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ORIGINAL ARTICLE

Risk Factors for Nutritional Rickets in Children under 36 months: A Civil Hospital Case Study

Sangeeta Santosh[1], Fehmina Arif[2] and Hina Raess[3]

ABSTRACT

Background: Nutritional rickets is a common problem in Pakistan especially in Karachi with majority of the population living in enclosed housing and slums having limited or no sun exposure. There is a dearth of significant data regarding rickets in Pakistan especially in Sindh which emphasizes the need for further research. This study can be a foundation for other studies regarding strategies for prevention and early diagnosis of rickets.

Objectives: To determine the clinical presentation and identify risk factors for nutritional rickets in children less than three years of age.

Methods: A cross sectional study conducted in the department of pediatrics DUHS/CHK from June 11, 2007 to December 10, 2007. Fifty patients aged two months to thirty six months presenting with the clinical manifestation of rickets were included in the study. Information recorded included symptoms, socioeconomic status, feeding patterns, sun exposure, clothing, housing and malnutrition. Diagnosis was based on clinical signs, serum levels of alkaline phosphatase, calcium, phosphorus and radiological changes in X-ray wrist joint.

Results: Approximately 60% reported a weight for height less than ISD criteria set by WHO. Of the total assessed 58% percent were exclusively breast fed, 30% partial breast fed and 12% on formula milk. Weaning age was not reached in 20% of the children. Complementary feeding initiated late for 40% of the children with 78% percent exposed to sunlight less than 30 minutes per day and. Gross motor delay existed in 30% of children and hypocalcaemia convulsions in 14%. Past H/O repeated was in 32% had 22% had persistent/recurrent diarrhea.

Conclusion: Exclusivity breast feeding to complementary feed, inadequate exposure to sunlight and delayed introduction of complementary foods are the main risk factors for the development of nutritional rickets which can manifest itself in the form of ARI and diarrhea.

KEY WORDS: *Rickets, Vit-D Deficiency, Biochemical Abnormalities*.

[1] **Sangeeta Santosh**

Senior Registrar, Ziauddin University & Hospitals Karachi

[2] **Fehmina Arif**

Professor, DUHS, Civil Hospital Karachi

[3] **Hina Raess**

Senior Registrar, Liaqat University of Medical and health Sciences, Jamshoro

Corresponding Author

Sangeeta Santosh

INTRODUCTION

Rickets is a term signifying failure of mineralization of growing bone or osteoid tissue with characteristic changes of growth plate cartilage among children before closure of growth plate. There are many causes of rickets; among them nutritional vitamin D deficiency remains the most common cause globally.[1] Independent research conducted in Lahore[2], Abbotabad[3], and Peshawar[4,5] also found nutritional deficiency of vitamin D as the most often cited cause of rickets.

Among ethnic minorities in the UK, 1.6% (77% of them of Southeast Asian descent) showed prevalence of rickets. The Center for Disease Control and Prevention places prevalence of nutritional rickets at 5 cases per 1 million children of six months to five years of age.[6] Multiple studies highlight most black children to be the most effected.[7]

Review of studies conducted between 1986 and 2003 highlighted 166 pediatric cases of rickets USA. Among the effected children, majority were less than 30 months old at presentation, of which 83% were black and 96% were breast-fed.[8]

Nutritional rickets is a common problem in Pakistan as highlighted in different studies. In Peshawar rickets was observed in 2.25% children.[5] There is dearth of significant data regarding rickets in Pakistan especially in Sindh which emphasizes the need for further research on this preventable disease. This study was undertaken to further evaluate the clinical presentation and risk factors of rickets. This can provide baseline data for other studies targeting early diagnosis and prevention of rickets.

METHODOLOGY

This cross-sectional study was conducted in the department of Pediatrics, CHK from June 2007 to December 2007. Clinical examination and laboratory investigations were used to assess the condition. Keeping the prevalence of rickets 2.25% with a CI of 95% and precision required 0.05 the sample size estimated was 39 using WHO sample size software. The study however involved 50 children as subjects. The sampling technique used was non-probability, convenience based. Children under three years of age, presenting symptoms of rickets and biochemical abnormalities regardless of gender were included. Those having chronic illness like hepatic or renal disease, on anticonvulsant medicines for more than six months, having evidence of skeletal dysplasia and pre-term children with hypocalcemia were excluded from the study.

