RESEARCH PAPER — FOOD SCIENCE RESEARCH JOURNAL

e ISSN-2230-9403 ■ Visit us : *www.researchjournal.co.in*
Volume 9 | Issue 1 | April, 2018 | 64-70
DOI : 10.15740/HAS/FSRJ/9.1/64-70

Food intake, BMI and hemoglobin level of urban adolescent girls

Sanju Devi and Madhu Goyal

One hundred and fifty urban adolescent girls (14-18 years), studying in Government senior secondary schools of Bikaner district (Rajasthan) were studied for their food and nutrient intakes, hemoglobin level and anthropometric measurements. Except milk and its products as well as fats and oils, the per cent adequacy of all other food items was found to be ranging from 23.88 to 87.57 per cent. The per cent adequacy of nutrient intake ranged from 61.25-199.0 per cent. Per cent energy derived from carbohydrate, protein and fat by the subjects was noted to be 58.53±11.42 and 12.72±2.68 and and 29.80±9.67 per cent of total energy, respectively. The mean hemoglobin level of the subjects was estimated to be 8.62±1.14 g/dl. A significant positive correlation was noted between consumption of protein, iron and folic acid and their hemoglobin levels. But the correlation was non-significant for ascorbic acid and vitamin B_{12} intake. The mean BMI values, respectively, for 14-15 and 16-18 years of the subjects were found to be 20.37±5.65 and 21.56±5.39 kg/m^2.

Key Words : Adolescent girls, BMI, Food and nutrient intake, Adequacy, Hemoglobin level

How to cite this article : Devi, Sanju and Goyal, Madhu (2018). Food intake, BMI and hemoglobin level of urban adolescent girls. *Food Sci. Res. J.,* **9**(1): 64-70, **DOI : 10.15740/HAS/FSRJ/9.1/64-70**.

INTRODUCTION

Adolescent girls are backbone of healthy and progressive family and thus future builders of positive health of community. During this period, adolescents gain upto 50% of their adult weight, 20% or more than that of their adult height and 50% of their adult skeletal mass (Joshi *et al.,* 2014). It is a considered a vulnerable period in human life cycle when nutritional requirements increase due to adolescent growth spurt. It is characterized by rapid physical, biological and hormonal changes resulting in to psychosocial, behavioral and sexual maturation. Adolescence is marked as a period of growth spurt and maturation (Parimalavalli and Sangeeta, 2011).

Inadequate nutrition during adolescence can have serious consequences throughout reproductive years and beyond. Extra nutritional requirements include increased intake of calcium, iron, iodine, minerals and proteins between the ages of 10 to 19 years in an individual, especially iron requirement is increased amongst adolescent girls. Among adolescents, girls constitute a vulnerable group, particularly in developing countries where they are traditionally married at an early age and exposed to a greater risk of reproductive morbidity and mortality. Adolescence represents a real opportunity to make a difference in lifelong patterns.

Nutritional deficiencies have far reaching consequences, especially in adolescent girls. If their nutritional needs are not met, they are likely to give birth to undernourished children, thus transmitting under nutrition to future generations (Mulugeta *et al*., 2009).

On the other hand over nutrition is mainly the

MEMBERS OF RESEARCH FORUM

Author for correspondence :
Sanju Devi, Department of Food and Nutrition, College of Home Science, S.K. Rajasthan Agricultural University, Bikaner (Rajasthan) India (Email : nainsanjusingh@gmail.com)

Associate Authors' :
Madhu Goyal, Department of Food and Nutrition, College of Home Science, S.K. Rajasthan Agricultural University, Bikaner (Rajasthan) India

problem of adults and adolescents especially in the urban dwellers. It is a rapidly escalating public nutrition problem. Principally reflecting shift in dietary patterns and more sedentary lifestyles. The rates of overweight and obesity among children worldwide have been increasing dramatically in the last few years (Shivkumar *et al.*, 2006).

There is a relative scarcity of available literature on such information particularly from arid areas. Keeping this in view, present study has therefore been planned and designed to assess food and nutrient intake of urban adolescent girls of Bikaner district (Rajasthan).

