

## Original Article

### **Frequency of nutritional rickets in children admitted with severe pneumonia**

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#### **Abstract**

**Objective:** To determine the frequency of nutritional rickets in children hospitalized with severe pneumonia.

**Method:** This study was carried out at the department of paediatric medicine at National Institute of Child Health Karachi. It is a case series done over a period of six months from 15th November 2008 to 15th May 2009.

Patients admitted (n=137) with severe pneumonia were included in the study and were investigated for presence of rickets with serum calcium, phosphorus and alkaline phosphatase. Those having low to normal calcium low phosphorus and raised alkaline phosphatase were labeled as having rickets. All data collected were entered on Performa. Children with familial, vitamin D dependent/resistant rickets, secondary rickets, and cerebral palsy or on anti convulsant therapy were excluded from this study.

**Results:** Out of 137 patients, with severe pneumonia, 83 were male and 54 female. Frequency of nutritional rickets in children with severe pneumonia was observed in 101(74%) cases. Rickets was more common in 2 to 12 months of age i.e. 79.8% (67/84) and in those children who were breast fed (85.3% vs. 40%). Frequency was higher in those children who were not exposed to sunlight.

**Conclusion:** Pneumonia is a very common presentation of rickets. This study suggests that rickets may be more common in children who are breast fed and those who have less exposure to sunlight (JPMA 60:729; 2010).

#### **Introduction**

Nutritional rickets is prevalent in developing regions of the world and rank among the five most common diseases in children.<sup>1</sup> Although in developed countries it was thought to be vanquished, but is emerging again.<sup>2</sup> Despite extensive search exact prevalence of rickets in Pakistan could not be found though in South East Asia its prevalence is about 15-18%.<sup>3</sup>

Rickets is failure of mineralization of osteoid tissue or growing bones caused by vitamin D deficiency.<sup>4</sup> Nutritional rickets is caused by vitamin D deficiency due to inadequate dietary intake and cutaneous synthesis.<sup>5</sup> Vitamin D deficiency results in growth retardation, muscle weakness, skeletal deformities, hypocalcaemia, tetany and

seizures.<sup>6</sup> Bony abnormalities include bowing of the legs, knock knees, rickety rosary, swelling of the end of the long bones, frontal bossing and pathological fractures in severe cases, as well as poor growth and delayed dentition.<sup>6</sup> Radiology shows metaphyseal flaring, irregularity and widening of epiphysis.<sup>8</sup>

Rachitic children are more prone to infection especially chest infections and may present with recurrent chest infection.<sup>9</sup> 25(OH)2D acts as immune system modulator, prevents excessive expression of inflammatory cytokines and increases the 'oxidative burst' potential of macrophages. It stimulates the expression of potent antimicrobial peptides, present in neutrophils, monocytes, natural killer cells, and in lining cells of respiratory tract. Thus

vitamin D may play a major role in protecting the lungs from infection.<sup>10</sup>

Childhood pneumonia continues to be a significant global health problem. Indeed, pneumonia affects 150 million children around the world on an annual basis<sup>11</sup> and leads to more than 2 million deaths per year in children less than 5 years of age.<sup>12</sup> Rachitic infants have been reported to have a higher risk of pneumonia and are at greater risk of dying from it when compared with non-rachitic infants

Rachitic children are commonly hospitalized due to lower respiratory tract infection so all the patients with pneumonia should also be looked promptly for rickets. This aspect of rickets has not been looked into so we planned to study the frequency of rickets in children hospitalized for severe pneumonia and the association of rickets with pneumonia. If significant frequency is found then we may recommend the prophylactic use of vitamin D in all children with pneumonia and subsequently to assess its impact.

### Patients and Methods

This is a case series study conducted over a period of six months from 15th November 2008 to 15th May 2009. This study was carried out in the department of paediatric medicine at National Institute of Child Health, Karachi which is a tertiary care hospital.

All patients admitted with severe pneumonia aged 2 months to 5 years were included. Severe pneumonia was diagnosed on clinical basis according to Integrated Management of Childhood Illnesses (IMCI) protocol by World Health Organization which is followed in our hospital. According to IMCI protocol children with history of cough, fever (temp  $\geq 100^{\circ}\text{F}$ ) or respiratory distress and on examination having tachypnea i.e respiratory rate  $\geq 50$ /minute for 2 months to 12 months,  $\geq 40$ /minute for 12 months to 5 years and chest indrawing with or without wheeze or crepitations were taken as having severe pneumonia.<sup>13</sup> All children having biochemical changes i.e low or normal calcium (8-10mg/dl), low phosphorus (5-7mg/dl) and raised alkaline phosphatase (50-200 IU) were considered as having rickets with or without radiological evidence of rickets. 25(OH) D3 levels could not be done because of financial constraints. Children with familial or vitamin D dependent/resistant rickets, secondary rickets like hepatic and renal disease and those having cerebral palsy or on anti convulsant therapy were excluded from the study.

Relevant information was collected in a specially designed form for this study, which contained the following data: age, sex, serum calcium, phosphorus and alkaline phosphatase, x-ray findings, history of exposure to sunlight and mode of feeding either breast fed or top feeding.

Informed consent was obtained from the guardians of

all children and the study was approved by the hospital scientific and ethical committee.

Sample size of 137 was calculated: based on a confidence interval 95%, margin of error 6% and prevalence 15%.