Written permission was sought from the ERC of CHK and informed consent was acquired from parents or attendants of the patients. Their anonymity, autonomy, confidentiality and beneficence were given top priority. The respondents were provided complete liberty not to answer any question or leave the study at any time.

A thorough history including, socioeconomic status, feeding pattern, weaning practices, sun exposure, type of clothing and housing condition were taken followed by a complete examination. Nutritional assessment of children was done using WHO Classification of normal, mild, moderate and severe malnutrition. Intake of vitamin D rich food was assessed in children by inquiring about the average intake of vitamin D rich food. Sun exposure in children was estimated approximately on average weekly exposure. The following investigations were done to confirm rickets, 1) serum calcium 2) serum phosphorus 3) Serum alkaline phosphatase 4) x-ray wrist joint.

Data was entered into SPSS version 16. Mean and SD were calculated for continuous variables. Frequencies were calculated for categorical variables and were exhibited through graphs

RESULTS

Out of the total 50 children with the rickets, 29 (58%) were male and 21 (42%) were female. Mean age was 15.13±9.6 months with mean age of male children at 13.3±9.1 months female at 17.6±10 months. The number of children in the age group 0-12 months were 25 (50%), with those belonging to the groups of 13-24 months and 25-36 months being 18 (36%) and 7 (14%) respectively. The Low socioeconomic group constituted of 32 (64%) cases, while 17 (34%) belonged to middle and 1 (1%) to the high socioeconomic group. Children who were malnourished were 30 (60%) depicting levels of mild in 10 (20%), moderate in 13 (26%) and severity in 7(14%) cases having weight for height below 3SD. Exclusive breast feeding was noted in 29 (58%) cases whereas 15 (30%) got supplemented with top feeding out of which 5 (10%) with formula feed, 10 (20%) with fresh milk and 6 (12%) were never been breast fed. Weaning age not reached in 10 (20%) children (Table 1). Vitamin D rich food was not being taken by 60% (24) children who had started weaning while 40% (16) partook egg or fish. In majority of the cases (78%) children had sunlight exposure less than 30 min/week and only 11 (22%) had the required proper sun exposure. Rickets was more prevalent in families residing in apartments with limited or no sun exposure. Main clinical presentation revealed gross motor delay for 15 (30%) cases, hypocalcemic convulsions in 7 (14%), acute gastroenteritis in 6(12%) and pneumonia in 4 (8%) (Table 2). The most common clinical signs were wide wrist and wide anterior fontanelle (Table 3). The children who had low serum calcium levels were 33 (66%). Hypophosphatemia was observed in 23 but alkaline phosphatase was markedly elevated in all.

Table 1: Complementary Feeding (n=50)

S. No	Complementary Feeding	n	%
1	Children below weaning age (<6 months)	10	20
2	Appropriate Onset	17	34
3	Inappropriate Onset	23	46
	Not Started	3	6
	Started Late	20	40
Total		50	100

Figure 1: Factor Relating Sun Light Exposure i.e. Housing (n=50)

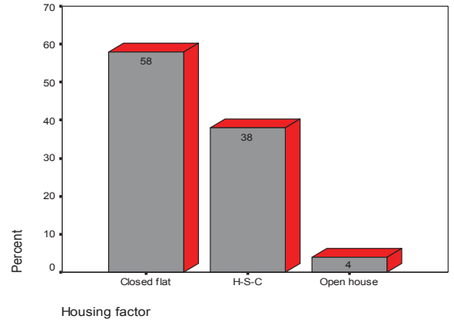

Table 2: Clinical Presentation (n=50)

S. No	Clinical Presentation	n	%
1	Delayed motor development	15	30
2	Hypocalcaemic seizure	7	14
3	Skeletal deformity	1	2
4	Acute gastroenteritis	6	12
5	Pneumonia	4	8
6	Co-morbid	8	16
7	Incidental finding	9	18
Total		50	100

Table 3: Clinical Presentation (n=50)

S. No	Clinical Sign	n	%
1	Wide wrists	38	76
2	Wide anterior fontanel	34	68
3	Frontal bossing of skull	18	36
4	Rachitcrosary	10	20
5	Bowing of legs	5	8
6	Kyphosis	4	8
7	Crainotables	3	6
8	Caput Qaudratum	3	6
9	Harrison's grove	1	2

DISCUSSION

Presentation of rickets in the present study seems to be the tip of the iceberg as 50 cases with apparent signs of rickets were documented in a 6 month period at single tertiary care teaching hospital.

