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Effects of Non-Compliance with the Protocol on InBody 770 in Students of Different Training

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Abstract

The research aimed to investigate whether alterations in the measurement protocol, accounting for dehydration, resulted in variations in body composition parameters among participants with different weekly training frequencies. The sample consited of ninety healthy participants categorized into three subgroups; the first group (n=28, body height 172.13±9.12 cm, body weight 67.05±11.38 kg) included students with low levels of weekly PA, the second group (n=35, body height 172.93±7.76 cm, body weight 67.53±9.06 kg) consisted of students whith medium level of PA, and the third group (n=27, body height 175.87±9.27 cm, body weight 71.14±11.58 kg) comprised students with high weekly training frequencies. Using the body composition analyzer, InBody770, various morphological characteristics were measured, including Body Height (BH), Body Weight (BW), Body Mass Index (BMI), Percent Body Fat (PBF%), Body Fat Mass (BFMkg), Fat Free Mass (FFM), Total Body Water (TBW), Intracellular Water (ICW), Extracellular Water (ECW), Proteins (PROT), Minerals (MNRL), Soft Lean Mass (SLM), Skeletal Muscle Mass (SMM), Waist-Hip Ratio (WHR), Visceral Fat Level (VFL), Visceral Fat Area (VFA), and Obesity Degree (OD). It can be detected that there is generally no significant difference between the initial and final measurements within the variables describing body composition. Additionally, when analyzing the effect size on the overall sample, it was found to be insignificant in almost all variables, except for the following parameters: Body Fat Mass (ES=.28); Body Mass Index (ES=.21); Percent Body Fat (ES=.21); Visceral Fat Level (ES=.24); Visceral Fat Area (ES=.26); Obesity Degree (ES=.22). The results of this study, following the water intake treatment, revealed a notable overall difference in body composition parameters. However, upon closer examination by group, it becomes evident that a statistically significant difference is particularly pronounced in individuals with a high exercise frequency (Group III), indicating their body's efficient capacity for rapid water absorption into various body composition parameters. These findings underscore the critical importance of adhering to the prescribed protocol when diagnosing body composition using the InBody 770 device, particularly among highly trained individuals..

Keywords: *body composition, bioelectrical impedance, In Body 770 protocol, dehydration, measurement protocol alterations*

Introduction

The method of bioelectric impedance analysis (BIA), as exemplified by the InBody 770, is a widely utilized approach for evaluating body composition due to its accessibility, non-invasive nature, and rapid results generation (Bosy-Westphal et al., 2008; Finn et al., 2015; McLester, Nickerson, Kliszczewicz, & McLester, 2018). This technique involves measuring the body's resistance to low-frequency electrical currents passed through contact points, such as the hands and feet (Esco et al., 2015). By employing an algorithm that takes into account physical characteristics like height, age, gender, and weight, this analysis aims to generate various parameters for assessing participants' body composition (Bosy-Westphal et al., 2008). Prior to the introduction of multi-frequency BIA, numerous studies conducted reliability tests comparing single-frequency BIA to reference instruments employing a similar methodology. Some

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studies found a concurrence of results (Goldfield, Cloutier, Mallory, & Prud'Homme, 2006; Jebb et al., 2007; Thomson, Brinkworth, Buckley, Noakes, & Clifton, 2007), while others reported disparities between BIA and reference methods (Frisard, Greenway, & DeLany, 2005). In recent years, advancements in technology have expanded bioelectrical impedance analysis to encompass the utilization of multiple frequencies and impedance measurements, thereby enhancing the precision and reliability of body composition assessments (Quiterio et al., 2009; Lee et al., 2018). Multi-frequency BIA devices, such as the InBody 770, represent high-tech instruments developed for the assessment of segmental and total body composition (Ramírez-Vélez et al., 2018; Schoenfeld et al., 2020).

