

Bioelectrical Impedance Analysis (BIA) of Body Composition in Children with Diabetes Mellitus Type 1

A. Baltadjiev, G. Baltadjiev

Medical University Plovdiv, Department of Anatomy, Histology and Embryology

The purpose of this study is to determine the components of active body mass, skeletal muscle mass, body water and skeletal (bone) mass of the body composition of children suffering from type 1 diabetes by the means of bioelectrical impedance analysis. 150 children with Diabetes mellitus 1 were tested, grouped by gender and in two age groups – 7-12 and 12-17 years of age. We defined the following components of body composition: active body mass /ATM/, skeletal muscle mass /SMM/, skeletal (bone) mass /SM/and body water /BW/, which were measured by Tanita apparatus. The results show that the relative (percentage) values of the main features of body composition in age comparison are higher in 12-17-year-old diabetic boys and the statistical reliability varies from the absence of such to a high level. The exception is %SM, since the values are higher in 7-12-year-olds and the statistical significance is of a high level. In diabetic girls, the percentage values are higher in the age group 7-12, with a statistical significance from absent to a high level. Intersexual comparisons of the relative values of the components show that they generally are higher in diabetic boys compared to girls in both age groups.

Key words: BIA, diabetes mellitus type 1, body composition, children.

Introduction

Diabetes mellitus is a socially significant disease with a progressively increasing number of patients [6, 9]. Diabetes mellitus type 1 is a nosology that appears in childhood and it is 1.5-2% of the total number of patients with diabetes. Its effect on body composition is in a correlation with the changes occurring with the upcoming puberty [6]. The most sensitive to changes they are in fat-free mass, also called active body mass [3, 7, 8]. Attention is drawn as well to the change in total body water [9] and changes in bone mass [4, 7, 8].

Bioelectrical impedance method is fast, mobile, noninvasive; it provides accurate data on body composition which are comparable to those obtained by other research [7].

The purpose of this study is to determine the components of active body mass, skeletal muscle mass, body water and skeletal (bone) mass of the body composition of children suffering from type 1 diabetes by bioelectrical impedance analysis.

Material and Methods

150 patients with Diabetes mellitus were tested; they are children from South Bulgaria (Central Southern region). The children were grouped into two gender groups: 75 girls and 75 boys, as well as into two age groups: 7-12- and 12-17-year-olds. The following components of body composition were examined: active body mass (ATM), skeletal muscle mass (SMM), skeletal (bone) mass (SM) and body water (BW) measured with the apparatus TANITA. For data processing we used the statistical programs SPSS and INSTAT. Comparing the average values, we calculated the coefficient t , and the statistical significance was set at four levels: high – $P \leq 0.001$, average – $P \leq 0.01$, low – $P \leq 0.05$, no significance $P > 0.05$.

Results and Discussion

The quantitative data of body composition components in children with diabetes are presented on Table 1.

1. Active body mass (ABM)

This component shows the value of lean mass (fat-free mass) in diabetic children's bodies.

The interage comparison within gender groups showed that boys with diabetes tend to have a higher percentage of that feature in the age group 12-17 years in comparison with that of the group 7-12 years, but there is lack of statistical reliability. In girls with diabetes, the relative value of the feature is much higher in the age group 7-12 years compared with that in 12-17 years, as the statistical reliability is high.

Intersexual comparison of ABM shows that the relative value of the feature for 7-12-year-olds is higher in boys compared to girls with diabetes, but the statistical significance is at the limit of standard ($P=0.05$). Comparing the age group 12-17 years shows that there is a clear predominance of the relative values of ABM in boys compared to girls and the statistical reliability is high.

2. Skeletal muscle mass (SMM)

This component of body composition shows the proportion of skeletal muscle, which is a major component of the indicator ABM.

The interage comparing of the relative values of this feature in boys with diabetes shows that the value in the age group 12-17 years is higher than that of 7-12 years, as the statistical reliability is of a high level. In diabetic girls, the relative values of SMM in both age groups are very close and there is a trend for higher value in 7-12-year-olds but without any statistical reliability.

The intersexual comparisons show that in both age groups SMM has higher relative values in diabetic boys than these of girls and the statistical reliability is of average to high level.

3. Skeletal (bone) mass (SM)

This feature defines the proportion of bones of the skeleton in body composition and it is a part of fat-free body mass.

The interage comparing of the relative values of this component in boys and girls with diabetes shows that they are higher in the 7-12-year-olds compared to those of 12-17 years and the statistical reliability is high.

