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ORIGINAL ARTICLE

Assessment of Nutritional Status for Nutritional Rickets Identification in Children Less Than Five Years of Age

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ABSTRACT

Aim: To estimate the nutritional status for nutritional rickets identification in children <5 years of age.
Study design: Prospective study
Place and duration of study: Memon Hospital Hyderabad from 1st February 2022 to 31st January 2023.
Methodology: One hundred children under the age of 5 were enrolled. Nutritional rickets diagnosis was based on clinical and biochemical examination followed by radiological imaging. The radiological X-ray was used for identifying spraying, fraying, cupping and widening of wrist presence. A 2cc blood of each patient was withdrawn and test for the levels of 25(OH) vitamin D3, serum calcium and alkaline phosphatase (ALP) through Enzyme linked immune sorbent assay and calorimetric method respectively. For each patient a food frequency chart was fulfilled which included their breast feeding, supplementation, cerelac and cow milk diet intake as well as intake of other dairy products.
Results: Radiological assessment of present study showed that cupping was the most prominent determinant followed by wrist widening and splaying in all age groups. In present study, rural participants are more exposed to sun light as compared to urban participants. Biochemical analysis revealed that means calcium, ALP and vitamin D levels was lower in almost every age group. Food frequency chart proved, 66% of the children were on breastfeeding but only 34% of the patients were taking supplements along with breastfeeding.
Practical Implication: supplementation and adequate awareness are the key elements that can prove substantial in improving the vitamin D status in developing regions of the world.
Conclusion: Majority of the children of present study were vitamin D and calcium deficient.
Keywords: Rickets, Vitamin D, Calcium, Sunlight

INTRODUCTION

Rickets is a disease of bone mineralization due to vitamin D and calcium deficiency effecting overall bone health and growth of children. Vitamin D helps in calcium regulation and absorption and prolonged vitamin D deficiency leads to calcium deficiency and softening of bone.[1,2] Although rickets is a global issue however, its prevalence is much higher in developing countries where nutritional deficiencies are already higher as compared to developed states of the world. Premature birth, vitamin D deficiency during pregnancy, certain medications and northern latitudes are additional risk factors for rickets development.[3,4]

There are various types of rickets including nutritional rickets, vitamin D dependent rickets, hypophosphatemic rickets and renal rickets. Nutritional rickets is the most common bone diseased mainly affecting children less than 5 years of age. It is primarily caused by vitamin D and calcium deficiency in blood due to genetic factors and lack of sunlight exposure.[5,6] Bone deformities can be accompanied by nutritional rickets. It can leads to muscle weakness, breastbone projection, delayed motor skill, knock knees, delayed growth, thickened wrist and ankles and pain in spine[7,8].

Sunlight is the main source of vitamin D production and stimulation in human body. Countries far from equator are deficient in vitamin D due to less UV light availability for vitamin D production and activation in skin. Therefore, vitamin D can only be regulated by food and nutrition in these countries. Fish and mushrooms are enriched with vitamin D. Similarly, cheese, milk, egg and meat also have sufficient amount of vitamin D. Studies have also proved that children on breastfeed have improved vitamin D status as compared to their counterparts.[9-11] Pakistan is currently facing serious issue of vitamin D deficiency due to poor supplementation, geological location, less outdoor activities and lack of supplementation.

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The purpose of the present study was to estimate the nutritional status of vitamin D in children and its role in improving vitamin D status.

