

Clinical Profile and Risk Factors of Nutritional Rickets among Children – a Hospital Based Study

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Abstract

Background: Nutritional rickets (NR) incidence is on the rise in developing countries, particularly in Middle Eastern, Asian and African communities. Recently, there have even been reports from Britain, Europe and America. Ironically, this once common nutritional deficiency disease, less common in the recent past, is again seen regularly in countries where there is no shortage of sunlight necessary for the synthesis of vitamin D.

Objective: This study was done to assess the clinical profile and risk factors of nutritional rickets among patients attending at Sylhet M.A.G. Osmani Medical College Hospital.

Methods: This study was a case control study. Patients attended with rickets in Department of Paediatrics, Sylhet MAG Osmani Medical College Hospital during the period from December 2010- June 2011 were the study population.

Results: Most of children with nutritional rickets present at 20-39 months of age. Widening of wrist was the commonest presentation of NR which was followed by bowing of legs, rachitic rosary, protruded abdomen and hypotonia. Low family income, paternal illiteracy, early starting of supplementary feeding, inadequate calcium intake and repeated attack of RTI were significantly associated with development of NR.

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Introduction

Rickets is a disease occurring in infants and young children characterized by softening of the bones resulting in deformity. A similar disease in adults is known as osteomalacia.¹ While some cases relate to hereditary syndromes, renal disease, or use of medication, rickets in the world mostly stems

from nutritional insufficiency². Nutritional rickets is prevalent throughout much of the developing world and is again being increasingly seen in more affluent countries.² The typical pictures of rickets are delayed growth, widening and bowing of weight bearing bones, tooth enamel hypoplasia, muscle hypotonia and even tetany.³

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Rickets in the world is mainly because of nutritional insufficiency although hereditary syndromes, renal disease, malabsorption or use of offending drugs also contribute in some cases.⁴ Nutritional rickets is gaining attention worldwide as the disease remains an endemic problem in many developing countries and has re-emerged in a number of developed countries, where it was thought to be almost eradicated.⁵ Nutritional rickets may be caused by either vitamin D or calcium deficiency but variable combination of these two is also possible. Until recently, it was generally accepted that nutritional rickets is caused by vitamin D deficiency alone and that dietary calcium deficiency might exacerbate the disease in the presence of vitamin D deficiency but by itself is not responsible for nutritional rickets. In the past twenty-five years, consensus regarding the pathogenesis of nutritional rickets has shifted as studies have suggested that, among older children in developing countries in particular, dietary calcium deficiency plays the pivotal role.⁵ Vitamin D deficiency occurs due to lack of vitamin D in diet and/or lack of exposure to sunlight. Factors that may limit sun exposure in children include use of sunscreens, increased indoor activities, industrial pollution, living in slum areas, wearing long dresses etc.⁶ Rickets has become common in some parts of Bangladesh during the past two decades and was first brought to broad attention in 1991 by workers from Social Assistance and Rehabilitation of the Physically vulnerable visiting the Chakoria region of southeastern Bangladesh after a devastating cyclone. An informal village survey found that approximately 1% of children had rachitic deformities. Focus group and local informants suggested that rickets was noticed first during the early 1970s. Subsequently, a collaborative assessment revealed that rickets was more common than expected in Chakoria; it was not generally associated with vitamin D deficiency but was

related to insufficiency of dietary calcium.⁷ The clinical features of rickets are similar around the world, but the age of presentation and the risk of hypocalcaemic symptoms, such as tetany, vary depending on the age of presentation and the relative importance of vitamin D (versus calcium) deficiency in different populations. In areas where vitamin D deficiency is more common, rickets usually presents in the first year of life often with clinically-significant hypocalcaemia. In parts of Africa and in Bangladesh (where calcium deficiency accounts for much of the prevalent nutritional rickets), rickets usually presents from the second year of life, and hypocalcaemic tetany is much less commonly seen. Growth plates become soft as a result of diminished mineralization. With weight-bearing, gravitational pressure causes soft bones to curve in response to forces exerted across joints. Thus, the long bones of the leg curve - becoming 'bow legs' or, show up later onset of rickets in the form of 'knocked knees'. Metaphyses expand laterally such that wrists and ankles can be palpably widened. Costochondral junctions also expand with demineralized bone structures, and beading or pearling of the chest-wall is noted. Fontanels close late, and teeth erupt later than in other children. Affected children potentially experience delays in learning to walk, pain and fractures, and crippling deformities.

