ASSESSMENT OF BODY COMPOSITION VARIABLES: COMPARISON BETWEEN YOUNG TRAINED ATHLETES AND HEALTHY SUBJECTS

Lucia Mala, Tomas Maly and Frantisek Zahalka

Faculty of Physical Education and Sport, Charles University in Prague, Czech Republic

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Abstract
Current life-style of all age categories of common population and a sedentary way of life without compensation by physical activity as a natural need of a human result in overweight and obesity, which are highly associated with the quality of life. Positive effects of physical activity are well known and described in scientific literature. However, differences of body composition indicators between health subject and well trained athletes in juvenile age are not well known. The aim of this study was to describe and compare the current profile of selected young athletes subjects and healthy male subjects base on body composition variables. The research group consisted of two 16 – years old male group from Czech Republic. The group 1 (Trained athletes): n = 57, age = 16.2 ± 0.6 years, body height = 177.21 ± 6.8 cm, body weight = 68.2 ± 10.8 kg) and the group 2(healthy male subject): (n = 65, age = 16.0 ± 0.3 years, body height = 172.2 ± 6.5 cm, body weight = 65.2 ± 10.8 kg). Body composition variables (percentage of fat mass - FM), lean body mass (LBM) and ratio of extracellular to intracellular mass (ECM/BCM) was measured with the whole-body bioelectrical-impedance analysis method (BIA 2000 M, Data Input GmbH, Germany). The results revealed that body fat mass in well trained athletes (9.85 ± 1.98 %) was significant lower compare to and healthy male subjects 17.27 ± 4.57 % (t_{120} = -11.34; p<0.01. The similarly ECM/BCM ratio was significant lower in athletes (0.79 ± 0.09) compare to healthy subjects (0.94 ± 0.12) (t_{120} = -7.52; p<0.01). We found out significant differences (t_{120} = 5.00; p<0.01) in lean body mass in athletes (61.28 ± 5.96 kg) compare to non-athletes (55.09 ± 7.49 kg), but body mass index were not significant (t_{120} = 0.33; p>0.05) between compared groups (athletes: 21.64 ± 1.56 kg.m^{-2}, healthy subjects: 21.46 ± 3.76 kg.m^{-2}).Optimal body composition is advisable as a predictor of movement and determinant of individual's quality of life.Sedentary way of life leads to reduction of lean body mass and increasing of fat mass as well as ECM/BCM ratio in juvenile male subjects.

Key words: *anthropometry, body fat percentage, fitness, testing, bioelectrical-impedance analysis*

Introduction

Lifestyle of a generation of young people is influenced by circumstances linked over the last two decades that have formed opinions, attitudes and habits of young people. The current lifestyle of population of all age categories and sedentary way of life without compensation in the form of physical activity. The consequence is overweight and obesity which is highly associated with the quality of human life (Bjorntorp, 2001). According to Larsson, Karlsson, and Sullivan (2002) and Yancy, Olsen, Westman, Bosworth, and Edelman (2002) obese individuals have poorer quality of life when compared to individuals with normal body weight. Despite this fact, the prevalence of obesity in European countries reaches up to 10 – 20 % in men and 15 – 30 % in women (TIOF, 2004). Obesity and overweight affects in the Czech Republic 20-30% of children. Approximately two-thirds of them are rid of excess kilograms even in adulthood. For many of them there are more or less serious health problems. Consuming way of life, stress stimuli, hypokinesis and low level of physical stimuli are only a part of negative elements leading to maladaptation processes of a body. One of such indicators is decreased quality of body composition characterized by higher proportion of fat mass and decreasing proportion of lean body mass. Body composition (BC) relates to common population not only with regard to nutrition and disorders (cardio-vascular disorders, diabetes, cancer) which are directly affected by overweight and obesity (Tsai, Yang, Lin, & Fang, 2004; Uppot, Sahani, Hahn, Gervais, & Mueller, 2007), but also with respect to ontogenesis. Reduction of fat mass is possible by reduction of fat as a nutrition element and by controlling intake and output of energy (Astrup, Grunwald, Melanson, Saris, & Hill, 2000). The effect of physical activity on reduction of body weight in sense of body fat mass in obese individual was confirmed by several studies (Berg & Halle, 1999;DiGuiseppi, Roberts, & Li, 1997; Gortmaker et al., 1996; Malá, Malý, Zahálka, & Bunc, 2014). Body composition is an important indicator of physical fitness and general health of athletes Warner, Fornetti, Jallo, & Pivarnik, 2004) and nowadays it also is a frequently discussed topic in scientific literature. According to Claessens, Hlatky, Lefevre, and Holdhaus (1994) the shape of the body and its morphology is, in addition to physical abilities, psychological characteristics and energetic system capacity, one of the major factors determining sporting performance. BC provides us with a detailed physiological profile of an athlete (Heyward & Wagner, 2004). The amount of active mass determines the value of individual parameters of physical fitness. Generally, lower fat mass proportion and higher musculature and more active mass are required in most sport disciplines

