Applied Biological Research 19 (3): 299-306; (2017)
DOI: 10.5958/0974-4517.2017.00043.X

ANTHROPOMETRIC PROFILE OF RURAL PUNJABI WOMEN AS INFLUENCED BY THEIR DIETARY AND NUTRIENT INTAKE

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(Received 16 May, 2017; accepted 3 October, 2017)

ABSTRACT

A cross sectional study was conducted on 154 moderately active adult women belonging to low - (LIG), medium- (MIG) and high-income groups (HIG) from two villages namely Bharonwal Kalan and Bhatha Dhua of Ludhiana district Punjab (India) in the year 2016. The data on dietary intake and anthropometric profile were recorded among the three income groups. The intake of all the foods was inadequate, except for milk and milk products, among the women of all income groups. The percent adequacy of protein among LIG, MIG and HIG income groups was 89.2, 117.1 and 135.6, respectively, as compared to RDA (recommended dietary allowances) while fat intake was much higher i.e. 105, 168 and 205%, respectively. Carbohydrate contributed 67, 62 and 60% to the total energy intake in LIG, MIG and HIG, respectively. The mean body mass index in LIG, MIG and HIG women was 21.4, 23.1 and 24.0 kg m^{-2}, respectively. A positively significant correlation was observed between intake of cereals and pulses and weight of the subjects.

Key words: Anthropometry, body mass index, correlation, dietary intake, obesity, women

INTRODUCTION

India has diverse agro-climatic regions, ethnic multiplicity, socio-cultural practices, life styles and eating habits which vary from state to state and even district to district (Garg and Varmani, 2014). In India, neither all the under-nourished belong to nutritionally-deprived households nor all the members of nutritionally-deprived households have poor nutritional status. Although India is experiencing a rapid economic growth, yet there is a sustained decline in per capita calorie and protein consumption during past 25 years with fats; the only major nutrient group showing unambiguous increase in per capita consumption (Prabhat and Begum, 2014).

Obesity is prevalent worldwide in all age groups and is on rise in adults, especially women in both developed and developing countries including India which is currently experiencing a rapid epidemiological transition. Comparison of two major studies conducted by National Family Health Survey (NFHS-2) in 1998-1999 and NFHS-3 in 2005-2006 showed that the prevalence of obesity among Indian women has risen from 10.6 to 12.6%. The prevalence is more in women of age group 40-49 years (23.7%). Highest percentage of obese women (29.9%) is in Punjab, followed by Kerala (28%) and Delhi (26%), all of which are relatively richer states (Garg *et al.*, 2010). The overall prevalence of overweight and obesity in selected 450 women from sub-mountainous region of Punjab reportedly is 56.6, 67.3 and 70.7% in low, middle and high-income groups, respectively (Aggarwal, 2016). Another study conducted on 77 household adult women in Tamil Nadu (India) revealed that

selected 65% adult women were at risk of obesity and had different grades of obesity I, II because of age and socio-economic status (Parimalavalli *et al.*, 2009).

Surveys conducted on diets consumption have revealed that majority of population depends on cereal based diet, being the cheapest source of calories, and contribute 70-80% total calories in diet (Kaur, 2005). Poor nutrition can lead to impaired physical and mental development, reduced productivity and lead to poor immunity. Poor nutritional outcomes of infants and children are due to the prevalence of high rates of poverty, poor health status of women, and lack of hygiene and proper health facilities. While the problem of under-nutrition exists in many parts of India, the additional burden of obesity due to increasing sedentary life-style in some urban and economically sound areas is alarming. The present study was aimed to study the anthropometric profile of rural Punjabi women belonging to the different income groups and compare the food and nutrient intake of selected subjects in the three income groups as well as to find correlation between food/nutrient intake and anthropometric profile of the subjects.

