Anthrop. Közl. *38;* 195-200. (1996/97)

SPORTS ACTIVITY AND BODY COMPOSITION IN HUNGARY

A. Vienna[1], O.G. Eiben[2], G. Gyenis[3], A Barabás[4], G. Farkas[5] and G. Hauser[6]

[1]University of Rome "Tor Vergata", Rome, Italy; [2,3]Eötvös Loránd University, Budapest, Hungary; [4]University of Physical Education, Budapest, Hungary; [5]József Attila University, Szeged, Hungary; [6]Histological-Embryological Institute University of Vienna, Vienna, Austria.

Abstract: *Bioelectrical impedance analysis is based on the electrical properties of biological tissues in that lean tissue contains large amounts of water and electrolytes and is highly conductive; fat and bones are poor of liquids and therefore are poor conductors (Lukaski 1987, Baumgartner et al. 1990). In two samples of sports students of both sexes from Hungary (Budapest and Szeged), physique was assessed by height, weight and body mass index, and body composition represented by resistance, reactance and phase angle was assessed by bioelectrical impedance analysis (BIA 109/S). From these measurements mean specific resistivity, fat mass and fat-free mass were calculated. The results obtained show significant differences between the two sexes in general. Differences between the two series as with stature in males probably reflect both socioeconomic and population specific effects. There is however no difference in hydration between sports students from Budapest and Szeged as indicated by similar values of mean specific resistivity within each sex. The metabolically active amount of cells as represented by reactance is also very similar, and may be interpretated to reflect the beneficial effects of sports activity on physique and body morphology.*

Key words: *Body Composition; Bioelectrical Impedance Analysis; Sports students.*

Introduction

Bioelectrical impedance analysis is based on the electrical properties of biological tissues in that lean tissue (fat-free mass) contains large amounts of water and electrolytes and is highly conductive. Fat (fat mass) and bones are poor of liquids and therefore are poor conductors and show mean specific resistivity in excess of 1000 Ohm/cm, in comparison to fat-free tissues, which have mean specific resistivity about 140 Ohm/cm. This method has become an important technique in the assessment of body compartments in that it has many advantages over others e.g. it does not bother the subject measured, is not invasive, safe, rapid, easy to perform, reproducible and requires minimal operator training.

There is an increasing amount of data on such constituent variables of body composition which estimate major components (water, fat-free mass, fat) for healthy individuals of various origin, and also for pathological conditions. However little is known on the effect of regular sports activity for young healthy adults.

The object of this study is therefore to enquire if and to what extent differences in body composition are observed between sports students of two cities in Hungary i.e. Budapest and Szeged. Budapest is the capital and collects students from all parts of Hungary while the province capital Szeged, located in the Hungarian Great Plain near the south east border mainly collects students from neighboring rural areas. Comparability of the results is by the use of the same methods and apparatus.

Material and Methods

The series studied consist of healthy young sports students from two Hungarian cities (50 males and 51 females from Budapest; 48 males and 41 females from Szeged) ranging in age between 18 and 27 years, who performed a regime of sporting activities of at least four hours a day. The subjects were volunteers from classes at the two Universities.

Body composition was measured using the BIA 109/S impedance analyzer (Akern/RJL Systems). This apparatus generates a constant excitation current at 800 μA at a signal frequency of 50 kHz with a four electrode arrangement. Great care was taken to ensure reliability of the technique by strict discipline with the subjects and by marking the electrode sites. The measurements were carried out on the left side of the body with the subjects supine on a large table when a minimum of four hours had passed after their last meal and at least 12 hours after physical training. Anthropological variables included were stature (measured with an anthropometer) and weight (measured with a calibrated scale), and body mass index (BMI). Bioelectrically determined variables were, the relation of fat-free mass to fat mass (FFM/FM), mean specific resistivity (Rho) corresponding to resistance standardized for height, reactance (Xc) and phase angle (PA). Statistical computation besides the standard procedures includes the non parametric Mann Whitney test. For testing independence of height on age a simple linear regression was applied. For this procedure a binary variable was used for Budapest versus Szeged as the independent variable and height as the dependent.

