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Effects of food and drink ingestion on body composition variables of abdominal bioelectrical impedance

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Abstract

Objective: **to know the changes in trunk fat and visceral fat level determined by abdominal bioelectrical impedance (BIA) as well as other anthropometric measures related to the central or abdominal fat after the ingestion of a lunch.**

Methods: **the experimental study was conducted to assess a longitudinal intervention descriptive study. Participants: 21 subjects (10 male and 11 female), volunteers who have access to a medical assessment, with an age of 74 ± 13.43 years. Measurements: Maximal waist circumference in standing position, waist circumference at navel level in supine position and sagittal abdominal diameter (SAD). In the same position trunk fat and visceral fat level by abdominal bioelectrical impedance analysis with Tanita AB-140 (ViScan) were obtained before and after meal.**

Results: **anthropometric measures as waist circumference in supine position and SAD did not show significant differences ($P > 0.05$), after food ingestion, except for a significant increase of the maximal waist circumference in standing position ($P < 0.05$). In addition trunk fat and visceral fat ratio did not change ($P > 0.05$). The percentage changes of the measures were less than 2% for waist circumference in standing position, waist circumference by Viscan, sagittal abdominal diameter and trunk fat and 5.9% for visceral fat ratio.**

Conclusions: **the effects on trunk fat and visceral fat ratio by abdominal bioelectrical impedance are minimal**

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EFECTOS DE LA COMIDA Y LA BEBIDA SOBRE LAS VARIABLES DE COMPOSICIÓN CORPORAL EN LA BIOIMPEDANCIA ABDOMINAL

Resumen

Objetivo: **conocer los cambios en la grasa del tronco y el nivel de grasa visceral determinado por BIA abdominal, así como otras medidas antropométricas relacionadas con la grasa abdominal o central después de la ingestión de una comida.**

Métodos: **se realizó un protocolo experimental para evaluar un estudio descriptivo de intervención longitudinal. Los participantes fueron 21 sujetos (10 hombres y 11 mujeres), voluntarios que tuvieron acceso a una evaluación médica, con una edad de 74 años ± 13,43. Las mediciones antropométricas fueron: circunferencia de la cintura máxima en posición de pie, circunferencia de la cintura a nivel del ombligo en posición de decúbito supino y diámetro sagital abdominal (SAD). Además se obtuvo la grasa del tronco y el nivel de grasa visceral, por análisis de impedancia bioeléctrica abdominal, con un dispositivo Tanita AB-140 (ViScan), todo ello antes y después de una ración de comida.**

Resultados: **las medidas antropométricas, como la circunferencia de la cintura en posición supina y SAD, no mostraron diferencias significativas ($P > 0,05$), después de la ingestión de alimentos, a excepción de un aumento significativo de la circunferencia de la cintura máxima en posición de pie ($P < 0,05$). Además, la relación entre la grasa visceral y en tronco no cambió ($P > 0,05$). Los cambios porcentuales de las medidas fueron menores del 2% para la circunferencia de la cintura en posición de pie, para la circunferencia de cintura por Viscan, para el diámetro sagital abdominal y la grasa del tronco, y un 5,9% para el nivel de grasa visceral.**

Conclusiones: **los efectos de una comida y bebida sobre la grasa del tronco y el nivel de grasa visceral, medidas por impedancia bioeléctrica abdominal, son mínimas,**

after the ingestion of a portion of food and drink, although it is always recommended to do it in fasting conditions.

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Key words: *Abdominal bioelectrical impedance. Trunk fat. Visceral fat. Waist circumference. Sagittal abdominal diameter. Food effects.*

aunque siempre es recomendable hacerlo en condiciones de ayuno.

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Palabras clave: *Impedancia bioeléctrica abdominal. Grasa del tronco. Nivel de grasa visceral. Circunferencia de cintura. Diámetro sagital abdominal. Efectos de la comida.*

Abreviations

BIA: Bioelectrical impedance analysis.
FFM: Fat-free mass.
FM: Fat mass.
ISAK: International Society for Advancement in Kinanthropometry.
Khz: kilohertz.
Kj: Kilojoules.
Kcal: kilocalorías.
R: Resistance (Ω).
SAD: Sagittal abdominal diameter.

