©Human Biology Review
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Human Biology Review (ISSN 2277 4424) 3 (1) 2014
Original Scientific paper (Singh and Kaur pp.105-115)
Revised and Accepted on January 23, 2014

Nutritional intake and energy expenditure of working obese women

P. Singh and A. Kaur

Citation: Singh P and Kaur A. 2014. Nutritional intake and energy expenditure of working obese women. Human Biology Review, 3 (1), 105-115.

Paramvir Singh, Associate Professor, Department of Sports Science, Punjabi University Patiala, **email: tparamvir@yahoo.com**

Amarjot Kaur, Assistant Professor, Department of Sports Science, Punjabi University Patiala**, email: akaur71@gmail.com**

Corresponding author: Paramvir Singh, Associate Professor, Department of Sports Science, Punjabi University Patiala, **email: tparamvir@yahoo.com**

ABSTRACT

The study is undertaken on 49 obese women out of 70 women in the age group of 35-40 years of Jalandhar who were surveyed for obesity with respect to their Body Mass Index. BMI of the subject is calculated with the help of height and weight measurements. Twenty four hour dietary recall method is used to calculate the intake of various nutrients. To calculate the energy expenditure of the sample under study, their daily life style activities are recorded. The intake of Carbohydrate and Iron are significantly less than their respective RDA. The intake of fat and Calcium in working obese women is significantly higher than their respective RDA. The Protein intake is almost equal to recommended levels. There is a significant difference between the observed energy intake and observed energy expenditure of working obese women. It was intriguing to find that the energy intake in obese women has been less than that of RDA. There are chances of underreporting of nutrient intakes and over reporting of energy expenditure in order to conform to social psyche and prejudice against obesity as shown by numerous other studies.

Key words: *BMI, RDA, Obesity, Energy Expenditure, Energy Intake, Jalandhar.*

INTRODUCTION

Obesity is the most prevalent nutritional disorder in which there is excessive storage of energy in the form of fat as per height, weight, race and gender (WHO 2005).Obesity is prevalent among all age groups and is on the rise among adults specially the women worldwide in both developed and developing countries (Wang et al. 2004; Flegal et al. 2005). In clinical terms, obesity is a condition of excess body weight, when a person is 10% or more above the ideal body weight (Srilakshmi 2011). Obesity is often expressed in body mass Index (BMI). Body mass index (weight in kg/height in meters^2) provides the most useful population level measure of obesity. The WHO expert committee report accepted a BMI of 18.5 to 24.9 as a normal range and classified overweight in three classes from a BMI above 25 (WHO 2005).

Obesity is a chronic metabolic disorder (metabolic syndrome MetS: a condition associated with glucose intolerance, insulin resistance hyperlipidemia and hypertension; strongly linked to abdominal obesity) caused by multiple and complex factors may be inherited or` acquired including excessive calorie and food intake, decreased physical activity and genetic influences. The defining characteristics are excess body fat which results from an imbalance between energy intake and energy expenditure (i.e. consuming more calories than are needed to support body's energy needs). The reason for this imbalance is unclear and the relationship between nutrient intake /expenditure, body fat storage and distribution varies from person to person. A wide variety of dietary interventions are available for the treatment of obesity including low calorie diets, very low calorie diets, milk diets and novel diets.

Review of Literature

Some obese persons who fail to lose weight on a diet, they state that they are low in calories and actually consume more energy than they report and over estimate their physical activity levels (Lichtman et al. 1992).

Sugars provide a strong, pleasant, sweet taste and at the same time deliver energy when ingested. Their effects on food intake and selection may therefore be a result of both their hedonic and their physiologic features. The theory that appetite signals arising from sugars are different from those arising from other carbohydrates because of sugars' sweetness has led to the hypothesis that sugars are a cause of excessive energy intake and obesity (Alfieri et al. 1993).

Wurtman et al. (1994) reported that elevated preferences for sugar or high fat foods were linked with obesity and weight gain. Frequency of meals also affects nutrient utilization i.e. frequent small meals increase the deposition of calories in the body, hence leading to overweight.

Lindroos et al. (1997) undertook a study in order to describe dietary intakes of obese and non-obese women (age 20-40 years); to assess dietary restraint, dis-inhibition, and hunger and determine which of the factors are independently associated with obesity. In absolute and relative terms, fat intake was higher and alcohol intake was lower in the obese subjects. Dis-inhibition is associated with both obesity and high-energy intakes and is therefore an important factor to consider in the treatment of women with obesity.