The author of one of the studies suggests that multi-frequency devices can be less subject to errors caused by redistribution of total body water to extracellular and intracellular water and that they represent a more superior method of assessment of total body composition (Moon, 2013). It is well-established that exercise can lead to fluctuations in total body water (TBW), potentially introducing methodological errors in various body composition categories that rely on a constant relationship between lean mass variables (FFM) (Clark, Kuta, & Sullivan, 1994). Variations in the density and composition of FFM, including water, minerals, proteins, and other constituents, between athletes and non-athletes are associated with corresponding methodological errors (Modlesky et al., 1996; Prior et al., 2001). Taking into account that electrical impulse travels through body water, hidratation may influence the validity and reliability of the results. Dehydration is a well-known factor that influences BIA measurement since it increases the body's electrical resistence and it can also lead to changes in FFM (Kyle et al., 2004). There is an insufficient body of research which are based on differences in body composition after the protocol of testing on bioelectrical impedance is changed. Also, it raises the question of whether altering the measurement protocol affects body composition parameters in individuals with varying levels of physical activity.

In line with the aforementioned objectives, the research aimed to investigate whether alterations in the measurement protocol, accounting for dehydration, resulted in variations in body composition parameters among participants with different weekly training frequencies.

Metods

Subjects

In this experimental research, the participant pool consisted of undergraduate students from the Faculty of Sports and Physical Education at the University of Nis. The study included a total of 90 healthy participants, encompassing both genders, with the following characteristics: an average height of 173.56±8.70 cm, an average weight of 68.47±10.63 kg, and an average BMI of 22.59±1.95 kg/m². Out of these participants, 61 were male, and 29 were female, with an age range of 18 to 24 years and an average age of 20.33±1.50 years. The participants were categorized into three subgroups based on their weekly engagement in organized physical activities. The primary criterion for this categorization was the frequency of weekly physical activity as determined by a pre-testing survey. The first subgroup (EGL: n=28, body height 172.13±9.12 cm, body weight 67.05±11.38 kg) included students with low levels of weekly physical activity, ranging from physical inactivity (no recreational physical activities) to a maximum of three training sessions per week. The second subgroup (EGM: n=35, body height 172.93±7.76 cm, body weight 67.53±9.06 kg) consisted of students who engaged in physical activity four to five times per week in addition to their regular academic studies. Lastly, the third subgroup (EGH: n=27, body height 175.87±9.27 cm, body weight 71.14±11.58 kg) comprised students who, alongside their regular studies, participated in six to ten training sessions per week. The participants in this experimental research willingly volunteered to take part and had no health issues or contraindications such as chronic illnesses, mobility limitations, cardiovascular problems, or respiratory conditions. The Ethics Committee of the Faculty of Sports and Physical Education at the University of Nis confirmed (decision number: 04- 542/2; date: 27.04.2023) that this experimental research adhered to all ethical standards governing scientific studies involving human participants, following the guidelines outlined in the Helsinki Declaration (World Medical Association, 2011).

Procedures

The research aimed to measure various morphological characteristics, including Body Height (BH), Body Weight (BW), Body Mass Index (BMI), Percent Body Fat (PBF%), Body Fat Mass (BFMkg), Fat Free Mass (FFM), Total Body Water (TBW), Intracellular Water (ICW), Extracellular Water (ECW), Proteins (PROT), Minerals (MNRL), Soft Lean Mass (SLM), Skeletal Muscle Mass (SMM), Waist-Hip Ratio (WHR), Visceral Fat Level (VFL), Visceral Fat Area (VFA), and Obesity Degree (OD). These measurements were conducted using a professional body composition analyzer, the InBody770 (Body Composition Analyzer – InBody770, InBody Co., Ltd., Chungcheongnam-do, Korea), which has been verified for its reliability with 95% accuracy (McLester, Nickerson, Kliszczewicz & McLester, in print). Body Height was measured with a Martin anthropometer with an accuracy of 0.1 cm, and Body Mass Index (BMI) was calculated using the standard procedure, dividing body weight in kilograms by the square of body height in meters (BMI=BW(kg)/BH(m²)).