Introduction

The definition of bioelectrical impedance (BIA) has been introduced in the 1950s. Thomasset, was the first to relate the total body water with the whole body impedance. Estimates of body composition, through the BIA, are based on different dielectric and conductive properties of body tissues, at different frequencies[1].

The single BIA uses the frequency of 50 kHz, to measure the impedance and estimate body composition. The multi-frequency BIA was developed by the need to know the distribution of extra and intracellular fluids (intracellular and extracellular water).

The BIA method of easy application and use in several settings, for body composition assessment, however the BIA measurements are standardized under several conditions[2], and this method is sensitive to the influence of different factors, e.g. temperature[3,4], food and drink ingestion, physical exercise and sweating among others[5], body position changes[6], or combinations of fasting conditions and rest[7].

These physiological situations are important to take into account when comparing studies of different authors and especially when we analyze repeated comparisons and for body composition assessments[8,9].

There are studies showing the effects of food and drink ingestion on the whole body impedance[10,11]. Within 4 hours after food ingestion, this has an effect of decrease of impedance, representing a relatively small error of up to 3%. This same percentage of change can also be 3% after being supine position for 60 minutes.

It has been recently approved device of abdominal bioimpedance, which are able to estimate trunk fat and visceral fat levels[12,13], but are unknown, the effects of food and/or drink, on outcomes that offers this instrument of abdominal bioimpedance. Measures of fat located regionally in the trunk and in particular in intra-abdominal location is visceral fat and are related to metabolic syndrome[14,15] and therefore highlights the importance of quantification in high risk groups.

These circumstances forced us to test possible changes in the variables of abdominal bioelectrical impedance, that some patients and residents who had to impose a schedule required of these people having to go out to eat, which, in some cases there was some disparity in the measurement conditions, therefore, the objective of the present study was to check, the magnitude of changes in trunk fat and visceral fat level determined by BIA as well as other anthropometric measures related to abdominal fat, due to ingestion of a lunch.

Methods

Subjects

Twenty-one (10 male and 11 female) volunteered subjects of 74.0 ± 13.43 years old participate in the study. All of them are older people living in a nursing home, subjected to strict timetables of the center. All of them, received detailed information from the study to be carried out within a medical examination by the Unidad de Residencias del Distrito Sanitario Costa del Sol (Consejería de Salud de la Junta de Andalucía-Málaga) and signed by the medical officer, the subsequent informed consent was given. Prior to the BIA outlined the need to urinate. The study was approved by our Ethics Committee of the University of Málaga and respected the principles of Helsinki for research in humans.

Study design

Participants were measured by anthropometric techniques and abdominal BIA, before and after lunch and similarly accessed to the dining room and the second body composition measurement. The mean time between measurements was 46.2 ± 3.4 min. All abdominal BIA and anthropometric measures were measured in duplicate, computing the average value.

Anthropometric measurements

Maximal waist circumference at the level of the iliac crests was measured with a Cescorf tape measured to the nearest 0.1 cm (Cescorf, Brazil). In supine position was measured the sagittal abdominal diameter (SAD) with an anthropometer with straight branches Holtain (Holtain, Crymich, Great Britain) to the nearest 0.1 cm. The intraclass correlation coefficient was greater than 0.97 for all measures. Technical error of measurement for anthropometric variables was < 1%. Anthropometric measurements were obtained according to the recommendations of the International Society for Advancement in Kinanthropometry (ISAK)[16].

Abdominal bioelectrical impedance

An abdominal BIA with Tanita AB-140, ViScan® (Tanita, Japan) were performed for measuring trunk fat and visceral fat ratio. With the subject in supine position, on a non-metallic table, was initially measured the waist circumference in the coronal plane and a central point on the omphalion, according to the manufacturer's instructions', by projecting a light. Trunk fat and visceral fat level ratio were obtained after having a belt with four electrodes, focused and willing at the level of the navel. Body composition values were derived by extrapolation of (6.25 to 50 Khz) impedance measures resulting values of trunk fat, expressed in percentage value (range 0-75%) and a level of visceral fat, expressed as visceral fat ratio (in arbitrary numerical units, from 1 to 59).

