

# Пищевой профиль пациентов с морбидным ожирением, находящихся на лечении в Центре высокотехнологической медицинской помощи Южной Индии

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**Актуальность.** Ожирение стремительно распространяется по странам и континентам, являясь одной из ключевых проблем общественного здравоохранения в современном обществе.

**Цель.** Основная цель этого исследования заключалась в изучении демографических, антропометрических и пищевых характеристик пациентов с морбидным ожирением, а также различий в потреблении нутриентов в зависимости от региона проживания.

**Материалы и методы.** Исследование проведено с участием 101 пациента с морбидным ожирением из разных регионов Индии. Все пациенты наблюдались в Клинике бариатрической хирургии, Центр высокотехнологической медицинской помощи, Индия. Зарегистрированы социально-демографические характеристики и антропометрические данные участников исследования. Оценка питания проведена на основании 24-часового дневника питания и опросника частоты потребления различных пищевых продуктов. Исследование одобрено Наблюдательным комитетом, от каждого участника исследования получено добровольное информированное согласие.

**Результаты.** Более 3/4 участников были женского пола, 61% имели сахарный диабет 2 типа. Средний возраст участников мужского и женского пола составлял  $41,3 \pm 15,5$  лет и  $36,7 \pm 11,9$  года соответственно. Средний ИМТ составлял  $41 \text{ кг/м}^2$ . Среднее ежедневное потребление калорий составляло более 2200 ккал/день, с дефицитом в потреблении микроэлементов. С учетом поправки Бонферрони удалось установить, что существуют различия в потреблении нутриентов в зависимости от региона проживания: наименьшее потребление микронутриентов характерно для пациенток с морбидным ожирением, проживающих в южных регионах Индии, наибольшее — для их соотечественниц из Восточной Индии. У мужского населения наблюдалась значительная региональная разница в потреблении белков ( $p=0,039$ ) и энергии ( $p=0,024$ ). С использованием критерия Стьюдента выявлено, что наибольшее потребление белка характерно для мужчин, проживающих в Южной Индии. Антропометрические данные показали положительную корреляцию с объемом потребления макронутриентов.

**Заключение.** Для значимого улучшения качества жизни пациентам с ожирением необходимо регулярное наблюдение мультидисциплинарной команды, состоящей из эндокринолога, психиатра, диетолога, бариатрического хирурга и социального работника. При ведении таких пациентов важно учитывать влияние региона проживания.

**Ключевые слова:** ожирение, питание, нутриенты, бариатрическая хирургия, антропометрия, ИМТ

## Nutritional profile of the morbidly obese patients attending a bariatric clinic in a South Indian tertiary care centre

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**Background:** Obesity is sweeping across continents and is a major public health concern of the modern society.

**Aims:** The main objective of this study was to study the demographic, anthropometric and dietary patterns of the morbidly obese and study region wise variation in their nutrient intake.

**Materials and Methods:** The study was conducted on 101 morbidly obese individuals from different regions of India who attended the Bariatric clinic of a tertiary care hospital in India. Their socio-demographic details, anthropometric measurements were collected. The dietary assessment was done using a 24 hour dietary recall and a food frequency questionnaire. The study was approved by the Institutional review board and informed consent was obtained from them.

**Results:** More than 3/4th of the patients were females and 61 per cent had Type 2 diabetes mellitus. The mean age of the male and female population was  $41.3 + 15.5$  years and  $36.7 + 11.9$  years respectively. Their mean BMI was  $41 \text{ kg/m}^2$ . The mean daily intake of calories was more than 2200kcal/day with a gross deficit in the intake of micronutrients. Bonferroni Test showed that there was region wise variation in dietary intake, South Indian female population had the lowest intake of the micronutrients and those from East India had the high-

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est intake. In the male population, there was a significant regional difference in intake of Proteins ( $p=0.039$ ) and Energy ( $p=0.024$ ). Independent Sample T test showed that South Indian had the highest intake of Energy and proteins. Anthropometric measures showed positive relation with various macronutrient intakes.

