

# NATIONAL RICKETS SURVEY IN BANGLADESH, 2008



## FINAL REPORT

**ICDDR, B: International Centre for Diarrhoeal Disease Research Bangladesh**

**Social Assistance and Rehabilitation for the Physically Vulnerable (SARPV)**

**Rickets Interest Group (RIG)**

**CARE, Bangladesh**

**UNICEF**

**National Nutrition Programme (NNP)**

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The National Rickets Survey in Bangladesh was the largest initiation to screen, diagnose, and estimate the prevalence of childhood rickets in Bangladesh. A preliminary study observed that all rickets in Bangladesh may not be due to Vitamin D deficiency, and that calcium metabolism was an important cause, which may be much easier to prevent. The National Rickets Survey was carried out in 2008 by investigators of (i) CARE Bangladesh (ii) UNICEF (iii) NNP (National Nutrition Program of the Bangladesh government) (iv) SARPV and (v) ICDDR,B. SARPV has extensive experience in diagnosis and treatment of calcium deficiency rickets in children and has thus been involved in project development. SARPV imparted training to the field data collection team for screening rickets in children and to a physician to examine clinically the rachitic children. The survey collected detailed information on household socio-economic status of 1-15 years old children, history of rickets, child feeding practices, access to and use of child health and nutrition services, mother's nutrition knowledge and practices, weight, height and MUAC of rachitic children, food intake and diagnosis of other diseases.

The results of the study would help the government in developing policy control rickets in children and formulating appropriate curative and preventive measures. If rickets is confirmed to be substantive and calcium deficiency is identified as a major factor, then intervention studies could be designed to improve in calcium intake.

The successful completion of the National Rickets Survey was accomplished for generous contributions of a number of organizations and individuals. I express my thanks to Mr. Shahidul Haque, Executive Director, SARPV for sharing his experience and imparting training to our field staffs in conducting the survey. Special thanks also goes to Mitra and Associates for their sincere efforts in conducting the field survey.

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ICDDR,B; H.K. Das, National Technical Coordinator, SHOUHARDO Program, CARE-Bangladesh; Dr. Mustafizur Rahman and Dr. Tahmina Talukder, NNP. We are also indebted to office staffs for their SARPV for extending cooperation and assistance to complete the survey. The survey field staffs, quality control field staff and independent quality control members also deserve special thanks. We extend our sincere acknowledgement and thanks to members of Rickets Interest Group for their continuous efforts to plan and execute the project.

## **Executive summary:**

Rickets, first reported in Europe in the mid-1600s, has been recognized as an important health problem in Bangladesh in 1991. Dozens of countries in different parts of the world have reported rickets in the past three decades. In Bangladesh rickets was first brought to broad attention by the workers of Social Assistance and Rehabilitation of the Physically Vulnerable (SARPV) visiting the Chakaria region of Southeastern Bangladesh after a devastating cyclone in 1991. The Helen Keller International (HKI) had conducted surveys in 28 Upazilas of Bangladesh in 2000 and 2004. “Rickets” was identified as visible varus and/or valgus deformities in children aged 1-15 years. Nationally, rachitic deformities were observed in 0.26% of 21,571 children surveyed in 2000 and in 0.12% of 10,005 children surveyed in 2004. Rickets was identified in over half of sub-districts with the highest prevalence in Sylhet (North East) and Chittagong (South East) divisions.

The highest prevalence (1.4% in children aged 1-15 years with visible rachitic deformities) was noted in the Cox’s Bazaar sub-district. BRAC conducted a survey among all inhabitants of Chittagong in 2003 and identified rachitic deformities in 0.9%. Let us describe the results of the ICMH survey first. This survey provoked HKI and BRAC to do the survey. The Institute of Child and Mother Health (ICMH) conducted a more detailed survey in the Chittagong Division in 1998, and observed at least one clinical feature indicative of rickets in 8.7% of children surveyed: 4% had lower limb deformities, 0.9% had radiological evidence of active rickets, and 2.2% had elevated levels of serum alkaline phosphatase. Interestingly, rickets was not identified in the indigenous populations in the Hill Tracts. Dietary calcium and vitamin D deficiency represent two ends of the spectrum in the pathogenesis of nutritional rickets, with their combination occupying the middle. In Bangladesh, earlier studies had suggested that vitamin D deficiency was not a major causal factor for rickets, and calcium deficiency was assumed to be the primary etiologic factor.

The aim of the National Rickets prevalence survey 2008 was to determine the national prevalence of rickets in children aged 1-15 years, and examine its association with their



nutritional status and dietary intakes of calcium and other nutrients. A sample of 16,000 children of either sex in rural areas and 4000 children in urban areas belonging to all socio-economic groups were randomly selected from rural and urban areas of all the 6 administrative divisions of Bangladesh. After enrolment, they were examined for presence of features of rickets and their parents/ guardians were interviewed to record age and sex of the children and household socioeconomic data. If rickets features were present, parents were asked about current and past feeding practices of the child. Additionally, representative food was sampled to assess their calcium content. Both qualitative and quantitative data was collected through anthropometrical measurement (weight, height, MUAC), and in-depth interviews. In clinically suspected cases, radiological examination was done for identifying radiological signs of active rickets and 5 ml of venous blood was taken for biochemical tests. The survey included current patients, and new cases were identified through case-finding strategy among their family members. The results were analyzed to determine the relationship of rickets with nutritional status of the children and their dietary (calcium, phosphorus, protein) deficiencies, and dietary and environmental inhibitors (phytates, oxalates).

Proportion of rachitic children was higher in 1-5 years. About 61.4% of male children were affected in rickets. The highest prevalence of rickets was found in Chittagong division, which was 76.6%.

The national survey showed the prevalence rate of rachitic children was 0.99%. The southern parts of Chittagong division; Chittagong and Coxes Bazar districts had the high prevalence. In Coxes Bazaar district, Chokoria, Maheskhali and Coxes Bazar Sadar Upazila were highly endemic for rickets and was being investigated by SARPV who contributed in the survey significantly. In these areas UNICEF has been supporting activities in identification of rickets and a community based prevention program through the SARPV.

In the survey 154 rachitic children aged 1-15 were measured for height, weight and MUAC by quality control team of ICDDR,B. The mean age of rachitic children was 5.6 years and mean weight was 13.89 kg. Stunting defined as HAZ <-2 SD was 75% and severe stunting was 53% (HAZ <-3 SD). The prevalence of under weight was 70% (WAZ <-2 SD) and

severe under weight was 40% (WAZ <-3 SD). The prevalence of wasting was 17% (WHZ <-2 SD) and severe wasting was 1.4% (WHZ <-3 SD).

The survey found that 76% of children were breastfed within 24 hours of birth. Mother's perception about colostrums feeding was satisfactory. About 62% of mothers knew that colostrum feeding would benefit the baby.

Maximum rachitic children were living in areas that were near the sea. The proportion of taking calcium tablet was 37% and Vitamin D was 19%. Parents of 14.5% rachitic children had blood relations (relatives). 34.6% mothers told that their relatives also had rickets. Most of the mothers of rachitic children told that leafy vegetable was the only source of calcium. The use of limestone in cooked rice is a practice that was introduced by SARPV in Chittagong area to improve the intake of calcium in the diet. The proportion of using limestone in family diet was 37%. But 54% of mothers never used limestone in their family food.

A food frequency questionnaire (FFQ) was used to determine the frequency of consumption of certain foods. It contains a list of foods and frequencies of intake during the last one week. The food frequency provides qualitative data on types and frequency of foods or food groups. About 30% children took leafy vegetables, 5% children took Dal ( pulses), 42% children took small fish, 25% took meat/fish, 1% took egg, 5% took milk, 24% took fruits and 29% took chira/muri ( puffed rice) for more than 1 times.

According to list of food frequency in last 24 hours, 28% children took leafy vegetables, 13% took small fishes, 12% took egg, 46% took chira/muri and 32% children took sugar/molasses for one time. Many items were not detected in 24h recall method.

There was a seasonal effect on disease pattern last 1 year.. At certain times, most of the children had suffered from fever and diarrhoea. The percentage distribution of duration of diarrhoeal diseases was 67% below 15 days. The proportion of duration of sufferings from pneumonia was 85.2 below 15 days. About 97% children suffered from fever and 98% children suffered from common cold.

X-ray was taken of 158 out of 197 rachitic children. According to radiological findings children were classified into three groups, about 24% children had active rickets. The

percentage of growing phase of rickets was 35%. But the rate of normal radiological status was higher than the others and the rate was 41%. Biochemical analyses conducted in the serum of rachitic children included calcium and albumin. Serum calcium levels need to be adjusted with serum albumin levels since 45% of calcium is bound to albumin in the serum. Variations in serum albumin concentrations alter the concentration of total calcium in serum. After adjusting the calcium levels with albumin considering the cut-off value of 2.19 mmol/L in plasma, we found that about 47.4% children were deficient in calcium levels. Out of 155 samples, 71 rachitic children were severely deficit, 81 rachitic children were moderate deficit level and only 3 children were in normal level. Near about 98% children's vitamin level were in deficit level and 2% children's vitamin D level were in normal level.

The high prevalence of rickets in this national survey is very important to bring to the attention of the policy makers for taking preventive approaches and intensity their activities according to the density of the incidence. The significant number of cases estimated (1% of 1-15 yrs old children) in the country needs adequate treatment with nutritional, medical and surgical interventions. The study will reveal dietary, biochemical and environment etiological factors for preventive and treatment strategies.

We hope that the results of our survey will help to identify interventions to reduce the burden of rickets among Bangladeshi children.

## OBJECTIVE

### General Objective

To determine the overall prevalence of rickets among 1- 15 year old children in Bangladesh

**Specific Objective:** The specific objectives of the survey are to assess:

1. Prevalence of rickets and its clinical manifestations among Bangladeshi children aged 1-15 years
2. Dietary intakes of calcium and other nutrients related to rickets among the sampled children; and
3. Nutritional status (weight- for-age Zscore) of the rachitic children.
4. Determination of Calcium, phosphorus, vitamin D, alkaline phosphatase, Para Thyroid Hormone in serum in the rachitic children.

## BACKGROUND

Rickets was a disorder of growing children associated with bony deformities resulting from inadequate mineralization of growing bones. It was first reported in the mid-1600s<sup>1</sup> from Europe. Glisson described the disease as bony deformity with curving of the legs. Treatment pattern changed over decades as sunlight (UV radiation) and cod liver oil were found effective in treating rickets in 1800s, and vitamin D was identified as the essential ingredient of this oil in the early 1900s<sup>2</sup>.

Vitamin D supplementation made rickets a rare disease in the industrialized countries during the 20th century<sup>3</sup>. However, at the end of the last century two striking things happened: (i) nutritional rickets became a widely seen problem in North America<sup>4,5</sup> and (ii) its higher prevalence in economically disadvantaged parts of the world where vitamin D insufficiency was uncommon<sup>6</sup>.

## **GEOGRAPHICAL DISTRIBUTION OF DISEASE**

In North America, rickets was most commonly seen in exclusively breastfed children with relatively greater pigmented skin. In Australia and Europe, rickets was mostly noted among populations who had migrated from the Middle East and the Indian subcontinent. Most affected patients develop the features within the first 6 to 12 months of life, with similar sex distribution. In the Middle East, rickets was often seen in sun-protected children of vitamin D-deficient mothers, but it also manifested as bone problems later in childhood. In sun-exposed regions of Asia and Africa, rickets typically manifested during the second or third year of life<sup>6</sup>.

## **GEOGRAPHICAL DISTRIBUTION OF DISEASE**

Nutritional rickets has been traditionally attributed to vitamin D deficiency related to decreased exposure to sunlight resulting from crowded living conditions under skies polluted by the products of industrialization<sup>7</sup>. In the 1600s, primary cause of rickets was wet nursing (use of mother substitutes to nurse infants) by women with calcium-poor breast milk<sup>8</sup>. Rickets associated with calcium deficiency has been reported from South Africa<sup>9</sup> and Nigeria<sup>10</sup>. The accumulated evidence suggested that low dietary calcium intake was indeed important in the pathogenesis of rickets during late 1900s<sup>11,12,13</sup>. In fact, in North America calcium insufficiency had also been suspected to contribute to some of the apparent vitamin D deficiency rickets<sup>14</sup>.

## **HISTORY AND EPIDEMIOLOGY OF NUTRITIONAL RICKETS IN BANGLADESH**

Rickets has been recognized as a concealed health problem in Bangladesh. SARPV (Social Assistance and Rehabilitation of the Physically Vulnerable) brought it to greater attention during their visit of Chakaria region of South-Eastern Bangladesh after a devastating cyclone in 1991. Approximately 1% of the total children showed rachitic deformities in an informal village survey. Focus Group Discussions (FGD) suggested that rickets was “new” in that community and had not been seen before the early 1970s. 441 Children from Chakaria with

Rickets received care at the Memorial Christian Hospital between 1991 to 1997. But vitamin D supplementation was disappointing & deformities recurred in children who had undergone corrective orthopedic surgery. In 1994, French physicians of Les Amis des Enfants du Monde (AEM) identified rickets in 4.5% in children younger than 10 years evaluated in the communities from Chittagong to Moheshkhali. In 1997, academicians from Cornell University and other American institutions were apprised of the situation. A collaborative assessment noted rickets to be more common in Chakaria than had been previously thought, and also that apparently it was not associated with vitamin D deficiency; the problem was considered to be related to dietary insufficiency of calcium<sup>17</sup>. An international “Rickets Consortium” was formed for collaborative research and to identify practical interventions<sup>18</sup>. This group was subsequently re-formed as the current “Rickets Convergence Group”, which serves as a repository of information and with expertise to facilitate works related to rickets in Bangladesh.

The Helen Keller Institute (HKI) conducted nationwide surveys in 2000 and 2004 in 28 upazilas. “Rickets” was identified as visible *genu varus* and/or *genu valgus* deformities in children aged 1-15 years. Nationally, rachitic deformities were observed in 0.26% of the 21,571 children surveyed in 2000 and in 0.12% of the 10,005 children surveyed in 2004. Children with rickets were found in over half of the sub-districts with the highest prevalence in Sylhet (North East) and Chittagong (South East) divisions. The highest prevalence (1.4% in 1-15 year-old with visible rachitic deformities) was found in the Cox’s Bazaar sub-district. BRAC conducted a survey among all inhabitants in Chittagong and noted rachitic deformities in 0.9% (24) of the people surveyed. The Institute of Child and Mother Health (ICMH) conducted a more detailed survey in the Chittagong Division and assessed 8.7% of the children to have at least one clinical finding consistent with rickets: 4% had lower limb deformities suggestive of rickets; 0.9% had radiological evidence of active rickets; and 2.2% had elevated levels of serum alkaline phosphatase<sup>16</sup>. Interestingly, rickets was not identified among the indigenous populations of the hilly regions (Hill Tracts) of the district.

In Bangladesh, results of the initial studies suggested that vitamin D deficiency wasn’t a major causal factor for rickets, and calcium deficiency was assumed to be the primary etiologic factor<sup>17</sup>. In the recent years, production of rice production has substantially increased in Bangladesh; however, crop rotation and diversity, and milk production has

reduced. The overall protein-energy malnutrition is decreasing in Bangladesh, but the diets have become more monotonous than it was three decades ago; more importantly, the current common diets contain lesser amounts of calcium. Less than 10% of the children assumed to be calcium-deficient actually develop clinical rickets. Boys seem to be more likely to develop rachitic deformities than the girls, and rickets is associated with larger family sizes and less maternal education. Rickets is associated with respiratory illness, but not with malaria or anaemia. The relationship between rickets and diarrhoea remains controversial. Genetic factors that potentially impact the risk of nutritional rickets have not been studied.

