Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XXIII, ISSUE 2, 2023, Romania
The journal is indexed in: ERIH PLUS, Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST, DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengage Learning, Cabell's Directories

Science, Movement and Health, Vol. XXIII, ISSUE 2, 2023
June 2023, 23 (2): 229 - 235
Original article

THE RELATIONSHIP BETWEEN BODY MASS INDEX AND CERTAIN BODY COMPOSITION PARAMETERS IN ADOLESCENTS WITH AND WITHOUT INTELLECTUAL DISABILITY

UNGUREAN BOGDAN-CONSTANTIN[1], ABALAȘEI BEATRICE-AURELIA [1], COJOCARIU ADRIAN[2]

Abstract

Aim. The study aimed to assess a series of body composition parameters in adolescents with and without intellectual disabilities to determine possible correlations between them and body mass index.

*Methods***.** Consists of using a professional device to assess body composition (Tanita 580) and dedicated software to store and analyse the data. The study comprised a group of 101 adolescents (boys aged 17.4±0.8) divided into three groups by disability type.

Results. Upon analysing the Pearson coefficient correlation, in the case of the group of boys WID, for r=0.899 (p<0.001), there is a significant positive correlation between BMI and body fat in Kg. BMI correlates positively with muscle mass in kg, too, for r=713 (p<0.001). However, the correlation between BMI and body fat in kg is stronger: the increase in body mass index is due to a higher amount (kg) of fat tissue.

Conclusions. The study found differences for five of the nine dependent variables, especially between the group of boys without intellectual disability and the group of boys with moderate intellectual disability. In general, it is important to consider BMI and body composition in adolescents with intellectual disabilities, as they may be at increased risk for obesity and associated complications such as diabetes and heart disease. It is important to take steps to promote a healthy lifestyle, including a balanced diet and regular physical activity, to reduce the risk of these health problems.

*Keywords***:** BMI, body composition, intellectual disability

Introduction

International statistics show that the number of disabled persons is ascending worldwide. World Health Organisation (WHO), in collaboration with the World Bank (BM), launched the first global report on disability (WHO & World Bank, 2011). Following the studies and research conducted to generate the report, it has been shown that over a billion people worldwide suffer from a form of disability; this figure represents around 15% of the world population. WHO had released its last statistics on disability in the 70s; at that point, the Organisation argued that 10% of the world population was impaired. The WHO report, conducted in collaboration with the World Bank, assessed that the number of disabled persons could increase in the subsequent period, primarily due to population ageing because they are highly more prone to develop a disability and due to an increased frequency of chronic diseases like diabetes, cardiovascular disease, cancer and mental health disorders. A recent study (Emerson & Llewellyn, 2021) shows that the evidence available regarding the variation among countries concerning the exposure to determining factors of intellectual disability (like poverty and malnutrition) suggests that the incidence of intellectual disability is probably higher in low-income nations. In the European Union (EU), the number of disabled persons is 80 million, around 15% of the EU population; one in four Europeans has a family member who has a disability (Field, 2018). In Romania, according to the National Authority for the Rights of Disabled People, Children and Adoptions within the Ministry of Labour and Social Protection. It comprises the General Directorates of Social Work and Child Protection at the level of each county and the local Directorates of the Bucharest districts. According to them, on 30 June 2022, the number of disabled persons was 853,465. Among them, 97.96% (836,074 people) were cared for by their families or lived independently (noninstitutionalised), and 2.04% (17,391 people) lived in public residential social work establishments for disabled persons (institutionalised) coordinated by the Ministry of Labour and Social Protection. Upon centralising the data, intellectual disability ranked third, accounting for 124,829 cases, of whom 9,588 were children (MMPS, 2020). Youths with intellectual disabilities participate in fewer physical activities than the rest of the same-age population. Due to idleness, kids with an intellectual disability are less likely to be physically fit than their colleagues without an intellectual disability, given that they are prone to increased body mass index (Rimmer et al., 2010). Long periods of physical idleness among this population could also indicate that multiple factors prevent these youths from participating in physical activities. There is a combination of personal (physical or cognitive) factors and determining environmental factors, given the

[1] Faculty of Physical Education and Sports, "Alexandru Ioan Cuza" University of Iași, Romania, E-mail address: ungurean.bogdan@uaic.ro
[2] Doctoral School in Sports and Physical Education Science, "Alexandru Ioan Cuza" University of Iasi, Romania

lack of opportunities to exercise or be physically active (Sallis et al., 2015). This interaction between factors leads to a lack of opportunities for youths with intellectual disabilities, thus limiting physical activity or sports practising because they depend on others (i.e., parents, caregivers, teachers etc.).

