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Frequency of Rickets in Patients Presenting with Lower Respiratory Tract Infection in Paediatric Unit of Ayub Teaching Hospital

Nabila Bibi, Shahzad Najeeb, Salman Khan, Maria Khalid

Department of Pediatrics, Ayub Teaching Hospital, Abbottabad, Pakistan.

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Corresponding Author: Nabila Bibi, Department of Pediatrics, Ayub Teaching Hospital, Abbottabad, Pakistan.
Email: drnabilakhan123@gmail.com

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ABSTRACT

Background: Rickets is a significant concern in children with lower respiratory tract infections, especially among those from low socioeconomic backgrounds. This study aimed to assess the prevalence of rickets in pediatric patients diagnosed with LRTIs and examine its association with demographic factors, disease duration, and serum biochemical markers. **Objective:** To determine the frequency of rickets in patients presenting with lower respiratory tract infection in Pediatric Unit of Ayub Teaching Hospital, Abbottabad. **Study Design:** Descriptive cross-sectional study. **Duration and Place of Study:** The study was conducted from June 2024 to December 2024 at the Pediatric Medicine Department of MTI-Ayub Teaching Hospital, Abbottabad. **Methodology:** A total of 189 patients aged 2 to 60 months, diagnosed with LRTIs, were enrolled. Data was collected through comprehensive medical histories, physical examinations, and biochemical tests measuring serum calcium, phosphorus, and alkaline phosphatase levels. Radiographic evidence of rickets was assessed using wrist X-rays. **Results:** Of the 189 children, 63.5% were diagnosed with rickets. The mean age was 28.37 ± 15.55 months, with a higher prevalence in children younger than 24 months (100%). Males exhibited a higher rate of rickets (87%) compared to females (37.1%), and 95.9% of children with symptoms lasting more than seven days had rickets. The prevalence was highest among children from low socioeconomic backgrounds (100%) and urban residents (92.2%). **Conclusion:** Our study shows a high prevalence of nutritional rickets in children with lower respiratory infections, especially those with chronic illness and low socioeconomic status. Vitamin D deficiency plays a key role, emphasizing early detection, supplementation, and screening in high-risk children.

INTRODUCTION

Lower respiratory tract infections (LRTIs) cause substantial morbidity and mortality worldwide, most especially in young children and the elderly.[1] LRTIs comprise a spectrum of lung and lower respiratory passage infections below the larynx, including pneumonia, bronchitis, and bronchiolitis.[2] Viruses, including respiratory syncytial virus (RSV), influenza, and parainfluenza, account for most infections, but bacterial pathogens, like Streptococcus pneumoniae and Haemophilus influenzae, also contribute significantly.[3] The presentation is variable but is most commonly cough, respiratory distress, chest pain, fever, and wheezing. In serious cases, LRTIs can lead to respiratory failure, requiring intensive care and hospitalization.[4]

Children, particularly young children under the age of five, are more susceptible to contracting lower respiratory tract infections due to their developing immune systems, smaller air passages, and susceptibility to viral infections.[5] Malnutrition, lack of hygiene, crowding, and non-breastfeeding also increase children's susceptibility to LRTIs.[6] The prevalence of LRTIs among children is highest during the winter period, when respiratory viruses spread more densely.[7] The severity of LRTIs among children can range from mild cases that can be treated as outpatients with observation and medication, but in cases with complications such as pneumonia, dehydration, or hypoxia, they can be more serious, requiring admission.[8]

Rickets, a condition caused by impaired mineralization of bones by vitamin D deficiency, has also been linked with increased susceptibility to lower respiratory tract infections in children.[9] Vitamin D plays a critical role in the function of the immune response and response to inflammation.[10] Vitamin D deficiency, which is common in children with rickets, can impair the body in responding properly against respiratory infections, thus making them more susceptible to LRTIs.[11] Evidence has shown that children with rickets can be subject to more frequent and more serious respiratory infections, with

longer recovery times. Besides, the impaired bone architecture in rickets can cause complications in respiratory disease, with possible implications in lung function and increased respiratory distress.[12]

In the pediatric cohort, the mean age was 2 years, with a standard deviation of 2.16. Males constituted 58% of the population, while females represented 42%. Among the 151 children assessed, the prevalence of nutritional rickets was 60%. This was evidenced by serum calcium deficiency in 65% of the cases, serum phosphorus deficiency in 58%, and elevated serum alkaline phosphatase levels in 60%.[13]

The study will investigate the prevalence of rickets in patients with lower respiratory infections (LRTI) to determine if the two have any association. Rickets, which result from vitamin D deficiency, can compromise the immune system and exacerbate respiratory infections in children. Determining this association is crucial to improving early detection, treatment methods, and patient outcomes by addressing nutritional and respiratory complications simultaneously.

