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PREVALENCE OF NUTRITIONAL RICKETS AMONG SYMPTOMATIC CHILDREN AND ASSOCIATED RISK FACTORS IN SPECIALISED SAM PAEDIATRIC CENTRE YEMEN

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ABSTRACT

Background: Nutritional rickets (NR) is more prevalent in economically deprived, developing countries.

Objectives: To determine the prevalence of NR and associated risk factors among symptomatic children.

Design: A record-based descriptive study.

Setting: Specialised Sam Pediatric Center (SSPC) Sana'a city Yemen during three years from 2011 to 2013.

Subjects: Out of the 645 patients seen with symptoms and/or signs of rickets, 615 (95.35%) were included in the study and diagnosed as NR. The diagnosis was based on clinical finding and radiological and laboratory investigations.

Results: The prevalence of NR among symptomatic children aged 0-3 years was 615 (95.35%). Males were 330 (53.7%), females were 285 (46.3%) with age ranging from 0 to three years. The prevalence of NR in the 6-12 months age group was 39.2% and 37.7% in the 1-1.5 year's age group. Exclusive breastfeeding rate at four months was 78.0% and 54.96% at six months. The breastfeeding extended until the end of their first one year in 215 infants (34.96%) and in 148 (24.06%) extended until around two years of age. All infants and mothers had no significant history of sun exposure and calcium and vitamin D supplementation.

Conclusion: The prevalence of symptomatic NR was high and more prevalent in the age groups of 6-12 months and 1-1.5 years than in the other age groups. Limited or non-sun exposure, insufficient calcium and vitamin D supplementation in children and mothers and exclusive breastfeeding infants with vitamin D insufficient mothers were the leading risk factors of NR.

INTRODUCTION

The majority of nutritional rickets (NR) patients caused by calcium deficiency occur in economically deprived, developing countries where important proportions of the population are undernourish. Nutritional rickets is a disease of the growing bones that afflicts children and adolescents before fusion of epiphyses, which caused by deficiency of vitamin D, calcium or both. Despite the availability of vitamin D and the role of sunlight for prevention and cure of vitamin D3 deficiency rickets, vitamin D deficiency and/or nutritional rickets remain significant problem in developing countries and still rising in several developed countries of the world. Suggested reasons for its reappearance include satisfaction in fortifying food and altering lifestyles where children spend the majority of their time at home watching television and working on computer rather than in the sun. Furthermore, with globalisation, which has resulted in

migration of different peoples to different geographic sites (1-10).

Nutritional rickets is more prevalent in ages 3-18 months. Children in this age group are breastfed and young infants who do not receive adequate sunlight exposure, vitamin D supplements or vitamin D-fortified foods and whose mothers' vitamin D deficiency, and darkly pigmented skin. In the Middle East and other more-tropical climates, social and religious customs that prevent sufficient sunlight exposure appear to be important. Traditional clothing (covering the entire body except the face and hands) further limits the exposure time to sunlight and, thus, decreases the endogenous synthesis of vitamin D. Infants whose mothers' were vitamin D deficient were infants' vitamin D concentration correlates to that of their mothers and especially breastfed infants without vitamin D supplementation. Breast milk normally contains insufficient concentrations of vitamin D or its metabolites. Vitamin D deficiency and/or nutritional

rickets can develop very early in infancy and usually causes severe hypocalcemic symptoms which is more frequent among neonates born to mothers with low 25-hydroxyvitamin D (25(OH)D) concentrations than among those born to mothers with normal vitamin D status. The development of clinical finding of vitamin D deficiency rickets is dependent on several factors, on the severity of the vitamin D deficiency [circulating concentrations of 25(OH)D], the duration of the deficiency, the dietary calcium content and on the rate of the child's growth (11-17).

The aim of the study was to illustrate the magnitude of the nutritional rickets and associated risk factors among children presenting to Specialised Sam Paediatric Centre Sana'a city.

MATERIALS AND METHODS

This descriptive study conducted at Specialised Sam Paediatric Center Sana'a city Yemen during three years from January 2011 to December 2013. The Centre provides services to the community through outpatient clinics and receives patients from Sana'a city, surrounding areas and sometimes from other governorates, beside referred cases from private clinics.

Sample size and collection: The sample comprised 645 children of both genders under the age of three years. Information regarding age, gender, breastfeeding (exclusive, non-exclusive and duration), mother and child's history of calcium and vitamin D intake and sun exposure and infant and mother's nutrition history were collected.

