# **Original Research Article**

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# Frequency of nutritional rickets, its clinicobiochemical profile and its relationship to the lower respiratory tract infections in indoor patients from 2 to 60 months of age

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#### **ABSTRACT**

**Background:** Frequency of nutritional rickets, its clinicobiochemical profile and its relationship to the lower respiratory tract infections in indoor patients from 2 to 60 months of age.

**Methods:** Children aged 2 to 60 months admitted for the first time were included in the study and divided into two groups i.e. with and without clinical signs of rickets. Disease profile was studied in both groups. Incidence of lower respiratory tract infection was compared between two groups. Children with clinicoradiological signs of rickets were also investigated for biochemical abnormalities.

**Results:** During the one year study period a total of 393 children were admitted, 65 were found to have rickets constituted as study group and 328 were without rickets were included the controls. Rickets incidence was 16.5% of which majority (74.6%) were males and most rachitic children (64.6%) were below six months of age. Acute lower respiratory tract infection (64.6%) was commonest in study group and acute gastroenteritis (24.4%) in the controls. The rate of ALRTI was nearly three times in study group. Frontal bossing (67.7%) was most common sign of rickets and increased alkaline phosphatase (93.8%) was the commonest biochemical abnormality.

**Conclusions:** Nutritional rickets, a multifactorial disease, is easily preventable. The present study has revealed the high incidence of rickets i. e., 16.5% and also show the strong statistically significant association of nutritional rickets with acute lower respiratory tract infections.

Keywords: Acute lower respiratory tract infections, Rickets, Vitamin-D

### INTRODUCTION

The name rickets is from the English word Wricken which means to twist. Nutritional rickets is thought to be an ancient disease, but it still exists in  $21^{\text{st}}$  century and its aetiology is multifactorial.<sup>1,2</sup> As vitamin D mainly comes from the ultraviolet light-B with wavelength of 290-315 nm, photo conversion of 7-dehydrocholesterol in skin to pre vitamin  $D_3$  which thermally isomerises to cholecalciferol (vitamin  $D_3$ ) hence inadequate sunlight exposure is most important factor associated with the development of vitamin-D deficient rickets.<sup>3</sup>

Vitamin-D is also found in the diet in one of the two forms: D2, ergocalciferol, from plants and D3, cholecalciferol, from animal products. Children with vitamin-D deficiency classically present soon after weight bearing age with bony abnormalities such as bowing of legs and knock knee due to poor mineralisation. Other features include rachitic rosary, swelling of ends of long bones, frontal bossing of skull poor growth, delayed dentition and slow motor development. Some may presents with features of hypocalcemia i.e., convulsions, tetany and anaesthesia.<sup>4</sup>

The peak age of presentation of rickets is 3-15 months of age.5 The important factors in pathogenesis of rickets at this age include exclusive breastfeeding, maternal vitamin-D deficiency, living in temperate climate, lack of sunlight exposure and darkly pigmented skin. There is mounting evidence for a pivotal role of vitamin D in the immune system. Monocytes, the leucocytes with highest phagocytic capacity, continuously experiment the vitamin D receptor. Calcitriol is able to induce the differentiation of monocytes into macrophages, increases the activity of lysosomal enzymes in macrophages and facilitate cytotoxic activity by enhancing the rate of phagocytosis. There is some evidence from epidemiologic data for a link between low vitamin D status and the increased risk of respiratory tract infections. It retards the growth and development and may indirectly be responsible for morbidity.

# **METHODS**

This study was conducted at tertiary level over one-year period. All the children between the ages of 2 months to 60 months admitted in children ward for the first time for acute illnesses were included in study and were examined for signs of rickets. Children found to have clinicoradiological signs of rickets were investigated for biochemical abnormalities. The diagnosis of rickets was made on the basis of these signs; craniotabes, frontal bossing, wide anterior fontanelle, rachitic rosary, Harrison sulcus, wrist widening, bowing of legs, delayed dentition and tetany and radiological signs on X-ray wrist and chest.