Objectives: to assess morphofunctional parameters in teenagers with and without an intellectual disability. To determine the morphofunctional parameters, we used bioelectrical impedance analysis (BIA) – a more commonly applied technology applied in studies referring to body composition because it is a quick and non-invasive method with a high data reliability degree; it can be easily moved from one location to another, used chiefly for populations with various types of intellectual disability, and the data obtained upon using the statistical and mathematical indicators in relation to the scientific literature.

Methods – the study includes 101 subjects (boys) from the education establishments mentioned below, distributed in two groups by the type of disability, as featured in Table 1. The research subjects learn in the following education establishments: "Sf. Andrei" School Centre Gura Humorului, "Constantin Păunescu" School Centre Iaşi, "Elisabeta Polihroniade" Inclusive Educational School Centre Vaslui, and in regular establishments.

Table 1. Subjects' distribution by age, cases, and educational establishments

Subjects	**Gen**	**N**	**Age (men±std.dev.)**	**Case observation**
Group 1(WID) Without an intellectual disability	M	44	17.7±0.9	WID
Group 3 Moderate intellectual disability (MID)	M	57	17.05±0.7	MID

To assess the morphofunctional parameters, we used bioelectrical impedance analysis (BIA) – a more commonly applied technology in studies referring to body composition because it is a quick and non-invasive method with a high data reliability degree; it can be easily moved from one location to another, used chiefly for populations with various types of intellectual disability. The data obtained using statistical and mathematical indicators are analysed in relation to scientific literature. The use of TANITA MC580 and TANITA PRO SOFTWARE (3.4.5. version) generates 11 measurements: Body mass-Kg; BMI (kg/h2); Body fat %; Muscle mass %; BMR (kcal); Body fat-Kg; Muscle mass-Kg; SMM – skeletal muscle mass; Total water; Bone mineral mass; Segmental analysis on upper/lower limbs, left/right.

Hypothesis: There are interaction effects between body mass index and specific body composition components by the type of intellectual disability.

Considering the high number of subjects (over 100), we used the skewness statistic to test data distribution normality to assess the asymmetry degree of distribution and the kurtosis indicator. SPSS provides both tests. Field (2000) proposed two z thresholds by the number of subjects tested. For a more significant number of data (over 100), the z threshold is 1.96 (Sava, 2004). Though we did not confirm the data distribution normality hypothesis for four of the nine parameters (Table 2), Pearson correlation is considered sufficiently robust to be applied.

Table 2. Skewness and Kurtosis values (testing data distribution normality)

Variables		H (cm)	MC (Kg)	BMI (kg/m^2)	GC (%)	MM (%)	GC (Kg)	MM (Kg)	SMM
N	Valid	101	101	101	101	101	101	101	101
	Missing	0	0	0	0	0	0	0	0
Mean		167.4	62.413	22.12	20.759	44.554	13.559	46.529	27.7
Std. Deviation		9.574	14.6358	4.427	8.5665	5.5875	8.2494	9.5670	5.91
Skewness		.295	1.216	1.446	.560	-1.155	1.859	.737	.843
Std. Error Skewness		.167	.167	.167	.167	.167	.167	.167	.167
Kurtosis		-.272	**2.025**	**3.213**	.325	**2.659**	**5.477**	.785	1.01
Std. Error of Kurtosis		.333	.333	.333	.333	.333	.333	.333	.333
Minimum		145.0	33.1	13.7	4.6	19.6	3.0	25.3	15.1
Maximum		193.0	121.1	41.7	51.1	54.0	56.4	83.2	49.5

Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XXIII, ISSUE 2, 2023, Romania
The journal is indexed in: ERIH PLUS, Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST, DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengage Learning, Cabell's Directories

H – height (cm); BM – body mass (Kg); BMI – body mass index (Kg/m2); BF% - body fat in %; MM% - muscle mass in %; BMR – basal metabolic rate (Kcal); BF (kg) – body fat in Kg; MM (kg) – muscle mass in Kg; SMM – skeletal muscle mass

Results

Though the data distribution normality hypothesis was not confirmed for four of the nine parameters (Table 2), to determine the power and direction of a linear relationship between two continuous variables of this study, we used Pearson correlation, considered robust to be applied.