(Mercier, Varray, Ramonatxo, Mercier, & Prefaut, 1991). Body composition is a key consideration in the physical make – up of elite athletes in terms of that one of aim of body composition assessment is to differentiate and quantify different body compartments(Sutton, Scott, Wallace, & Reilly, 2009). On the other hand, it also detects symmetry of active mass distribution in individual segments as injury prevention (Malá et al., 2014). Nowadays, there are several possible approaches (two to five component model) to assess BC in laboratories (medical imaging – magnetic resonance imaging, computed tomography, dual-energy X-ray absorptiometry, underwater weighing, displacement plethysmography, hydrometry, ultrasound, three-dimensional photonic scanning) as well as in field conditions (anthropometry - skinfolds, bioelectrical impedance analysis, body mass index and mass index).At present, in clinical and epidemiology research bioelectrical-impedance method appears to be an appropriate and relatively available method, which has high affinity to reference methods for body composition identification. It is important in clinical, field research, exercise science and epidemiological investigation to develop easy, accurate, portable and inexpensive device for BC assessment. The aim of this study was to describe and compare the current profile of selected young athletes subjects and healthy male subjects base on body composition variables.

Methods

Subjects

The research group consisted of two 16 – years old male groups from Czech Republic. The group 1 (Trained athletes): n = 57, age = 16.2 ± 0.6 years, body height = 177.21 ± 6.8 cm, body weight = 68.2 ± 10.8 kg) and the group 2(healthy male subject): (n = 65, age = 16.0 ± 0.3 years, body height = 172.2 ± 6.5 cm, body weight = 65.2 ± 10.8 kg). Testing took place in the scholar condition (healthy male subject), or in training session (trained athletes).

Assessment of body composition variables

Measurements were performed in the morning (8:30 – 9:30^{AM}) by the same examiner in all monitored subjects. analysis of body composition (BC), the subjects took part in basic measurement of anthropometric parameters. Body height was measured using a digital stadiometer (SECA 242, Hamburg, Germany) and body weight using a digital scales (SECA 769, Hamburg, Germany).

BC was measured using the bioimpedance method under the standard conditions described in the BIA guidelines(Kyle et al., 2004). In the 24 hours prior to the measurements, the participants did not consume any medications (including alcohol and caffeine) or pharmacological agents that could influence the results of the measurement. They were also told not to eat or drink before the measurement. Furthermore, 48 hours before the tests the subjects did not perform regular high intensity physical activity.

BC of our research group was determined with the whole-body bioimpedance method using a BIA 2000 M device (Data Input GmbH, Germany), which works on four frequencies 1, 5, 50 and 100 kHz. The measurement was carried out using tetra-polar electrodes which were placed on the limbs on the same side of the body. Electrodes were placed in the middle of metacarpal bones and wrist and metatarsal bones and the ankle. Standard conditions of bioimpedance measurement were kept during the diagnostics. We registered the following BC variables: percentage of fat mass (FM), lean body mass (LBM) and ratio of extracellular to intracellular mass (ECM/BCM) During the measurement, subjects lay on the back on a nonconductive surface with stretched lower limbs without socks or shoes and with upper limbs lying loosely along the body. After degreasing of the skin, four measuring electrodes were fixed on the right-side limbs, two electrodes were distally located on the dorsum of ipsilateral hand and foot and two proximally from the previous ones – distally from the base of joint of the middle finger and proximally from the base of joint of medium fingers. Measurements were performed according to the ethical standards of the Helsinki Declaration and the ethical standards in sport and exercise science research described by (Harriss & Atkinson, 2011). The participants received a verbal description of the study procedures before testing and completed a written informed consent that was approved by the ethical committee of Faculty of Physical Education and Sport, Charles University in Prague.

