Original Article

Dietary pattern, nutritional status, anaemia and anaemia-related knowledge in urban adolescent college girls of Bangladesh

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Abstract

Objectives: To examine dietary pattern and nutritional status of adolescent college girls of Dhaka, Bangladesh with a particular focus on the prevalence of anaemia and appropriate knowledge about it among them.

Methods: A cross sectional study was conducted. Sixty-five adolescent girls aged 15-19 years were selected randomly from Home Economics college of Dhaka. A 7-day food frequency questionnaire was used to investigate the dietary pattern. Nutrient intake of the participants was assessed by 24h recall method.

Results: Habitual dietary pattern indicated poor consumption of milk, liver and leafy vegetables. Food intake data revealed a deficit of 473 kcal/day in energy. Mean intake of carbohydrate and fat were lower than RDA; while protein, iron, vitamin A and vitamin C intakes were much higher. Anthropometric data indicated that 63% of the girls were stunted (height-for-age <95% of NCHS reference values) and 45% were underweight (weight-for-age <75% of NCHS reference values). The prevalence of anaemia (Hb<12 g/dl) among the participants was 23%. About 17% had low serum iron (<40 µg/dl), 23% showed evidence of iron-deficient erythropoiesis (Transferrin Saturation <15%) and only 8% had vitamin C deficiency (<0.29 mg/dl). About 65% of the participants had correct knowledge about the causes of anaemia; while 72.3% and 80% respectively, knew about the prevention and treatment of anaemia. Surprisingly, 73.8% of the participants were not aware about the sources of iron-rich foods.

Conclusions: Results indicate an overall poor nutritional status of the urban adolescent college girls in Bangladesh and need for appropriate nutrition interventions to overcome the problem (JPMA 60:633; 2010).

Introduction

Adolescents are considered to be a nutritionally vulnerable segment of the population. Due to enhanced growth during adolescence, the requirement of some minerals is of paramount important. A rapid growth rate combined with a marginal nutrient intake increases the risk of nutritional deficiencies in this population. Micronutrients such as iron and zinc are essential trace elements involved in the high growth rates of adolescents.[1] In Bangladesh, a large number of adolescent girls suffer from various degrees of nutritional disorders.[2-5] Poor nutritional status during adolescent is an important determinant of health outcomes at a later stage of life. Therefore, attention should be given to adolescent health and nutrition. Few studies have been done in the last couple of years to identify the extent and consequence of malnutrition in rural and urban adolescent school girls, and adolescent female workers of Bangladesh.[2-5] Results of these studies particularly confirmed the higher prevalence of anaemia and iron deficiency along with some other micronutrient deficiencies.

Although few studies characterized the dietary pattern and nutritional status of adolescent school girls, we are not aware of any systematic report that has characterized the dietary pattern, nutritional status and prevalence of anaemia in adolescent college girls of Bangladesh. Most of the college girls in Bangladesh are in late adolescent stage; while few are in mid adolescent stage of their lifespan. Their health and nutritional status have great impact on the quality of the next generation and consequently the future of the country. The present study aimed at investigating dietary pattern, nutrient intake and nutritional status in urban adolescent college girls of Bangladesh, with a particular focus on the prevalence of anaemia and appropriate knowledge about it among them. Findings of this study could be critical to formulate the appropriate intervention programmes to solve nutritional problems among adolescent college girls.

Subjects and Methods

Sixty five female students between 15-19 years were selected randomly from Home Economics college of Dhaka. Those with any sign of chronic infection or metabolic disorder were excluded from the study after recording their history of occurance of diseases and examining the clinical signs of diseases by a physician. The study was approved by the Department of Biochemistry and Molecular Biology, University of Dhaka, Bangladesh and was conducted after obtaining written consent from the parents of the participants.

Information on socio-economic conditions, dietary

intake and food habit, knowledge about anaemia was obtained with a pre-tested questionnaire. Food consumption of the subjects was assessed using a 24-hour recall method. To estimate portion size of food consumed, different types of serving plates, glass, cups, and spoons were displayed. From the size and volume of food consumption obtained by this method, weight of each serving of different food items was calculated. The equivalent weight of raw food was calculated using a conversion table for Bangladeshi foods formulated at the Institute of Nutrition and Food Science (INFS).[6] To compute nutrient intake from raw food weight, a table developed by the INFS based on Bangladeshi and Indian food composition tables was used.[7,8] Information about the habitual dietary pattern of the subjects was obtained using a 7-day food frequency questionnaire on selected food items. All participants were asked about the causes, preventive measures and treatments of anaemia to examine their knowledge about this major public health problem. Appropriate knowledge of the participants on various iron rich foods was also assessed.

