Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.elsevier.com/locate/jcot

Original Article

Prevalence of skeletal deformity due to nutritional rickets in children between 1 and 18 years in tea garden community

Tarun Chabra^{a,*}, Pranjal Tahbildar^a, Ayush Sharma^b, Sushanta Boruah^a,
Rajat Mahajan^c, Amrut Raje^d

^a Assam Medical College and Hospital, Guwahati, India

^b Central Railways Hospital, Mumbai, India

^c ISIC, New Delhi, India

^d AIIMS, New Delhi, India

ARTICLE INFO

Article history:

Received 19 March 2015

Accepted 23 January 2016

Available online 17 March 2016

Keywords:

Nutritional rickets

Skeletal deformities

Tea gardens

ABSTRACT

Introduction: The present study was undertaken to find out the prevalence of skeletal deformity due to nutritional rickets in children aged 1–18 years in tea garden community in Dibrugarh District of Assam.

Methodology: It was a cross-sectional study and two-stage cluster sampling was used. In the selected tea gardens, all the children aged 1–18 years were screened for skeletal deformity by house-to-house visit.

Results and observations: The overall prevalence of skeletal deformity was 2.7 per thousand. Majority of children with deformities (57.27%) were between 7 and 12 years of age. Widening of wrists and ankle was the most frequent symptom (53.8%). Most of the children with deformity had moderate malnutrition (77.27%). Most of the children with skeletal deformity belong to lower (v) (45.45%) grade of Kuppaswamy's grading scale. Bilateral genu valgus deformity (54.54%) and bilateral genu varum (25.92%) deformity were the most common deformities. Widening of wrists and ankle was the most frequent symptom (61.66%).

Conclusion: Of the 16,274 tea garden children included in our study (male and female) in the age group 1–18 years, 44 had skeletal deformity due to nutritional rickets. The prevalence of skeletal deformity due to nutritional rickets was found to be 2.7 per thousand children, which are significantly higher when compared with the only other such study, which was on general population in Bangladesh.

© 2016 Delhi Orthopedic Association. Published by Elsevier B.V. All rights reserved.

* Corresponding author. Tel.: +91 9599127021; fax: +91 01662245020.

E-mail address: tarunkchabra@gmail.com (T. Chabra).

<http://dx.doi.org/10.1016/j.jcot.2016.01.005>

0976-5662/© 2016 Delhi Orthopedic Association. Published by Elsevier B.V. All rights reserved.

1. Introduction

Information available on prevalence of rickets and its consequent skeletal deformities in different communities and areas of the world is limited and the importance of the problem has not so far been recognized.¹ This paucity of information is even more so in the tea garden community in which the incidence is supposed to be even higher. There are 160 tea gardens in Dibrugarh District and Assam Medical College & Hospital, Dibrugarh is a referral center for almost all of them, It has been seen that a sizeable number of rickets patients come to Assam Medical College & Hospital, Dibrugarh from the tea garden community for their management; till now, there is no published study on prevalence and associated factors, which may be responsible for the large number of patients of the community suffering from rickets.

We take up this study so that the prevalence can be determined, possible etiological factors can be identified, and preventive measures can be formulated for the future.

2. Methodology

The present study was undertaken to find out the prevalence of skeletal deformity due to nutritional rickets in children between 1 and 18 years in the tea garden community in Dibrugarh District under the guidance of Department of Orthopaedics, AMCH Dibrugarh. The study was conducted in 20 randomly selected tea gardens (random table technique) out of 160 tea gardens in Dibrugarh district from April 2012 to March 2013. It was a cross-sectional study and two-stage cluster sampling was used in the selected tea gardens. All the children aged 1–18 years were screened for skeletal deformity by house-to-house visit. All children of 1–18 years age were selected and those who did not give informed consent were excluded from the study. After obtaining ethical clearance, data were registered in predesigned and pretested schedule.