Table 3. Synthetic Table featuring the value of the r (Pearson) coefficient for the group of boys WID

Variables		H (cm)	BM (Kg)	BMI (kg/m2)	BF (%)	MM (%)	BF (Kg)	MM (Kg)	SMM
H (cm)	Pearson Correlation	1	.552*	.086	-.019	.106	.224	.696*	.605*
BM (Kg)	Pearson Correlation	.552*	1	.873**	.662*	-.563	.864*	.934*	.873*
BMI (kg/m2)	Pearson Correlation	.086	.873*	1	.806*	-.737	.899*	.713*	.692*
BF (%)	Pearson Correlation	-.019	.662*	.806**	1	-.880	.935*	.360*	.370*
MM (%)	Pearson Correlation	.106	-.563	-.737**	-.880	1	-.814	-.293	-.432
BF (K)g	Pearson Correlation	.224	.864**	.899**	.935**	-.814*	1	.628**	.604**
MM (K)g	Pearson Correlation	.696**	.934**	.713**	.360*	-.293	.628**	1	.924**
SMM	Pearson Correlation	.605**	.873**	.692**	.370*	-.432	.604**	.924**	1

*The correlation is significant for p<0.05

H – height (cm); BM – body mass Kg); BMI – body mass index (Kg/m2); BF% - body fat in %; MM% - muscle mass in %; BMR – basal metabolic rate (Kcal); BF (kg) – body fat in Kg; MM (kg) – muscle mass in Kg; SMM – skeletal muscle mass

Table 4. Synthetic Table featuring the value of the r (Pearson) coefficient for the group of boys with MID (appendix 10)

Variables		H (cm)	BM (Kg)	BMI (kg/m2)	BF (%)	MM (%)	BF (Kg)	MM (Kg)	SMM
H (cm)	Pearson Correlation	1	.345**	-.033	-.016	-.003	.054	.619**	.621**
BM (Kg)	Pearson Correlation	.345**	1	.921**	.471**	-.489**	.910**	.858**	.857**
BMI (kg/m2)	Pearson Correlation	-.033	.921**	1	.511**	-.526**	.943**	.659**	.658**
BF (%)	Pearson Correlation	-.016	.471**	.511**	1	-.318*	.528**	.279*	.279*
MM (%)	Pearson Correlation	-.003	-.489**	-.526**	-.318*	1	-.616**	-.207	-.204
BF (K)g	Pearson Correlation	.054	.910**	.943**	.528**	-.616**	1	.569**	.567**
MM (K)g	Pearson Correlation	.619**	.858**	.659**	.279*	-.207	.569**	1	1.000**
SMM	Pearson Correlation	.621**	.857**	.658**	.279*	-.204	.567**	1.000**	1

*The correlation is significant for p<0.05

H – height (cm); BM – body mass Kg); BMI – body mass index (Kg/m2); BF% - body fat in %; MM% - muscle mass in %; BMR – basal metabolic rate (Kcal);BF(kg) – body fat in Kg; MM(kg) – muscle mass in Kg; SMM – skeletal muscle mass

Discussions

Upon analysing the values of this coefficient (Table 3) for the group of boys WID, we note that for r=0.899 (p<0.001), there is a significantly positive correlation between BMI and body fat in Kg (Figure 1). BMI correlates positively with muscle mass in kg, for r=713 (p<0.001), as noted in Figure 2. However, the relationship between BMI and body fat in kg is more substantial; namely, increased body mass index is considered due to an increase in (kg) of fat tissue. Body mass index (BMI) and fat mass are two different measures to assess body composition in teenagers. Generally, a positive correlation exists between BMI and fat mass in teenagers. In other words, the higher the BMI, the more likely to have a higher body fat percentage.