**Conclusion:** The obese patients require intense counselling by a dedicated team of an endocrinologist, psychiatrist, dietician, bariatric surgeon and a social worker to make achievable changes in the quality of life of the morbidly obese patients. Regional influences must be considered when counselling the patient.

**Keywords:** obesity, diet, nutrients, bariatric, anthropometry, BMI

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## Introduction

Obesity is sweeping across continents and is a major public health concern of the modern society (1). Morbid obesity is a medical term describing people who have a Body Mass Index (BMI) of more than 40 or of 35 to 40 with significant medical problems, caused by or made worse by their weight (2). This is a serious health condition that negatively impacts the physical, mental and social well-being of an individual. The morbidly obese are at a higher risk for illnesses including diabetes, hypertension, obstructive sleep apnoea, gastro-oesophageal reflux and cancer (3).

The prevalence and incidence of Obesity is increasing rapidly in developed and developing countries (3). The global burden of Obesity is 9.8% (7.7% in males and 11.9% in females). By 2030, it is projected to afflict 1.12 billion individuals worldwide (4).

In the United States of America, there has been a rapid increase in the prevalence of obesity across different BMIs. There has been a 50% to 75% increase in those with BMI over 40 and 50 respectively between 2000 and 2005 (5).

Data from the Gulf countries showed that adult women in the 30-60 years age group had highest prevalence of obesity. Overweight and obesity was found amongst 70-85% in men and 75-88% in women in Kuwait, Qatar and Saudi Arabia (6).

In Asia, Thailand (7) has the highest rate of obesity (6.8%) followed by Singapore (8) (6%) and China (4%) (1).

Phase I of the Indian Council Of Medical Research study conducted in three States across the Indian continent indicated that generalised obesity classified according to WHO Asia Pacific guidelines (3), ranged between 11.8% to 31.3% and was significantly higher among the urban residents compared to rural areas (9).

The paradigm shift in eating habits, from coarse traditional diets to polished and fast foods has been the major reason for this burgeoning burden. The excess consumption of processed calorie dense foods combined with a declining physical activity has triggered a positive energy balance in the general population.

This is a cross-sectional study of morbidly obese patients being managed in the Bariatric clinic of the Department of Endocrinology, Diabetes & Metabolism of

Christian Medical College, Vellore, Tamil Nadu, India. This hospital is a 2600 bedded tertiary care teaching hospital catering to the medical needs of patients from all over India and its neighbouring countries. The main objectives of this study were to look at the nutrient intake and regional differences in dietary pattern of morbidly obese patients.

## Materials and methods

The study was conducted on 113 morbidly obese individuals who attended the Bariatric clinic over a 6 month period (June to Dec 2016). None of the patients had prior dietary counselling. All patients with a Body Mass Index greater than 35 kg/m<sup>2</sup> were included in the study.

The demographic details of the patients were obtained by face to face interview using a pre-tested questionnaire. All the patients were examined by an endocrinologist. Anthropometric measurements including weight, height, waist and hip circumference, of the patients were measured using standard procedures ( $n=113$ ). Their BMI was interpreted according to Asia-Pacific guidelines (3).

Nutritional data of the patients was recorded by 24 hour recall along with a frequency questionnaire, by a qualified dietician. The food frequency questionnaire elicited data related to intake of cereals, pulses, vegetables, fruits, nuts & oilseeds, milk & milk products, meats, eggs and poultry. Standardised vessels and pictorial representation of foods were used to achieve accuracy in the data.

The nutrient composition of diet was computed from the book- Nutritive Value of Indian Foods (10). Patients were provided individualized advice on diet modification for optimal nutrient intake and sustained weight loss.

The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki (and revised in 2000) and approval was obtained by the Institutional Review Board of Christian Medical College & Hospital, Vellore, India (IRB Min. No 1014 dated 22-06-2016).

**Statistical analysis:** The data was statistically analysed using SPSS version 18. Chi-square test and Pearson Correlation was used to study the association between nutrient data and demographic and anthropometric data. ANOVA analysis and post-hoc analysis (Bonferroni Test) were done to study regional difference in nutrient intake of the populations. P values  $<0.05$  were considered statistically significant.

