Original Article

Energy balance of the obese subject

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SUMMARY

Obesity is a real epidemic with significant health effects. The pathophysiology of obesity involves environmental factors such as excess diet and/or decreased physical activity. In all cases, the energy balance of the obese subject is positive. As part of an efficient management of this ever-increasing pathology, we wanted to measure the energy balance of a population of Algerian adults (402 subjects aged 30 to 60 years followed in medical consultation). Body composition and energy metabolism were assessed by bioelectrical impedancemetry; the energy intake and the level of physical activity were assessed on codified interrogation. It turns out that obese subjects underestimate their dietary intake and are in their great majority inactive. The therapeutic management of these patients requires a nutritional education program combined with recommendations of adapted sports practice.

Key words: Obesity- energy balance- body composition- bioelectric impedancemetry-activity-dietary intake

INTRODUCTION

The factors involved in the development of obesity are multiple and entangled, among these factors the imbalance of energy metabolism seems to hold an important place.

It is important to emphasize that the stability of the weight is the result of a remarkable balance between the energy expenditure of the organism corresponding to the outputs and the energy supply corresponding to the inputs. In the case where this equilibrium or energy homeostasis is broken, the energy balance is said to be positive; the resulting energy storage is a source of inflation of the adipose tissue leading to the installation of overweight.

It would be interesting to know if there is an excess of food intake and/or a decrease in energy expenditure in the common obesity.

We carried out a food survey in association with an anthropometric profile study and the measurement of energy expenditure in a population of overweight and obese Algerian adults in order to contribute to the management of this pathology with nutritional determinism.

In light of all these data, and once the relationships between anthropometric measurements and energy balance components are better established, the evidence for establishing a strategy for prevention and management of obesity and its complications could be proposed, namely a nutritional education program aimed at promoting healthy eating behavior and a suitable physical activity pattern for the mobilization of adipose tissue in order to maintain an anthropometric status in so-called normal margins to improve the metabolic profile and reduce the risk of cardiometabolic diseases.

PATIENTS AND METHODS

(A) Patients

402 adult subjects of both sexes (obese or overweight and controls) between the ages of 30 and 60 years participated in our study which lasted 2 years since 2014.

- Inclusion criteria: subjects whose body mass index (weight/height²) exceeds 18.5 kg/m².
- Exclusion criteria: lean, undernourished, subjects with endocrine or chronic disabling conditions.

The subjects of our study were subjected to anthropometric measurements, impedancemetric measurements and a food survey, in the laboratory of physiology of hospital N. Hamoud of UHC Hussein Dey.

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(B) Methods

- Anthropometric Measurements
  
  • Weight: weight measurement is one of the highlights of nutritional diagnosis, as it is essential to correctly estimate the corpulence of the patient and to quantify a possible weight change. The weighing is carried out in the morning on an empty stomach, the bladder empty, the patient being in underwear. The search for the presence of edema which, if present, disturbs the assessment of the patient's "dry weight", a more reliable indicator of his or her actual nutritional status.
  
  • Size: this is the second basic parameter required. It must be measured directly by means of a measuring rod, the patient having removed his shoes or, if this is not possible, he can be collected by interrogation, with the risk of overestimating his actual value.
  
  • BMI: The most commonly used body mass index is the BMI. It corresponds to the following formula: BMI (kg/m$^2$) = weight (kg) /size$^2$ (m$^2$).
  
  It is a corpulence index that makes it possible to evaluate both the nutritional status of malnourished patients and that of obese subjects.

  • Measurements of waist circumference and hip circumference: they are made using a tape measure, the patient being supine, the ribbon passing, according to the recommendations of the WHO, halfway between the Lower ridge and iliac ridges for waist measurement and large trochanters for hip measurement. These two parameters are used to assess the distribution of adipose tissue in overweight or obese patients. Waist circumference is a marker of perivascular abdominal adipose tissue and its increase defines abdominal and orroid obesity, and is often accompanied by metabolic complications (metabolic syndrome, type 2 diabetes, dyslipidemia, hypertension) or cardiovascular diseases.

  Normal values of waist circumference vary with the ethnic origin of the populations studied. Thus, according to the International Diabetes Federation (IDF), the waist circumference is increased when it exceeds 94 cm in a European male or 80 cm in a woman. The thresholds being even stricter for Asian populations (90 cm for men and 80 cm for women).

  The hip circumference represents a reflection of the subcutaneous adipose tissue and its increase characterizes a gynoid distribution of the fat mass, ie predominant at the level of the lower part of the body and more readily associated with complications of mechanical type (osteoarthritis). The ratio between waist circumference and hip circumference corresponds to the waist-to-hip ratio, a ratio also recommended by WHO to define abdominal obesity when it exceeds 0.90 in men and 0.85 in women. However, this report tend to be supplanted at the present time by the measurement of the waist that is simpler to implement and equally informative on the clinical level.

- Measurement of body composition, energy requirements and expenditure
  
  • Bioelectrical impedancemetry: among the non-anthropometric methods it is certainly the one most used because the most easily accessible. There are several types of appliances ranging from consumer and inexpensive fat mass analysis devices on a standing subject to more sophisticated devices with multiple electrodes used on a supine patient and allowing for segmental analyzes of the body composition. It is a non-invasive technique based on resistance to the passage of a low intensity electrical current through the body.

