

DIABETES RISK, NUTRITIONAL STATUS AND ENERGY BALANCE AMONG SELECTED OBESE/OVERWEIGHT MALE COLLEGE STUDENTS IN COIMBATORE CITY AND IMPACT OF NUTRITION EDUCATION

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Abstract: Obesity is one of the major causative factors for precipitating diabetes and many other disorders. From 100 obese / overweight male college students, data on anthropometry, diet, exercising habits and energy expenditure were collected. Using the tool-IDRS (Indian Diabetes Risk Score) given by Mohan *et al.* (2005) the degree of risk of developing diabetes was studied. Food intake, nutrient intake and energy expenditure / day were also determined. Nutrition education was imparted and the impact of the education was studied. The body mass index (BMI) and waist hip ratio (WHR) were above normal for all. None of them had the habit of doing any physical exercise. Family history of obesity and diabetes were seen in 70% and 42% respectively. High and moderate risk (IDRS) of developing diabetes was seen in 41% and 59% respectively. Mean intake/day of cereals, pulses, fruits, milk, fat and sugar were higher (22% to 368%) than the ICMR recommendations. Intake of greens (80%), roots and tubers and other vegetables (69%) were significantly lower. With respect to the nutrient intake, the mean intake of energy, fat and protein were much higher. The mean energy intake and expenditure were 3680kcal and 1874kcal respectively with a shocking positive energy balance of +1806kcal / day. The fiber intake was only 16.36g. The mean score obtained by the students was 6.66 out of 15 in the 'pre-test' and it increased to 13.49 in the 'post-test', registering a significant improvement in their knowledge as proved by paired-'t' test. Diabetes risk is high among the youth and it needs to be reduced by sustained nutrition education.

Index Terms – Obesity, Diabetes, IDRS, Nutrition Education

1. INTRODUCTION

Obesity is becoming prevalent globally. Earlier known for under nutrition, Indians now exhibit more prevalence of obesity and overweight. Obesity has been proved to be a major causative factor for precipitating diabetes, heart disease, stroke, hypertension, high LDL, low HDL, some forms of cancer, gallbladder and joint diseases and psychological problems. Obesity leads to an alteration in the profile of hormones secreted by adipose tissue (adipokines). In the obese state, adipose tissue secretes more adipokines that cause insulin resistance. Visceral obesity has important role in developing insulin resistance through certain inflammatory cytokines, such as IL-6, TNF-alpha and TGF b1 (Abdullah *et al.*, 2014).

Keeping the above facts in mind, this study was undertaken with the objectives listed here under:

1. To study the nutritional status of the selected obese / overweight male college students.
2. To find the energy balance and risk of diabetes using the tool 'Indian Diabetes Risk Score' (IDRS) and
3. To impart nutrition education and to study the impact.

2. MEHODOLOGY

2.1 Selection of Area

PSG College of Arts and Science, Coimbatore was chosen for the study, as obesity and overweight (the main causative factor for various non – communicable diseases like diabetes, CVD, hypertension, cancer, sleep apnea etc.) are prevalent among adolescents and young adults.

2.2 Selection of Students

Obese / Overweight male college students (100 no.) were chosen by convenient sampling method. Their heights and weights were measured to ascertain that they were obese / overweight. They were between the age group of 19 and 24 years.

1.3 Preparation of the questionnaires

1.3.1 Questionnaire 1 (Anthropometry)

The questionnaire 1 was prepared to elicit data on anthropometric measurements.

1.3.2 Questionnaire 2 (The tool IDRS- Indian Diabetes Risk Score)

The questionnaire 2 had the tool – IDRS (Indian Diabetes Risk Score) given by Mohan *et al.* (2005). The details included in the tool were age, waist circumference, physical activity and family history of diabetes mellitus. The range of scores and the corresponding degree of risk of diabetes are given in table 1 & 2

Table 1 Criteria for assessment of risk of diabetes*

PARTICULARS	SCORE
Age [years]	
<35	0
35-49	20
≥50	30
Abdominal obesity	
Waist <80cm [female], <90[male]	0
Waist ≥ 80-89 cm [female], ≥ 90-99cm [male]	10
Waist ≥ 90cm [female], ≥100 cm [male]	20
Physical activity	
Exercise [regular] + strenuous work	0
Exercise [regular] or strenuous work	20
No exercise and sedentary work	30
Family history	
No family history	0
Either parent	10
Both parents	20
Minimum score	0
Maximum score	100

*To be filled by the researcher

Table 2 Range of scores & degree of risk of diabetes

Range of scores	Degree of risk of developing Diabetes
<30	Low risk
30-50	Moderate risk
≥60	High risk

1.3.3 Questionnaire 3 (Diet Survey and Energy Balance Study)

Questionnaire 3 was framed to conduct the diet survey (24 hours recall method) to study the food and nutrient intake and dietary pattern of the selected male students. Activity and energy expenditure chart (Sathyanarayana *et al.*, 1977) was also included in this questionnaire to study the energy balance.