METHODOLOGY

This descriptive cross-sectional study was conducted at the Pediatric Medicine Department of MTI-Ayub Teaching Hospital in Abbottabad from June 2024 to December 2024. The study encompassed 189 pediatric patients diagnosed with lower respiratory tract infections (LRTIs). LRTIs were defined as children presenting with a history of fever, cough, wheezing, or respiratory difficulty/tachypnea, along with recessions and a chest X-ray revealing infiltration or dense consolidation. The sample size was calculated using a 95% confidence interval and a 7% margin of error, based on an anticipated prevalence of rickets by 60% among these patients.[13]

The inclusion criteria comprised children aged between 2 to 60 months, admitted to the pediatric unit with symptoms characteristic of lower respiratory tract infections. Exclusion criteria encompassed children with chronic renal failure, cerebral palsy, chronic malabsorption, chronic lung conditions, bone dysplasias, congenital heart diseases, and those on anticonvulsants or with vitamin D resistant rickets.

Upon admission, parents or legal guardians provided informed consent for their child's participation in the study. A comprehensive evaluation was performed on admitted patients, which included detailed medical histories and physical examinations to ascertain signs indicative of rickets. Laboratory tests, conducted within the hospital, measured serum levels of alkaline phosphatase (ALP), phosphorus, and calcium. Children with elevated ALP levels (>552 IU/L) and radiographic evidence of rickets identified through wrist X-rays were classified as having the condition. Height and weight measurements were recorded for each patient to monitor growth parameters. A pro forma was utilized to document pertinent information such as age, gender, symptom duration, residency, socioeconomic status, and rickets status.

Data analysis was performed using SPSS Software Version 23.0. Descriptive statistics were applied, with mean and standard deviation calculated for numerical variables, while categorical variables were presented as frequencies and percentages. The study further stratified the frequency of rickets according to factors such as age, gender, residency, and social class to identify potential effect modifiers. Significance was determined using the chi-square test or Fisher's exact test, with a p-value of less than 0.05 considered statistically significant.

RESULTS

The data from Table-1 on patient demographics reveal that the mean age of the participants was 28.37 ± 15.55 months. The mean duration of symptoms was 7.02 ± 2.44 days. The serum calcium level was 2.12 ± 0.27 mmol, while the phosphorus level averaged 1.25 ± 0.31 mmol. The mean ALP (alkaline phosphatase) level was 556.88 ± 65.16 IU/L. Regarding gender distribution, 52.9% of the patients were male, while 47.1% were female. The social class breakdown showed that 56.6% of the participants belonged to the low social class, 23.3% to the middle class, and 20.1% to the high social class. In terms of residence, 39.2% were from rural areas, and 60.8% were from urban areas.

Table 1

Patient Demographics

Demographics		Mean ± SD / n (%)
Age (months)		28.365±15.55
Duration of Symptoms (days)		7.016±2.44
Serum Calcium (mmol)		2.120±0.27
Phosphorus (mmol)		1.252±0.31
ALP (IU/L)		556.884±65.16
Gender	Male	100 (52.9%)
	Female	89 (47.1%)
Social Class	Low	107 (56.6%)
	Middle	44 (23.3%)
	High	38 (20.1%)
Residence	Rural	74 (39.2%)
	Urban	115 (60.8%)

Figure 1

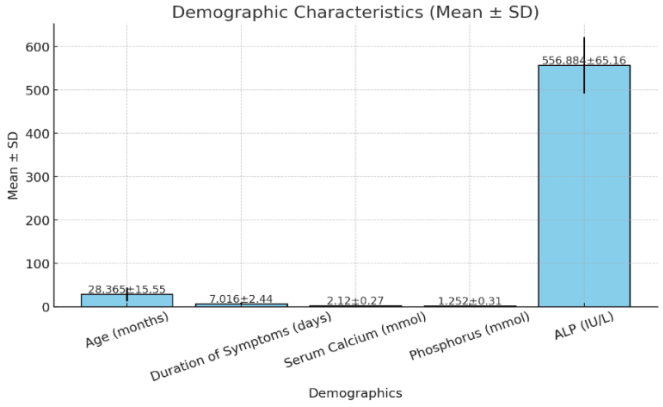


Table-2 presents the prevalence of rickets, with 63.5% of the participants diagnosed with rickets and 36.5% not diagnosed, based on the total of 189 participants.

