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

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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 monitorized 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 (VO_2 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 b/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.*

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Rezumat

Introducere: Analiza nutriţională oferă informaţii exacte şi reproductibile cu privire la existenţa unui metabolism energetic optim: consumul energetic de repaus (RMR), proporţia principiilor alimentare (lipide, carbohidraţi, proteine) utilizate de către organism în cadrul metabolismului bazal, intensitatea efortului din timpul exerciţiului fizic la care se atinge rata de oxidare maximă a grasimilor (MFOR). Aceste informaţii sunt utilizate pentru individualizarea programelor de antrenament fizic şi ajustarea aportului caloric în funcţie de necesităţile organismului. *Scopul* acestei lucrări este de a sublinia încă odată importanţa activităţii fizice în managementul greutăţii corporale şi îşi propune să demonstreze importanţa analizei nutriţionale în prescrierea antrenamentului fizic la tinerii obezi. *Material şi metode:* Lotul iniţial de subiecţi incluşi 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 nutriţională (folosindu-se metoda calorimetriei indirecte), şi testul de efort maximal la inceputul (octombrie 2008) şi la sfârşitul studiului (după 6 luni). În urma testării la efort, subiecţii au efectuat un antrenament fizic individualizat cu o frecvenţă de minim 3 ori pe săptămână, fiind supravegheaţi de un kinetoterapeut. Frecvenţa cardiacă a acestora a fost monitorizată cu ajutorul unor pulsmetre (Polar F3, Finlanda). Rata de renunţare la programul de antrenament fizic din cadrul studiului a fost de 35%, la final rămânând doar 28 de subiecţi. *Rezultate:* După cele 6 luni de antrenament fizic individualizat s-a constatat o creştere 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 cardiace la MFOR (HR_MFOR) care a crescut de la 127.1±18.37 la 135±25.09 b/min, p=0.1396. *Concluzii:* Includerea subiecţilor tineri obezi într-un program de antrenament fizic individualizat este sigură şi eficientă. Astfel, acest studiu demonstrează creşterea eficienţei programelor de antrenament fizic în ceea ce priveşte pierderea în greutate şi creşterea MFOR datorită capacităţii aerobe de efort mai mare.

***Cuvinte cheie**: analiză nutriţională, 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/m^2, no contraindications to perform exercise trening, 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 respitory 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 ergometrer, crosstrainers, treadmill and hydraulic stepper for at least 3 times a week. Subject's heart rate was monitorized 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 unavailabe (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.).

