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Assessment of nutritional status of celiac disease patients in Ludhiana city of Punjab

SHIWALI MITTAL

A sample of 30 celiac patients including 20 adults and 10 children was enrolled to assess their nutritional status. Mean height of females, males and children was 157.78 cm, 160.48 cm and 95.56 cm, respectively and weight was 44.17 kg, 46.58 kg and 14.13 kg, respectively. Both height and weight were less than the standard height and weight of Indians. The mean intake of cereals was 114.65g, 102.13g, 75.83g and pulse intake was 54.66g, 58.36g, 65.95g by females, males and children, respectively. Pulse intake in case of children was significantly higher whereas intake of all other food groups in all the three groups were significantly lower ($P<0.01$). Energy intake by all the three groups was less *i.e.* 1268 kcal by females, 1/3rd of RDA by males (929 kcal) and ½ of RDA by children (888 kcal). As compare to RDA the protein intake was adequate in case of females (43.26g) and children (32.68g) but less in males (31.50g) as compare to suggested intake. Carbohydrate and fibre intake was significantly lower ($P<0.01$) in all the three groups as compare to suggested intake. Fat intake was significantly lower ($P<0.01$) by males and children as compare to calculated value based on 20 per cent and 25 per cent of energy, respectively. It was found that celiac patients were using only maize flour and besan to make chapattis and they were not taking any inbetween meal because of lack of availability of gluten free foods.

Key Words : Mean height, Mean weight, Cereal, Pulse, Carbohydrates, Proteins

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INTRODUCTION

Celiac disease also known as gluten sensitive enteropathy is a condition when patient eat foods or use products containing gluten, their immune system responds by damaging or destroying villi-the tiny, fingerlike protrusions lining the small intestine. Without healthy villi, a person becomes malnourished, no matter how much food one eats (Fasano *et al*., 2003). Females predominate over males in a ratio of 3:1 and 25 per cent of newly diagnosed celiac disease occurs in patients older than 60 years of age (Dewar and Ciclitira, 2005).

At the time of diagnosis, some patients present with substantial weight loss, anemia, and evidence of overt vitamin/mineral deficiencies. Malabsorption of iron, folate, and calcium is common, as these nutrients are absorbed in the proximal small bowel. As the disease progresses along the intestine, malabsorption of carbohydrates, fat, and fat-soluble vitamins A, D, E and K, and other micronutrients occur. Patients who present with nutrient deficiencies may require temporary or long-term nutrient supplementation with gluten-free vitamins, minerals and protein to correct deficiencies and replenish nutrient stores (Fasano and Catassi, 2001).

The only treatment for celiac disease is a gluten free diet. For most people following this diet will stop symptoms and prevent further damage. People with celiac disease can eat a well balanced diet with a variety of foods. They can use oats, sorghum, maize, rice, pulses and soya instead of wheat flour.

AUTHOR FOR CORRESPONDENCE

SHIWALI MITTAL, Department of Food and Nutrition, Punjab Agricultural University, LUDHIANA (PUNJAB) INDIA

METHODOLOGY

An interview schedule was developed to collect general information, health information and to assess the nutritional status of subjects. A sample of 30 celiac patients was selected, out of which 12 were adult females, 8 were adult males and 10 were children. Adult celiac patients were selected from the Dayanand Medical College and Hospital in Civil Lines and children were selected from two pediatric clinics in Model town and Dugri road of Ludhiana city of Punjab. Data was collected personally by interviewing the subjects and filled accordingly in the interview schedule.

OBSERVATIONS AND ASSESSMENT

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

General information of the subjects :

Age :

The mean age of females was 29 years while the mean age of males was 33 years and children were between 4-6 years of age.

Education :

The majority of the female celiac patients were 10+2 and males were graduate.

Income :

The mean total income of the subjects was Rs.35,000/month with per capita income of Rs.7000.

Occupation :

All the female patients were housewives while males were servicemen.