METHODOLOGY

The study was conducted on 14-18 years old adolescent girls studying in two randomly selected Government senior secondary schools of Bikaner district (Rajasthan).

After seeking permission from the school authorities a list of students belonging to the age group of 14-18 years, was prepared. These students were studying in class 10^{th}-12^{th} standards. Out of the procured lists, 75 adolescent girls from each school, thereby making a total of 150 subjects were selected on the basis of probability proportionate to size sampling (PPS) technique. Willingness of the subjects to cooperate during the study as well as their regularity in attending the school was also taken care before selection of the subjects. The study was conducted during October, 2016 to February 2017.

For obtaining the requisite information, a well structured interview schedule was developed. It was pre-tested on non-sample adolescent population and required amendments were made for the actual data collection. The subjects were categorized in two age groups i.e. 14-15 and 16-18 years. All subjects in both the age groups were assessed for their general information, anthropometric measurements and dietary intake.

The subjects were studied in detail for their food and nutrient intakes, percentage of energy derived, height and weight, (Body Mass Index) BMI and hemoglobin level as follows:

Food and nutrient assessment:

A 24 hours dietary recall method for three consecutive days was adopted to find out the intake of various foods consumed by the subjects. Daily intake of each type of food by the subjects was derived; the mean food intakes were calculated and compared with the balanced diet as given by IDA (2011) for adolescent girl (14-18 years) to find out the food adequacy ratios as given below:

$$\text{Per cent food adequacy ratio} = \frac{\text{Mean food intake}}{\text{Suggested food intake}} \times 100$$

Using the food consumption tables (Gopalan *et al.*, 1989) their nutrient intakes were estimated. Their mean nutrient intakes were compared with RDA given by ICMR (2010) to find out nutrient adequacy ratio (NAR) as follows:

$$\text{Per cent nutrient adequacy ratio} = \frac{\text{Mean nutrient intake}}{\text{Recommended nutrient intake}} \times 100$$

The subjects were also evaluated in terms of percentage of energy derived by them from carbohydrate, protein and fat (Lagergren *et al*., 2013).

Height measurement:

The measurements were noted down for each subject to the nearest 0.1 cm. (Jelliffe, 1966). The mean values were compared with the reference values given by NCHS (ICMR, 2010).

Weight measurement:

The measurements were noted for each subject to the nearest of 0.5 kg **(**Jelliffe, 1966). The mean values were compared with the reference values given by NCHS (ICMR, 2010).

BMI estimation:

It was calculated and interpreted as per method given by WHO (2004).

Hemoglobin estimation:

It was estimated by using Sahli's hemoglobinometer method. Hemoglobin level of the subjects was classified as suggested by WHO (1999).

Statistical analysis of the data:

Statistical analysis was carried out using SPSS software to draw meaningful interoperations. Statistical parameters used were mean percentage, standard deviation and correlation co-efficient. Correlation co-efficient was calculated between hemoglobin level of the subjects with their protein, iron, ascorbic acid, folic acid, and vitamin B_{12} values.

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Dietary assessment :

Food intake:

Adequacy of cereals (85.18 and 87.57 %), pulses (45.36 and 51.01%), green leafy vegetables (27.62 and 23.88%), roots and tubers (55.05 and 59.17, %), other vegetables (77.97 and 81.43%), fruits (75.39 and 74.66%) and sugar (89.2 and 85.56 %) intake was found to be less than recommended balanced diet for 14-15 and 16-18 years age groups, respectively. Whereas, per cent adequacy of milk and its products (104.40 and 109.98 %) as well as fats and oils (134.52 and 137.68%) intake was noted to be more than RDI for both the age groups (Table 1). Similarly, Hemalatha *et al.* (2013) reported that compared with the ICMR recommendation, food allowances were in deficit except for fats and oils and sugar and Jaggery. Green leafy vegetables and Milk and milk product intake was very little among the adolescent girls (12-16 years) of Madurai district of Tamil Nadu reflecting on their health. Although, during present study subject's intake of sugar and Jaggery was low and milk and milk products were higher than the recommendations.