Table 2
Rickets prevalance

Rickets	Frequency	Percentage
Yes	120	63.5%
No	69	36.5%
Total	189	100%

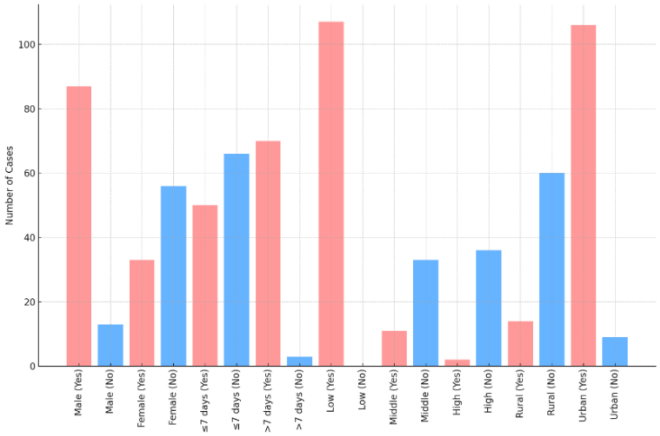
Age had a significant association, with all patients aged 24 months or younger (100%) having rickets, compared to only 34.9% of patients older than 24 months. The p-value for age was <0.001, indicating a strong association. Gender also showed a significant association, with 87% of males diagnosed with rickets versus only 37.1% of females (p-value <0.001). The duration of symptoms was associated with rickets, with 43.1% of those with symptoms lasting 7 days or fewer diagnosed with rickets, compared to 95.9% of those with symptoms lasting more than 7 days (p-value <0.001). Social class was another significant factor, with 100% of patients from the low social class having rickets, compared to only 25% from the middle class and 5.3% from the high class (p-value <0.001). Finally, residence also showed a significant difference, with 92.2% of urban residents having rickets compared to just 18.9% of rural residents (p-value <0.001) (as shown in Table-3).

Table 3
Association of Rickets with Demographic Factors

Demographic Factors		Acute hepatitis		p-value
		YES n (%)	NO n (%)	
Age (months)	≤24	83 (100%)	0 (0%)	<0.001*
	>24	37 (34.9%)	69 (65.1%)	
Gender	Male	87 (87%)	13 (13%)	<0.001
	Female	33 (37.1%)	56 (62.9%)	
Duration of Symptoms (days)	≤7	50 (43.1%)	66 (56.9%)	<0.001*
	>7	70 (95.9%)	3 (4.1%)	
Social Class	Low	107 (100%)	0 (0%)	<0.001*
	Middle	11 (25%)	33 (75%)	
	High	2 (5.3%)	36 (94.7%)	
Residence	Rural	14 (18.9%)	60 (81.1%)	<0.001
	Urban	106 (92.2%)	9 (7.8%)	

*Fisher Exact Test

GRAPH 1: *Demographic Associations with Rickets Prevalence*



DISCUSSION

The results indicate a high prevalence of rickets with 63.5% of the study population of the children with LRTIs being diagnosed with the condition. This observation indicates that rickets is a significant comorbidity in children with LRTIs and can have worse clinical outcomes. Demographics related to the risk of rickets are of particular relevance. Age was the most critical factor with children younger than 24 months being significantly affected with rickets (p-value <0.001). This is in agreement with the known fact that rickets occurs in infants and toddlers mainly because they are more susceptible to vitamin D deficiency due to rapid bone growth and higher nutritional demands. Further, males had a higher frequency of rickets compared to females (p-value <0.001) that may be due to differences in nutrient metabolism based on sex or lifestyle factors that are worth investigating.

The duration of illness was also significant with longer duration of illness (greater than 7 days) being associated with higher likelihood of developing rickets (p-value <0.001). This may reflect that longer illness due to nutritional deficiencies may play a role in precipitating or exacerbating the condition of rickets. Social class was also significant with strong correlation of lower social class with risk of developing rickets (p-value <0.001). This may reflect lack of access to proper nutrition, health care, and supplementation of vitamin D in lower socio-economic groups. Urban residents also had higher risk of developing rickets, which may reflect differences in dietary habits, access to health care, and environmental factors related to synthesis of vitamin D in the urban environment (p-value <0.001). These are indicative of the need for intervention in terms of targeting rickets in high risk groups and also of the role of nutrition and socio-economic status in the etiopathogenesis of rickets in children with LRTIs.