MATERIALS AND METHODS

Selection of subjects

Two villages namely Bharonwal Kalan and Bhatha Dhua of Central plain zone of Punjab in district Ludhiana (India) were selected for the present study. Bharowal Kalan village is located in Jagraon tehsil of Ludhiana district in Punjab. It is situated 13 km away from sub-district headquarter Jagraon and 25 km away from district headquarter Ludhiana with a population of 1706. Bhatha Dhua village is also located in Jagraon tehsil of Ludhiana district in Punjab, India. It is situated 17 km away from sub-district headquarter Jagraon and 21 km away from district headquarter Ludhiana, having a population of 1469. Before collecting actual data, 20 women were pre-surveyed which were not considered for later study. Based on various socioeconomic factors of families, 154 women were selected randomly and screening of subjects was done in 3 categories with mean socioeconomic scores of ≤30 (low), 31-50 (middle) and >50 (high). The social scores comprised of caste, family structure, family education and organizational membership, whereas economic scores included farm and household assets, ownership of media, transport, electricity, household items and distinctive features.

Food intake

Detailed information on food intake was obtained for three consecutive days using 24 h recall method (Willett, 1998) during the months of June-August, 2016. Quantities of food consumed by the subjects were obtained using standardized containers. From the collected data on food intake, nutrient intake was calculated using Dietcal software (Kaur, 2014). In order to determine the nutrient adequacy of diet, the nutrient adequacy ratios (NAR) were calculated for each of 5 micro-nutrients (β-carotene, folate, ascorbic acid, iron and calcium) and energy and protein. NAR was calculated as the intake of a nutrient divided by the recommended dietary allowance (RDA) for that nutrient (ICMR, 2010b).

$$\text{NAR (\%)} = (\text{Intake of nutrient/Recommended intake of nutrient}) \times 100$$

NAR were categorized as per Jood *et al.* (1999) as adequate (100% and above); marginally adequate (75 to 99.9%); marginally inadequate (50 to 74.9%) and inadequate (below 50%).

Anthropometric measurements and statistical analysis

Height and weight of subject were recorded using standardized methods (Jellife, 1966). Based on the measurements, body mass index (BMI) was calculated (WHO, 2005). The data was analyzed by using appropriate statistical tools like mean, standard error and percentage. To test the significance, analysis of variance was applied. Also, the relevant correlation coefficient (r) was computed.

RESULTS AND DISCUSSION

Food intake

The main cereals consumed by the subject were wheat and maize in the form of *chapattis*. The mean intake of cereals in 3 income groups was 252.2, 249.3 and 264.0 g day^{-1} with percent adequacy of 76.4, 75.5 and 80.0 in low (LIG), middle (MIG) and high (HIG) income groups, respectively (Fig. 1). The mean intake of pulses and legumes in 3 income groups ranged from 34.3 to 38.0 g day^{-1} with percent adequacy of 46.0, 51.0 and 51.0, respectively. Non-significant ($p<0.05$) difference was observed with respect to daily cereal and pulse consumption in 3 income groups. However, the intake of cereals and pulses in all income groups was lower than the suggested dietary intake of 330 and 75 g, respectively (ICMR, 2010a). Similar findings on diet and nutritional status of women have been reported by Rao *et al*. (2010). Diet and nutrition are important factors in the promotion and maintenance of good health throughout the life cycle. Income, prices, individual preferences and beliefs, cultural traditions, as well as geographical, environmental, social and economic factors interact in a complex manner to shape dietary consumption patterns and affect the morbidity and clinical status of women (Mittal, 2013).

