ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN - POLONIA
VOL.LVIII, SUPPL. XIII, 297 SECTIO D 2003

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The influence of physical activity on energetic profil in women

Wpływ aktywności fizycznej na profil energetyczny kobiet

INTRODUCTION

Daily energy expenditure can be divided into three major components: the resting energy expenditure (REE), which usually represents 50-70% of daily energy expenditure; the thermic effect of food (TEF), which represents ~10% of daily energy expenditure; and the energy cost of physical activity , which represents 20-40% of daily energy expenditure [4]. It is well documented that REE is influenced by age, sex, and body size, including fat-free mass (FFM) and fat mass and physical activity (types of training program) [2,3] Exercise can affect energy expenditure both directly and indirectly. Metabolism increases during exercise, directly increasing the amount of energy expended. Exercise can also increase energy expenditure indirectly by increasing a person`s amount of fat-free mass (FFM), which in turn elevates REE [4,5]. Researchers have reported that there is the strong correlation between resting energy expenditure and excess post–exercise oxygen consumption (EPOC). The different intensity and duration of training can change the magnitude energy expenditure during exercise and EPOC [1]. After that it was observed higher resting energy expenditure but the influence of different training programs on resting energy expenditure isn't clear. Particularly it is interesting , if the longitudinal training change resting energy expenditure, which range of changes in REE is or isn`t caused in people, who have been training in the past but in this time they are out of the training.

The first aim of this study was to compare resting energy expenditure and contribution of carbohydrates, lipids and proteins in energy release production in women: students-volunteers of physical education: who have never been training (n=7) and trained aerobically before study (n=7). Their training status was 4-6 years-lasting. The second aim was to determinate the relationship between fitness level (expressed the maximal oxygen uptake - VO_2 max), body composition and resting energy expenditure .

MATERIALS AND METHODS

Subjects. Fourteen women– students of University School of Physical Education volunteered for this study. The subjects were divided in two groups. The first group were untrained women (UN) and the second group were women, who in their age 13-17 were long-distance runners but in this time they take part only in students occupations (AAT). All women ate in students canteen but we didn`t control their diet.

Preexperimental protocol. In both groups were determined main aerobic components: values of VO_2 max in ml O_2 / min/ kg b.m. and values of anaerobic threshold (AT) in % VO_2 max using gas analyser EOS SPRINT Jaeger. Peak oxygen uptake (VO_2 max) and anaerobic threshold (AT) was measured for each subject during incremental cycling exercise to volitional fatigue on cycloergometer Monark.

Experimental protocol. Resting energy expenditure and percentage of energy delivered from carbohydrate, fat and protein were estimated in the morning, using Jaeger Nutrition program and indirect calorimetry based on basic primary variables: VO_2 , VCO_2 , rate of nitrogen excretion and RQ , supplemented by blood pO_2, pCO_2 , pH and hemoglobin concentration (two weeks after VO_2 max test). All women were tested in follicular phase of the menstrual cycle.

Statistic. All reported values are means ± SD. The data were statistically analyzed according to the t-Student's test using the variance analysis. The level of $p< 0.05$ was considered as statistical significant.

RESULTS

The anthropological and physiological parameters of subjects participated in experiments are shown in table 1, 2. We observed the significant differences in body composition between groups: lower fat mass and the higher fat free mass in after aerobically trained women (AAT) than untrained group (UNT). We observed the higher fitness level in previously aerobically trained women, expressed in VO_2max and the level of the anaerobic threshold. In both groups it is the relationship between fitness level and resting energy expenditure [Fig1] but we didn`t observe relationship between REE and fat free mass.

There was not significant difference in REE expressed as kJ/24h and kJ/24h/kg between groups. The contribution of carbohydrate, fat, protein in yielding energy is shown in table 3. Protein oxidation was higher in untrained group than in after aerobically but fat oxidation was higher in aerobically group, which had lower fat mass [Fig 2].