Five milliliters of blood were collected from each participant with a disposable syringe and 20 µl of whole blood were directly transferred into 5.0 ml Drabkin's reagent for the measurement of hemoglobin. An aliquot of blood was dispensed into a heparinized tube for collection of plasma and remaining portion was used to separate serum.

Anthropometric data and blood samples were collected following the interview. Body weight (bare footed) of the subjects was measured to the nearest 0.1 kg. Height (bare footed) was measured in the standing position to the nearest 0.1 cm. Weight and height were measured on a combined height-weight scale (Detecto-Medic; Detecto Scales Inc., USA). Body mass index (BMI) was calculated as weight (kg) divided by height in meter squared. Height-for-age (Ht/Age) and weight-for-age (Wt/Age) were calculated from United States National Center for Health Statistics' (NCHS) reference value.[9]

Haemoglobin and total-iron-binding capacity (TIBC) concentration were measured by using commercial kits. Serum transferrin saturation was calculated by dividing serum iron concentration by TIBC, multiplied by 100. Plasma vitamin C was measured with dinitrophenylhydrazine according to Lowry method.[10]

Data were analyzed using SPSS for Windows version 12 (SPSS Inc, Chicago). Results are expressed as mean±SD (standard deviation), median and range wherever appropriate. Pearson's correlation test was performed to determine the association among various biochemical indices.

Results

Majority (44.6%) of the girls were 17 years old. About half of the participants' fathers (53%) were university graduates, whereas only 13.8% of their mothers had a graduation degree. The majority of the participants came from medium-sized (5-6 members) and large (≥ 7 members) families, 46% and 39% respectively. Eighty percent of the participants family had low (18.5%, taka ≤ 1000) to moderate (61.5%, taka 1001-3000; 1 US$ = approx. 68 taka) per capita monthly income. A substantial proportion (43.2%) of the participants lived in a rented house.

Table 1: Pattern of intake of selected food items by urban adolescent college girls.

Food item	Frequency of intake /week				
	0 %	1-2 %	3-4 %	5-6 %	≥ 7 %
Meat	7.4	26.2	36.3	10.4	19.7
Fish	10.7	23.1	30.7	16.8	18.7
Eggs	16.0	29.2	29.2	15.4	10.2
Milk	46.1	23.1	12.3	12.3	6.2
Liver	64.6	27.8	4.6	1.5	1.5
Leafy vegetables	27.7	44.6	15.4	4.6	7.7
Other vegetables	9.2	18.6	23.1	18.5	30.6
Fruits		6.5	15.4	10.9	67.2

Results are expressed as the percentage (%) of the participants consuming different frequencies of each food items in the week preceding the interview.

Table-2: Daily intake of energy and nutrients by urban adolescent college girls in relation to RDA*

Energy/nutrients	Total intake		RDA	Percentage of RDA
	Mean	SD		
Energy (kcal/day)	1495.0	370.0	1968.0+	76.0
Protein (g/day)	68.0	26.0	44.0	154.5
Carbohydrate (g/day)	250.0	65.0	369.0	67.8
Fat (g/day)	25.0	7.0	32.8	76.2
Iron (mg/day)	28.8	12.2	15.0	192.0
Vitamin A (RE, µg/day)++	1530.0	420.0	750.0	204.0
Vitamin C (mg/day)	75.6	32.7	60.0	126.0

*RDA: Recommended Dietary Allowances. +Calculated using factor for activity level with a multiple of BMR based on body weight of the individuals according to FAO/WHO/UNU11 . ++Calculated using factors recommended by IVACG12 . RE: Retinol equivalents.

A large proportion of the participants consumed meat (62.5%), fish (53.8%) and eggs (58.4%) 3 to 4 times or less in the week preceding the interview (Table-1). A substantial proportion of the girls did not take milk (46.1%) and liver (64.6%) at all in the week. About 27.7% did not take leafy vegetables; while substantial proportions of the participants had other vegetables (72.2%) 3 to 4 times or more in the week. Fruits were highly popular among the girls, being consumed at least 3 times in the week by an overwhelming majority of the participants (93.5%). Most of the fruits consumed were mango, jackfruit, pineapple, banana, lemon and guava.

There was a mean deficit of daily energy intake of

Table-3: Anthropometric and biochemical indices of urban adolescent college girls.