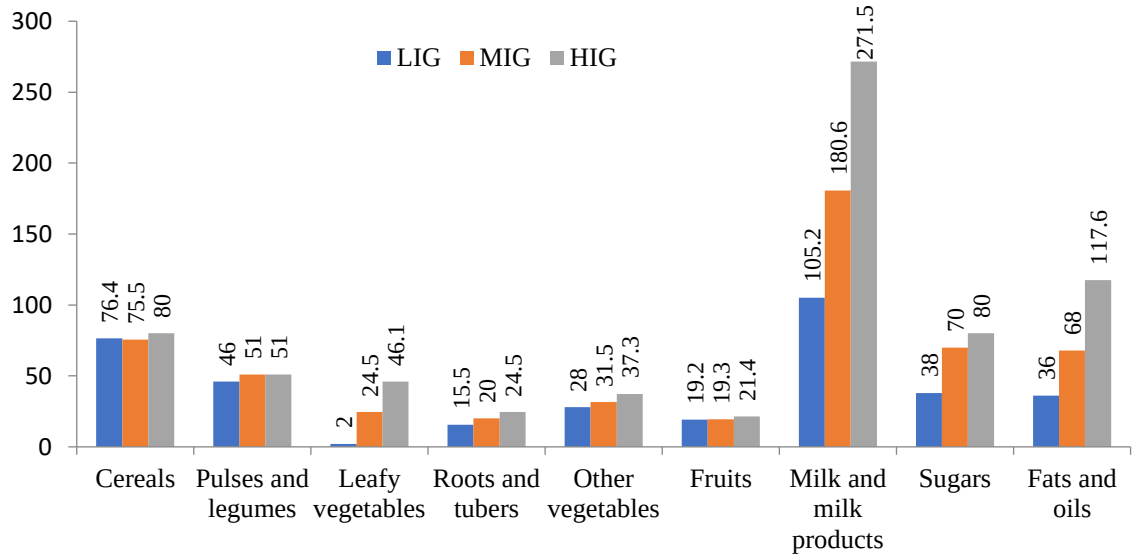

Fig. 1: Percent adequacy of food intake of rural Punjabi women

The difference in mean daily consumption of green leafy vegetables and roots and tubers among the women of 3 income groups was significant with mean values of 2.0, 24.5 and 46.1 g and 31.0, 39.5 and 49.1 g, respectively, revealing inadequate intake. However, intake of these vegetables increased with increase in income in all the 3 income groups. The mean daily intake of other vegetables was 56.0, 63.0 and 74.6 g in LIG, MIG and HIG, respectively, indicating insignificant difference with a per cent adequacy of 28.0, 31.5 and 37.3 (Fig. 1). The mean daily intake of fruits among LIG, MIG and HIG adult females was 19.2, 19.3 and 21.4 g, respectively, which was significantly lower when compared to suggested dietary intake (ICMR 2010a).

The mean daily consumption of milk and milk products in 3 income groups was 315.5, 542.0 and 814.5 g day^{-1}, with percent adequacy of 105.2, 180.6 and 271.5, respectively (Table 1). The consumption of milk products increased significantly with increase in income. Average milk consumption in 3 income groups was significantly higher than the dietary intake as per the suggestions of ICMR (2010a). Singh *et al*. (2014) reported the overall adequacy of cereals, pulses, green leafy vegetables, roots and tubers, fruits, other vegetables, milk and milk products, sugars and fats & oils in the diets of Punjabi farm women to be 98, 54, 5, 63, 49, 16, 122, 141 and 216%, respectively. Present study revealed highest sugar consumption in HIG (24.0 g), followed by MIG

Table 1: Average daily food intake (g) of women in three income groups in Punjab (mean ± SE)

Food groups	LIG (n = 45)	MIG (n = 49)	HIG (n = 60)	Suggested dietary intake*
Cereals	252.2^{c} ±14.0	249.3^{c} ±9.6	264.0^{c} ±7.0	330
Pulses and legumes	34.3^{c} ±2.6	38.0^{c} ±3.0	38.0^{c} ±3.0	75
Leafy vegetables	2.0^{c} ±0.9	24.5^{b} ±6.5	46.0^{a} ±9.0	100
Roots and tubers	31.0^{c} ±2.1	39.5^{b} ±2.2	49.1^{a} ±3.4	200
Other vegetables	56.0^{c} ±5.1	63.0^{c} ±10.0	74.6^{c} ±9.0	200
Fruits	19.2^{c} ±2.5	19.3^{c} ±2.0	21.4^{c} ±7.0	100
Milk & milk products	315.5^{c} ±26.6	542.0^{b} ±30.3	814.5^{a} ±34.1	300
Sugars	11.4^{c} ±0.6	21.0^{b} ±1.4	24.0^{b} ±1.3	30
Fats and oils	9.0^{c} ±0.6	17.0^{c} ±1.2	29.4^{b} ±6.2	25