The subjects of 14-15 and 16-18 years age groups of present study were found to be consuming 1.6 and 1.9 liters of water per day which represents 69.56 and 82.60 per cent adequacy, respectively. Yadav *et al.* (2015) also found that adolescent subjects (17-19 years) under their study consumed less than 2 litres of water a day.

Nutrient intake :

The per cent adequacy of nutrient by the subjects in 14-15 and 16-18 years age groups was found to be 77.60-77.24 per cent for energy, 107.97-103.41 per cent for protein, 145.4-174.9 per cent for total fat, 165-197.8 per cent for visible fat, 125.8-151.9 per cent for invisible fat, 70.20-69.5 per cent for carbohydrates,111.63-122.35 per cent for calcium, 61.25-67.61 per cent for iron, 61.81-62.16 per cent for zinc, 78.54-69.6 per cent for β-carotene, 78.96-71.84 per cent for vitamin A, 145-180 per cent for thiamin, 108.57-117.5 per cent for riboflavin, 101.85-101.21 per cent for niacin, 130.3-91.71 per cent for folic acid, 100-100 per cent for vitamin B12 and 199.0-170.0 per cent for vitamin C as compared to RDA (2010) (Table 2).

The findings of Kabir *et al.* (2010) correspond well with present results with respect to energy, carbohydrate, iron, vitamin A and vitamin C intakes of adolescent girls (15-19 years).

Percentage of energy derived from its sources:

As per ICMR (2010) recommendation these nutrients should contribute 65, 15 and 20 per cent of total energy, respectively for a healthy living. Energy intake of the subjects was therefore assessed, in terms of percentage of energy derived from total carbohydrate, fat (invisible and visible) and protein consumed by them.

Table 1 : Mean intake of the subjects **(n=150)**

Food intake	Balanced diet* (g)	Number of subjects					
		14-15 years (n=33)		16-18 years (n=117)		Total	
		Mean ±SD intake	Per cent adequacy	Mean ± SD intake	Per cent adequacy	Mean ± SD intake	Per cent adequacy
Cereals grains and products (g)	300	255.55±56.06	85.18	262.73±55.60	87.57	261.15 ± 55.59	87.05
Pluses and legumes (g)	60	27.22±14.20	45.36	30.61±16.42	51.01	29.86 ± 15.98	49.76
Milk and milk products (ml)	500	522.02±134.81	104.40	549.91±124.17	109.98	543.77 ± 126.65	108.75
Green leafy vegetables (g)	100	27.62±20.09	27.62	23.88±20.11	23.88	24.71 ± 20.10	24.71
Roots and tubers (g)	100	55.05±22.04	55.05	59.17±33.49	59.17	58.26 ± 31.32	58.26
Other vegetables (g)	100	77.97±42.07	77.97	81.43±38.38	81.43	80.67 ± 39.10	80.67
Fruits (g)	100	75.39±52.23	75.39	74.66±53.06	74.66	74.17±52.71	74.17
Total fat	25	33.0±12.64	134.52	34.63±10.84	137.68	34.25 ± 11.22	137.0
Sugars and Jaggery (g)	30	26.76±7.80	89.2	25.67±7.13	85.56	25.91 ± 7.27	86.36
Nuts and oil seeds (g)	-	2.42±6.83	-	4.72±9.77	-	4.22 ± 9.24	-
Flesh foods (g)	-	10.10±25.32	-	3.56±15.44	-	5.00 ± 18.190	-
Water (L)**	2.3	1.6±0.41	69.56	1.9±45	82.60	1.7±0.46	73.91

*Indian Dietetic Association (2011): SD-Standard Deviation, ** Institute of medicine food and nutrition board.

