Nutritional assessment and its role in evaluation and prescription of exercise training

Loredana Meşină¹, Lucian Hobe², Andreea Cocaina², Timea Szasz¹, Claudiu Avram³

Abstract

Introduction: Nutritional assessment gives accurate and reproducible information as regards the existence of an optimal energy metabolism: resting metabolic rate (RMR), the proportion of nutritional principles (fat, carbohydrate, protein) used by the body in the basal metabolism, the intensity of effort during exercise where the maximum fat oxidation rate (MFOR) is achieved. These information are used for the individualization of physical training programs and for the calorie intake adjustment in accordance with the body needs. The aim of this study is to underline once again the importance of physical activity in the weight management and to demonstrate the importance of nutritional assessment in the prescription of physical training in obese subjects. Material and methods: We investigated 43 young obese, with a mean age of 21.2 ± 3.1 years old, of which 93% were females. The subject’s evaluations consisted in: nutritional assessment (using indirect calorimetry method), maximal exercise test at baseline and the end of the study (after 6 months). After the exercise test, the subjects performed an individualized physical training with a minimum frequency of three times a week. Subject’s heart rate was monitored during exercise by a physical therapist using a heart rate monitor (Polar F3, Finland). The dropout rate from the physical training program as part of the study was 35%, in the end remaining only 28 subjects. Results: After 6 months of individualized exercise training, we noticed a statistically significant increase of the following parameters: maximum fat oxidation rate (MFOR) from 16.96±7.75 to 22.07±8.4 g/h, p=0.0043; resting metabolic rate (RMR) from 2007±300.3 to 2105±290.4 kcal/day, p = 0.0026; along with the resting oxygen uptake (VO₂ rest) from 0.29±0.04 to 0.3±0.04 l / min, p = 0, 0035. The only parameter that has improved, but not reaching statistical significance was heart rate average at MFOR (HR_MFOR) which increased from 127.1±18.37 to 135±25.09 /min. Conclusions: Physical training in young obese subjects is safe and effective; thus, this study demonstrates the increased efficiency of physical training programs regarding weight loss and higher MFOR due to a higher aerobic capacity.

Key words: nutritional assessment, resting metabolic rate, maximum fat oxidation rate.

¹ Physical therapist, master student at West University of Timișoara, Physical Education and Sport Faculty, e-mail: lucy_mes_lory2004@yahoo.com
² Physical therapist, University of Medicine and Pharmacy ‘Victor Babes’, Faculty of Medicine
³ Assistant lecturer PhD, Physical Education and Sport Faculty, West University of Timișoara
Rezumat

Introducere: Analiza nutrițională oferă informații exacte și reproducibile cu privire la existența unui metabolism energetic optim: consumul energetic de repaus (RMR), proporția principiilor alimentare (lipide, carbohidrați, proteine) utilizate de către organism în cadrul metabolismului bazal, intensitatea efortului din timpul exercițiului fizic la care se atinge rata de oxidare maximă a grasimilor (MFOR). Aceste informații sunt utilizate pentru individualizarea programelor de antrenament fizic și ajustarea aportului calorici în funcție de necesitățile organismului. Scopul acestei lucrări este de a sublinia încă odată importanța activității fizice în managementul greutății corporale și își propune să demonstreze importanța analizei nutriționale în prescrierea antrenamentului fizic la tinerii obezi. Material și metode: Lotul inițial de subiecți incluși în acest studiu a cuprins 43 de tineri obezi, sedentari cu vârsta medie de 21.2±3.1 ani, dintre care 93% de gen feminin. Evaluările realizate acestora au constat în: analiza nutrițională (folosindu-se metoda calorimetriei indirecte), și testul de efort maximal la începutul (octombrie 2008) și la sfârșitul studiului (după 6 luni). În urma testării la efort, subiecții au efectuat un antrenament fizic individualizat cu o frecvență de minim 3 ori pe săptămână, fiind supravegheați de un kinetoterapeut. Frecvența cardiacă a acestora a fost monitorizată cu ajutorul unor pulsmetre (Polar F3, Finlanda). Rata de renunțare la programul de antrenament fizic din cadrul studiului a fost de 35%, la final rămâne doar 28 de subiecți. Rezultate: După cele 6 luni de antrenament fizic individualizat s-a constatat o creștere semnificativă statistic a următorilor parametrii: rata de oxidare maximă a grăsimilor (MFOR) de la 16.96±7.75 la 22.07±8.4 g/h, p=0.0043; consumul de energie în repaus (RMR) de la 2007±300.3 la 2105±290.4 kcal/zi, p=0.0026; consumul de oxigen în repaus (VO_{2rest}) de la 0.29±0.04 la 0.3±0.04 l/min, p=0.0035. Singurul parametru care a suferit modificări, dar nu îndeajuns de mari pentru a atinge pragul semnificaţiei statistice a fost media frecvenţei cardioare MFOR (HR_MFOR) care a crescut de la 127.1±18.37 la 135±25.09 `/min, p=0.1396. Concluzii: Incluirea subiecților tinerii obezi într-un program de antrenament fizic individualizat este sigură și eficientă. Astfel, acest studiu demonstrează creșterea eficienței programelor de antrenament fizic în ceea ce privește pierderea în greutate și creșterea MFOR datorită capacității aerobe de efort mai mare.

