

EVALUATION OF DIETARY HABITS AND NUTRITIONAL CONTENT OF FOOD INTAKE IN OVERWEIGHT AND OBESE PATIENTS

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received: December 19, 2013

accepted: February 21, 2014

available online: March 15, 2014

Abstract

Background and Aims To document the nutritional content of food intake in overweight and obese people, in order to change dietary habits for acquiring the normal weight. **Material and methods** We assessed the nutritional content of food intake (kilocalories, vitamins and minerals) in a sample of 124 overweight and obese people and 33 subjects with normal weight. We also measured abdominal circumference, percent of body fat and resting metabolic rate. **Results** Overweight and obese patients, compared to normal weight, have a significant increased intake of vitamin A ($p=0.002$), vitamin B1 ($p=0.037$), vitamin B5 ($p=0.047$), vitamin C ($p=0.029$) and vitamin D ($p=0.015$), sodium ($p=0.036$), iron ($p=0.032$) and selenium ($p=0.007$). The percent of body fat in obese persons is increased ($p=0.00001$) and very close to abnormal in patients with no weight problems. An increased food intake, above the calculated resting metabolic rate, is associated with a slower metabolism and a rapid resting metabolic rate is often associated with food intake below resting metabolic rate ($p=0.002$). **Conclusions** All subjects had imbalanced intake of vitamins and minerals. The normal weight group didn't achieve the dietary recommendations for vitamins and minerals and we found that these subjects had risk factors for cardiac diseases like increased abdominal circumference, body fat and sodium intake.

key words: vitamins, minerals, obese, resting metabolic rate.

Backgrounds and Aims

According to the International Association for the Study of Obesity there are 1.5 billion adults in the world that have weight problems [1]. Obesity is a risk factor for type 2 diabetes, cardiovascular diseases, cancer, pulmonary diseases, osteoporosis, periodontal diseases and

has consequences on lipid, glucose and protein metabolism. Obesity appears as a consequence of increased energy intake by high caloric meals to the disadvantage of energy expenditure by physical activities. The dietary habits of the obese people usually don't include breakfast and consist in consuming a larger number of meals later during the day and many snacks of high

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caloric foods such as cookies, biscuits, chips, lollipops, etc. A sedentary life, using car driving and spending free time in front of the TV, computer games etc. is associated with the increasing prevalence of obesity [2].

Vitamin D is the only vitamin that is synthesized in the human body, in the cutaneous tissue, in response to sunlight exposure [3]. All other vitamins are provided by food intake. There are fat-soluble vitamins (such A, D, E, and K) and water soluble - all the other ones. The fat soluble vitamins are stored in the body and a high level can be dangerous as well as their absence from the body, leading to symptoms or diseases in cases of high or low intake. The excess of water soluble vitamins is eliminated via kidney or liver so that symptoms of intoxication with these vitamins rarely occur. Minerals represent only 4-5 % of body weight but they are very important by participating to all vital functions [4].

A closer look to the dietary habits and to the nutritional content of the food intake is necessary considering the increasing number of overweight and obese people. There are vitamin deficiencies described in obese patient with bariatric surgery but there are few studies evaluating the intake of vitamins and minerals from food as well as the dietary habits of overweight and obese people with no such intervention. Resting metabolic rate (RMR) is the largest component of the daily energy expenditure in most humans and, therefore, any increases in RMR in response to exercise interventions are potentially of great importance. The Harris- Benedict equations:

Men: $RMR = 665 + (13.75 \times \text{weight in kg}) + (5 \times \text{height in cm}) - (6.78 \times \text{age in years})$

Women: $RMR = 655 + (9.56 \times \text{weight in kg}) + (1.85 \times \text{height in cm}) - (4.68 \times \text{age in years})$

are only approximating the basal metabolic rate and the measurement of metabolic rate using an

indirect calorimeter is more useful for the management of body weight.

The aim of the study was to document the nutritional content of the food intake in people with or without weight problem in order to make a guideline for overweight and obese people to help them change their eating habits. Knowing exactly what they eat, how many kilocalories, vitamins and minerals, we can modify the content of the meals, we can develop a well-balanced meal's program in order to reach a normal weight and to prevent the risks associated with obesity.