Health regarding information of subjects :

Information regarding health of subjects is given in the Table 1. The most common health problem faced by celiac patients was diarrhoea followed by abdominal cramps in case of adults as well as children. Seventy five per cent females, 87.5 per cent males and 100 per cent children were suffering from diarrhoea and 58.3 per cent females, 50 per cent males and 100 per cent children were suffering from abdominal cramps. Problems faced by only adults were osteopenia and diabetes where 91.7 per cent and 87.5 per cent of females and males, respectively were suffering from osteopenia and 8.3 per cent and 25 per cent of females and males, respectively were suffering from diabetes. Corazza *et al.* (1995) evaluated bone mass density (BMD) and metabolism in adults with celiac disease in a cross-sectional study and found that BMD was significantly lower in patients with untreated celiac disease than in patients with treated celiac disease. Stenson *et al.* (2005) reported that prevalence of celiac disease among osteoporotic individuals is much higher (3.4%) than that among non-osteoporotic individuals (0.2%).

Barera *et al.* (2002) reported that the prevalence of celiac disease in patients with type 1 diabetes is approximately 20 times higher than in the general population. Mulder *et al.* (2002) conducted a study in which they found that the prevelance of celiac disease in patients with type 1 diabetes is 20-fold than in the general population, ranging between 2 per cent and 6 per cent.

Nitritional accessment of the subjects :

Anthropometric measurements :

Data pertaining to anthropometric measurements of the subjects is given in the Table 2.

Height :

The mean height of females was 157.78 cm which was less than the height of Indian adult women *i.e.* 164 cm (ICMR, 1990). The mean height of males was 160.48 cm which was lower as compare to height of Indian adult men *i.e.* 170 cm (ICMR, 1990).

Table 1 : Health problems faced by subjects

Problem	Female (n=12)	Male (n=8)	Children (n=10)
Diarrhoea	9 (75)	7 (87.5)	10 (100)
Constipation	1 (8.3)	0	0
Abdominal cramps	7 (58.3)	4 (50)	10 (100)
Osteopenia	11 (91.7)	7 (87.5)	0
Diabetes	1 (8.3)	2 (25)	0

Figures in parenthesis are percentages

Weight :

The mean weight of females was 44.17 kg which was less than the weight of Indian adult women *i.e.* 50 kg (ICMR, 1990). The mean weight of males was 46.58 kg which was less as compare to weight of Indian adult man *i.e.* 60 kg (ICMR, 1990).

Body mass index (BMI) :

The mean BMI of females and males was 17.7 and 18.0, respectively. According to WHO (2004) classification of BMI all the subjects were below the normal range of 18.-24.99.

Bardella *et al.* (2000) reported that the mean weight and BMI of the 51 female celiac patients and 20 male celiac patients were significantly lower ($p<0.05$) than those of the female and male control subjects whereas height had non-significant difference as compare to control.

Height and weight of children :

Height and weight of children is given in the Table 3. The mean height of children *i.e.* 95.56 cm was lower as compare to height of Indian children (4-6 years) *i.e.* 109 cm (ICMR, 1990 and NCHS, 1987). The mean weight of children was lower (14.13 kg) as compare to weight of Indian children (4-6 years) *i.e.* 19 kg (ICMR, 1990) and 18.2 kg (NCHS, 1987). Rea *et al.*, 1996 assessed the nutritional status of 23 Italian children using anthropometry, biochemical analysis, and bone densitometry measurements, it was found that patients were clearly malnourished.

Food intake of respondents :

The food intake and per cent adequacy of subjects is presented in Table 4 and 5, respectively.