Description of the Experiment

The tests for all the participants in this experimental research were performed during October, 2020 in the Hall of the Centre for Multidisciplinary Research of the Faculty of Sports and Physical Education in Nis, from 8-10 am in order to avoid daily variations of measurements. The air temperature in the Hall during testing ranged from 22°C to 26°C. Testing in this study was conducted according to previously established protocols, which implied that: participants had to be of normal nutrition (BMI=18-25 kg/m²); participants did not have a chronic illness and were not consuming medications as prescribed therapy for the treatment of any type of illness; female participants should not be menstruating; participants should not eat or drink 8 hours before testing (no food and drink from 00:00 to 8:00); participants had to empty their bladder before testing; participants, due to the testing requirements, had to be barefoot and wear only their bathing suits.

The testing process was carried out by experienced experts and it was divided into four phase. Body height measurement of the participants was done in the first phase while the values were recorded on the previously prepared research protocol list. The second phase involved the body composition assessment (the initial measurement) using a professional body composition analyser of brand InBody770. After receiving the report on the analysis of the subject's body composition, the participants, according to the protocol of the third phase of the testing, consumed liquid in the form of a bottled natural non-carbonated mineral water „Aqua viva", nutritional value of water: Calcium (Ca^{2+}): 88.09 mg/lit; Magnesium (Mg^{2+}): 44.96 mg/lit; Calium (K^+): 2.01 mg/lit; Natrium (Na^+): 9.17 mg/lit; Bicarbonates (HCO_3): 305 mg/lit; Sulfates (SO_4^{2-}): 17.77 mg/lit; Chlorine (Cl^-): 13.51 mg/lit; Dry residue: 329 mg/lit). In the fourth phase of the testing, a repeated analysis of the subjects' body composition (the final measurement) was conducted 30 minutes after the consumption of the liquid. During the final phase of testing, after collecting all the results of the variables which were tested, the statistical data processing was done.

Statistical Analysis

All data obtained will be represented by descriptive statistical parameters, including the average value (mean), standard deviation (SD), minimum result (min), and maximum result (max). The Kolmogorov–Smirnov test was used to assess the

Table 1. Descriptive results of body composition parametres and results of ANOVA analysis between the groups