Results

Within cities variation: Within series variation relates to differences between males and females.There are highly significant and consistent sex differences in both cities in that higher values are observed in males for stature, weight, and body mass index, and with bioelectrical variables for phase angle and the ratio of fat-free mass to fat mass (Table 1). Females on the other hand show significantly higher values for reactance and mean specific resistivity.

Between cities variation: The most conspicuous and significant differences between the Budapest and Szeged sports student are observed for males. Though higher values for reactance and phase angle are observed in both Budapest series these are only significant for males ($p < 0.01$). There is also a tendency for greater height in Budapest males. Though less marked but also significant ($p < 0.05$) differences are observed between the females in that the Szeged females show significantly higher bioelectrical values for fat-free mass/fat mass ratio than the Budapest females (Figure 1). This finding corresponds to the anthropological figures in that Budapest females are slightly heavier, a tendency also visible by somewhat greater values of mean and median of BMI. In both sexes the range of the distributions of the variables of Szeged sports students is somewhat smaller with a tendency for a shift to lower values (Figure 1).

Discussion

As was to expect, the fact that "women contain less water than men of similar weight because women have a higher ratio of adipose tissue to lean body mass" (Greenleaf 1992,

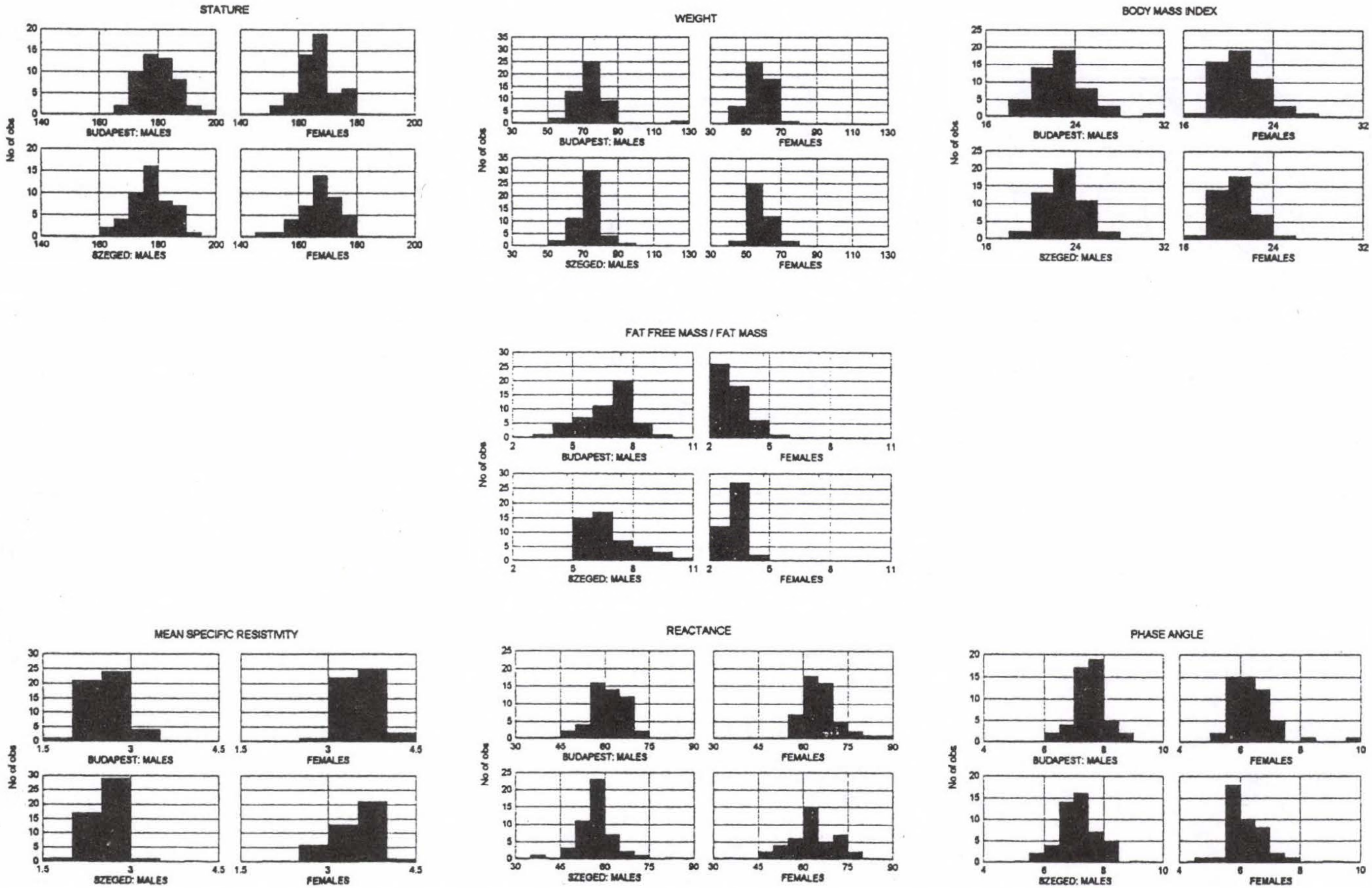

Fig. 1: Physique and bioelectrical impedance variables distributions in the Hungarian sports students by sample and sex

Table 1: Sample sizes, physique and bioelectrical impedance results in the four subsamples of sports students in Hungary

	MALES													
	Budapest							Szeged						
	N	Mean	Median	SD	Min	Max	Range	N	Mean	Median	SD	Min	Max	Range
Stature	50	179.8	179.0	6.5	166.8	197.7	30.9	48	177.4	177.4	6.6	162.4	191.9	29.5
Weight	50	73.9	72.1	10.3	58.6	122.5	63.9	48	72.3	72.0	7.3	55.0	98.5	43.5
Body mass index	50	22.8	22.3	2.3	18.1	31.3	13.3	48	23.0	22.9	1.7	18.2	27.9	9.7
Mean specific resistivity	50	2.5	2.5	0.3	1.8	3.2	1.3	48	2.6	2.5	0.2	1.9	3.5	1.6
Reactance	50	61	60	5.8	46	74	28	48	56	58	5.4	39	70	31
Phase angle	50	7.5	7.5	0.7	6.0	10.3	4.3	48	7.1	7.1	0.6	5.6	8.4	2.8
Fat free mass / Fat mass	50	6.7	7.0	1.3	3.4	9.7	6.3	48	6.7	6.4	1.3	5.0	10.1	5.1

	FEMALES													
	Budapest							Szeged						
	N	Mean	Median	SD	Min	Max	Range	N	Mean	Median	SD	Min	Max	Range
Stature	51	166.1	165.8	6.0	150.8	178.0	27.2	41	167.3	167.8	6.9	149.0	179.8	30.8
Weight	51	58.1	57.8	6.4	47.6	75.1	27.5	41	57.8	57.0	6.3	43.0	76.0	33.0
Body mass index	51	21.0	20.7	1.8	17.9	26.6	8.7	41	20.6	20.3	1.6	17.6	25.2	7.6
Mean specific resistivity	51	3.5	3.5	0.3	3.0	4.3	1.4	41	3.5	3.5	0.3	2.7	4.2	1.5
Reactance	51	66	65	6.9	57	92	35	41	63	62	7.2	47	76	29
Phase angle	51	6.4	6.3	0.8	5.3	9.6	4.3	41	6.1	6.0	0.6	4.6	7.8	3.2
Fat free mass / Fat mass	51	3.1	2.9	0.7	2.2	5.6	3.4	41	3.3	3.3	0.5	2.4	4.4	2.0