Methods

Study institution & design of the experiment:

This was a case control study. The study place was Inpatient and Outpatient Department of Paediatrics of Sylhet MAG Osmani Medical College Hospital, Sylhet. The study duration was seven months, from December 2010-June 2011. All clinically suspected rickets cases those attended to the Paediatrics Outpatient and also admitted during the study period were included.

Sampling technique:

Purposive sampling method was used to select 60 patients consisting 30 cases with Rickets and 30 healthy controls with age and sex matched.

Procedure of data collection:

This case-control study involved all clinically suspected rickets cases visiting to the Paediatrics outdoor and also admitted to Paediatrics department. For each patient, a control subject suitably matched for age and sex presenting with a non-nutritional illness were recruited from the same settings.

Result

In this case control study a total 60 subjects (30 cases and 30 controls) were interviewed. Among the respondents 26.7% of cases and controls were aged below <20 months. Majority of the participants, 46.7% of cases

and 43.3% of controls were aged between 20-39 months. Mean age among cases was 35.83 ± 21.67 months and controls were 35.03 ± 21.44 months. The two groups showed no statistically significant difference in age ($P > 0.05$). Among cases 66.7% were male and among the controls 70.0% were male. The sex distribution in two groups were almost similar ($P > 0.05$). Among cases 10.0% and among controls 20.0% belong to urban population. About 90.0% cases and 70.0% controls came from rural areas.

According to monthly family income 63.3% of cases had less than 5000 taka per month in comparison with controls only 23.3% were in the same income range. And this was also statistically significant ($P = 0.004$). So, family income had some contribution to nutritional rickets.

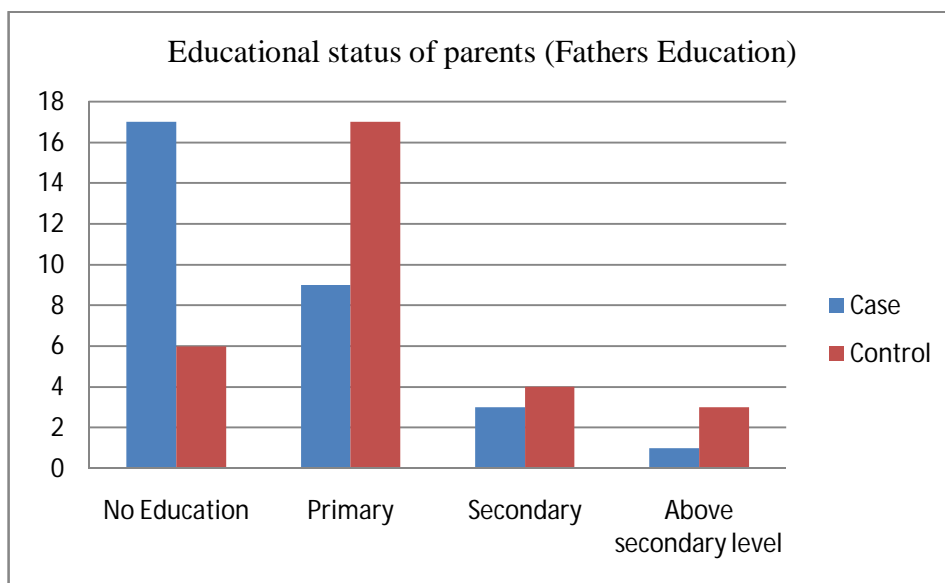


Figure 1. Educational Status of Parents (Fathers Education)