Inclusion criteria: All patients who were diagnosis as nutritional rickets which based on clinical findings and radiological and laboratory investigations were included. Almost all patients who had Clinical findings (one or more symptoms and / or signs) of the rickets were recorded and underwent radiological and laboratory investigations. Clinical findings of rickets included wide fontanel, delayed teething, rosary rickets, craniotabes, enlargement of wrists, carious teeth, bowing of the legs develop once the infant starts walking, and kyphoscoliosis is observed after two years of age. Other features are chest deformities, greenstick fractures, caput quadratum, frontal bossing, and extremity pain, hypotonia, constipation, hypocalcemic convulsions (18,-21). Radiological investigations included wrist joint X ray or other joint X rays. Positive when there was radiological changes in X ray joints like widening, fraying and cupping. Laboratory investigations included alkaline phosphatase, calcium, phosphate level,

25(OH) D levels, white blood cell count(WBC), platelet count and other investigations according to the presentation of the patients. Serum levels of the biochemical parameters were determined according to standard laboratory procedures. Positive laboratory investigations when alkaline phosphatase was high more than 500 international unit / liter (IU/L), calcium was normal or low hypocalcemia when a total calcium is less than 2 mmol/L, phosphorus was low when a serum phosphate (P) is less than 1.45 mmol/L. Vitamin D insufficiency when 25(OH)D level is below 20 ng/mL. Patients were divided into four groups according to the age less than six months, >6-12 months, >1-1.5 years and >1.5-3 years for assessment of the frequency of NR. All patients with nutritional rickets were treated by adequate doses of vitamin D and calcium.

Exclusion criteria: Patients with non-nutritional forms of rickets like that had liver disease, renal disease, hypo-parathyroidism or on anti-convulsions, medications and those patients whose parents refused investigations were excluded from the study. Statistical methods: The collected data were processed manually and by using the Chi-Square test. Results were formulated in tables and calculated in frequencies and percentages.

Ethical approval: The study was approved by Specialized Sam Pediatric Center Medical Corporation.

Definitions: Exclusive breastfeeding: infant does not receive other food or drink, even water, except breast milk including milk expressed or from a wet nurse. Mixed feeding: infant receives breast milk and any other food or liquid including water, non-human milk and formula.

RESULTS

Out of the total 645 children with one or more symptoms and / or signs of rickets, 615 were diagnosed as nutritional rickets giving a prevalence of 95.35% Table 1. Males were 330 (53.7%), females were 285 (46.3%) with age ranging from zero to three years. Patients with age group of 6-12 months and with age group of 1-1.5 years constitute 241 (39.2%) and 232 (37.7%) respectively (Table 2). Exclusive breastfeeding rates at, four and six months were 78.0% and 54.96%, respectively. In 215 infants (34.96%) the breastfeeding extended until the end of their first one year and the breastfeeding extended until around 2 years of age in 148 (24.06%). All infants and mothers had no significant history of sun exposure and calcium and vitamin D supplement (Table 3).

Table 1

Patients with clinical rickets (one or more symptoms and/or signs of rickets) in a study among Yemeni children (n= 645)

Clinical rickets	Frequency	%	P value
Nutritional rickets (NR)	615	95.35	
Refused investigation	8	1.24	< 0.00001
Non NR forms of rickets	22	3.41	

The chi-square statistic is 1675.1023. The p-value is < 0.00001. The result is significant at $p < .05$.

Table 2

Frequency of nutritional rickets (NR) in children according to age and gender in a study among Yemeni children. (n=615)

Variable	Frequency	%	P value
Sex			
Males	330	53.7	0.010282
Females	285	46.3	
Age groups			
<6 months	69	11.2	
>6-12 months	241	39.2	0.00001
>1-1.5 years	232	37.7	
>1.5-3 years	73	11.9	

Table 3

Frequency of nutritional rickets (NR) in children by breast-feeding and sun exposure in a study among Yemeni children. (n=615)

Variable	Frequency	%
Breastfeeding (BF)		
Excusive BF at 4 months	480	78
Excusive BF at 6 months	338	54.96
Breastfeeding for 1 year	215	34.96
Breastfeeding for 2 years	148	24.06
Exposure to sun light		
Patients		
In the first year	None	0
In around 14 months and above	Irregular	
Mothers		
During pregnancy and lactation	None	0
Vitamin D and Calcium intake		
Mothers during pregnancy	369	60
Mothers during lactation	None	0
Patients	None	0

DISCUSSION

The risk factors of nutritional rickets in infants are lack of vitamin D supplementation, maternal vitamin D deficiency and exclusive breastfeeding with limited sunlight exposure (6,11). In our study the patients' age ranged from 0-3 years. This is the age of rapid growth period and breast-feeding of infancy. The majority of the infants in Yemen are on exclusive breast-feeding and all infants and mothers had irregular history of sun exposure and limited or no calcium and vitamin D supplement. Although breast milk is unquestionably the ideal food for infants, it is low in calcium and vitamin D. Breast milk normally contains about 25 IU or less vitamin D per liter, which is insufficient for rickets prevention. Various studies reveal that the prevalence of vitamin D insufficiency particularly in fertile women of reproductive age is as high as 80%. This condition increases the incidence of vitamin D insufficiency during early infancy (13,22).