Material and methods

We evaluated 157 subjects - 124 overweight and obese and 33 with normal weight. We collected data regarding age, gender, height, abdominal circumference, weight, percent of body fat, resting metabolic rate. We recorded the body weight and percent of body fat using a body composition analyzer that performed whole body and segmental measurements, with three frequency ranges and eight touch electrodes (IOI 353 Body Composition Analyzer, Jawon Medical, Korea). Resting metabolic rate was performed after eight hours fasting with an indirect calorimeter that uses the dilution technique for accurate measurements (Fitmate Pro, Cosmed, Italy). We compared total energy intake with resting metabolic rate. Using a 7-day food self record questionnaire, we assessed in all the patients the intake of macro and micronutrients, including energy (kilocalories), carbohydrates, proteins, lipids, cholesterol, vitamins A, B1, B2, B3, B5, B6, B12, C, D, E, folic acid, and minerals like calcium, iron, magnesium, phosphorus, zinc, copper, manganese, selenium, and sodium. All these data were reported as a percent of dietary reference intake using US National Nutrient Database for Standard Reference release 24 [5]. We analyzed the frequency of a low intake of vitamins and

minerals among overweight, obese but also among normal weight patients. We also evaluated the mean sodium intake reported as mg/day and this level was only provided by food because the patients didn't self-confessed the salt add-on.

Statistical analysis

For collection, analysis and interpretation of results we used the Microsoft Excel and Statistica var 4.3 software. For comparison of the means and frequencies we used Student and CHI² tests for independent samples. To confirm the null hypothesis we set a p >0.05. For p<0.05 the null hypothesis is disproven.

Results

The study included one group of 33 patients with normal weight (group A) and 124

overweight and obese patients (group B). Distribution by age, sex, weight, body mass index (BMI), percent of body fat (PBF) and abdominal circumference (AC) is showed in [Table 1](#). There were more women in both groups which show that women are more interested in controlling their weight. In group A the mean abdominal circumference was 82.82 cm, ranging from 79 cm to 94.5 cm. The mean AC in group B was 102.21 cm (ranging from 80 to 143 cm), significantly higher than in group A (p<0.0001).

We found a significant smaller RMR in normal weight patients than in obese and overweight people (p=0.0001). We also found that overweight/obese people have an average food intake (FI) of 1683.162 kilocalories, non significantly (p = 0.14) higher than in normal weight subjects (1508.905 kilocalories) as shown in [Table 1](#).

Table 1. Characteristics of subjects in the two study groups.

	Group A (n=33)	Group B (n=124)	p
Age (years)	30.76±8.016	38.36±10.357	0.0001
Sex (F/M)	32/1	95/29	0.017
Weight (kg)	64.27±5.506	91.31±19.192	<0.00001
BMI (kg/mp)	22.77±1.63	33.28±6.02	<0.00001
PBF(%)	29.02±5.51	37.33±5.33	< 0.00001
AC (cm)	82.82±5.448	102.21±14.175	<0.00001
RMR (kilocalories)	1295.52±202.837	1585.03±384.855	0.0001
FI (kilocalories)	1508.905±377.34	1683.162±505.927	0.14

Considering a normal PBF for women between 20 and 30 and for men between 15 and 20, the mean value of PBF in group B, was

significant higher in women than men (p <0.00001) as shown in [Figure 1](#).

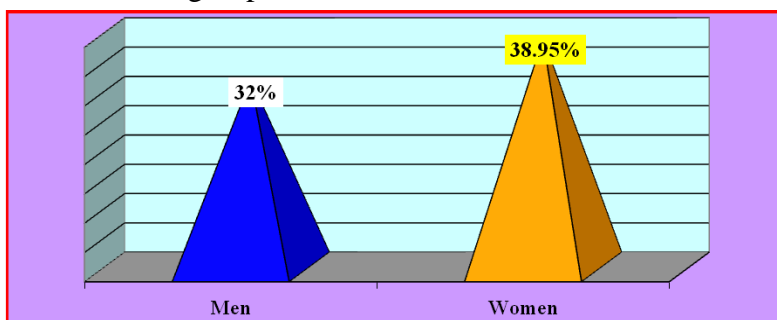


Figure 1. PBF Distribution in group B according to sex.

