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RESEARCH ARTICLE

IMPROVING NUTRITIONAL STATUS OF FEMALE OBESE SUBJECTS WITH DIETARY INTERVENTIONS

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ABSTRACT

Obesity is a state which arises by excess accumulation of fat. Obesity is an epidemic that's spreading rapidly in developing countries like India also. The present study was conducted in rural area of Kurukshetra and urban area of Delhi. The obese female subjects were selected by purposive random sampling. The subjects having BMI > 29.9 kg/m^2 were selected. The main purpose of the study was to improve the nutritional status of obese subjects with achievement of weight loss as well. The nutrient intake was studied minutely and the micronutrients were also kept for consideration. Three experimental groups were E1 – the subjects doing exercise, E2- Hyocaloric diet and E3 – Exercise and Hypocaloric diet and Control group who were not following any interventions. The study concluded in there was significant improvement of vitamins & minerals such as Thiamine, Riboflavin, Niacin, Vitamin A and Ascorbic acid in the diet simultaeneouly decrease in energy, proteins, calcium and fat intake.

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INTRODUCTION

Anrig (2003) stated that obesity is abnormal body weight that is usually more than 20 per cent or above average weight for a particular age, height or bone structure. Obesity results from the collection of excessive fat around abdomen, hips and thigh areas and it has adverse effects on the health. Nafisa (2006) reported that, the most common clinical tool to define obesity is increase in body weight that has been used since years. It is still being used, although its not accurate measure of obesity. The earliest attempts to define obesity were based on body weight for height standards framed by Metropolitan Life Insurance Company (1959) for healthy people.So height weight tool is very popular till now.

Diagnosis of Obesity: Obesity is an abnormally high proportion of body fat. The doctor can often determine the obesity by simply looking at the body of the patient and assessing the percentage of body fat (Deurenberg, 2003).

The different methods of assessing body fat are as follows-

Body Mass Index: BMI is calculated by dividing your weight in kilograms by height in meter square. A BMI of 25 to 29.9 is considered obese. The International Obesity Task Force (2002) proposed a different classification of obesity for Asians.

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Waist circumference: According to Staveren (2000) waist circumference is the simple measurement that estimates the amount of fat deposited in the skin and inside the abdominal cavity. Waist circumferences that exceed 102 centimeters (40 inches) men or exceed 88 centimeters (35 inches) in women are associated with an increased risk of heart disease.Waist - hip ratio is greater than 1 in obese men and greater than 0.85 in obese women.

Skin - fold thickness: Fausi (1998) stated that most fat is deposited beneath the skin. This test measures fat just beneath the skin, but cannot measure fat accumulated inside the abdomen. The skin fold thickness is measured from the four sides such as Triceps, Biceps, Subscapular and Superiliac regions. In obese young adults the combined thickness at the four sides is more than 80 cms.

Blood tests: To rule out other medical conditions that may cause excess body weight, such as a thyroid disorder or other endocrinological disorders

Obesity is increasing at an alarming rate throughout the world. Today it is estimated that there are more than 250 million obese people worldwide, equivalent to seven per cent of the adult population (WHO, 1998). The WHO Expert consultation (2004) on Obesity held in 1997 warned of an escalating epidemic of obesity that would put the populations of most countries at risk.

Table 2.1 IOTF – proposed classification of BMI

BMI Kg/m2	Classification
< 18.5	Under weight
18.5 – 22.9	Normal Weight
23.0 – 24.9	At risk for obese
25.0 – 29.9	Obese I
> 30	Obese II

Today the World Health Organisation (WHO, 1998) finds itself needing to deal with the new epidemic of obesity and its accompanying non-communicable disease. In 1995, there were an estimated 200 million obese adults worldwide and another 18 million children were classified Obese. As of 2000 the number of obese adults has increased to over 300 millon (WHO, 2002). The WHO (1998) recently stated that the growth in the number of severly overweight adults is expected to be double than that of under weight during 1995-2025. A national survey among South America young adults showed that prevalence of obesity in black female college going students was 20.9 per cent compared to 4.2 per cent in males (Taylor, Reddy 2007). The prevalence of obesity in any individual depends on a number of factors. The rising prevalence of obesity among young adults in the U.S. population is a growing public health concern (Webb & Janson, 2009). Obesity is not only a problem found in the adult population but is also occurring at an increased frequency in children in both the developed and the developing world.Thus, a national survey among south african school children showed that the prevalence of over weight in black female students was 20.9 per cent as compared to 4.2 per cent in males (Crowther, 2009).