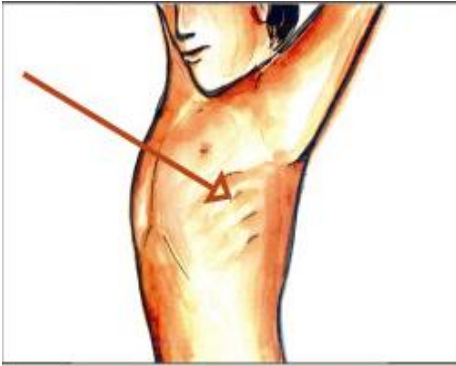
### **CLINICAL FEATURES OF RICKETS–IN BANGLADESH AND OTHER PLACES**

Clinical features of rickets were similar around the world, but relative vitamin D deficiency causes variation in the age of presentation and the risk of hypocalcaemic symptoms, such as tetany in different populations. In areas where vitamin D deficiency was more common, rickets usually presents in the first year of life, often with clinically significant hypocalcaemia. But in parts of Africa and in Bangladesh, where calcium deficiency accounted for much of the prevalent nutritional rickets, it usually presents from the second year of life, and hypocalcaemic tetany was much less commonly seen.

Diminished mineralization of growing epiphyses occurs of in Rickets. Weight bearing bones such as long bones of leg & hand becomes soft. Gravitational pressure caused soft bones to curve in response to forces exerted across them. Thus, the long bones of the leg curve becoming “bow legs” or “knocked knees” in late onset rickets<sup>20</sup>. Epiphyses expand laterally such that wrists and ankles could be palpably widened. Costochondral junctions also expanded with demineralization of bones, and beading or pearly of the chest wall was noted. Fontanelles close late, and teeth erupt later than in other children.

**Figure 1: Clinical Features of Rickets**

Rib Beading



Wrist Enlargement



Knock Knee



Bow Leg





Windswept



Sabre Tibia

The clinical examination may show one or more of the following signs of rickets:

For 1-5 Years Children: (i) Age less than 5 (ii) Height:  $<-2.0$  SD (iii) Wrist Joint Swelling (iv) costal rosary (v) Leg pain during walking (vi) Slight Bowing of whole leg (vii) Slight bowing between knee & ankle joint. Presence of any 3 of them indicates rickets.

For 6-15 Years Children: (i) Wrist Joint Swelling (ii) Costal Rosary (iii) Leg Pain During Walking (iv) Bow Leg (v) Knock Knee (vi) Wind Swept (vii) Sabre Tibia. Presence of any of the visible symptoms indicates rickets<sup>1</sup>.

Clinical diagnosis of rickets using specific criteria may be difficult, and in subtle cases determination of “wide” wrists and “beaded” ribs could be very difficult, which depends on the assessor’s experience. There were broad ranges of “normal” lower limb curvature, fontanel closure, and tooth eruption. A Nigerian study has provided some basis for a clinical diagnosis of rickets in situations where estimation of serum alkaline phosphatase and performing of wrist/knee radiographs were not available<sup>20</sup>. Specifically, for children with lower limb deformities, the finding of at least 3/5 features (age less than 5 years, short stature, leg pain while walking, wide wrists, costal beading) identified 87% of children with active rickets.

## **BIOCHEMICAL MARKERS:**

Rickets is mainly classified into 3 groups:

(i) Nutritional rickets due to Ca or vitamin D deficiency:

This type of rickets is most common. It occurs due to Vitamin D deficiency in western countries due to deficient diet or lack of sunlight. But in eastern countries it occurs due to calcium deficiency.

(ii) Vitamin D dependent rickets (high calcitriol levels)

It is of two sub-types. Type I is secondary to a defect in the gene that codes for the production of renal 25(OH)D<sub>3</sub>-1-alpha-hydroxylase . Type II is a rare autosomal disorder caused by mutations in the vitamin D receptor. Type II does not respond to vitamin D treatment; elevated levels of circulating calcitriol differentiate this type from type I.

### **Vitamin D resistant rickets (hypophosphatemia).**

Rickets refractory to vitamin D treatment may be caused by the most common heritable form, known as vitamin D-resistant rickets or familial hypophosphatemic rickets.

(Ref: American Family Physician)

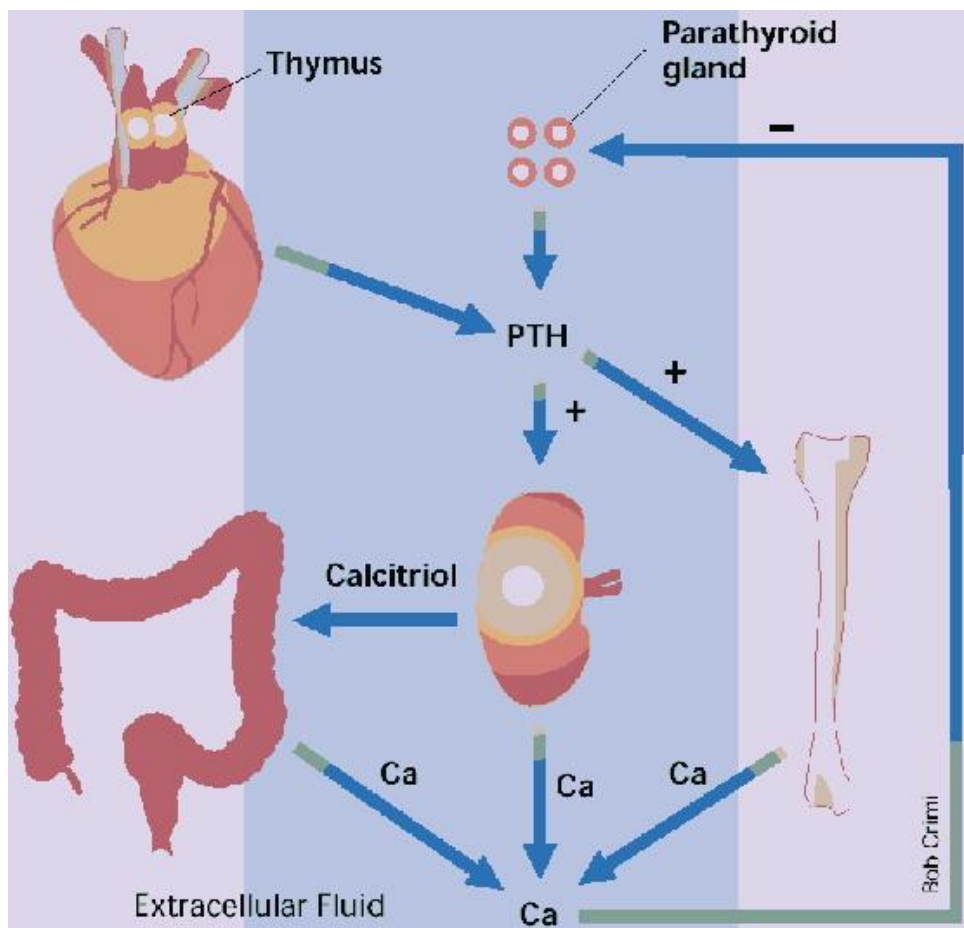
The other forms of rickets were rare which were renal rickets, oncogenic rickets and rickets of prematurity. Determination of biochemical markers in patients with clinical suspicion of rickets would help to identify and diagnose the type of rickets prevalent in Bangladesh (eg. nutritional rickets due to Ca or vitamin D deficiency or hypophosphatemic rickets). Other forms of rickets were rare which were renal rickets, oncogenic rickets and rickets of prematurity

The interaction of Ca, P, Vit-D, and PTH-ALP was a complex process involving many enzymes and markers which regulate the levels of each other in a complex manner. Measurement of many of these biomarkers in the patients would help to understand the mechanism and provided a biochemical picture of the onset of rickets. This in the long run would aid in early diagnosis of and prompted treatment of rickets.

The skeleton serves as a stable reservoir of calcium and other minerals in the bone matrix. When labile reserves of Ca were fully depleted, stable reserves from bone was released to maintain plasma calcium levels. This process involves accelerated rates of bone resorption in response to increased osteoclastic activity. Circulating levels of PTH, vitamin D, and

calcitonin influenced the regulation of Ca and phosphate balance. When blood Ca level was too low, the parathyroid glands release more PTH, which causes bones to release more Ca into the blood and reduces the amount of Ca released by the kidneys into the urine. PTH stimulates conversion of vitamin D into a more active form, causing the intestine to absorb more Ca and phosphorus. If Ca level was too high, the parathyroid glands release less PTH, and the whole process was reversed.

In bone,  $1,25(\text{OH})_2\text{D}$  stimulates osteoclastic activity which increased bone resorption to release Ca and phosphorus into the blood. Activation of Vitamin D was directly induced by a decrease in serum phosphorus levels. Changes in serum Ca levels affect vitamin D through PTH stimulation of renal hydroxylation. Again, activation of the vitamin was inhibited by increased serum phosphorus levels or increased serum levels of calcitonin. A deficiency of vitamin D made it difficult to maintain proper Ca and phosphorus levels in bones.



**Calcium Homeostasis of Body**

The above picture shows normal Calcium homeostasis of human body. Parathyroid hormone plays an important role in maintaining Calcium homeostasis. Parathyroid hormone (PTH) is secreted from the parathyroid glands. A new auxiliary source of PTH has been located in the thymus. PTH increases mobilization of calcium (Ca) from bone by enhancing bone turnover. In the kidney, PTH stimulates tubular reabsorption of Ca and favors the synthesis of the steroid vitamin D hormone, calcitriol. The main physiological function of calcitriol is to increase intestinal Ca absorption. Therefore, all effects of PTH act to directly or indirectly increase the calcium concentration in the extracellular fluids when extracellular Calcium level decreases. An increase in the concentration of ionized Ca in the extracellular fluids is the major feedback mechanism that inhibits PTH secretion from the parathyroid glands and possibly also from the thymus by a Ca-sensing receptor expressed in the membrane of PTH-secreting cells. In the absence of parathyroid glands, thymic PTH secretion seems to be a backup mechanism for emergency regulation of Ca metabolism.

When resources were available, laboratory and radiological examinations should be used to confirm the diagnosis and to determine the aetiology of rickets. The serum alkaline phosphatase level is elevated in active rickets, and X-rays of the knees and wrists demonstrate widened epiphyses with cupping and fraying of the epiphyseal border. Serum parathyroid hormone concentrations were usually elevated. With vitamin D deficiency rickets, the 25-hydroxyvitamin D level was low, and was typically below 10 mg/mL (25 nmol/L). In the absence of vitamin D deficiency, calcium deficiency stimulated elevations of the 1,25-dihydroxyvitamin D level.

## **METHODOLOGY**

### **Survey Design:**

National Rickets Prevalence Survey in Bangladesh was a nation wide survey conducted to identify, diagnose and find out the prevalence of childhood rickets within 1-15 years aged children. Administratively, Bangladesh is divided into 6 administrative divisions, each division is divided into districts and each district into upazilas. The area of an upazila was divided into unions and each union consists of several villages. The urban municipality area

is divided into wards and each ward is divided into mahallas and mohallas into slums and non-slums. There were 64 districts in Bangladesh and half (32) of them were randomly selected for the survey. Each district has several upazilas but only three of them were randomly selected. Then two unions were randomly selected from each upazila, and two villages were randomly selected from each union. In each village, 42 children within 1-15 years were randomly selected. For urban areas, 50 wards were selected in six divisional cities; 16 wards were selected from Dhaka city, 10 from Chittagon, 8 from each of Rajshahi & Khulna, 4 from each of Barisal & Sylhet towns were randomly selected. Number of selected wards in a city was proportional to the city populations. From every ward, 4 slums were randomly selected and from every slum, 20 children were sampled.

**Outcome variables:**

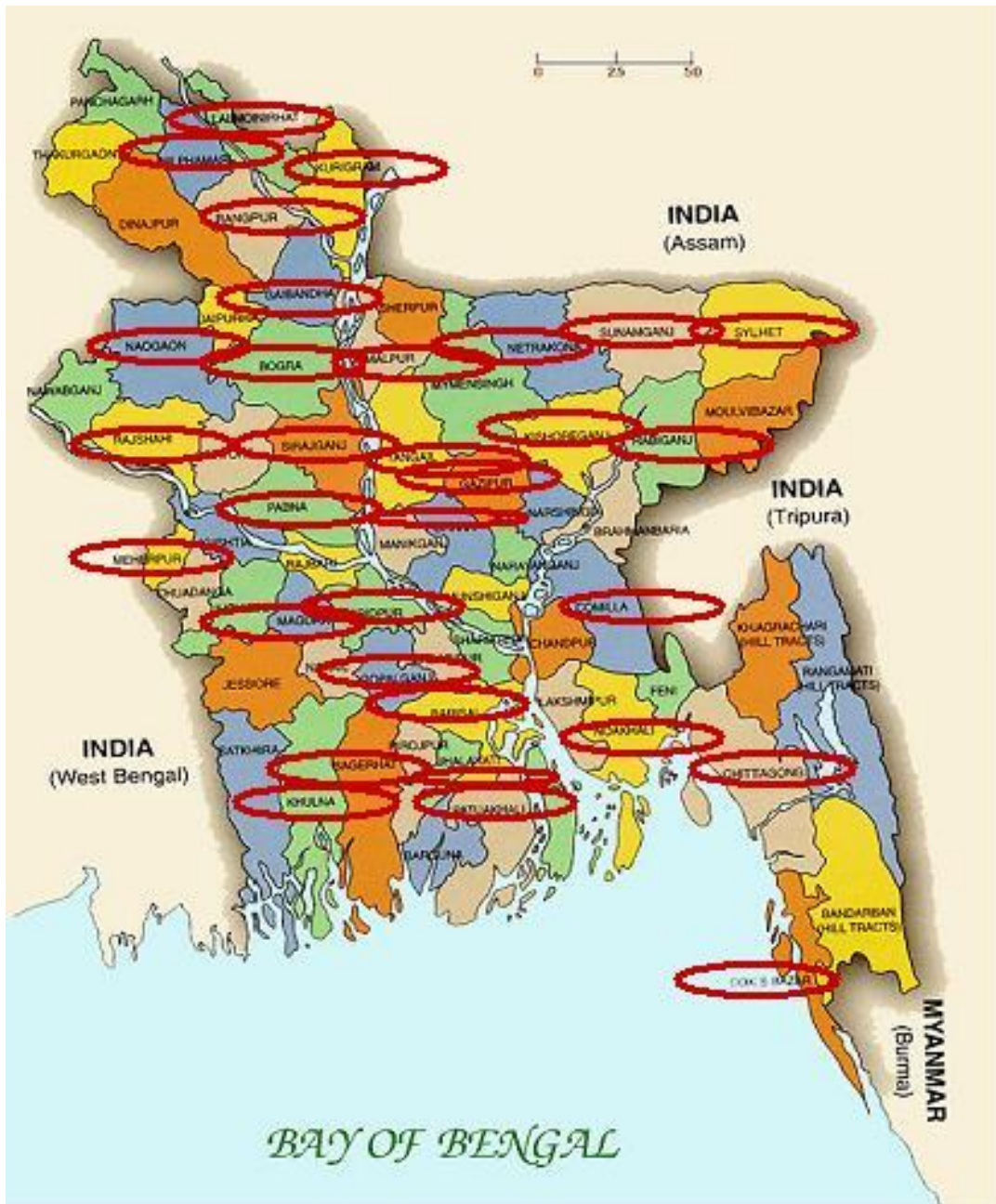
1. Identification of features of rickets and rachitic children
2. Biochemical markers of relevance in rachitic children
3. Nutritional prevalence of rachitic children.
4. Information on child feeding practice, disease control and caring practices

**Study population:**

Children aged 1-15 years were randomly selected from all socio-economic groups living in the rural and urban areas of the six divisions of Bangladesh. Parents was informed about the study and asked if they agree to participation of their child, and subject to their signing an informed consent form and meeting the enrolment criteria children will be recruited. The whole procedure was approved by Ethical Review Committee of ICDDR,B.

**Study Area:**

The study was conducted in rural and urban areas of all six divisions of Bangladesh.



**AREAS COVERED BY SURVEY TEAM**

### **Staff Recruitment for the Study:**

For primary data collection, data collectors from Mitra & Associates were hired. There were five teams of Mitra & Associates each with 4 members. To check the quality of their work, 4 quality control teams of ICDDR,B, consisting of 2 field research assistants in each team was assigned. They all had Masters Degree in nutrition & adequate knowledge and skill on fieldwork and quantitative data collection. To supervise all the activities in the field, 1 field research supervisor was also assigned. He supervised all the activities in the field like data collection, interview procedure, examination procedure etc to improve the quality of the survey. The project also had 2 research officers. They were responsible for managing survey & project activities & ensure logistic support. They were also responsible for organizing work schedule, developing questionnaire, analyzing collected data, writing reports & manuscript, preparing concept papers & controlling financial transactions related to partner organization and donors. For proper diagnosis of rachitic child 1 project research physician was recruited. He was responsible for collecting blood sample & x-rays of the rachitic children. He was also responsible for writing analysis & preparing concept paper. After data collection, it was responsibility of senior data management assistant to edit, entry & analysis the collected data & prepare graph, chart, and tabulations. For nutritional assessment of rachitic children by anthropometrics measurement 1 anthropologist was recruited.

