinical signs (palmar and conjunctival pallor) or hemoglobin levels below 11 g/dL.⁸ Rickets was diagnosed based on physical findings' such as wrist widening or radiological confirmation. Worm infestation was noted if there was a history of worm passage, and ear infections were diagnosed based on purulent discharge and ear pain. Children with chronic illnesses, critical conditions requiring resuscitation, or whose parents did not consent were excluded. Ethical guidelines were followed, and informed consent was obtained from guardians. Data collection involved demographic details, breastfeeding and weaning practices, vaccination status, and physical

examinations, including anthropometric measurements. Findings were documented, and laboratory/radiological tests confirmed anemia and rickets. Statistical analysis was performed using SPSS version 21.0, with quantitative data presented as means and standard deviations, and qualitative data as frequencies and percentages. Chi-square tests were applied to assess associations, with a significance level of $p \le 0.05$.

Results

The mean age of the participants was 2.98 years (SD = 1.42), and the mean weight was 9.90 kg (SD = 2.18). Of the participants, 53.3% (204 children) were male, and 46.7% (179 children) were female. The duration of diarrhea varied, with 48% experiencing symptoms for 1–3 days, 32.1% for 4–6 days, and 19.8% for over 7 days. Regarding prior medical consultations, 34.2% (131 children) reported previous visits, while 65.5% (251 children) had none. Vaccination status revealed 56.9% were fully vaccinated, 29.5% partially vaccinated, and 13.6% unvaccinated. Breastfeeding practices showed 34.7% were exclusively breastfed, 38.1% partially breastfed, and 27.2% not breastfed. Appropriate weaning was observed in 43.5%, while 56.4% had inappropriate weaning practices.

The prevalence of Integrated Management of Childhood Illness (IMCI)-related comorbidities showed significant findings. Malnutrition was prevalent in 34.4% (mild), 13.8% (moderate), and 6.3% (severe) of children, while 45.4% were unaffected. Anemia was present in 55.9%, and rickets affected 30.8% of children. Ear infections were relatively rare at 4.17%, and worm infestations were observed in only 1.3% of children.

Chi-square analysis highlighted significant associations among IMCI-related comorbidities. Malnutrition was significantly associated with anemia ($\chi^2 = 15.8$, df = 3, p = 0.001) and rickets ($\chi^2 = 20.2$, df = 3, p < 0.001). Anemia also demonstrated a significant association with rickets ($\chi^2 = 11.4$, df = 1, p = 0.001). Although worm infestation trended toward association with anemia ($\chi^2 = 3.4$, df = 1, p = 0.06), it was not statistically significant. No significant relationship was observed between ear infections and other comorbidities ($\chi^2 = 2.1$, df = 1, p = 0.15). Furthermore, malnutrition displayed a highly significant association with diarrhea prevalence (χ^2 = 49.06, p < 0.001), as did anemia (χ^2 = 56.92, p < 0.001) and rickets (χ^2 = 21.96, p < 0.001). Ear infections were less common but still statistically significant (χ^2 = 3.87, p = 0.049). However, worm infestation exhibited no significant relationship with diarrhea prevalence (χ^2 =0.07, p=0.79).

Table 1: General & Health Characteristics				
	Frequency	Percent		
Gender				
Male	204	53.3		
Female	179	46.7		
Duration of diarrhea				
1-3 days	184	48		
4-6 days	123	32.1		
>7 days	76	19.8		
Previous Visits				
Yes	131	34.2		
No	251	65.5		
Vaccination Status				
Vaccinated	218	56.9		
Partially vaccinated	113	29.5		
Unvaccinated	52	13.6		
Breastfeeding				
Exclusive	133	34.7		
Partial	146	38.1		
Not breastfed	104	27.2		
Weaning				
Appropriate	132	43.5		
Not appropriate	171	56.4		



Table 2: Prevalence of IMCI related comorbidities

	Frequency	Percent		
Malnutrition				
Mild	132	34.4		
Moderate	53	13.8		
Severe	24	6.3		
Absent	174	45.4		
Anemia				
Present	214	55.9		
Absent	169	44.1		
Rickets				
Present	118	30.8		
Absent	265	69.2		
Ear infection				
Yes	16	4.17		
No	367	95.8		
Worm Infestation				
Yes	5	1.3		
No	378	98.7		

Discussion

The analysis of Integrated Management of Childhood Illness (IMCI)-related comorbidities in children with diarrhea using chi-square tests revealed several critical associations between malnutrition, anemia, rickets, ear infections, and worm infestations. The study highlights the interdependence of these conditions, emphasizing the need for integrated interventions targeting nutritional deficiencies.