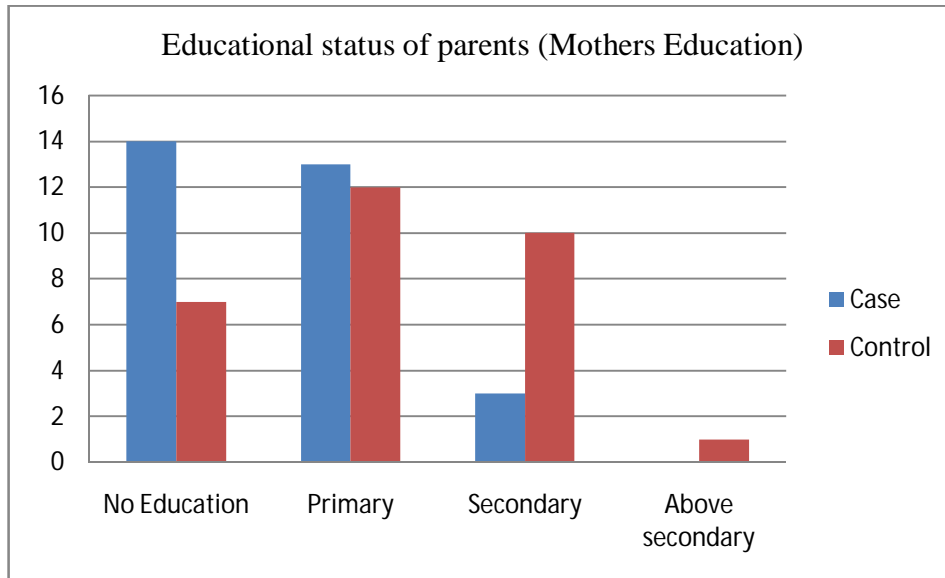


Figure 2. Educational Status of Parents (Mothers Education)

Fathers had no education in 56.7% of cases and only 20% of controls had no education and it is statistically significant ($P < 0.05$). Among the cases 46.7% mothers did not have any education in comparison the percentage among controls were only 23.3% but this is not statistically significant ($P > 0.05$).

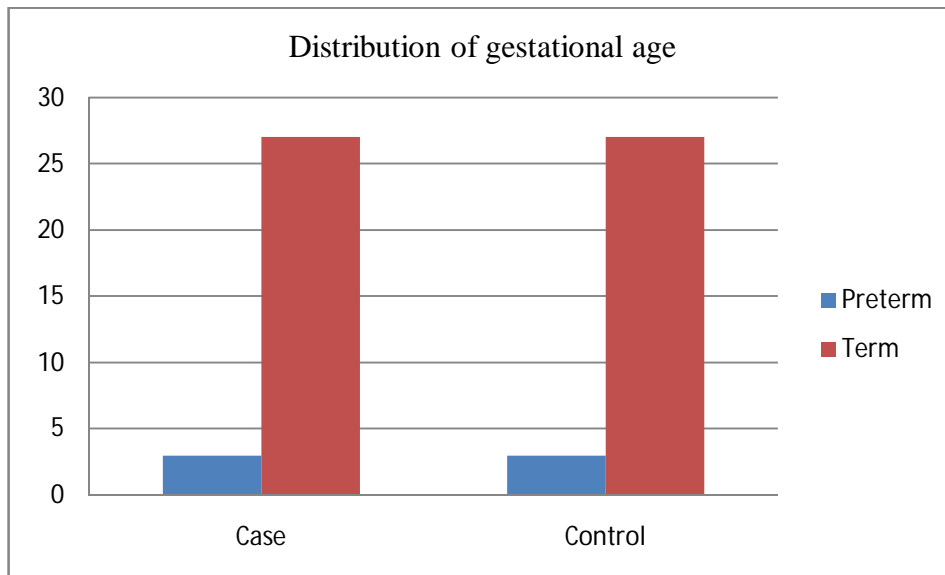


Figure 3. Distribution of gestational age

The above table compares the gestational age of the respondents which is similarly distributed among case and controls (OR 1.0). (fig 3)