### **Staff training by SARPV:**

SARPV (Social Assistance and Rehabilitation for the Physically Vulnerable) and ICDDR,B developed staff-training curriculum on the basis of the former's earlier study on identification of rickets, and their training manual was prepared on the basis of in-depth interview and collect information on dietary intake and food habit. Staff training was conducted at Lalmatia, Dhaka in SARPV office. Initially field workers and one medical officer were trained to identify children with rickets. There were 7 signs of rickets and presence of at least three of them will constitute rickets for this survey. Assessors were trained on collection of the socio-demographic, anthropometric, and dietary recall histories. Anthropologist was also trained on rickets and calcium rich food, and on understanding perception and behaviour on feeding.







## DIFFERENT SIGNS OF RICKETS



**Active Rickets**



**Normal Bone**

### Radiological Features of Rachitic & Normal Wrist Joint

#### Method used for identification of the rachitic children

**a) Identifying present rickets patients:**

With the help of a multi coloured poster depicting features of costal, lower and upper limb clinical rickets deformities was diagnosed.

**b) Clinical analysis of the deformities:**

The clinical examination may show one or more of the following signs of rickets for 1-5 Years Children: (i) Age less than 5 (ii) Height:  $<-2.0$  SD (iii) Wrist Joint Swelling (iv) costal rosary (v) Leg pain during walking (vi) Slight Bowing of whole leg (vii) Slight bowing between knee & ankle joint and presence of any 3 of them indicate rickets.<sup>1</sup>

For 6-15 Years Children: (i) Wrist Joint Swelling (ii) Costal Rosary (iii) Leg Pain during Walking (IV) Bow Leg (v) Knock Knee (vi) Wind Swept (vii) Sabre Tibia. Presence of any of the visible symptoms indicate rickets. <sup>1</sup>

**Estimation of Sample size:**

**Sample size Estimation for Rural areas:**

The minimum sample size was calculated to estimate the prevalence of rickets with precision of 0.025% at 5% statistical significance.

Using formula (with replacement)  $n_0 = \frac{p(1-p)}{d^2} Z^2_{\alpha/2}$

Where

p = proportion of children aged 1-15 years have rickets and it was set to be 0.0125

d = Marginal error permissible in the estimate, which was set at 0.0025.

Z<sub>α/2</sub> = level of significance at 5%

$$n_0 = \frac{0.0125(1-0.0125)}{0.0025^2} 1.96^2 = 7588 \approx 7600$$

Prospective children, aged 1-15 years, was selected using stratified multistage cluster sampling to minimize travel cost and time as well as to facilitate supervision of field data collection activities. Sampling was proportionate to size (in terms of population in the 2002 census) of the division. The sample size needs to be adjusted for adopting stratified cluster sampling. The final sample size, accounting for the design effect for deviation from simple random sampling to stratified multistage random cluster sampling, was 7600 x 2.0 = 15200. The final sample size was rounded to 16000 children aged 1-15 years in rural areas.

**Sample size Estimation for Urban areas:**

In absence of prior estimate of the rickets prevalence in children living in poor areas of the cities in Bangladesh, the prevalence was assumed to be similar to the prevalence in rural children. For financial constraint, the prevalence was estimated with a precision of 0.05% (which was lower than 0.025% set for rural children) at 5% statistical significance.

Using formula (with replacement)  $n_0 = \frac{p(1-p)}{d^2} Z^2_{\alpha/2}$

Where

p = proportion of children aged 1-15 years have rickets and it was set to be 0.0125

d = Marginal error permissible in the estimate, which was set at 0.005

$Z_{\alpha/2}$  = level of significance at 5%

$$n_0 = \frac{0.0125(1-0.0125)}{0.005^2} 1.96^2 = 1822$$

The final sample size, accounting for the design effect for deviation from simple random sampling to stratified multistage random cluster sampling, was  $1822 \times 2.0 = 3644$ . The estimated sample size for urban areas was  $3644 \sim 4000$  children aged 1-15 years. Distribution of sample children across the cities was proportional to the population size of the cities.

List of slums/ villages in selected unions/ wards was used as sampling frame., From the list 384 clusters/villages in 6 administrative divisions and they were randomly selected. Number of children aged 1-15 years was 42 per cluster/village and they were selected systematically for interview. In 6 cities 50 wards was selected randomly. In each sampled ward, 4 slums were selected randomly and 20 children per slum were selected systematically for interview.

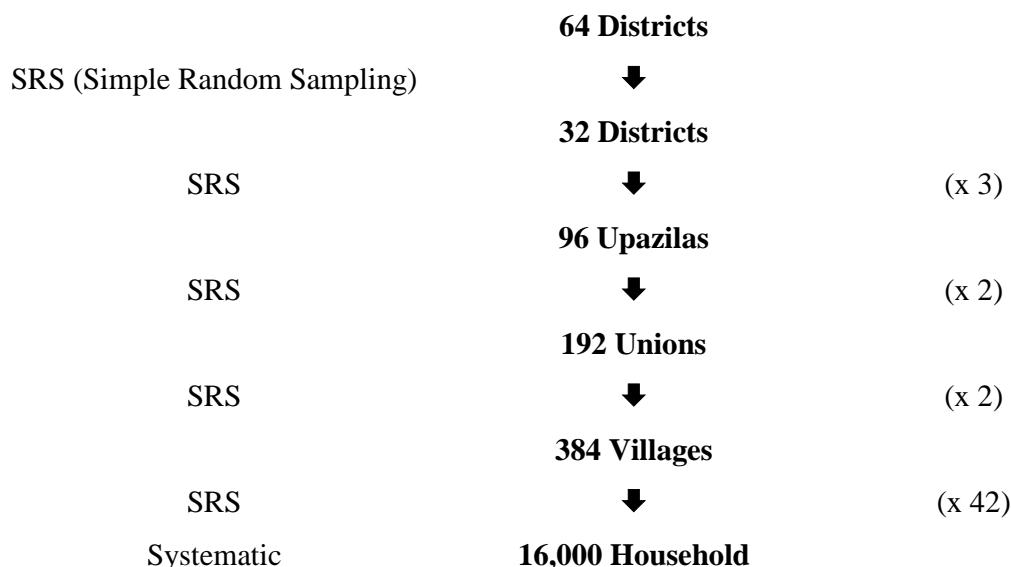
### **Biochemical samples:**

Children clinically diagnosed rickets was taken into the biochemical study. Around two hundred subjects with rickets were identified in the survey. Blood samples of all of the subjects with rickets will be tested to see the association of different biochemical markers with clinical rickets and interrelations among the biochemical markers. Around two hundred rachitic children will enable to estimate bio-chemical parameters with considerable degree of precision at 5% level with 80% power.

### **Selection Procedure**

The following multistage cluster and random sampling method will be followed to select households:

### Schematic Diagram of National Rickets Survey for rural areas



#### For urban areas:

Cities were divided into wards. A sample of 50 urban wards (16 wards from Dhaka city, 10 from Chittagong, 8 from Khulna and Rajshahi each and 4 from Barisal and Sylhet each) will be selected randomly. From the list of slums in a ward, 4 will be selected randomly and 20 children in each slum will be selected systematically for interview.

#### Quantitative Data Collection Procedure:

##### a) Data collection by Mitra & Associates:

##### (i) Household screening of all children:

Mitra & Associates collected preliminary data. There were two teams consisting of two members in each team. In total 10 teams dividing into 5 groups of Mitra & Associates worked in the field. They went to selected village or slum according to the tour programme. One team started from middle of a village & another from the entrance of another village. On entering into a village they introduced themselves. They showed the flipchart to the villagers & asked them if they find this kind of child in their village. Then they started data collection from household of 42 children in a row. The data includes household identification, socio-

economic condition & household information of the child. They also examined the child properly to find any deformities due to rickets or due to any other cause.

## **(ii) Questionnaire Filled up of Rachitic Children**

After identification of a rachitic child, full interview was conducted and questionnaire was filled up. Parents or caregivers were interviewed about current and past feeding practices of respective child. Children assessed to have active rickets or a bony deformity consistent with rickets was further investigated, and was advised to attend nearest health facility. Cultural practices, feeding behaviour and attitudes to food in different geographical areas were assessed through anthropological study. Issues to be explored include dietary intake, knowledge of caretaker on balanced and calcium-rich food, process/method of preparation of diets, religious influences on feeding practices, frequency of feeding, and gender bias on feeding and medical care practices. Moreover, the willingness of the caregivers for a change to improve nutritional status of their children was also investigated.

## **b) Quality Control of the study by ICDDR,B:**

Quality was ensured through adequate training of the study staff, standardization of study procedures and supervision. A major responsibility of ICDDR, B was to maintain the quality of data and its analysis. Five quality control teams each with 2 members supervised the interviewer team of Mitra & Associates. So each member followed 2 interviewers of Mitra & Associates. Quality Control Team visited the survey sites and re-interviewed every rachitic child. They also assessed the quality of work done by interviewers in every 4<sup>th</sup> household. They observed onsite interviews and anthropometric measurements of the children by interviewers. They also observed whether the interviewers examine the child properly so that every rachitic child should count.

## **Quantitative Data**

### **1. Anthropometry:**

#### **(a) Weight:**

UNISCALE had been used to take weight of the rachitic child with precision of 2 decimal places (0.00kg). The child was placed over the scale & weight was taken. If the child was

frightened, time was allowed to settle down. The child along with its mother was placed over the scale & reading was taken. Then the mother was placed alone over the scale & reading was taken. The difference between two readings was original weight of the rachitic child.

**(b) Height (for children aged 24 months or more):**

Height board had been used to measure children of 24 months or more. Two trained quality control officers of ICDDR,B took height of every suspected rachitic child. One of them acted as an assistant, another one was measurer. Assistant placed the child over the board & fixed the knees with her hands against the base of the board. Then the measurer fixed the chin with left hand & lowered the headpiece with right hand to take the measurement.

**(c) Length (for children aged 12-23 months):**

Length board had been used to measure children of 0-23 months of age. The assistant laid the child carefully over the board & placed the head against the head board. Then the measurer fixed the knees with left hand & placed the footplate firmly against the child's heel to take the measurement.

**(d) MUAC:**

Mid upper arm circumference (MUAC) was measured to assess the nutritional status of the rachitic child. TALC tape had been used to measure MUAC. For measurement, midpoint of the left upper arm had been marked by identifying the midpoint between tip of shoulder & elbow. Then the tape was wrapped around mid point to take measurement.

**2. Biochemical Diagnosis**

After clinical diagnosis the parents was asked to come to a nearby diagnostic centre on a fixed date and time. For biochemical test 5 ml blood had been collected from every child with proper precaution. Then collected blood was allowed to stand still for at least 45 minutes. Serum had been separated from collected blood by ultracentrifuge machine and kept in  $-20^{\circ}\text{C}$ . The clotted serum was sent to centre by icebox. The following biochemical test will be performed later.

- a) Serum calcium,
- b) Serum albumin for adjusting serum Calcium values
- c) Alkaline phosphatase, (bone specific)
- d) Parathyroid hormone (PTH),
- e) 25-OH-vitamin D

### **3) Radiological Diagnosis:**

After clinical diagnosis the parents of the clinically suspected rachitic child was asked to come to a nearby diagnostic centre on a fixed date. X-ray of both wrist joint and knee joint was performed there. Diagnosis was confirmed by an expert radiologist. On the basis of radiological findings whole rachitic children was divided into 3 groups:

#### **(a) Active Rickets:**

This group contains typical findings of rickets like splaying, fraying & cupping of metaphyses of long bones with widening of growth plate.

#### **(b) Growing phase of rickets:**

This group shows widening of growth plate with long deformity. It does not show typical radiological features of rickets. But clinical features suggest rickets. We need biochemical test to confirm rickets in this group.

#### **(c) Normal finding:**

No rachitic abnormalities seen in the X-ray.

### **4. Dietary Assessment:**

#### **(a) 24 hours recall method**

Dietary intake of calcium and phosphorus was estimated by Dietary Recall Method. An interviewer, trained in this method, asked the mothers or primary caregivers (if different from mother) to recall all foods consumed by the children in the past 24 hours. The interviewer also prompted respondents for collecting information on the types of food, portion sizes, recipe ingredients, cooking methods, condiments, and beverages. Information on the types and proportion of food was recorded.

#### **(b) Food Frequency Questionnaire**

A food frequency questionnaire (FFQ) was used to determine the frequency of consumption of certain foods. It contains a list of foods and frequencies of intake during the last 24 hours & last week. The food frequency provides data on types and frequency of foods or food

groups. The questionnaire includes name of foods that were good sources of calcium to discriminate between low and high consumers.

### **Qualitative data collection:**

The qualitative data was collected through In-depth interviews. Mother or primary caregivers of children were involved in the discussion of the problem and to initiate remedial measures using resources that were available in their own households/environment. . A tape recorder was used to record the discussion. Mother of two rachitic & two non-rachitic from each division was taken for in-depth interview. In total  $6 \times 2 \times 2 = 24$  household was interviewed. The following topics were discussed during In-depth interview:

1. Mothers' understanding and ability to identify rickets in children.
2. Mothers' understanding on consequence of rickets.
3. Mothers' knowledge on feeding practices and source of calcium-rich food.
4. Food intake information of the child within 24 hours before interview
5. Frequency of home feeding (breast-feeding, other source(s) of milk and intake of calcium phosphate rich diets).
6. Family behavior towards the child & genetic issues.
7. Frequency of seeking medical care and referral to doctors.
8. Parents'/ primary caregivers' perception on social/economical disability of the rickets affected child.
9. Mothers' perception about the future of the child & expectation to the government.

### **Local Support during survey:**

The whole survey team got a tremendous support from local administration, local professionals & local people during whole survey. Especially the name of SARPV should be mentioned. They helped a lot during survey in Cox's Bazar district. They helped the survey team to identify the village, to communicate with the local people, to make them understand the severity of disease & to motivate them to come to the diagnostic centre for investigation. During survey in the "Souhardo" area, their people helped in many ways to make the whole survey easier.



**Challenges faces during survey:**

The whole survey team faces a lot of challenges during whole survey. Firstly, some areas of Sunamganj, Kishoreganj, Maheshkhali etc were very remote area. There were no other alternatives but to use boats to go to those areas. Secondly, the whole country was flooded during survey. Many of road communication disrupted due to flood. There was a miserable condition over whole country and whole team suffered a lot during that time. But survey team overcame the challenges with success.

**Visits during survey:**

Dr. S.K. Roy, principal investigator of National Rickets Survey in Bangladesh made supervisory visits in 3 areas of Bangladesh during the whole survey. He visited Awaliapur of Patuakhali district, Dimla of Nilphamari district & Chittagong city, Chakaria, Maheshkhali, Cox's bazaar of Chittagong division. He observed procedure of interview by the survey teams. He also observed examination procedure carefully & gave necessary advice.

Dr. Omar Farque, nutrition coordinator of CARE visited slum areas of Chittagong city. He observed interview procedure by field surveyors & gave satisfactory comments.

**Data Safety Procedure:**

Data is now kept as confidential and only available to the investigators. Data collecting personnel was advised and motivated to keep the information confidential, and data may be shared only with respective respondent or participating mothers/primary caregivers if requested. Data does not carry the name of the participants and instead codes were entered onto computer.