The influence of dietary fat intake on subsequent change in body mass index (BMI) of adult women was examined by Lissner et al. (1997), while taking into account predisposition for obesity. It was found that high dietary fat intake has an obesity-promoting effect in women with a genetic predisposition.

Bray et al. (1998) concluded that dietary fat plays a role in the development of obesity. To reduce the prevalence of obesity, there must be an increase in energy expenditure, a reduction in total energy intake, or both. This goal can be facilitated by reducing the amount of fat in the diet.

According to Grundy (1999), a high proportion of fat energy to total energy favours the development of several chronic diseases. Among these are obesity, coronary heart disease, diabetes, and cancer. The theory that a high proportion of fat relative to other nutrients promotes the development of obesity is founded on research with experimental animals and in human population surveys. In summary, clear evidence points to the need to reduce intakes of saturated and trans-fatty acids in the diet. Beyond this change, a balanced ratio of unsaturated fatty acids to carbohydrate leading to fat intake of approximately 30% of total energy seems appropriate for the average adult.

According to a study by Dyck (2000), the consumption of high-fat diets appear to be strongly implicated in the development of obesity. Evidence that fat oxidation does not adjust rapidly to acute increases in dietary fat, as well as a decreased capacity to oxidize fat in the postprandial state in the obese, suggest that diets high in fat may lead to the accumulation of fat stores.

Sujatha et al. (2000) attempts to measure the energy cost of activities of women from the poor socio-economic group in India and found that the energy expenditure of activities did not differ significantly between women with different occupations.

Obesity has increased dramatically over the past two decades. The current epidemic of obesity is caused largely by an environment that promotes excessive food intake and discourages physical activity. Recent trends in food supply, eating out, physical activity, and inactivity, as well as advertising and promotion of food items are all contributory factors(French et al. 2001).

Low-intensity exercise training increases the contribution of fat oxidation to total energy expenditure during exercise in obese women (Van Aggel-Leijssen et al. 2001).

Bonnie et al. (2005) found that the results of their study conform that short-term weight loss is greater in obese women on a low-carbohydrate diet than in those on a low-fat diet even when reported food intake is similar. The differential weight loss is not explained by differences in REE (Resting Energy Expenditure), TEF (Thermic Effect of Food), or physical activity and likely reflects underreporting of food consumption by the low-fat dieters.

Aull et al. (2008) concluded that the oxygen costs of various activities are similar among obese, overweight and normal-weight girls when expressed relative to fat-free mass. When engaging in self-selected levels of activity, obese girls have higher absolute energy expenditure than normal-weight girls.

Antoine-Jonville et al. (2009) concluded under-reporting was probably present in overweight women. However, higher energy intake and expenditure were observed in larger persons who were consequently not identified as less active.

Jyothy et al. (2010) highlights that obesity is getting increasing attention in the recent past as a risk factor for many diseases like diabetes and heart problems. Although obesity is a prevalent problem in all parts of the world, very few data are available in India regarding abdominal obesity and its risk factors.

Kaur et al. (2010) found that the prevalence of obesity was found more in postmenopausal women as compared to premenopausal women according to Body Mass Index, waist circumference as well as waist- hip ratio. According to Body Mass Index, the prevalence was 70.30% and 75.09% in pre- and postmenopausal women, respectively. Similarly the prevalence of central obesity according to waist circumference was 75.15% and 89.05% in pre- and postmenopausal women, respectively. According to waist-hip ratio, this prevalence was 74.54% in premenopausal women and 87.92% in postmenopausal women of Jalandhar District, Punjab.

Bleich et al. (2011) concluded on the basis of the current evidence, there is no consensus on the main driver of secular trends on weight gain among US children and adolescents. More research and better methods are needed to identify the relative contribution of energy intake and energy expenditure to obesity in the paediatric population.

Raymond et al. (2011) tried to determine whether there are differences in energy intake or energy expenditure that distinguish overweight/obese women with and without binge eating disorder (BED). And it was found that there was no difference between BED nonbinge day intake and control group intake (2,233 vs. 2,140 kcal). Similar results were found for food log data. Dietary recall data indicated a trend toward higher average daily intake in the BED group (2,587 vs. 2,140 kcal). Furthermore, when comparing TDEE (Total Daily Energy Expenditure) to dietary recall and food log data, both groups displayed significant under-reporting of caloric intake of similar magnitudes ranging from 20 to 33%. Predicted energy requirements estimated via the Harris-Benedict equation (HBE) underestimated measured TDEE by 23-24%. Our data suggest that increased energy intake reported by BED

individuals is due to increased food consumption and not metabolic or under-reporting differences.