MATERIALS AND METHODS

The present study was carried out on Five hundred subjects which were selected by Random sampling belonging to region of Kurukshetra and Delhi. The subjects were selected from two cities of Kurukshetra and Delhi with the method of cluster sampling. After selecting five hundred subjects from these regions, BMI was calculated. The subjects having BMI > 29.9 – 34.9 were selected by purposive sampling. These subjects were categorized under Obese Grade I. After cluster sampling 56 obese subjects were selected from Kurukshetra and 69 obese subjects from Delhi city.

Selection of the subjects

- One thousand young adults between 18 - 25 years of age were selected from different localities and institutions, namely Kurukshetra (Ladwa), and Delhi (NCR) region and slimming centres.
- The height and weight of all the subjects were measured to find the obese subjects among them.
- From above the BMI was calculated by following the method of Quetelet (1835) and five hundred obese subjects were selected.
- All the selected five hundred subjects were
    - Obese with body mass index (BMI) of > 29.9 kg/m^2
    - Free from any serious disease.
    - Not following any dietary restrictions.

    (iv)Out of the surveyed young adults, 320 subjects were selected randomly from the regions of Kurukshetra and Delhi (NCR) both taken equally from either sex (n= 160 each). The 160 males comprised of Kurukshetra and Delhi (NCR) regions, 80 from each one. This division was also exercised for the females accordingly in the same manner. Further the fig no. 3.1 shows the subsampling of both of the subjects (males and females) into 20 each categorized as Experimental group and control group. The Experimental group consisted of E1, E2, E3 with the number of subjects as twenty each. While the control group numbered twenty only.
- The objective and experimental protocol of the study was explained to the subjects, and their prior consent was taken.

Experimental Group: The Obese subjects were willing to lose their weight through Healthy Dietary Interventions. The Dietary Intake before the study was collected by 24 hour recall method. A questionnaire was developed by the researcher which included their General Information, Medical History and Dietary intake. Then the validity of the questionnaire was also calculated by a panel of experts which included Three Dieticians and two Doctors. A pilot study was done on 20 Obese subjects to find the reliability. The Cronbach's α coefficient of attitude (0.77); subjective norms (0.80); Perceived behavioral control (0.85) and behavioral intention (0.86) were all at the favorable level. The subjects were told about the relevance of eating healthy diet rather than following fad diets. In the second phase, three experimental groups were designed for three different weight – reducing interventions on sub samples of the selected subjects. The effect of each treatment was studied for a period of three months, at the end of which the results were compared with a control group. The study groups were.

First experimental group (E_1): This group comprised of obese male and female subjects who opted to reduce weight by doing cardio exercise (Brisk Walking or Jogging or Treadmill) They exercised for 30 -45 minutes daily, on three to four days per week . Their daily exercise routine included 8-10 minutes of warming up exercises. 15-20 minutes of moderate to vigorous workout, followed by five minutes of cooling down and 10 minutes of stretching exercises.

Second experimental group (E2): This group comprised of male and female subjects who volunteered to reduce weight by following the advised **hypocaloric diet**. They were provided guidance and dietary counselling for selecting and consuming low calorie diet.

Third experimental group (E_3): This study group was constituted of obese subjects who opted to reduce weight by following the suggested **hypocaloric diet along with cardio work out**. The venue, duration and type of exercise were the same as for the first group (E_1). Dietary conselling was also provided to these subjects.

Control group (C): This group was not engaged in any weight – reducing intervention. It followed with their existing dietary and activity pattern.

Statistical Analysis The collected data were decoded, tabulated and statistically analysed using standard techinques such as arithmetic mean, standard deviation, frequencies and Dunkan's post hoc. Students t-test was used for testing significance of difference between two groups and one way ANOVA was used for testing the variation among all groups.