Study group comprised of rachitic children and the remaining children without rickets were taken as control. In study group biochemical profile i.e. serum calcium, phosphorus and alkaline phosphatise was done.

Acute lower respiratory infection was defined as child with cough and/or difficulty in breathing, with any of general danger signs or fast breathing with or without chest indrawing or radiological evidence of alveolar infiltrate. The children already treated for ALRTI and rickets, with renal failure, hepatic disorders, cerebral palsy, chronic G.I. disturbances, congenital and acquired immuno deficiencies and congenital heart diseases were excluded from study. Descriptive statistics was calculated for all items as per relevance.

#### **RESULTS**

During the study period 393 children admitted to paediatrics ward, 65 were found to have rickets; the incidence came out to be 16.5%. Males formed the majority (74.6%) with male to female ratio 2.5:1. Most (64.6%) were below 6 months of life. ALRTI was leading cause of hospitalization (64.6%), acute gastroenteritis was the 2<sup>nd</sup> common clinical presentation (20%) in the study group (Table 1).

Table 1: Illnesses among study group.

Diagnosis	Male		Female		Total	
	N	(%)	N	(%)	N	(%)
Acute lower respiratory tract infection	31	(47.7)	11	(16.9)	42	(64.6)
Acute Gastroenteritis	11	(16.9)	2	(3.1)	13	(20.0)
Convulsions	4	(6.2)	2	(3.1)	6	(9.3)
Others	1	(1.5)	3	(4.6)	4	(6.1)
Total	47	(72.3)	18	(27.7)	65	(100.0)

Table 2: Illnesses among children in controls.

Diagnosis	N	(%)
Acute gastroenteritis	80	(24.4)
Acute lower respiratory tract infections	75	(22.9)
Septicemia	25	(7.6)
Aurti	24	(7.3)
Nutritional anemia	22	(6.7)
Febrile convulsions	17	(5.2)
Acute bacterial meningitis	15	(4.6)
Rickettsial fever	15	(4.6)
Bronchial asthma	14	(4.3)
Viral hepatitis	10	(3.0)
Enteric fever	8	(2.4)
Pulmonary tuberculosis	6	(1.8)
Uti	4	(1.2)
Viral encephalitis	4	(1.2)
Others	9	(2.7)

Table 3: Frequency of various signs of rickets.

Sign	Total	%
Frontal bossing	44	67.7
Craniotabes	41	63.0
Wide AF	31	47.7
Wrist widening	18	27.0
Rachitic rosary	17	26.1
Convulsions	11	18.4
Double medial malleolus	5	8.0
Harrison sulcus	4	6.0
Bowed legs	2	3.0

Acute gastroenteritis was leading cause of hospitalization (24.4%), ALRTI was the  $2^{nd}$  common clinical presentation (22.9%) in the control (Table 2).

In study group frontal bossing was the commonest finding 44 (67.7%), craniotabes the 2<sup>nd</sup> commonest finding 41 (63%) and the bowing of legs the least common (Table 3).

Raised alkaline phosphatase was observed with mean value of 557.55±47.60 and a range of 49-1706 KAU (n=3-13 KAU). It was the commonest biochemical abnormality (Table 4).

Age	Нуро	calcemia	Hypophosphataemia		Raised Alkaline Phosphatase	
	N	%	N	%	N	%
<6 months	9	13.8	15	23.1	41	63.1
6-12 months	5	7.7	5	7.7	14	21.5
1-2 years	1	1.5	3	4.6	3	4.6
>2 vears	1	1.5	1	1.5	3	16

36.9

Table 4: Bio chemical profile among different age groups.

Comparison of rachitic children with ALRTI was done with nonrachitic children with ALRTI. Pneumonia was the commonest acute lower respiratory infections among both rachitic and non rachitic. However the rate of ALRTI was nearly three times among those with rickets. Nearly half of rachitic children 29 (44.6%) and control 194 (59.2%) were exclusively breastfed. Top fed children in both groups mostly received diluted cow's milk. Top feeding was found more common among cases than controls (26.2% vs 9.6%).