Diet

The meal of the participants consisted of a bowl of lentils with rice, hake with salad and a pear. The energy content of the meal was of 3495 Kj or 840 Kcal. The average volume of water ingested by subject was 300 ± 247 mL.

Statistical methods

All results are expressed as means ± standard deviation. The homogeneity of the variances of the dependent variables was assessed by means of the Shapiro-Wilk. Normality Test show a normal distribution. The difference between before and after was tested by Student *t*-test, for paired data. Also, found the size effect, calculated from data and is a descriptive statistic that conveys the magnitude of changes. The Cohen coefficient is the index that shows us the ability to show any change (Cohen's *d*)[17,18]. Values of the Cohen's coefficient of 0.2 to 0.3 were considered low, 0.2 to 0.5 medium and a value > 0.8 was a large value[19]. Statistical analyses was performed by using the MedCalc software for Windows version 14.12.0 (Mariakerke, Belgium) and the significance level was previously set at $P < 0.05$.

Results

Table I described the variables studied, which did not show significant differences, after ingestion of the food ($P > 0.05$), except for a significant increase of the maximum waist circumference in standing position ($P < 0.05$). The percentage changes of the measures were less than 2% for waist circumference in standing position, waist circumference by Viscan, sagittal abdominal diameter and trunk fat and 5.9% for visceral fat ratio.

Moreover, the analysis of the effect size, shows that the coefficients *d,* are very low in all tested variables (< 0.20) (Table II).

Discussion

The results of this research show that a food and drink ingestion, do not produce significant changes in anthropometric variables and body composition variables by abdominal bioelectrical impedance. Both, the anthropometric measures and abdominal bioimpedance changes are very small and not significant. There are no works that examined these variations of the ab-

Table I
Anthropometric and abdominal bioelectrical impedance changes after food ingestion

Variable		*Before*	*After*	*P*
Waist circumference	cm	101.71 ± 15.80	102.8 ± 14.96	0.007
Waist circumf. Viscan	cm	100.55 ± 11.84	101.7 ± 12.14	0.170
SAD	cm	23.29 ± 4.73	23.55 ± 5.08	0.258
Trunk fat	%	38.05 ± 8.70	37.3 ± 9.24	0.464
Visceral fat ratio		13.50 ± 5.05	14.35 ± 5.10	0.068

SAD: Sagittal abdominal diameter

Table II
Differences and effect size of anthropometric and abdominal bioelectrical impedance changes after food ingestion

Variable	*Difference*	*SD of differences*	*Cohen's d*
Waist circumference	1.055	1.56	0.068
Waist circumf Viscan	1.15	3.60	0.095
SAD	0.265	1.01	0.054
Trunk fat	-0.75	4.48	-0.083
Visceral fat ratio	0.85	1.96	0.167

Max: maximal; Abd: Abdominal. SAD: Sagittal abdominal diameter. SD: Standard deviation.

dominal BIA after solid meal and beverage ingestion. This study is very important in the context of nursing homes, because the timetables can produce variations in research methodology.

Universally standardized protocols of BIA measurements have to be developed and implemented. The standard recommendations for the use of the BIA are well known and are related to the use of the equipment and the use of electrodes, as well as care available in which to avoid the contact with metals and magnetic fields, the previous measurement of height and weight, as well as compliance with the instructions of the manufacturer[2,20]. These described recommendations, are for the whole body impedance and it is not necessary to enter the weight or height of the individuals in the abdominal BIA.

There are described, variations of the whole body impedance, with supine position[6,9]. The small variation of the abdominal BIA not may have been due to supine position, because the BIA carried out, obtaining the results, not requires hardly more than 100-120 seconds.