**Data Analysis****Analysis of Quantitative data:**

Data was entered into the desktop computer following double entry procedure, checked for consistency and edited by Mitra & Associates. A QC from ICDDR,B, consisting of a member designated Senior Data Management Assistant, monitored the whole procedure. The cleaned data set was also re-checked by the QC and analysed by using SPSS software. Data were first entered using the CPro 3.3 Designer (version 3.3.003) Database programme and then converted into SPSS (version 11.5) data file to analyze. Anthropometric indices were calculated using the WHO ANTHRO 2005 and Epi-Info 2000. Malnutrition was classified using the standard cut-off values for

different anthropometric indices. Cleaned data were used for generating tables of relevant variables. The cases of rickets would be related with other morbidity, dietary, nutritional and socio-economic variables. Analysis was carried out to estimate the prevalence of rickets.

Vitamin-D level was categorized into three level, such as

- Severely deficit (0-14.9 ng/ml)
- Moderate deficit and (15.0-31.9 ng/ml)
- Normal level (32.0-100.0 ng/ml)

**Analysis of Qualitative data:**

Data collected from the In-depth interview and observation was ordered, reduced and coded according to the qualitative data analysis method (Applied Health Research Manual: Anthropology of Health & Medical Care). All qualitative data was summarized and a detailed report was presented. Emphasis was given on changes in KAP (Knowledge, Attitude and Practice), BCC (Behavior Change Communication) among the mothers/primary caregivers of participating children. Statements about various important issues and graphical presentation of the reason behind the issues and socio-economic cycle behind the important issues were presented.

# Results

**Table 1.1: Background characteristics of study children**

Indicator	Total	
	Number	Percent
<b>Age of the children</b>		
1-5 years	7730	36.3
6-10 years	7929	37.2
11-15 years	5643	26.5
<b>Sex of the children</b>		
Male	10852	50.9
Female	10450	49.1
<b>Residence</b>		
Urban	4324	20.3
Rural	16978	79.7
<b>Division</b>		
Barisal	1888	8.9
Chittagong	3249	15.3
Dhaka	5597	26.3
Khulna	2786	13.1
Rajshahi	5908	27.7
Sylhet	1874	8.8
<b>Area</b>		
Shouhardo	7120	33.4
Non-Shouhardo	14182	66.6
<b>Religion</b>		
Islam	7666	87.0
Hindu	1106	12.6
Buddhist	1	0.0
Christian	37	0.4
<b>Total (N %)</b>	<b>8810</b>	<b>100.0</b>

**Table 1.1** shows the distribution of study children by background characteristic, age, sex, residence, division, areas and religion. It shows that 36.3% were found in 1-5 years of children and 37.2% and 26.5% found in 6-10 years and 11-15 years of children respectively. According to sex 50.9% were boys and 49.1% were girls.

Division wise distribution reveals that 27.7% belonged to Rajshahi division, 26.3% to Dhaka division, 15.3 % to Chittagong division, 13.1% to Khulna division, 8.9% to Barisal division and 8.8 % in Sylhet division.

In household questionnaire, respondents were asked about their religion and area of living. 87% of households were Muslim, 12.6% were Hindus and 0.4% was Chistrains.

**Table 1.2: Distribution of households by housing characteristics**

Characteristics	Total	
	Number	Percent
<b>Main materials of roof</b>		
Leaves/Straws	558	6.3
Bamboo	24	0.3
Tin	7961	90.4
Pucca/Cenments/Tiles	267	3.0
<b>Total</b>	<b>8810</b>	<b>100.0</b>
<b>Main materials of walls</b>		
Leaves/Straws	1101	12.5
Mud	1215	13.8
Bamboo	1541	17.5
Tin	3422	38.8
Pucca/ Cenments/Tiles	1531	17.4
<b>Total</b>	<b>8810</b>	<b>100.0</b>
<b>Main materials of floor</b>		
Mud	7317	83.1
Bamboo	61	0.7
Pucca/ Cenments/Tiles	1432	16.3
<b>Total</b>	<b>8810</b>	<b>100.0</b>
<b>Electricity</b>		
Yes	4219	47.9
No	4591	52.1
<b>Total</b>	<b>8810</b>	<b>100.0</b>
<b>Land ownership</b>		
Yes	7576	86.0
No	1234	14.0
<b>Total</b>	<b>8810</b>	<b>100.0</b>

**Table 1.2** show the distribution of household by electricity, materials used in house building and land ownership. A total of 8810 Households were interviewed. About half (49%) of the households have access to electricity and rest o do not have access to electricity. Tin was the most common roofing material, accounting for 90.4% of sampled households. Only 3% household roofs were made of pucca, cement or tiles. Half's of the household lived in structures with walls made of naturals materials, leaves, straws, bamboo and mud. Another half lived in structures with walls made of durable materials, tin accounting for 38.8% and Pucca/ Cements/ Tiles accounting for 17.4%. The most commonly used materials for flooring was mud accounting for 83.1% followed by Pucca/ Cements/ Tiles accounting for 16.3%. Out of 8810 households, 86% household had own land and 14% household was landless.

**Table 1.3: Percent distribution of households by possession of durable goods and monthly income**

Monthly income and durable goods	Total	
	Number	Percentage
<b>Households Interviewed</b>	8810	100.0
<b>Family Income/month</b>		
Less than 3000 Taka	461	5.2
3000-5000 Taka	4507	51.2
5001-10000 Taka	3131	35.5
> 10000 Taka	711	8.1
<b>Family Expenditure/month</b>		
Less than 3000 Taka	538	6.1
3000-5000 Taka	5029	57.1
5001-10000 Taka	2897	32.9
> 10000 Taka	346	3.9
<b>Fan</b>		
Yes	3632	41.2
No	5178	58.8
<b>Television</b>		
Yes	2513	28.5
No	6297	71.5
<b>Radio</b>		
Yes	870	9.9
No	7940	90.1
<b>Twin one</b>		
Yes	919	10.4
No	7891	89.6
<b>Refrigerator</b>		
Yes	381	4.3
No	8429	95.7
<b>Khat/ chawki</b>		
Yes	8055	91.4
No	755	8.6
<b>Almirah/ wardrope</b>		
Yes	3684	41.8
No	5216	59.2
<b>Table</b>		
Yes	5212	59.2
No	3598	40.8
<b>Watch</b>		
Yes	5471	62.1
No	3393	38.5

Information on household possession of durable goods and average monthly income is showed in **Table 1.3**. About 5% of household income was less than 3000 taka per month and about 51% of households' income fall between 3000-5000 taka per month and 36% of family income was more than 5000 taka per month. About half of the household of the rachitic and non-rachitic families with monthly income was between 3000-5000 taka and the monthly expenditure was same for those families. About 41% household had fan, 28.5% had television, 4.3% had refrigerator, 91.4% had khat/chawki, 41.8% had Almirah/wardrope, 59.2% had table and 62.1% household had watch.

**Table 1.4: Percent distribution of rachitic children by physical deformities**

Indicator	Rickets		Non-rickets		Total Number	Prevalence rate of Rachitic children
	Number	Percent	Number	Percent		
<b>Physical deformities</b>						
Cleft lip/cleft palate	0	0	22	0.1	22	0
Polio	0	0	14	0.1	14	0
Congenital hand & foot deformities	1	0.5	97	0.5	98	1.02
Squint	1	0.5	95	0.5	96	1.04
Blind/deaf/dumb	4	2	90	0.4	94	4.26
Macrocephaly/ Microcephaly	0	0	40	0.2	40	0
Cerebral palsy	0	0	30	0.1	30	0
Bone TB	0	0	7	0.03	7	0
None						
<b>Problem due to deformities</b>						
Yes	7	3.6	149	0.7	156	4.49
No	6	3	127	0.6	133	4.51
Not applicable	184	93.4	20829	98.7	21013	0.88
<b>Total (N)</b>	<b>197</b>	<b>100</b>	<b>21105</b>	<b>100</b>	<b>21302</b>	<b>0.92</b>

There were many children 1-15 aged year suffering problems due to other physical deformities such as Cleft lip/cleft palate, polio, Congenital hand & foot deformities, Squint, Blind/Deaf/dumb, Macrocephaly/ Microcephaly, Cerebral palsy, Bone TB. It was reported

that 1.02% children are suffering congenital hand & foot deformities, 1.04% children were Squint and 4.26% children were Blind/Deaf/dumb.

**Table-1.5: Distribution of rachitic children by division**

	<b>Total</b>	<b>%</b>
<b>Division</b>	<b>(n)</b>	
Barisal	7	3.6
Chittagong	151	76.6
Dhaka	14	7.1
Khulna	5	2.5
Rajshahi	9	4.6
Sylhet	11	5.6
<b>Total</b>	<b>197</b>	<b>100.0</b>

Among 20,000 children of 1-15 years of age, 197 (0.99 %) had rickets. The percentage of rickets was highest in Chittagong division, (76.6%). In Dhaka division, the percentage of rickets was 7.1%, in Barisal it was 3.6%, in Khulna it was 2.5, in Rajshahi it was 4.6% and 5.6 % in Sylhet division.

**Table-2.1: Prevalence (%) of rachitic children in Shouhardo and non-Shouhardo areas**

<b>Areas</b>	<b>Total Children</b>	<b>No of Rachitic children</b>	<b>Prevalence (%)</b>
<b>Shouhardo</b>	7120	159	2.2
<b>Non-Shouhardo</b>	14182	38	0.3
<b>Total</b>	<b>21302</b>	<b>197</b>	<b>0.9</b>

Among 21,320 children survey 197 had rickets, yielding the prevalence of 0.9%. Compare to Non-Shouhardo area, the prevalence of rachitic children was higher in Shouhardo area (**Table 2.1**). The prevalence was 2.2% in Shouhardo area and 0.3% in Non-Shouhardo area. . The number of rachitic children in shouhardo area was 159 and non-shouhardo area was 38. Higher number of children was affect in Shouhardo area than the Non- Shouhardo area.



**Table-2.2: Prevalence (%) of rachitic children in NNP and non- NNP areas**

Areas	Total Children	No of Rachitic children	Prevalence (%)
NNP	4932	18	0.36
Non-NNP	16370	179	1.09
<b>Total</b>	<b>21302</b>	<b>197</b>	<b>0.9</b>

Compare to NNP area, the prevalence of rachitic children was higher in Non-NNP area (**Table 2.2**). The prevalence was 1.09 % in Non-NNP area and 0.36% in NNP area. The number of rachitic children in NNP area was in 18 and non-NNP area was 179. Higher number of children was affected in Non-NNP area than the NNP area.

**Table-03: Percentage of status of the rachitic children**

Status	Number (N)	Percent (%)
Active rickets	38	24
Growing phase of rickets	53	34
Normal	65	42
<b>Total</b>	<b>156</b>	<b>100</b>

**Table 3** shows that the percentage of radiological status of the rachitic children. Radiological findings were classified into three groups. About 24% children had active rickets. The percentage of growing phase of rickets was 35%. But the rate of normal radiological status was higher than the others and the rate was 42%.

**Table-04: Distribution of rachitic boys and girls by number of clinical signs**

Clinical sign	Boys		Girls		Total	
	(n)	(%)	(n)	(%)	(n)	(%)
Below 3 signs	7	5.8	8	10.4	15	7.6
3 signs	48	40.0	25	32.5	73	37.1
4 signs	44	36.7	32	41.5	76	38.5
5 signs	15	12.5	7	9.1	22	11.2
6 signs	6	5.0	5	6.5	11	5.6
<b>Rachitic children</b>	<b>120</b>	<b>100.0</b>	<b>77</b>	<b>100.0</b>	<b>197</b>	<b>100.0</b>

The clinical examination showed one or more signs of rickets for 1-15 years children (**Table 4**). About 5.8% boys and 1.4% girls had present of below 3 signs. Among the seven signs, 40% boys and 32.5% girls had 3 signs. Five percent boys and 6.5% girls had 6 signs. Most of children had present 4 signs of clinical examination.

**Table 5: Distribution rachitic signs by monthly income**

Indicator	Rachitic Signs									
	Below 3 signs		3 signs		4 signs		More than 4 signs		Total	
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
<b>Monthly Income</b>										
<= 3000 Tk.	3	(21.4)	15	(20.3)	15	(19.7)	7	(21.2)	40	(20.3)
3001 - 5000 Tk.	4	(28.6)	27	(36.5)	27	(35.5)	14	(42.4)	72	(36.5)
5001 - 8000 Tk.	4	(28.6)	23	(31.1)	22	(28.9)	10	(30.3)	59	(29.9)
8000+ Tk.	3	(21.4)	9	(12.2)	12	(15.8)	2	(6.1)	26	(13.2)
<b>Total</b>	<b>14</b>	<b>(100.0)</b>	<b>74</b>	<b>(100.0)</b>	<b>76</b>	<b>(100.0)</b>	<b>33</b>	<b>(100.0)</b>	<b>197</b>	<b>(100.0)</b>

Distribution of monthly income by their rachitic signs in **Table 5**. In the household monthly income between 3001-5000Tk, about 28.6% rachitic children who had below 3 signs, 36.5% rachitic children who had 3 signs, 35.5% rachitic children who had 4 signs and 42.4% rachitic children who had more than 4 signs.

Total 197 rachitic children, 20.3% household monthly income was between <3000 Tk. 36.5% household monthly income was 3001-5000Tk, 29.9% household monthly income was 5001-8000 Tk, and 13.2% household monthly income was more than 8000 Tk.

**Table-06: Average (and SD) of age, height, weight and MUAC of the rachitic children**

Indicator	No. of children	Mean $\pm$ SD
Age (in year)	197	5.60 $\pm$ 3.54
Height (in cm)	152	94.31 $\pm$ 17.29
Weight (in kg)	150	13.89 $\pm$ 5.98
MUAC (in mm)	150	154.58 $\pm$ 49.13

SD = standard deviation

**Table 6** shows the distribution of rachitic children by age, height, weight and MUAC. The mean age distribution of rachitic children was 5.6 years; the mean height was 94.31 cm, and the mean weight was 13.89 kg. The mean MUAC of children was 154.58 mm.

**Table-07: Nutritional status of children by their rachitic status**

Indicator	Rachitic children	
	Number	Percent
<b>LAZ/HAZ</b>		
<-3.00 SD	82	53.3
-3.00 SD to -2.01 SD	33	21.4
-2.00 SD to above	39	25.3
<b>Total (N)</b>	<b>154</b>	<b>100.0</b>
<b>WAZ</b>		
<-3.00 SD	61	40.1
-3.00 SD to -2.01 SD	45	29.6
-2.00 SD to above	46	30.3
<b>Total (N)</b>	<b>152</b>	<b>100.0</b>
<b>WLZ/WHZ</b>		
<-3.00 SD	2	1.4
-3.00 SD to -2.01 SD	21	15.1
-2.00 SD to above	116	83.5
<b>Total (N)</b>	<b>139</b>	<b>100.0</b>

**Table 7** shows the nutritional status of rachitic children in the survey children is compared with the World Health Organization (WHO) child growth standard. Three standard indices of physical growth that describe the nutritional status of children are presented:

- Height for Age Z-score (HAZ)
- Weight for Height Z-score (WHZ)

- Weight for Age Z-score (WAZ)

In the survey 154 rachitic children aged 1-15 were measured for height, weight and MUAC by quality control team of ICDDR,B. The stunting defined as HAZ <-2 SD. The over all stunting prevalence was 75% and severe stunting was 53% (HAZ <-3 SD). The prevalence of under weight was 70% (WAZ <-2 SD) and severe under weight was 40% (WAZ <-3 SD). The prevalence of wasting was 17% (WHZ <-2 SD) and severe wasting was 1.4% (WHZ <-3 SD).

**Table-8: Percent distribution of rachitic children by perception and knowledge of mothers about child feeding practices**

Child feeding practices	Total	
	n	%
<b>Breastfeeding initiation</b>		
Immediately after birth	9	4.6
Within 1 hour of birth	7	3.6
Within 24 hours of birth	150	76.1
After 24 hours of birth	31	15.7
<b>Fed colostum</b>		
Yes	148	75.1
No	49	24.9
<b>Perception about colostrums feeding</b>		
Upsets baby's stomach	6	3
Benefits mother	5	2.5
Benefit baby	122	61.9
Benefit both mother and foetus	2	1
Makes on difference	15	7.6
Others	9	4.6
Not known	51	25.9
<b>Has separate pot for feeding the child</b>		
Yes	52	26.4
No	145	73.6
<b>Total (N)</b>	<b>197</b>	<b>100</b>

Feeding practices played a private role in determining the optimal development of infants. Initiation of breastfeeding was one of the most cost effective's strategies for improving child

health globally. The survey found that 76% of children were breastfed with 24 hours of birth (Table 8).