Statistical analysis

Collected data were subjected to statistical analysis. We used the methods of descriptive statistics (arithmetic mean - as a measure of central tendency and standard deviation and standard error of the mean - as measures of variability). The statistical significance between selected groups was determined using the independent sample *t*-test, which was preceded by analysis of variance identity based on an *F*-test.To detect the relationship between selected parameters and their determination we used Pearson's correlation and, subsequently, the coefficient of determination (R^2). Statistical analysis was performed using IBM® SPSS® v21 (SPSS Inc., Chicago, IL, 2012).

Results

The average body fat mass in well trained athletes was 9.85 ± 1.98 % and healthy male subjects 17.27 ± 4.57 %. This difference was statistically significant t_{120} = -11.34; $p<0.01$ (Table 2) and made 41.4 %. The values of ECM/BCM ratio in were: athletes0.79 ± 0.09 and in non-athletes 0.94 ± 0.12 (Table 1). Analysis of mean differences revealed significance between two independent groups (t_{120} = -7.52; $p<0.01$). The similarly, we found out significant differences (t_{120} = 5.00; $p<0.01$) in lean body mass in athletes (61.28 ± 5.96 kg) compare to healthy male subjects (55.09 ± 7.49 kg).

Table 1.The body composition variables of monitored groups

VariableGroup		Mean	Std. Deviation	Std. ErrorMean
Body height (cm)	Athletes	177.21	6.82	0.90
	Non-athletes	172.23	6.53	0.81
Body weight (kg)	Athletes	68.19	7.22	0.96
	Non-athletes	65.23	10.84	1.34
ECM/BCM	Athletes	0.79	0.09	0.01
	Non-athletes	0.94	0.12	0.01
Body Fat (%)	Athletes	9.85	1.98	0.26
	Non-athletes	17.27	4.57	0.57
Lean Body Mass (Kg)	Athletes	61.28	5.96	0.79
	Non-athletes	55.09	7.49	0.93
BMI index (kg.m^{-2})	thletes	21.64	1.56	0.21
	Non-athletes	21.46	3.76	0.47

(BMI – body mass index)

Table 2. Comparison of body composition variables between well trained athletes and healthy male subjects.

Variables	t-test forEqualityofMeans					
	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval	
					Lower	Upper
Body height (cm)	4.11	0.00	4.97	1.21	2.58	7.37
Body weight (kg)	1.75	0.08	2.96	1.69	-0.39	6.31
ECM/BCM	-7.52	0.00	-0.14	0.02	-0.18	-0.10
Body Fat (%)	-11.34	0.00	-7.42	0.65	-8.71	-6.12
Lean Body Mass (Kg)	5.00	0.00	6.19	1.24	3.74	8.64
BMI index (kg.m^{-2})	0.33	0.74	0.17	0.53	-0.88	1.23

(BMI – body mass index, *t* – value of testing criterion in t-test, Sig. – significance probability.)

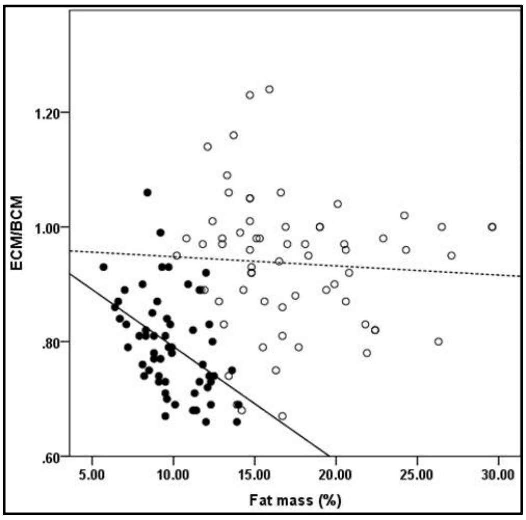
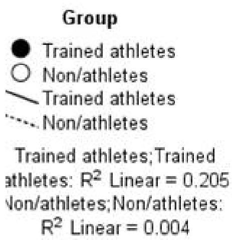


Figure 1.The correlation and determination (R^2) between ECM/BCM ratio and body fat mass in both groups.



