Calcium status of adolescent girls in relation to economic background

∎ VIBHA BHATNAGAR, RICHA SONI **AND** NIDHI KALRA

∎**ABSTRACT :** Adequate intake of calcium is important for skeletal growth. Low calcium intake during adolescence may lead to decreased bone mass accrual thereby increasing the risk of osteoporotic fractures in later stages of life. The aim of the present study was to assess dietary calcium and serum calcium of adolescent girls from different economic background. One eighty adolescent girls (10-15years) were selected from government and private schools. 24 hour dietary recall and food frequency questionnaire were used to evaluate intake of calcium and Calcium Arsenazo Reagent Kit was used to measure serum calcium. The mean calcium intake was significantly different in all three groups with maximum intake in girls from High Income Group (HIG) (1238.81 mg/day) and lowest in Low Income Group (LIG) girls (447.87 mg/day). Although the main source of calcium in all three groups was dairy products, the quantity of intake differed considerably. Despite low calcium intake,serum calcium was found normal in the subjects from LIG. Measures need to be taken to rectify low calcium intake in LIG. Bone mineral density is better indicator of calcium status than serum calcium.

∎ **KEY WORDS:** Adolescent, Osteoporosis, FFQ, BMD, HIG, LIG

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Adolescents account for 1/5th of the World population and have been on an increasing trend. The population projections of India indicate that the number of adolescents will increase from 200 million in 1996 to 215.3 million in 2016 representing 21.4 per cent of population, making it largest adolescent population in the world (UNICEF, 2011). Although India has one of the fastest growing youth populations in the world, its gender disparities pose significant barriers for the future of girls. Adolescent girls between 10-19 years constitute close to half (111 million) of this population group (Nanda *et al.*, 2013). Adolescence is a phase of life characterized by rapid physical growth and development. It is one of the nutritional shift periods of life. About 45 per cent of adult skeletal mass is formed during adolescence. The achievement of peak bone mass during childhood and adolescence is crucial to reduce the risk of osteoporosis in later life (Kumar, 2005).

Calcium is an important nutrient for skeletal health throughout life, contributing to bone mineral accrual during early adulthood and helping to prevent subsequent bone loss at maturity (Bachrach, 2001). Calcium plays a vital role in the formation of peak bone mass. However, it is seen that calcium intake among teenage girls starts

to decline at the time of maximum requirement *i.e.* during puberty. Dietary calcium was found inadequate in comparison to the recommended intake in both rural and urban subjects in and around Tirupati as reported by Harinarayan *et al.*, 2004 and in Gilan/ Iran (Pourmoghim and Abtahi, 2006). Several other studies also support the same (Islam *et al.*, 2003; Shatrugna *et al.*, 2005 and Chittari *et al.*, 2007).

Key influences on food intake of adolescents are altered meal pattern (e.g. snacks), changing food consumption (tea/ coffee/ soft drinks) and concern with body weight. Teenagers are being exposed to periodic fast foods and slimming trends, tend to skip meals and develop irregular eating habits. These faulty food habits can lead to different nutritional deficiencies, under or / over nourishment (Feskanich *et al.*, 1997).

Diet quality is affected not only by age and sex, but also by occupation, education, and income levels. The different socio-economic indicators appear to have similar, although independent, effects on nutrition and diet (Darmon and Drewnowski, 2008).

The nutritional concerns of adolescents have largely been neglected. Though adolescent girls have been included as beneficiaries in ICDS program, the main focus is on iron deficiency anaemia. There is dearth of information on the calcium nutriture of adolescents girls. Besides, no data are available from different economic background. Therefore present study was planned to assess the nutritional status of adolescent girls from various economic backgroundwith special reference to calcium.

■ RESEARCH METHODS

The study was carried out on urban adolescent girls (10–15 years) of Udaipur city. List of all government and private higher secondary schools located in Udaipur city was obtained through internet. Preliminary survey revealed that majority of adolescent girls studying in government school were from lower socio-economic status whereas those in private schools belonged to middle and higher socio-economic status. The principals of all schools were approached personally / telephonically. On the basis of their responses and as per objective of the study, six schools: 3 government and 3 private schools were purposively selected. A list of girls in the age range of 10-15 years along with the monthly family income was procured from the office records of selected schools.

