Evaluation of Macro-micronutrient Intake in Overweight People in Grodno, Belarus

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Abstract

Introduction Obesity is a multi-cause disease characterized by excessive fat accumulation, which leads to health problems and chronic diseases in the future [1]. Based on the concept of energy imbalance, which is the main cause of this disease, weight loss in patients with metabolic obesity can be achieved by reducing the energy value of the diet, which leads to energy deficiency and stimulates fat mobilization from fat depots. The purpose of the work is to assess the intake of macro- and micronutrients in the diets of overweight individuals.

Materials and methods A survey was conducted to study actual nutrition based on the method of analyzing the frequency of food consumption. Observer groups, aged >18 years (only young people), sexed, living in Grodno, Belarus. During the survey of the respondent, the number of food products actually consumed by him during the previous day was established. The applied method of studying actual nutrition is simple and widely available.

Results and Discussions In the group of females with BMI 25-29, the number of cases of increased macronutrient intake in the sample reached 89.4% of cases and micronutrient intake decreased by 94.7% of cases, while in the group of males with BMI 25-29.9, macronutrient intake increased by 84.2% of cases and micronutrients decreased by 86.6% of cases, respectively.

Conclusion The energy imbalance, especially the deficiency of micronutrients, which have a major role in the synthesis of enzymes that catalyze chemical reactions as well as their role in balancing some hormones, leads to an imbalance in the metabolism process, causing overweight and obesity. Our study advises that nutrition should be corrected early on by making bread enriched with microalgae.

Keywords: Obesity, proteins, Fats, Carbohydrates, Vitamin B6, Vitamin B12.

1 Introduction

Obesity is a multi-cause disease characterized by excessive fat accumulation, which leads to health problems and chronic diseases in the future [1]. Based on the concept of energy imbalance, which is the main cause of this disease, weight loss in patients with metabolic obesity can be achieved by reducing the energy value of the diet, which leads to energy deficiency and stimulates fat mobilization from fat depots. At the same time, a hypocaloric diet, according to which the patient either experiences a gradual decrease in body weight to the appropriate weight value or there is no further increase in body weight, should be selected individually [2, 3]. When topics such as
nutrition, healthy eating, or obesity are discussed, numerous terms appear that are a priori unknown to the general public who is not specialized in health sciences, as is the case with the different types of nutrients [4]. Although the most common classification is focused on the needs of the human being—energy, functional, and structural—the traditional division should not be lost sight of, according to the amounts we need to ingest, that is, macronutrients and micronutrients[5]. To put an end to doubts related to them, we reveal their properties, differences, and degree of relevance. Macronutrients are the nutrients that give us energy[6]. They are essential for the body, in greater quantity than micronutrients. This group would include fats, carbohydrates, proteins, and water. This energy is measured in calories and is essential for the proper functioning of our body’s processes [7]. Within the macronutrients would be the following elements: Fats or lipids: They allow the creation of a valuable energy reserve—which provides 9 calories per gram—that is stored in adipose tissue and that the body uses when it ends up burning them when it has used up the power provided by carbohydrates [8,9]. In addition, they are necessary for the absorption and transport of vitamins called liposolubles (A, D, E, and K), they favor the secretion of bile, and they aid in the absorption of calcium, among other essential functions[10]. Carbohydrates: they provide 4 calories per gram and are considered the main source of energy for the body [11]. They are essential to metabolize fats or for the development of microbial flora. Proteins: they are part of all the tissues of our body, which allows us to get an idea of their great relevance at a nutritional level[12]. Since they cannot be stored, it is important to distribute their intake among the different meals of the day. A protein deficit causes the loss of muscle mass or an incorrect functioning of the brain, something that can cause memory loss, lack of concentration, or learning difficulties[13]. It provides, like carbohydrates, 4 calories per gram. Micronutrients are essential for correct daily activity, but the amount required by the body is less than that of macronutrients[14]. The work they perform is mainly to promote numerous internal chemical reactions. This group would include vitamins and minerals. Vitamins are essential for human growth and development, as well as the proper functioning of the living cells that comprise the body[15]. They constitute a defensive system against the attack of the so-called free radicals (the “residues” that remain after the different processes that occur in the body), and our health depends, to a large extent, on them. Minerals: present in a small proportion in both plant and animal foods, they constitute 4% of body mass,[16] They are divided into macrominerals (calcium, potassium, iron, sodium, and magnesium) and microminerals (zinc, copper, fluoride, cobalt, and chromium) [17]. Their consumption is vital since they are one of the essential factors in the creation of enzymes. Many studies have proven that a balanced diet can improve many disorders[18]. Mention may in particular be made of weight loss or gain, digestive disorders, sleep disorders, or eating disorders. An improved diet is also effective for aging. Nutrition helps prevent certain disorders sometimes linked to a poor diet: cardiovascular disease, diabetes, cancer, etc [19]. Nutrition is also important for top athletes to improve their performance[20]. Based on prevention, having a balanced diet is the basic principle for long-term good health and is specific to everyone. Finally, dietary evaluation methods, particularly retrospective methods, must be strengthened in order to provide accurate dietary information that can be used to establish more robust diet-health associations[21]. To this end, the scientific community has made leaps and bounds with the development of technological methods that make it possible to overcome memory errors and the difficulty of estimating the portions consumed. Likewise, the discovery of dietary biomarkers through nutritional metabolomics will allow health researchers to obtain objective information for the determination of food intake.