24.6

#### **DISCUSSION**

Total

Severe nutritional deficiencies are common in developing countries. Nutritional ignorance rather than simple food deprivation is involved in significant proportion of cases. Rickets has been ranked among five most prevalent diseases among children in developing countries and it causes considerable disability among children.<sup>7</sup>

In our study the incidence of rickets was 16.5% which is comparable with a study by Salimpur et al who reported an incidence of 15% among children below 6 years. However wide geographical variations in the frequency of rickets have been reported worldwide, which probably relates to genetic, ethnic, environmental factors and/or using clinical signs to diagnose rickets. The studies conducted by Tserendolger et al and Muhe et al showed very high incidence of rickets i.e., 32 and 47% respectively.<sup>8,9</sup> The reason for this higher incidence of rickets could be due to over diagnosis based only on clinical examination. The peak age at which the rickets is most common is 3-18 months. In our study the peak age of incidence was 2-12 months. Most of the children were less than one year. The predilection of nutritional rickets in early months of life is less sun exposure, because children were likely to be kept indoors due to social customs and to prevent the cold exposures. The results are comparable to other studies conducted by Aggarwal et al, Salimpur et al, Aptasanis L et al, Radhi El et al and Bahl et al. 10,11 In all these studies the predominant age involved was 0-12 months. The diagnosis of rickets was based upon clinicoradiological examination as in ours. Male preponderance in our study has also been reported by others in the literatures as our society is male dominated and males dominated and male children are privileged to have early attention and more protected environment which leads to less sun exposure in males. The common signs of rickets are due to decreased

mineralization of epiphyseal cartilages varying abnormalities at growing ends of bones. These signs are craniotabes, frontal bossing, large AF, wrist widening, rachitic rosary etc. Various studies report the relative frequency differently.<sup>12</sup> The differing study design and population studied has bearing on varying frequency of clinical features. Biochemical profile of children with rickets revealed high frequency of raised alkaline phosphatase and hypophosphataemia. Hypocalcemia was least detected. Despite the varying study population and diagnostic criteria most studies have shown this trend.<sup>13</sup>

93.8

61

We found significantly increased incidence of acute lower respiratory tract infections and children with rickets as compared to those without rickets. Our findings are in keeping with the observations in literatures with the range 38.1 to 85.1 of incidence of ALRTI. Relative higher incidence of ARI by Najada et al, (85.1%) could be due to smaller study group and they had included all cases of ARI but in present study only ALRTI cases has been included.<sup>14</sup> The incidence of ALRTI in our study group was significantly higher (64.6%) as compared to the control group (22.8%). We did not study the reasons for this predilection, but the effect of other variables like age, sex, nutritional status, breast feeding, and age of weaning and indoor pollution did not show any statistical significant difference between the study and control group.

Muhe et al have quoted in their study that calcitriol stimulates phagocyte dependent and antibody dependent macrophage cytotoxicity and is important for inhibition of mycobacterial growth in infected children. Calcitriol also acts on T and B cells and can modulate functions of lymphocytes that produce cytotoxins and antibodies. Increased susceptibility to infections with vitamin-D deficiency may be due to impaired phagocytosis. The increased incidence of pneumonia may also be due to physical changes in chest wall. The both physiological and immunological factors may contribute for the increased incidence of ALRTI.<sup>9</sup>

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#### CONCLUSION

Nutritional rickets, a multi factorial disease, is easily preventable. The present study has revealed the high incidence of rickets i.e., 16.5 % in children between 2-60 months of age admitted in the hospital with different illnesses. The present study also shows the strong statistically significant association of nutritional rickets with acute lower respiratory tract infections (ALRTI). The prevention of rickets through means such as health education, exposure of infants to sunlight and vitamin D, and /or calcium supplementation, as well as early treatment of rickets, may be an important intervention in the global efforts to prevent and control acute lower respiratory tract infections. Further studies are required to be conducted at community level to reveal the exact burden of nutritional rickets. Studies are also required to know the role of vitamin D in protection of children against ALRTI even in sub clinical rickets by including serum vitamin D level assessment.

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Institutional Ethics Committee

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