For colostrum feeding, overall 75.1% of rachitic children fed colostrum. Perception about colostrum feeding was also optimal. About 61.9 % mother knew that colostrum feeding would benefit for baby and 2.5% mother knew that colostrum would benefit for mother. The proportion of having separate pot for feeding was 26.4%. But most of the children have no separate pot for feeding.

**Table-9: Access of Immunization Services**

Indicator	Total	
	n	%
<b>Received any nutrition counseling</b>		
Yes	89	45.2
No	108	54.8
<b>Immunization status</b>		
BCG	187	94.9
DPT 1	186	94.4
DPT 2	183	92.9
DPT 3	180	91.4
HEPATITIS 1	93	47.2
HEPATITIS 2	90	45.7
HEPATITIS 3	89	45.2
POLIO 1	187	94.9
POLIO 2	187	94.9
POLIO 3	184	93.4
POLIO 4	177	89.8
MEASLES	166	84.3
<b>Total (N)</b>	<b>197</b>	<b>100</b>

In Table 9, the estimates of vaccination coverage among children age 1-15 years were based on information taken from the health card and for those for whom a cards was not seen, on information provided by mother. According to the information, about 94.9% was given BCG. The proportion of the three doses of DPT vaccines was similar (94.4%). Much lower percentage of (47.2%, 45.7% and 45.2%) was received Hepatitis1, Hepatitis 2 and Hepatitis 3 vaccine. About 84.3% children received measles vaccine.

The proportion of receiving nutrition counseling was 45.2%.

**Table-10: Treatment history of rachitic children**

Indicator	Total	
	n	%
Taken Ca tablet	72	36.5
Taken Vitamin-D	37	18.8
Taken Brace treatment	13	6.6
Taken surgical treatment	3	1.5
Has blood relation between parents	27	13.7
Have rickets of any relatives	59	29.9
<b>Geographical nature of living area</b>		
Plain land	24	12.2
Plain land beside sea and mountain	3	1.5
Near the sea (within 50 km)	95	48.2
Hilly area (within 50 km)	40	20.3
Near the river (within 3 km)	35	17.8
<b>Total (N)</b>	<b>197</b>	<b>100</b>

**Table: 10** shows the treatment history of rachitic children

**Calcium and vitamin D Intake:**

Calcium tablet intakes 36.5 % and Vitamin D intakes were 18.8%.

**Brace treatment:**

About 6.6% rachitic children have taken brace treatment.

**Surgical Treatment:**

1.5% rachitic children have taken surgical treatment.

29.9% rachitic children reported that they have rickets in relatives

**Geographical nature of living area:**

According to the geographical nature of living area, 12.2% lived in plain land, 48.2% rachitic children lived near the sea (within 50 km) and 20.3% rachitic children lived near the hilly area (within 50 km).

**Table-11: Mothers' knowledge about calcium rich food for rachitic children**

Knowledge	Calcium content	Total	
	mg/100g	N	%
<b>Knowledge on Ca-rich food</b>		84	42.6
<b>Know about Ca sources in food</b>			
Rice	3	38	19.3
Wheat	15	3	1.5
Leafy vegetables	40	78	39.6
Non leafy vegetables	150	73	37.1
Dal	25	21	10.7
Small fish	200	62	32
Big fish	30	8	4.1
Duck	12	2	1
Chicken	12	13	6.6
Egg	22	58	29.4
Milk (150 ml)	180	49	24.9
Fresh fruits	13	19	9.6
Ground sesame seed (5g)	60	30	15.2
<b>Uses of lime (CaCo<sub>3</sub>) in family diet practice</b>			
Always		73	37.1
Sometimes		18	9.1
Never		106	53.8
<b>Total (N)</b>		<b>197</b>	<b>100</b>

**Table 11 shows** the mothers or caregivers knowledge on calcium rich food of rachitic children. 42.6% of rachitic children have reported that they have known about calcium rich food. Highest calcium contain in small fish, milk and vegetables.

About 37% mother or caregivers of rachitic children reported that they used lime in family food always, 9 % sometimes and 54% never used lime in family food.

According to knowledge of calcium rich food, about 40% mother or caregivers of rachitic children have they used vegetables, 29.4% used egg and 25% used milk.

**Table-12: Water sources and type of cooking pots used**

Water source/cooking pot	Total	
	n	%
<b>Sources of drinking water</b>		
Tubewell	183	92.9
Tap/supply water	14	7.1
River/pond/canal/lake	0	0
Well water	0	0
Rain water	0	0
<b>Type of pots used for cooking food</b>		
Aluminum pot	196	99.5
Clay Pot	6	3
Steel pot	10	5.1
Brass pot	2	1
Iron pot	18	9.1
<b>Type of salt used for cooking food</b>		
Iodized Packet salt	73	37.1
Non-Iodized Packet salt	4	2
Unpacked Salt	120	60.9
<b>Total (N)</b>	<b>197</b>	<b>100</b>

Tube-well was the major source of drinking water for rachitic household. About 92.9% of household was used tube-well for drinking water. Only 7.1% household used tap/supply water. 99.5% households used aluminum pot for cooking. About 9% household and 5% household used Iron pot and steel plot for cooking. Only 3% household used iron pot for cooking.

The proportion of using iodized packet salt was 37.1%. About 60.9% household used unpacked salt and only 2% household used unpacked iodized salt.



**Table-13: Feeding pattern of rachitic children When? last 24 hours or 7 days**

Indicator	Total	
	n	%
<b>Given Ca-rich food</b>	99	50.3
<b>Type of Ca-rich food given</b>		
Rice with lime	78	39.6
Rice without lime	124	62.9
Wheat	61	31
Leafy vegetable	189	95.9
Vegetable	192	97.5
Dal	174	88.3
Small fish with bone	127	64.5
Small fish without bone	163	82.7
Big fish with bone	31	15.7
Big fish without bone	172	87.3
Mashed fish	41	20.8
Meat with bones (Pigeon, chicken, duck)	81	41.1
Meat without bones (Pigeon, chicken, duck)	143	72.6
Red meat (cow, goat)	125	63.5
Egg	171	86.8
Milk	111	56.3
Fresh fruits	174	88.3
Battle leaves	8	4.1
Ground sesame seed	53	26.9
<b>Total (N)</b>	<b>197</b>	<b>100</b>

**Table 13 shows** the feeding pattern of rachitic children. Total 50.3% mother gave calcium rich food to their children and 40% mother used lime in rice to increase calcium intake of their children. 65% mother gave small fish with bones to their children and 56% mother gave milk to their children. About 82.7% mother gave small fish without bone, 87.3% mother gave big fish without bone and 88.3% mother gave fresh fruits. Only 4% household take battle leaves.

**Table-14: Distribution of rachitic children by morbidity in last year**

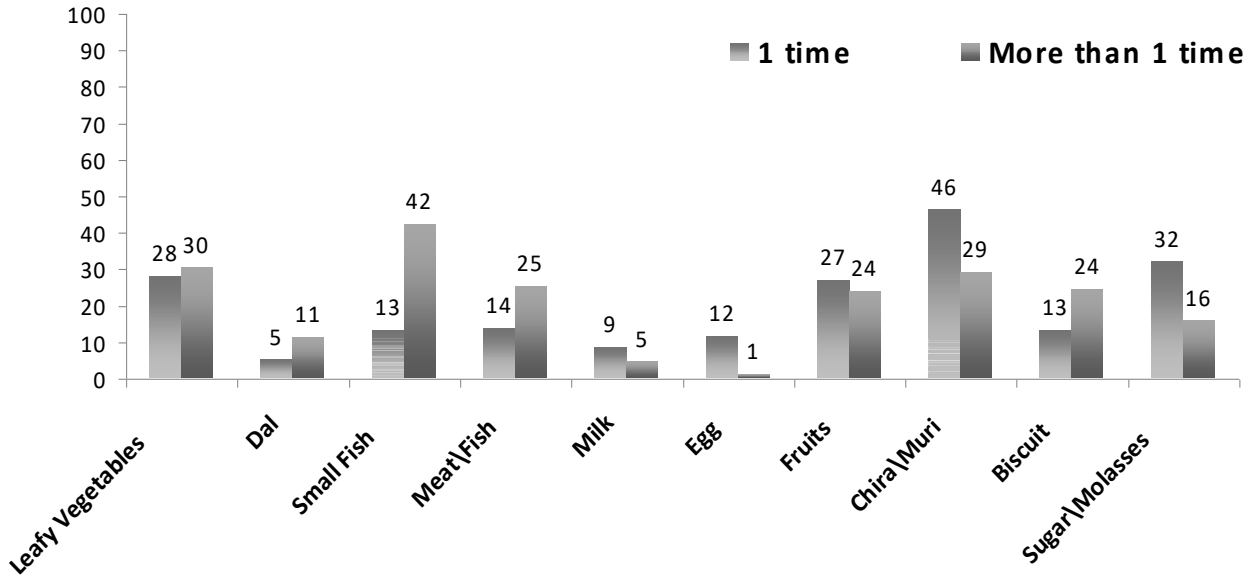
Indicator	Total	
	N	%
<b>Suffering from Fiver</b>	191	97
<b>Duration of Fever</b>		
Below 15 days	83	43.5
16 - 30 days	56	29.3
More than 30 days	44	23
Don't remember	8	4.2
<b>Suffering from common cold</b>	193	98
<b>Duration of common cold</b>		
Below 15 days	76	39.4
16 - 30 days	57	29.5
More than 30 days	47	24.4
Don't remember	13	6.7
<b>Suffering from Diarrhoea</b>	133	67.5
<b>Duration of Diarrhoea</b>		
Below 15 days	89	66.9
16 - 30 days	30	22.6
More than 30 days	12	9
Don't remember	2	1.5
<b>Suffering from Dysentery</b>	104	52.8
<b>Duration of Dysentery</b>		
Below 15 days	78	75
16 - 30 days	14	13.5
More than 30 days	11	10.5
Don't remember	1	1
<b>Suffering from Pneumonia</b>	27	13.7
<b>Duration of Pneumonia</b>		
Below 15 days	23	85.2
16 - 30 days	4	14.8
More than 30 days	0	0
Don't remember	0	0
<b>Total (N)</b>	<b>197</b>	<b>100</b>

Percentage distribution of duration of diarrhoeal diseases was 66.9% below 15 days. About 97% children were suffering from fever. The proportion of diarrhoea was 67.5% and the duration of diarrhoea was 66.9 % below 15 days. About fifty two percent children were suffering from dysentery and the proportion of duration of dysentery was 75% below 15

days. Mother of rachitic children told that 13.7% children were suffering from pneumonia. Most of the children were suffering from common cold. About 85.2% children were suffering from pneumonia below 15 days and 14.8% children were suffering from pneumonia 16-30 days.

# Food Intake

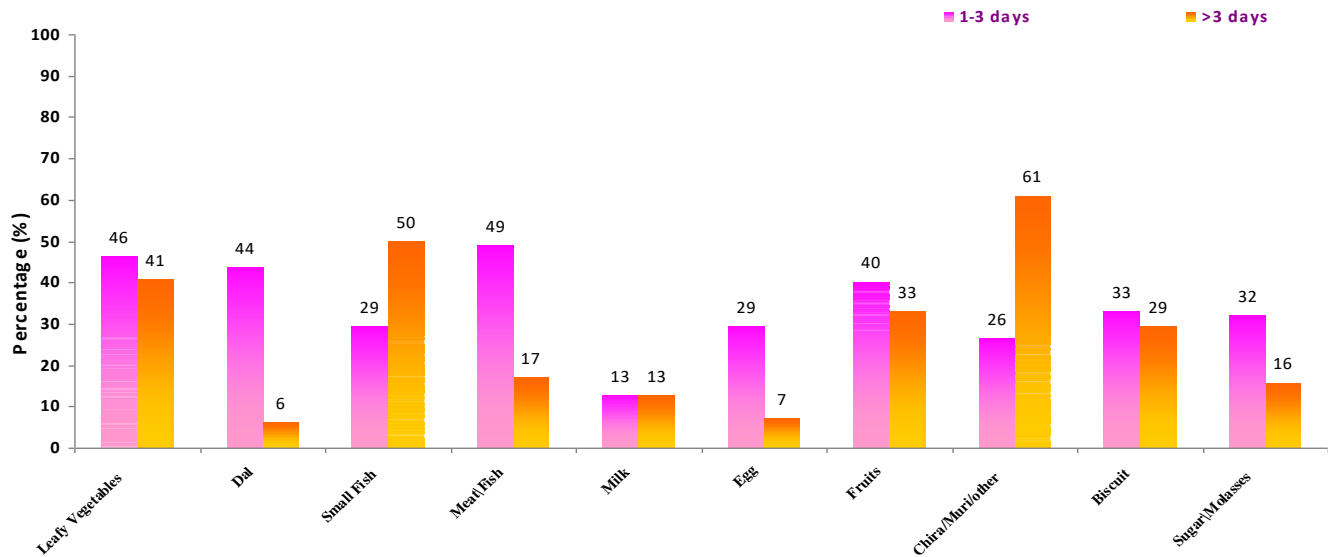
**Figure: 1.1 Food Frequency of rachitic children in last 24-hour (n=197)**



Food frequency of rachitic children in last 24 hours is shown in **Figure 1.1**. About 30% children took leafy vegetables, 5% children took Dal, 42% children took small fish, 25% took meat/fish, 1% took egg, 5% took milk, 24% took fruits and 29% took chira/muri for more than 1 times.

According to list of food frequency in last 24 hours, 28% children took leafy vegetables, 13% took small fish, 12% took egg, 46% took chira/muri and 32% children took sugar/molasses for one time.

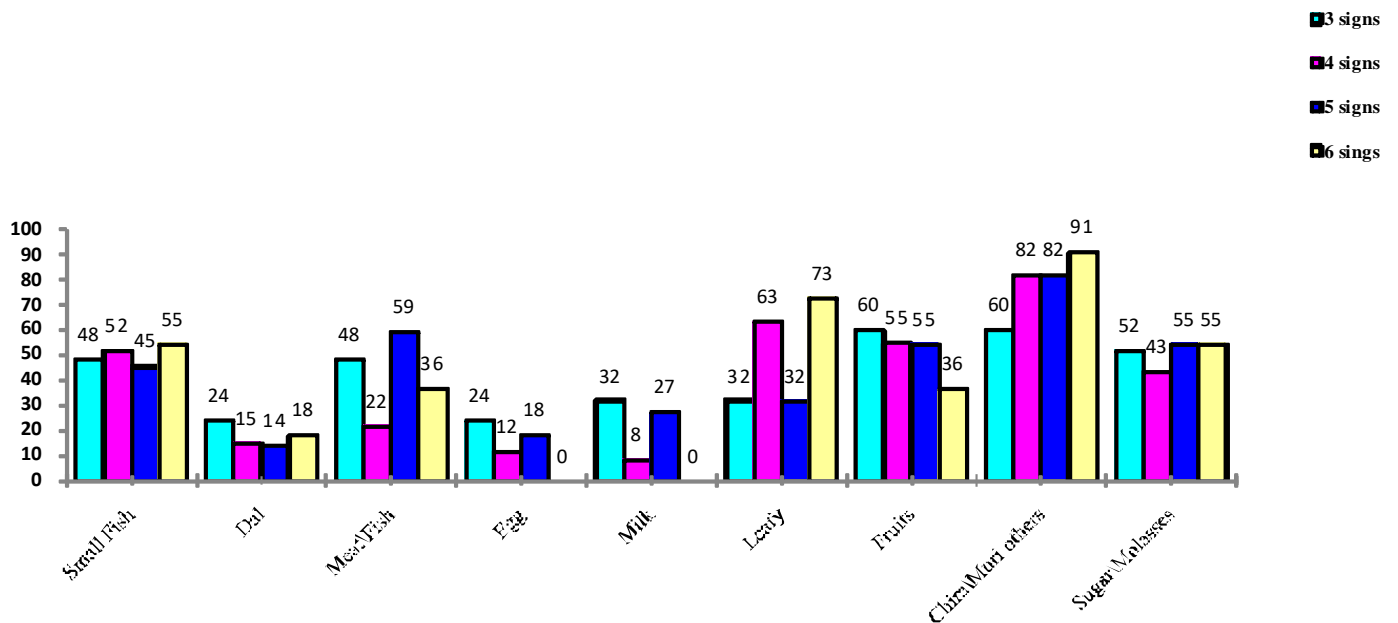
**Figure 1.2: 7-day food frequency of rachitic children (n=197)**



**Figure 1.2** shows the food frequency of dietary intake of last 7 days of rachitic children.

About 43% children took leafy vegetables, 44% children took dal, 29% children took small fish, 49% children took meat/fish, 13% took milk, 29% took egg, 40% took fruits and 33% children took biscuit for 1-3 times.