Per cent energy derived from carbohydrate, protein and fat by 14-15 and 16-18 years age groups was noted to be 58.65±11.42 and 58.50±10.53, 12.39±2.68 and 12.27±4.56 and 28.94±9.67 and 29.23±12.26 per cent of total energy, respectively. The invisible fat contributed 12.52±4.97 and 12.69±5.71 per cent as compared to 16.42±6.22 and 16.54±5.41 per cent energy provided by visible fat in the diet of 14-15 and 16-18 years age groups, respectively.

Lagergren *et al*. (2013) also analyzed energy contribution from the proximate principles in the diets of adolescent girl. But they found higher energy contribution from carbohydrates (69.6) and lesser energy from protein (10.5) and fat (19.6) when compared with present results.

But alike present findings Kucukkomurler and Istik (2016) found that even though the total energy intake of adolescents (12-15 years) residing at Istanbul (Turkey), was not above the requirements of their age group, the energy intake from fats was mostly higher than the rates recommended.

Anthropometric measurements:

Height :

It is clear from the Table 4 that mean height (156.69±6.53 cm) of the subjects belonging to 14-18 years was found to be 96.15 to 97.53 per cent of the NCHS standards.

These findings are almost in line with the results reported by Kabir *et al*. (2002) who also found that height-for-age of the adolescent girls (15-19 years) was <95% of NCHS reference values. Venkaiah *et al*. (2002) also suggested that the adult women's average height is 152.6 cm in India. Similarly, Census of India (2001) also had reported a lower figure (154.6 cm) for average height of adult girl's in Rajasthan.

Weight:

It can be perceived from the Table 4 that mean body weight of the subjects of different age groups was found to be 98.63-100.75 per cent of NCHS reference values (48.0-54.4 kg.) which seems to be falling almost in normal range. However, this has to be viewed in terms of their BMI.

Body mass index (BMI) :

It can be observed from the data displayed in Table 5 that the mean BMI of the subjects belonging to 14-15 and 16-18 years age group category was found to be 20.37 and 21.56 kg/m^2, respectively.

In 14-15 years age group category (n=33), only 9.1 per cent of the subjects had their mean BMI in normal category whereas 18.2-24.2 per cent of them fell in

Table 2 : Mean nutrient intake of the subjects

Nutrients	Number of subjects 14-15 years (n=33)			Number of subjects 16-18 years (n=117)		
	RDA	Mean±SD intake	Per cent adequacy	RDA	Mean±SD intake	Per cent adequacy
Energy (kcal)	2330	1808.16 ± 386.12	77.60	2440	1884.67 ± 414.77	77.24
Protein (g)	51.9	56.04 ± 12.33	107.97	55.9	57.81 ± 12.53	103.41
Visible fat	20	33.0 ± 12.50	165	17.5	34.63 ± 10.93	197.8
Invisible fat	20	25.16± 10.86	125.8	17.5	26.59 ± 12.70	151.9
Total fat (g)	40	58.16 ± 19.45	145.4	35	61.23 ± 21.41	174.9
Carbohydrate (g)	378.62	265.14 ± 51.64	70.02	396.5	275.59 ± 49.61	69.5
Calcium (mg)	800	893.09 ± 231.65	111.63	800	978.86 ± 323.008	122.35
Iron (mg)	27	16.54 ± 4.12	61.25	26	17.58 ± 4.44	67.61
Zinc (mg)	11	6.80 ± 1.56	61.81	12	7.46 ± 2.90	62.16
β-carotene (µg)	4800	3770.33 ± 1824.20	78.54	4800	3345.43 ± 1490.55	69.6
Retinol (µg)	600	473.76 ± 228.15	78.96	600	431.05 ± 188.61	71.84
Thiamine (mg)	1.2	1.74 ± 0.48	145	1.0	1.80 ± 0.88	180
Riboflavin (mg)	1.4	1.52 ± 0.55	108.57	1.2	1.41 ± 0.53	117.5
Niacin (mg)	14	14.26 ± 3.82	101.85	14	14.17 ± 3.64	101.21
Folic acid (mg)	150	195.45 ± 69.05	130.3	200	183.42 ± 46.19	91.71
Vitamin B_{12} (µg)	0.2-1	0.70±0.59	100.0	0.2-1	0.66±0.93	100.0
Vitamin C (mg)	40	79.88±45.49.11	199.0	40	68.02±39.47	170.0

*ICMR, 2010

different forms of thinness, similarly 24.2 of them were pre-obese and 3.0 per cent each of them were obese grade I and obese grade II.