The purpose of the work is to assess the intake of macro- and micronutrients in the diets of overweight individuals.

2 Materials and methods

A survey was conducted to study actual nutrition based on the method of analyzing the frequency of food consumption [22–25]. Observer groups, aged >18 years (only young people), sexed, living in Grodno, Belarus. During the survey of the respondent, the number of food products actually consumed by him during the previous day was established. The applied method of studying actual nutrition is simple and widely available. This method can be applied to perform research on large samples. A good comparability of the 24-hour recall of nutrition data with the results obtained by the weighing method and the method of assessing the amount of food consumed by the test subjects was noted. The study used a specially designed questionnaire, which includes a questionnaire form for recording data on nutrition for the day preceding the survey: about the time, place, and characteristics of each consumed food product (dish), as well as its quantity. In total, 152 people were under observation. The number of males was 72 (38 were overweight and 38 were normal weight), and the number of females was 72 (38 were overweight.
Informed consent was obtained from everyone to conduct the questionnaire. Computer programs aim to collect dietary information during a specific short- or long-term period[26]. These methods are similar to the traditional ones, with the difference that they are accompanied by multimedia attributes such as colors, food images, audio narration, animated guides, graphics, and web cameras. To obtain the information, subjects are asked to report food intake during a specific period and add it to the program, which can probe for omitted foods. The statistical processing of the research material was performed using the SPSS Statistics 26.0 statistical software package. At p 0.05, differences between the compared groups were considered statistically significant.

### Table 1: Indicators of consumption of macro- and micronutrients with diets of a group of females with BMI=18-24.9 and BMI=25-29.9