**Figure 3: Dietary intake of rachitic children according to rachitic signs (n=197)**



# **Bio-Chemical Findings**

**Table 15.1: Serum calcium level of rachitic children**

Age group	Mean	Unit	Reference value
1-2 years	2.26	mmol/L	2.24-2.74 mmol/L
3-12 years	2.20	mmol/L	2.19-2.69 mmol/L
4-15 years	2.19	mmol/L	2.09-2.69 mmol/L

Table 15.1 presents the serum calcium level of rachitic children. The mean serum calcium level was within the reference value for different age group. The mean serum calcium level was 2.26 mmol/L for 1-2 years aged children, 2.20 mmol/L for 3-12 years old children and 2.19 years for 4-15 years aged children.

Considering the cut-off value of 2.19 mmol/L in plasma as normal for the age group, we found that about 47.4% (74 out of 156) children were deficient in serum calcium levels.

**Table-15.2: Distribution of rachitic children by calcium levels and number of clinical signs**

Sign of rickets	Deficient serum calcium level n (%)	Normal Calcium level n (%)
<b>1-5 years</b>		
3 Sign	5 (31.2)	11 (68.8)
4 sign	22(45.8)	26(54.2)
5 sign	12 (63.2)	7 (36.8)
6 sign	6(60.0)	4 (40.0)
<b>6-15 years</b>		
2 sign	3 (33.3))	6(66.7)
3 sign	17(45.9)	20(54.1)
4sign	12(80.0)	3 (20.0)

The clinical examination showed one or more signs of rickets for 1-15 years children (**Table 15.2**). Calcium deficiency was more common among children having more rachitic signs compared to children having fewer rachitic signs. For example, among children of 1-5 years

**Table-15.3: Distribution of radiological status of the rachitic children with calcium level**



old calcium deficiency was more than 60% if they had 5 or more signs as opposed to 31% if they had 3 signs. Similar pattern was found for children 6-15 years old.

<b>Radiological Status</b>	<b>Deficient serum calcium level n (%)</b>	<b>Normal Calcium level n (%)</b>
Active rickets	12(15.4)	24(31.1)
Growing phase of rickets	32(41)	23(29.9)
Normal	34(43.6)	30(39.0)
<b>Total</b>	<b>78(100)</b>	<b>77(100)</b>

**Table 15.3** shows that the percentage of radiological status of the rachitic children. Radiological findings were classified into three groups. In the deficient serum calcium level, 15.4% have active rickets, 41% have growing phase of rickets and 43.6% have normal types rickets.

Half of the rachitic children are calcium deficient and child's was not associated with prevalence of calcium deficiency (Table 15.4).

**Table: 15.4: Percentage distribution of serum Ca level in different age group**

<b>Age</b>	<b>Deficient serum calcium level n (%)</b>	<b>Normal Calcium level n (%)</b>
1-5 years	48 (50.0)	48(50.0)
6-10 years	18 (46.2)	21 (53.8)
11-15 years	11(57.9)	8 (42.1)
All	77 (50.0)	77 (50.0)

**Table 16.1: Serum vitamin-D level of rachitic children**

Vitamin D level (Reference value)	n	%
Severely deficit (0-14.9 ng/ml)	71	45.8
Moderate deficit (15.0-31.9 ng/ml)	81	52.3
Normal (32.0-100.0 ng/ml)	3	1.9
<b>Total</b>	<b>155</b>	<b>100.0</b>

**Table 16.1** shows that the percentage distribution of vitamin-D level of the rachitic children. Vitamin-D level was categorized into three levels, such as severely and moderately deficient and normal levels. About 98% children were deficient in vitamin D concentrations and only 2% children had normal levels.

**Table: 16.2: Percentage distribution of serum Vit-D level in different age group**

Age	Severely Deficient Vitamin D level n (%)	Moderate Deficient Vitamin D level n (%)	Normal n (%)	Total n(%)
<b>1-5 years</b>	45(46.9)	50( 51.1)	1 (2.0)	96(100)
<b>6-10 years</b>	15 (38.5)	23 (59.0)	1(2.5)	39 (100)
<b>11-15 years</b>	11 (57.9)	7 (36.8)	1(5.3)	18(100)

Percentage distribution of vitamin D level in different age group was shown in **Table 16.2**. About 46.9% of children aged 1-5 years were severely deficit, 51% were moderately deficit level and 2% were in normal level. Among the children aged 6-10 years old, 39% of rachitic children were severely deficit, 59% of children were moderate deficit and 3% of children were normal. Among the Children aged 11-15 years old, 57.9% of rachitic children were severely deficit, 36.8% of rachitic children were moderately deficit and 5.3% of children were in normal.

**Table-16.3: Distribution of radiological status of the Rachitic Children with Vitamin D level**

<b>Radiological Status</b>	<b>Severely Vitamin D Deficient N (%)</b>	<b>Moderate Vitamin D Deficient n (%)</b>	<b>Normal n (%)</b>
Active rickets	23 (63.9)	13 (36.1)	0(0.0)
Growing phase of rickets	27(49.0)	27(49.0)	1(2.0)
Normal	21 (32.8)	41 (64.1)	2 (3.1)
<b>Total</b>	<b>71(45.8)</b>	<b>81(52.3)</b>	<b>3(1.9)</b>

**Row % appropriate**

**Table 16.3** shows the distribution of vitamin D level by radiological status of the rachitic children. Among 36 active rachitic cases 64% were severely vitamin-D deficient, 36% were moderate vitamin-D deficient and none were found normal. Prevalence of severe vitamin-D deficiency was little less (49%) among children with growing phase of rickets, but higher than the prevalence of severe vitamin-D deficient (33%) among children with radiological normal status.

**Table: 16.4: Percentage distribution of Rachitic children by their sex and serum Vit-D level**

<b>Age</b>	<b>Severely Deficient n (%)</b>	<b>Moderate Deficient level n (%)</b>	<b>Normal n (%)</b>
<b>Male</b>	38(42.2)	49(54.4)	3 (3.3)
<b>Female</b>	33 (50.8)	32 (49.2)	0(0.0)
<b>Total</b>	<b>71(45.8)</b>	<b>81(52.3)</b>	<b>3(1.9)</b>

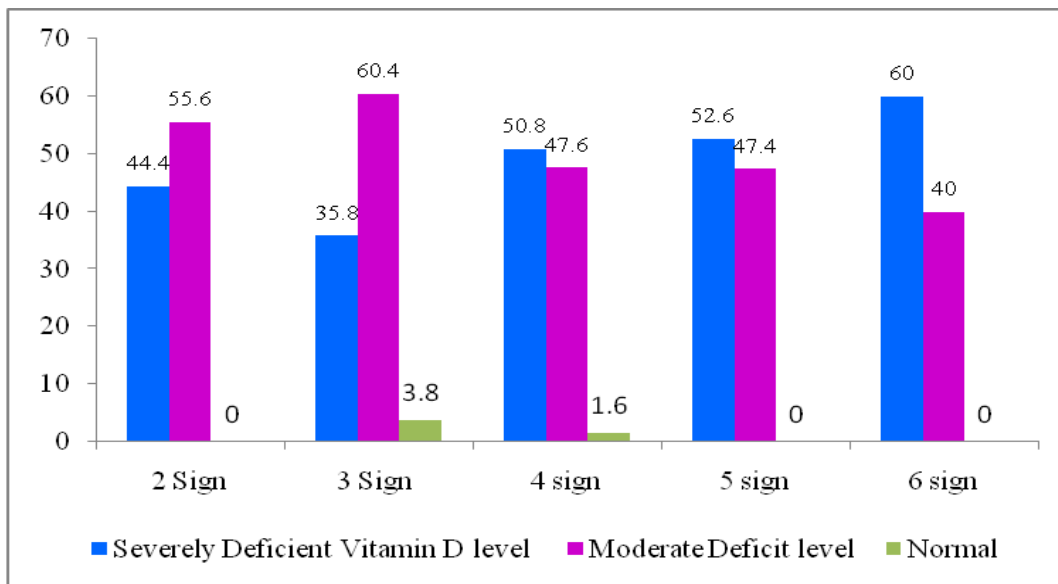
Table 16.4 represents the percentage distribution of serum vitamin D by sex. Among boys 42 were severely vitamin D deficient as opposed to 51% in girls.

**Table 16.5 Percentage distribution of children by their serum Vit-D level and serum calcium level**

<b>Calcium Level</b>	<b>Severely Deficient Vitamin D level n (%)</b>	<b>Moderate Deficient level n (%)</b>	<b>Normal n (%)</b>
<b>Normal level</b>	40(56.3)	34(42.0)	3 (100)
<b>Deficit level</b>	31 (43.7)	47 (58.0)	0(0.0)
<b>Total</b>	71(100)	81(100)	3(100)

Association between calcium level and vitamin-D level is shown in **Table 16.5**. Among 71 severely vitamin D deficient patients, 44% of the children had calcium deficiency. About 58% of the moderate Vitamin A deficient children had calcium deficiency, suggesting for negative association between calcium level and vitamin-D level.

**Figure 2: Distribution of Rachitic children with Vitamin levels by number of clinical signs**



**Figure 1** shows the distribution of rachitic children with calcium level by number of clinical signs. Among 3 sign, 60.4% rachitic children was severely deficient vitamin D level, 35.8 % rachitic children was moderate deficit level and only 3.8% children were in normal level. Among 4 sign, 50.8% children was severely deficient vitamin D level and 47.6% children was moderate deficit level. Among 5 sign, 52.6% rachitic children was severely deficient vitamin D level and 47.4% rachitic children was moderate deficit level but no children were in normal level. Among 6 sign, 60% rachitic children was severely deficient vitamin D level and 40% children was moderate deficit level.

**Table 16.6: Percentage distribution of sign of rickets with radiological findings**

Radiological findings	Sign of rickets		
	Below 3 sign	3-5 sign	More than 5 sign
Active rickets	11 (17.5)	10(15.4)	14(48.3)
Growing phase of rickets	21(33.3)	23(35.4)	11(37.9)
Normal	31(49.2)	32(49.2)	4(13.8)
<b>Total</b>	63(100)	65(100)	29(100)
<b>X<sup>2</sup>= 17.90, p&lt;0.001</b>			

**Table 16.6** represents the percentage distribution of sign of rickets. According to radiological findings 48.3% of patients with active rickets showed more than 5 signs while only 17.5 % had less than 3 signs. It was also found that 37.9% of the patients at growing phase of rickets had more than 5 signs where as 33.3% had signs below 3. Around 35% of the patients were showing 3-5 signs of rickets. On the other hand upon testing 13.8% of normal rachitic subject showed more than 5 signs.

**Table 16.7: Analysis of variance of different variables with radiological feature**

variables	Active rickets (mean ±SD) n=36	Growing phase of rickets (mean ±SD) n=55	Normal (mean ±SD) n=64	P-Value
<b>Vitamin D level(ng/l)</b>	12.55 ±4.77 n=36	16.1±6.29 n=55	17.02±6.87 n=64	0.001
<b>Serum calcium level (mmol/l)</b>	2.14±0.133 n=36	2.23±0.11 n=55	2.21±0.14 n=64	0.008
<b>Para-thyroid hormon(pg/ml)</b>	58.18±43.14 n=36	28.96±31.14 n=55	30.85±32.32 n=64	0.001
<b>Alkaline phosphatase(mg/dl)</b>	110.07±56.54 n=36	57.45±19.52 n=55	68.13±32.22 n=64	0.001

**Table 16.7** demonstrates the relationship between different phases of rickets with radiological features. Patients with active rickets were found to have higher level of serum alkaline phosphatase (110.07±56.54 mg/dl) and parathyroid hormone

(58.18± 43.14 pg/ml) than those at the growing phase. Radiological finding also showed that vitamin D level among active rachitic patients (12.55 ±4.77 ng/l) were comparatively lower than that of normal subjects (17.02±6.87 ng/l). It was also revealed that serum calcium level were almost same for all of the three stages.

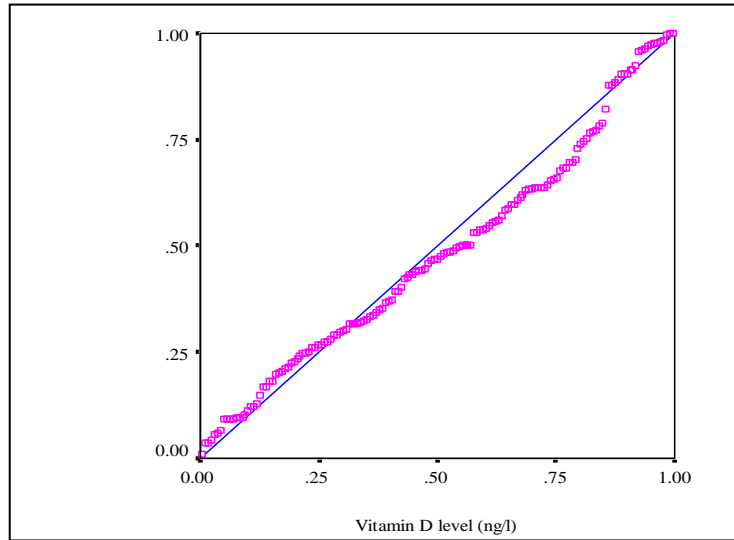
**Table 16.8: Analysis of variance of nutritional status with biochemical markers**

Variables	Nutritional Status(WHZ)		
	Normal (-2.00 SD to above)	Moderate (-3.00 SD to -2.01 SD)	Severe (<-3.00 SD)
Vitamin D level (ng/l)	14.37±5.23	13.12±5.56	14.42±5.27
Serum calcium level (mmol/l)	2.19±0.14	2.24±0.14	2.20±0.11
Para-thyroid hormone (pg/ml)	43.58±50.26	48.93±40.16	36.36±35.18
Alkaline phosphatase (mg/dl)	67.60±23.38	87.12±58.16	71.76±38.67

p>0.005

**Table 16.8** represents the relationship between biochemical findings and different grades of wasting. Patients with moderate wasting were found with the highest serum level of Alkaline Phosphatase (87.12±58.16 mg/dl) and parathyroid hormone (48.93±40.16 pg/ml) while their vitamin D level (13.12±5.56 ng/l) were found to be the lowest among different grades of wasting.

**Figure 3.1: Regression of calcium level with vitamin D of rachitic children**

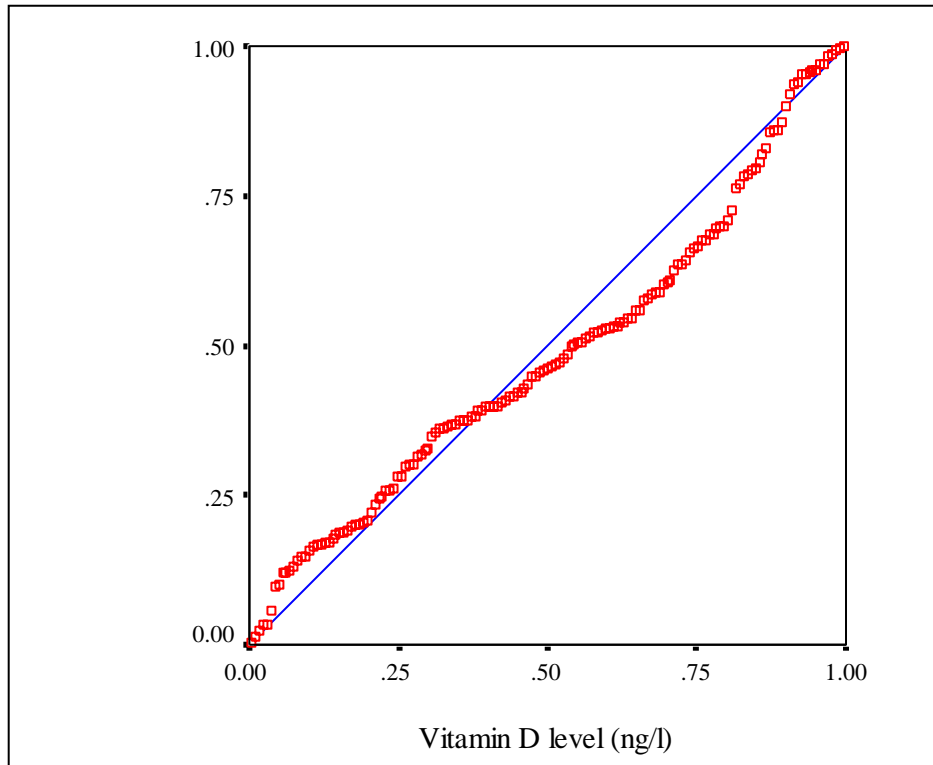


**$R^2 = 0.61$ ,  $p < 0.002$**

Regression of calcium level with vitamin D level of rachitic children shows in **Figure 3.1**.  $R^2 = 0.61$  which indicates that calcium level are significantly positive correlated with vitamin D level ( $p < 0.001$ ).