Cuvinte cheie: analiză nutrițională, consum energetic de repaus, rata de oxidare maximă a grăsimilor

Introduction

In recent decades, the obesity has seen one of the most spectacular developments, largely overlapping to the development of modern civilization. In Romania, the last year statistics show that 20% of people are suffering of obesity and others 40% are overweight, which places us on the third place in Europe as obesity prevalence. What is most alarming is that over 40% of Romanian children are overweight [1].

For all the subjects who intend to lose weight, the increase in physical activity is very important to achieve long term result. The physical training is a central component of multifactorial intervention program in obesity because it has proved that regular physical activity brings significant benefits and improves the survival not only in subjects without heart disease but also in cardiovascular subjects [2-3].

To know the real energy needs and to make individualized recommendations for both calorie intake and physical training in order to reduce the body weight is necessary to perform a nutritional assessment, part of ergospirometry test (analysis and interpretation) [4].

Nutritional assessment gives accurate and reproducible information as regards the existence of an optimal energy metabolism: rest energy expenditure (RMR), the proportion of nutritional principles (fat, carbohydrate, protein) used by the body in the basal metabolism, the intensity of effort.
during exercise where the maximum fat oxidation rate (MFOR) is achieved (reached). These information are used for the individualization of physical training programs and for the calorie intake adjustment in accordance with the body needs [5]. The aim of this study is to underline once again the importance of physical activity in the weight management and to demonstrate the importance of nutritional assessment in the prescription of physical training in young obese. The intervention on these subjects suggested by this study is confined to a few main goals:

- The body weight decrease by increasing exercise capacity;
- To determine as accurately as possible the RMR and the daily caloric needs of these subjects;
- To increase the efficiency of physical training program by determining the effort intensity in which MFOR is achieved;
- To increase the resting metabolic rate in order to maintain the weight achieved on a long term.

Material and methods

We investigated 43 young obese, with a mean age of 21.2±3.1 years old, of which 93% were females. The selection was made in the University of West Timisoara based on the value obtained after calculating body mass index (BMI). The main criteria for inclusion in the study were: the age between 18-25 years, BMI > 25 kg/m², no contraindications to perform exercise training, had availability to perform physical training in order to reduce weight and increase exercise capacity. The subject’s evaluation consisted in: nutritional assessment, using indirect calorimetry, and the maximal exercise test at baseline and at the end of the study (after 6 months).

1. Nutritional assessment: subjects were placed in supine position with eyes closed, in the presence of a relaxing atmosphere for 15 minutes, during which it was recorded the heart rate and respiratory gas exchange; this was performed using a silicone mask and an oxygen sensor (connected to the gas analysis device - Metalyzer 3B, Germany). The evaluated subjects were advised to be more relaxed - this state was induced by the presence of an relaxing background music hall and the absence of test examiners during the evaluation (15 minutes) (figure 1).

