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EATING HABITS IN NORMAL WEIGHT AND OBESE PEOPLE

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Abstract

Background and Aims: *The aim of this study was to document the eating habits of normal weight and obese patients in order to implement a new and healthier lifestyle.* ***Material and Methods:*** *We evaluated the intake of energy and that of vitamins and minerals in a sample of 199 normal weight and obese subjects. We also performed anthropometric's measurements, paraclinic's and laboratory's tests.* ***Results:*** *The mean intake of vitamins and minerals is significantly different for B1 and B3 vitamins and for iron, phosphorus, copper and selenium. Vitamins like B1, B2, B3, B6, B12, C and A vitamin and minerals like, zinc, manganese, phosphorus and selenium are over consumed in both groups. Regarding the sodium's intake, only 37.04% of normal weight patients fulfill the recommendations of less than 2 g/day. The prevalence of a high fat diet is about 59.29% in normal weight people and 60.69% among obese ones. Only 25% of normal weight patients had normal abdominal circumference and 58.47% of obese subjects had normal HDL-cholesterol levels.* ***Conclusions:*** *Regardless the body mass index (BMI) status, neither normal weight subjects nor the obese ones' had an adequate micronutrient intake. Also, there is a high prevalence of high sodium's intake and a high fat diet among the normal weight patients.*

key words: *obese, vitamins, minerals, salt intake, HDL-cholesterol.*

Backgrounds and Aims

In the last decades, obesity became a major problem of public health and there is a huge need of knowing eating habits and of trying to change them in order to achieve a healthy lifestyle for a long period of time. In Romania, a cross sectional study from 2014 regarding obesity and health related lifestyle factors in the general population (the ORO Study) showed that the prevalence of obesity was about 21.3 % and the most frequent unhealthy eating habits were irregular meals and eating while watching TV, both in normal weight and obese subjects [1].

Knowing the nutritional content of the food intake is needed, given the fact that there is an increasing number of overweight and obese people in our country. The trend of increasing number of people with weight problems in Romania is supported by previous studies of prevalence. Thus, in 2000, the reported Eurostat data showed a prevalence of obesity in males 7.7% and females 9.5% [2]. Five years later, in

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2005, SEPHAR I study (Study for the Evaluation of prevalence of hypertension and cardiovascular risk in the adult population of Romania), showed a prevalence of obesity (defined as body mass index) of 24% [3]. In 2013, according to another research (PREDATORR, a national study on the prevalence of diabetes, prediabetes, overweight, obesity, dyslipidemia, hyperuricemia and chronic kidney disease), the figures show a worrying prevalence of overweight reaching 34.7% of the population and obesity 31.9% of Romanian population [4].

Obesity is a consequence of positive energy balance by increasing daily caloric intake in parallel with decreased energy consumption due to changes in physical activity, people becoming increasingly sedentary. Therefore, detailed knowledge of and modifying the factors involved in obesity (such as daily energy intake and physical activity), can lead to the implementation of a new type of lifestyle, healthier and that can be maintained on the long term. Food and nutrient intake assessment is complex due to its high variability, both intra and inter individual [5] and the necessity for cognitive capacity of individuals evaluated by call to memory and ability to weigh each food consumed at each meal [6].

Obese people generally have inadequate food behavior, characterized by an increased intake of energy, thus having a food imbalance of vitamins and minerals and this may have consequences for their health.

The overall objective of this study was the assessment of micro and macronutrients in food intake of both normal weight and obese people, in order to assess deficits or excess of vitamins and minerals. Another aim of our study was to examine some of the biochemical and anthropometric parameters in all the subjects. We also looked for the most frequent nutritional imbalances which appear in people with or without a weight problem.

Material and methods

This was an observational, retrospective study performed in two centers, which included 199 subjects: one group of 54 normal weight subjects and another one of 145 obese people. We collected data regarding age, gender, height, abdominal circumference (AC), weight, body fat mass, percent of body fat (PBF), body mass index (BMI) and blood pressure.