From that list, 60 girls from each income group (HIG, MIG and LIG) were selected. Categorization of income group was based on as per criteria laid down by the Urban Improvement Trust, Udaipur. The total sample thus consisted of 180 girls.

Calcium status was assessed by dietary survey using 24-hour recall method. Nutrient intake was calculated using food composition tables and then compared with recommended dietary allowances (ICMR, 2010). A food frequency questionnaire (FFQ) was also developed for exploring the frequency of consuming calcium rich foods. A list of calcium rich food commonly consumed by local people was prepared and frequency was noted in terms of daily/weekly/occasional and never. Quantitative determination of calcium in serum of sub samples of ten subjects from each economic group was done using Calcium Arsenazo reagent kit.

■ RESEARCH FINDINGS AND DISCUSSION

Data presented in Table 1 revealed that majority of girls were of 13 years of age followed by 12 and 14 years. Background profile of the subjects indicated that maximum respondents (88.3 %) were hindu irrespective of their socio-economic status. Most of them belonged to general category (72.7 %) whereas, only 10.3, 5.4 and 11.6 per cent subjects belonged to other backward class, schedule cast and schedule tribes category, respectively.

It was also observed that majority of respondents from HIG, MIG belonged to small family (90 and 80 %), whereas, 58.3 per cent of respondents from LIG were having large family size with more than five members in their family.

Frequency of consumption of calcium rich foods :

A list of sources of calcium rich foods was prepared and the respondents were asked about frequency of consuming these items. It was revealed from results (Table 2) that daily milk consumption was high (91.66%) in HIG, followed by MIG (68.3%) and LIG (43.3%). Results showed that HIG subjects were having more milk while LIG subjects were consuming more tea, 45 per cent of LIG subjects were consuming tea daily as compared to only 26.6 per cent from HIG.

Fifty per cent of respondents from LIG never had cheese. Buttermilk consumption was high in LIG, 55 per cent were having it daily. Most of the respondents were

consuming ice cream occasionally but intake was much higher in LIG group whereas MIG and HIG respondents were also taking it weekly. Intake of coffee was also higher in HIG than MIG group. 41.6 per cent of LIG subjects never tasted coffee. Data further revealed that consumption of green leafy vegetables was occasional in majority of subjects irrespective of their socio-economic status. Weekly ingestion of beans was higher (60%) in LIG group as compared to 26.6 per cent in MIG and 41.6 per cent in HIG group. It was also noted that 55 per cent of LIG subjects never consumed almonds, whereas, its intake was high in MIG and HIG group. When asked about other calcium rich foods like gingelly seeds, *Ragi*, dried figs, fish (bones) etc. majority of subjects in all socio-economic background were not consuming these foods. Gingelly seeds consumption was seasonal in all groups.

Thus, it is evident that in HIG group consumption of milk, coffee, cheese, paneer, curd, almonds and ice cream was higher while consumption of tea, buttermilk, beans was higher in LIG group. Intake of green leafy vegetables and gingelly seeds was occasional in all the groups.

Similarly dairy products were found to be the main source of calcium intake upper socio-economic strata while, it was dark green leafy vegetables in lower socio-economic strata in a study conducted by Sanwalka *et al.* (2010) on calcium intake and source of calcium in adolescent boys and girls from two socio-economic strata.

Dietary calcium intake :

Calcium intake in milligrams per day was assessed in all respondents by 24 hour dietary recall method. From

Table 1 : Percentage distribution of respondents by their age and socio-economic status

Age (Years)	HIG (n=60)	MIG (n=60)	LIG (n= 60)	Total (n=180)
10	27 (8)	20 (6)	27 (8)	24 (22)
11	20 (6)	47 (14)	40 (12)	36 (32)
12	53 (16)	33 (10)	33 (10)	40 (36)
13	37 (11)	40 (12)	47 (14)	41 (37)
14	40 (12)	40 (12)	33 (10)	38 (34)
15	23 (7)	20 (6)	20 (6)	21 (19)