Variables	Initial (Mean±SD)	Final (Mean±SD)	Initial I group	Final I group	Initial II group	Final II group	Initial III group	Final III group	Initial p	Final p
Body Height (cm)	173.56 ± 8.70		172.13 ± 9.12		172.93 ± 7.76		175.87 ± 9.27			
Body Weight (kg)	68.47 ± 10.63	69.75 ± 11.41	67.05 ± 11.38	69.13 ± 12.75	67.53 ± 9.06	71.01 ± 10.61	71.14 ± 11.58	68.75 ± 11.24	.29	.70
Total Body Water (L)	41.84 ± 8.07	41.93 ± 8.39	40.19 ± 8.20	41.61 ± 8.87	41.08 ± 7.17	42.46 ± 7.88	44.55 ± 8.63	41.57 ± 8.80	.10	.89
Intracellular Water (L)	26.30 ± 5.17	26.33 ± 5.36	25.24 ± 5.23	26.12 ± 5.66	25.77 ± 4.60	26.68 ± 5.06	28.07 ± 5.52	26.09 ± 5.60	.09	.87
Extracellular Water (L)	15.55 ± 2.91	15.60 ± 3.04	14.95 ± 2.98	15.49 ± 3.22	15.31 ± 2.59	15.79 ± 2.83	16.48 ± 3.12	15.49 ± 3.22	.12	.90
Protein	11.36 ± 2.24	11.37 ± 2.31	10.90 ± 2.27	11.29 ± 2.44	11.13 ± 2.00	11.53 ± 2.18	12.13 ± 2.38	11.26 ± 2.42	.09	.88
Minerals	3.97 ± 0.75	3.99 ± .80	3.81 ± .77	3.99 ± .86	3.85 ± .62	4.02 ± .75	4.28 ± .83	3.94 ± .81	.03*	.93
Body Fat Mass (kg)	11.28 ± 3.66	12.45 ± 4.65	12.15 ± 3.88	12.24 ± 4.47	11.45 ± 3.82	12.99 ± 5.36	10.17 ± 3.01	11.96 ± 3.86	.12	.67
Soft Lean Mass (kg)	53.89 ± 10.44	54.00 ± 10.84	51.74 ± 10.61	53.59 ± 11.47	52.89 ± 9.28	54.69 ± 10.20	57.41 ± 11.15	53.52 ± 11.34	.10	.89
Fat Free Mass (kg)	57.18 ± 11.04	57.30 ± 11.49	54.91 ± 11.22	56.89 ± 12.17	56.08 ± 9.77	58.01 ± 10.80	60.97 ± 11.82	56.79 ± 12.01	.09	.90
Skeletal Muscle Mass (kg)	32.29 ± 6.75	32.33 ± 6.99	30.93 ± 6.84	32.05 ± 7.37	31.61 ± 6.01	32.80 ± 6.59	34.59 ± 7.20	32.02 ± 7.31	.09	.88
Body Mass Index	22.59 ± 1.95	23.03 ± 2.30	22.49 ± 2.17	22.86 ± 2.22	22.49 ± 1.86	23.25 ± 2.52	22.82 ± 1.86	22.91 ± 2.13	.76	.76
Percent Body Fat (%)	16.84 ± 5.89	18.15 ± 6.65	18.40 ± 6.02	17.99 ± 6.09	17.26 ± 6.21	18.48 ± 7.36	14.66 ± 4.80	17.90 ± 6.45	.05*	.93
Waist-Hip Ratio	.85 ± .05	.85 ± .05	.86 ± .06	.86 ± .06	.85 ± .05	.86 ± .04	.83 ± .04	.85 ± .04	.16	.80
Visceral Fat Level	4.09 ± 1.88	4.61 ± 2.37	4.43 ± 1.95	4.61 ± 2.30	4.23 ± 1.99	4.83 ± 2.72	3.56 ± 1.58	4.33 ± 1.98	.19	.72
Visceral Fat Area	45.72 ± 18.63	51.30 ± 23.25	49.45 ± 19.39	50.85 ± 22.38	47.17 ± 19.56	53.85 ± 27.15	39.97 ± 15.68	48.45 ± 18.66	.14	.66
Obesity Degree	103.42 ± 8.44	105.46 ± 10.12	103.14 ± 9.39	104.68 ± 9.46	103.00 ± 8.31	106.37 ± 11.49	104.26 ± 7.81	105.07 ± 9.14	.82	.78

Note Mean – arithmetic mean; SD - standard deviation; p - significance coefficient; * - denotes statistical significance of $p<0.05$.

normal distribution of the results. A t-test was employed to determine the differences between the initial and final measurements for each individual group, along with the inclusion of an effect size (ES) for each independent variable, following the methodology of Hopkins, Marshall, Batterham, & Hanin (2009). The ES was estimated using Cohen's d effect size. The criteria for determining the magnitude of the effect were as follows: <0.20 trivial (t); 0.20-0.50 small (s); 0.50-0.80 moderate (m); 0.80-1.3 large (l); and >1.3 very large (vl) (Cohen, 1988). Additionally, univariate analysis of variance (ANOVA) was utilized to identify differences between the groups of participants. A significance level of 0.05 (p<0.05) was applied to assess the statistical significance of differences in results between the initial and final measurements, as well as differences among groups. Data analysis was conducted using the statistical package SPSS (IBM Corp. Released 2010. IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp.)

Results

Based on the ANOVA analysis (Table 1), it was determined that there were no differences between the subgroups of participants in the initial measurement, except for the variables of Minerals (p=0.03) and Body Fat Percentage (p=0.05). While, there were no significant differences among the subgroups of participants in the final measurement.

Based on the results presented in Table 2, which illustrates the differences between the initial and final measurement within the variables describing the body composition, it can be detected that there is not a statistically generally significant difference between the initial and final measurement of the participants Additionally, when analyzing the effect size on the overall sample, it was found to be insignificant in almost all variables, except for the following parameters: Body Fat Mass (kg) (ES=.28); Body Mass Index (ES=.21); Percent Body Fat (ES=.21); Visceral Fat Level (ES=.24); Visceral Fat Area (ES=.26); Obesity Degree (ES=.22). Here the effect was low.