LIG - Low income group, MIG - Middle income group and HIG - High income group
Means with different notation (a, b and c) indicates significant difference at 5% level; *ICMR (2010a)

(21.0 g) and LIG (11.4 g) with per cent adequacy of 80, 70 and 38, respectively. A significant difference was observed in sugar intake by LIG women as compared to MIG and HIG. The mean consumption of fats and oils in women of HIG was significantly higher (29.4 g) than those of LIG (9.0 g) and MIG (17.0 g). Another study conducted by Mittal (2013) documented that the overall quality of food and nutrient intake among the rural women of Gurgaon, Haryana was poor as the intake of all the food groups (except fats, sugars and milk and milk products) was found to be much lower than their recommended dietary allowances (RDA).

Nutrient intake

Nutrient intake of subjects revealed that energy intake was lower as compared to RDA (ICMR, 2010b) in women of all the three income groups (Table 2). Nutrient adequacy ratio (NAR) showed that energy intake was marginally inadequate in women of LIG and MIG, but marginally adequate in women of HIG (Fig. 2); which depicted that energy intake is affected by socioeconomic status of individuals. The protein intake varied from 49.1 to 74.6 g day^{-1} and the adequacy of protein intake was between 89.2 to 135.6% of RDA. Bains *et al.* (2012) reported daily energy intake of 1681 kcal by farm women. The mean consumption of energy was marginally adequate in present study and is comparable with the intakes reported in literature. Protein intake was marginally adequate in women of LIG and adequate in subjects of MIG and HIG in contrast to the findings reported by Kaur *et al*. (2012b) which revealed that the percent adequacy of protein by different age groups i.e. 21-30, 31-40, 41-50 and 51-60 years was found to be 69.6, 7 8.2, 80.0 and 66.3, respectively. Adequate protein intake in studied subjects might be due to the high consumption of pulses and milk and milk products.

Table 2: Average daily nutrient intake of women in the three income groups in Punjab (mean ± SE)

Nutrients	LIG (n = 45)	MIG (n = 49)	HIG (n = 60)	RDA*
Energy (kcal)	1310.0^{c} ±57.0	1663.0^{b} ±49.0	1900.0^{a} ±60.4	2230
Protein (g)	49.1^{c} ±2.0	64.4^{b} ±1.5	74.6^{a} ±1.6	55
Fats (g)	26.2^{c} ±1.3	42.0^{b} ±2.0	51.3^{a} ±5.1	25
Carbohydrates (g)	219.4^{c} ±10.3	258.0^{bc} ±7.7	285.0^{b} ±7.4	360
B-carotene (µg)	178.0^{c} ±54.2	952.0^{b} ±175.3	867.2^{b} ±163.5	4800
Thiamine (mg)	1.5^{c} ±0.1	1.5^{c} ±0.05	1.6^{c} ±0.04	1.1
Riboflavin (mg)	0.7^{c} ±0.03	1.0^{b} ±0.02	1.0^{b} ±0.02	1.3
Niacin (mg)	12.0^{c} ±0.7	12.2^{c} ±0.5	12.5^{c} ±0.4	14
Folic acid (µg)	132.0^{c} ±6.5	173.1^{b} ±6.6	195.1^{a} ±7.6	200
Vitamin B_{12} (µg)	0.3^{c} ±0.02	0.5^{b} ±0.02	0.6^{a} ±0.02	1.0
Vitamin C (mg)	38.5^{c} ±6.0	31.4^{c} ±3.1	46.3^{c} ±5.5	40
Iron (mg)	15.0^{c} ±0.7	17.0^{b} ±0.6	19.6^{a} ±0.6	21
Calcium (mg)	593.1^{c} ±32.4	1003.5^{b} ±45.1	1149.5^{a} ±32.1	600

LIG - Low income group, MIG - Middle income group; and HIG - High income group
Means with different notation (a, b and c) indicates significant difference at 5% level. *ICMR (2010 b)