Lee et al. (2012) concluded that there is high quality, consistent evidence that reduction of total fat intake has been achieved in large numbers of both healthy and at risk trial participants over many years. Lower total fat intake leads to small but statistically significant and clinically meaningful, sustained reductions in body weight in adults in studies with baseline fat intakes of 28-43% of energy intake and durations from six months to over eight years. Evidence supports a similar effect in children and young people.

Alberto et al. (2013) found that activity energy expenditure (AEE) is the component of daily energy expenditure that is mainly influenced by the amount of physical activity (PA) and by the weight of the body displaced. In conclusion, exposure to physical activity is essential to improve weight maintenance. Indeed, mechanisms modulating AEE in response to fluctuations in energy intake are important to maintain body weight. However, after weight loss, due to the lower weight carried, a higher amount of body movement is required to adjust for excess in energy intake. Although a mild increase in physical activity was stimulated by weight loss in the study population, preservation of baseline AEE could not be achieved. A behavioral change equivalent to a 2-hour reduction per day of sedentary time, and an increase in ambulatory activities showed to compensate for the decline in AEE. Thus, subjects can offset the weight loss induced decrease in AEE by increasing physical activity, and this certainly contributes to the successfulness of weight maintenance after a dieting program.

Objectives of the Study

Two factors that significantly impart weight gain are excessive calorie intake and lack of physical exercise which results proportionately decline in lean body mass. Increase in body fat or weight gain generally occurs when intake is more than the energy expenditure. A complete nutritional assessment would include an evaluation of current intake. Keeping in mind of the above, the present study is undertaken with the following objectives:

1. To compare the nutrient intake with recommended intake;
2. To compare the energy intake with energy expenditure.

RESEARCH METHODOLOGY

The study is undertaken on 49 obese women out of 70 women of the age group of 35-40 years in Jalandhar who were surveyed for obesity with respect to their BMI index. The suggested critical limits of BMI by WHO (http://apps.who.int/bmi/index.jsp?introPage=

intro_3.html accessed on January 2, 2014) were utilised for the assessment of obesity as given in Table 1.

Table 1. Distribution of 70 Respondents as per Classification of BMI by WHO

Body Mass Index (BMI) kg/m^2	**Classification**	**Number of Respondents**	**% of Respondents**
< 18.5	Underweight	03	4.29
18.5-24.99	Normal	18	25.71
25.0-29.99	Pre - obesity	31	44.29
30-34.99	Obesity Class I	16	22.85
35.99-39.99	Obesity Class II	02	2.86
>40	Obesity Class III	00	nil

The convenient sampling technique is used to select the samples. Data was collected through a structured questionnaire to access the various parameters i.e. anthropometric measurements, nutrient intake and lifestyle activities. BMI of the subject is calculated with the help of height and weight measurement. This is a measure of the relative body fatness to evaluate risk factors associated with obesity. It is based on weight (in kg) and height (in meters square) and is expressed as Wt. (kg) / Ht. (meters^2). Twenty four hour dietary recall method is used to calculate the intake of various nutrients. Information regarding the type and amount of food eaten on the previous three days was recorded and the nutritive values of these diets in terms of energy, protein, carbohydrates, fats and micronutrients namely calcium and iron were calculated with the help of "Nutritive values of Indian foods" by Gopalan et al. (2004).The average nutrient intake per day per subject was calculated and compared with the recommended allowances as given by ICMR (2004). To calculate their energy expenditure their daily life style activities are recorded. Total energy expenditure is calculated by multiplying the rate of the energy expenditure of the activity with duration of activity in minutes and total body weight (Thomson et al. 2007).

RESULTS AND DISCUSSION

Table 2. Mean values and t values for Normal & Obese women with reference to Height, Weight and BMI

	Normal		**Obese**		**t-value**
	Mean	**SD**	**Mean**	**SD**	
Ht.	157.48	10.47	155.46	16.55	1.759
Wt.	56.43	19.74	70.44	55.87	-6.868*
BMI	22.76	3.05	29.20	6.26	-9.253*

* Significant t values at $p<0.05$

Table 2 shows that the difference between the height of normal and obese women is non-significant statistically (t-value=1.759). The difference between the mean weight of normal and obese women is statistically significant (t-value -6.868)at5% level. Similarly the t value of BMI comes out to be -9.25 which is greater than the t critical value (2.002) implying that difference between mean BMI values of normal and obese people is significant.