Table 1

Baseline characteristics of Bariatric patients		
Profile	Frequency	Percent
Age in years		
<17	8	7.1
>18 to 37	50	44.6
>38	54	48.2
Mean Age in years <sup>a</sup>	4 1.4 (12.7)	38.8 (11.2)
Gender		
Male	21	18.6
Female	92	81.4
Educational status		
<12th Class	48	48.5
>12th Class	51	51.5
Region of Origin		
South India	55	49.5
East India	44	39.6
Central India	4	3.6
Others	8	7.2
Marital Status		
Married	78	75
Single	26	25
Diabetes status		
Non-Diabetes	46	41.1
Pre-Diabetes	4	3.6
Diabetes	62	55.4

<sup>a</sup>Reported in Mean and Standard deviation

## Results

### Baseline details

A total of 113 morbidly obese patients were included in the study. Their baseline characteristics are presented in Table 1. The mean age of the subjects was 37.6 years (SD 12.6). This included eight adolescents in the age group of 13-17 years. More than 90 per cent of the patients were females. Half the population were educated beyond school. There were a large number of patients from East India (West Bengal). Eight of the patients (7.2%) hailed from the neighbouring countries of Bangladesh and the Gulf countries. Three-fourth of them was married. More than half the study population had Diabetes

The above Table 2 highlights the anthropometric measurements of morbidly obese adults (BMI >34.9) who were managed at the Bariatric clinic. Only adults (age >18years) were included in this analysis. All the anthropometric measures were higher than the Asia Pacific standards (3). The male subjects had a higher BMI than the female population. The mean waist circumference (124.7 cm) was larger than the mean hip circumference (119.9 cm) in the males, and in the female population it was the reverse (115.5cm; 121.5cm).

### Energy and nutrient data

The nutrient data indicates that the male and female subjects were consuming more than 2200 calories per day. Fats constituted a major proportion of the total calories. There was a deficit in the intake of proteins.

Forty nine patients (females n=38; males n= 11) who underreported their dietary intake (total calories intake < 1800kcal/day) were excluded from this analysis to prevent data distortion.

The above figure illustrates the intake of nutrients and energy of morbidly obese male and female patients as percentages of their RDA. It is apparent that the intake of Fats and energy was grossly greater than the RDA in both the male and female subjects. However there was

Table 2

Anthropometric data of Morbidly Obese adult male (n=19) and female patients (n=85)		
Variables	Male Mean (SD)	Female Mean (SD)
Mean Weight kg	116.4 (27.0)	96.4 (14.6)
Mean Height cm	169.9 (9.0)	156.9 (6.0)
Mean Body Mass Index	42.5 (13.1)	39.3 (4.8)
Waist circumference	124.7 (22.2)	115.5 (13.9)
Hip circumference	119.9 (16.2)	121.5 (11.9)
Waist Hip Ratio	1.0 (0.1)	0.95 (0.1)
Waist Height Ratio	0.73 (0.1)	0.74 (0.1)

a deficit in the intake of micronutrient intake in this population.

### Gender and Region wise distribution of Nutrients & Energy

ANOVA was done to find if there were regional differences in the nutrient intake of patients from South India (Tamil Nadu, Karnataka, Kerala, Andhra Pradesh), East India (West Bengal, Chattisgarh, Jharkhand), Central parts of India (Madhya Pradesh, Maharashtra) and neighbouring countries (Bangladesh and the Gulf).

In the female population (n=54) there was a significant difference in the intake of fibre ( $p<0.001$ ) carotene ( $p=0.025$ ), niacin ( $p<0.001$ ), Folic acid ( $p<0.019$ ), Calcium ( $p<0.022$ ) and Iron ( $p<0.001$ ) between the different regions. Bonferroni Test showed that the South Indian female population had the lowest intake of these micronutrients and those from East India had the highest intake.

In the male population (n=10), there was a significant regional difference in intake of Proteins ( $p=0.039$ ) and Energy ( $p=0.024$ ). Independent Sample T test showed that South Indian had the highest intake of Energy and proteins.