Cereals :

The major cereal consumed was rice followed by

Table 2 : Anthropometric information of the subjects

Variable	Group	Mean ± S.E.	Reference standard*
Height (cm)	Female	157.78±1.24	164
	Male	160.48±1.05	170
Weight (kg)	Female	44.17±1.17	50
	Male	46.58±0.73	60
BMI	Female	17.7±0.31	
(kg/m^2)	Male	18.00±0.26	18.5-24.99#

*ICMR (1990) #WHO (2004)

Table 3 : Height and weight of children

Variable	Mean ± SE	NCHS*	%age	ICMR**	%age
Height (cm)	95.56±2.22	109	87.7	109	87.7
Weight (kg)	14.13±0.61	18.2	77.6	19	74.4

*NCHS (1987) **ICMR (1990)

Table 4 : Dietary intake of subjects

Food groups	Female			Male			Children		
	Actual intake	Suggested# intake	t-value	Actual intake	Suggested# intake	t-value	Actual intake	Suggested# intake	t-value
Cereals	114.65±21.82	360	11.24*	102.13±19.35	480	19.53*	75.83±9.15	210	14.66*
Pulses	54.66±20.65	75	0.98 NS	58.36±20.62	90	1.53 NS	65.95±6.29	45	3.33*
Milk and milk products	338.47±59.54	300	0.65 NS	249.09±42.95	300	1.18 NS	342.43±19.54	500	62.53*
Roots and tubers	58.48±11.96	100	3.47*	45.62±2.79	200	55.33*	30.18±2.52	100	27.71*
Green leafy vegetables	20.23±4.59	100	17.38*	21.24±5.57	100	14.14*	11.96±1.61	50	23.63*
Other vegetables	23.52±3.09	100	24.75*	18.31±5.42	100	15.07*	13.51±0.12	50	304.08*
Fruits	79.21±3.54	100	5.87*	79.12±4.63	100	4.51*	48.12±3.06	100	16.95*
Fats and oils	20.81±1.25	30	7.35*	16.27±3.87	35	4.84*	26.52±1.07	25	1.42 NS
Sugars	13.16±1.25	25	9.47*	14.56±1.34	40	18.98*	25.64±1.45	30	3.0**

ICMR (1999) * and ** indicate significance of values at P=0.01 and 0.05, respectively NS=Non-significant

maize flour in form of chapattis, by females and males. The mean cereal intake by females was 114.65g which was significantly lower (P<0.01) as compare to suggested intake (360g) with 31.84 per cent adequacy. The mean cereal intake by males was 102.13g which was significantly lower (P<0.01) as compare to suggested intake (480g) with 21.28 per cent adequacy. The cereal consumed by children was only rice with mean intake of 75.83g which was significantly lower (P<0.01) as compare to suggested intake (210) with 36.11 per cent adequacy. Singh and Grover (2003) reported lower intake of cereals (150.76g) by 4-6 year children as compare to suggested intake with 56 per cent adequacy.

Pulses :

The major pulse consumed was Bengal gram flour by all the three groups followed by green gram. The mean pulse intake by females was 54.66g with non-significant difference as compare to suggested intake (75g) with 72.9 per cent adequacy. The mean pulse intake by male was

Table 5 : Per cent adequacy of foods

Food groups (g/day)	Female	Male	Children
Cereals	31.84	21.28	36.11
Pulses	72.9	64.84	146.6
Milk and milk products	112.82	83.03	68.49
Roots and tubers	58.48	22.81	30.18
Green leafy vegetables	20.23	21.24	23.92
Other vegetables	23.52	18.31	27.02
Fruits	79.21	79.12	48.12
Fats and oils	69.37	46.49	106.08
Sugars	52.64	36.4	85.47

Table 6 : Average daily nutrient intake of subjects

Nutrient	Mean±SE	RDA¥	Per cent adequacy	t- value
Energy (kcal)				
Female	1263±100.11	2225	56.76	9.6*
Male	929±170.41	2875	32.31	11.42*
Children	888±32.32	1690	52.54	24.81*
Protein (g)				
Female	43.26±4.18	50	86.52	1.61^{NS}
Male	31.50±5.16	60	52.5	5.52*
Children	32.68±0.97	30	108.9	2.76**
Fat (g)				
Female	51.46±4.34	49.4[1]	104.17	0.47^{NS}
Male	38.91±7.7	64[1]	60.8	3.26**
Children	28.00±0.66	47[2]	59.6	28.79*
Carbohydrates (g)				
Female	155.63±12.59	340#	45.8	14.64*
Male	123.89±17.65	340#	36.44	12.11*
Children	125.33±8.0	311©	40.29	23.21*
Fibre (g)				
Female	8.06±0.26	25¶	32.24	65.13*
Male	7.48±0.14	38¶	19.68	218*
Children	6.02±0.09	25¶	24.08	204*