Mean value of energy, protein, fat, carbohydrate, calcium and iron intakes have been given in Table 3. The required level of energy intake is 2225 kilo calories and the mean score for 49 subjects is 2249.75 (Table 3). The value of t-test is 0.630 which is found to be non-significant at 5% significance level; therefore energy intake of the present sample is similar to that of the RDA.

The intake of protein which as recommended by ICMR is 50 gm and the mean value of the present sample is 49.21gm (Table 3). The value of t-test is -0.503 which is found to be non-significant at 5% significance level.

The mean value of fat intake in the present sample of study is 37.31gm (Table 3) where as the recommended value is20 gm. The value of t-test is 16.004 which is significant at 5% level shows that the observed fat intake by subjects under study is significantly greater than the recommended fat intake.

The required level of carbohydrate intake is 461 gm but the mean value of the present sample is 430.86 (Table 3). The value of t-test is -3.006 which is found to be significant at 5% significance level. This indicates that mean value of carbohydrate among respondents under study was less than the recommended value.

Table 3

Distribution of mean values and t values for all Nutrients

Nutrients	Mean	RDA	t-value
Energy	2249.75 kilo calories	2225	0.630
Protein	49.21gm	50	-0.503
Fat	37.31gm	20	16.004*
Carbohydrate	430.86gm	461	-3.006*
Calcium	715.77mgm	400	7.365*
Iron	21.04mgm	30	-18.744*

*Significant t values at $p<0.05$

The level of calcium intake which is required to be 400 mg and the mean value of the present sample under study is 715.76 mg (Table 3). The value of t-test i.e. 7.365 is found significant

at 5% level that shows that the observed calcium intake is significantly greater than recommended calcium intake in the obese women.

The recommended level of iron intake is 30 mg and the mean value among the present sample is 21.04 mg (Table 3). The value of t-test is -18.744 and is found to be significant at 5% significance level. This indicates that mean value of respondents under study was less than the recommended value implying that the observed iron intake is lesser than the recommended iron intake.

It appears from the above results that the respondents' intake of Fat and Calcium is more than the recommended levels whereas the intake of Carbohydrate and Iron is less than the recommended level. The probable reasons for the said outcomes may be due to underreporting of nutrient intake. Results also reflect that the working women being conscious of their obesity tried to reduce their Carbohydrate intake by decreasing the quantity of cereal products from their meal.

An attempt has been made to compare the energy intake and energy expenditure of the same subjects with a view to gathering information about their energy situation. The energy intake of the subject is the mean of three days energy intake calculated from 24 hour dietary recall method. The energy expenditure was measured from the daily activity schedule on 24 hour basis out of the days on which energy intake was measured. The analysis has shown that the energy expenditure in the present sample is significantly higher (t-value = -8.682) than the energy intake (Table 4) which is significant at 5% level. There is enough evidence available to indicate that absolute daily energy expended by obese is higher than that expended by the lean (www.rowett.ac.uk, 2013). Another study by Delany et al. (2012) also throws light on the fact that greater body weight in obese individuals leads to actually higher total daily energy expenditure and higher activity energy expenditure, which masks the fact that obese are less physically active, which can be influenced by duration or intensity of activity, than in lean individuals.

Table 4 Mean value and t value for Energy Intake and Energy expenditure

		Mean	N	Std. Deviation	Std. Error Mean	t	Sig.(2 tailed)
Pair 1	Energy intake (Kcal)	2249.7502	49	275.03505	39.29072	-8.682	.000
	Energy Expenditure	2957.8596	49	491.02321	70.14617		

It was intriguing to find that the energy balance in obese women of the present study has been negative indicating more energy expenditure but less energy intakes. How this situation would change the body composition of these individuals is unclear?

However some studies indicate the under-reporting of nutrient intakes in obese men and women (Bonnie et al. 2005; Antonie-Jonville et al. 2009) and some other studies have reported the over estimation of physical activities by the obese persons (Lichtman et al. 1992) thus indicating a greater energy expenditure. It may be assumed that in the present sample of obese women, there are chances of under-reporting of nutrient intakes and over-reporting of energy expenditure in order to conform to the social psyche and prejudice against obesity.

In depth follow up studies of the obese women from the standpoint of energy expenditure and energy intake are required to be undertaken in order to conclusively comment upon the energy balance in the obese individuals.

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