In the current study, the prevalence of nutritional rickets among children who had symptoms or signs of rickets were 615 (95.35%). This study was in unhealthy symptomatic infants but all the studies in multiple countries, which we reviewed, were in healthy asymptomatic population. A study in Qatar by Bener *et al*, three revealed that the prevalence of NR in the healthy young Qatari population aged 0-5 years was 23.9% (3). Another study also in Qatar (23) revealed the prevalence of vitamin D deficiency among the studied Qatari children was (68.8%), mostly in the age group (11-16) years (61.6%). Other survey screening studies among asymptomatic subjects in Saudi Arabia (24) and Emirate (25) showed vitamin D deficiency and insufficiency were highly prevalent in children and more common in girls. This high prevalence of NR in our study may be caused by cold weather, (Sana'a city 2100 meter above sea level) mothers are completely covered by cultural use of protective clothing, minimal exposed to sunlight, many of them had closely spaced pregnancies, prolonged lactation and took poor diet in vitamin D and calcium.

In this study, males with nutritional rickets were more than females with a ratio of 1:16. This study nearly agrees with a study in Saudi Arabia by Al-Atawi *et al*, (26) they found male infants outnumbered the females 2:1. But disagrees with studies in Saudi Arabia (24), Emirate (25) and Qatar (23) they reported that in Saudi Arabia, Vitamin D deficiency was significantly higher in girls than boys (47.0% versus 19.4%; $p < 0.001$). In Emirate, Vitamin D deficiency and insufficiency were highly prevalent in adolescents, and more common in girls. In Qatar, the prevalence of vitamin D deficiency is high in children and more common in girls.

The current study revealed that the prevalence of nutritional rickets among age group 6-12 months and age group 1-1.5 years was more than in the other

age groups. This can be explained by the fact that many parents look for medical advice only when there are clinical rickets such as wide fontanel, delayed teething, rosary rickets, bow legs, and widened wrists, ankles ...etc..., which are more clear in these ages of six months to 1.5 years. While in the age group < 6 months the clinical rickets are still not clearly present as in the other age groups, whereas children of > 1.5 years usually expose to sunlight due to their activities. In addition, prolongation of exclusive breast-feeding until the age of one year or more without vitamin D supplement is an important factor leading to the development of rickets in the rapid growth period of infancy. There were limited or no history of exposure to direct sunlight and vitamin D supplement and none of the lactating mothers received any form of vitamin D supplementation during their lactation. Vitamin D prophylaxis is not only by prevention of clinical rickets but also through maintenance of optimal serum 25 (OH) D levels in order to prevent vitamin D insufficiency. It is suggested that vitamin D should be administered during the last trimester of pregnancy to mothers with limited exposure to sunlight due to a variety of reasons and who are at high risk of vitamin D deficiency rickets (17, 22). The present study found that almost all patients and mothers during pregnancy and lactation had limited or no history of direct sun exposure with irregular or limited calcium and vitamin D supplement. This is explained by the weather in Sana'a city is cold, (Sana'a city 2100 meter above sea level) mothers remaining indoors, or being excessively covered by traditional clothes when outside. Nutritional rickets is different from other types of rickets in that it just caused by a simple deficiency in vitamins and nutrition. It can be easily prevented and treated if detected early by an inexpensive treatment (vitamin D and calcium) may be administered gradually over long-term or in a single day's dose (stoss vitamin D therapy) for those patients who are suspected to have poor compliance and/or difficulty to follow-up. However, such high doses of vitamin D can lead to hypercalcemia (16, 17,19,26).

In conclusion, the prevalence of nutritional rickets among children was high and was more prevalent in age groups of 6-12 months and 1-1.5 years than in the other age groups. Males were more affected than females. Risk factors of nutritional rickets in children were all mothers and patients who had history of limited or non-sun exposure, insufficient calcium and vitamin D supplementation and exclusive breastfeeding infant with vitamin D insufficient mothers. Therefore, mothers, children and infants should be exposed to sunlight and take vitamin D and calcium rich diet. Besides, it is important to pay attention to maternal vitamin D status during pregnancy and lactation. Moreover, vitamin D

supplementation of all infants should be started from the first days of life.

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