An increase in the whole-body resistance (R), produces a decrease of the fat-free mass (FFM) and an increase of fat mass (FM). The decrease R by food and fluids ingestion produces the opposite effect, for greater easily pass of alternating current through the water component[11,21].

The effects of food intake on R, may take several hours, even until there is the night fasting[21]. Changes of bioelectrical impedance with food and beverages may decrease whole body resistance and it is related to changes of different fluids and electrolytes, as well as its distribution, which follow the absorption and digestion of food[11] and in addition the decrease of impedance are greater, in relation to amount of food and beverage intake[21].

The effect of food on the BIA, after an hour, shows decreases of trunk fat and this circumstance, would be in line with the decrease in body resistance. Greater measurement of liquids, a greater assumption of water and fat-free mass and therefore there is a decrease in fat[10,21,22]. Normally, less than 3% fat, changes which would be consistent with the present study[22]. Percentage of anthropometric measures and variations of BIA, in this study, are less than 2%. These changes are considered very low, because the variations between days under the same conditions as the fast, or in the morning and after emptying the bladder, are checked a few minor variations of 3%[10].

It should take into account that the supine or the resting position produces a decrease in the BIA, with an increase in the fat percent. The differences in the fat percentage may reach 10%. Changes in visceral fat level have been 6.3%, albeit with a proven, small size effect and without statistical significance.

The abdominal bioelectrical impedance can measure fat trunk, which is closely related to the total intra-abdominal fat and subcutaneous fat, however the level of visceral fat is related to intra-abdominal fat[13]. The values of abdominal fat measured by BIA have a good concordance with DXA as reference method[23]. Studies of BIA should respect the standardized methodology to optimize the measures. Once again, it seems that the most influential factor in the variation of the values of the BIA is the intake of food and drink and not to the redistribution of liquids determined by orthostatic changes.

Study limitations

The results should be interpreted with caution given the small sample size and it must be studied over one period longer than 2-3 hours after food and drink ingestion.

Conclusions

This study shows that measures of abdominal bioimpedance, does not produce variations in the variables of trunk fat and visceral fat level, so it can be used under the conditions referred to in the study without variations in the outcome variables in the first hour after lunch.