Abnormalities accounted for waist circumference in this study are those of the IDF consensus definition of the metabolic syndrome [7]: abdominal circumference greater than 80 cm in women and greater than 94 cm in men.

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). According to device's specifications, the percentage of normal body fat for female is considered to be between 20 and 30% by total weight. Regarding males, the percentage of fat is considered to be normal between 15-20% of total weight.

Blood pressure was measured with an arm blood pressure cuff sphygmomanometer (M6 Omron AC), using the oscillometric technique for accurate measurement. Normal values considered in this study, for the blood pressure, are those of the IDF consensus definition of metabolic syndrome [7]: systolic blood pressure less than 130 mmHg and diastolic blood pressure less than 85 mmHg.

Laboratory assessments were made after 12 hours of fasting and included magnesium, iron, calcium, total cholesterol, HDL cholesterol, glucose, and thyroid-stimulating hormone

(TSH). Normal values considered in this study, for the fasting glucose, are those of the IDF consensus definition of metabolic syndrome: less than 100 mg/dl [7]. HDL cholesterol is one of the defining criteria of the metabolic syndrome and normal values are: > 50 mg/dl for females and 40 mg/dl for males.

Using a 7-day food diary, we recorded the amount of every ingested food; a software programmer was developed using the US National Nutrient Database for Standard Reference release 24 [8] and we were able to assess 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 (DRI). We set that a vitamin or a mineral is normal consumed if the mean intake is between 85-115 % of DRI. Thus, we assessed the vitamins and minerals which are over-consumed or deficient among obese but also among normal weight patients. We also evaluated the mean sodium's intake and the mean macronutrients (lipids, proteins and carbohydrates) from diet. For the salt, we considered as normal a sodium intake below 2,000 mg/day, according to the WHO recommendations on this mineral intake, among adults and children [9].

The normal limits for the macronutrient's intake are the limits established by Food and Nutrition Board/Institute of Medicine of the National Academies [10]:

- For carbohydrates: 45-65 % of total energy's intake;
- For proteins: 10 -15 % of total energy's intake;
- For lipids: 25-35 % of total energy's intake.

All the blood tests were made in several private laboratories, the normal range of different parameters may be slightly different from one laboratory to another. For ease of processing, we took into account the limits provided by the Synevo laboratory.

Statistical analysis For collection, analysis and interpretation of results we used the Microsoft Excel and Statistica version 4.3 software. For comparison of the means and frequencies we used Student and Chi square 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

Anthropometric, clinical and laboratory's tests

The anthropometric and clinical data for the two study groups are shown in Table 1.

Table 1. Mean anthropometric and clinical data of the subjects.

Variables	Normal weight	Obese	p
Height (cm)	167.08±5.585	169.64±9.371	0.061
Weight (kg)	63.99±5.993	103.91±18.521	<0.001
BMI (kg/m2)	22.90±1.615	35.97±4.766	<0.001
Body fat mass (kg)	18.51±4.091	40.08±9.134	<0.001
PBF (%)	28.77±5.062	38.65±5.418	<0.001
AC (cm)	86.30±8.658	116.03±13.121	<0.001
SBP (mmHg)	116.08±11.726	135.07±19.113	<0.001
DBP (mmHg)	71.92±8.285	80.85±11.984	0.001

(All data are mean ± SD)

As expected, we found significant differences between the groups regarding body fat mass (40.48 kg vs. 18.51 kg, p <0.001), PBF (38.65% vs. 28.77% of, p <0.001) and abdominal circumference (116.03 cm vs. 86.3cm, p <0.001), suggesting that weight gain is mainly due to the growth of body fat mass.

All the obese patients and 75% of normal weight people had an increased abdominal circumference as shown in Table 2.

Table 2. Prevalence of normal and above normal abdominal circumference in normal weight and obese subjects.