Table 1. Relative values of the body composition indices of children with type 1 diabetes mellitus

Girls						Boys					
Age groups	Count	Mean	SD	SE	♂/♂	Count	Mean	SD	SE	♀/♀	♀/♂
Fat-free mass											
<12	75	79.48	6.53	1.69	-	75	81.50	5.99	2.44	-	p=0.05
>12	75	73.33	5.20	1.30	p<0.0001	75	82.49	5.05	1.46	p>0.05	p<0.0001
Skeletal muscles											
<12	75	38.04	5.20	1.34	-	75	45.23	6.91	2.82	-	p<0.0001
>12	75	36.87	3.94	0.99	p>0.05	75	49.01	4.38	1.27	p<0.0001	p<0.0001
Bone mass											
<12	75	37.17	4.34	1.12	-	75	41.20	4.20	1.72	-	p<0.0001
>12	75	34.95	5.48	1.37	P=0.0067	75	34.08	4.88	1.41	p<0.0001	p>0.05
Body water											
<12	75	58.68	5.05	1.30	-	75	59.97	4.62	1.89	-	p>0.05
>12	75	53.66	3.81	0.95	p<0.0001	75	60.39	3.69	1.06	p>0.05	p<0.0001

The intersexual comparison of the relative values of SM shows that in the age group 7-12 years they are higher in boys compared to girls and the statistical reliability is high. In the age group 12-17 years, the values are very close and there is no statistical reliability.

4. Body water (BW)

This component of body composition indicates the percentage of water in the body of diabetic patients. It is part of the lean mass of body composition. The interage comparison of water values in boys with diabetes shows that the proportion is likely to be higher in the age group 12-17 years, but there is no statistical reliability. The comparison in diabetic girls shows a higher % share of water in the age group 12-17, compared to 7-12, and the statistical reliability is high.

Intersexual comparison of the relative values of water in the age group 7-12 tends to have greater value in boys, compared to girls with diabetes, but there is no statistical reliability. The age group 12-17 years has a significantly higher value in boys than in girls and the statistical reliability is high.

Conclusion

Bioelectrical impedance analysis provides an accurate picture of the effect of type 1 diabetes on body composition in children with diabetes in the age and gender aspects.

The relative (percentage) values of the main features of body composition, in the age comparison in diabetic boys, are higher in 12-17-year-olds and the statistical reliability ranges from the absence of such to a high level. The exception is %SM, since the values are higher in 7-12-year-olds and the statistical significance is high. In diabetic girls, the percentage values are higher in the age group 7-12, where the statistical significance varies from absent to a high level.

Intersexual comparisons of the relative values of the components show that they generally are higher in boys, compared to girls with diabetes, in both age groups.

References

1. Eisenmann, J. C., K. A. Heelan, G. J. Welk. Assessing body composition among 3- to 8- year-old children: anthropometry, BIA and DXA. – *Obes. Res.*, 12, 2004, 1633-1640.
2. Gomez, J. M., F. J. Maravall, J. Soler, M. Fernandez-Castaner. Body composition assessment in type 1 diabetes mellitus patients over 15 years old. – *Horm. Metab. Res.*, 33, 2001, 670-673.
3. Hui, S. L., S. Epstein, C. C. Jr. Johnston. A prospective study of bone mass in patients with type 1 diabetes. – *J. Clin. Endocrinol. Metab.*, 60, 1985, 74-80.
4. Ingberg, C.M., S. Sarnblad, M. Palmer, E. Schvarcz, C. Berne, J. Aman. Body composition in adolescent girls with type 1 diabetes. – *Diabet. Med.*, 20, 2003, 1005-1011.
5. Ingberg, C. M., M. Palmer, J. Aman, B. Arvidsson, E. Schvarcz, C. Berne. Body composition and bone mineral density in long-standing type 1 diabetes. – *J. Intern. Med.*, 255, 2004, 392-398.
6. Lamendola, C. J. *Cardiovasc. Nurs.*, 18, 2003, 103-107.
7. Phillips, S. M., L. G. Bandini, D. V. Compton, E. N. Naumova, A. Must. A longitudinal comparison of body composition by total body water and bioelectrical impedance in adolescent girls. – *Nutritional Methodology*, 2003, 1419-1425.
8. Weber, G., L. Beccaria, M. de' Angelis, S. Mora, L. Galli, M. A. Cazzuffi, F. Turba, F. Frisone, M. P. Guarneri, G. Chiumello. Bone mass in young patients with type 1 diabetes. – *Bone Miner.*, 8, 1990, 23-30.
9. Карамфилова, В. Съвременно лечение на захарен диабет тип 2. – *MedInfo*, VIII, 2008, 26-30.