1.4 Collection of Data

1.4.1 Anthropometric Measurements (n=100)

Height (cm), weight (kg) and waist & hip circumferences (cm) were measured by following standard procedures. From the measurements, Body Mass Index (BMI) and Waist Hip Ratio (WHR) were computed.

1.4.2 Study of Diabetes Risk (IDRS)

Using age, waist circumference, physical activity pattern and family history of diabetes, IDRS was computed and level of risk of developing diabetes was assessed.

1.4.3 Diet Survey and Study of Energy Balance (n=25)

For diet survey (24 hours recall method), the 3rd questionnaire was given to the selected sub sample of 25 students and they were asked to fill up the questionnaires. Doubts pertaining to food consumption pattern, meal frequency, quantities taken etc. raised by the respondents were cleared in order to make them provide right information in the suitable format. The mean food and nutrient intake including energy intake by the sub sample was calculated from the data gathered by 24 hours recall method.

The chart for the study of energy expenditure given by Sathyanarayana *et al.*, (1977) was given to them and they were made to fill up the activities performed by them every 15 minutes. Using that data the mean energy expenditure per day was calculated and the energy balance was also derived.

1.5 Study of Impact of Nutrition Education Program (n=100)

1.5.1 Pretest of the 'Knowledge on Nutrition' among the Selected Students

To test the knowledge of the selected male students in the field of food and nutrition, a set of 15 questions were framed and they were asked to fill up the answers. One mark was allotted to each question. The answers were corrected and the initial score obtained by the selected students were recorded. The questionnaire prepared for the test of knowledge included questions on Ideal Body Weight (IBW), BMI, WHR, fatty foods, food groups, physical activity, risk factors of obesity etc.

1.5.2 Conduct of Nutrition Education Program

Nutrition education is an evidence based, economic way to improve health outcomes and foster healthy eating habits for a life time. Useful and interesting information regarding obesity / overweight and ill effects were gathered and arranged coherently. A set of slides including definition of obesity, etiology, ill effects, complications of obesity / overweight, management of obesity, relation between obesity and diabetes etc. were prepared. The selected obese / overweight male students were asked to assemble in batches and the nutrition education was imparted to them using PowerPoint presentation to impress upon the importance of maintaining ideal body weight to lead a healthy life. After presentation a group discussion was held and their doubts were cleared. Repeated sessions were held for a period of two weeks.

1.5.3 Post test of the 'Knowledge on Nutrition' among the Selected Male Students

The same set of 15 questions used for 'pretest' was given to the students after the nutrition education program. They were asked to fill up the questionnaires and the scores obtained were recorded for comparison with the respective scores obtained in the pre-test of knowledge.

1.6 Consolidation of Data and Statistical Analysis

The collected data were consolidated for tabulation and statistical analysis. Paired 't' test was applied to study the impact of nutrition education.

2. RESULTS & DISCUSSION

2.1 Body Mass Index of the Selected Obese / Overweight Students (n=100)

Body mass index (BMI) is a measure of weight adjusted for height, calculated as weight in kilograms divided by the square of height in meters (kg/m^2). Although BMI is often considered an indicator of body fatness, it is a surrogate measure of body fat because it measures excess weight rather than excess fat. However, Body Mass Index (BMI) is an appropriate measure for screening for obesity and its health risks. High BMI predicts future morbidity and death (Centers for Disease Control and prevention, 2011).

