ORIGINAL ARTICLE

Subclinical Nutritional Rickets Among Adolescents in Kaghan Valley

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Abstract

Objective: To determine the occurrence of subclinical rickets and its causing factors among adolescent students of schools in Kaghan Valley, Pakistan.

Study Design: Observation cross-sectional study.

Place and Duration of Study: Department of Biochemistry and Health Sciences, Hazara University, Mansehra, Ayub Medical College and Teaching Hospital, Abbottabad, from March to April 2012.

Methodology: Sixty seven students (34 boys and 33 girls) age between 11 - 16 years included in the study from different schools of Kaghan Valley, Pakistan. Characteristic, serum biochemical and nutritional status were measured for all the participants. On the basis of biochemical finding the boys and girls students were divided in to two groups, normal subjects and subclinical rickets (absent symptoms with altered biochemistry).

Results: Twenty six participants, 19 (73%) girls and 07 (27%) boys had biochemical abnormality but no clinical signs and symptoms of rickets. Low vitamin D and high alkaline phosphatase level were observed in 26 (100%), 21 (81%), low calcium in 17 (65%) and low phosphorus 7 (27%) subjects with subclinical rickets. None had high parathormone level above normal range. Nutritional intake of calcium, phosphorus and vitamin D was found less than the recommended daily intake in all the participants.

Conclusion: Subclinical rickets is common problem among adolescent students especially in girls which is due to low nutritional intakes and avoidance of sunshine due to environmental and traditional impacts.

Key Words: *Subclinical rickets. Nutrients. Sunlight. Environmental effect. Traditional impact. Adolescent students. Kaghan Valley.*

INTRODUCTION

Rickets is caused by inadequate mineralization of bone and its signs mostly appear in the skeleton.[1] Vitamin D facilitates the absorption of calcium and phosphorus from intestine and due to its deficiency the absorption of minerals is impaired.[2] Vitamin D is mainly produced by human skin and also derived from dietary source.[3] Among adolescents, proper functioning of metabolic process is more essential and can be carried through adequate nutrition.[4] Nutritional rickets is a major life threatening problem all over the world.[5]

Most of the studies were conducted on clinical rickets but no information is present about subclinical rickets in adolescents. The objective of this study was to evaluate the occurrence and factors associated with subclinical rickets.

METHODOLOGY

This cross-sectional study was started in the month of March 2012 in different Government-run high schools of Kaghan valley. Study consist of a total 70 boys and girls students having age 11 years to 16 years who willingly participated from various schools. This study was started through permission from higher authority of education and parents of the students. This research study was approved by Ethical Committee of Ayub Medical College and Teaching Hospital, Abbottabad and Hazara University, Mansehra, Pakistan.

In first phase 2 students were excluded from the study because they were taking some medicine which could affect vitamin D status in blood. In second phase, one participant was also excluded through laboratory verification of abnormal urea and creatnine levels. A data form was designed enquiring age, weight, height, daily food intake, living, clothing style, availability and exposure to sunlight.

A nutritionist estimated the average daily intakes of calcium, phosphorus and vitamin D for each student from their total intake of one-month food. Each participant was physically examined by a physician.

After informed consent from participants and approved by ethical committee, blood sample was taken from each individual with the help of expert medical technician and then blood was centrifuged to obtain the serum. After final screening, 67 students were included for further biochemical analysis. Subclinical rickets cases were diagnosed on the basis of biochemical findings, such as low vitamin D, high or normal alkaline phosphatase, low or normal calcium and phosphorus, normal and high level of parathyroid hormone and with no signs and symptoms of rickets. For statistical analysis, Minitab 11

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software was used and p-values calculated by using t-test. Values were taken as mean and ± SD. A significant and non-significant difference was considered as $p < 0.05$ and $p > 0.05$ respectively.

RESULTS

Sixty seven students, 34 boys and 33 girls, who looked physically normal having age 11 - 16 years finally analyzed in the study. Mean age was 13.69 ± 1.69 years in boys and 13.96 ± 1.54 years in girls. There was no significant difference in the age between boys and girls (p=0.050).

A total of 26 (39%) students were diagnosed as subclinical rickets, with 19 (73%) girls and 07 (27%) boys, with significant gender difference ($p < 0.001$).

Daily intake of vitamin D, calcium and phosphorus in foods for boys who were assigned as subclinical rickets case was 26.86 ± 2.67 IU, 247.28 ± 22.5 mg and 305.7 ± 31.7 mg respectively. Normal boys' mean intake of vitamin D was 29.48 ± 3.14 IU, of calcium was 268.92 ± 25.9 mg and of phosphorus 335.4 ± 26.0 mg.

Girls with subclinical rickets took 27.95 ± 3.08 IU of vitamin D, 267.2 ± 27.4 mg calcium and 310.6 ± 23.7 mg phosphorus on daily basis. Foods content had 30.64 ± 4.22 IU vitamin D, 290.14 ± 34.57 mg calcium and 327.92 ± 30 mg phosphorus in normal girls. Comparatively both gender of subclinical group intake less amount of nutrients than normal cases, however, there was no significant gender difference in the intake (Table II).

The mean serum level of vitamin D calcium, phosphorus, alkaline phosphatase and parathyroid hormone are given in Table III. Significant differences were observed in boys regarding serum 25 (OH) D concentration ($p < 0.001$), calcium (p=0.008) and alkaline phosphatase (p=0.002) among biochemical normal and abnormal adolescents. No significant difference was seen regarding phosphorus (p=0.33) and parathyroid level (p=0.054, Table III). Significant lower serum level of vitamin D, calcium and high alkaline phosphatase were found in subclinical ricketic girls' cases as compared to normal ($p < 0.001$). No significant difference was seen in serum phosphorus (p=0.13) and parathyroid hormone level (p=0.052) among normal and subclinical ricketic girls (Table III).