Biasioli and Talluri 1995) also relates to people who regularly perform sports, as visible from consistent sex differences in Budapest and Szeged for the variables studied. The greater body height in male Budapest students compared to the Szeged ones coincides with the findings reported by Gyenis et al. (1989) for 23 to 59 years old bus drivers. However also a socioeconomic effect cannot be excluded in that Gyenis (1985) reported a tendency for greater stature and weight in sons of non manual workers with high level of schooling. When compared to earlier studies on male Budapest sports students, mean stature of our male Budapest sample clearly reflects a still ongoing effect of secular trend when compared to that of male sports students measured in Budapest in 1985 and 1987 (Mészáros et al. 1989/90), i.e. in 1985: mean stature was 177.6, SD 6.6; in 1987: 178.5, SD 6.9; and in the present study in 1994: 179.8, SD 6.5). In view of these findings our series were also tested for a possible influence of their age distribution on height, but for none of them any effect of age on height was evident (males $p = 0.08$, females $p = 0.38$).

The consistently higher values of height, weight, body mass index, phase angle and the ratio of fat free mass to fat mass for males in comparison to females are expressions of greater robusticity and muscularity. The higher values of mean specific resistivity and reactance on the other hand in females are consistent with their higher content of fat mass. These findings are in accordance with observations on samples of sports and medicine students from Vienna (Austria) and Wroclaw (Poland) of similar ages (Hauser et al. 1996), and of a sample drawn from the population healthy of Italian adults of the same age (Biasioli and Talluri 1995).

Explanation of the differences observed for the bioelectrical variables reactance and phase angle between the sports students from Budapest and Szeged, especially marked in males would point towards a greater response of muscular tissue to sports activities in the Budapest series. Though more marked in the Budapest males the sports students in the Hungarian capital altogether appear more robust, a little fatter but also more muscular. It seems that overall the Szeged sports students similar to the Wroclaw sports students with their slightly smaller body weight and lower FFM/FM ratio in comparison to those from Budapest and from Vienna respectively may either vary with respect to nutrition, or the regime of athletic activity is less demanding in a small town than in the capital of a country, or as a further possibility the difference might be due to a different genetic composition (Roberts 1985).

Acknowledgement:This research is supported by a grant from the Jubiläumsfond of the Austrian National Bank.

References

Baumgartner R. N., Chumlea W. C. and Roche A. F. (1990): Bioelectrical impedance for body composition. - *Exerc. Sports Sci. Rev., 18;* 193-224.

Biasioli S. and Talluri T. (1995): La Bioimpedenza In Nefrologia. Edit. EGIDA, Vicenza, Italy.

Greenleaf J. E. (1992): Problem: thirst, drinking behaviour, and involuntary dehydration. - *Med. Sci. Sports Exerc. 24;* 645-656.

Gyenis G. (1985): Body composition and socioeconomic factors in male university students in Hungary. - *Humanbiol. Budapest.16;* 65-69.

Gyenis G., Dajka J. and Finta L.(1989): Body build Hungarian long- distance bus drivers. - *Humanbiol. Budapest.19;* 205-208.

Hauser G., Bergman P., Hlatky S., Krajewska A. and Vienna A. (1996): Bioelectric impedance analysis of body composition in students (Austria and Poland). - In: B. É. Bodzsár and C. Susanne (Eds): *Studies in Human Biology,* Eötvös Univ. Press, Budapest, Hungary, 89- 94.

Lukaski H. C.(1987): Methods for the assessment of human body composition; Traditional and new. - *Amer. J. Clin. Nutr. 46;* 537-556.
Mészáros J., Sabir A. R., Farkas A. and Szmodis I. (1989/90): Body build and motor performance of male university students of physical education. - *Anthrop. Közl. 32;* 201-204.
Roberts D. F. (1985): Genetic contribution to phenotype variation in growth and body composition.- *Humanbiol. Budapest.16;* 123-138.

Mailing address: Dr. A. Vienna
Department of Biology
University of Roma "Tor Vergata"
I-00133 Roma
Italy