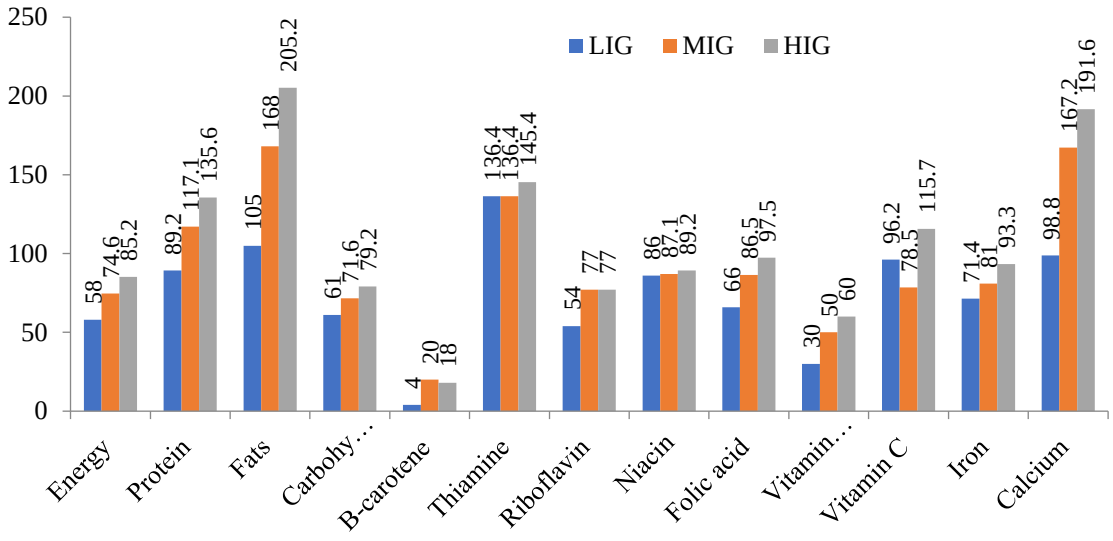

Fig. 2: Nutrient adequacy ratio (NAR) of the rural Punjabi women

Prabhat and Begum (2014) reported that mean energy, protein and fat intake of females were 1745.0 kcal, 51.2 g and 56.9 g, respectively.

Fat intake of 26.2, 42.0 and 51.3 g was reported in the women of LIG, MIG and HIG, respectively, which was higher than RDA of 25 g day^{-1} (ICMR, 2010b). Kaur *et al*. (2012b) had also reported that diets of working women were higher in fat and lower in energy, which was similar to the findings of present study. Intake of β-carotene was inadequate among women of all three income groups, which might be due to a very low intake of vegetables and fruits. Adequacy of thiamine intake was adequate among all the subjects. However, intake of riboflavin was marginally inadequate among LIG women and marginally adequate among the women of MIG and HIG. Niacin intake was in the range of 12.0-12.5 mg day^{-1} which was marginally adequate in MIG and HIG women whereas, it was marginally inadequate in women of LIG.

Adequate intakes of fat, thiamine and calcium in the present study may be due to the high consumption of milk and milk products in the Punjabi diets especially in HIG. Vitamin B_{12} intake was marginally inadequate in women of MIG and HIG; however, it was inadequate in LIG women. The percent adequacy of vitamin C was in the range of 78.5 - 115.7 mg, indicating an adequate intake among subjects of HIG and marginally adequate among women of LIG and MIG. Intake of iron was 15.0, 17.0 and 19.6 mg day^{-1} which were low as compared to RDA of 21 mg day^{-1} (ICMR, 2010b). However, the nutrient adequacy ratio (NAR) was marginally inadequate in LIG women and marginally adequate in women of MIG and HIG. The percent adequacy of calcium was marginally adequate in LIG women and adequate in MIG and HIG women.

Carbohydrate contributed 67.0, 62.0 and 60.0% of total energy intake in the women of LIG, MIG and HIG, respectively (Fig. 3), which was within the recommended range of 60 - 70%. As the income increased, the contribution of carbohydrates to total energy intake. However, no difference was observed in per cent contribution of protein to total energy intake. An increase in income resulted in the increase in contribution of energy from fat.