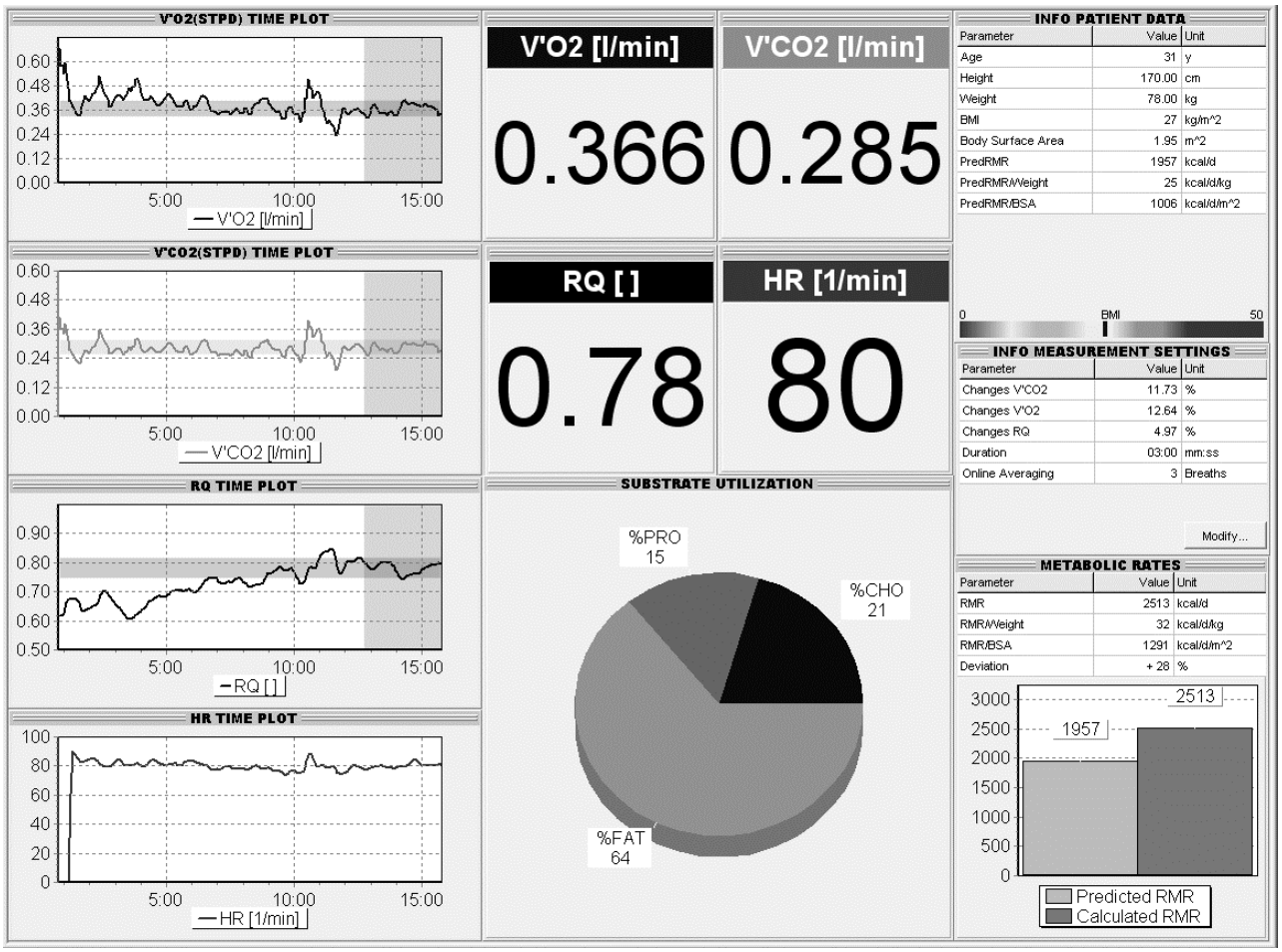

Figure 1. Data recorded on the computer screen durind the assessment

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 (VO_2 rest) and average heart rate at MFOR (HR_MFOR) (Table I).

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

Parameters	Baseline	After 6 months	p value
MFOR (g/h)	16.96±7.75	22.07±8.4	0.0043
RMR (kcal/day)	2007±300.3	2105±290.4	0.0026
VO_2rest (l/min)	0.29±0.04	0.3±0.04	0.0035
HR_MFOR (b/min)	127.1±18.37	135±25.09	0.1396 (ns)

Data analysis was performed using GraphPad statistical software for applying the paired t test to calculate the statistical significance of the analyzed parameters.

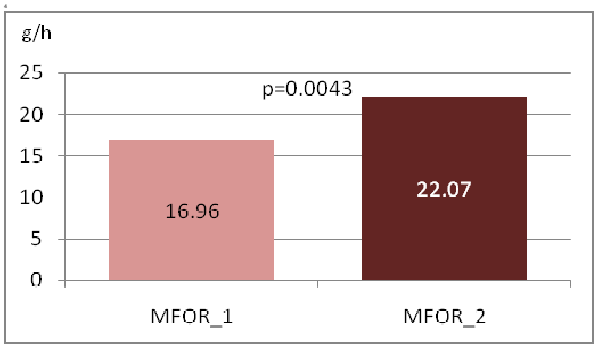

Figure 2. Evolution of maximum fat oxidation rate after 6 months of individualized exercise training.
MFOR: The average of maximum fat oxidation rate at initial evaluation (MFOR_1) and final evaluation (MFOR_2)

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.

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).

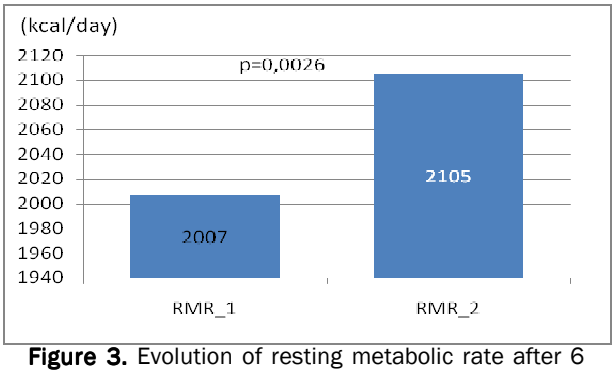

Figure 3. Evolution of resting metabolic rate after 6 months of individualized exercise training.
RMR: The average of resting metabolic rate at initial evaluation (RMR_1) and final evaluation (RMR_2)

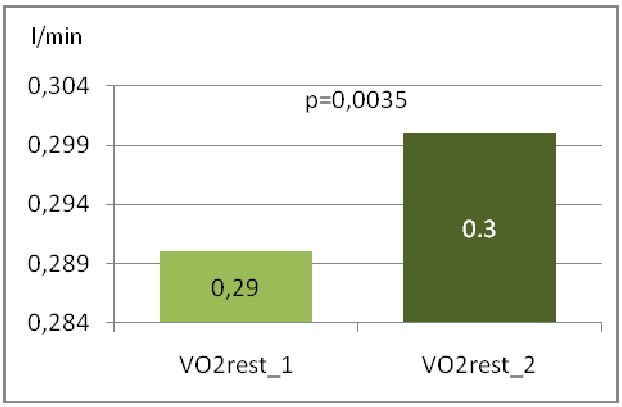

Figure 4. Evolution of resting oxygen uptake after 6 months of individualized exercise training.
VO_2rest: The average of resting oxygen uptake at initial evaluation (VO_2rest_1) and final evaluation (VO_2rest _2)

Discussion and conclusions

The resting metabolism increased after 6 months of exercise training despite of the fact that muscle mass was poorly developed after cardio exercises (aerobic training). On the other hand, we can consider a limit of the study the fact that we didn't take into account that some subjects quite smoking on the study period and the RMR can be affected by this.

Increased maximum fat oxidation rate was due to increased aerobic and anaerobic thresholds and 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.

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