	Normal		Above normal	
Groups	n	%	n	%
Normalweight	13	25	39	75
Obese	0	0	119	100
p	*<0.001*		*<0.001*	

Table 3. Mean values of laboratory tests in the subjects.

Laboratory tests	Normal weight	Obese	t	p
Magnesium(mg/dl)	2.06±0.171	2.05±0.229	0.114	0.909
Iron (µg/dl)	88.98±33.980	93.80±30.761	0.768	0.443
Calcium (mg/dl)	9.25±0.382	9.42±0.522	1.684	0.094
Total Cholesterol (mg/dl)	193.51±52.352	201.59±43.870	0.971	0.332
HDL cholesterol (mg/dl)	63.33±14.222	50.48±11.614	5.366	<0.001
Glucose (mg/dl)	82.84±11.017	99.44±26.345	3.876	0.001
TSH (µUI/ml)	2.09±1.194	1.97±1.148	0.497	0.619

(All data are mean ± SD)

Table 4. Prevalence of normal and below normal HDL cholesterol values in the two groups.

	Below normal		Normal	
Groups	n	%	n	%
Normalweight	7	21.21	26	78.79
Obese	49	41.53	69	58.47
p	*0.03*		*0.03*	

Table 5. Mean intake of macronutrients, sodium and cholesterol in groups

Variables	Normal weight	Obese	t	p
Energy intake (Kcal/day)	1539.96±454.787	1888.70±658.862	3.582	0.0004
Carbs (% of total intake)	42.86±9.448	41.44±8.028	1.059	0.29
Proteins (% of total intake)	20.33±7.053	21.53±6.059	1.186	0.24
Lipids (% of total intake)	35.80±6.217	36.26±6.222	0.466	0.64
Cholesterol (mg/day)	280.02±154.071	367.39±245.218	2.443	0.015
Sodium (mg/day)	2497.31±944.916	3089.95±1304.810	3.051	0.0026

(All data are mean ± SD)

The results of the blood tests for the two study groups are given in Table 3. Obese subjects appeared to have significantly higher average blood glucose value (close to the definition of impaired fasting glucose at 99.44 mg/dL).

There is a significant higher prevalence of normal HDL cholesterol values in normal weight patients compare to obese people (78.79 % vs. 58.47 %, p=0.03) (Table 4).

The analysis of the intake of macronutrients, vitamins and minerals

Comparing the average values of nutrients intake in the two groups we showed that the obese ones appeared to have a significantly

higher daily calorie intake (1888.70 kcal compared to 1539.96 kcal in normal weight subjects, p = 0.0004), without other significant differences in other macronutrient's intake as detailed in Table 5. There were however significant differences regarding sodium and cholesterol's intake, as showed in Table 5. The average sodium's intake was increased in all subjects, both normal weight and obese.

Compared to the recommended macronutrient intake, the prevalence of a high fat diet was about 59.29 % in normal weight people and 60.69 % among obese as shown in Table 6. Compared with the recommended daily intake of proteins, 94.44% of normal weight patients and 97.24% of the obese subjects (p = NS) have an appropriate protein intake. In addition, we found that 59.26% of the patients with normal weight have a dietary intake of cholesterol below 300 mg/day, significantly more than obese subjects (39.31%, p = 0.006). Finally, normal sodium intake (<2.000 mg/day) is found significantly more often in patients with normal body weight (37.04% vs. 22.07%, p = 0.016).

Table 6. Percentage of patients with low, normal and increased intake of macronutrients, cholesterol and sodium in the two study groups.