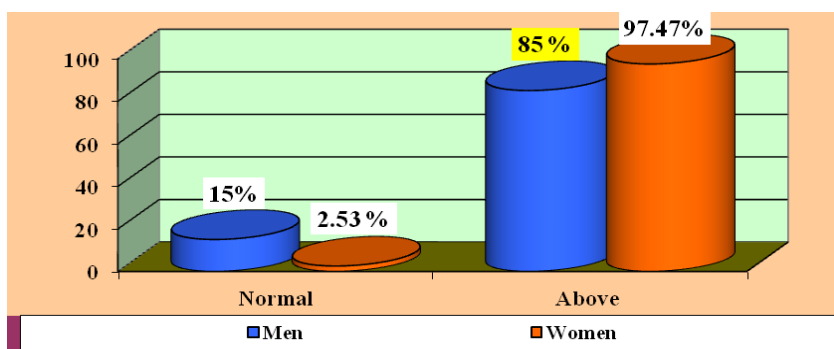


Figure 2. Distribution of AC in group B subjects.

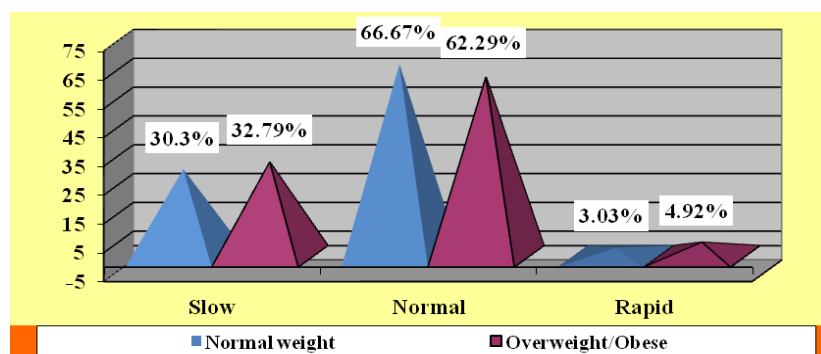


Figure 3. Type of RMR in the two groups.

Table 2. Food intake versus RMR.

Groups	FI versus RMR				χ^2	p
	FI < RMR		FI > RMR			
	n	%	n	%		
Group A	9	27.27	24	72.73	0.90	0.34
Group B	43	36.13	76	63.87		

In the group of overweight and obese people we found that women have significantly more often values of abdominal circumference over normal and that men have more often a normal AC—(15% compare to 2.53% in women), $p=0.025$ (Figure 2).

We consider that a patient had a slow resting metabolic rate (Slow RMR) if the ratio RMR measured with indirect calorimetry/ RMR estimate by Harris-Benedict equation $\times 100$ is less than 86 %, a normal RMR if that ratio is 86-114% and a rapid RMR if the ratio is above 114% (based on the limits recommended by Fitmate Pro RMR measuring device). According to this classification, we found that there are no significant differences between the two groups regarding the type of RMR (Figure 3).

We compared the food intake (FI) with the resting metabolic rate (RMR) and found that there are no significant differences between the two groups, as shown in Table 2.

We also compared the frequency of the cases with slow/normal/rapid RMR in patients with $FI > RMR$ versus patients with $FI < RMR$ and we found that the slow RMR is often associated with $FI > RMR$ (40.4% of $FI > RMR$ have a slow RMR, compared to only 17.31% in subjects with $FI < RMR$, $p=0.002$) and the rapid RMR is often associated with $FI < RMR$ (11.54% of patients with $FI < RMR$ have rapid RMR, compared to only 1.01% of patients with $FI > RMR$, $p=0.002$) as shown in Table 3.

Table 3. Type of metabolism compared to food intake.