Table 2 : Frequency of consuming calcium rich foods by the respondents belonging to different socio-economic status

Foods	HIG (n=60)				MIG (n=60)				LIG (n=60)			
	Daily (%)	Weekly (%)	Occasionally (%)	Never (%)	Daily (%)	Weekly (%)	Occasionally (%)	Never (%)	Daily (%)	Weekly (%)	Occasionally (%)	Never (%)
Milk	91.60	8.30	Nil	Nil	68.30	15	Nil	16.60	43.30	23.30	Nil	16.60
Curd	35	53.30	10	1.60	25	51.60	16.60	6.60	26.60	70	1.60	1.60
Cheese	1.60	33.30	48.30	20	1.60	36.60	28.30	33.30	Nil	26.60	23.30	50
Paneer	Nil	21.30	70	8.30	1.60	26.60	46.60	25	1.60	25	46.60	26.60
Buttermilk	38.30	33.30	16.60	11.60	31.60	31.60	28.30	8.30	55	40	Nil	5
Ice cream	8.30	38.30	51.60	1.60	16.60	40	58.30	Nil	5	26.60	68.30	Nil
Tea	26.60	16.60	30	26.60	36.60	18.30	16.60	35	45	18.30	10	26.60
Coffee	11.60	30	20	38.30	13.30	13.30	36.60	36.60	3.30	46.60	8.30	41.60
Beans	Nil	41.60	40	18.30	3.30	26.60	38.30	23.30	Nil	60	26.60	10
GLV's	10	5	80	5	13.30	3.30	81.60	1.60	10	15	65	13.30
Almonds	28.30	16.60	41.60	13.30	35	23.30	31.60	10	8.30	10	26.60	55

Table 3 : Dietary calcium intake and Serum calcium of respondents

Socio-economic status	Calcium intake (mg/d)	RDA (mg/d)	% RDA	Serum Calcium (mg/dl)	Reference range (mg/dl)	Interpretation
HIG	1238.81±58.23	800	154.85	10.05±0.11	9.0 – 11.0	Normal
MIG	901.34±47.94		112.66	9.77±0.14		Normal
LIG	447.87±34.20		55.98	9.93±1.0		Normal

the raw weights, nutrient contents were calculated with the use of a published food composition table, detailing the nutritive value of Indian foods (Gopalan *et al.*, 2004) and then results were compared with recommended dietary allowances (ICMR, 2010) suggested for adolescent girls.

There was a considerable difference in the mean calcium intake among the three income groups. The mean calcium intake of adolescent girls from HIG was highest *i.e.* 154.85 per cent of recommended dietary intake (800 mg/day). Whereas, intake of calcium was adequate in MIG girls (112.66 %) but the daily intake of calcium was far below the RDA level (55.98 %) in girls from LIG (Table 3). This might be due to the higher intake of calcium rich foods by the respondents of HIG and MIG.

It was also observed that dietary calcium intake was strongly linkedwith total food intake, energy intake, protein intake and body weight. All the girls from LIG were either mild or moderately undernourished.

The results of the present study are in line with the study on 6-17 year old girls from Delhi, India, Marwaha *et al.* (2010) have reported a calcium intake of 480 mg/day in LES girls whereas, it was 707 mg/day in UES girls. In a similar study from Delhi, Puri *et al.* (2008) have reported a calcium intake of 454 mg/day in LES girls and 685 mg/day in UES girls. The calcium intake in both these studies is in line with the intake in present study group.

Low calcium intake (324 ± 64 mg/day) along with energy, protein, iron, vitamin A in adolescent girls was also observed by Saibaba *et al.* (2010).

Islam *et al.* (2003) also found low calcium intake in 191 Bangladeshi premenopausal women (16-40 years). Mean dietary calcium was found to be higher in HIG women as compared to LIG women. Although in HIG group, 47 per cent of subjects failed to meet even the lowest level (400-500 mg/day) of WHO recommended dietary allowances (RDA) of calcium for adult women. No subject in group LIG was found to meet the RDA level. Moreover, 63 per cent of the women in group LIG had calcium intake lower than 200 mg/day.