In case of 16-18 years old subjects, maximum of them (26.49 %) were either had normal BMI or were suffering from pre-obesity followed by mild to severe thinness (9.40-15.38 %), obesity grade I (6.83 %) and grade II obesity (1.85 %).

The Table 5 clearly indicates that maximum percentage of all the subjects were undernourished (44.0%) followed by pre-obesity and obesity (33.34) and normal state (22.66 %). Thakkar *et al.* (2010) reported lower (23 %) prevalence of obesity among the urban college going girls (n=400) of Agra in age group of 18-24 years. However, present finding about prevalence of obesity is in close conformity with the results reported by Reddy *et al.* (2012) who found that 34.0 per cent of women were overweight or obese in Kerala.

Hemoglobin assessment:

The Table 6 reveals that maximum number of the subjects (21.3-20.25 %) in both the age groups were found to be moderately anemic (7-9.9g/dl), followed by mild anemia (3.3 %) and severe anemia (0.8-1.6 %).

The subjects belonging to different categories of anemia like Severe, moderate and mild anemia had their mean Hb levels as 6.7±0.17, 8.37±.0.74 and 10.75±.58 g/dl, respectively. The mean Hb level of all the subjects (n=75) was noted to be 8.62 ±1.14 g/dl, which is in close conformity with the value reported (8.87 g/dl) by Dekha

Table 3 : Percentage of energy derived from carbohydrate, fat and protein by the subjects **(n=150)**

Source of energy	Percentage of energy derived by the subjects			Recommended values#
	14-15 years	16-18 years	14-18 years	
Carbohydrates (g)	58.65	58.50	58.53	65
Protein (g)	12.39	12.27	12.72	15
Total Fat (g)	28.94	29.23	29.80	20
Invisible (g)	12.52	12.69	12.61	10
Visible fat (g)	16.42	16.54	16.71	10

#=Recommended by ICMR (2010)

Table 4 : Distribution of the subjects according to their of height and weight **(n=150)**

Age groups (years)	No. of subjects	Height* (cm)	Mean ± SD (cm)	Per cent adequacy	Weight* (kg)	Mean ± SD (kg)	Per cent adequacy
14	17	159.0	154.17±5.08	96.96	48.0	48.23±15.15	100.47
15	16	161.0	157.03±5.53	97.53	51.4	51.12±14.40	99.45
16	57	162.0	156.57±6.82	96.64	53.0	53.40±15.14	100.75
17	42	163.0	157.33±6.50	96.52	54.0	53.85±14.20	99.72
18	18	164.0	157.70±7.64	96.15	54.4	53.66±13.54	98.63
Overall mean			156.69±6.53			52.73±14.54	

*NCHS standards

Table 5 : Distribution of the subjects according to their BMI (kg/m^2)

BMI classification grades	Cut-off points (kg/m^2)*	14-15 year		16-18 year		Total (14-18 years)	
		BMI (mean±SD)	No. of Ss. (n=33)	BMI (mean±SD)	No. of Ss. (n=117)	BMI (mean±SD)	No. of Ss. (n=150)
Severe thinness	<16.00	15.01±0.46	6(18.2)	15.21±0.63	17(14.52)	15.16±0.58	23(15.3)
Moderate thinness	16.00-16.99	16.56±0.32	6(18.2)	16.65±0.24	11(9.40)	16.62±0.26	17(11.3)
Mild thinness	17.00-18.49	17.70±0.53	8(24.2)	17.73±0.42	18(15.38)	17.72±0.44	26(17.3)
Normal range	18.50-24.99	20.93±3.06	3(9.1)	20.42±1.45	31(26.49)	20.46±1.56	34(22.66)
Pre-obese	25.00-29.99	26.18±1.33	8(24.2)	26.65±1.89	31(26.49)	26.72±1.51	39(26.0)
Obese grade l	30.00-34.99	32.7	1(3.0)	31.28±1.44	8(6.83)	31.45±1.42	9(6.0)
Obese grade ll	35.00-39.99	36.1	1(3.0)	35.7±2.54	1(1.85)	35.83±1.81	2(1.33)
Overall mean		20.37±5.65		21.56±5.39		21.30±5.45	