<table>
<thead>
<tr>
<th>N</th>
<th>Normal values for daily consumption X±δ</th>
<th>BMI = 25-29.9 X ±δ</th>
<th>BMI = 18-24.9 X ±δ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proteins, g</td>
<td>38 64.5 ± 2.12</td>
<td>115.21 ± 28.96 ***</td>
<td>74 ± 23.36</td>
</tr>
<tr>
<td>Fats, g</td>
<td>38 71.5 ± 2.12</td>
<td>102.17 ± 31.42 ***</td>
<td>81 ± 2.36</td>
</tr>
<tr>
<td>Carbohydrates, g</td>
<td>38 348 ±42.42</td>
<td>520.72 ±63.46 **</td>
<td>305.76±41.81</td>
</tr>
<tr>
<td>Folacin, mg</td>
<td>38 500 ±141.42</td>
<td>241.3 ±42.82  ***</td>
<td>392.31±56.17</td>
</tr>
<tr>
<td>Beta-carotene, mg</td>
<td>38 5.2 ±3.67</td>
<td>4.25 ± 2.16 *</td>
<td>6.43±3.17</td>
</tr>
<tr>
<td>Vitamin A, mg</td>
<td>38 1.95±1.48</td>
<td>0.55±0.38</td>
<td>0.58±0.41</td>
</tr>
<tr>
<td>Vitamin C, mg</td>
<td>38 495 ±572.7</td>
<td>87.58±24.56 ***</td>
<td>122±33.12</td>
</tr>
<tr>
<td>Vitamin E, mg</td>
<td>38 82.5±95.45</td>
<td>41.24±7.59 ***</td>
<td>59.21±8.14</td>
</tr>
<tr>
<td>Vitamin PP, mg</td>
<td>38 40±28.28</td>
<td>16.84±4.16 ***</td>
<td>31.64±5.12</td>
</tr>
<tr>
<td>Vitamin B1, mg</td>
<td>38 3.25±2.74</td>
<td>2.14±0.36 ***</td>
<td>3.01±0.42</td>
</tr>
<tr>
<td>Vitamin B2, mg</td>
<td>38 3.9±2.96</td>
<td>1.34±0.48 ***</td>
<td>2.91±0.79</td>
</tr>
<tr>
<td>Vitamin B6, mg</td>
<td>38 4±2.82</td>
<td>1.72±0.19 ***</td>
<td>3.82±0.26</td>
</tr>
<tr>
<td>Vitamin B12, mcg</td>
<td>38 6±4.24</td>
<td>4.12±1.24 ***</td>
<td>9.05±4.13</td>
</tr>
</tbody>
</table>

* -p<0.05 / ** P<0.01 / *** p<0.01

### 3.1 Females group

The analysis of macronutrients (proteins, fats, and carbohydrates) found them to be higher in females with a BMI of 25–29.9 than in females with a BMI of 18–24.9 (55%, 25.9%, 70.4%) (p 0.001, p 0.001, and p 0.01 respectively). Compared with the level of physiological intake, it was found that the analysis of macronutrients (proteins, fats, and carbohydrates) is higher by 78.2%, 42.8%, and 49.6%, respectively (table 1) (figures 1-3). The number of cases of violation of the physiological norms of macronutrients (in general and regardless of type) in the diet of females with a BMI of 25–29.9 reached 89.4% of cases, and cases of violations of proteins, fats, and carbohydrates were 76.3%, 68.4%, and 47.3% of cases, respectively. In the group of females with a BMI of 25–29, a violation in the consumption of micronutrients was revealed both in comparison with the indicators of physiological intake and in comparison with the group of females with a BMI of 18–24.9. It was found that the consumption of (Folacin, Beta-carotene, Vitamin A, Vitamin C, Vitamin E, Vitamin PP, Vitamin B1, Vitamin B2, Vitamin B6, Vitamin B12) decreased (51.8%,18.2%,71.7%, 82.3%, 85.1%, 57.9%, 34.1%, 65.6%, 57%, 31.3%) compared with the physiological norms of consumption, respectively, and decreased by (38.5%, 33.9% 5.1%, 28.2% 49.4%, 46.7%...
28.9%, 53.9% ,54.9%, 54.4% ) (p 0.05, p 0.05 p 0.05, p 0.001, p 0.001, p 0.001, p 0.001, p 0.001 ) when compared with a group of females with a body mass index of 18-24.9, respectively (table 1) (figures 4-13). Micronutrient deficiency (in general and regardless of type) was found in 94.7% of females with a BMI of 25-29 when compared to physiological intake. The decrease (folacin, beta-carotene, vitamin A, vitamin C, vitamin E, vitamin pp, vitamin B1, vitamin B2, vitamin B6, vitamin B12) was 73.6% 71.05% 31.5% 50%, 68.4% 60.5% , 57.8%, 68.4%, 57.8% 47.3% of cases (compared with physiological intake). The number of cases in the sample was calculated according to the minimum and maximum values of the physiological norm of consumption and not according to the average value of consumption.