Table 1. Anthropometric characteristics of subjects

Subjects	Age [yr]	Weight [kg]	Height [cm]	% Fat	Fat free mass [kg]	Fat mass [kg]
Untrained N=7	22,4± 0,8	57,0± 4,5	166± 3,2	21,3± 2,3	12,2± 2,1	44,8± 2,7
After aero-biccaly training N=7	22,1± 0,4	57,1± 5,2	169± 2,8	15,6± 2,7	9,0± 2,2	48,2± 3,3
				P<0,001		P<0,01
Values are mean ± SD, n no of subject, * differences from height activity (as determined by paired t-test)						

Table 2. Aerobic capacity measurements and resting energy expenditure

Subjects	VO_2 max [ml/min/kg]	AT [ml/min/kg]	AT [%Vo_2max]	REE [kJ]	REE [kJ/kg]
Untrained N=7	38,9 ± 2,9	27,3 ± 6,2	62,1±10,6	8156,7 1566,4	143,7 29,0
After aerobi-cally training N=7	45,3 ± 4,0	44,5 ± 6,7	55,2 ±5,4	9127,1 1334,5	160,1 21,4
	P< 0,001				
* differences from height activity (as determined by paired t-test)					

Table 3. Contribution of carbohydrate, fat, protein in yielding energy

Subjects	CHO [g]	CHO [g/kg]	CHO [%]	FAT [g]	FAT [g/kg]	FAT [%]	PRO [g]	PRO [g/kg]	PRO [%]
Untrained N=7	304,8 ±38,1	5,4 ±1,0	66,1 ±6,5	52,3 ±28,8	0,9 ±0,5	24,3 ±8,0	42,0 ±15,2	0,7 ±0,3	7,8 ±3,1
After aerobically training N=7	308,2 ±93,5	5,3 ± 1,3	57,8 ±11,8	86,2 ±28,8	1,5 ±0,6	37,9 ±10,9	23,6 ±7,7	0,4 ±0,2	4,5 ±2,0
					P<0,05	P<0,05	P<0,05		
* differences from height activity (as determined by paired t-test)									

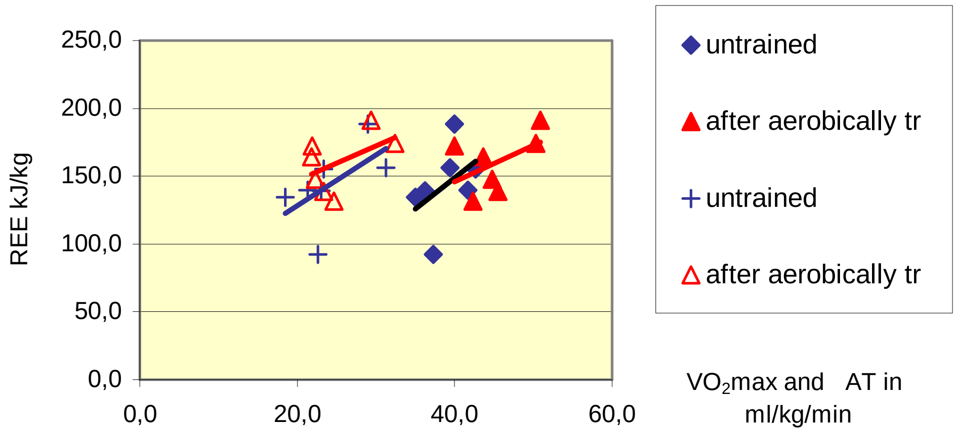

Fig.1 The corelation between fitness level (expressed in VO_2 max and anerobic threshold) and resting energy expenditure.

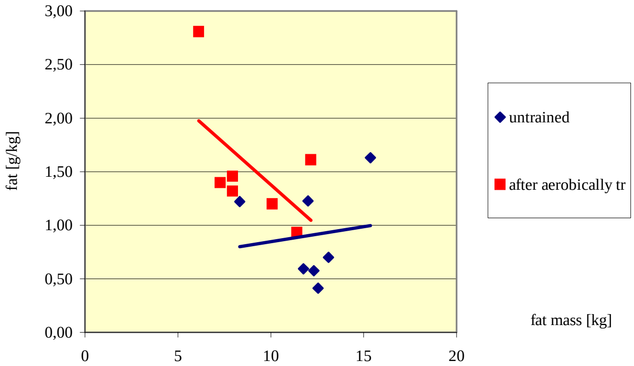

Fig.2 Corelation between fat mass and the amount of fat oxidation in aerobically trained women [r=-0,60 *] and untrained [r=0,13]