Anthropometric measurements

Anthropometric measurements revealed that the mean height of women from LIG, MIG and HIG was 161.0, 161.6 and 162.6 cm, respectively (Table 3), clearly indicating a non-significant difference, same as also reported by Kaur *et al*. (2012a). The mean weight of subjects in LIG, MIG and HIG was higher than the reference weight of (55 kg) in Indian women. The weight of subjects in three income groups ranged from 34.0 - 81.0, 41.0 - 95.0 and 40.0 - 85.0 kg with mean values of 55.4, 60.5 and 63.6 kg, respectively. The mean BMI of subjects in LIG, MIG and HIG was 21.4, 23.1 and 24.0 kg m^{-2}, respectively, which is similar to the study conducted in Amritsar depicting mean BMI of young

Table 3: Anthropometric measurements of the subjects (mean ± SD)

Parameters	LIG (n = 45)	MIG (n = 49)	HIG (n = 60)	Reference
Height (cm)	161.0[a] ±5.0	161.6 [a] ±6.1	162.6[a] ±5.6	161.0[#]
Weight (kg)	55.4[a] ±11.3	60.5[b] ±11.8	63.6[b] ±10.7	55[^]
BMI (kg m^{-2})	21.4[a] ±4.3	23.1[b] ±4.2	24.0[b] ±3.5	18.5-24.99*

LIG-Low income group, MIG- Middle income group and HIG- High income group
Means with different notation (a, b and c) indicates significant difference at 5% level
[#]ICMR (2010 b) ^ ICMR (2010 a) * WHO (2005)

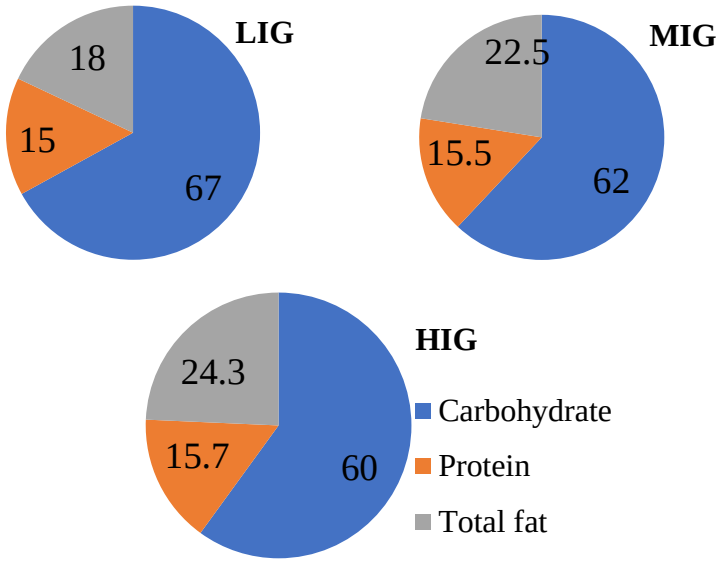

Fig. 3: Contribution of carbohydrates, protein and fats (%) to the total energy intake

adult females as 21.35 ± 3.40 kg m^{-2} (Sudhera and Sidhu, 2012). It may be concluded that there is a gradual increase in weight and BMI with increase in income. A significant difference was observed in weight and BMI of LIG women as compared to those from MIG and HIG. Similar to present study, Hira *et al.* (2004) reported that BMI of women from endemic and non-endemic areas of Punjab were 21.05 and 24.23 kg m^{-2}. Sharan and Puttaraj (2006) reported that the body weight were higher in the Punjabi women as compared to their counterparts from other states of the country. According to BMI classification, majority of subjects i.e. 51.1, 61.2 and 60.0% were normal (18.5 - 24.99 kg m^{-2}), followed by 15.5, 20.5 and 26.6% in pre-obese (25.00 - 29.99 kg m^{-2}) and 26.7, 12.2 and 6.7% in underweight category (<18.5 kg m^{-2}) in LIG, MIG and HIG group, respectively (Table 4). It was also noticed that 6.7, 6.1 and 6.7% subjects from LIG, MIG and HIG, respectively, came under obese I category (30-34.99 kg m^{-2}). Contrary to the present study, Parimalavalli *et al.* (2009) reported that 65% of selected adult women were at risk of obesity and had different grades of obesity I, II because of age and socioeconomic status.