History of nutritional status, family income, family diet, sunlight exposure, similar deformity in siblings, and other points as per Performa were recorded. Clinical evaluation like weight for height and BMI (body mass index) was done and socioeconomic status was assessed using Kuppuswamy's scale. Laboratory investigations of serum calcium, serum phosphate, serum alkaline phosphatase, serum urea, serum creatinine, hemoglobin, and urine routine were conducted. Serum 25(OH) and 1,25(OH)₂D are not available in Dibrugarh and Assam Medical College & Hospital, Dibrugarh, so that was excluded from the study. Radiological investigations of posterior and anterior radiographs of the wrist and X-rays of the deformed part were taken. Performa was used, which included all details including dietary history, sunlight exposure, drug history, family history, income, siblings, thorough clinical examination for signs of malnutrition, and rickets (craniotabes, bossing of skull, delayed closure of anterior fontanelle, rachitic rosary, pigeon chest, Harrison sulcus, and protruding abdomen). Skeletal abnormalities (knock knees, bow legs, wind swept deformities, anterior bowing of tibia and femur, coxa vara, kyphosis and scoliosis, and lordosis). Systemic examination of all systems was done. To rule

out renal rickets clinically, following signs were seen – alopecia, hyperpigmented macules, hematuria and urinary tract infections.

2.1. Statistical analysis

Data were presented in terms of percentage and mean $\pm$ SD and also in the form of diagrams; t-test for testing the difference between two proportions was applied to find out the difference between sex-wise prevalence; *p* value of <0.05 was considered as statistically significant.

3. Results and observations

The overall prevalence of skeletal deformity due to nutritional rickets in children 1–18 years in tea garden community in Dibrugarh District is 2.7 per thousand. Prevalence of skeletal deformity in males is 2.54 per thousand, and in females, it is 2.87 per thousand; however, the difference between their prevalence was not significant. Majority of children with deformities (57.27%) were between 7 and 12 years age group ([Graph 1](#)). Widening of wrists and ankle was the most frequent symptom (53.8%) and rachitic rosary (15.3%) and protruded abdomen (15.3) were the second most common symptom observed ([Table 1](#)).

Most of the children with deformity had moderate malnutrition 77.27% and only 13.6% of the children had normal nutrition ([Table 2](#)). Most of the children with skeletal deformity belong to lower (v) 45.45% and upper lower (IV) 29.45% grade of Kuppuswamy's grading scale ([Graph 2](#)). Bilateral genu valgus deformity (54.54%) and bilateral genu varum (25.92%) deformities were the main deformities found among all the deformities ([Table 3](#)). Serum calcium and phosphate were in normal range in all the subjects but serum alkaline phosphatase (which is a marker of osteoblastic activity) levels were raised in all the children. Serum levels of urea and creatinine were in normal range, which shows that there is no renal rickets component ([Tables 4 and 5](#)).

Graph 1 – Age-wise distribution of skeletal deformities due to nutritional rickets.

Table 1 – Showing various signs and symptoms.

Signs and symptoms	Number (n)	Percentage (%)
Craniotabes	0	0
Bossing of skull	0	0
Delayed closure of anterior fontanelle	0	0
Rachitic rosary	4	15.3
Pigeon chest	3	11.5
Harrison sulcus	1	3.8
Protruding abdomen	4	15.3
Widened wrists and ankles	14	53.8
Total	26	100

Table 2 – Number of children with skeletal deformity with respect to nutritional status.

Nutritional status	Number of children with skeletal deformities	Percentage (%)
Normal nutrition	6	13.6
Borderline malnutrition	2	4.5
Moderate malnutrition	34	77.27
Severe malnutrition	2	4.5

4. Discussion

Rickets prevails in epidemic proportions over parts of India as its prevalence varies from region to region due to change in socioeconomic status and due to cultural diversity. Prevalence rates in Delhi are 4–27%, 20% in central India, and 3.3% among preschool children in Calcutta.^{2–5} Incidence of rickets is considered to increase with latitude and malnutrition, which also applies to tea garden community of Assam. Singleton R in his article on rickets and vitamin D deficiency in Alaska native children concluded that rickets incidence increased with latitude and rickets/vitamin D deficiency cases are more likely to have malnutrition (OR 38.1; 95% CI 4.9–294).⁶

No such study has been conducted any where in the world on the tea garden community in spite of possible evidence of higher incidence of rickets in this community due to altitude, malnutrition, and low socioeconomic status. On extensive

Table 3 – Shows distributions of various skeletal deformities.