Anthropometric measures showed positive relation with various nutrient intakes. In female subjects, Pearson correlation found that the BMI of the subjects were positively correlated with their intake of proteins ( $r=0.413$ ,  $p=0.002$ ), carbohydrates ( $r=0.280$ ,  $p=0.040$ ), fat and negatively correlated with the vitamin C ( $r=-0.319$ ,  $p=0.019$ ). The Hip circumference correlated with carbohydrates intake ( $r=.285$ ,  $p=0.040$ ). There was a strong positive correlation between the intake of fibre and micronutrients. A high fibre intake ensured a good intake of micronutrients like Iron ( $r=0.455$ ,  $p<0.001$ ), Riboflavin ( $r=0.567$ ,  $p<0.001$ ), Niacin ( $r=0.479$ ,  $p<0.001$ ), Folic acid ( $r=0.791$ ,  $p<0.001$ ) and Vitamin C ( $r=0.715$ ,  $p<0.001$ ).

In the case of the male subjects positive correlation was significant between waist circumference and energy intake ( $r=0.029$ ,  $p=0.029$ ), the hip circumference and fat and iron intake respectively ( $r=0.851$ ,  $p=0.007$ ;  $r=0.776$ ,  $p=0.024$ ).

Based on the BMI of the patients they were classified into 4 quartiles. Anova and post hoc Bonferroni test revealed that those with the largest BMI had the highest protein intake ( $p=0.017$ ).

### Diet Quality

The qualitative data was obtained from a sub-sample of the patients (n=52). Majority of the patients were

Table 3

Nutrients	Mean (SD) Nutritional data of Morbidly Obese adult male and female patients per day			
	Males		Females	
	Mean	SD	Mean	SD
Energy kcal	2309.4	405.6	2412.6	323.0
Proteins gm	70.1	20.8	77.7	17.3
Fat gm	81.3	22.2	71.0	21.9
CHO gm	324.3	80.1	366.0	58.0
Fibre gm	11.7	6.4	13.8	6.2
Calcium mg	648.9	248.1	655.5	211.4
Phosphorous mg	4234.4	7491.2	3996.6	4391.8
Carotene mcg	3729.4	2515.4	2750.1	1963.0
Thiamine mg	1.2	0.5	1.4	0.5
Riboflavin mg	0.9	0.4	1.1	0.3
Niacin mg	13.2	5.0	15.4	4.1
Folic acid mg	244.0	86.3	311.6	116.8
vitamin mg	93.9	94.1	82.7	26.9
Iron mg	16.2	5.0	17.5	4.6
Percent of calories from CHO	55.5	7.9	60.4	7.3
Percent of calories from proteins	12.6	3.3	13.2	2.8
Percent of calories from fat	32.0	7.6	26.5	7.2

non- vegetarians (84.7%) and consumed fish, meat and eggs. Nearly half the population skipped meals (42.3%). The most frequently missed meal was breakfast (86.4%). Three-fourths (73.3%) of them reported that dinner was their heaviest meal. Refined foods were consumed by 84.6% of them. All of them had fried snacks and bakery items three to four times a week. Carbonated drinks were also popular amongst this group. The mean fruit and vegetable consumption (n=52) was 207.14 + 117.7 gm/day. The water consumption was 2.05 + 1.01 litres/day. The daily oil consumption in cooking was 31.6 + 14.9 gm/day.

## Discussion

There is a paucity of research on the nutrient intake of morbidly obese patients from India. This study attempts to study the nutritional data of morbidly obese patients and detect any regional differences in their dietary habits.

Our study found an excess of 510 kcal per day in the female population and 100 kcal per day in the male population. Region-wise analysis found that South Indians consumed significantly more calories than those from other parts of India. We had to exclude data from forty nine patients since they underreported their diet intake. Under reporting is not uncommon in this group of subjects (11). A US study found that 35-38% of the male and female subjects underreported their nutrient intake (12). These findings have significance in dietary surveillance and epidemiology studies.