¥ ICMR (1990)
[1]Based on 20 per cent of energy
* and ** indicate significance of values at P=0.01 and 0.05, respectively
[2]Based on 25 per cent of energy
¶Food and Nutrition Board (2002)
Ghafoorunissa and Krishnaswamy (2000)
© Calculate value

58.36g with non-significant difference as compare to suggested intake (90g) with 64.84 per cent adequacy. The mean pulse intake by children was 65.95g which was significantly higher (P<0.01) as compare to suggested intake (45g) with 146.6 per cent adequacy. Singh and Grover (2003) reported lower intake of pulses (27.18g) by 4-6 year children as compare to suggested intake with 78 per cent adequacy.

Milk and milk products :

Female and male celiac patients mainly consumed milk as such followed by curd. The mean intake of milk and milk products by females was 338.47g with non significant difference as compare to suggested intake (300g) with 112.82 per cent adequacy. The mean intake of milk and milk products by males was 249.09g with non-significant difference as compare to suggested intake (300g) with 83.03 per cent adequacy. Children celiac patients mainly consumed milk followed by cheese. The mean intake of milk and milk products by children was 342.43g which was significantly lower (P<0.01) as compare to suggested intake (500g) with 68.49 per cent adequacy. Singh and Grover (2003) reported higher intake of milk and milk products (400g) by 4-6 year children as compare to suggested intake.

Roots and tubers :

Most commonly consumed roots and tubers by patients was potato followed by onion by all the three groups. The mean intake of roots and tubers by females was 58.48g which was significantly lower (P<0.05) as compare to suggested intake (100g) with 58.48 per cent adequacy. The mean intake of roots and tubers by males was 45.62g which was significantly lower (P<0.01) as compare to suggested intake (200g) with 22.81 per cent adequacy. The mean intake of roots and tubers by children was 30.18g which was significantly lower (P<0.01) as compare to suggested intake (100g) with 30.18 per cent adequacy.

Green leafy vegetables (GLV) :

The major green leafy vegetable consumed by male and females was mustard leaves followed by fenugreek. The mean GLV intake by females and male was 20.23g and 21.24g, respectively which was significantly lower (P<0.01) as compare to suggested intake (100g) with 20.23 per cent and 21.24 per cent adequacy. The mean GLV intake by children was 11.96g which was significantly lower (P<0.05) as compare to suggested intake (50g) with 23.92 per cent adequacy. Singh and Grover (2003) reported higher intake of roots and tubers (36.63g) and lower intake of GLV (11.95g) by 4-6 year children as compare to suggested intake.

Other vegetables :

The mean vegetable intake by female and male was 23.52g and 18.31g, respectively which was significantly lower (P<0.01) as compare to suggested intake (100) with 23.52 per cent and 18.31 per cent adequacy. The mean vegetable intake by children was 13.51g which was significant lower (P<0.01) as compare to suggested intake (50) with 27.02 per cent adequacy.

Fruits :

The main fruit consumed by female and male was guava whereas children mainly consumed orange. The mean fruit intake by females and males was significantly lower (P<0.01) as compare to suggested intake (100) with 79.21 per cent and 79.12 per cent adequacy. The mean fruit intake by children was 48.12g which was significantly lower (P<0.05) as compare to suggested intake (100) with 48.12 per cent adequacy.

Fats and oils :

Mainly consumed fat by all the three groups was ghee followed by mustard oil. The mean fat intake by female was 20.81g which was significantly lower (P<0.01) as compare to suggested intake (30) with 69.37 per cent adequacy. The mean fat intake by male was 16.27g which was significantly lower (P<0.01) as compare to suggested intake (35) with 46.99 per cent adequacy. The mean fat intake by children was 26.52g which was comparable to suggested intake (25) having non-significant difference with 106.08 per cent adequacy. Singh and Grover (2003) reported fat intake of 24.59g by 4-6 year children with 100 per cent adequacy.