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Referencias

1. Thomasset A. Measurement of the extracellular fluid volume by the electro-chemical method. Biophysical significance of 1 kilocycle impedance onthe human body. *Lyon Med* 1965; 214: 131-143.
2. Alvero-Cruz JR, Correas-Gómez L, Ronconi M F-, Vázquez R P i MJ. Bioelectrical impedance analysis as a method of body composition estimation: a practical approach. *Rev Med Deport* 2011; 4(4): 167-174.
3. Caton JR, Molé PA, Adams WC, Heustis DS. Body composition analysis by bioelectrical impedance: effect of skin temperature. *Med Sci Sports Exerc* 1988; 20(5): 489-491.
4. Gudivaka D. Kushner, R. F. RS. Effect of skin temperature on multifrequency bioelectrical impedance analysis. *J Appl Physiol* 1996; 81(2): 838-845. http://jap.physiology.org/content/81/2/838.abstract.
5. Demura S, Yamaji S, Goshi F NY. The influence of transient change of total body water on relative body fats based on three bioelectrical impedance analyses methods. Comparison between before and after exercise with sweat loss, and after drinking. *J Sport Med Phys Fit* 2002; 42(1): 39-44.
6. Slinde F, Bark A, Jansson J, Rossander-Hulthén L. Bioelectrical impedance variation in healthy subjects during 12 h in the supine position. *Clin Nutr* 2003; 22(2): 153-157. doi:10.1054/clnu.2002.0616.
7. Cáceres DI, Sartor-Messagi M, Rodríguez DA, Escalada F, Gea J, Orozco-Levi M ME. Variability in bioelectrical impedance assessment of body composition depending on measurement conditions: influence of fast and rest. *Nutr Hosp* 2014; 30(6): 1359-1365. doi:10.3305/nh.2014.30.6.7934.
8. Kyle UG, Bosaeus I, De Lorenzo AD, et al. Bioelectrical impedance analysis--part I: review of principles and methods. *Clin Nutr* 2004; 23(5): 1226-1243. doi:10.1016/j.clnu.2004.06.004.
9. Kyle UG, Bosaeus I, De Lorenzo AD, et al. Bioelectrical impedance analysis-part II: utilization in clinical practice. *Clin Nutr* 2004; 23(6): 1430-1453. doi:10.1016/j.clnu.2004.09.012.
10. Deurenberg P, Weststrate JA, Paymans I, van der Kooy K. Factors affecting bioelectrical impedance measurements in humans. *Eur J Clin Nutr* 1988; 42(12): 1017-1022.
11. Gallagher M, Walker KZ, O'Dea K. The influence of a breakfast meal on the assessment of body composition using bioelectrical impedance. *Eur J Clin Nutr* 1998; 52(2): 94-97. doi:10.1038/sj.ejcn.1600520.
12. Zamrazilová H, Hlavatý P, Dusátková L, et al. [A new simple method for estimating trunk and visceral fat by bioelectrical impedance: comparison with magnetic resonance imaging and dual X-ray absorptiometry in Czech adolescents]. *Cas Lek Cesk* 2010; 149(9): 417-422.
13. Thomas EL, Collins AL, McCarthy J, et al. Estimation of abdominal fat compartments by bioelectrical impedance: the validity of the ViScan measurement system in comparison with MRI. *Eur J Clin Nutr* 2010; 64(5): 525-533. doi:10.1038/ejcn.2010.237.
14. Gomez-Huelgas R, Bernal-López MR, Villalobos A, et al. Hypertriglyceridemic waist: an alternative to the metabolic syndrome? Results of the IMAP Study (multidisciplinary intervention in primary care). *Int J Obes (Lond)* 2011; 35(2): 292-299. doi:10.1038/ijo.2010.127.
15. Kuk JL, Katzmarzyk PT, Nichaman MZ, Church TS, Blair SN, Ross R. Visceral fat is an independent predictor of all-cause mortality in men. *Obesity (Silver Spring)* 2006; 14(2): 336-341. doi:10.1038/oby.2006.43.
16. Marfell-Jones M, Olds T, Stewart A CL. *International Standards for Anthropometric Assessment*. Potschefstroom (South Africa): International Society for Advancement in Kinanthropometry (ISAK).; 2006.
17. Norman GR, Wyrwich KW, Patrick DL. The mathematical relationship among different forms of responsiveness coefficients. *Qual Life Res* 2007; 16(5): 815-822. doi:10.1007/s11136-007-9180-x.
18. Husted JA, Cook RJ, Farewell VT, Gladman DD. Methods for assessing responsiveness: a critical review and recommendations. *J Clin Epidemiol* 2000; 53(5): 459-468. doi:10.1016/S0895-4356(99)00206-1.
19. Cohen J. Quantitative Methods in Psychology- A Power Primer. *Psychol Bull* 1992; 112: 155-159. doi:10.1038/141613a0.
20. Assessment NIOHT, Statement C. Bioelectrical impedance analysis in body composition measurement: National Institutes of Health Technology Assessment Conference Statement. *Am J Clin Nutr* 1996; 64(3 Suppl): 524S-532S. http://www.ncbi.nlm.nih.gov/pubmed/8780375.
21. Slinde F, Rossander-Hulthén L. Bioelectrical impedance: Effect of 3 identical meals on diurnal impedance variation and calculation of body composition. *Am J Clin Nutr* 2001; 74(4): 474-478.
22. Kushner RF, Gudivaka R, Schoeller DA. Clinical characteristics influencing bioelectrical impedance analysis measurements. *Am J Clin Nutr* 1996; 64(3 Suppl): 423S-427S.
23. Manios Y, Kanellakis S, Moschonis G, Pipidis I, Skoufas E Z V. Estimation of abdominal fat mass: validity of abdominal bioelectrical impedance analysis and a new model based on anthropometry compared with dual-energy x-ray absorptiometry. *Menopause* 2013; 20(12): 1280-1283.