Variable	Mean (±SD)	Median	Range
Anthropometry			
Body weight (kg)	44.3 (±6.4)	44	32.0-60.0
Height (cm)	152.9 (±5.7)	152.4	139.7-167.6
Height for age (%)	93.8 (±3.8)	93.7	85.5-103.1
Weight for age (%)	77.2 (±11.3)	76.4	54.8-105.2
BMI (kg/m2)	19.0 (±2.6)	18.9	14.7-27.3
Biochemistry			
Hemoglobin (g/dl)	12.8 (±1.6)	12.7	8.3-17.3
Iron (µg/dl)	90.7 (±34.9)	110.6	25.5-146.2
TIBC (µg/dl)	372.9 (±55.3)	363.6	285.6-570.4
TS (%)	24.5 (±12.2)	26.2	4.6-49.5
Vitamin C (mg/dl)	1.2 (±0.6)	1.1	0.20-2.7

SD: Standard deviation, BMI: Body mass index, TIBC: total iron binding capacity, TS: Transferrin saturation.

473.0 kcal (Table-2). The largest proportion of energy (67%) was obtained from carbohydrates, followed by protein (18%) and fats (15%). Mean intakes of iron and vitamin A were almost double of the RDA. Intake of vitamin C was also above the RDA (Table-2).

Table-3 shows the biochemical indices for iron and vitamin C status and the nutritional characteristics of the participants. Compared to NCHS values, the mean Ht/Age and Wt/Age were 93.8 ± 3.8% and 77.2 ± 11.3%, respectively. About 63% of the girls were stunted using a cut-off point of <95% Ht/Age and 45% girls were found to be underweight (<75% Wt/Age, NCHS reference value), reflecting worse nutritional condition in urban adolescent college girls (Figure). Among the participants, BMI ranged from 14.7 to 27.3 kg/m^2. When considering BMI categories, about 48% of the participants were underweight, 49% were normal and only 3% were overweight.

Mean serum values of iron, TIBC, TS and vitamin C of the adolescents were within the normal range (Table-3). Nearly 77% of the subjects had normal haemoglobin concentration (Hb?12.0 g/dl); while 23% had anaemia (Hb<12.0 g/dl) as per WHO recommendation[13] (Figure). Of the total participants, about 17% of the girls had low serum iron (<40.0 µg/dl). A considerable proportion of the participants (23%) had iron deficient erythropoiesis as per the cut-off value of serum TS (<15%).[14] Among the participants,

Table-4: Correlation* between hemoglobin, iron indices and vitamin C.

Variable	Hb (g/dl)	Iron (µg/dl)	TIBC (µg/dl)	TS (%)
Hb (g/dl)	r = 1.0	r = 0.70	r = -0.70	r = 0.70
Iron (µg/dl)		r = 1.0	r = -0.70	r = 0.90
TIBC (µg/dl)			r = 1.0	r = -0.80
Vitamin C (mg/dl)	r = 0.62	r = 0.89	r = -0.71	r = 0.89

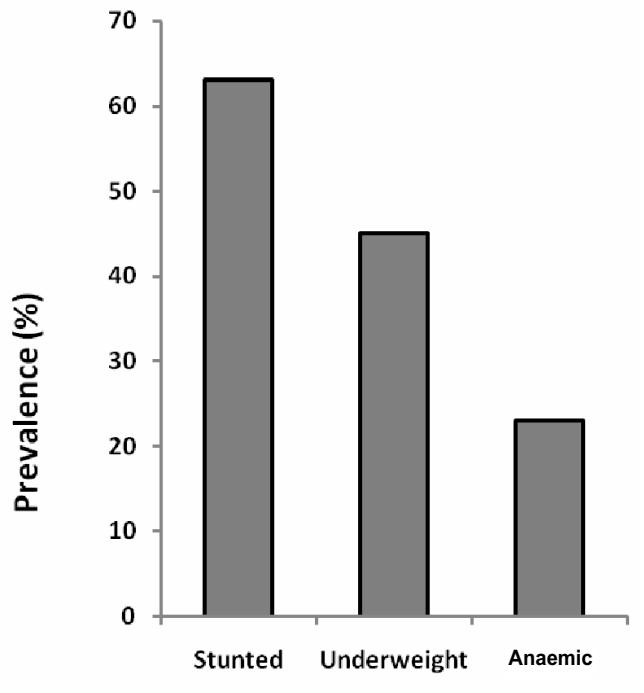

Figure: Prevalence of stunting, underweight and anaemia in urban adolescent college girls.