Deformities	Number (n)	Percentage (%)
Bilateral genu valgus	24	54.54
Bilateral genu varum	14	25.92
Wind swept deformity	1	2.27
Anterior bowing of tibia and femur with varus or valgus deformity	3	6.81
Unilateral coxa varus	2	2
Unilateral coxa valgus	3	6.8
Kyphosis	1	2.27
Scoliosis	1	2.27
Lordosis	2	4.5

Table 4 – Representing laboratory parameters.

Laboratory parameters	Mean $\pm$ SD	Range	Normal range
Serum calcium	9.46 $\pm$ SD	8.5–10.5 mg/dl	8.5–10.5 mg/dl
Serum phosphate	4.95 $\pm$ SD	4–6 mg/dl	4.6 mg/dl
Serum alkaline phosphatase	198.7 $\pm$ SD	140–410 units/lit re	50–136 units/l
Serum urea	26.1 $\pm$ SD	15–35 mg/dl	15–39 mg/l
Serum creatinine	0.906 $\pm$ SD	0.6–1.2 mg/dl	0.6–1.3 mg/l

Table 5 – Various clinical signs of rickets.

Clinical signs of rickets	Number	Percentage (%)
Widened wrists	37	61.66
Rachitic rosary	22	36.66
Bow legs	5	8.33
Craniotabes	5	8.33

literature search, only one other study conducted in Bangladesh has tried to identify incidence of skeletal deformity in rickets. The Helen Keller International conducted a nationwide survey in Bangladesh in 2000 and repeated it in 2004. Rickets was identified as visible varus and/or valgus deformities in children aged 1–15 years. Nationally, rachitic

Graph 2 – Showing distribution of children with skeletal deformities with relation to socioeconomic status.

deformities were found in 0.26% of 21,571 surveyed children in 2000 and in 0.12% of 10,005 surveyed children in 2004.^{1,7} In the present study, which surveyed 16,274 children between the ages of 1 and 18 years, prevalence of skeletal deformity due to nutritional rickets in children between the ages of 1 and 18 years was found to be 2.7 per thousand children, which is much higher compared to the Bangladeshi study. Although this is the first study to document incidence of skeletal deformity due to rickets done in India, our study does have its limitations like serum 25(OH) and 1,25(OH) 2D was excluded from the study while diagnosing rickets due to unavailability of the test.

5. Conclusion

In the present study, we conclude that deformity due to nutritional rickets in children between 1 and 18 years in tea garden community is significantly high – 2.7 per thousand children. Based on our findings, more similar studies need to be conducted in tea garden community in other parts of India to find the prevalence of rickets and its consequent skeletal deformities and a national survey needs to be done to identify incidence of skeletal deformity in rickets. Deformity due to nutritional rickets should be considered as a major healthcare problem in the tea garden community and necessary action should be taken for the prevention and treatment of these deformities.

Conflicts of interest

The authors have none to declare.

REFERENCES

1. Craviari T, Pettifor JM, Thacher TD, et al. In: *A Summary of the Rickets Convergence Group Meeting*. 2006.
2. Dawodu A, Agarwal M, Sankarankutty M, Hardy D, Kochiyi I J, Badrinath P. Higher prevalence of vitamin D deficiency in mothers of rachitic than nonrachitic children. *J Pediatr*. 2005;147(1):109–111.
3. Lulseged S, Fitwi G. Vitamin D deficiency rickets: sociodemographic and clinical risk factors in children seen at a referral hospital in Addis Ababa. *East Afr Med J*. 1999;76(8):457–461.
4. Prevalence of nutritional rickets in various developing countries. Hochberg Z, ed. In: *Vitamin D and Rickets*. 2003; 221. <http://books.google.co.in>.
5. Thacher TD, Fischer PR, Strand MA, Petti for JM. Nutritional rickets around the world: causes and future directions. *Ann Trop Paediatr*. 2006;26:1–16.
6. Singleton R, Lescher R, Gessner BD, et al. Rickets and vitamin D deficiency in Alaska native children. *J Pediatr Endocrinol Metab*. 2015.
7. Rickets: an overview and future directions, with special reference to Bangladesh. In: *A Summary of the Rickets Convergence Group Meeting*. 2006.