FI/RMR	Type of metabolism					
	Slow		Normal		Rapid	
	n	%	n	%	n	%
FI> RMR	40	40.00	59	59.00	1	1.00
FI< RMR	9	17.31	37	71.15	6	11.54
P	0.002		0.07		0.002	

Table 4. Differences in dietary vitamin intake (as a percent of Recommended Daily Intake) in normal and overweight/obese patients.

Vitamins	Normal weight (Group A)		Overweight/Obese (Group B)		p
	Mean	SD	Mean	SD	
Vitamin A (%)	285.09	159.653	998.87	1299.972	0.002
Vitamin B1 (%)	121.00	62.205	168.47	124.884	0.037
Vitamin B2 (%)	159.12	69.683	156.97	54.999	0.85
Vitamin B6 (%)	143.48	67.717	161.18	62.602	0.16
Folic acid (%)	88.18	50.060	104.90	61.060	0.15
Vitamin B3 (%)	159.88	63.635	149.04	60.814	0.37
Vitamin B5 (%)	109.79	60.635	132.17	55.967	0.047
Vitamin B12	235.76	150.222	255.62	365.611	0.76
Vitamin C	139.27	75.943	192.18	131.726	0.029
Vitamin D	27.15	20.816	62.44	81.496	0.015
Vitamin E	58.52	37.389	57.56	35.672	0.89

*Group A – 33 patients and Group B- 119 patients

Table 5. Dietary minerals intake as a percent of Recommended Daily Intake (except for sodium reported in mg/day) for the two study groups.

Minerals	Normalweight		Overweight/Obese		p
	Mean	SD	Mean	SD	
Sodium (mg/day)	2355.82	888.557	2735.00	917.565	0.036
Calcium (%)	106.58	221.222	71.45	30.468	0.093
Magnesium (%)	75.88	26.486	77.47	27.278	0.77
Phosphor (%)	154.76	47.644	148.97	58.461	0.60
Iron (%)	77.64	60.549	108.18	74.687	0.032
Zinc (%)	126.94	68.994	120.69	40.418	0.51
Copper (%)	116.21	39.527	147.80	114.841	0.12
Manganese (%)	138.76	65.402	142.71	58.829	0.74
Selenium (%)	169.79	69.173	214.84	87.619	0.007

*Group A – 33 patients and Group B- 119 patients

We evaluated the mean dietary intake of vitamins as a percent of the Recommended Daily Intake (we consider that a mean intake between 90 % and 110 % is normal) in normal weight patients and found there is not enough intake of vitamin D, E and folic acid and there is an excessive intake in vitamins A, B1, B2, B3, B6, B12 and C. In obese patients, we found that they don't eat enough vitamin D and E and they have an excessive intake for all the other vitamins,

except for folic acid which is normal. Group B had a significantly higher intake of vitamin A ($p=0.002$), vitamin B1 ($p=0.037$), vitamin B5 ($p=0.047$), vitamin C ($p=0.029$) and vitamin D ($p=0.015$) compared to Group A, as shown in [Table 4](#).

Comparing the intake of minerals between the two groups, we found that overweight/obese subjects eat more sodium, iron and selenium than normal weight subjects, as shown in [Table 5](#). Normal weight people eat more than 2 g/day sodium.

We compared the frequencies of vitamin's and mineral's intake deficiency (the percentage of patients that don't achieve the Recommended Daily Intake). Thus, we determined that the first five vitamin intake deficits (both in normal and obese patients) are vitamin D, vitamin E, folic acid, vitamin B5 and vitamin B1 as shown in [Figure 4](#). Regarding the minerals, there is a low intake of calcium, magnesium, iron, zinc and manganese as shown in [Figure 5](#).