Sugars :

The mean sugar intake by female subjects was 13.16g which was significantly lower (P<0.01) as compare to suggested intake (25) with 52.64 per cent adequacy. The mean sugar intake by male subjects was 14.56g which was significantly lower (P<0.01) as compare to suggested intake (40) with 36.4 per cent

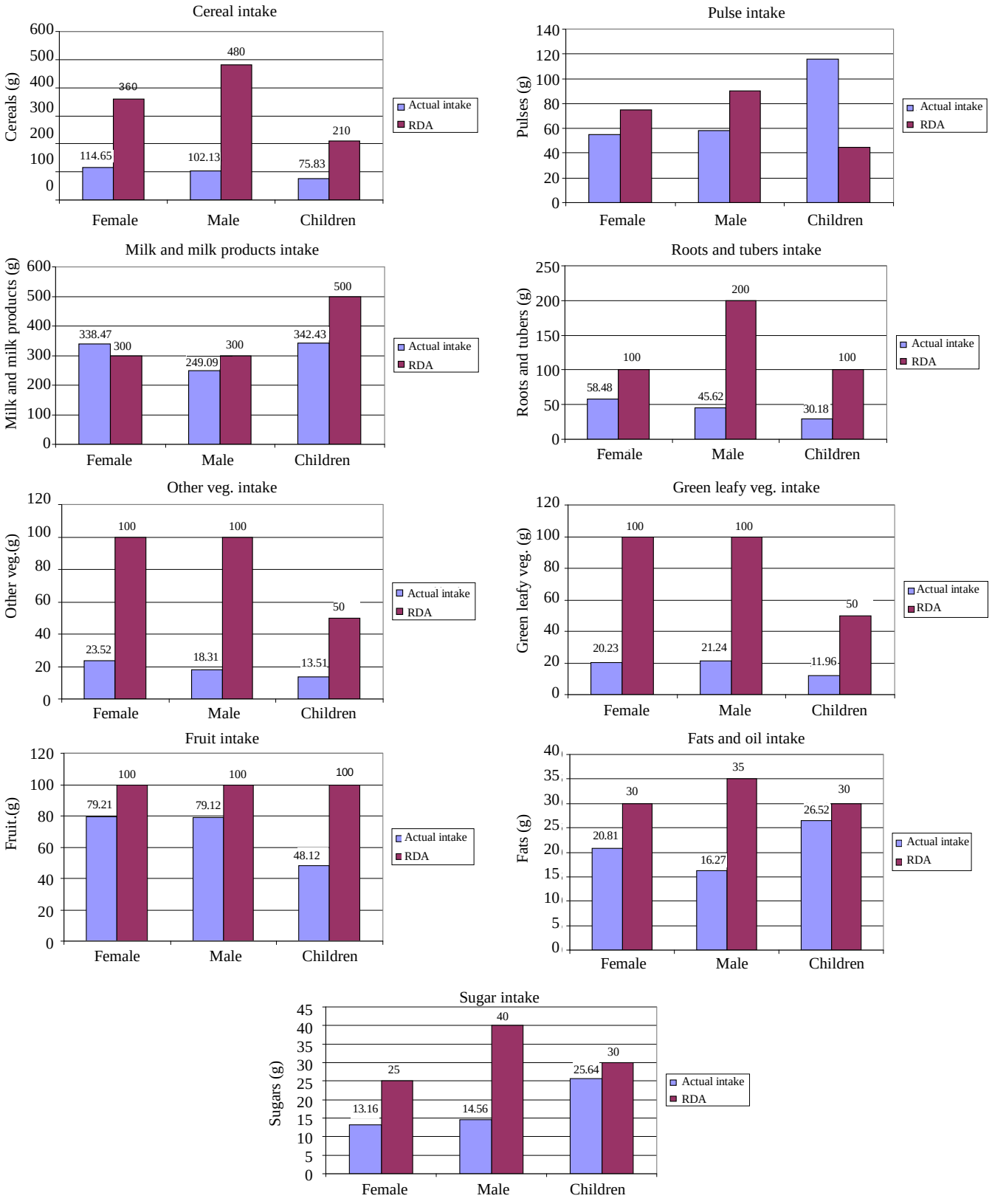

Fig. 1 : Food intake of respondents

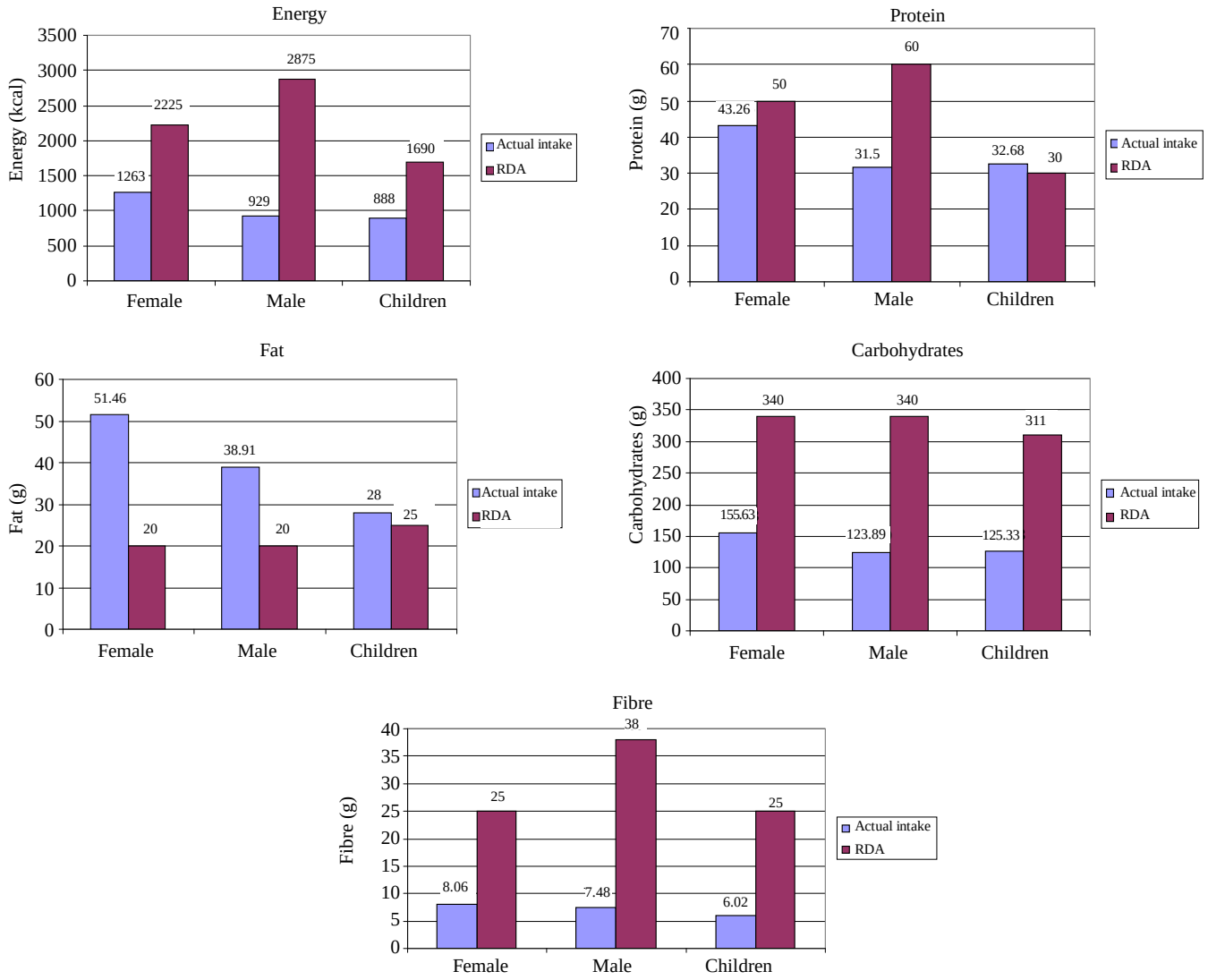

Fig. 2 : Nutrient intake of respondents

adequacy. The mean sugar intake by children was 25.64g which was significantly lower (P<0.05) as compare to suggested intake (30) with 85.47 per cent adequacy Singh and Grover (2003) reported lower intake of sugar (32.59g) by 4-6 year children as compare to RDA with 82 per cent adequacy.

Nutrient intake of respondents :

Nutrient intake of respondents is given in the Table 6

Energy :

Data indicated that the energy consumed by the female and male celiac patients was 1263 kcal and 929 kcal, respectively which was significantly lower (P<0.01) as compare to RDA. Energy intake by females was about half of the RDA with 56.76 per cent adequacy. Energy intake by males was about one third of the RDA with 32.31 per cent adequacy. Energy intake by children was 888 kcal which was significantly lower (P<0.01) and about half of the RDA with 52.54 per cent adequacy. Bardella *et al.* (2000) reported that male and female celiac patients consumed less total daily energy than the control subjects and consumed a significantly higher (P<0.05) percentage of energy as fat and a lower percentage of energy as carbohydrates (P<0.01).