Variables	Below normal		p	Normal		p	Above normal		p
	N	O		N	O		N	O	
Carbs	57.41	67.59	NS	42.59	31.72	NS	0.00	0.69	NS
Proteins	0.00	0.00	NS	94.44	97.24	NS	5.56	2.76	NS
Lipids	3.70	4.14	NS	37.04	35.17	NS	59.26	60.69	NS
Cholesterol	0.00	0.00	NS	59.26	39.31	0.006	40.74	60.69	0.006
Sodium	0.00	0.00	NS	37.04	22.07	0.016	62.96	77.93	0.017

(N- Normal weight, O – Obese)

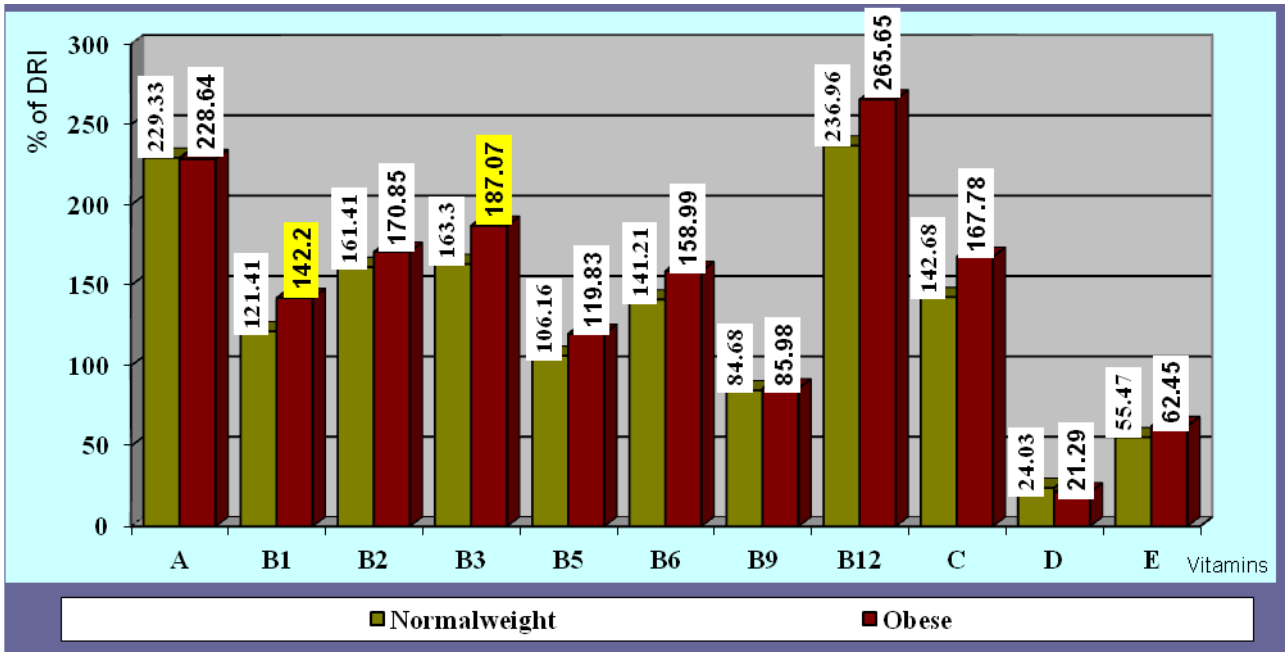

Figure 1. *Mean intake of vitamins for normal weight and obese subjects.*

There were significant differences regarding the mean intake of vitamins. Thus, the obese subjects have an increased intake of B1 and B 3 vitamins (142. 2 % vs. 121.41% of DRI, p=0.02, respectively 187.07% vs. 163.3% of DRI) as shown in Figure 1. Also, regarding the mean intake, we found that there are 2 vitamins for which mean intake is more than 200 % of DRI,

both in normalweight and obese persons: vitamin A and B12. For two of the vitamins, there is an insufficient daily intake: E vitamin (55.47% of DRI in normal weight, respectively 62.45 % in obese) and D vitamin (24.03% and 21.29 % of DRI in normalweight, respectively obese subjects).