Statistical analysis was done on SPSS version 10.0. Frequency and percentages were calculated for gender, age groups and presence of rickets. Mean and standard deviation were calculated for the age, calcium, phosphorus and alkaline phosphatase of the children. Stratification by age, feeding status and sunlight exposure were undertaken to control for its effect on outcome.

### Results

One hundred and thirty seven patients with severe pneumonia were included in this study. Eighty four (61.3%) children's age were from 2 to 12 months, 40(29.2%) were 13 to 24 months and 13(9.5%) were greater than 24 months. The average age of the patients was  $13.30 \pm 10.61$  months (95%CI: 11.51 to 15.09) and median age was 10(13) months. Age range was from 2 to 48 months.

Out of 137 patients with severe pneumonia, 83(61%) were male and 54(39%) were female. Frequency of nutritional rickets in children with severe pneumonia was observed in 101(74%) cases. With respect to age, rickets was more common in 2 to 12 months of age i.e. 79.8% (67/84) as mentioned in Table-1. Similarly, males were more affected than females (80.7 vs. 63%) with 1.9:1 male to female ratio.

**Table-1: Nutritional rickets with respect to age groups.**

Age Groups	Rickets	
	Present (n=101)	Absent (n=36)
2to 12 months	67(79.9%)	17(20.2%)
13 to 24 months	29(72.5%)	11(27.5%)
> 24 months	5(38.5%)	8(61.5%)

**Table-2: Frequency of nutritional rickets with respect to Sunlight.**

Sunlight	Rickets		Total
	Present	Absent	
Positive	43(55.1%)	35(44.9%)	78
Negative	58(98.3%)	1(1.7%)	59
Total	101	36	137

**Table-3: Frequency of nutritional rickets with respect to Breast Feeding.**

Breast feeding	Rickets		Total
	Present	Absent	
Positive	87(85.3%)	15(14.7%)	102
Negative	14(40.1%)	21(60%)	35
Total	101	36	137

Radiological evidence of rickets was present in 83% of patients (84/101).

Frequency of rickets was higher in those children who had little or no exposure to sunlight than those who had exposure of sunlight (98.3% vs. 55.1%) as shown in Table-2.

Regarding breast feeding, Rickets was more common in those children who were breast fed than those children who were given top feed (85.3% vs. 40%) as presented in Table-3.

## Discussion

Rickets is often considered a 19th century disease. However, despite the availability of vitamin D and demonstration of its efficacy in preventing rickets, vitamin deficiency rickets still exists as a public health problem with significant morbidity. In many countries, there are reports of a high prevalence of subclinical vitamin D deficiency in children and adolescents and clinical rickets may merely represent the tip of the iceberg.<sup>14</sup>

Total number of children in the present study were 137 with male to female ratio of 1.9:1 which is comparable with other studies with similar results. In a study carried out by Siddiqui et al there was high male predominance with male to female ratio of 3.71:1(78% vs 21%).<sup>8</sup> In another study from Turkey male to female ratio was 2.9:1.<sup>15</sup> Same results were reported in a study from Peshawar by Khattak et al with male to female ratio of 1.77:1.<sup>9</sup> While in a very large study from Denmark, Beck-Nielson et al observed no difference in gender distribution.<sup>16</sup>

Highest incidence of rickets was found in age between 2 to 12 months that is 79.8%. Even in studies from other cities of Pakistan same fact was enhanced like in studies from Abbotabad and Peshawar, 90% patients were below 2 years while from Lahore 76% were under 2 years consistent with this study.<sup>8,9,17</sup>

In this study rickets was more common in breast fed infants that is 85.3%. In a study from United States, 96% of children who developed rickets were breast fed while in a Canadian study 94% rachitic children were breast fed.<sup>18,19</sup> For this reason it has been recommended by American Academy of Paediatrics that breastfed and partially breastfed infants should be supplemented with 400 IU/day of vitamin D beginning in the first few days of life. Supplementation should be continued unless the infant is weaned to 1 L/day or 1 qt/day of vitamin D-fortified formula or whole milk.<sup>20</sup>

Rickets in this study was found to be more common in children who were not exposed to sunlight i-e 98.3%. In a study from Sydney 89% of children with rickets had none or minimal exposure to sun light.<sup>21</sup>

In Karachi city there is an increased trend of living in multistoried apartments where there is no or minimal sunlight exposure. Other possible reasons could be living indoors due to hot climate and wearing fully covered clothes with most of the women covering their head and few their faces as well. There is also a trend of keeping children inside fully wrapped in covers. Darker skin pigmentation and air pollution are other contributing factors to reduced sunlight exposure in our set up despite ample sunlight.

There was an increased incidence of rickets in patients admitted with severe pneumonia i-e 74 % (101/137) in this study. A similar study from Jordan has shown 85% patients having rickets presented with respiratory tract infections.<sup>22</sup> While in other studies chest infections were the second most common presentation.<sup>14,15</sup>

It is recommended to have proper anticipation, prevention, and early treatment of vitamin D deficiency rickets, not only to reform the skeletal system but also to avoid increased infection rate in such patients.<sup>23</sup>

## Conclusions

In children with severe pneumonia associated rickets is often present. These children may have the clinical signs of rickets. Further investigation with biochemical test is recommended. Also Vitamin D supplementation of 400IU/day in breast fed infants within the first few days not only enhances immunity but vitamin D also has its effect on multiple system organs.

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