The fat intake was higher than the RDA for Indians (10). Added fats during food preparations were a significant contributor of calories. The mean quantity of cooking oil used for daily preparations was 31.6 + 14.9 gm/day. This disproportionate calorie intake from fats over a period of time accrues as excess adipose tissues initiating obesity.

The diet of the study population was deficit in proteins. The male population in South India consumed significantly higher proteins than the overall population. It was interesting to find that there were no regional

differences in the protein intake amongst the female population.

Similar findings have been reported by a Spanish study on the morbidly obese patients (BMI of  $48.2 \pm 7.8$  kg/m<sup>2</sup>) who found that their mean energy intake was  $2,584 \pm 987$  kcal/day in males and  $2,094 \pm 669$  kcal/day in females ( $p < 0.05$ ). The fats contributed 41.9% calories in males (CI 39.6 to 44.2) and 43.0% in females (CI 41.7 to 44.8) (13). The protein intake of this population was 19.1% of calories in males (CI 17.7 to 20.5) and 17.3% in females (CI 16.4 to 18.1) respectively.

It was not surprising to find that the intake of micronutrients was below the RDA. There was a deficit in the intake of micronutrients like carotene, riboflavin and Iron. This can be attributed to the poor intake of fibre rich foods like fruits and vegetables in the diet. The National Health service (UK) has recommended that an individual consume five servings of fruits and vegetables per day (1 fresh serving = 80gm) (14). Our data indicated a low intake of fruits and vegetables ( $207.14 + 117.7$  gm/day) which was far below the recommended intake resulting in a deficit in micronutrient intake. These patients should be encouraged to include fruits and vegetables at each meal. Thus the present obesogenic diet they are consuming should be replaced by a nutrigenic diet. A Spanish community out-reach program for the morbidly obese of BMI 45.5 kg/m<sup>2</sup> showed positive changes in their body weight with a subsequent increase in the consumption of fruits & vegetables at the 3rd and 6th month follow-up visit (15). Thus inculcating healthy eating habits and reinforcing them at frequent intervals shows promising results.

The food frequency assessment revealed that cereals constituted the major portions at each meal (56% to 60% of the total calories). The South Indian population had the lowest intake of fibre and this can be attributed to polished rice, which was the staple food. This refined cereal is devoid of nutrient rich fibre and B-complex vitamins and is available at a subsidised cost in the public distribution system (PDS). Millets (small high



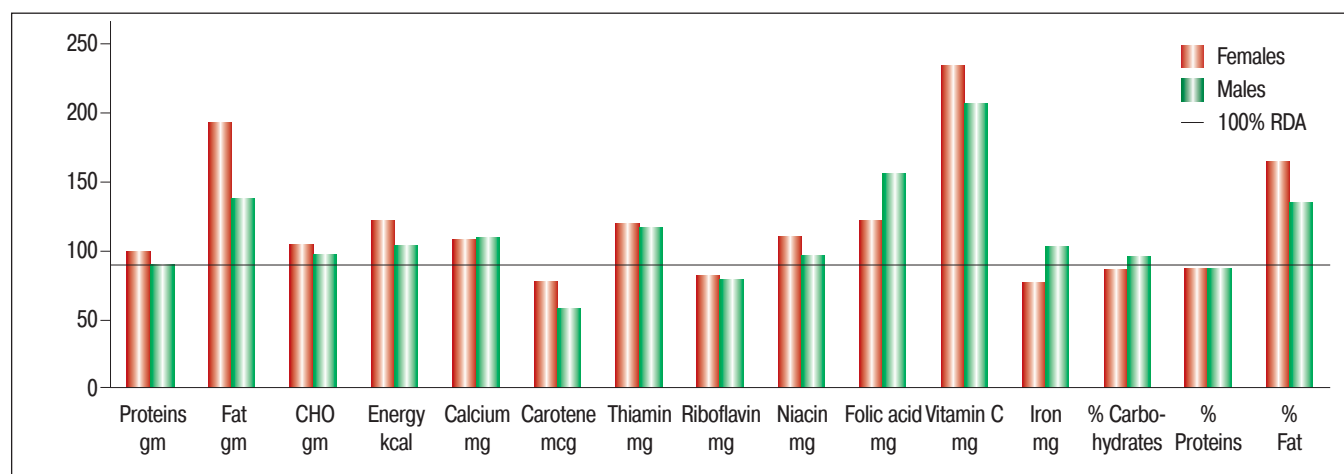


Рис. 1. Потребление энергии и питательных веществ участниками исследования мужского и женского пола, в процентах от рекомендуемой суточной нормы.