2. Exercise test: for determine the maximum fat oxidation rate we performed a maximal effort test on bicycle ergometer (Lode Corival, Netherlands). We also used a gas exchange analyzer (Cortex Metalyzer 3B, Germany) and a 12 lead stress electrocardiographic device (General Electric Medical System, Germany). In the same time we recorded blood pressure, heart rate and cycling workload. In the absence of any bad symptom, the subjects were encouraged to perform a maximal exercise test. At the end of the test, the parameters obtained were interpreted and explained to the subjects and physical therapists.

3. Exercise training program: Using the exercise test results, it was possible to make a personalized exercise training program for each subject. This program has been prescribed based on a report about training zones intensity intervals and MFOR of each subject. There were performed an indoor exercise training on bicycle ergometer, crosstrainers, treadmill and hydraulic stepper for at least 3 times a week. Subject’s heart rate was monitored during exercise by a physical therapist using a heart rate monitor (Polar F3, Finland).

The dropout rate from the physical training program as part of the study was 35%, in the end remaining only 28 subjects. The reasons were various: the subjects were unavaiable (establish-ment of other
priorities, increase working hours, employment), health problems (joint problems outside of the training sessions, medical treatments that had contraindication for exercise etc.).

Results

The study group had a modest but significant results regarding weight. After six months of physical training we have seen improvements in the following parameters: maximum fat oxidation rate (MFOR), resting energy expenditure (RMR), resting oxygen uptake (VO₂ rest) and average heart rate at MFOR (HR_MFOR) (Table I).

Table I. Arithmetic mean and standard deviation of the studied parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Baseline</th>
<th>After 6 months</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MFOR (g/h)</td>
<td>16.96±7.75</td>
<td>22.07±8.4</td>
<td>0.0043</td>
</tr>
<tr>
<td>RMR (kcal/day)</td>
<td>2007±300.3</td>
<td>2105±290.4</td>
<td>0.0026</td>
</tr>
<tr>
<td>VO₂rest (l/min)</td>
<td>0.29±0.04</td>
<td>0.3±0.04</td>
<td>0.0035</td>
</tr>
<tr>
<td>HR_MFOR (b/min)</td>
<td>127.1±18.37</td>
<td>135±25.09</td>
<td>0.1396 (ns)</td>
</tr>
</tbody>
</table>
Data analysis was performed using GraphPad statistical software for applying the paired t test to calculate the statistical significance of the analyzed parameters.

Thus, after the evaluation of the data, there was a statistically significant increase in the maximum fat oxidation rate (MFOR) from 16.96±7.75 to 22.07±8.4 g/h, p=0.0043 (Figure 2).

The resting metabolic rate (RMR) has significantly increased from 2007±300.3 to 2105±290.4 kcal/day, p=0.0026 (figure 3). The result was the effect of increasing VO2 at rest from 0.29±0.04 to 0.3±0.04 l/min, p=0.0035 (figure 4). Moreover, the average heart rate at MFOR (HR_MFOR) increased, but without reaching statistical significance threshold: from 127.1±18.37 to 135±25.09 b/min, p=0.13.

In conclusion, the physical training in young obese subjects is safe and effective; thus, this study therefore aerobic performance of the investigated subjects. The resting metabolic rate increased proportionally with the increasing of resting oxygen uptake as a consequence of the increase in cardiopulmonary fitness.

The exercise heart rate at maximum fat oxidation rate also increased, but not significantly, probably due to its different adaptation depending on the subject’s physical fitness.

In conclusion, the physical training in young obese subjects is safe and effective; thus, this study
demonstrates the increased efficiency of physical training programs regarding weight loss and higher MFOR due to a higher aerobic capacity. We recommend to each subject to continue physical training after getting out of this research project, in order to maintain the gained exercise capacity and continue to lose weight. Another essential advice was to get specialized advice from nutritionists in order to adopt a proper balanced diet.

References