In the first group of participants, the results of the T-test of repeated measurements showed no statistically significant differences between the initial and final measurements in any variables. However, when analyzing the effect size, only the 'Minerals' variable showed a small effect (ES=.22), while all other variables had trivial (insignificant) effects. For participants in the second group, who trained four to five times per week, the T-test did not detect statistically significant differences between the initial and final measurements. Nevertheless, the effect size analysis revealed small effects in variables such as Weight of the respondent (ES=.35), Minerals (ES=.25), Body Fat Mass (kg) (ES=.33), Body Mass Index (ES=.34), Waist-Hip Ratio (ES=.22), Visceral Fat Level (ES=.25), Visceral Fat Area (ES=.28), and Obesity Degree (ES=.34), while other variables exhibited trivial effects.In the third group of participants, the T-test results indicated statistically significant differences in the following variables: Body Fat Mass (kg) (p=.04), Percent Body Fat (p=.05), and Visceral Fat Area (p=.04). The effect size analysis in this group demonstrated small effects in nearly all variables, except for Body Mass Index (ES=.05) and Obesity Degree (ES=.10), where the effect was trivial.

Table 2. Differences of body composition parameters following the application of the experimental treatment for every subsample and generally (t-test)

Variables	General		I group		II group		III group	
	p	ES (95% CI)	p	ES (95% CI)	p	ES (95% CI)	p	ES (95% CI)
Weight (kg)	.46	.12 (.12 to .12)^T	.54	.17 (.18 to .17)^T	.12	.35 (.38 to .35)^S	.52	.21 (.21 to .21)^S
Total Body Water	.95	.01 (.01 to .01)^T	.53	.17 (.17 to .17)^T	.43	.18 (.19 to .18)^T	.30	.34 (.35 to .34)^S
Intracellular Water	.97	.01 (.01 to .01)^T	.55	.16 (.17 to .16)^T	.42	.19 (.20 to .19)^T	.28	.36 (.36 to .36)^S
Extracellular Water	.91	.02 (.02 to .02)^T	.50	.17 (.18 to .17)^T	.45	.18 (.19 to .18)^T	.34	.31 (.32 to .31)^S
Protein	.97	.00 (.00 to .00)^T	.54	.16 (.17 to .16)^T	.42	.19 (.20 to .19)^T	.27	.36 (.37 to .36)^S
Minerals	.87	.03 (.03 to .03)^T	.40	.22 (.23 to .22)^S	.31	.25 (.27 to .25)^S	.22	.41 (.41 to .41)^S
Body Fat Mass (kg)	.05*	.28 (.32 to .28)^S	.93	.02 (.02 to .02)^T	.18	.33 (.40 to .33)^S	.04*	.52 (.59 to .52)^M
Soft Lean Mass (kg)	.95	.01 (.01 to .01)^T	.53	.17 (.17 to .17)^T	.42	.18 (.19 to .18)^T	.29	.35 (.35 to .35)^S
Fat Free Mass (kg)	.95	.01 (.01 to .01)^T	.52	.17 (.18 to .17)^T	.42	.19 (.20 to .19)^T	.29	.35 (.35 to .35)^S
Skeletal Muscle Mass (kg)	.97	.01 (.01 to .01)^T	.56	.16 (.16 to .16)^T	.41	.19 (.20 to .19)^T	.28	.35 (.36 to .35)^S
Body Mass Index	.18	.21 (.23 to .21)^S	.57	.17 (.17 to .17)^T	.15	.34 (.41 to .34)^S	.87	.05 (.05 to .05)^T
Percent Body Fat	.15	.21 (.22 to .21)^S	.77	.07 (.07 to .07)^T	.47	.18 (.20 to .18)^T	.05*	.57 (.68 to .57)^M
Waist-Hip Ratio	.46	.00 (.00 to .00)^T	.98	.00 (.00 to .00)^T	.87	.22 (.20 to .22)^S	.19	.50 (.50 to .50)^S
Visceral Fat Level	.08	.24 (.28 to .24)^S	.74	.08 (.09 to .08)^T	.30	.25 (.30 to .25)^S	.07	.43 (.49 to .43)^S
Visceral Fat Area	.06	.26 (.30 to .26)^S	.79	.07 (.07 to .07)^T	.24	.28 (.34 to .28)^S	.04*	.49 (.54 to .49)^S
Obesity Degree	.15	.22 (.24 to .22)^S	.58	.16 (.16 to .16)^T	.16	.34 (.41 to .34)^S	.71	.10 (.10 to .10)^T

