Original Article

Association Between Nutritional Status and Severity of Pneumonia in Under Five Years of Children Admitted at Birat Medical College Teaching Hospital

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ABSTRACT

Introduction: Childhood malnutrition is common in low-income and middle-income countries and increases the frequency and severity of pneumonia. The objective of this study was to determine the association between nutritional status and severity of pneumonia in under five children.

Materials and Methods: This was a hospital based cross-sectional study of data of children between 3 months to 5 years admitted in the Department of Pediatrics of Birat Medical College Teaching Hospital with a clinical diagnosis of pneumonia from December 2023 to July 2024.

Results: One hundred seventy children were included in the study with a majority of age group 3 to 12 months (46.5 %) and male to female ratio of 3:1. There were 69 (40.6%) undernourished children and 73 (42.9%) anemic. On applying bivariate analysis, undernourishment (p<0.001, unadjusted OR=8.2, and 95% CI,3.9-17.5) and anemia (p<0.001, unadjusted OR=6, and 95%CI,2.9-12.6) were statically significant for severe pneumonia.

Conclusion: The risk of having severe pneumonia was more in children with undernutrition and anemia. Prevention and treatment of malnutrition in children should be prioritized to reduce severe pneumonia as well pneumonia related mortality.

Keywords: Anemia; Children; Malnutrition; Nepal; Pneumonia

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INTRODUCTION

Pneumonia is a form of acute respiratory infection that affects the lungs which makes difficulty to breathing and restricts oxygen intake. It is the major cause of death in children worldwide. Pneumonia killed 740180 children under the age of 5 in 2019 which account for 14% of all deaths of under 5 years old children.[1] Highest mortality are seen in southern Asia and sub-Saharan Africa.

Globally in 2022, 149 million children under 5 were estimated to be stunted and 45 million were estimated to be wasted. Nearly half of the deaths among children under 5 years of age are associated to undernutrition.[2] The prevalence of stunting and wasting among children under age 5 are 25% and 8%, respectively in Nepal.[3] Undernutrition is usually associated with micro-nutrition deficiency. Among them, iron deficiency anemia is the second most common micro-nutrition deficiency worldwide. Nepal

demographic health survey 2022 shows anemia in children aged 6–59 months is 43%.[3] Malnutrition increases the frequency and severity of common childhood infections including pneumonia as well as delays recovery and mortality.[4] Moreover, acute infections also worsen nutritional status through higher catabolism, anorexia and nutrient loss, contributing to a worsening cycle of infections and malnutrition.[5]

Preventing pneumonia is a necessary component of a policy to reduce mortality in under 5 years old children. Among various modalities, identification of undernourished children and providing adequate nutrition is the most effective way to prevent pneumonia. Hence, this study was conducted to identify the association between undernutrition and anemia to severity of pneumonia.

MATERIALS AND METHODS

A hospital-based cross sectional study was conducted at Birat Medical College Teaching Hospital located in Eastern Nepal from December 2023 to July 2024 among children aged 3 months to 5 years admitted with a diagnosis of pneumonia. Children with congenital anomalies, congenital heart disease, immunodeficiency, history of low birth weight, prematurity, asthma and refusal to give consent were excluded. Prior to the study, permission was obtained from IRC, Birat Medical College Teaching Hospital (IRC-PA-349/2023).

With a prevalence (p) of 26.8% (malnutrition in pneumonia),[6] a 95% confidence interval and an allowable error of 5% with the calculated sample size was 314. We admitted around 350 cases of pneumonia last year. So adjusted sample size for finite population is 166.

A case of pneumonia was defined as cough, fever with or without signs of respiratory distress. The severity of pneumonia was classified based on criteria defined by World Health Organization (WHO).[7] Severe pneumonia was pneumonia with any danger sign. (Table 1) The nutritional status was assessed using the WHO Z-Score weight for height. Weight for height <-2 SD of the WHO Child Growth Standards median was taken as an undernourished child.[8] WHO defines anemia in children aged under 5 years as a haemoglobin concentration <11 g/dL.[9]

Table 1: Classification of pneumonia according to WHO[7]

Classification	Signs and symptoms
No pneumonia	Cough or cold. No signs of pneumonia or very severe disease.
Pneumonia	Chest in-drawing in calm child* OR Fast breathing**
Severe pneumonia	Oxygen saturation < 90%; Stridor in calm child***.; Central Cyanosis; AVPU = V, P or U ****
Very severe disease	Any general danger sign. *****

*Chest in-drawing is present if the lower chest wall moves in during inspiration.
** Fast breathing: 2 months up to 12 months minute 50 breaths per or more and 12 months to 5 years up 40 breaths per minute or more
*** Stridor: a harsh sound heard during inspiration.
****AVPU: Alert, Voice, Pain and Unresponsive.
***** Danger signs: Poor feeding, repeated vomiting, lethargic or unconsciousness, convulsion

Written consent from parents were taken before including in the study. Data had been collected on a pre-designed questionnaire which included basic demographics, and clinical and laboratory information. An anthropometric assessment along with general and systemic examination was conducted. Chest X-ray findings, hemoglobin, oxygen saturation and other relevant examinations were conducted as advised by the clinician. Weight for height was calculated to assess the nutritional status.