  For our protocols we used a multi-frequency impedance meter type Quadscan 4000.

  Impedance measurements are performed on the subjects lying in supine position, the patients being at rest at the time of filling the questionnaire. Two electrodes are placed at the level of the hand and two others at the level of the homolateral foot.

  Then the anthropometric measurements are recorded in the instrument and the measurement is immediately carried out.

  The examination lasts a total of 4-5 min (5-10 min of rest).
- Food survey:
The simplified evaluation seeks an excess of dietary fats (butter, cheese, cooking fats, fries ...); an excess of sugary or alcoholic beverages; a particularly salty food (bread, cheese, preserves ...). The use of simple marks makes it possible to quantify the contributions: number of plates, cans, glasses, duration of use of one liter of oil or a plate of butter, etc. The dietary intake survey shows the level of daily energy intake (in kcal/24 h) and the relative proportion of macronutrients (as a% of total energy intake).

- Statistic study
The Statistical Package of Social Science (SPSS 17.0) software was used.

To evaluate the statistical significance of the parameters, we used the Student (t) test. The 95% confidence interval represents the interval that contains the true value of the parameter with an error risk of 5%.

The parameters are presented as averages.

For the comparison of the means, the result is given in the form of p (statistical significance).
- If p ≥ 0, 05: the comparison is not significant.
- If p <0, 05: the result is significant.
- If p = 0, 001: the result is highly significant.

### RESULTS

<table>
<thead>
<tr>
<th>Groups</th>
<th>witnesses (n=110)</th>
<th>overweight (n=156)</th>
<th>obeses (n=136)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>60,0</td>
<td>74,0</td>
<td>86</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>158</td>
<td>159</td>
<td>165</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>24,0</td>
<td>29,3</td>
<td>31,7</td>
</tr>
<tr>
<td>Waist circumference (cm)</td>
<td>79</td>
<td>91</td>
<td>95</td>
</tr>
<tr>
<td>Hip circumference (cm)</td>
<td>98</td>
<td>110</td>
<td>119</td>
</tr>
<tr>
<td>Level of activity</td>
<td>medium</td>
<td>medium</td>
<td>low</td>
</tr>
<tr>
<td>Fat body mass</td>
<td>25,3</td>
<td>41,9</td>
<td>37</td>
</tr>
<tr>
<td>Lean body mass</td>
<td>61,7</td>
<td>58,1</td>
<td>63</td>
</tr>
<tr>
<td>Basal metabolism BMR (kcal)</td>
<td>1247</td>
<td>1378</td>
<td>1618</td>
</tr>
<tr>
<td>Energy inputs (kcal/d)</td>
<td>1995</td>
<td>2706</td>
<td>3265</td>
</tr>
</tbody>
</table>

The fat mass ratio is relatively high in overweight or obese subjects compared to controls (P < 0, 05).

There was no significant difference in lean mass between the 3 groups.

Waist circumference is also increased in both overweight subjects compared to controls (P < 0, 05).

There was a significant difference in the level of basal metabolism between obese subjects and normal or overweight subjects (P < 0, 001).

The level of physical activity (NAP) in obese subjects is low.

In addition, obese and overweight subjects had higher energy intake compared with normal subjects (P < 0, 001).

### DISCUSSION

Energy intake is an essential determinant in weight stability, both quantitatively and qualitatively, and in particular the intake of undifferentiated lipids.

Quantitatively, the obese subject underestimates his dietary intake.

Obese subjects have a preference for and taste for lipids.

Excess lipids in a diet do not increase their oxidation; On the other hand the lipids are not very satisfactory compared to the other nutrients.

However, the capacity of oxidation of nutrients varies from one family to another, or even from one individual to another.

Total energy expenditure (TED) consists of three main components: resting energy expenditure (DER) is about 60-70% of TED, postprandial food thermogenesis is about 10% to 20% of TED, more Proteins and lower for lipids; The excess of ingestion of the lipids does not increase the food thermogenesis which accumulated over several years leads to an “energy saving” and a remarkable weight gain.

Physical activity which is the most variable parameter and therefore the most likely to increase metabolism seems to be low in obese subjects although the energy cost for locomotion is increased in the obese subject relative to the normal weight subject.

### CONCLUSION

Obesity is undoubtedly one of the major health challenges, a veritable epidemic explosion, a genuine chronic pathology, obesity is the main provider of numerous co-morbidities dominated by cardimetabolic diseases, thus increasing the risk of mortality and hindering the quality of life of the obese.

This highlights the need for early identification and optimized, specialized and specific management of these complications.

This approach remains the best guarantee to increase the life expectancy of the obese while preserving his psychological and social well-being.

The World Health Organization currently places the prevention and management of obesity as a priority in the field of nutritional physiology.

Obesity as a chronic disease requires comprehensive management which should take into account not only the usual anthropometric measurements used to define the severity and
type of obesity (BMI, waist circumference) other parameters for the individual assessment of adipose overweight and lean capital status. For this purpose, knowledge of body composition, energy expenditure and usual energy inputs provide essential information at the precise moment of the initial assessment of obesity in order to work with the patient on a weight control project. They are even more valuable for the regular follow-up of therapeutics.

**REFERENCE**