only 8% had Vitamin C deficiency (<0.29 mg/dl) according to definition used by Jelliffe and Jelliffe.[15]

Table-4 shows the significant correlation between various biochemical variables. Haemoglobin (Hb) concentrations were found to be positively correlated (r= 0.70, p<0.001) with serum iron, and TS (r = 0.70 p< 0.001); while negatively correlated with serum TIBC (r = -0.70, p<0.001). Plasma vitamin C was found to be positively correlated with haemoglobin (r = 0.62, p<0.001), serum iron (r = 0.89, p<0.001) and TS (r = 0.89, p<0.001) and was negatively correlated with TIBC (r = -0.71, p<0.001),

Sixty eight percent of the participants had no idea about anaemia. The remaining 32% of the participants said that when a person has iron deficiency it hampers the formation of haemoglobin and causes deficiency of haemoglobin in the blood which is known as anaemia. Among them about 35% of the participants said that they do not know about the causes of anaemia; while the remaining 65% replied in the affirmative. The participants who knew about the causes of anaemia gave multiple answers. All participants responded with iron deficiency and majority with inadequate intake of specific food items as the causes of anemia. Among the food items, majority of the participants mentioned about the inadequate intake of liver (88.1%), egg (76.1%), fish (73.8%), meat (47.6%), vegetables (92.8%), and fruits (76.2%).

About 72% participants said that anaemia can be

prevented and 21.5% had no idea about prevention; while 6.2% said that anaemia cannot be prevented. Among the participants who said that anaemia can be prevented, many gave multiple answers. Nearly 98.0% of the participants believed that taking iron tablet and iron containing foods; while 82.2% and 74.4%, respectively, said that taking vitamins and medicine were preventive measures. Among those who mentioned taking iron containing foods as preventive measures of anaemia, a large number talked about the intake of green leafy vegetables (93.6%), liver (91.4%), fruits (85.1%), fish (68.1%), meat (44.6%) and egg (74.4%).

When the participants were asked about the treatment of anaemia, nearly 80% said that it can be treated; while the remaining 20% had no idea. Among the participants who said that anaemia can be treated, many gave multiple answers. Most of the participants mentioned about taking iron tablet (88.4%), vitamins (73.1%), medicine (67.3%) and iron containing foods (88.4%) as a measure of treating anaemia. Among those who believed that taking iron containing foods was a treatment of anaemia, a large number mentioned about the intake of green leafy vegetables (84.6%), liver (82.6%), fruits (80.7%), egg (67.3%), fish (55.7%) and meat (42.3%).

Majority of the participants (73.8%) had no knowledge about iron rich foods. The remaining 26.2% of the participants, who said they knew, gave multiple answers. Among them about 76.4%, mentioned dark green leafy vegetables, liver and egg as rich sources of iron; while 58.8% said fish and fruits.

Discussion

Data collectively indicate that majority of the participants belonged to the families of low to moderate socio-economic status. The consumption frequencies of protein rich foods such as meat, fish and eggs, in most of the participants were good, although a large proportion (46.1%) did not drink milk. It was also observed that considerable proportions of the participants did not take leafy vegetables (27.7%). The intake of leafy vegetables was poor on the basis of the requirement of nutrients from them. Comparatively higher percentage of the participants (67.2%) ate fruits at least 7 times in a week, similar findings was reported previously on adolescent school girls.[5] Fruits consumed are good sources of energy, iron and vitamin C. The higher intake frequency of fruits may be due to the usual practice of eating seasonal fruits.

Food consumption data revealed that the daily energy intake by the adolescent college girls of the present study was almost similar to the energy intake in urban adolescent school girls of Bangladesh.[5] The energy intake was not sufficient; fulfilled only 76% of RDA, much lower than the energy intake of their counterparts in rural areas.[16] Protein intake of the participants was 68 g/day which was 154.5% of RDA, indicating adequate intake of protein. Meat and eggs, which are rich sources of protein, are the preferred food items in the urban society of Bangladesh.[17] Adolescent girls are no exception of it. Accordingly, high intake of protein by adolescent college girls of the present study was expected and quite rationale. Intake of carbohydrate by the participants was 250 g/day, representing about 67.8% of RDA. This was similar to that of the mean carbohydrate intake (231 g/day) in urban adolescent school girls of Bangladesh.[5] Although urban adolescent college girls were deficient in carbohydrate intake; it provided the highest percentage of energy (67%) of the total. Intake of fat by the participants was below the RDA. Cooking oil is thought to be the major contributor of fat intake. Ahmed et al.[5] previously reported that urban adolescent school girls of Bangladesh consumed iron only 10 mg/day. Adolescent girls of the present study consumed iron 28.8 mg/day, which was sufficient in terms of RDA. This revealed an improvement in iron intake in adolescent college girls. The improvement in iron intake might be related to the knowledge and awareness of their parents about the major iron rich foods and requirement of iron at that age and participant's preferential treatment by parents at college level due to their age of getting married. The intake of vitamin A and C by participants were well above the RDA. Fish, milk, green leafy vegetables and fruits are the rich sources of vitamin A (pro and preformed vitamin A). Frequent intakes of these food items in the diet contributed to the higher intake of vitamin A. The study period (summer) was the peak time for seasonal fruits such as mango, jackfruit, pineapple and various citrus fruits. Due to easy availability, consumption of these fruits is usually higher than any other season of the year.[18] This may also be the reason of high dietary intake of vitamin C than its RDA.