Table 7 : Per cent contribution of carbohydrate, protein and fat to the total energy intake of subjects

Nutrient	Female	Male	Children
Carbohydrates	49.3	53.3	56.4
Protein	13.1	13.6	14.7
Fat	36.7	37.7	28.4

Protein :

Data revealed that the protein intake by the female was 43.26g having non-significant difference as compare to RDA (50g) with 86.52 per cent adequacy. Protein intake by male was 31.50g which was significantly lower as compare to RDA (60g) with 52.5 per cent adequacy. Protein intake by children was 32.68g which was significantly higher as compare to RDA (30g) with 108.9 per cent adequacy. In a study by Mariani *et al.* (1998) the diets of children complying with a strict gluten free diet were found to be unbalanced, with a significantly higher protein and fat consumption.

Fat :

Data indicated that the fat intake by the female was 51.46g with non-significant difference as compare to calculated value based on 20 per cent of energy (49.4) with 104.17 per cent adequacy. Fat intake by male was 38.91g which was significantly lower ($P<0.05$) as compare to calculated value based on 20 per cent of energy (64) with 60.8 per cent adequacy. Fat intake by children was 28g which was significantly lower ($P<0.01$) as compare to calculated value based on 25 per cent of energy (47).

Carbohydrates :

Data indicated that the carbohydrates consumed by the female and male celiac patients were 155.63g and 123.89g, respectively which was significantly lower ($P<0.01$) as compare to RDA *i.e.* 340g with 45.8 per cent and 36.44 per cent adequacy. Carbohydrates consumed by children were 155.63g which were significantly lower ($P<0.01$) as compare to calculated value.

Fibre :

Data indicated that the fibre consumed by the female and male celiac patients was 8.06g and 7.48g, respectively which was significantly lower ($P<0.01$) as compare to RDA with 32.24 per cent and 19.68 per cent adequacy. Fibre intake by children was 6.02g which was significantly lower ($P<0.01$) as compare to RDA with 24.08 per cent adequacy.

As compare to RDA intake of energy, carbohydrates and fibre was lower in all the three groups. Intake of protein was adequate in females and children but less in males. Intake of fat was adequate in females but less in males and children.

Per cent contribution of carbohydrate, protein and fat to the total energy intake of subjects :

Per cent contribution of carbohydrates to the total energy intake was 49.3 in females, 53.3 in males and 56.4 in children. Per cent contribution of proteins to the total energy intake was 13.1 in females, 13.6 in males and 14.7 in children. Per cent contribution of fats to the total energy intake was 36.7 in females, 37.7 in males and 28.4 in children (Table 7).

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