Statistical program for Social Sciences (SPSS) 26.0 version was used for collected data entry and statistical analysis. Data was summarized by using frequency, mean and percentage for qualitative variables. A bivariate analysis by chi squared statistic was carried out to determine the association between nutritional status and status of anemia on severe pneumonia. Variables which has $p<0.05$ were taken as the significant factor of severe disease.

RESULTS

There were 170 children from 3 to 60 months old with pneumonia admitted to Birat Medical Teaching Hospital, Nepal over the period from December 2023 to July 2024 were included in this study. The median age of study children was 2.1 years, 129 (75.9%) were male, and 79 (46.5 %) were in the 3 to 12 months' age group. We found undernutrition in 69 (40.6%) and anemia in 73 (42.9%). Regarding the severity of pneumonia, 51 (30%) of children suffered from severe pneumonia. (Table 2) The mean hemoglobin was 10.8gm/dl. In bivariate analysis, factors significantly associated with severe pneumonia included undernutrition ($p<0.001$, unadjusted OR=8.2, and 95%CI,3.9-17.5) and anemia ($p<0.001$, unadjusted OR=6, and 95%CI,2.9-12.6). (Table 3)

Table 2: Characteristics of children with pneumonia

Characteristics		Frequency (n)	Percentage (%)
Age group	3 - 12 months	79	46.5
	12 - 36 months	50	29.4
	36 - 59 months	41	24.1
Gender	Male	129	75.9
	Female	41	24.1
Nutritional status	Normal	101	59.4
	Undernutrition	69	40.6
Anemia	Absent	97	57.1
	Present	73	42.9
Severity of pneumonia	Mild	119	70
	Severe	51	30

Table 3: Association between nutritional status and anemia to severity of pneumonia

Variables		Severity of pneumonia				95% CI	
		Mild pneumonia	Severe Pneumonia	Un-adjusted Odds ratio	P value	Lower	Upper
Nutritional status	Normal	88	13	Reference			
	Undernutrition	31	38	8.200	< 0.001	3.915	17.586
Anemia	Absent	83	14	Reference			
	Present	36	37	6.000	<0.001	2.940	12.629

DISCUSSION

A total of 170 cases of pneumonia were included in the study. The majority of the patients were from the younger age group in this study. A prospective cohort study done in India showed young age a significant independent risk factor for pneumonia.[10] Similarly, another study also revealed younger age group a significant factor for severe pneumonia.[11] This could be possibly because of underdeveloped immune system, immature respiratory system and relatively narrow airway that predisposes to developing severe disease among infants.,[12,13] In this study, there was a predominance of male patients which were 76%. Generally, pneumonia was reported more frequently in males than females. A study conducted in Dhulikhel Hospital, Kathmandu, Nepal identified a significant proportion of under-five pneumonia burden with male and female ratio of 1.69:1.[14] Moreover, some studies showed male gender as a significant risk factor for severe pneumonia.,[15,16] The role of male gender as a risk factor for pneumonia remains unclear. The cause behind the high susceptibility of male children could be either genetic or gender bias, which might causes a higher attention to male children for seeking health care much earlier than female children.[17]

A significant association between undernutrition (low weight for height/length) and severe pneumonia was observed. Among 69 children with undernutrition, 38 (55%) were having severe pneumonia. There are various studies showed a significant association between malnutrition and pneumonia in children.,[10,18] A study by Srivastava et al also showed a statistically significant association of severe pneumonia with the status of malnutrition (P = 0.001).[19] Malnourished children are at a greater risk of developing pneumonia due to their weakened immune systems, inability to fight against infections, and impaired respiratory function.[20] It also leads to deficiencies of essential nutrients such as vitamin A, zinc, and iron, which are necessary for normal immune response against pathogens.,[21-23] This study also identified anemia as a significant risk factor for severe pneumonia. Children under 5 years old are very susceptible to anemia, especially in low income countries and was also associated with severe infection.[24]

A study done in 2021 showed the presence of anemia in children hospitalized for pneumonia increases the risk of severe disease and also found to be one of the independent risk factors for deaths during hospitalization.[25] Anemia can damage the immune system of children which aggravate the infection. Evidence shows that red blood cells are directly involved in the maintenance of innate and adaptive immune systems as well as regulators of T-cell proliferation. Therefore, children with anemia are more likely to have severe infections.[26] However, a study conducted in Vietnam found no significant association between anemia and severe pneumonia.[27]

CONCLUSIONS

There are various risk factors for severe pneumonia among which undernutrition and anemia are the major factor responsible for it. Identifying undernourished and anemic children and work for its prevention and treatment will lower the cost as well as avoid mortality. This study identified malnutrition and anemia as the significant risk factors for severe pneumonia. These findings provided valuable information to identify factors associated with severe disease. However, it is important to identify other considerable risk factors in our region by conducting multi-center studies.

Recommendation: We recommend to conduct more multi-center research to clearly identify other risk factors associated with severe pneumonia in our region so that the government can develop policies and programs for its prevention.

Limitation of the study: The sample size is small and only focused on nutritional cause of severe pneumonia. We need large scale study to understand the other factors associated with severe pneumonia in the pediatric age group.

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