About 63% of the adolescent girls showed evidence of stunting on the basis of height-for-age <95% of the NCHS reference value. Higher prevalence of stunting in the girls suggests that they were suffering from chronic undernutrition which might result in slowing their maturation. On average, about 45% of the girls were also found underweight (weight-for-age <75% of the NCHS reference value), reflecting an inadequate linear growth and poor body proportion in the participants. Also using a cut-off point of <18.5 kg/m^2 for BMI, about 48% of the girls were found underweight. These results provide substantial evidence of an overall worse nutritional status in the urban adolescent college girls of Bangladesh.

In the present study, 23% of the girls were anaemic (Hb<12 g dl), which was similar to an estimate of 22% in an earlier study in urban adolescent school girls;[8] but lower than the peri-urban (27%) adolescent school girls[3] and adolescent female garment factory workers (44%).[5] Relatively high prevalence of anaemia in urban adolescent college girls

(students of the Department of Food and Nutrition) may be due to the lack of appropriate knowledge on anaemia and iron rich foods as well as inadequate intake of foods, rich in iron. Though the data of the present study was very different from the data of developed countries, our findings correspond with studies from SAARC countries.[19-23] The studies highlight a high prevalence of anaemia with multiple micronutrient deficiencies in adolescent girls. The high prevalence of anaemia and iron deficiency in the subcontinent can be related to a similar kind of diet consumed in these areas.

Among the participants about 17% had low serum iron (<40 µg/dl); and 23% had iron deficient erythropoiesis (serum TS<15%). The reason of iron deficiency in some participants may be due to relative unavailability of iron in the diet or due to endogenous control of the rate of uptake. The study has a limitation in identifying iron deficiency, as we did not estimate serum ferritin, which is considered as the most sensitive indicator of iron status. It may also be mentioned that now serum transferrin receptor is considered to be the more reliable indicator for the assessment of iron deficiency.[24] Thus, the present study merits further investigation. Most of the participants in the present study had TIBC value within the normal range. Increased TIBC level was found only in the participants with iron deficiency, indicating that they had low iron stores in the body and fewer of the iron spots on the transferrin molecules were filled by iron, thereby increasing TIBC. Vitamin C level was also found normal in the overwhelming proportion of the participants, which may be due to high dietary intake of vitamin C rich fruits available in Bangladesh during the study period.

We found an association between Hb levels and various iron indices and vitamin C. A significant positive association between haemoglobin and serum iron levels reveals that good iron status compromises iron metabolism and hence haemoglobin formation. Positive correlation of haemoglobin with TS and negative correlation with TIBC further indicating the availability and essentiality of iron in haemoglobin formation. The positive correlations between iron and TS and negative correlation with TIBC suggest that saturation of transferrin increases with increased iron availability, which consequently decreases TIBC. Significant correlation between plasma vitamin C and various iron indices indicate that vitamin C has significant importance in the absorption of iron and therefore in haemoglobin formation.

Majority of the participants (68%) had no idea about anaemia. About 35% of the participants were not aware about the causes of anaemia. Surprisingly, the perception regarding the prevention and treatment of anaemia was high among them. Conversely, a large proportion of the participants (73.8%) had no idea about the sources of iron rich foods.

Conclusion

The overall nutritional status in urban adolescent college girls of Bangladesh is not satisfactory. Prevalence of anaemia and knowledge regarding anaemia as well as iron rich foods is not adequate among college girls in this study. Thus, effective measures should be undertaken to improve their nutritional status and reduce the prevalence of anaemia.

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