Table 1. Mean of daily nutrient intake of young female human adults before (B) and after (A) weight reducing interventions

Nutrient intake											
Nutrients	Kurukshetra					Delhi					
	Experimental group (E)			Control Group (C)	F	Experimental Group(E)			Control Group (C)	F	RDA
	Exercise (E1)	Hypocaloric diet (E2)	Exercise & Hypocaloric diet (E3)			Exercise (E1)	Hypocaloric diet (E2)	Exercise & Hypocaloric diet (E3)			
Energy B	2359.8±320.2	2390.8±191.6	2312.8±53.6	2481.3±12.5	NS	2285±144.7	2560.9±210	2468.7±6.7	2771±86.7	NS	1875
(Kcal)A	1499±69.99	1595±68.3	1459±66.5	1922±59.8	11.3**	1475.4±51.6	1548±41.6	1525±96.6	1535.5±28.8	627.8**	kcal
t value	10.2**	25.3**	49.6**	35.2**		19.4**	26.2**	31.2**	56.04**		
(B) E vs C	NS	NS	NS			NS	NS	27.2**			
(A) E vs C	26.213**	32.410**	NS			21.401**	23.401**	33.412**			
ProteinB	66.7±3.7	76.2±11.8	60.7±13.6	71±6.14	NS	70.5±2.71	66.6±3.3	60.3±5.59	68.3±2.71	10.6**	50 gms
(g)A	47.5±2.6	51±2.1	53.3±1.9	50±0.0	87.4**	52.6±3.1	47.5±2.6	51±2.1	50.3±3.7	70.3**	
t value	13.1**	6.6**	NS	10.8**		13.5**	14.1**	4.9**	12.1**		
(B) E vs C	NS	NS	NS			12.1**	NS	NS			
(A) E vs C	15.221**	NS	NS			10.201**	NS	12.201**			
TotalB	67±7.8	48±16.9	55.26.1	66.9±10.4	5.9*	66.1±7.6	58.5±3.8	55.5±3.3	71.8±13.8	6.98**	22 gms
fatA	21±1.05	23.5±1.8	24±1.30	22±2.05	143.6**	17±2.58	22.2±3.4	20.3±4.4	20.7±3.7	96.03**	
t value	18.2**	NS	15.7**	13.3**		19.2**	22.3*	20**	11.2**		
(B) E vs C	NS	NS	NS			NS	21.05**	NS			
(A) E vs C	NS	15.04**	NS			27.021**	19.041**	NS			

B – Intake before intervention ** Significance at 1% level # ICMR – 1989 A - Intake after intervention

* Significance at 5% level

(B)/ (A) – Difference between control and each experimental group on basis of Dunkan Post hoc test.

Nutrient intake											
Nutrients	Kurukshetra					Delhi					
	Experimental group (E)			Control Group (C)	F	Experimental Group (E)			Control Group (C)	F	RDA
	Exercise (E1)	Hypocaloric diet (E2)	Exercise & Hypocaloric diet (E3)			Exercise (E1)	Hypocaloric (E2)	Exercise & Hypocaloric diet (E3)			
Carbos B	372.5±64.6	413.6 ±36	393.3±103.6	398.8±45.7	NS	352.3±32.3	442.9±18.6	432±33.5	462.9±68.6	NS	
(g)A	280±30.5	295±15.8	280±5.3	373.3±30.5	11.2**	278±24.4	288±10.3	284.7±6.2	287±16.3	81.2**	300 g
t value	NS	9.5**	NS	7.1**		5.7**	22.9**	13.6**	3.4**		(Variable)
(B) E vs C	NS	NS	9.55**			NS	NS	2.023**			
(A) E vs C	NS	6.023**	11.232**			5.334**	NS	4.125**			
Fibre B	28.3±1.8	28.2±2.22	18±1.33	18.8±1.03	NS	23.3±3.5	19.7±3.71	20.2±1.7	22.4±4.3	NS	
(g)A	39.8±4.13	42±2.58	38.5±2.08	18±2.58	83.09*	40.5±1.5	42±2.58	40.5±1.5	22.5±1.5	239.1*	
t value	8.006**	12.7**	26.7**	26.3**	*	14.06**	15.5**	27.2**	12.3**		25-40 g
(B) E vs C	NS	NS	NS			NS	NS	NS			
(A) E vs C	NS	9.388**	1.995*			NS	NS	NS			
CalciumB	1165±404.1	1060±96.16	1101.1±81.6	1060±96.6	NS	1120±103.2	1220±147.5	1115.4±62.9	1480±147.5	NS	
(mg)A	640±353.3	970±211.08	760±148.6	883±260.9	NS	770±223.3	770±176.9	700.2±83.4	615.4±79.9	NS	
t value	5.3**	NS	6.3**	NS		NS	NS	13.7**	10.6**		400 g
(B) E vs C	NS	1.981**	NS			NS	NS	NS			
(A) E vs C	6.634**	8.393**	NS			2.712**	2.823**	NS			