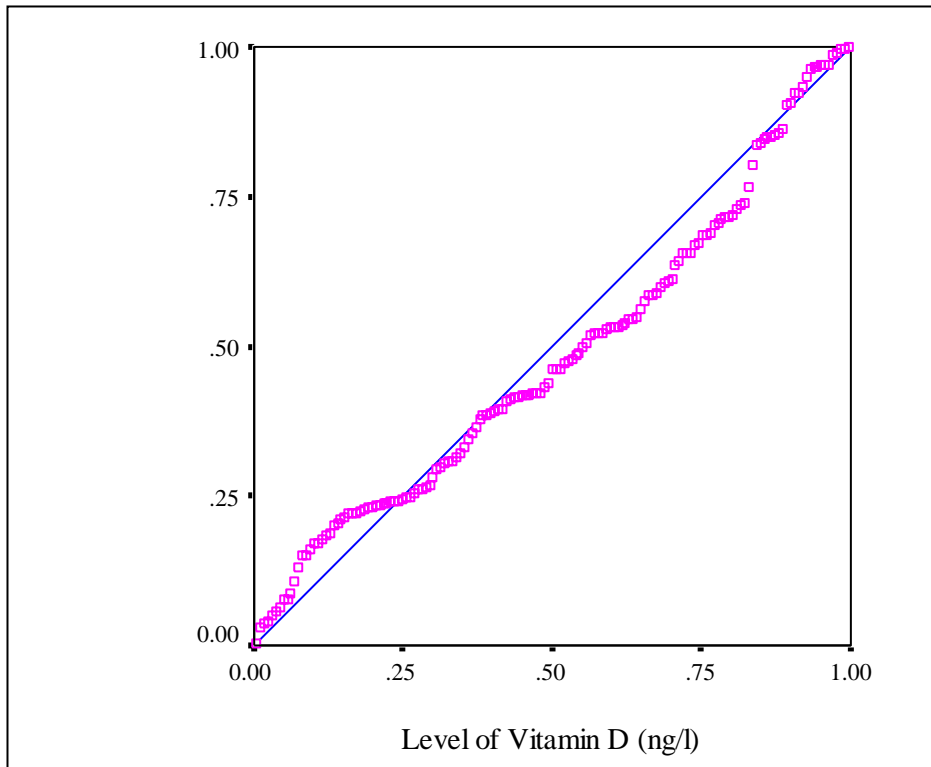
**Figure 3.2: Coefficient of regression of Vitamin D level on Para Thyroid Hormone (PTH) of rachitic children**



**$R^2 = 0.15, p < 0.001$**

**Figure 3.2 shows** that the correlation coefficient of vitamin D with para thyroid hormone of rachitic children. There is a positively correlation (15%) between vitamin D level and para thyroid hormone of rachitic children ( $p < 0.001$ ).

**Figure 3.3: Coefficient of regression of vitamin D level on Alkaline phosphatase of rachitic children**



**$R^2 = 0.07, p < 0.001$**

**Figure 3.3** shows the coefficient of regression of vitamin D level on Alkaline phosphatase of rachitic children. The figure indicates that there is positive correlation between the level of alkaline phosphatase and vitamin D level ( $p < 0.001$ ).

# Qualitative Findings

## Summary of Qualitative study

This is the first time national rickets survey held in Bangladesh. The study was conducted in six divisions such as Dhaka, Chittagong, Rajshahi, Khulna, Barishal and Shylet division. The data had collected through in-depth interview. A tape recorder had used to record the interview. We had taken in-depth interview on 26 mothers. 14 of them were rachitic child's mother. Rests of 12 were non-rachitic child's mothers. We had discussed with mothers to understand and ability to identify rickets in children, knowledge of mothers on feeding practices and source of calcium rich food, frequency of home feeding (breast feeding, other source of milk and intake of calcium phosphate rich diets), frequency of seeking medical care and referral to doctors and socioeconomic status.

### **Identification of rachitic children:**

Most of mothers understanding and perception about common causes of rachitic and non-rachitic children are all the same- fever, common cold, diarrhoea, few rachitic babies mothers have no idea about this.

Both of rachitic and non-rachitic child's mothers have no idea about rickets. Some of them said –

- *“Ati notun shunsi”*.
- *“Baccha pa terai terai hate”*.
- *“Doctor valo bolte parbe”*.

Most of rachitic child's mother identified when their child shows rachitic symptom are all the same. They said –

- When baby had learnt walking then she noticed that her baby was going to have bowlegs.

Some said –

- I knew my baby has rickets after you had come from ICDDR, B.

Their opinion –

- *“Vevesi boro hole ai baka thik hoe jabe”.*

Most of rachitic child’s mothers have no idea about why rickets appear. But some of them said the following reasons –

- Evil eye.
- Evil face.
- Evil air.
- No vaccination.
- No massaging with mustard oil in childhood.
- Rickets arise by birth.

Most of non-rachitic child’s mothers have no concept about this too. But some others said –

- Rickets is arising by deficiency of vitamin and calcium.
- If children do not take food properly, rickets appear.
- If children did not take treatment they become malnourished resulting in rickets.
- It appears because of poverty.

### **Frequency of seeking medical care and referral to doctor:**

Most of the children did not take any treatment for rickets. Few mothers had taken some treatment. Their opinion –

- *“Kabiraj dekhaisi, mollar kase nie gie jhara disi, tabij anaisi”.*
- *“Kabiraj abong moulobir kase nie giesi. Tel pora, Ghee pora, Tabij abong Pani pora khaiesi”.*
- *“Kabiraj jhar fuk dise abong bolse chondra grohoner shomoy ami boshe silam tai bacchar rog soto hoe gese”.*

- *“Doctor dekhaisilam; amnitei valo hoe jabe, kono shomossa nai.”*

This means they had taken treatment from moulobi, kabiraj and mollah, which were the following –

- Chanted oil
- Chanted Butter oil.
- Chanted water.
- Holy locket.
- Chanting on the baby.

Few of the rachitic children took treatment from doctors.

#### **Perception on dietary intake pattern:**

Perception on breast-feeding:

Most of rachitic child’s mothers have no idea about exclusive breastfeeding. Non-rachitic child’s mother said about this – children should feed exclusive breast-feeding till 6 months.

#### **Perception on complementary feeding:**

Few rachitic and non-rachitic children’s mothers have provided complementary food to their children from six months. On the other hand most of the mothers have provided complementary food to their children from 3 months, 9 months, 8 months, 7 months. Rachitic and non-rachitic child’s mother had provided complementary food to their child like as Suji, Khichuri, Rice, Banana, Biscuit, Muri. One of rachitic children mother said –

- *“Amar bacchar barti khabar beshi lageni. Majhe majhe khichuri ranna kore khauatam;Dui charta kore bhat kheto.”*

Perception on calcium rich food:

Most of rachitic child’s mothers have no idea about the source of calcium rich food. But most of non-rachitic child’s mothers have idea about this. They said – milk, egg, leaf vegetables and fruits contain calcium.

### **Knowledge on health and nutrition:**

Most of rachitic child's mothers have no idea about nutrition and they did not get advice about it. Non-rachitic child's mothers have idea, they said – leaf vegetables, fruits, egg, banana contain nutrition and it is good for babies.

The opinion of rachitic and non-rachitic child's mothers about vaccination –

- *“Tika na dile bacchar jor hoi, haat pa baka hoe jai, kotha bolte parena.”*
- *“Tika dile soiti rog theke mukti paowa jai.”*
- *“Tika dile bacchar valo hoi.” (Vaccination is good for children)*

This means vaccination prevents diseases and it is good for babies.

### **Information on socioeconomic status:**

Both of rachitic and non-rachitic child's families' monthly incomes are all the same. Most of rachitic and non-rachitic child's parents are illiterate. But few of them are literate.

## **Dhaka Division**

### **Identification the rachitic children:**

Mothers understanding and conception about common disease of rachitic and non-rachitic babies are – Fever, Common cold, Diarrhoea, Jaundice.

Mothers of rachitic and non-rachitic babies have no idea about rickets and its feature or signs and symptoms. One of non-rachitic mother said-

*“Boite poresilam, akhon mone nai”.(I read in book, but cannot remember now)*

The mother of rachitic child understood when their child shows rachitic symptom:

- When baby had learnt walking then she noticed that her baby was going to have bowlegs slowly. She also followed the baby played less than other children.

Rachitic child's mothers have idea about why rickets appear. Those are –

- ❑ Rickets appear because of evil air.
- ❑ It may be caused because of no vaccination.
- ❑ Rickets arise by birth.

### **Frequency of seeking medical care and referral to doctor:**

Rachitic child's mother took some treatment. For that their opinions are-

- ❑ Doctor dakhaisilam; amnitei valo hoe jabe, kono shomossa nei.
- ❑ Doctor dekhaisi; calcium tablet khaiesilam kintu tate kono upokar hoini.

### **Perception on dietary intake pattern:**

Perception on breast-feeding:

Rachitic child's mothers have no idea about exclusive breast-feeding.

Non-rachitic child's mother said about this- children should feed exclusive breast-feeding till six months.

Rachitic and Non-rachitic child's mothers' opinions are all the same about how long should breastfeeding in the child. That is –

- ❑ Baby should feed breast milk from 2½ years to 3 years.

### **Perception on complementary feeding:**

At what age did the mother start giving to their children complementary foods beside breast milk about this, rachitic and non rachitic mothers said-

It should be fed complementary food to the children from 6 months.

- ❑ One of rachitic child's mothers had given complementary food to their children from 8 months.

Rachitic and non-rachitic child's mother had provided complementary food to their child like as Suji, khichuri, Rice, Biscuit, Muri.



One of the rachitic child's mother said-  
“ Amar bacher barti khabar beshi lageni, Majhe majhe khichuri ranna kore khawatam; Dui charta kore bhat kheto.

### **Perception on calcium rich food:**

There is no idea about the source of food of rachitic child's mother. One of them said that she had idea; Egg, Rice, Fish, Meat, milk, kochu shag, contain calcium.

On the other hand non-rachitic children mother have idea about calcium rich food. They said –  
Milk, Egg, Leaf vegetable and Fruits contain calcium.

### **Knowledge on health and nutrition:**

Rachitic child's mothers have idea about nutrition but they did not get any advice about this.

On the other hand non-rachitic child's mother said about nutrition-  
“I had haired green vegetable, Egg, Pumpkin, Pui shag, Lal shag etc contain nutrition.  
About vaccination rachitic and non-rachitic child's mothers' conception is –

- Tika dile bacchar valo hoi.

This means vaccination is good for baby.

### **Information on socioeconomic status:**

Rachitic and non-rachitic child's families socioeconomic status are all the same. Monthly incomes of rachitic child's families are 5000 Tk. And non-rachitic child's families are 5000-6000 Tk.

## Sylhet Division

### **Identification the rachitic children:**

Mothers understanding and conception about common disease of rachitic and non-rachitic babies are all the same – Fever, Dysentery, Diarrhoea, and Common cold.

One of rachitic baby's mothers has no idea about this.

The opinions of rachitic child's mother about rickets are –

- ❑ Aita notun shunsi.
- ❑ Baccha pa teraiterai hate.

Non-rachitic child's mothers have no idea about this.

Rachitic child's mother understood when their child shows rachitic symptom:

- ❑ I knew my baby has rickets after you had come from ICDDR,B.
- ❑ When baby had learnt walking after one year then she noticed that her baby was going to have bowlegs.

Rachitic and non-rachitic child's mothers have no idea about why rickets appear.

### **Frequency of seeking medical care and referral to doctor:**

The opinions of rachitic child's mother about the treatment of rickets are –

- ❑ Kobiraj dekhaisi, Mollar kase niea giea jhara diesi, tabij anaisi.
- ❑ Kono chikitsha koraini.

This mean the mothers of rachitic child had taken some treatment from Moulovi, Kabiraj and Mollah which were holy locket, chanting on the baby.

### **Perception on dietary intake pattern:**

Perception on breast-feeding:

Rachitic and non-rachitic child's mothers have idea about exclusive breast-feeding. Their opinion:

- ❑ Children should feed exclusively breast-feeding till (3-5) months.

One of the rachitic and non-rachitic child's mothers fed their babies exclusively breast milk only four days.

Rachitic child's mothers have conception about how long should breast feed in the child. Their opinion –

Child should feed breast milk till one year.

Non-rachitic child's mother's opinion –  
Child should fed breast milk till ( 2 - 2½ ) years.

Rachitic child's mothers have no idea about colostrum. One of them said –

- ❑ Shall dudh khawale bachhar rog hoi, kharap hoi, shall dudh tule fele dite hoi; tarpor 2/3 din por buker dudh khawate hoi.

That means if children feed colostrum they are fall in disease.

Non-rachitic child's mothers have idea about colostrum. Their opinion-

- ❑ If children feed colostrum it is better for both of baby and mother.

### **Perception on complementary feeding:**

At what age did the mother start giving to their children complementary foods beside breast milk about this, rachitic and non rachitic mothers said-

They would give complementary food to their children between (3-5) months.

Rachitic child's mother had given to their homemade food as complementary food.

Non-rachitic child's mother would give their babies – suji, banana, khichuri, grape as complementary food.

### **Perception on calcium rich food:**

Rachitic child's mothers have no idea about calcium rich food.

Non-rachitic child's mothers have idea about this. Their opinion –

- ❑ Milk, Khichuri, Banana, Leafy vegetable, Egg, Fish, Grape, apple contain calcium.

### **Knowledge on health and nutrition:**

Rachitic child's mothers have idea about nutrition. Their opinion-

- ❑ To eat vegetable, it is good for health. They get advice about nutrition from CARE.

The opinion of rachitic and non-rachitic child's mother about vaccination.

- ❑ Vaccination is good for baby.

### **Information on socioeconomic status:**

One rachitic child's family's monthly income is 10,000Tk and another one is 1500 Tk. All of them parents are illiterate.

On the other hand non-rachitic child's families' monthly income varies from 6000 – 10,000 Tk. All of them parents are literate.

## **Chittagong Division**

### **Identification the rachitic children:**

Mothers understanding and conception about common disease of rachitic and non-rachitic babies are all the same – Fever, Diarrhoea, and Common cold.

One of rachitic baby's mother has no idea about this.

Two rachitic child's mothers have no idea about this.

- ❑ Rachitic and non-rachitic babies mother have no idea about rickets.
- ❑ Rachitic child's mother understood when their child shows rachitic symptoms:
- ❑ When baby had learnt walking then she noticed that her baby was going to have bowlegs and besides SARPV said – the name of this disease is called rickets.

Rachitic child's mothers have idea about why rickets appear. That is-

- ❑ Rickets appear because of evil face.

Most of the rachitic child's mothers have no idea about this.

These opinions of non-rachitic child's mothers are –

- ❑ Rickets appear deficiency of calcium and vitamin D.
- ❑ It appears because of poverty (Poor people do not provide food timely).