Malnutrition emerged as a key factor in this study, with 54.6% of children (mild to severe malnutrition) presenting with significant comorbidities, most notably anemia. The chi-square analysis showed a strong association between malnutrition and anemia ($\chi^2 = 15.8$, df = 3, p = 0.001), confirming the welldocumented vicious cycle where malnutrition exacerbates anemia by impairing the absorption of essential nutrients, including iron and folate, leading to anemia.¹⁰ This bidirectional relationship between diarrhea and malnutrition aligns with findings from Soboksa et al. (2021), who demonstrated a significant correlation between malnutrition and diarrhea in Ethiopian children, with malnourished children being more prone to diarrhea due to impaired immunity.¹¹ The high prevalence of anemia (55.9%) in the current study also mirrors similar findings in Islam et al. (2023), where anemia was common among underweight children,¹² highlighting the critical role of addressing underlying nutritional deficiencies to mitigate the burden of diarrhea,^{13,14} this can be particularly debilitating as diarrhea contributes to nutrient loss, thereby worsening the nutritional status of affected children.¹⁵

Rickets, a condition linked to vitamin D and calcium deficiencies, was observed in 30.8% of the study population, a significant finding that reinforces the role of chronic nutritional deficiencies. The association between malnutrition and rickets ($\chi^2 = 20.2$, df = 3, p < 0.001) suggests that children with inadequate dietary intake or malabsorption are at a higher risk of developing rickets, which may further exacerbate their vulnerability to severe diarrhea. This aligns with El-Desouky et al. (2020), who noted a strong link between vitamin D deficiency and recurrent diarrhea in children.¹⁶ Vitamin D deficiency impairs immune response and reduces the activity of gut antimicrobial peptides, which could increase the severity and frequency of diarrhea episodes.¹⁷

No significant association was revealed between ear infections and other comorbidities ($\chi^2 = 2.1$, df = 1, p = 0.15), suggesting that ear infections may not be directly influenced by or contribute to other IMCIrelated conditions in this population. However, the study by Alabedi et al. (2022) found a significant prevalence of acute otitis media (AOM) in infants with diarrhea,¹⁸ particularly those who were underweight or had ear pain, underlining the potential overlap between these two conditions. In their study, AOM was found in 45% of cases with diarrhea. The lack of significant findings in this study might be due to the specific population studied or diagnostic practices, as AOM in young children with diarrhea can often go undiagnosed unless specifically investigated.

Worm infestations showed a borderline trend toward an association with anemia ($\chi^2 = 3.4$, df = 1, p = 0.06), but the relationship did not reach statistical significance. This may be attributed to the low prevalence of worm infestations (1.3%) in the study population, which limits the statistical power to detect a significant correlation. The lower prevalence in this cohort might reflect the effectiveness of deworming interventions, a perspective supported by Bauhofer et al. (2020), who observed that children in Mozambique with lower birth weight were more likely to experience comorbidities,^{19,20} including those linked to infections like worms . Additionally, the associeen worm infestations and diarrhea has been extensively documented in other regions, but the absence of a significant correlation here suggests that the impact of worm infestations may be less pronounced in populations with better access to deworming programs.

The study underscores the interconnectedness of malnutrition, anemia, and rickets on the prevalence and severity of diarrhea among children. The strong associations between these conditions emphasize the need for integrated approaches targeting both prevention and treatment. Public health efforts should prioritize improving nutrition, vaccination, breastfeeding practices, and deworming interventions to reduce the burden of diarrhea and its associated comorbidities in children. Additionally, there is a need for further research to better understand the relationship between ear infections, worm infestations, and diarrhea, particularly in different demographic settings.

Conclusion

This study provides valuable insights into the prevalence of IMCI-related comorbidities among children aged 1-5 years presenting with diarrhea. The significant associations between malnutrition, anemia, and rickets highlight the critical role of nutritional deficiencies in exacerbating diarrheal morbidity in this population. These findings underscore the need for comprehensive public health interventions targeting both the prevention and treatment of malnutrition and its associated comorbidities, including anemia and rickets. Furthermore, the study emphasizes the importance of addressing gaps in vaccination, breastfeeding, and weaning practices to improve child health outcomes. While ear infections and worm infestations were less prevalent and showed weaker associations, continued surveillance and targeted interventions remain essential for reducing the overall burden of diarrheal diseases in children. This research underscores the necessity of integrated healthcare approaches, guided by evidence, to reduce child mortality and morbidity

associated with diarrhea and related comorbidities in resource-limited settings such as Pakistan.

Conflict of Interest:	None
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Authors Contribution

- MAF: Conceptualization of Project
- **BBM:** Drafting, Revision
- **ZR:** Statistical Analysis
- AS: Writing of Manuscript
- MRB: Data Collection
- AA: Literature Search