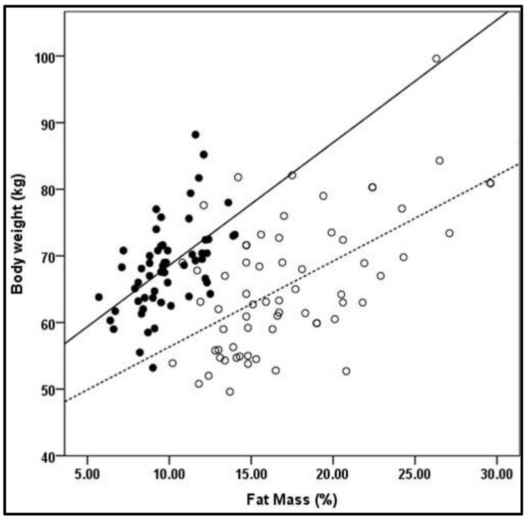
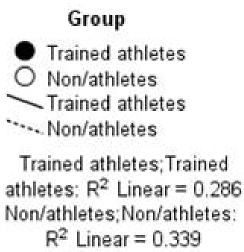


Figure 2. The correlation and determination (R^2) between body weight and body fat mass in both groups.



The values of body mass index were not significant (t_{120} = 0.33; p>0.05) between compared groups (athletes: 21.64 ± 1.56 kg.m^{-2}, healthy subjects: 21.46 ± 3.76 kg.m^{-2}). The descriptive values of selected variables are expressed in Table 1 and statistical analysis (comparing means differences) are reported in Table 2.

Discussion

The recorded mean values of body height, body mass and body mass index (Table 1) are in line with values commonly found in standards of the World Health Organization (WHO, 2006) for juvenile subjects and in general Czech adolescent population (Malá et al., 2014).

On the other hand the results for well-trained athletes are in line with the results of elite Belgian soccer player (van den Driessche et al., 2012) which reported body height in Belgian player 175.4 ± 8.5 cm, body height 64.0 ± 6.8 kg and body mass index 20.8 ± 1.5 kg.m^{-2}. The significant higher values for body weight in male well trained athletes (Table 1, 2) indicates biological acceleration of this group, and this parameter can be selected as one of the determinant for talent identification for elite team sports. However, the body height, body mass i.e. body mass index in itself does not show anything concrete about the body composition of the observed team, although indices based on a one – component model of the body are commonly used in practice and science and show a high correlation between the percentage fat mass proportion and the body mass index value (Bandyopadhyay, 2007). The body fat mass in well trained athletes was 9.85 ± 1.98 %. This value is similar with research by van den Driessche et al. (2012), which reported 10.4 ± 2.4 in Belgian soccer players. The recorded values of lean body mass are in line with other research. The non-athlete subjects have values near the mean of general population (Heyward & Wagner, 2004; Malá et al., 2014). Our well-trained athletes have the similarly value compare to soccer players (Abade, Goncalves, Leite, & Sampaio, 2014; Deprez et al., 2015; van den Driessche et al., 2012). Consistent with the available literature tested athletes have high values of lean body mass compared to the general adolescent population. A significantly greater percentage of lean body mass, as well as significantly lower proportion of adverse body fat mass in physically active population compared to the inactive group (Table 1, 2), be the result of control and intentionally carrying out regular physical activity in this group. Andreoli et al. (2003) reported significant differences in body cell mass proportion between general population and individuals performing physical activity at the elite level. Lean body mass shows high genetic dependence (Guo et al., 1997).