MATERIALS AND METHODS

This prospective study was conducted at Memon Hospital Hyderabad from 1stFeb 2022 to 31st January 2023 and 100 post-diagnoses of children of nutritional rickets were enrolled. The informed consent of each child was taken from his/her parents or guardian. Nutritional rickets diagnosis was based on clinical and biochemical examination followed by radiological imaging. The radiological X-ray was used for identifying spraying, fraying, cupping and widening of wrist presence. Children under year 5 were included in the study. Those children who had any perithyroidal or any other congenital issues affecting calcium and vitamin D levels were not included in the study. The study sample size was calculated through WHO sample size calculator using 80% power of test and 95% confidence of interval. Those children who were found positive for their nutritional rickets were considered as study participants. A 2cc blood of each patient was withdrawn and test for the levels of 25(OH) vitamin D3, serum calcium and alkaline phosphatase (ALP) through Enzyme linked immune sorbent assay and calorimetric method respectively. The blood test was conducted under standard operating procedure where quality assurances were strictly followed. For each patient a food frequency chart was fulfilled which included their breast feeding, supplementation, cerelac and cow milk diet intake as well as intake of other dairy products. Complete information regarding the sun exposure was also documented on a well-structured questionnaire. The BMI of each child was also documented for correlating it with nutritional deficiencies. All the clinical and demographic details were noted. Patients with severe deficiency of vitamin D and calcium were recommended for supplementation and follow-up as a treatment plan of nutritional rickets. Data was analyzed using SPSS version 26.0. The analysis test chi square

was applied for interpreting the frequencies and percentages. A p value <0.05 was taken as significant.

RESULTS

Radiological assessment of present study showed that cupping was the most prominent determinant followed by wrist widening and splaying in all age groups. Forty-four, fifty and forty-six percent of the patients in three age groups had cupping as the most prominent feature (Fig 1). In rural participants are more exposed to sun light as compared to urban participants. Fifty-four percent of the rural children had adequate sun exposure while only 325 of urban residents got sun exposure during their daily activities (Fig 2).

Biochemical analysis revealed that means calcium and vitamin D levels was lower in almost every age group. Sixty-nine percent of the infants within age group of 0-12 months had insufficient vitamin D level. Similarly, ALP was also inadequate in all study groups (Table 1).

Relation with sunlight exposure showed that 37% of the child had adequate sun exposure. Food frequency chart proved, 66% of the children were on breastfeeding but only 34% of the patients were taking supplements along with breastfeeding. Majority of the participants (64%) were taking ice creams in their diets (Table 2).

Table 1: Biochemical assessment of rickets' children

Laboratory Tests	0-12 Months (N=35)	1-2 year (N=26)	3-4 year (N=39)	P-value
Calcium Level (mg/dl)	7.9±1.2	8.1±1.4	8.2±0.9	0.65
Serum Vitamin D (ng/ml)				
Mean deficient/Insufficient (10-29) value	24.6±1.2	26.5±3.9	32.2±4.3	0.09
Deficient/Insufficient N (%)	24(68.5)	16(61.5)	22 (56.4)	0.15
Sufficient (>30)	11 (31.4)	10 (38.4)	17 (43.5)	0.12
Alkaline phosphatase (ALP) Level	1219±555	1200±540	1195±325	0.55

Table 2: Relation of sun exposure and food frequency chart in rickets children

Variable	0-12 Months (N=35)	1-2 year (N=26)	3-4 year (N=39)	Total (N=100)	P value
Sun Exposure					
Adequate	13 (37.1%)	9 (34.6%)	15 (38.4%)	37 (37%)	0.004
Inadequate	22 (62.5%)	17 (65.3%)	24 (61.5%)	63 (63%)	
Food Frequency					
Breast feed without supplement	29 (82.8%)	18 (69.2%)	19 (48.1%)	66 (66%)	0.003
Breast fed with supplement	6 (17.1%)	08 (30.7%)	20 (51.2%)	34 (34%)	
2 cup cerelac per day (200mg)	28 (80%)	23 (88.4%)	20 (51.2%)	71 (71%)	0.231
Cow's milk (1 cup)	7 (20%)	11 (42.3%)	26 (66.6%)	44 (44%)	0.083
Ice cream (1cup)	11 (31.4%)	22 (84.6%)	31 (79.4%)	64 (64%)	0.665
Cheese (30 g)	2 (5.7%)	13(50%)	18 (46.1%)	33 (33%)	0.042