Table 3. BMI of the selected obese / overweight students (n=100)

BMI	Category	Number / Percentage of Students
< 25	Normal	-
25-29.9	Overweight	61
30-34.9	Grade I obesity	37
35-39.9	Grade II obesity	02
≥ 40	Grade III obesity	-
Total	-	100

In the present study, the students were selected only in obese and overweight category; obviously no one recorded BMI of <25. From the table 3 it is clear that 61% of the selected students were overweight and the rest were obese. Grade I and grade II obesity were recorded by 37% and 2% respectively. None of the selected students were under the category of grade III obesity. A high BMI is associated with risk of hypertension, higher total cholesterol, and lower level of HDL cholesterol. The overall risk of coronary heart disease and stroke therefore increases substantially with weight gain and obesity (Jung, 1997).

2.2 Waist Hip Ratio of the Selected Obese / Overweight Students

In the present study it was seen that the waist hip ratio was above normal (>1.0) for all the selected obese students. WHR is the most useful measure of obesity and the best simple anthropometric index in predicting a wide range of risk factors and related health conditions (Akpınar *et al.*, 2007).

2.3 Frequency of Physical Exercises done by the Selected Obese / Overweight Students (n=100)

It was shocking to see that none of the selected students had the habit of doing physical exercise daily. Sedentary or inactive behaviors and low levels of physical activity are important contributors to the increasing prevalence of obesity among children and adolescents. Strategies to increase physical activity are therefore one of the key elements in the treatment of childhood obesity, along with changes in eating behavior. In addition, participation in physical activity may improve psychological well-being and cardiovascular fitness (Grilo, 1994).

2.4 Family History of Obesity and Diabetes Mellitus among the Selected Obese / Overweight Students (n=100)

The data revealed that 70% of the selected students had the family history of obesity and 42% had the family history of diabetes. The family members were parents / grandparents / siblings. Sanjay *et al.* (2014) also studied the prevalence of obesity and overweight among college students and found significant association with family history.

2.5 Degree of Risk of Developing Diabetes among the Selected Obese / Overweight Students (n=100)

Using the tool (IDRS – Indian Diabetes Risk Score) given by Mohan *et al.* (2005), scores were given to the selected students as mentioned in the table 2. Based on the total scores of the selected obese / overweight students, the degree of risk for developing diabetes was found. The table 4 gives the various level of risk predisposing to diabetes mellitus.

Table 4. Degree of Risk of Developing Diabetes among the Selected Obese / Overweight Students (n=100)

Scores	Degree of risk	Number / percentage of students
<30	Low risk	Nil
30 – 50	Moderate risk	59
≥60	High risk	41
Total	-	100

From the table 4 it is obvious that 41% of the selected obese / overweight students had **high risk** of developing diabetes mellitus. **Moderate risk** was observed in 59% of the selected students. Presence of such high risk in young adults is not a healthy picture. Though the risk factors listed included non-modifiable factor i.e., age and genetic factor, the other factors were definitely modifiable. Hence proper dietary habits and physical exercise put together would undoubtedly help these obese / overweight students to reduce the above mentioned risk factors thereby preventing the predisposition of diabetes.

2.6 Mean Food Intake by the Selected Obese / Overweight Students (n=25) in Comparison with ICMR RDA (2011)

From the table 5 it can be seen that the intake of cereals and pulses were considerably higher among the selected obese / overweight students when compared to the ICMR (2011) recommendations. Discouragingly the intake of green leafy vegetables and other vegetables was significantly lower than the recommendations. Interestingly, the nutrient rich fruits and milk and milk products were consumed in excess (74.4% and 22.6%) in comparison with ICMR (2011) recommendations.

ICMR (2011) recommends that 50g (one portion) of egg / meat / chicken / fish may be exchanged with 30g (1 portion) of pulse. In the present study though there was excess intake of pulses (60%), 68.4g of non-vegetarian foods were consumed over and above the pulses. Obese / overweight individuals are generally recommended a low calorie diet where sugars and fats and oils have to be restricted strictly. But unfortunately the selected obese / overweight students of the present study consumed excess of sugars (178.5%) and fats and oils (142%).

2.7 Mean Nutrient Intake by the Selected Obese / Overweight Students (n=25) In Comparison with ICMR RDA (2011)

Principles of diet management for the obesity include low calorie, normal protein, normal vitamins and minerals, liberal fluids and high fiber diet (Sreelakshmi, 2007). But it was discouraging to note in the present study that the intake of protein, fat and energy were much higher than the ICMR RDA (2011). This could be attributed to the excess intake of cereals, milk and milk products, sugars, fats, and oils and fleshy foods which are rich in calories and proteins. It was also discouraging to note that the

mean consumption of fiber was only about 16.36 g/day which was lesser than the recommendation. The reason is solely because of such low consumption of other vegetables (69%) and green leafy vegetables (80 %) which are rich sources of fiber.