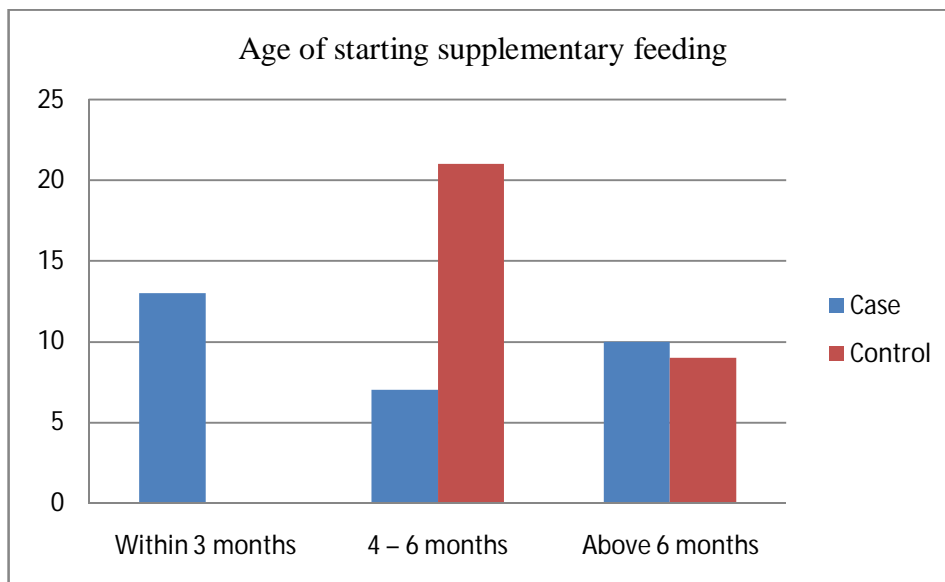


Figure 4. Age of starting supplementary feeding

Almost half (43.3) of the cases started supplementary feeding within 3 months or less and among the controls none started within this time. About 23.3% cases and 70.0% controls started supplement between 4 to 6 months and 33.3% cases, 30.0% controls were above 6 months when they first started supplement feeding. There had been a definite relation between age of starting supplementary feeding and nutritional rickets and the chi-square value is highly significant ($P < 0.01$). (fig 4)

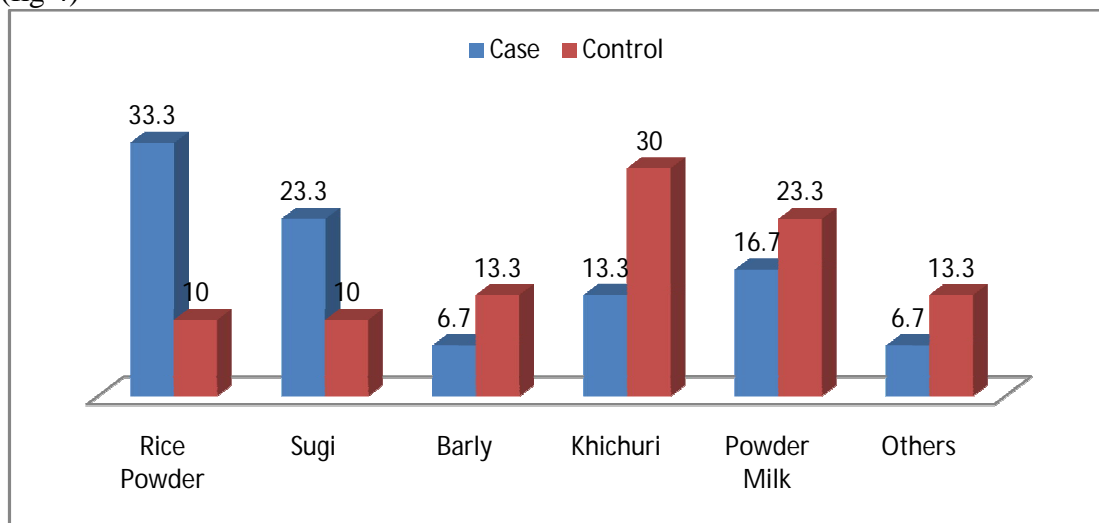


Figure 5. Type of feeding respondents started for supplementation

According to type of supplementary feeding, 33.3% cases started with rice powder and 23.3% started with sugi in contrast, 10.0% of controls had either one of these as supplementary food. About 23.3% controls started supplementary feeding with powder milk in comparison only 16.7% cases had the same and 30% of controls and 13.3% cases took khichuri for supplementary feeding. (Fig 5)