Note: Values in parenthesis indicate percentage of the subjects. Ss=subjects
*Classification devised by WHO (2004)

Table 6 : Distribution of the subjects according to their hemoglobin level

Hemoglobin levels* g/(dl)	Interpretations	14-15 yrs		16-18 yrs		Total	
		Mean±SD	No. of Ss. (n=16)	Mean±SD	No. of Ss. (n=59)	Mean±SD	No. of Ss. (n=75)
<7	Severe anemia	6.8	1 (1.6)	6.65 ±0.21	2 (.8)	6.7 ±0.17	3 (4.0)
7-9.9	Moderate anemia	8.34±0.62	13 (21.3)	8.38 ±0.77	49 (20.25)	8.37 ±.0.74	62 (82.7)
10-11.9	Mild anemia	10.75±1.06	2 (3.3)	10.75 ±0.53	8 (3.3)	10.75±.58	10 (13.3)
>12.0	Normal	Nil	Nil	Nil	Nil	Nil	Nil
Overall mean		8.55±1.12		8.64±1.15		8.62±1.14	

Note: Values in parenthesis indicate percentage of the subjects. Ss=subjects
*Classification devised by WHO (1999)

Table 7 : Correlation co-efficient of hemoglobin level with protein, iron, ascorbic acid, folic acid and vitamin B_{12}

Relationship of the nutrient intake with hemoglobin	r-value
Protein and hemoglobin	0.644**
Iron and hemoglobin	0.639**
Folic acid and hemoglobin	0.355**
Ascorbic acid and hemoglobin	0.056
Vitamin B_{12} and hemoglobin	-0.066

Note: **Significant positive relationship

(2015) while studying hemoglobin level of urban slum adolescent girls (10-19 years) of Guwahati city, Assam. Although, the scientist had found prevalence of mild anemia to be 28.46 per cent, moderate anemia to be 57.31 per cent and severe anemia 14.23 per cent, respectively being higher than the present findings may be due to difference in the locale of the subjects.

It is important to note that none of the subjects of present study in both the age groups fell in the normal category (>12.0 g/dl) of the hemoglobin. Rajni (2011) also observed that majority (90.5%) of 13-15 years old adolescent girls under their study showed clear cut presence of anemia with hemoglobin less than 10 g/dl.

Correlation co-efficient between nutrients intake and hemoglobin level:

A significant positive correlation was noted between mean daily intake of protein, iron and folic acid content of the diets consumed by the subjects (n=75) and their mean hemoglobin levels. But the correlation was non significant for ascorbic acid and vitamin B_{12} intake may be due to their higher per cent adequacies in the diets. However, the results clearly indicate the important role of nutrients in hemoglobin formation in the body.

Conclusion:

Although the mean BMI, of the subjects was as per reference values but majority of them were suffering from anemia and perceivable number of them were either undernourished or overweight/obese. At the same time food and nutrient inadequacies were also noted to be correlated well with their hemoglobin levels. Thus, present study indicated a great scope for intervention programme for batter nutritional status of adolescent girls.

LITERATURE CITED

Deka, C. (2015). A study on Reproductive Health and Health seeking Behavior of Adolescent Girls residing in urban slums. *The New Indian J. OBGYN*, **2** (1) : 51-55.

ICMR (2010). Nutrient requirement and recommended allowance for Indians. Indian Council of Medical Research, New Delhi.

Indian Dietetic Association (IDA) (2011).