B – Intake before intervention ** Significance at 1% level # ICMR – 1989

A - Intake after intervention * Significance at 5% level

(B)/ (A) – Difference between control and each experimental group on basis of Dunkan Post hoc test

Nutrient intake											
Nutrients	Kurukshetra					Delhi					
	Experimental group(E)			Control Group (C)	F	Experimental Group (E)			Control Group (C)	F	RDA
	Exercise (E1)	Hypocaloric diet (E2)	Exercise & Hypocaloric diet (E3)			Exercise (E1)	Hypocaloric (E2)	Exercise & Hypocaloric diet (E3)			
IronB	24.4±10.9	20.6±5.6	23.9±6.26	18.2±2.9	NS	18.4±2.2	26.7±10.5	18±2.40	19.4±3.4	NS	30
(mg)A	32.3±4.9	37.4±5.56	37.2±4.5	19.5±1.5	5.4**	41±3.92	43.5±3.3	39.6±3.7	19.5±1.5	11.4**	(mg)
t value	NS	6.6**	5.4**	NS		15.7**	NS	15.2**	NS		
(B) E vs C	NS	NS	NS			NS	NS	NS			
(A) E vs C	4.032**	82.58**	5.231			3.292**	NS	NS			
B- B	2613±284.4	2380.2±620.6	2123± 21.2	2100±68.7	NS	2831±178.6	2393±310	1900±502.1	2560±231.9	4.45*	2400
Carotene A	2590±202.4	2413 ±62.7	2429± 59	2450±59.6	NS	2375±160	2420±510	2420±91.8	2370±156.7	46.6**	(microgm)
(microgms)	NS	NS	5.14**	NS		16.2**	91.8**	NS	NS		
t value	NS	NS	8.050**			NS	NS	NS			
(B) E vs C	NS	3.513**	1.995**			2.258*	NS	NS			
(A) E vs C											
Thiamine B	0.85±.278	0.49±.219	1±0	0.64± .241	9.81**	0.51±.354	0.75±0.212	.83±.200	.86±.20	NS	.9 (mg)
(mg) A	0.62±.268	0.59±.32	0.93±0. 124	0.68±.30	5.6**	0.93±.067	1.03±0.309	.88±.096	.90±.30	2.0**	
t value	NS	NS	NS	NS		NS	NS	NS	NS		
E vs C(B)	NS	NS	NS			NS	NS	NS			
E vs C(A)	NS	2.395**	NS			NS	3.395**	NS			

B – Intake before intervention ** Significance at 1% level # ICMR – 1989
A - Intake after intervention * Significance at 5% level
(B)/(A) – Difference between control and each experimental group on basis of Dunkan Post hoc test.

Nutrient intake											
Nutrients	Kurukshetra					Delhi					
	Experimental group (E)			Control Group (C)	F	Experimental Group			Control Group (C)	F	RDA (mg)
	Exercise (E1)	Hypocaloric diet (E2)	Exercise & Hypocaloric diet (E3)			Exercise (E1)	Hypocaloric diet (E2)	Exercise & Hypocaloric diet (E3)			
RiboB	1±.2	0.95±0.22	0.77±.262	0.78±0.13	NS	0.92±.214	.68±0.28	0.50±.17	.66±.89	NS	1.1
flavinA	1.1±.08	1.04±.11	1.02±0.105	1.03±1.25	16.5**	1.06±0.12	.33±.14	1.17±0.17	1.26±.084	14.1**	
(mg) t value	NS	NS	NS	.954*		NS	NS	8.6**	8.97**		
E vs C(B)	NS	NS	NS			2.953**	NS	NS			
E vs C(A)	3.987**	2.135**	1.293*			3.156**	NS	4.234**			
Niacin B	9.8±1.93	9.2±3.3	8.9±2.8	10.5±1.26	NS	7.6±1.77	9±2.2	7.8±2.29	8.8±2.4	NS	12
A	12.7±.48	11.7±.94	11.5±.54	8.7±0.74	24.9**	11.6±.69	11.6±0.51	11.7±0.31	81.6±.516	18.1**	
(mg) t value	12.6**	2.3*	NS	NS		6.6**	NS	5.3**	NS		
E vs C(B)	NS	NS	NS			5.673**	NS	NS			
E vs C(A)	NS	NS	2.953*			8.789**	10.356*	NS			
AscorB	39.2±6.69	29.7±3.5	33.2±4.3	32.1±3.24	NS	30.1±4.6	34.4±5.2	40.1±4.33	35.7±46.9	NS	40
bic acidA	41.8±1.75	40.6±6.9	40.5±.53	33.2±2.1	26.7**	41.1±1.5	42.2±1.03	41.6±1.3	33.1±2.8	29.6**	
(mg) t value	NS	9.4**	5.2**	8.2**		7.07**	NS	0.285*	4.3*		
E vs C (B)	NS	NS	NS			NS	NS	NS			
E vs C(A)	12.238**	15.359**	NS			10.393**	NS	9.359**			