### **Frequency of seeking medical care and referral to doctor:**

Rachitic child's mother took some treatment. For that their opinion –

- ❑ Kabiraj o moulovir kase nie giesi. Tel pora, Ghee pora, tajij abong panipora khaiesi. Tarpur jhawtola doctor dekhisi.

Which rickets child's mother had taken some treatment from kabiraj and moulovi which were –

- ❑ Chanted oil, chanted butter oil, chanted water and holy locket.
- ❑ SARPV have showed the baby and advice what kind of food had taken and did not take advice from any other doctor.

### **Perception on dietary intake pattern:**

Perception on breast-feeding:

The opinion of rickets child's mother about exclusive breastfeeding – They fed their baby's breast milk exclusively till one month.

One rickets child's mother opinion-

- ❑ Jomaj bachha hobar karone buke dudh ashe nai, tau jonmabar 1 din por thekei gorur dudh diesi.

Non-rickets child's mother fed their babies' breast milk exclusively till two months and five months.

The opinion of rickets and non-rickets child's mother about how long should breast feed in the child are all the same.

- ❑ Child should feed breast milk till (2-2½)

Rickets child's, other have idea about colostrum. They said –

- ❑ Rickets child's mothers have conception about how long should breast feed in the child. Their opinion –

Child should feed breast milk till one year.

Non-rickets child's mother's opinion –

Child should feed breast milk till (2 - 2½) years.

Rickets child's mothers have idea about colostrum. They said –

- ❑ After birth which milk first comes from breast called colostrum, and it is good for baby.

One rickets babies mother said-

- ❑ Ami amar bacchake shall dudh khawaini, gele fele diesi. Jonmabar 3 ghonta por mukhe dudh diesi.

Non-rachitic child's mothers have idea about colostrum. Their opinion-

- ❑ After birth which milk comes first from breast called colostrum. It is one kind of medicine.

To fed colostrum it is useful for babies. After childbirth it is necessary to feed colostrum on the first hour.

#### **Perception on complementary feeding :**

From 8-9 month rachitic child's mother start given complementary food to their child.

Non-rachitic child's mother start given to their complementary food from 6 months.

Rachitic child's mother would given to their child suji, serelac, biscuit, rice, leafy vegetable, fruits and home made food as complementary food.

Non rachitic child's mother would give to their child- suji, rice, leafy vegetable, egg, banana and home made food as complementary food.

#### **Perception on calcium rich food:**

Rachitic child's mothers have no idea about calcium rich food. Two rachitic child's mother conception is – Leafy vegetable, Apple, Grape, Banana, Lime rice contain calcium.

Non-rachitic child's mothers have idea about this. Their opinion –

- ❑ Egg, Pulse, Vegetable, Fish and Meat contain calcium.

#### **Knowledge on health and nutrition:**

Most of rachitic child's mothers have no idea about nutrition. Few of them get advice about nutrition but forget it.

Non-rachitic child's mothers have idea about nutrition. They said-

All food elements need for health. Fish, Meat, Egg, and Pulse contain calcium. Leafy vegetable contain vitamin. It increases immunity.

The ideas of rachitic and non-rachitic child's mother about vaccination are all the same. Their opinion-

- ❑ Tika, dile bacchar valo hoi, polio hoina, thang baka hoi na.
- ❑ Oshukh bishukh hoina.

That means vaccination is good for baby and it prevent from disease.

#### **Information on socioeconomic status:**

Rachitic child's family's monthly income varies from 4000Tk to 10,000 Tk. Most of rachitic child's parents are illiterate.

Non-rachitic child's families' monthly income varies from 7000 Tk to 10,000 Tk. The parents of those families are mostly literate.

## **Barishal Division**

### **Identification of rachitic children:**

Mothers understanding and conception about common disease of rachitic and non rachitic child's are all the same – Fever, common cold, Diarrhoea, Pneumonia, Dysentery, Typhoid.

Both of rachitic and non-rachitic child's mothers have no idea about rickets. But one of rachitic child's mother said-

I knew rickets is a bone disease after you had come from ICDDR,B.

Rachitic child's mother understood when their child shows rachitic symptom:

When baby had learnt walking then she noticed that her baby was going to have bowlegs. As long as the baby growing up his legs became more curved.

- ❑ When baby was 3 years then the baby was affected by typhoid fever. After one month she had noticed that legs of her baby were curving.
- ❑ Rachitic and non rachitic child's mother has no idea about why rickets appear.

### **Frequency of seeking medical care and referral to doctor:**

Rachitic child did not take any treatment for rickets.

One rachitic child's mother said –

- ❑ “Medical a akbar dekhaisi , tobe kew boleni rickets.”

### **Perception on dietary intake pattern:**

Perception on breast-feeding:

Rachitic child's mother had fed their child breast milk exclusively till (3-4) months.

On the other hand non-rachitic child's mother had fed till 6 months.

- ❑ Both of rachitic and non rachitic child's mother had fed breast milk to their children till 3 months.
- ❑ One rachitic child's mother had fed her child till one year.

Rachitic child's mothers have no idea about colostrum. On the other hand non rachitic child's mothers opinion –

- ❑ After birth which milk first comes from breast called colostrum. Colostrum provides nutrition.
- ❑ Colostrum fed just after birth.

Perception complementary feeding:

Both of rachitic and non-rachitic child's mother provided complementary food to their child after 6 months. The provided – Rice, Potato, Khichuri, Suji, Vegetables, Home made food as complementary food.

Perception on calcium rich food:

Rachitic child's mothers have no idea about calcium rich food. On the other hand non-rachitic child's mothers have idea about this. Their opinion –

- Egg, Milk, Leaf vegetables, Small fish contains calcium.

Knowledge on health and nutrition:

The opinion of rachitic child's mother about nutrition:

- I did not get any advice about nutrition but I know milk, banana, vegetables and little fish contain nutrition. It is good for health.

Rachitic child's mothers have no idea about vaccination.

About this non-rachitic child's mothers opinion –

- Vaccination prevents diseases.

### **Information on socioeconomic status:**

Monthly incomes of rachitic child's families are 900tk and 3500tk. Parents of these families are mostly illiterate.

On the other hand non-rachitic child's families monthly income – 4500tk and 6000tk. Father of these families are literate.

## **Rajshahi Division**

### **Identification of rachitic children:**

Mothers understanding and conception about common disease of rachitic and non-rachitic babies are all the same – Fever, Common cold, and Diarrhoea.

Both of rachitic and non-rachitic child's mothers have no idea about rickets.

Rachitic child's mother understood when their child shows rachitic symptom:

- When baby had learnt walking she noticed that her baby was going to have bowlegs.
- I knew my baby has rickets after you had come from ICDDR,B.

Both of rachitic and non-rachitic child's mothers have no idea why rickets appear.

### **Frequency and seeking medical care and referral to doctor:**

Rachitic child did not take treatment for rickets. One mother of them said –



- ❑ Kabiraj dekhaisi, kabiraj jharfuc diese abong bolese chandra grahaner shomoi ami bose silam tai bacchar pa baka.

Which means – they took treatment from kabiraj which were –

- ❑ Chanting on the baby.
- ❑ Because of chandra grahan.

### **Perception on dietary intake pattern:**

Perception on breast-feeding:

Both of rachitic and non-rachitic child's mothers have idea about exclusive breast feeding all are the same.

- ❑ Child should feed exclusively breast-feeding till 5 months.

One rachitic child's mother fed breast milk to her baby besides water also.

One non-rachitic child's mother fed her baby exclusive breast milk till one year.

Conception of rachitic and non-rachitic child's mother is – child should feed breast milk till (2-3) years.

Rachitic child's mothers have idea about colostrum. Their opinion –

- ❑ After birth which milk first comes from breast called colostrum, and it is good for baby.

Non-rachitic child's mothers' opinion about this –

- ❑ Colostrum can provide vitamin. It is good for babies' brain.

Perception on complementary feeding:

Rachitic and non rachitic child's mother had provided their child – rice, pulse, leaf vegetables, milk, banana, egg, biscuit, sweet, suji, etc. as complementary food.

Perception on calcium rich food:

Rachitic and non-rachitic child's mothers have no idea about calcium rich food.

One non-rachitic child's mothers have idea. She said –

- ❑ Leaf vegetables, Milk, Egg, Banana, Small fish contain calcium,

**Knowledge on health and nutrition:**

Most of rachitic child's mothers have no idea about nutrition.

One of rachitic child's mother's opinions –

- ❑ Vegetables and pulses provide nutrition.

Non-rachitic child's mothers have idea about nutrition. Their opinion –

- ❑ Leaf vegetables, Ladies figure, pumpkin, Egg, Banana and Milk contain nutrition.

Rachitic child's mothers have idea about vaccination. Their opinion –

- ❑ Vaccination is good for baby.
- ❑ Tetanus, Epilepsy can be prevented by vaccination.

**Information on socioeconomic status:**

Rachitic child's families' monthly income (3500-5000) tk and non rachitic child's families monthly income (2500-3500) tk. Rachitic child's parents are illiterate.

## Khulna Division

**Identification of rachitic children:**

Mothers conception about common disease of rachitic child's, those are –fever, common cold, diarrhoea.

Non-rachitic child's mothers have no idea about this.

Rachitic child's mothers have no idea about rickets. One rachitic child's mother said-

- ❑ “Doctor valo bolte parbe.”

That means doctor will say better about rickets.

Rachitic child's mother identified when their child shows rachitic symptom:

- ❑ When baby had learnt walking then she noticed that her baby was going to have bowlegs.

Their opinion –

- ❑ “Vebesi boro hole ai baka thik hoe jabe.”

Rachitic child's mothers have idea why rickets appear. Their opinion –

- ❑ “Oneke bolese soto balai shorishar tel die pa malish na korle pa baka hoi. Tel die malish korle abar thik hoe jai.”

That means- Rickets appear by no massaging with mustard oil in childhood.

Non-rachitic child's mothers have no idea about this.

**Frequency of seeking medical care and referral to doctor:**

Rachitic childs did not take any treatment for the rickets.

**Perception on dietary intake pattern:**

The opinion of rachitic child's mothers about exclusive breast feeding –

- They fed their babies' breast milk exclusively till (1½-2) months.

One rachitic child's mother said –

- “Bacchake jorner por thekei chamuche kore pani dea shuru koresi. Bacchar gola shukie jai, tai pani khaisi.”

Both of rachitic and non-rachitic child's mothers have no idea about colostrum.

One rachitic child's mothers have idea about this. She said –

- After birth which milk first comes from breast called colostrum. It should fed just after birth.

**Perception on complementary feeding:**

From 3 months rachitic child's mother start given complementary food to their child.

They would given their child – suji, biscuit, milk, cake as complementary food.

From 6 months non-rachitic child's mother start given complementary food to their child.

They had fed their child – shagu, khichuri, banana, apple, bread etc. as complementary food.

**Perception on calcium rich food:**

Rachitic and non-rachitic child's mothers have no idea about calcium rich food. One rachitic child's mother said –

- “Ata jani je nodules, maser katai calcium ase.”

It means – Nodules, fish bone contain calcium.

**Knowledge on health and nutrition:**

Rachitic child's mother has no idea about nutrition and they did not get advise about it.

Non-rachitic child's mother said-

- Leaf vegetables, fruits contain nutrition and it is good for babies.

The opinion of rachitic child's mother about vaccination –

- “Tika na dile bacchar jor hoi, haat, pa baka hoe jai, kotha bolte pare na.”
- “Tika dile 6 ti rog theke mukti paoua jai.”

Non-rachitic child's mothers opinion –

- “Tika nea valo, na nile jokha, haat-pa shukie langra hoe jai.”

## **DISCUSSION**

The bone disorder most clearly related to nutrition is rickets. Rickets in the growing child or adolescent develop in a variety of clinical situations and have in common an absence or delay in the mineralization of growth cartilage and in newly formed bone collagen. Classically, deficiency of vitamin D, which is essential for the absorption of dietary calcium, has been the major cause.<sup>13</sup> Rickets is characterized by weak bones that become curved or misshapen from bearing the weight of the body. The causes of rickets are best understood against the background of our knowledge of vitamin D metabolism. Different studies re-emphasized the importance of ultraviolet light in vitamin D economy, and the widespread effect of this vitamin/hormone throughout the body.

The national survey showed that the prevalence rate of rachitic children was 0.99%. The southern parts of Chittagong division; Chittagong and Cox's Bazar districts had the highest prevalence. Interestingly, rickets was not identified among the indigenous populations of the hilly regions (Hill Tracts) of the district. But the parts where there was a lack of sun exposure showed a higher prevalence. Most humans depend on sun exposure to satisfy their requirements for vitamin D. Season, latitude, time of day, skin pigmentation all influence the cutaneous production of vitamin D3. elderly people that stay inside and have poor diets often have atleast subclinical deficiency. Ironically, it appears that hypovitaminosis D is very common in some of the most sunny countries in the world- the cause of this problem is the cultural dictate that women be heavily veiled when outside in public. Breastmilk of such mothers may also be deficient of vitamin D. Although chronic excessive exposure to sunlight increases the risk of nonmelanoma skin cancer, the avoidance of all direct sun exposure increases the risk of vitamin D deficiency, which can have serious consequences.<sup>14</sup>

Most of the patients were from non NNP area. Subjects from NNP areas were more likely to get intervention and nutrition education which may have helped them to bring about change in their knowledge about health and nutritional status.

Vitamin D deficiency is now recognized as a pandemic. In vitamin D deficiency, calcification of bone does not take place which causes the disruption of the orderly

processes of bone formation. Radiological findings of this study demonstrated that presence of more than five signs were common among active rachitic patients. Results of this study showed the prevalence of stunting around 75%. During anthropometric assessment the common scales were used to measure height. Rickets is characterized by weak bones that become curved or misshapen from bearing the weight of the body and rachitic children cannot stand properly. This could be the one of the reasons behind the stunting found among our study subjects. From the history of dietary intake it was revealed that patients with more number of signs had less intake of rich sources of vitamin D.

According to our findings of serum vitamin D level, most of the rachitic children ( 52%) were found to be moderately deficient (reference value 15.0-31.9%). Radiological findings of our study showed that presence of more than five signs were prevalent among patients at active phase. Analyzed biochemical markers confirmed the relationship of the disease with serum level of vitamin D, Alkaline phosphatase and parathyroid hormone. There was a positive correlation between vitamin D level and para thyroid hormone of rachitic children. The regression analysis of vitamin D level on Alkaline phosphatase of rachitic children also indicated the positive correlation between the level of alkaline phosphatase and vitamin D level. Upon analysis, both the findings of serum calcium and serum vitamin D showed a negative correlation which was found to be significant. A previous study aiming to test the relationship between vitamin D, calcium and parathyroid hormone concluded on the point that only when the 25-hydroxyvitamin D (25(OH)D) level dropped below 25 nmol/l, there was a significant rise in PTH. Levels of 1,25-dihydroxyvitamin D (1,25(OH)<sub>2</sub>D) are tightly regulated by parathyroid hormone (PTH), phosphate and calcium. Vitamin D deficiency causes a compensatory increase in PTH, in an effort to maintain calcium. Vitamin D levels can be sub-optimal even if calcium and parathyroid hormone (PTH) levels are within reference intervals. A raised PTH with a normal/decreased calcium can be a marker of more severe vitamin D deficiency<sup>15</sup>.

Most of the parents of rachitic patients were found to be illiterate and had no idea about the disease. It was revealed that mothers of non-rachitic subject had a better perception of

the disease, its symptoms and its prevention compared to that of rachitic patients . These mothers of non-rachitic subjects were also found to have better knowledge about introduction of complementary feeding and nutritious food on time. They seemed to be aware of the importance of vaccination and exclusive breastfeeding. These mothers also confirmed that they had knowledge about food sources of calcium and vitamin D.

## **RECOMMENDATIONS**

The National Rickets Survey conducted during May 2008- October 2008 showed that Rickets is an emerging public health problem.

It is recommended that,

- Government policy should be developed to prevent rickets in children and take curative measures
- Intervention programme should be incorporated for prevention and early detection.
- Nutrition education on dietary measures for prevention and treatment be undertaken in geographically risk areas.
- A case control study for risk factors should be under taken.
- Provide education of families regarding the importance of breastfeeding after birth.

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