A recent study (Rigamonti et al., 2023) found that BMI was highly associated with other metabolic factors in teenagers, such as high blood pressure, insulin and total cholesterol. In another study (Skrzypek et al., 2021), significant differences were found in body fat levels between teenagers of various races and ethnicities with similar BMI.

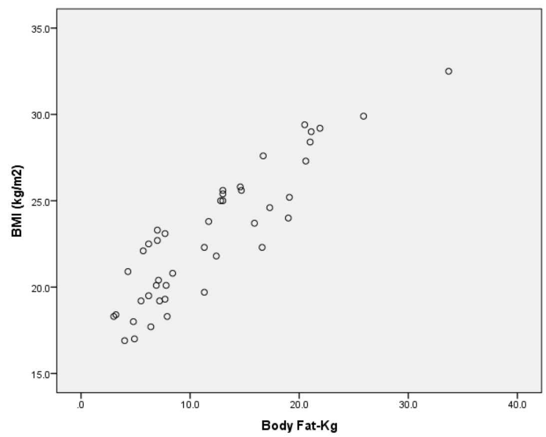

Figure 1. The correlation between BMI and body fat (kg) for the group of boys WID

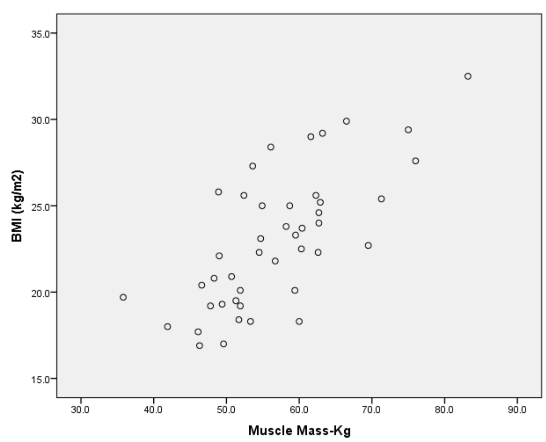

Figure 2. The correlation between BMI and muscle mass (kg) for the group of boys WID

Body mass (kg) correlates positively with body fat in kg for r=864 (p<0.001) and with muscle mass in kg for r=934 (p<0.001) and, as we can see, the values of the correlation coefficient (Table 3) are very close.

The fact that increased BMI is due to the amount of fat tissue (kg) is also supported by the highly negative correlation for r= -0.737 (p<0.001) between BMI and muscle mass percentage (Figure 3) and the highly positive correlation between BMI and the body fat percentage for r=806 (p<0.001) (Figure 4).

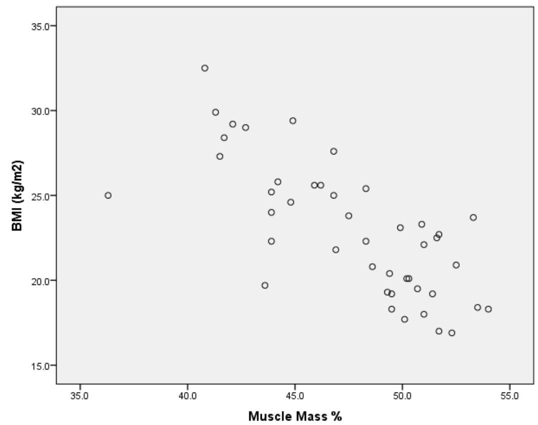

Figure 3. The correlation between BMI and percentage muscle mass (%) for the group of boys WID

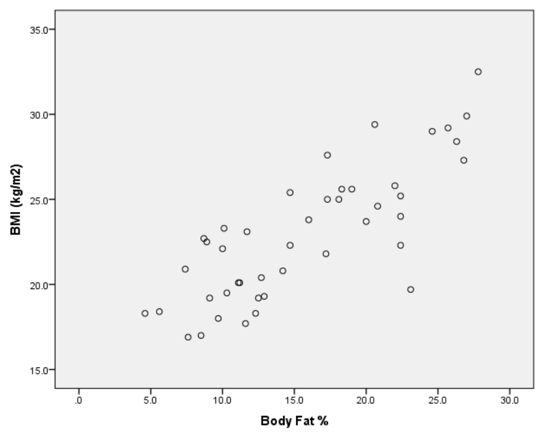

Figure 4. The correlation between BMI and body fat (%) for the group of boys WID

Another very strong positive correlation r=873 (p<0.001) was recorded between BMI and body mass in Kg. Concerning the other component of BMI, height, no relationship was demonstrated for r=0.86 (p>0.05).