Gopalan, C., Ramsastri, B.V. and Balasubramanian, S.C. (1989). Nutritive value of Indian Foods, NIN, ICMR, Hyderabad pp. 47-52.

Hemalatha, R., Ramalaxmi, Baru Anantha, Swetha, Eluru, Balakrishna, N. and Mastromarino, Paola (2013). Evaluation of vaginal pH for detection of bacterial vaginosis. *Indian J. Med. Res.*, **138**(3): 354–359.

Jelliffe (1966). Assessment of nutritional status of community monographs. WHO Geneva; 53.

Joshi, S.M., Likhar, S., Agrwal, S.S., Mishra, M.K. and Shukla, U. (2014). A study of nutritional status of adolescent girls in rural area of Bhopal dirstrict. *National J.*

Community Medicine V., **5**(2).

Kabir, S., Raju, P.S., Prasad, K.V. and Ramana, Y., (2002). Study on Tests and Predication Equations in Indian male children. *Indian Pediatrics,* **40**:705-711.

Kabir, M., Marlucia, O., Assiss, A., Baqueiro, C.M. and Morris (2010). A cross sectional study on sixty- five adolescentgirls aged 15-18 years. *Abs. Nutri. Soci. India,* 157-163.

Kucukkomurler, S. and Istik (2016). Energy intake, energy disprision and body mass index interaction in adolescents. *J. Human Sci.,* **13**(2) : 2793-2803.

Lagergren, K., Anna Lindam and Jesper Lagergren (2013). Dietary proportions of carbohydrates, Fat and protein and Risk of Oesophageal Cancer by Histological Type 10. 1371/*journal. Pone.* 0054913.

Mulugeta, A., Hagos, F., Stoecker, B., Kruseman, G., Linderhof, V. and Abraha, Z. (2009). Nutritional status of adolescents girls from rural communities of tigray, northern ethiopa, *Ethiop J. Health Development*, **23** : 5-11.

Parimalavalli, R. and Sangeetha, M. (2011). Antrropometric measurements and nutrient intake of adolescent girls, *Anthropologost,* **13** (2): 111-115.

Rajni, Dhingra (2011). A study on "assessment of health status of adolescent Gujar tribal girls of Jammu district. M.Sc. Thesis, Department of Home Science, University of Jammu, Jammu and Kashmir, India. 2011; 133-138

Reddy, K.S., prabhakaran, D., Shah, P. and Shah, B. (2012). Difference in body mass index and waist: Hip ratio in North Indian rural and urban populations. *Obes. Rev.,* **3** : 197-202.

Sivakumar, B., Vijayaraghavan, K., vizar, S., Balakrishan, N., Shatrugana. V. and Sarma, K.V. (2006). Effect of micronutrients supplementation on health and nutritional status of school children growth and morbidity, *Nutrition*, **21**: S 1-7.

Thakkar, H.K., Mishra, S.K. and Gupta, S.C. (2010). Obesity and weight control measures: findings from female college students of Agra. *Indian J. Prev. Soc. Med.,* **43**:4.

Venkhaiah, K., Damayanti, Nayak, M.U. and Vijayaraghavan, K. (2002). Diet and nutritional status of rural adolescents in India. *European J. Clinical Nutri.,* **56**(11): 1119-25. http://www.censusindia.in.

WHO Expert, consultation (2004). Appropriate body-mass index for Asian populations and its implications for policy and interventions intervention strategies. *Lancet,* **363** (9403): 157-63.

WHO (1999). Programming for adolescent health and adolescent technical report scries.i-iv: 1-260 pubmed.

Yadav, H., Naidu, S., Baliga, S. S. and Mallapur M. D. (2015). Dietary pattern of college going adolescents (17-19) in urban area of Belagav. department of community medicine, Jawaharlal Nehru medical college, Nehru nagger, Belagavi Karnataka India. *Internat. J. Recent Scientific Res.,* **6**: 3774-377.

Received : *28.09.2017;* **Revised:** *03.02.2018;* **Accepted :** *21.02.2018*