When assessing changes of body composition we can also observe lean body mass, extracellular mass and intracellular mass components. Intracellular mass is perceived as the sum of weight of all cells that utilize oxygen and thus it can be identified as a quality parameter for assessment of muscle mass which appreciably affects muscle performance. It participates in every human ´s movement. Extracellular mass is composed of the sum of extracellular water and extracellular solids. These parameters, as a part of fat free mass, can also be influenced by physical activity but only to a limited extent. Its amount is determined genetically (constitute type). In assessment of the current body composition, values of fat free mass and ratio extracellular mass / intracellular mass as a part of fat free mass can be considered as decisive. Ratio between body cell mass and extracellular mass is also one of indicators of nutrition condition – it may vary along with the weight sustainment and lean body mass sustainment; it only emphasizes the importance of continual observation of subjects body composition (Malá et al., 2014). The mean body cell mass proportion was higher than that of extracellular mass in both groups (Table 1,2). According to Datainput (2004) recorded values ratio of extracellular / intracellular mass are in line with norms of common population for non-active subjects (0.8 – 1.0) and for elite athletes (0.4-0.7). Increased values in non – athletes may relate to ontogenesis and indicate possible reserves in the observed parameter indicating predisposition for muscle activity.

The ratio of extracellular mass to body cell mass is not related has lower dependence to percentage of fat mass in both groups (Trained athletes: R^2 = 0.205, Non-athletes: R^2 = 0.04) (Figure 1). While in athletes this relationship explains more than 20 % of the common variance in non-athletes is this relationship unexplained. On the other hand body fat mass is more related for non-athletes(R^2 = 0.339) compare to trained athletes: (R^2 = 0.286) (Figure 2). For this reason, we can deduce that even if fat mass proportion exceeds the recommended value, it does not have to limit his / her predisposition for implementation of physical activities (i.e. the person has higher value of body fat mass, or overweight).

Conclusion

Optimal body composition is advisable as a predictor of movement and determinant of individual's quality of life. Sedentary way of life leads to reduction of lean body mass and increasing of fat mass as well as ECM/BCM ratio in juvenile male subjects. Bioelectrical impedance is a valid method to estimate the body composition variables in a field condition and could be used to assess for well-trained and non-trained juvenile population. We found difference more than 41 % for body fat mass between active and non-active subjects, 16 % for extracellular to intracellular ratio, 10 % for lean body mass, while for body weight was only 4 % and even for body mass index only less than 1 %.For this reason, physical activities can have positive health outcomes by improving physical fitness and body composition variables and it can potentially modifying the risks for such chronic disease, hypertension, and obesity in a future. From practical point of view, for a complementary approach to the assessment of body composition and anthropometry is necessary to evaluate several parameters.

Bioelectrical impedance methods are in practice commonly used for their advantages, such as inexpensive, non-invasive, portable, quick, safety of operation, neither requires a high degree of technical skill compare to the other methods for body composition assessment (e.g. medical imaging – magnetic resonance imaging, computed tomography, dual-energy X-ray absorptiometry, underwater weighing, displacement plethys-mography, hydrometry, ultrasound, three-dimensional photonic scanning).

References

Abade, E.A., Goncalves, B.V., Leite, N.M., & Sampaio, J.E. (2014). Time-Motion and Physiological Profile of Football Training Sessions Performed by Under-15, Under-179 and Under-19 Elite Portuguese Players. *International Journal of Sports Physiology and Performance, 9*(3), 463-470.

Andreoli, A., Melchiorri, G., Brozzi, M., Di Marco, A., Volpe, S.L., Garofano, P., . . . De Lorenzo, A. (2003). Effect of different sports on body cell mass in highly trained athletes. *Acta Diabetologica, 40*, 122-125.

Astrup, A., Grunwald, G.K., Melanson, E.L., Saris, W.H.M., & Hill, J.O. (2000). The role of low-fat diets in body weight control: a meta-analysis of ad libitum dietary intervention studies. *International Journal of Obesity, 24*(12), 1545-1552.

Bandyopadhyay, A. (2007). Anthropometry and body composition in soccer and volleyball players in West Bengal, India. *Journal of Physiological Anthropology and Applied Human Science, 26*(4), 501-505.