For the group of boys with MID, we found the exact highly significant positive correlation between BMI and body fat r=0.943 (p<0.001) (Table 4, Figure 4). Still, concerning the correlation between BMI and percentage muscle mass, we found a negative correlation for r= -0.526 (Table 4, Figure 3).

Concerning Body mass (kg), as in the case of the group of boys WID, we note (Table 3) that it correlates significantly with Muscle mass (kg), for r=0.858 (p<0.001) and with Body fat (kg) for r=0.910 (p<0.001). However, this time, the relationship between Muscle mass (kg) and Body fat (kg) changed, a higher value of the correlation was found between Body mass (kg) and Body fat (kg) compared to the group of boys WID.

Within the group of boys with MID, significantly positive correlations were found between skeletal muscle mass (SMM) and body mass (BM-kg) for r=0.857 (p<0.001) and between skeletal muscle mass and muscle mass in kg, where the correlation is highly significant, i.e., r=1,00 (Figure 5).

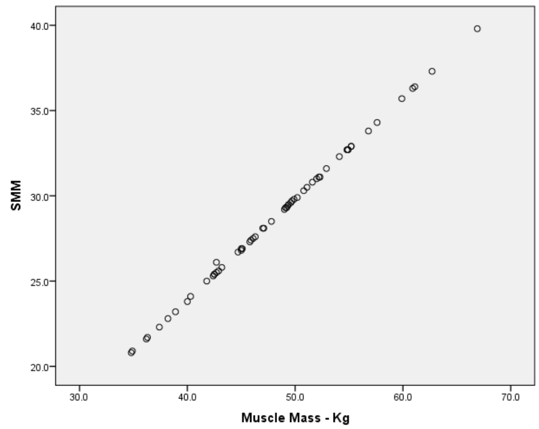

Figure 5. The correlation between skeletal muscle mass and muscle mass (kg) for the group of boys with MID

The combined prevalence of overweight and obesity among European teenagers ranges from 22-25% (Nils, 2020). The figure has been increasing constantly in the last decades, but it has a higher pace in Western countries. However, studies show differences by socioeconomic status and geographical location (Chung et al., 2016, Martinho et al., 2022), with higher rates among children and teenagers with lower living standards and with an intellectual disability (Farías-Valenzuela et al., 2022). Because they go through the growth and development phase, body composition modifications are typical for this age; in boys, muscle mass indicator increases are expected due to the significant changes recorded – sexual hormones led to substantial muscle mass growth. The differences presented may be due to multiple aspects featured by the persons with ID, which could be approached from an individual or collective perspective, ascribing them to sedentary behaviours, social barriers hindering the access to exercising programs, at the same time affecting BMI and BMC (Abe et al., 2022). Substantial body composition modifications during teenage years are natural due to puberty, the development process occurring in this stage of life, with considerable differences between sexes. Hence, separating unhealthy weight gains from natural body composition modifications is challenging in longitudinal studies.

Conclusions

Our study has shown significant differences in the groups of boys for five of the eight dependent variables, especially between the group of boys without an intellectual disability and the group of boys with moderate intellectual disability. One of the dependent variables not influenced by the type of disability or the sex is body mass index. Despite finding no significant differences between groups, the BMI means per group exceeds the WHO guidelines for the group WID and MID. However, there is no direct correlation between body composition and intellectual disability. Still, it is essential to consider these aspects in health and well-being management for persons with intellectual disabilities. It is vital to provide support to encourage an active and healthy lifestyle, thus minimising the risk of health issues associated with atypical body composition. Consequently, a positive correlation exists between BMI and fat mass in teenagers and intellectual disability. However, further research is required to understand this relationship better and develop effective bodyweight management strategies for this population.