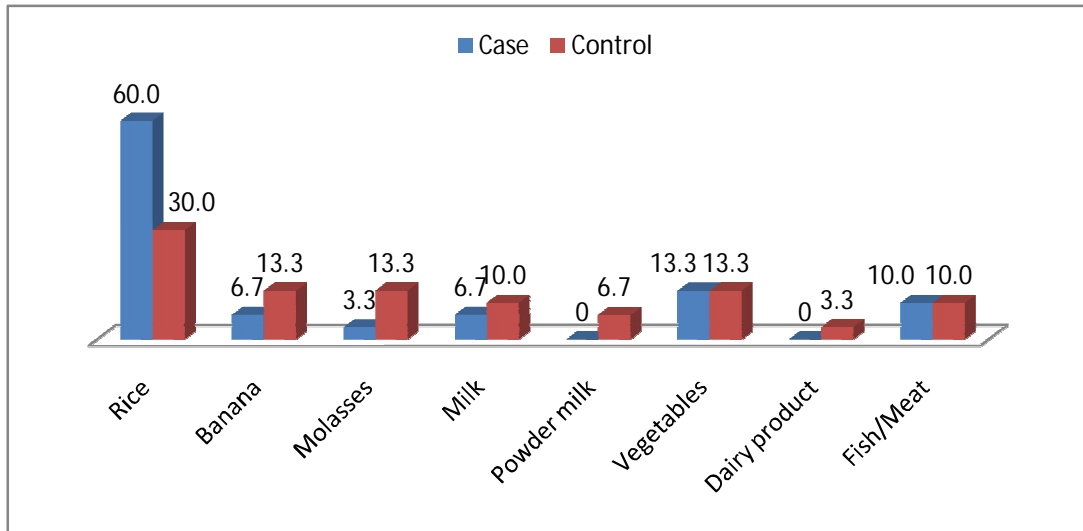


Figure 6. Type of feeding respondents had within last 24 hours

Most of the cases (60.0%) and 30.0% controls took rice within last 24 hours as feeding. Milk and other calcium containing dairy products were taken by very few cases (6.7%) in comparison to control. So, dietary calcium was inadequate. (Fig 6)

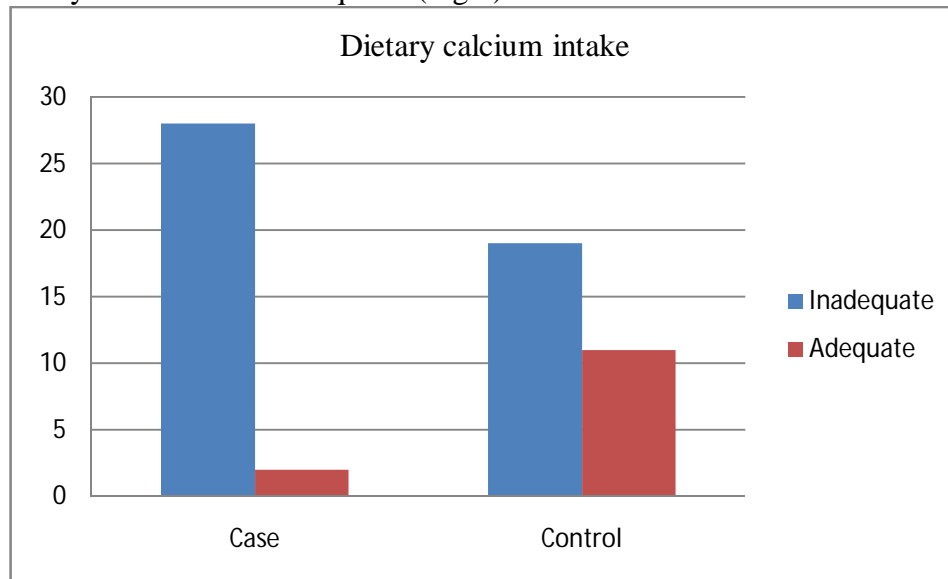


Figure 7. Dietary calcium intake

The Odds ratio between case and control due to adequate amount of dietary calcium was 8.105. And statistical significance represents 8 times more risk of inadequate dietary calcium among cases than controls. (fig 7)