In our study, 63.5% of the subjects were found to have been diagnosed with rickets, as also noted by Qureshi and Saifuddin,[14] who noted high rates of vitamin D

deficiency in children with LRTI. This rate of rickets is also in accordance with that of Haider et al. [15] who noted 74% of hospital-admitted children with severe pneumonia had rickets. Rickets has been implicated in respiratory infection in other studies, and our study also notes this with the finding that children with illness of longer duration (longer than 7 days) had significantly higher rates of rickets (95.9%), corroborating the finding that prolonged illness may exacerbate or precipitate the condition of rickets.[14,16]

Our study also found strong correlations with demographic variables such as age, sex, social class, and residence. Demographically, it was found that all children of 24 months and below had rickets, as also found in the study conducted by Raza Q,[16] where the highest number of children with rickets was found in children less than 12 months of age. Qureshi and Saifuddin [14] also found that younger children are at greater risk of developing rickets due to higher nutritional requirements and exposure to sunlight during growth. The strong correlation with age in our study (p-value <0.001) is in agreement with previous studies that have also found younger children to be more prone to developing rickets as well as respiratory infections.

The disparities in our study with regard to gender, where 87% of males were diagnosed with rickets compared to 37.1% of females, are also consistent with the study of Haider et al.[15] where the incidence of rickets was greater in males. These disparities with regard to gender may be due to many factors such as genetic factors, dietary factors, or environmental factors. But the reasons behind the disparities are not entirely clear and require further research.

Our findings also revealed a strong correlation of low social class with the incidence of rickets, with 100% of children belonging to the low social class presenting with rickets. This observation is consistent with the conclusions of Thakur and Kumar [17] who noted that socioeconomic factors such as poor nutrition and less access to health care are major factors contributing to the high rates of rickets. That the incidence of rickets was higher in urban dwellers (92.2%) than in rural dwellers (18.9%) in our study is a novel observation contrasting with some studies where higher rates of rickets have been reported in rural areas because of less access to health care or lack of proper nutritional education.[15] However, our observation may be due to differences in access to health care in urban areas, nutritional practices, and possibly environmental factors influencing the synthesis of vitamin D.

Biochemically, our study recorded mean of 2.12 ± 0.27 mmol/L for calcium in the serum, 1.25 ± 0.31 mmol/L for phosphorus, and mean ALP of 556.88 ± 65.16 IU/L, all of which were consistent with the typical biochemical abnormalities of children with rickets. These are consistent with biochemical abnormalities of children with rickets as reported by Siddiqui et al. [18] with special mention of elevated levels of alkaline phosphatase. Biochemical parameters in our study validate the role of vitamin D in bone mineralization and the immune system as also reported earlier.[19]

These findings are consistent with the overall body of evidence that indicates that younger children, those with lower socioeconomic status, and those with longer duration of illness increase the risk of respiratory infections. It supports the argument for routine screening and supplementation with vitamin D in susceptible groups in order to avoid the risk of rickets as well as respiratory tract infections.

Nevertheless, our study has some limitations. It was conducted in a single center only, and this may limit the generalizability of the finding to other groups or regions. Additionally, the observational nature of our study makes it impossible to establish causality between respiratory infections and vitamin D deficiency. Furthermore, the lack of a comparator group with no respiratory symptoms makes it impossible to directly compare the vitamin D status of the general population. Multi-center studies with higher sample sizes and with a more heterogeneous population would provide us with greater insight into the role of vitamin D in respiratory infections as well as in rickets in children.

CONCLUSION

Our studies have demonstrated that nutritional rickets is highly prevalent in children with lower respiratory tract infections, particularly those with chronic illness and of lower socioeconomic status. There was strong evidence of association with vitamin D deficiency for the etiology of rickets and further established its role in immunity and bone health. These findings highlight the importance of early detection, supplementation with vitamin D, and routine screening for rickets in children at risk of respiratory infection, particularly in high-risk groups.

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***Author Contributions**

The authors have each played a key role in the creation of this manuscript, outlined as follows:

Dr. Nabila Bibi was responsible for formulating the study concept, drafting the article, and overseeing the collection of hospital data.

Dr. Shahzad Najeeb assisted with the development of the article, contributed to the conceptualization of the study, and was involved in the analysis and interpretation of the data.

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