B – Intake before intervention ** Significance at 1% level # ICMR – 1989
A - Intake after intervention * Significance at 5% level
(B)/(A) – Difference between control and each experimental group on basis of Dunkan Post hoc test

The post-hoc analysis of the data was done using Duncan test, where the value of 'F' was significant. The statistical analysis was done using SPSS-Version 17.0 computer programme.

RESULTS AND DISCUSSION

The mean daily energy and nutrient intake of the subjects was calculated. In Table 1 the values are elaborated and are compared with the Recommended Dietary Allowance (RDA).The total subjects were 200 in number and were divided into male and female subjects from Kurukshetra and Delhi (NCR) region as 50 each. The Table 1 shows the data of females belonging to regions of Kurukshetra and Delhi (NCR). The energy intake was really high before conduction of the study but after interventions the decrease in energy intake reduced significantly. The variation after the study period among all the experimental and control groups was highly significant ($P \leq 0.01$) while in the beginning of the study it was non significant as the energy intake was almost the same in all obese female subjects. The post analysis of the data showed the difference from the control group was significant ($P \leq 0.01$) in groups E1, E2 and in E1, E2, E3 in females of Kurukshetra and Delhi subjects respectively. The variation among the groups was non significant in females of Kurukshetra while the variation among rest of the experimental and control groups was significant ($P \leq 0.01$) . The difference from the control group was significant ($P \leq 0.01$) in groups E1 and E1, E3 in females of Kurukshetra and Delhi (NCR) respectively. (Levin, 1998) stated that high protein diets have to be suggested for a limited period of time for such diets as they can have adverse effect on health otherwise high protein weight loss diets are those that provide more than 1.6 grams per kg of desirable weight loss per day. So such mono diets were not prescribed to the subjects. The mean intake of fat by female subjects of Kurukshetra and Delhi (NCR) of experimental groups – E1 (Exercise), E2 (Hypocaloric diet), E3 (Exercise plus Hypocaloric diet) was reduced after intervention from 67 ± 7.8 to 21 ± 1.05 , 48 ± 16.01 to 23.5 ± 1.8 , 55.2 ± 6.1 to 24 ± 1.30 and in Delhi subjects reduction from 66.1 ± 7.6 to 17 ± 2.58 , 58.5 ± 3.8 to 22.2 ± 3.4 , 55.5 ± 3.3 to 20.3 ± 4.4 and in control group from 66.9 ± 10.4 to 22 ± 2.05 and 71.8 ± 13.8 to 20.7 ± 3.7 respectively. The variation among the experimental and control group was highly significant ($P \leq 0.01$) both before and after the intervention. The difference from the control group was significant ($P \leq 0.01$) in groups E2 and E1, E2 in females of Kurukshetra and Delhi (NCR) respectively. The female subjects were taking fat in the beginning to a greater extent and after that their fat intake was reduced due to dietary intervention.