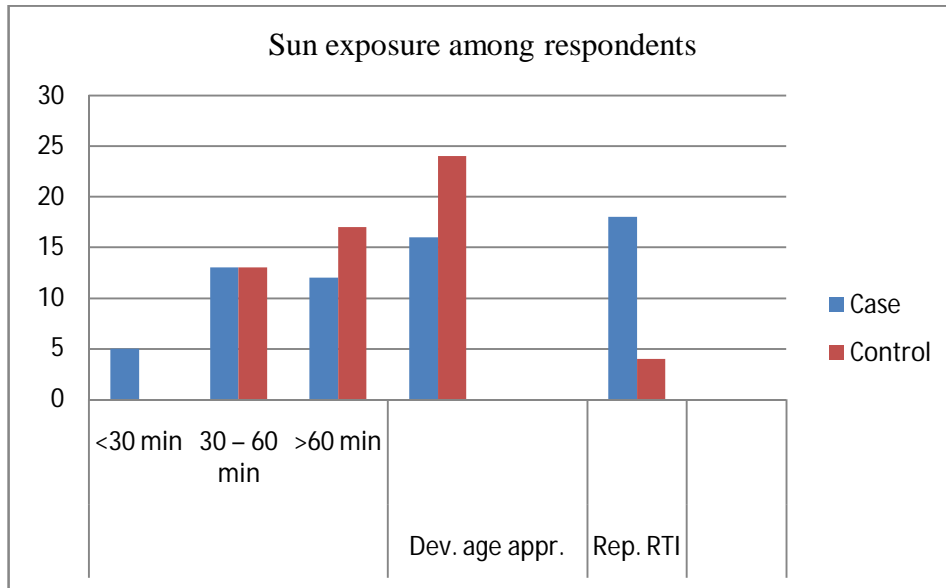


Figure 8. Sun exposure among respondents

Only 16.7% cases had less than 30 min of sun exposure and all the controls had 30-60 min sun exposure or more. And statistical significance level was very close to being significant, so there might be some relation with amount of sun exposure. Development age was appropriate for 53.3% cases and 80.0% controls. Repeated RTI found in 60.0% cases. Mean BMI among cases were 0.612 less than mean BMI of controls but there was no statistical significance ($P>0.05$). (fig 8)