Shatrugna *et al.* (2005) also reported low dietary calciumin women (30-60 years) from low income group. The mean calcium intake was only 270 ± 57 mg/ day. The intake of energy, protein and micronutrients was also below RDA.

Sources of calcium :

Contributory sources of dietary calcium were different in all three groups (Fig. 1). Though major part of the calcium intake in all three groups came from milk and milk products, the quantity of intake differed considerably. Contribution of dairy products to overall calcium intake was highest in HIG, where milk and milk products were the main source of calcium and contributed 76.5 per cent of the total daily intake. The rest was distributed among different food groups including GLV's, nuts and oilseeds. Likewise in MIG70.7 per cent share of calcium intake came from dairy products. But in LIG this share decreased to 55.7 per cent only. About half of the calcium (44.3 %) in low income group came from the plant sources, which are known to have low bioavailability. Whereas, this tendency was less in MIG (only 28.9%) and lowest in HIG, where plant sources supplied nearly 23.5 per cent of calcium.
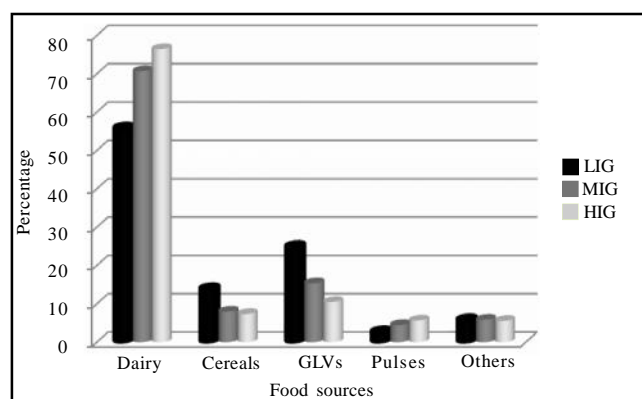

Fig. 1 : **Per cent contribution of different foods sources to daily calcium intake by respondents**

Islam *et al.* (2003) also observed different sources of dietary calcium in different economic groups.

These results also correspond to those reported by the Nation Nutrition Monitoring Bureau (NNMB) surveys, which are large scale national nutrition surveys in India (NNMB, 2002).

Serum calcium :

Ninety nine per cent of calcium in the human body is distributed in the skeleton. The one per cent, which is extra skeletal, is present in every cell in the body, and in the extracellular fluid (ECF). Ionized calcium concentration in the ECF is 4.8 mg/dl (1.2 mmol/l) and total calcium is approximately double. Serum calcium is

maintained within a narrow normal range, chiefly by resorption from the skeleton and alteration of urinary calcium loss and absorption from gut (Bhatia, 2008).

Serum calcium level of sub sample of 30 subjects was estimated. It was evident that mean serum calcium of all subjects was within normal range irrespective of their socio-economic status. Serum calcium is an indicator to assess the blood calcium status of a subject. On correlation, the dietary calcium status and the serum calcium status of the subjects from different income group, it was found that the dietary calcium had no significant effect on serum calcium levels.

Similarly, despite of low calcium intake no effect on serum calcium of women (30-60 years) was documented by Shatrugna *et al.* (2005). However, bone mineral density, bone mineral content and T scores were found below normal.Chittari *et al.* (2007) also reported normal range of serum calcium in 1148 urban and rural subjects in south India even though the dietary calcium intake was inadequate by both urban and rural subjects.

Conclusion :

The findings of the present study indicate that the income level has a definite impact on the dietary intake of calcium. Adolescent girls from low income group had lower calcium intake as compared to counterparts from middle and high income groups and it was more likely to be derived from non-dairy products with high oxalic acid and phytin content, which impair gastrointestinal absorption. Educational measures areneeded to increase intake of calcium rich foods in adolescents from LIG. Calcium Intake has definite impact on bone homeostasis but the dietary intake of calcium does not affect serum calcium level which is maintained despite of low calcium intake. Thus, it can be concluded that bone mineral density is more influential indicator to assess the relationship between dietary calcium and calcium status of a human being.

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