**Table 2:** Indicators of consumption of macro- and micronutrients with diets of a group of females with BMI=18-24.9 and BMI=25-29.9

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<tr>
<td></td>
<td>Fats, g</td>
<td>38</td>
<td>88 ± 7.07</td>
</tr>
<tr>
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<td>Carbohydrates, g</td>
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<td>383±42.42</td>
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<tr>
<td></td>
<td>Vitamin B12, mcg</td>
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<td>6±4.24</td>
</tr>
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* p<0.05 / ** P<0.01 / *** p<0.001

### 3.2 Males group

In males with a BMI of 25–29.9, it was found that the analysis of macronutrients (proteins, lipids, and carbohydrates) is higher than in males with a BMI of 18–24.9 (51.9%, 43.1%, and 40.7%) (p <0.01, p <0.01 p<0.05), respectively (Table 2). Compared with the level of physiological intake, it was found that the analysis of macronutrients (proteins, lipids, and carbohydrates) is higher by 73.9%, 48%, and 24.9%, respectively Table 2 1, 2, 3. The number of cases of violation of the physiological norms of macronutrients (in general and regardless of the type) in the diet of males with a BMI of 25–29.9 reached 84.2% of cases, and cases of violations of proteins, lipids, and carbohydrates were 68.4%, 57.8%, and 50% of cases, respectively. In the group of males with a BMI of 25–29.9, a violation in the consumption of micronutrients was revealed both in comparison with the indicators of physiological consumption and in comparison with the group of males with a BMI of 18-24.9. It was found that the intake of (Folacin, Beta-carotene, Vitamin A, Vitamin C, Vitamin E, Vitamin PP, Vitamin B1, Vitamin B2, Vitamin B6, vitamin B12) decreased (51.7%,7.69%,5.1%, 68.6%, 27.07%, 47.2%, 10.7%, 51.2%, 39.7%, 19.1%) compared with the physiological norms of consumption, respectively, and decreased by (38.4%, 32.3% 36.2%, 23.1% 32.5%, 43.6% 23.6%, 40.8% 41.5%, 48.4%) (p 0.05, p 0.05 p 0.05, p 0.05 p 0.05, p 0.05 p 0.05, p 0.05 p 0.05) when compared with a group of males with a body mass index of 18-24.9, respectively Table 2 Figures (4-13). Micronutrient deficiency (in general and regardless of type) was discovered in 86.6% of males with a BMI of 25–29.9 when compared to physiological intake. The decrease (folacin, beta-carotene, vitamin A, vitamin C, vitamin E, vitamin pp, vitamin B1, vitamin B2, vitamin B6, and vitamin B12) was 31.5%, 39.4%, 28.9%, 36.8%, 34.2%, 52.6%, 47.3%, 50%, 26.3%, and 36.8% of cases) compared with physiological intake. The number of cases in the sample was calculated according to the minimum and maximum values of the physiological norm of consumption and not according to the average value of consumption.
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Figure 1: Protein consumption in normal-weight and overweight females and males.

Figure 2: Fat consumption in normal-weight and overweight females and males.

Figure 3: Carbohydrates consumption in normal-weight and overweight females and males.

Figure 4: Vitamin A consumption in normal-weight and overweight females and males.

Figure 5: Vitamin B1 consumption in normal-weight and overweight females and males.

Figure 6: Vitamin B2 consumption in normal-weight and overweight females and males.

Figure 7: Vitamin B2 consumption in normal-weight and overweight females and males.