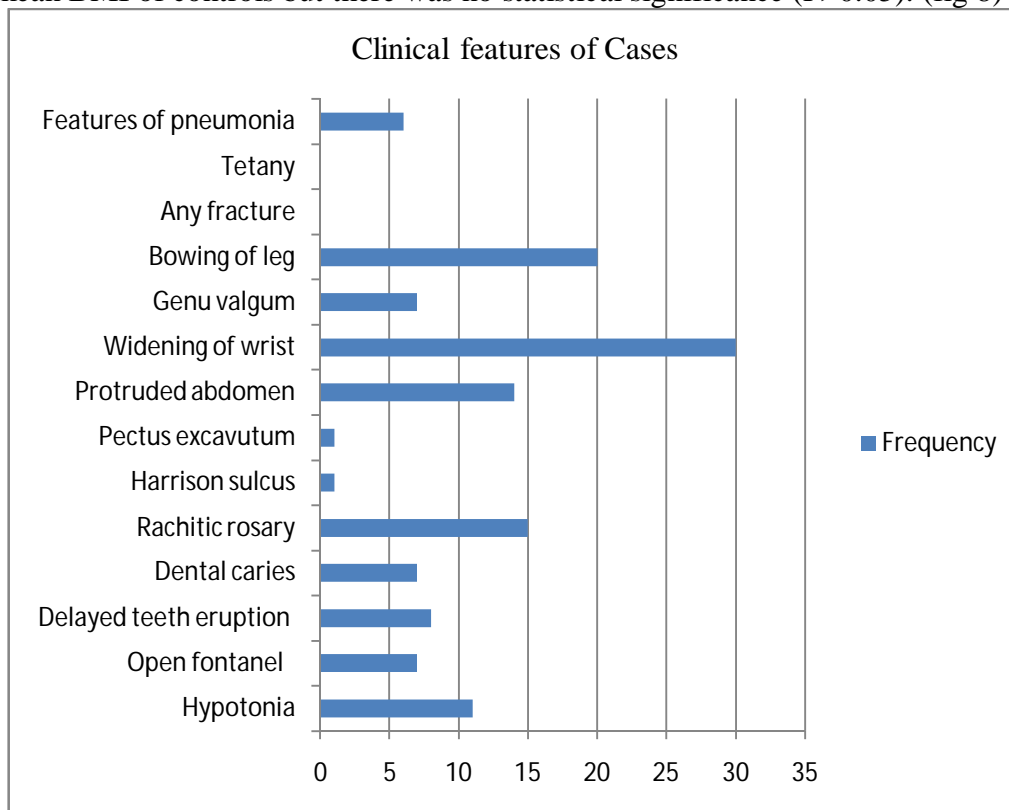


Figure 9. Clinical features of cases

Different clinical features were present among the cases of nutritional rickets. Widening of wrist was present among all 30 cases (100%). Bowing of leg present in 66.7%, Rachitic rosary in 50.0%, Protruded abdomen in 46.7%, Hypotonia among 36.7% and Open fontanel was present among 23.3% of the cases of NR. (fig 9)

Discussion

This case control study was conducted to explore the clinical profile and risk factors of nutritional rickets among patients attending to inpatient and outpatient department of Paediatrics in a tertiary level hospital and were interviewed by using semi-structured questionnaires. Nutritional rickets is still frequently seen in many parts of the world. While vitamin D deficiency causes rickets in areas where either latitude is associated with relatively decreased exposure to sunlight or cultural habits block exposure to sunlight, calcium deficiency has emerged as an important cause of rickets in parts of Africa and Asia, including Bangladesh. National Rickets Survey Bangladesh 2008 was conducted to measure the overall national prevalence of rickets among Bangladeshi children aged 1-15 years. Data were collected from 20,000 children in all six divisions in Bangladesh, among these children, 197 (0.99%) had rickets. The prevalence was highest in children aged 1-5 years. In our study majority of the participants were within 5 years of age as, 46.7% of cases and 43.3% of controls were aged between 20-39 months. Mean age among cases was 35.83 ± 21.67 months and controls were 35.03 ± 21.44 months, which is almost similar to National Rickets Survey Bangladesh 2008⁸. Twenty percent of children with rickets in National Rickets Survey Bangladesh 2008 were from low income (Tk. <3,000/month) families and 56% of children were from middle income (Tk. 5,001-8,000/month) families. In current study, 10.0% cases and 20.0% controls belong

to urban population in comparison 90.0% cases and 70.0% controls came from rural areas and 63.3% of cases had less than 5000 taka/month family income. So socio-economic background might have some influence over NR. A study conducted in Turkey found that NR was a disease of the 'underprivileged' being strongly correlated with negative social background and lack of vitamin D supplementation. In our study, more than half (56.7%) of the fathers of rickets patient's and about 46.7% of the mothers were illiterate, which means parents education playing a role in occurrence of NR as the parents were not aware of proper feeding. Nonetheless, an Egyptian study did not find poor living conditions to be related to NR; in fact it is found that maternal education was higher in patients with NR than in controls.⁹ Among the rickets patients 66.7% were male. Nutritional Rickets was nearly 1.5 times more common in boys, suggesting some genetic factor in the etiology. The NR continues to be problematic among infants in many communities, especially who are exclusively breast-fed inappropriately for long duration. In Turkey, exclusive breastfeeding without supplementation were reported to be the most prominent reasons leading to NR.¹⁰ A study at Hyderabad in Pakistan found significantly higher number 52(86.66%) among controls as compared to rickets started weaning at age of 4-6 months.¹¹ But In current study, almost half (43.3) of the cases started supplementary feeding within 3 months or less in comparison to controls none started at this age. And a strong co-relation indicates a complete opposite trend between the starting age of supplement feeding and cases of NR. But considering 4-6 months period the proportion of cases and controls were equal. So no significant difference was established between groups and the result did not support age of starting supplementary feeding as a cause of NR. Calcium deficiency playing the