Note p - significance coefficient; ES - Cohen's d effect size (<0.20 trivial (t); 0.20-0.50 small (s); 0.50-0.80 moderate (m); 0.80-1.3 large (l); and >1.3 very large (vl)); * - denotes statistical significance of p<0.05.

Discussion

According to a goal of this research, differences in certain parametres of body composition were determined. These differences arose due to variations in participant hydration levels, which resulted from non-compliance with the prescribed protocol, across individuals with different weekly training frequencies.

According to the World Health Organization (WHO) in

2020 (World Health Organization, 2020), individuals in the specified age group should engage in aerobic physical activities for 150-300 minutes per week at a moderate intensity level, or at least 75-150 minutes of vigorous aerobic exercise. Alternatively, they can engage in an equivalent combination of moderate and vigorous activities throughout the week. To gain additional health benefits, one can increase the duration of these activities and incorporate muscle-strengthening exercises for all major muscle groups on two or more days per week. However, it's important to avoid excessive exercise, as intense physical activity can lead to oxidative stress, which can be particularly harmful to lymphatic tissues, as it is a natural byproduct of oxidative metabolic processes during exercise (Nunes-Silva & Freitas-Lima, 2015; Salim, 2016; Estruel-Amades et al., 2019). Moderate exercise has been found to increase levels of reactive oxygen species (ROS) while also enhancing the body's antioxidant defense mechanisms, which contributes to maintaining a healthy oxidative status (He et al., 2016). It also plays a role in activating the immune system (Dröge, 2002). However, engaging in intense exercise can lead to a significant increase in ROS production, surpassing the body's antioxidant capacity and resulting in oxidative stress (Neubauer et al., 2010). Several studies have demonstrated excessive ROS production during strenuous exercise, particularly among athletes (Lee, Kim, Lim, Kim, & Kang, 2015; Vezzoli et al., 2016; Thirupathi & Pinho, 2018). This heightened ROS production during intense exercise can have various effects, including potential muscle damage and a subsequent reduction in muscle performance (Thirupathi & Pinho, 2018). Given the aforementioned facts, it can be concluded that the first group participating in the research engages in university activities and 0-3 training sessions per week while maintaining a balance between ROS and antioxidants in their body. For the second group, it cannot be claimed with certainty, but it is highly probable (considering their frequency of training - 4-5 times per week, and university activities) that an imbalance exists, leaning toward the generation of ROS, indicating oxidative stress. In the third group, they train 6-10 times per week alongside regular activities at the university. There is no balance between ROS and antioxidants; that is, it is directed towards the creation of ROS which overcomes antioxidants – an oxidative stress.

These conclusions find support in the data presented in Table 2, which demonstrates a small level of effect for most variables (except for BMI and OD) when assessed using the BIA method for the third group of participants. Similarly, the second group shows a small effect level for most variables (except for PBF, Protein, TBW, ICW, and ECW). In contrast, the first group of participants only exhibits such results for the mineral variable. Upon comparing the values from Table 2 for the second and third groups of participants, it becomes apparent that all variables related to lipids (except PBF in the second group) show a small effect level. This observation supports the hypothesis of increased ROS production relative to antioxidants in these two groups of participants, indicating oxidative stress. Specifically, heightened oxidative stress can disrupt adipocyte differentiation and contribute to dysfunction in adipose tissue (Murdolo et al., 2013).