Figure 8: Vitamin B12 consumption in normal-weight and overweight females and males.
The human body’s calorie requirements are met primarily by three dietary macronutrients: carbohydrates, fats, and proteins[27]. Because within-person variance in energy intake is minimal over long periods of time, increases in one macronutrient frequently lead to reductions in another[28]. In addition to quantity, the food sources and kinds of macronutrients are essential for comprehending their correlations with disease risks. Changes in the economy, nutrition-related regulations, and food processing technologies can all have an impact on the macronutrient composition and diet quality of the population[29]. However, research on changes in macronutrient composition, subtypes, and dietary sources remains scarce. Conducted in the last decade, clinical and epidemiological studies of external factors in the pathogenesis of obesity have shown that, in addition to the excessive energy value of the diet in general, the leading cause of obesity is a diet high in fat[30, 31]. Such a diet causes even more pronounced weight gain than a high-carbohydrate diet with the same total calorie content. With increased consumption of fats, the rate of their oxidation, especially in overweight and obese individuals, increases slightly or does not increase at all, while excessive consumption of proteins or carbohydrates is accompanied by their accelerated oxidation[32, 33]. However, a long-term, sharp restriction of fat intake is undesirable since polyunsaturated fatty acids, which are essential for the body, come with fat and fats are involved in the absorption of fat-soluble vitamins and a number of minerals from the intestines. Vegetable fats slightly increase the activity of enzymes that stimulate fat breakdown in the body. As a result, the percentage of fats in the daily calorie intake for an obese should be no more than 30% . In addition, there should be a limit on the intake of animal fats as vegetable oil consumption should rise to 40% of total fat consumption[34, 35]. The results of our study indicate that there is a positive relationship between the pattern of food used and weight gain. The findings revealed that consuming macro- and micronutrients together was a major cause of weight gain in adults and Predict the risk of future diseases. According to the World Health Or-
ization, the largest frequency currently is the consumption of macronutrients in foods such as fats, carbohydrates, and foods rich in sugar, which is associated with weight gain due to dependence on soft drinks in conjunction with the decrease in sources of micronutrients such as vegetables and fruits in many countries[36].

In a study conducted by Aminova O.S et al. in 2017 to find out the consumption of macronutrients between men and women compared to physiological standards, it became clear that there was a disorder in the dietary pattern in 24% of men and 23% of women, which led to weight gain in both groups [37].

A 2019 study conducted by Yi Yi Lee et al. on a sample of Malaysians assessed dietary intake in comparison to current guidelines and recommendations[38]. The relationship between food consumption and obesity factors was also evaluated. This study found that the majority of study participants were overweight or obese. Although protein intake exceeded recommended levels, fruit and vegetable consumption as sources of dietary fiber was lower than recommended, whereas sugar and fat consumption was much greater.

In a study conducted by Shinyoung Jun et al. on a group of the adult population in the United States to assess micronutrients and diet quality in obese people, it was found that there is a significant deficiency of micronutrients compared to their healthy-weight counterparts[39].

Numerous studies conducted by Russia’s Federal Research Center of Nutrition, Biotechnology, and Food Safety revealed vitamin C deficiency in 34.8% of the examined, vitamin B1 deficiency in 75% of the examined, B2 deficiency in 47.4% of the examined, vitamin B6 deficiency in 72.6%, B12 deficiency in 40%, folic acid deficiency in 90%, and -carotene deficiency in 62%[40].

One thing to remember about the results of total macronutrient (carbohydrates, protein, and fat) and micronutrient consumption is that the main sources of these in foods can be determined by evaluating the amount of these in each food as well as the amount of food consumed. In this sense, eggs and fatty cuts of meat account for the largest share of total fat consumption, not only because they are consumed in large quantities but also because they are foods that are high in both protein and fat. Finally, a satisfactory assessment of the intake of macro- and micronutrients in the diet of practically healthy groups of males and females aged >18 years (for young people) living in the city of Grodno, Belarus, was given during the course of the study. There were violations in macro- and micronutrient consumption levels that had gender differences and did not meet the normal values of physiological nutrient needs for adult groups of the Republic of Belarus population.

4 Conclusion

The energy imbalance, especially the deficiency of micronutrients, which have a major role in the synthesis of enzymes that catalyze chemical reactions as well as their role in balancing some hormones, leads to an imbalance in the metabolism process, causing overweight and obesity. Our study advises that nutrition should be corrected early on by making bread enriched with microalgae.

Conflict of Interest: The authors declare no conflict of interest.

Financing: The study was performed without external funding.

Ethical consideration: The study was approved by the local ethics committee.

References


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