Considering a normal nutritional intake between 85-115% of the DRI, vitamin B9 is the only one consumed according to nutritional recommendations by the obese patients (Figure 1), as opposed to normal weight patients whose mean intake reaches only 84.68 % of DRI.

Regarding mineral's intake, obese subjects consumed significantly higher amounts of phosphorus (199.67% compared to 162.25%, p = 0.00019), iron (131.82% compared to 79.37%, p = 0.000029), copper (146.07% compared to 114.4% t, p = 0.0008) and selenium (229.56% versus 174.95%, p = 0.000025) compared to normal weight subjects, as shown in Figure 2.

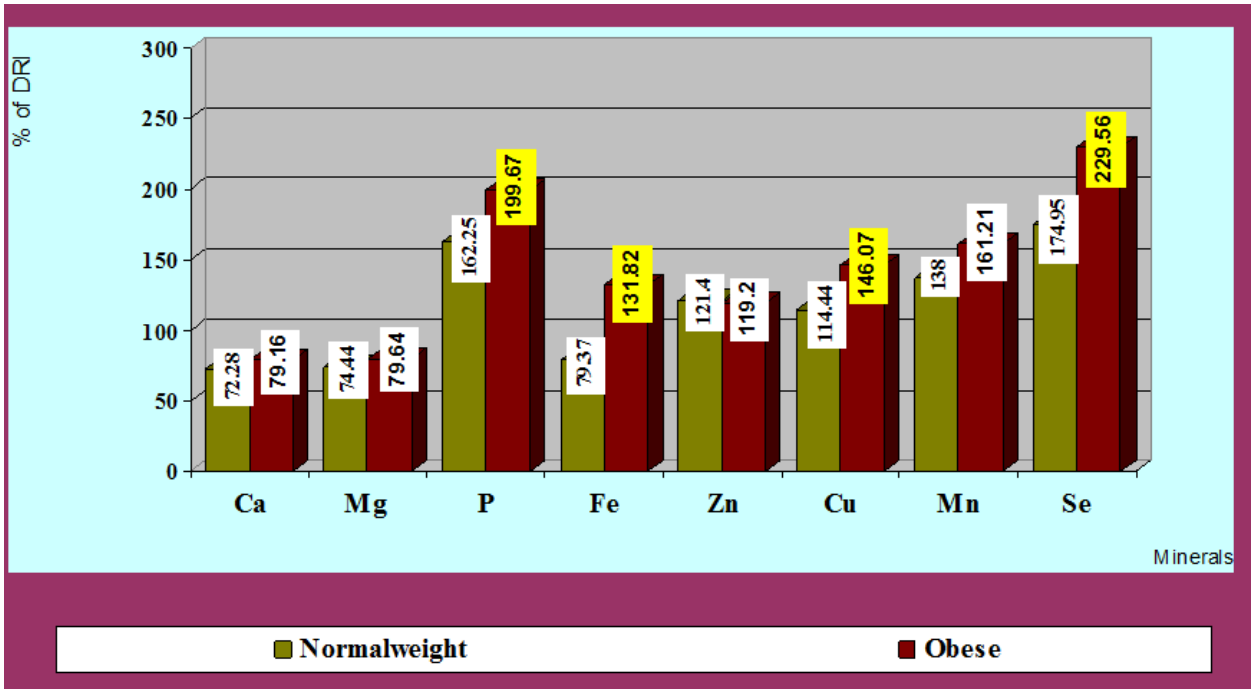

Figure 2. *Mean intake of minerals for normal weight and obese subjects.*

Of the 8 studied minerals, 4 are over consumed, both by normal weight and obese persons: zinc, manganese, phosphorus and selenium. Calcium and magnesium are deficient minerals in the diet of both normal weight and obese subjects. Regarding the iron's intake, it is over-consumed by obese subjects and it is below DRI in normal weight patients.

Discussion

The results of the blood pressure in obese patients from our research are supported by the study SEPHAR I, where the mean was 136.4 / 82.2 mmHg [3].