CONCLUSIION

1. The resting energy expenditure is depend on fitness level, express in maximal oxygen consumption and the level of anaerobic threshold.
2. There isn`t correlation between fat free mass and resting energy expenditure.
3. The longitudinal training increases fat oxidation at rest.
4. Adaptation after the longitudinal training in connection with physical activity prevent before obesity

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SUMMARY

Daily energy expenditure can be divided into three major components: the resting energy expenditure (REE), the thermic effect of food (TEF) and the energy cost of physical activity. It is well documented that REE is influenced by age, sex, and body size, including fat-free mass (FFM) and fat mass and physical activity. It isn't clear if different training programs change resting energy expenditure. The aim of this study were to compare resting energy expenditure and contribution of carbohydrates, lipids and proteins in energy release production in women: students-volunteers of physical education: who have never been training (n=7) and trained aerobically before study (n=7). Their training status was 4-6 years-lasting and the second aim was to determinate the relationship between fitness level (expressed the maximal oxygen uptake -VO_2 max), body composition and resting energy expenditure. Resting energy expenditure and substrate utilization were measured in the morning, using the expiratory gas analyzer EOS sprint and computer program Nutrition of Jaeger. It was the indirect calorimetric method. Aerobic capacity we determined in VO_2 max and the level of anaerobic threshold. We didn`t observe the relationship between free fat mass and energy expenditure in both groups, but we reported that fitness level can change resting energy expenditure. The longitudinal training increases fat oxidation. Adaptation after the longitudinal training in connection with physical activity prevent before obesity .

This work was supported by KBN statutory grant.

STRESZCZENIE

Dobowy wydatek energii w ustroju człowieka składa się ze spoczynkowego wydatku energetycznego (REE), cieplnego wpływu posiłków (zwanego także specyficznym dynamicznym działaniem pokarmu) oraz wydatku energetycznego związanego z aktywnością ruchową człowieka. Udowodniono wpływ szeregu czynników, do których należy płeć, wiek, skład ciała na wielkość spoczynkowego wydatku energetycznego. Zagadnienie wpływu aktywności fizycznej na wielkość REE nie jest w pełni wyjaśnione. Szczególnie pytania dotyczące długoletniego treningu i jego wpływu na kierunek zmian spoczynkowego wydatku energetycznego, czasu ich trwania , pozostają bez odpowiedzi. Celem pracy była ocena spoczynkowego wydatku energetycznego oraz udziału węglowodanów, tłuszczów i białek w pokrywaniu zapotrzebowania energetycznego u studentek (n=14) Akademii Wychowania Fizycznego i Sportu podzielonych na dwie grupy: nie trenujące i trenujące przed rozpoczęciem studiów Średni staż treningowy badanych kobiet wynosił 4-6 lat. W pracy szukano również zależności między wydolnością fizyczną mierzoną wartością VO_2 max i wartością progu przemian anaerobowych AT , a spoczynkowym wydatkiem energii. Ocenę spoczynkowego wydatku energetycznego oraz udziału substratów w uwalnianiu energii dokonano metodą kalorymetrii pośredniej. Badania przeprowadzono rano. Do oceny wykorzystano program kalorymetrii pośredniej - Nutrition firmy Jaeger.Uzyskane wyniki wskazują na zależność wydatku energetycznego od poziomu aktywności fizycznej mierzonej wielkością VO2 max i wartością progu przemian anaerobowych. Wielkość beztłuszczowej masy ciała nie wpływa na wielkość spoczynkowego wydatku energetycznego. Zaobserwowano zwiększone utlenianie tłuszczów w grupie kobiet trenujących w przeszłości. Zmiany spowodowane treningiem wytrzymałościowym połączone ze zwiększona aktywnością fizyczną mogą zapobiegać rozwojowi otyłości.