BMI serves as an anthropometric method to assess generalized obesity and offers the most accurate prediction of total fat tissue value, with an error margin of up to 11% (Kvist, Chowdhury, Grangard, Tylen, & Sjostrom, 1988). Additionally, it's crucial to note the substantial correlation between WHR and the ratio of cross-sectional area VFL (Visceral Fat Level) and subcutaneous fat tissue. A higher WHR is indicative of a greater proportion of intra-abdominal fat (Ashwell, Cole, & Dixon, 1985).

The BIA (Bioelectrical Impedance Analysis) method employed for measurements in this study offers the advantage of being radiation-free, making it suitable for assessing body composition in various participants (Kyle et al., 2004; Mourtzakis et al., 2008). However, it has limitations in terms of specificity and accuracy because it relies on the differences in electrical resistance between fat and lean-fat-free components of the body. Recent efforts to estimate intra-abdominal fat and WHR using BIA have shown significant correlations with precise recording techniques like computerized tomography (CT scan) (Nagai et al., 2008; Shoji et al., 2008). Nevertheless, it's important to interpret these results cautiously since they are based on the measurement of fat-free tissue, while BIA calculates total fat mass by subtracting lean mass from body weight. Additionally, the hydration status can impact the measurement of lean tissue, which, in turn, may affect the accuracy of fat measurement (Shuster, Patlas, Pinthus, & Mourtzakis, 2012). The limited effect observed in the mineral variable for all three groups of participants (Table 2) can be attributed to dehydration, as evidenced by the statistically significant difference between participant subgroups in the initial measurement analyzed using the ANOVA method (Table 1), which was not present in the final measurement after the described fluid intake. Water and electrolytes are important components of 'interiour ambience' of a body. It surrounds almost all cells through which different metabolites and gasses pass through in all directions (Sobotka, Allison, & Stanga, 2008). Disorders of water and electrolyte balance in the body can negatively affect both cellular and systemic function in the body thus, one should consume an adequate liquid 24 hours prior to exercising Convertino et al. (1996) or, at least, a few hours before exercising (Sawka et al., 2007). Every shortage of liquid before exercising can potentially endanger thermoregulation during the following exercising, especially if there is no an adequate liquid substitution (Convertino et al., 1996). Some studies have indicated that water intake and maintaining a proper water-electrolyte balance in the body can have significant implications for weight and body composition management (Laja García et al., 2019). Indicators such as decreased urination and loss of body mass, are more reliable indicators of dehydration than thirst (Maughan, Leiper, & Shirreffs, 1997). Research results Marta Milla-Tobarra et al. (2016) show an inverse relationship among water (in ml/kg of body weight) and BMI, BFM, FFM, waist circumference and other clinical parameters in children and young people. Essentially, increase of sympathetic activity (skeletal muscles, fat tissue, heart, lungs, metabolism, mental activity, etc.) induced by consuming water is an important and not widely known component of daily energy consumption (Vij & Joshi, 2014).

The strength of the study lies in the fact that it is one of the rare studies that have explored the impact of different InBody protocols on the body composition of students. Additionally, it should be emphasized that the study was conducted on a large sample size and with a comprehensive set of body composition variables.

However, like any study, this one has certain limitations. One of the limitations is related to the assessment of physical activity levels, which relied on sports activity frequency. Hence, a recommendation for future research is to incorporate an objective assessment of PA using accelerometers or include an evaluation of students' physical fitness levels, forming subgroups accordingly. Additionally, it is essential to segregate male and female participants and conduct separate subgroup analyses.

Conclusion

The results of this study, following the water intake treatment, revealed a certain difference in body composition parameters. However, upon closer examination by group, it becomes evident that a statistically significant difference is particularly pronounced in individuals with a high exercise frequency (Group III), indicating their body's efficient capacity for rapid water absorption into various body composition parameters. Additionally, it is apparent that the parameters exhibiting statistically significant increases include measures related to fat, minerals, and bodily fluids. These findings underscore the critical importance of adhering to the prescribed protocol when diagnosing body composition using the InBody 770 device, particularly among highly trained individuals.

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Conflict of Interest
The author declares that there is no conflict of interest.

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