Statistically in the start of the study there was a non significant variation among all the groups with respect to carbohydrate intake. While at the end of the study period there was highly significant ($P \leq 0.01$) variation in the carbohydrate intake among the experimental and control group. The mean difference between the groups before and after intervention was non significant. The subjects were taking refined carbohydrates like roots and tubers, rice, white bread so the after dietary counseling the subjects were taking whole cereals, pulses and more of complex carbohydrates than the simpler forms. The subjects were found to be ignorant towards fibre intake and had no knowledge of fibre rich food groups in the beginning of the study. So after dietary guidance the food groups such as whole cereals, sprouts, lotus stem vegetable, fruits such as guava and papaya, figs were inducted in their daily dietary schedule. According to Mishra (2009), High fibre diet results in weight loss as it is low in calories and our body burns calories while digesting fibre. According to the RDA'S (ICMR 1989) the calcium intake was 400 g/day. The calcium intake was more among the subjects so after interventions it was reduced back to normal. According to table no. 1, the intake of dairy products was very high so calcium levels also exceeded more than the RDA'S. After imparting nutrition education and dietary counseling the calcium intake came almost normal. The mean iron intake of female subjects of Kurukshetra and Delhi (NCR) was increased from 24.4 ± 10.9 to 32.3 ± 4.9 , 20.6 ± 5.6 to 37.2 ± 5.56 , 23.9 ± 6.26 to 37.2 ± 4.5 and in Delhi (NCR) subjects reduction from 18.4 ± 2.2 to 41 ± 3.94 , 26.7 ± 10.5 to 43.5 ± 3.3 , 18 ± 2.40 to 39.6 ± 3.7 and in control group from 18.2 ± 2.9 to 39.5 ± 1.5 and 19.4 ± 3.4 to 44.5 ± 1.5 respectively. The previous table showed the increase in consumption of Green leafy vegetables, meat and meat products so the iron levels were also increased among both male and female subjects. The dietary intervention helped the subjects to change and induce healthy food groups in their diet. The ascorbic intake was increased after imparting dietary counseling and the subjects induced citrus fruits, GLV's and sprouts in their diets. The dietary intake of whole cereals and whole pulses was not adequate so thiamine levels were improved after the intervention. The study showed not much inadequacy of the vitamin. Therefore according to the RDA'S (ICMR 1989) the Thiamine intake was 1.2 mg/day. Further the induction of whole cereal grains and pulses in the diet maintained healthy thiamine levels. Therefore intake of thiamine content remained sufficient despite of low calorie diets also. The intake of niacin was less before the intervention then after the dietary counseling the levels were improved due to induction of healthy various food products like whole cereals, pulses, vegetables and fruits. Sandhu (2002) supported the increase in niacin intake after dietary intervention. The present study showed the effect of dietary counselling in improving the food habits among the subjects .The subjects were taking healthy diets after the intervention and also adequate amount of nutrients in the diet.

Conclusion

The present study was conducted keeping in view the deteriorating health of obese subjects. They start following unhealthy or fad diets in order to lose weight. The vitamins and mineral deficiencies were common in the subjects. They often complained of joint pains, body aches and fatigue. Therefore the nutritional status was improved for the subjects. According to Ogden (1997), the recommendation of low calorie diets is 1300-1500 calories per day and 1000-1200 calories per day for young adult female and male respectively. A deficit of 500 – 1000 calories per day resulted in a slow progressive weight loss of 0.5 - 1 kgs per week. This is healthy way to loose weight without any nutritional deficiencies. The protein intake of subjects was decreased after the dietary counselling as intake of food groups such as pulses, dairy products meat products was reduced. The subjects were also aware that they had to avoid fat in their diet so the variation was less among them. Low fat and very low fat diets are also recommended for fat loss.Very low fat diets such as Pritkin diet and Ornish diet are advocated not only for weight reduction but also for improving CHD risk profiles (Okens, 2005). The Ornish diet, which is very low in fat (13 per cent of calories) and saturated

fat, very high in fiber (38 g) is a part of programme that includes exercise and behavior modification. It was found to reduce CHD in long term. The subjects were advised to avoid the food products of high glycemic index such as rice, cornflour, refined flour products as these were converted to fatty acids in the body hence causing weight gain in the subjects. Moreover fibre increases peristalsis movement of intestines which enhances digestion. Sharma (1998) also supported increase in fibre intake among obese subjects after imparting dietary counselling. Sandhu (2002) reported an increase in beta carotene was due to increased consumption of dairy products, GLV's before study and was stabilized after the dietary intervention. The iron intake was also increased as the subjects were not eating enough green leafy vegetables, beet root and other lean meats. Overall improvement in fruits, vegetables and cereals intake resulted in the improvement of B complex vitamin class. The subject lost weight with meager nutritional deficiencies.

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