Fig. 1: Radiological assessment in rickets patients

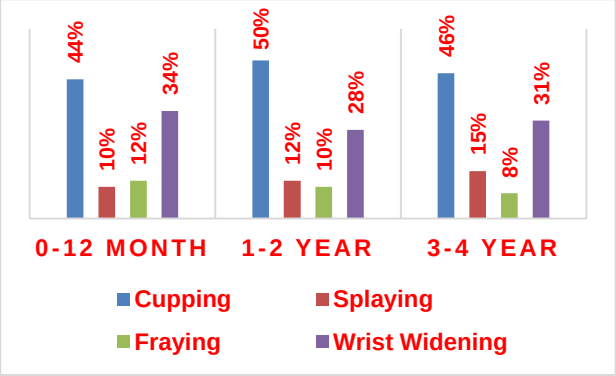
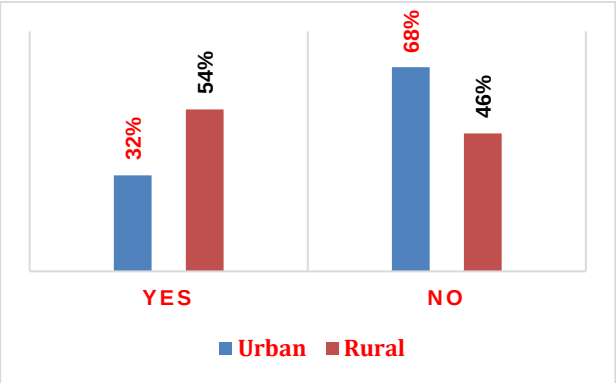


Fig 2: Association of sunlight exposure among rural and urban residents



DISCUSSION

Rickets is a common bone disorder especially in growing aged children. Various genetic and environmental factors paid the contribution in the development of rickets. Major sign and symptoms of rickets include cupping, fraying, splaying, delay in motor skill, growth impairment and muscle weakness. Nutritional rickets is the most common type of rickets which majorly affects children of developing and under developed countries where children are already suffering from various forms of malnutrition.[12-14] Present study was designed for the estimation and assessment of nutritional status for nutritional rickets identification in children less than five years of age.

Pakistan and specifically province Sindh is currently facing challenging issue of vitamin D deficiency which further worsens and elevates the chances of bone disorders including rickets. Result of the present study revealed that majority of children had inadequate level of vitamin D and serum calcium. International data also highlights that, vitamin D is the most important factor for calcium regulation and its deficiency leads to bone problems in growing aged children.[15-17] Nutritional rickets often lead to growth retardation and stunting in growing aged children.

Inadequate sun exposure also proved to be an additional factor for rickets development in children. Geological location of Pakistan is already making the country deprived of adequate sunlight exposure. Furthermore, lack of outdoor activities and cultural norms to stay in homes further worsening the present state. Only 37% of the study participants were getting adequate sun exposure whereas 67% of the children did not have adequate sun exposure during their daily routines. Role of sunlight in stimulation of vitamin D production is already published.[18,19] Fortification, supplementation and adequate awareness are the key elements that can prove substantial in improving the vitamin D status in developing regions of the world.[20-22]

Medical resources, diagnosis, and treatment must improve in developing countries. There are limited resources: access to

medical and health resources; knowledge about disease; awareness, trainings, and awareness about health. The heath literacy is mandatory for any disease and facilitate the patients with resources, databases, and trainings about disease[23,24,25,26,27,28,29].

CONCLUSION

Majority of the children had inadequate vitamin D levels. Along with vitamin D deficiency, most of the children were also calcium deficient and these factor together leads to bone deformities and formation of rickets in growing aged children.

Conflict of interest: Nothing to declare

Ethical consideration: The study was approved by hospital ethical committee.

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