major role in causing NR as in our study about 23.3% controls started supplementation with powder milk in comparison only 16.7% cases had powder milk as supplementation and most of the cases (60.0%) took rice within last 24 hours as feeding. Milk and other calcium containing dairy products were taken by very few cases (6.7%) so, dietary calcium was inadequate, Odds ratio for dietary calcium intake was 8.105 (1.612, 40.766). Most of the respondents 93.3% patients and 63.3% controls had inadequate dietary calcium. And statistical significance represents 8 times more risk of inadequate dietary calcium among cases than controls. A study among Saudi adolescent girls showed daily calcium intake was significantly less in girls with rickets than in controls ($P < 0.05$). In another study in Turkey reported that vitamin D deficiency and/or nutritional rickets can develop very early in infancy and is usually characterized by severe hypocalcemic symptoms.¹⁰ Most cases of NR caused by calcium deficiency occur in countries where significant proportions of the population have malnutrition.¹² A combination of findings from our study suggests that a considerable proportion of Nutritional Rickets may have been caused by calcium deficiency due to low income, illiterate parents, and inadequate diet. In current study most of the respondents were within 35.43 ± 21.372 months and only 16.7% among rickets patients were exposed to sunlight less than 30 min/day and no controls had inadequate sun exposure. So sun exposure was almost adequate among majority of the study population. But a study conducted among Saudi adolescent girls showed Sun exposure was significantly less in girls with rickets than in controls ($p < 0.01$).¹⁰ And another study in Saudi Arabia found that children of lower socioeconomic status were more exposed to sunlight as they were allowed to play outside more often than children of other classes.¹³ So that indicates Children from rural areas may not always

have deficiency of Vitamin D. Also, their results revealed that maternal vitamin D deficiency and limited sunlight exposure are the leading risk factors for the development of nutritional rickets in infants. It is important to note that, compared with the controls, the rickets patients in general demonstrated clinical as well as biochemical features of malnutrition. For example, BMI and dietary calcium intake both were lower in the rickets patients. Mean BMI among cases were 0.612 less than mean BMI of controls but there was no statistical significance ($P > 0.05$). This suggests that the rickets patients in general were more malnourished. Maternal education may play an important role. It is expected that an educated mother will have better and improved child-rearing practices. This was reflected in the behavior of our control mothers, who were more aware of the weaning food, its quality and the appropriate age for starting to wean.

In current study, different clinical features were present among the cases of nutritional rickets. Widening of wrist was found among all 30 cases. Bowing of leg present in 66.7%, Rachitic rosary in 50.0%, Protruded abdomen in 46.7%, Hypotonia among 36.7% and Open fontanel was present among 23.3% of the cases of NR. And these are the most common clinical symptoms of nutritional rickets patients. In a similar study in Hyderabad of Pakistan found 83.0% cases with open anterior fontanel and 70.0% with Rachitic rosary¹⁴. In another study at Hazara division of Pakistan also found Widening of wrists among 61.6% of NR cases and 36.6% with Rachitic rosary¹⁵ Nutritional rickets is a multi-factorial condition and several factors seem to make important contributions to NR. Among these, lack of exposure to sunlight, prolonged breast-feeding without supplementation and inadequate weaning practices are important. It is suggested that a national campaign to promote awareness of the risks of vitamin D

deficiency, particularly among susceptible populations be done to eliminate rickets as a cause of morbidity. A community-based study is necessary to find the true incidence, and primary healthcare doctors should be more vigilant in detecting early this treatable and preventable condition. Weaning food should be started from the age of 6 months. Community health education is very important to the eradication of this easily preventable disease. The vitamin D and calcium status of pregnant and lactating mothers should also be studied to determine the incidence of this deficiency amongst them. Pregnant and lactating mothers should receive regular vitamin D supplementation.

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