In the present study majority of the cases (50%) involved children less than one year of age. Kreiter in USA[10] reported high prevalence of rickets in 5-25 month age. In Pakistan Khan et al[2] reported that 74% of rachitic children were aged below 12 months. The reason for increased incidence in this age group is the

increased metabolic demand due to rapid growth.

In the present study there was a male preponderance with a male to female ratio of 1.3. A male predominance has been reported in previous studies conducted in Australia, Ethiopia, and Sydney.[11,12,13] Comparatively a Copenhagen based study depicted a large female predominance[14], whereas a 1:1 ratio was reported from Saudi Arabia[15]. The reason of high incidence of nutritional rickets in female sex is not clearly understood, this may reflect preferential treatment given to male children in some societies and cultures. Additional research is required to identify the reasons for the disparity.

In the present study, rickets was associated with children suffering from malnutrition. In Ethiopia most of the patients with rickets were also malnourished.[11] The positive association of malnutrition with rickets is based on the prevalence of nutrient deficiencies and presence of other risk factors in their families. Lack of exposure to sunlight exposure was found as a major contributing factor for rickets in children (78%). A study based in Saudi Arabia also cited lack of sunlight exposure as a major cause of nutritional rickets.[12] Nutritional rickets was strongly associated with families living in apartments. In a study conducted in slum areas of Karachi most of the effected children resided in apartments.[13]

Nutritional rickets was more associated with exclusively breast fed children in this study. This finding is consistent with other studies in Pakistan, in which Hatun et al observed that 83% infants who had vitamin D deficiency were exclusively breast-fed.[14] Fresh milk, because of its high phosphorus content, can also lead to hypocalcemia.[15] Other factors that play significant a role include cultural beliefs and religious orientation, where conservative clothing is donned by those observing pardah which limits sun exposure of sunlight.

In this study prevalence of nutritional rickets was observed in children who had not yet been weaned, or were weaned at a delayed stage. This finding is consistent with research conducted in Kuwait[16] that cited delayed weaning as a factor for rickets in children. Children with delayed weaning miss the opportunity of obtaining vitamin D from solid foods.

The study revealed intake of vitamin D rich food in children to be low (40%) which is consistent with previous studies[17,18] that cite vitamin D poor foods as one of the cause of nutritional rickets. Majority of children suffering from nutritional rickets were from low and middle socioeconomic classes. Contrary to the findings, research conducted in India[19] and Pakistan[20] showed high prevalence of vitamin D deficiency in infants and nursing mothers belonging to upper socioeconomics class as well.

Hypocalcemic fits were present in 7 (14%) cases. Findings by Ladhani et al attribute symptomatic hypocalcemia in almost half of children to nutritional vitamin D deficiency.[21] In the present study all children presenting with fits were aged less than 6 months. Pal reported 9 cases of symptomatic hypocalcemia in young infants, more than half of whom were under 5 months of age.[22] Thirty two percent of these children had history of recurrent respiratory tract infections. 1,25(OH)2D acts as an immune system modulator. Yener et al have reported more episodes of bacterial infections in children with vitamin D deficiency as compared to healthy children.[23] Recurrent diarrhea was present in 11 (22%) cases which is congruent with previous studies[3,13,5] reporting positive association of rickets with recurrent and chronic diarrhea.

Present study identified 39 (78%) children having radiological findings of rickets, while these findings were detected as 73.84%[21], 38.09%[12], and 100%[10] in different studies. Elevated levels of serum alkaline phosphatase were a consistent finding in all rachitic children. Joiner et al[24] suggested a more cost effective approach of targeted screening of high-risk groups with alkaline phosphatase levels to detect asymptomatic affected infants.

CONCLUSION

Infants under 2 years of age are liable to have vitamin D deficiency rickets if they are exclusively breast fed and having inadequate exposure to sunlight. Delayed introduction of complementary foods and malnutrition are also important contributing factors in nutritional rickets. Vitamin D deficiency can present with variety of symptoms other than musculoskeletal symptoms like recurrent ARI, diarrhea and seizures. These are under recognized features of vitamin D deficiency. It is therefore recommended that rickets should be investigated for patients reporting these complaints. It is also possible for clinical signs and symptoms to be present with no radiographic evidence of rickets.

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