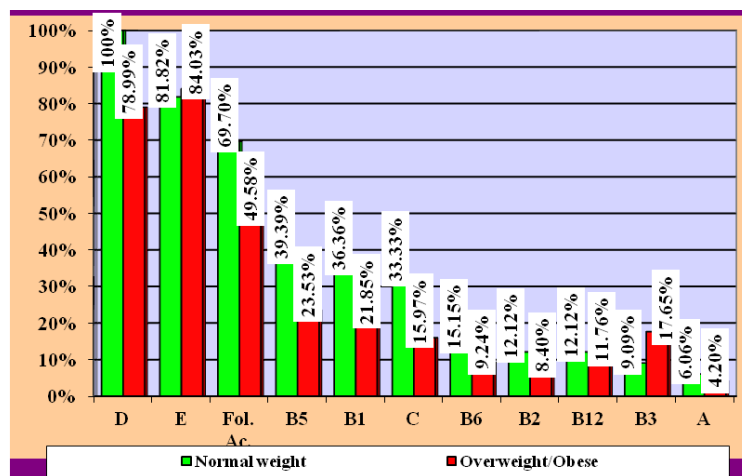


Figure 4. Frequencies of dietary intake vitamin's deficits in the two study groups.

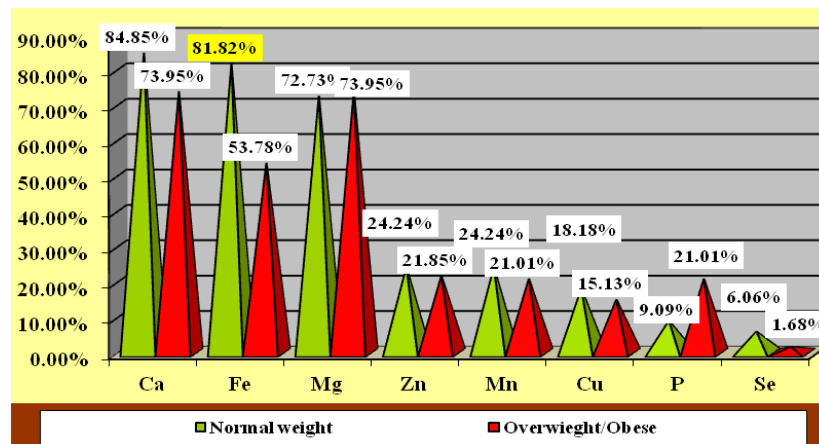


Figure 5. Frequencies of mineral's dietary intake deficiencies in the two study groups.

Discussion

As we expected, we found an increased percent of body fat in obese patients and very close to abnormal level for patients with no weight problems. Shea JL et al consider that

those with elevated percent of body fat are at increased risk of developing cardiometabolic disease despite having a normal BMI [6]. As we know, abdominal body fat is considered a risk factor for death, independent of BMI [7]. Unexpectedly, we found that even if the weight

is normal, the mean value of abdominal circumference for women in group A is above the normal limit of 80 cm. In the obese group, again women have more often abnormal AC than men. Resting metabolic rate (RMR) is responsible for 70% of daily energy consumption. In our study groups, all the patients were sedentary (they declared that they are not doing any physical activities) so we considered that RMR approximates the total energy consumed. Diet and exercise induce weight loss and have beneficial effects on RMR [8]. We found a significantly lower RMR in the group of normal weight patients but no differences regarding the type of metabolism (slow/normal/rapid). Also the kilocalorie energy intake was not significantly different between the two groups. This may be the result of not correctly self reporting the food intake, although we encouraged subjects to write down all the snacks, beverages and meals in order to correct wrong habits and to promote a healthy life. An increased food intake, above the calculated RMR, is associated with a slower metabolism and a rapid RMR is often associated with food intake below the RMR.

We also found an unbalanced diet regarding the intake of vitamins and minerals in

overweight and obese patients but also in normal weight subjects. Except vitamin D (which can be produced by the body), all other vitamins must be acquired through a healthy diet. All our patients don't eat enough vitamin D, vitamin E, folic acid, vitamin B5 and vitamin B1. Also there is a low intake of calcium, magnesium, iron, zinc and manganese and an increased level of sodium intake.

Because there are more women than men in the study groups and due to the limited number of patients this study cannot be representative for general population.

Conclusions

All patients had an imbalanced intake of vitamins and minerals. The normal weight group didn't achieve the dietary recommendations for vitamins and minerals intake and often had increased abdominal circumference, body fat and sodium intake, which are known as risk factors for cardiac diseases. The unbalanced diet that doesn't provide the recommended daily intake of vitamins and minerals can lead to health problems so we need a better promotion for lifestyle changes, both in normal weight and obese subjects.

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