Berg, A., & Halle, M. (1999). Körperliche Aktivität und kardiovaskuläreMortalität: Von der Epidemiologie zur medizinischen Praxis. *Med Welt, 50,* 359-362.

Bjorntorp, P. (2001). *Why quality of life measures should be used in the treatment of patients with obesity*. In M. Sullivan, J. Karlsson & L. Sjostrom (Eds.), International textbook of obesity (pp. 485-510). London: John Wiley & Sons.

Claessens, A.L., Hlatky, S., Lefevre, J., & Holdhaus, H. (1994). The role of anthropometric characteristics in modern pentathlon performance in female athletes. *Journal of Sports Sciences, 12*(4), 391-401.

Deprez, D., Fransen, J., Boone, J., Lenoir, M., Philippaerts, R., & Vaeyens, R. (2015). Characteristics of high-level youth soccer players: variation by playing position. *Journal of Sports Sciences, 33*(3), 243-254.

van den Driessche, J.B., Vaeyens, R., Vandorpe, B., Lenoir, M., Lefevre, J., & Philippaerts, R.M. (2012). Biological maturation, morphology, fitness, and motor coordination as part of a selection strategy in the search for international youth soccer players (age 15-16 years). *J of Sports Sciences, 30*(15), 1695-1703.

Di Guiseppi, C., Roberts, I., & Li, L. (1997). Influence of changing travel patterns on child death rates from injury: Trend analysis. *British Medical Journal, 314*(7082), 710-713.

Gortmaker, S.L., Must, A., Sobol, A.M., Peterson, K., Colditz, G.A., & Dietz, W.H. (1996). Television viewing as a cause of increasing obesity among children in the united states, 1986-1990. *Archives of Pediatrics& Adolescent Medicine, 150*(4), 356-362.

Guo, M.W., Xu, J.P., Mori, E., Sato, E., Saito, S., & Mori, T. (1997). Expression of Fas ligand in murine ovary. *American Journal of Reproductive Immunology, 37*(5), 391-398.

Harriss, D.J., & Atkinson, G. (2011). Update - Ethical Standards in Sport and Exercise Science Research. *International Journal of Sports Medicine, 32*(11), 819-821.

Heyward, V.H., & Wagner, D.R. (2004).*Applied Body Composition Assessment.* Champaign: Human Kinetics.

Kyle, U.G., Bosaeus, I., De Lorenzo, A.D., Deurenberg, P., Elia, M., Gomez, J.M., . . .Pichard, C. (2004). Bioelectrical impedance analysis - part II: util. in clinical practice. *Clinical Nutrition, 23*(6), 1430-1453.

Larsson, U., Karlsson, J., & Sullivan, M. (2002). Impact of overweight and obesity on health-related quality of life - a Swedish population study. *International Journal of Obesity, 26*(3), 417-424.

Malá, L., Malý, T., Zahálka, F., & Bunc, V. (2014). *Fitness Assessment: Body Composition*. Prague: Karolinum Press.

Mercier, J., Varray, A., Ramonatxo, M., Mercier, B., & Prefaut, C. (1991). Influence of anthropometric characteristics on changes in maximal exercise ventilation and breathing pattern during growth in boys. E*uropean Journal of Applied Physiology and Occupational Physiology, 63*(3-4), 235-241.

Sutton, L., Scott, M., Wallace, J., & Reilly, T. (2009). Body composition of English Premier League soccer players: Influence of playing position, international status, and ethnicity. *Journal of Sports Sciences, 27*(10), 1019-1026.

Tsai, W.L., Yang, C.Y., Lin, S.F., & Fang, F.M. (2004). Impact of obesity on medical problems and quality of life in Taiwan.*American Journal of Epidemiology, 160*(6), 557-565.

Uppot, R.N., Sahani, D.V., Hahn, P.F., Gervais, D., & Mueller, P.R. (2007). Impact of obesity on medical imaging and image-guided intervention. *American Journal of Roentgenology, 188*(2), 433-440.

Warner, E.R., Fornetti, W.C., Jallo, J.J., & Pivarnik, J.M. (2004). A skinfold model to predict fat-free mass in female athletes.*Journal of Athletic Training, 39*(3), 259-262.