fibre grains) which was the primary food of the earlier generations, has a lower glycaemic index due to its high fibre content and higher satiety index. These nutriceals need to be introduced into the public distribution system so that it can be available at a subsidized cost. Amongst those from East and Central India, wheat was the staple food.

Majority of them consumed fish, meat and poultry less than thrice a week. Milk, pulses and refined cereals were the major contributor of proteins. There was a distinct difference in the style of food preparations. The fish preparations were always fried prior cooking amongst those from East India. Mustard oil was popular in those from East India and refined vegetable oils were used by others.

A review paper on the global snacking pattern of the obese/overweight, revealed that the frequency of consumption, quality of food choices and context/environment of eating snacks contribute to excess energy from fats with little nutrition. The author goes on to say that in this vulnerable population of obese/overweight individuals, snacking often happens in the absence of hunger, in an irregular fashion and due to non-physiological cues. This snacking pattern is a major cause of obesity. Thus interventions aimed at decreasing snacking should address food choices and behavioural components (16).

Substituting with fresh fruits and vegetables will not only reduce the calorie intake but fill the micronutrient gap in this group of patients.

A study of French adults found that sweets, cereal bars, biscuits, and sodas were mostly consumed as snacks (17). Brazilian study found that snacking was more prevalent during the afternoon and evening hours. Sweetened coffee and tea, sweets and desserts, fruit, sugar-sweetened beverages, and high-calorie salgados (fried/baked dough with meat/cheese/vegetable) were the top five most commonly consumed snacks (18).

Our study population snacked on traditional fried snacks, bakery snacks and Indian sweets which are rich in added sugars and solid fats. Carbonated drinks and Western fast foods (burgers, pizzas) were more popular with the younger generation. Majority of them attributed to eating snacks even in the absence of hunger.

Meal pattern showed that nearly half of them skipped their meal, mostly breakfast. They indulged in a calorie dense snack at mid-morning and late afternoon/evening. Dinner was the heaviest meal for 84.6% of the study population. Emerging evidence suggests that eating irregularity and eating later in the day may be detrimental for weight control. Ensuring regular regime in eating is pivotal in weight management (19).

Recent epidemiological studies from France points out that, increased feeding frequency reduces the total secretion of insulin, insulin resistance, improves blood glucose control and blood lipid profile. The authors recommend to split the total energy intake into as many meals as our social pattern allows without exceeding our daily requirements, keeping a good balance of macronutrients and micronutrients (20). The major problem in our population was the "uncontrolled grazing through the day" pattern which was the major root for intake of excess calorie intake.

Anthropometric measures like BMI, waist and hip circumference of our subjects positively correlated with the proteins, carbohydrates and fat intake. Thus reiterating that in these groups of patients, a daily reduction in the intake of these macronutrients is the key to weight reduction.

To our knowledge, this is the first study from Southern India that looked at the dietary pattern of morbidly obese patients. The limitation of the study was that the dietary data was obtained by the 24 hour recall method and self-reported food frequency, the accuracy of which is questionable. This output tends to over or underestimate the actual intakes. Moreover nearly one-third of them under reported their dietary intake and it was not possible to extrapolate their actual food intake. Studies with more objective measures of dietary intake will give a more vivid picture.

### Conclusions:

The Obese patients are a vulnerable group who require intense and frequent counselling by a dedicated team of an endocrinologist, psychiatrist, dietician, bariatric surgeon and a social worker to make sustained diet alterations and achieve desirable body weight within a feasible period of time.

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