Coefficient correlation (r)

A significantly positive correlation ($p \leq 0.05$) was observed between intake of cereals and pulses and the weight of subject, whereas a negative correlation existed between intake of roots and tubers, other vegetables and fruits and the weight of subjects (Table 5). The correlation was significantly positive ($p \leq 0.05$) between intake of milk and milk products, sugars and fats & oils and the weight of subjects.

Table 4: Distribution of selected rural Punjabi women as per BMI classification (WHO, 2005)

Categories of body mass index (kg m^{-2})*	Risk of co- morbidity	LIG (n = 45)	MIG (n = 49)	HIG (n = 60)
Underweight (<18.5)	Low (but risk of other clinical problems)	12 (26.7)	6 (12.2)	4 (6.7)
Normal (18.5-24.99)	-	23 (51.1)	30 (61.2)	36 (60.0)
Overweight (≥25.00)	Average	-	-	-
Pre-obese (25-29.99)	Increased	7 (15.5)	10 (20.5)	16 (26.6)
Obese I (30-34.99)	Moderate	3 (6.7)	3 (6.1)	4 (6.7)

The figure in parenthesis indicate percentage

Table 5: Correlation between food intake and anthropometric parameters of selected rural Punjabi women

Food intake	'r value'		
	LIG (n = 45)	MIG (n = 49)	HIG (n = 60)
Cereals	0.20**	0.13*	0.12*
Pulses and legumes	0.22***	0.35***	0.21***
Leafy vegetables	-0.14*	-0.14*	-0.18**
Roots and tubers	- 0.11 ^{NS}	-0.06 ^{NS}	-0.28***
Other vegetables	- 0.25***	-0.03 ^{NS}	-0.05 ^{NS}
Fruits	- 0.05 ^{NS}	-0.06 ^{NS}	-0.39***
Milk and milk products	0.35***	0.26***	0.35***
Sugars	0.24***	0.12*	0.18**
Fats and oils	0.26***	0.14*	0.20 **

LIG-Low income group, MIG- Middle income group and HIG- High income group;
*Significant at 0.001 level; ** Significant at 0.05 level; *** Significant at 0.01 level; NS = Non-significant

Table 6: Correlation between nutrient intake and anthropometric parameters of selected rural Punjabi women

Nutrients	'r value'		
	LIG (n = 45)	MIG (n = 49)	HIG (n = 60)
Energy (kcal)	0.11^{NS}	0.15**	0.04^{NS}
Protein (g)	-0.15**	-0.16**	-0.17**
Fats (g)	0.01 ^{NS}	0.08 ^{NS}	0.08 ^{NS}
Carbohydrate (g)	0.13*	0.27***	0.03 ^{NS}
Iron (mg)	-0.16**	-0.15**	-0.26***
Calcium (mg)	-0.01 ^{NS}	-0.12*	-0.06 ^{NS}

LIG-Low income group, MIG- Middle income group and HIG- High income group;
*Significant at 0.001 level, ** Significant at 0.05 level, *** Significant at 0.01 level; NS = non-significant

There was a significantly positive correlation ($p \leq 0.05$) between energy, fat and carbohydrate intake and the weight of subjects (Table 6). However, a statistically significant negative correlation was observed between the intake of nutrients i.e. protein, iron and calcium with the weight of subjects.

Conclusion: From the present study, it may be concluded that the diets of rural Punjabi women are deficit in cereals, pulses and all types of vegetables including roots and tubers, leafy and other vegetables and fruits leading to lower energy, riboflavin, vitamin B_{12} and iron intake. However, the diets contain higher amounts of milk and milk products leading to sufficient amount of calcium. Punjabi farm women need to be nutritionally educated about the consumption of balanced diets in their daily life. There is need to create awareness in farm families regarding the inclusion of seasonal green leafy and other vegetables in daily diet and supplementation of micronutrient.

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