Yancy, W.S., Olsen, M.K., Westman, E.C., Bosworth, H.B., & Edelman, D. (2002).Relationship between obesity and health-related quality of life in men.*Obesity Research, 10*(10), 1057-1064.

* * * (2004). /Datainput/. *Nutri 4 Multifrequency Software for the Determination of body water, body composition and nutritional status.* Instructions for Use, Firma Data Input GmbH, Trakehner Strasse 5, Frankfurt am Main, Germany.

* * * (2004). /TIOF - The International Obesity Task Force/. E*U Platform on Diet, Physical Activity and Health*. [cit. 2014/09/12]. Available at: www <http://ec.europa.eu/health/ph_determinants/life_style/nutrition/platform/platform_en.htm>.

* * * (2006). /WHO/. *Multicentre Growth Reference Study Group: WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development.* Geneva, World Health Organization, Available at: http://www.who.int/childgrowth/standards/technical_report/en/ index.html.

OCJENA VARIJABLI TJELESNOG SASTAVA: USPOREDBA IZMEĐU MLADIH TRENIRANIH SPORTAŠA I ZDRAVIH SUBJEKATA

Sažetak

Trenutni stil života svih dobnih kategorija zajedničkog stanovništva i sjedilački način života bez nadoknade kretanja od strane fizičke aktivnosti kao prirodne ljudske potrebe rezultira prekomjernom težinom i pretilosti, što je jako povezano s kvalitetom života. Pozitivni učinci tjelesne aktivnosti su dobro poznati i opisani u znanstvenoj literaturi. Međutim, razlike u pokazateljima sastava tijela između zdravog subjekta i dobro treniranog sportaša u maloljetničkoj dobi nisu poznati. Cilj ovog istraživanja bio je opisati i usporediti trenutni profil odabranih mladih sportskih subjekata i zdravih muških ispitanika temeljem varijabli sastava tijela. Istraživane skupina sastojale su se od dvije grupe 16-godišnjaka muškog spola iz Češke. Skupina 1 (Školovani sportaši): n = 57, uzrast = 16.2 ± 0,6 godina, visina tijela = 177.21 ± 6,8 cm, tjelesna težina = 68,2 ± 10,8 kg) i skupina 2 (zdravi muški subjekti): (n = 65, uzrast = 16.0 ± 0.3 godina, tjelesna visina = 172.2 ± 6.5 cm, tjelesna težina = 65,2 ± 10,8 kg). Varijable sastava tijela (postotak masnog tkiva - FM), nemasne tjelesne mase (LBM) i omjer izvanstanične na unutarstaničnu masu (ECM / BCM) izmjerena je s Bioelektrička-impedancija metodom analizom za cijelo tijelo (BIA 2000 M, Data Input GmbH, Njemačka). Rezultati su pokazali da je masa tjelesne masti u dobro obučeni sportaša (9,85 ± 1,98%) značajno niža u usporedbi sa zdravim muškim ispitanicima (17.27 ± 4.57%),) (t_{120} = -7.52; p<0.01). Pronađena je značajna razlika (t_{120} = 5.00; p<0.01) u tjelesnoj masi kod sportaša (61,28 ± 5,96 kg) u usporediti s nesportašima (55.09 ± 7.49 kg), ali razlike indeksa tjelesne mase nisu bile značajne (t_{120} = 0.33; p>0.05) između skupina (sportaši: 21.64 ± 1.56 kg.m^{-2}, zdravi subjekti nesportaši: 21.46 ± 3.76 kg.m^{-2}). Optimalni sastav tijela je poželjan kao prediktor kretanja i odrednica kvalitete života pojedinca. Sjedilački način života dovodi do smanjenja mišićne mase i povećanja masnog tkiva kao i ECM omjer / BCM u maloljetnih muških ispitanika.

Ključne riječi: *morfologija, postotak tjelesne masti, fitnes, test, analiza bioelektrične impedance*

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Correspondence to:
Lucia Mala, PhD.
Faculty of physical education and sport
Charles University
16252 Prague, Jose Martiha 31, Czech Republik
Phone: +20 77 653 11 43
E-mail: tomimaly@yahoo.com

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