The findings regarding mean plasma values of HDL cholesterol are similar with the ones found in a study regarding abdominal obesity and cardio metabolic risk factors in US where the mean HDL cholesterol in obese was 48 mg/dl and in normal weight- 60.7 mg/dl [11]. HDL particles have the potential to provide protection due to their numerous properties but further research is needed to determine the type of particles that offer protection. The findings regarding mean plasma glucose are in line with those of the same study from US, where the average blood glucose in patients with BMI between 30-34.9 kg/m^2 was 98 mg/dl, for

patients with a BMI> 35 kg/m^2 it was 104.3 mg/dl while for the normal weight subjects it was 89 mg/dl [11].

The data obtained by us about the prevalence of normal levels of HDL cholesterol are consistent with those from the USA: obese patients have a higher prevalence of low HDL-cholesterol levels compared to those with normal body weight [12].

We noticed the increased fat content and low in carbohydrate diet of both groups without significant differences between normal weight and obese patients. Therefore, it can be said that the participants in this research have a lower intake of carbohydrates, high fat diet, with normal intake of proteins. Our results regarding the mean total calorie intake and that of different macronutrients are lower than the ones found by Bleich et al, who have studied the association of calorie beverages consumption with total daily energy intake and weight status: 2095 kcal in normal weight versus 2280 kcal to obese [13].

Epidemiological studies have shown inconsistent results about the risk to become overweight or obese due to a fat diet [14]. Data from interventional trials have shown that when fat intake is increased, it is associated with a higher calorie intake and weight gain, although this is related mostly to changes in the energy density of food and not to caloric intake from fat per se. Given that the contribution in the diet of a macronutrient is decreasing, it is very important with what it is replaced, because each change can lead to different metabolic effects.

Both groups of patients had an increased average sodium intake and this is consistent with recent data showing that people consume more sodium than physiological needs [15]. However, it should be taken into account that one of the limitations of our study was that sodium intake in this study was determined only by food consumed, and patients were not trained to measure salt intake added during food preparation.

For dietary intake of cholesterol, in early research it was taken into account a maximum value of 300 mg/day. Subsequently, Dietary Guideline for Americans-2015 no longer supports an upper limit of intake for cholesterol because current studies have not shown a clear relationship between the consumption of cholesterol and its serum threshold [12].

We found that Vitamin D is below DRI in all subjects, but, the major source of vitamin D is represented by exposure to sunlight, levels of endogenous secretion depending on the constitutional pigmentation, skin surface exposed, or latitude season [16]. There are also foods rich in vitamin D such as mackerel, trout, salmon, butter, cod, herring but the low level of D vitamin observed in the diet of our individuals demonstrate that their intake is deficient.

Contrary to the results obtained in this study, a research on the coexistence of malnutrition in patients with severe obesity has shown that they meet the DRI for vitamins of group B, and fat-soluble vitamins intake is insufficient [17].

Similar with the data of our research, the data regarding the dietary intake of nutrients in people aged over 2 years in the US, shows that magnesium and calcium are not consumed in the recommended limits [18].

Our study has several limitations. First, in assessing the total intake of calories we used food diary, based on the fairness of the patient to record the amount of food consumed and this is a highly subjective assessment of nutritional status. As a consequence, although food-depth analysis of the food dairy showed some deficiencies or excesses vitamins and minerals, it could not be confirmed by laboratory analysis and this can be a starting point for a further research.

Finally, due to relatively small size of the group (292 patients), the results cannot be representative at a nation-wide level.

Conclusions

Regardless the BMI status, there are few vitamins and minerals that reached the DRI in both normal weight and obese subjects. There is a high prevalence of increased abdominal circumference and excessive sodium's intake among normal weight subjects and these are well-known cardiovascular risk factors. As obesity is increasing, these results support the need for balanced nutritional recommendations as to achieve a healthy lifestyle that can be implemented in the long term, both in normal weight and obese people.

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