Table 5. Mean Food Intake by the Selected Obese / Overweight Students in Comparison with ICMR RDA (2011) (n=25)

Food Items	Mean intake (g)	ICMR RDA (g) For Sedentary working adult men	Percentage Deficit / excess
Cereals grain and products	744	375	+98.4
Pulse and legumes*	150	90*	+60
Green leafy vegetables	20	100	-80
Roots and tubers	192	200	-4
Other vegetables	62	200	-69
Fruits	174	100	74.4
Milk and milk products	368	300	+22.6
Sugars	55.6	20	+178
Fats and edible oils	48.4	20	+142
Meat and poultry	68.4*	*one portion of pulses (30g) may be exchanged with one portion (50g) of egg / meat / chicken / fish	-

From table 6 it is clear that fat consumption is 368% more than the RDA, which would have contributed for the chronic positive energy balance precipitating obesity / overweight. Fat provides twice as many calories (kcal) per gram as either carbohydrate or protein. Consequently people who eat high fat diets regularly may exceed their energy need and gain weight. Dietary fat provides more energy (9 kcal) per gram than other nutrients. The fat induces over consumption and weight gain through its low satiety properties and high caloric density (Golay and Bobbioni, 1997).

Table 6. Mean Nutrient Intake by the Selected Obese / Overweight Students in Comparison with ICMR RDA (2011) (n=25)

Nutrient	Unit	Mean intake (g)	ICMR / RDA for sedentary working man (g)	Percentage deficit / excess
Protein	Gram	134	60	+123.3
Fat	Gram	117	20	+368
Fiber	Gram	16.4	30	-45.4
Energy	kcal	3680	2320	+58.6

2.8 Mean Energy Intake, Expenditure and Balance among Selected Obese / Overweight Students (n=25)

Knowing the energy balance is an important step in correcting obesity / overweight since chronic positive energy balance is the major reason for obesity. In the present study the selected sub samples of obese / overweight students recorded a mean positive energy balance of 1805.6 kcal / day as shown in the table 7. If energy intake exceeds expenditure over time, obesity is likely to result. There must be proper balance between intake and output.

Table 7. Mean Energy Intake, Expenditure and Balance among Selected Obese / Overweight Students (n=25)

Mean energy intake (kCal)	Mean energy expenditure (kCal)	Mean energy balance (kCal)
3680	1874.4	+1805.6

Obesity is the end result of mismatch between energy intake and energy expenditure, such that intake exceeds expenditure, resulting in net accumulation of energy stores in the body. Ultimately, obesity is due to excess energy intake and / or a reduction in energy expenditure (Goran, 2000).

2.9 Impact of Nutrition Education Program (n=100)

The mean scores obtained by the selected students were only the 6.66 out of 15 in the pre-test. As seen in the table 8, very low scores (0-5 out of 15) were obtained by 17 students and medium scores (6-9 out of 15) were obtained by a majority of 80 students in the 'pre-test'. Only 3 students recorded the highest scores (10-15) in the pretest. During the nutrition education program most of the respondents were receptive, attentive and interested in the topic.

Table 8. Scores obtained by the Selected Obese / Overweight Students in the Pre Test and Post Test of Knowledge on Nutrition (n=100)

Range of Scores out of 15	Number of students	
	Pre test	Post test
0-5	17	-
6-9	80	-
10-15	3	100
Total	100	100
Mean score	6.66	13.49

p>0.05

In the post test all the 100 students scored above 10 out of 15. The mean score increased to 13.49 out of 15 registering a statistically significant improvement in their knowledge as proved by paired-‘t’ test. Food and Nutrition service (2010) has demonstrated the effectiveness of nutrition education and its significant contribution to improved dietary practices. Well-designed and effectively implemented nutrition education can motivate those participating to change dietary behaviors and provide them with the knowledge and skills to make healthy food choices in the context of their lifestyles and economic resources.

CONCLUSION

Young adults in every society need to be healthy to form a prosperous world. It is unfortunate that urbanization, modernization and many other factors have resulted in faulty food habits and life style precipitating obesity among the youth which would increase the risk of development of non-communicable diseases. Hence it is the responsibility of the health care providers to educate the mass widely making use of all possible ways and means to correct the food habits and life style of people in order to build nations with healthy citizens.

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