Acknowledgements - This work was co-funded by the European Social Fund, through Operational Programme Human Capital 2014–2020, project number POCU/993/6/13/153322, project title "Educational and training support for PhD students and young researchers in preparation for insertion in the labor market".

References

Abe, T., Thiebaud, R.S., Ozaki, H., Yamasaki, S., Loenneke, J.P. (2022). Children with Low Handgrip Strength: A Narrative Review of Possible Exercise Strategies to Improve Its Development. Children, 9, 1616. https://doi.org/10.3390/children9111616

Chung, A.; Backholer, K.; Wong, E.; Palermo, C.; Keating, C.; Peeters, A. Trends in child and adolescent obesity prevalence in economically advanced countries according to socioeconomic position: A systematic review. Obes. Rev. 2016, 17, 276 295. https://doi:10.1111/obr.12360.

Emerson E., & Llewellyn G. (2021). Identifying children at risk of intellectual disability in UNICEF's multiple indicator cluster surveys: Cross-sectional survey, Disability and Health Journal, 14(1), https://doi.org/10.1016/j.dhjo.2020.100986

Farías-Valenzuela, C., Ferrero-Hernández, P., Ferrari, G., Cofre-Bolados, C., Espoz-Lazo, S., Álvarez-Arangua, S., Marques, A., Valdivia-Moral, P. (2022). Effects of Multicomponent Physical Exercise Programs on Physical Fitness in People with Intellectual Disabilities: A Systematic Review. Sustainability, 14, 16728. https://doi.org/10.3390/su142416728

Field, A. Discovering Statistic Using SPSS for Windows; Sage Publication: London, UK, 2000 Jurnalul Oficial al Uniunii

Europene, 2018 https://eur-lex.europa.eu/legal-content/RO/TXT/PDF/?uri=CELEX:52017IP0474&from=EN accesed on 28.03.2023

Martinho, D.V., Gouveia, É.R., França, C., Lopes, H., Ihle, A., Marques, A., Rodrigues, A., Alves, R., Sarmento, H. (2022). Body Composition and Physical Fitness in Madeira Youth. Children, 9, 1833. https://doi.org/10.3390/children9121833

MMPS (Ministerul Muncii și Protecției Sociale) Autoritatea Națională pentru Drepturile Persoanelor cu Dizabilități – Date statistice, http://andpdca.gov.ro/w/statistici/ , accesed on 18.04.2023.

Nils, A.A. Physical Activity and Body Composition in Norwegian Adolescent. Ph.D. Thesis, The Arctic University of Norway, Tromsø, Norway, October 2020

Rigamonti, A.E., Frigerio, G., Caroli, D., De Col, A., Cella, S.G., Sartorio, A., Fustinoni, S. A. (2023). Metabolomics-Based Investiga-tion of the Effects of a Short-Term Body Weight Reduction Program in a Cohort of Adolescents with Obesity: A Prospective Interventional Clinical Study. Nutrients, 15, 529. https://doi.org/10.3390/nu15030529

Rimmer, J. H., Yamaki, K., Davis Lowry, B. M., Wang, E., Vogel, L. C. (2010). Obesity and obesity related secondary conditions in adolescents with intellectual/developmental disability, Journal of Intellectual Disability Research, 54(9), 787 794

Sallis, J. F., Owen, N., & Fisher, E. B. (2015). Ecological models of health behavior, Health behavior and health education: Theory, research, and practice-4th ed., pp. 465 485.

Sava, F. (2004). Data Analysis in Psychological Research. In Complementary Statistical Methods; *ASCR Publishing House*, Cluj-Napoca, Romania

Skrzypek, M., Koch, W., Goral, K., Soczyńska, K., Poźniak, O., Cichoń, K., Przybysz O., Marcin, C. (2021). Analysis of the Diet Quality and Nutritional State of Children, Youth and Young Adults with an Intellectual Disability: A Multiple Case Study. Preliminary Polish Results. Nutrients, 13(9), 3058; https://doi.org/10.3390/nu13093058

WHO, ICD Working Group on the Classification of Intellectual Disability. (2011). *Intellectual developmental disorders: towards a new name, definition and framework for "mental retardation/intellectual disability"* in ICD-11. World Psychiatry, 10, 175-180, accesed on 22.04.2023