Table I: Gender-wise occurrence of subclinical rickets.

Groups	Boys n (%)	Girls n (%)	Total n (%)
Normal	27 (79)	14 (42)	41 (61)
Sub clinical	07 (21)	19 (58)	26 (39)
Total	34 (100)	33 (100)	67 (100)

Table II: Daily intakes of nutrients in foods by normal and subclinical rickets cases

Daily intakes	Gender	Groups		p-value
		Normal cases Mean ± SD	Subclinical cases Mean ± SD	
Vitamin D (IU)	Boys	29.48 ± 3.14	26.86 ± 2.67	0.050
	Girls	30.64 ± 4.22	27.95 ± 3.08	0.055
Calcium (mg)	Boys	268.9 ± 25.9	247.3 ± 22.5	0.053
	Girls	290.1 ± 34.6	267.2 ± 27.4	0.051
Phosphorus (mg)	Boys	335.4 ± 26.0	305.7 ± 31.7	0.052
	Girls	327.9 ± 30.1	310.6 ± 23.7	0.088

Table III: Gender-wise comparison in biochemical serum level of different parameters in normal and subclinical cases.

Daily intakes	Gender	Groups		p-value
		Normal cases Mean ± SD	Subclinical cases Mean ± SD	
Vitamin D (nmol/l)	Boys	67.07 ± 6.06	27.0 ± 1.91	< 0.0001
	Girls	59.57 ± 8.55	23.42 ± 3.98	< 0.0001
Calcium (mg/dl)	Boys	8.87 ± 0.11	8.52 ± 0.15	0.0008
	Girls	8.98 ± 0.18	8.47 ± 0.10	< 0.0001
Phosphorus (mg/dl)	Boys	3.40 ± 0.15	3.51 ± 0.26	0.33
	Girls	3.50 ± 0.21	3.30 ± 0.48	0.13
Alkaline phosphatase(U/l)	Boys	407 ± 43.0	608 ± 103	0.0023
	Girls	470 ± 76.4	612.3 ± 97.6	< 0.0001
Parathyroid hormone (pg/ml)	Boys	39.89 ± 4.57	48.71±9.48	0.054
	Girls	49.28 ± 15.8	58.68 ± 5.04	0.050

DISCUSSION

No school-based study is available on this problem among adolescents of the studied area. Present study has pointed out that subclinical rickets is a major health problem in Kaghan valley with prevalence rate of 39% among school students having age 11 - 16 years.

Although in this study, subclinical rickets was also found in 27% boys but more commonly seen in girls, which is 73%.

A study from Turkey in agreement with those finding highlighted that 30 (62.5%) girls are affected by rickets.[6] The present data shows that subclinical cases were takeing less amount of vitamin D, calcium and phosphorus in their daily diet as compared to normal cases.

The necessary role of vitamin D is for maintaining normal level of calcium in the blood through absorption from the diet.[7] In this study, all of the subclinical cases had lower level of vitamin D due to limited available sunshine. The alarming factor of low and poor sun rays was due to the environmental and traditional impacts.

Sukru *et al*. concluded that none of the cases had low calcium and high alkaline phosphatase level in vitamin D deficiency or insufficiency cases.[8] A study on girls in Tehran shows that 29 (66%) asymptomatic cases had elevated alkaline phosphatase with normal vitamin D level and 15 (34%) of normal alkaline phosphatase in low vitamin D status.[9] Pettifor *et al*. found that 25 (OH) D level was < 12 ng/ml in all infants with rickets.[10]

An elevated alkaline phosphatase is reported as a major tool for vitamin D deficiency cases.[11,12] A study conducted in Saudi Arabia pointed out that high alkaline phosphatase level was found in cases with low vitamin D status.[13]

In this study, high alkaline phosphatase above upper normal limit was noted in 21 out of a total 26 cases with low vitamin D level.

In vitamin D deficiency cases, normal level of phosphorus was found in all subjects,[14] and 12 out of 21 in another study due to hyperthyroidism.[15] In the present study, phosphorus level was found within normal range in all subclinical cases except 7 with no significant difference.

Inverse relation was observed between 25 (OH) D and parathyroid hormone in different studies.[16] A study on clinical rickets revealed that parathyroid hormone is significantly increased from the above upper normal limits.[15]

A level of < 3 ng/ml vitamin D,[17] < 9 ng/dl level[18] and < 5 ng/ml is variously considered for the elevation of parathyroid hormone.[19,20] No correlation was noted between the level of vitamin D and PTH in some other.[6,8] In authors' observation, none of the subclinical rickets cases had parathyroid hormone level above upper normal range.

All subclinical cases of present study had no clinical signs and symptoms of rickets despite of having biochemical evidence of rickets. That might be absence due to an initial stage or lack of consistency in biochemical abnormalities. The lack of pumping action of parathyroid hormone on bones may also be responsible for it.

Long-term nutritional deficiency along with lack of sun light due to environmental and traditional impact, may have a synergistic effect on the biochemical values of the studied variables.

CONCLUSION

Subclinical rickets is common problem among adolescent students especially in girls which is likely to be due to low nutritional intakes and avoidance of sunshine due to environmental and traditional reasons.

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