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Original Research

Estimates of Agreement Between Three Low-cost and One High-cost Bioelectrical Impedance Analyzers using Classical and Contemporary Dancers

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ABSTRACT

International Journal of Exercise Science 16(4): 353-363, 2023. The aim of this study was to determine the concordance between the estimates of three low-cost and one high-cost electrical bioimpedance equipment (BIA) in classical and contemporary dancers. Participation in the study included 28 subjects (15 men and 13 women) 18 to 35 years old, who perform classical and/or modern dance, thrice weekly, from 60 to 120 min per session, for 10 years or more. Those who presented any disease, consumed drugs, supplements or multivitamins; had prostheses, surgical metal parts or pacemakers, had problems maintaining the correct anatomical positions for taking measurements, and pregnant women were excluded. Their body composition was determined with 3 low-cost BIA equipment (OMRON HBF-306C, SKULPT CHISEL and BEURER BF 1000) and one high-cost equipment (SECA mBCA 515). The results indicated that in men, SKULTP in its "complete" modality had the highest agreement with SECA (CCC=0.73, 95% CI=0.46-0.88) for body fat percentage (%BF); in women, OMRON in its "normal" modality had the highest agreement with SECA (CCC=0.85, 95% CI=0.62-0.94) for %BF; while BEURER had poor concordances (CCC=0.86-0.03) for the rest of the estimates in its different modalities, in both sexes. It is concluded that the lower cost equipment (SKULPT and OMRON) were the most consistent with SECA for %BF in normal weight dancers. BEURER had the lowest agreements with SECA, in all its modalities, as well as inconsistent estimates for all parameters. Therefore, there was no relationship between the cost of the low-cost impedance equipment and its agreement with those of a high-cost one.

KEY WORDS: Body composition, bioimpedance equipment, concordance, dancers

INTRODUCTION

Bioelectrical impedance (BIA) is a simple, fast and non-invasive method that allows estimating body composition. Compared to other indirect methods such as Computerized Axial Tomography (CAT), Nuclear Magnetic Resonance (NMR), Air Displacement

Plethysmography (BOD POD) and Dual X-Ray Absorption (DXA), it is a lower cost and more accessible method for using in daily clinical practice (8,14).

BIA bases its principle on the fact that different body tissues exhibit differences in electrical conductivity, measuring the impedance to a small undetectable electrical current that is applied as it passes through the body. Fat mass, due to its lower content of water and electrolytes, does not have good conductivity, so the impedance is directly proportional to the amount of body fat (5).

Currently, there are numerous commercially available equipment that can vary in the number and type of electrodes, number of frequencies and in the proprietary equation with which they make their estimates, which can explain the differences between them (5,14). The SECA mBCA 515 (seca, Hamburg, Germany) unit is among the highest cost BIA equipment (>$10,000 USD) today. It has been shown to have validity and accuracy compared to other two-compartment reference methods (DEXA, BOD POD, deuterium and bromide dilution), when estimating body composition in euvolemic adults (3). For its part, a higher concordance between the SKULPT CHISEL (Skulpt, Inc., San Francisco, California) and DXA equipment has been reported, for the percentage of body fat (%BF), than compared with other higher cost BIA equipment (18). Furthermore, its estimation of muscle quality has had moderate correlations with other BIA equipment (13) and significant differences in their hydrostatic weight (HW) determinations (22). OMRON (omron, Kyoto, Japan) hand-hand BIA equipment have been shown to underestimate %BF and overestimate fat-free mass (FFM) when compared to DXA; however, high concordances and correlations have been reported with high-cost BIA (6,11). On the other hand, there are no studies that compare the HBF-306C single-frequency bipolar equipment with any reference method or other high precision BIA equipment. The BEURER (beurer GmbH, Uttenweiler, Germany) has compared some of its instruments with DXA, finding differences in the mean values of %BF, with high correlations and tendency to underestimate them (21). Among its different equipment is the BF 1000 analyzer, which is promoted as a high precision equipment despite not having validation studies.

For its part, dance is a demanding and vigorous performance sport that requires a high level of strength, endurance, and flexibility. This aesthetic sport places a strong emphasis on lean body composition, however this may vary depending upon the style of dance (4).

It is because of the above, that we consider it necessary to know the concordance between the estimates of different commercially available BIA equipment. Therefore, the objective of this study is to determine the concordance between the estimates of three low-cost BIA analyzers (SKULPT CHISEL, OMRON HBF-306 and BEURER BF 1000, <$500 USD) and a high-cost

and high precision equipment (SECA mBCA 515) in dancers of classical and contemporary dance.

METHODS

Participants

An observational, cross-sectional concordance design and a non-probabilistic sampling for convenience was used. The sample size was not determined prior to the study because there are no reliable records on the total population of dancers.

Men and women, between 18 and 35 years old, who performed classical and/or modern dance three times or more per week, for 60 to 120 minutes per session, for 10 years or more were included. Those who presented some disease, consumed drugs, supplements or multivitamins; had prostheses, surgical metal parts or pacemakers, had problems maintaining the correct anatomical positions for taking measurements, and pregnant women were excluded. Likewise, subjects who became infected with COVID-19 were eligible if the infection had occurred more than a month ago, were asymptomatic or had mild symptoms, and had no sequelae. The invitation to participate in the study was made by phone calls with the help of the dance academies teachers.

All participants had their body temperature and oxygen saturation measured on admission to the clinic, before the measurements with the BIA equipment; those with less than 37°C and more than 95% sO2 were included.

Protocol

The measurements were made in the morning, with study subjects fasting, wearing light clothing, and complying with the recommendations for the correct application of the BIA according to the manufacturer's instructions (1). They were instructed not to consume caffeine and alcoholic beverages, as well as not to engage in physical exercise the day before the measurements.

Height was determined for all participants with a SECA model 274 digital stadiometer (measuring range of 30 – 220 cm and precision of 1 mm); the total body weight was taken from the estimates recorded by the SECA model mBCA 515 equipment (measuring range of 0 – 300 kg and precision of 50 g); and waist circumference (WC) was measured with a LUFKIN model W606PM metallic tape (measuring range of 0 – 200 cm and precision of 1 mm). All measurements were made in accordance with the International Standards for Anthropometric Assessment (17) by trained personnel.

With the SECA mBCA 515 equipment estimates of the percentages of body fat (%BF), lean mass (%LM), muscle mass (%MM), total body water (%TBW) and extracellular water (%ECW) were obtained; in addition, the level of visceral fat (VF) and the segmental %MM (trunk, arms and legs) were determined.

The BEURER Bf1000 analyzer (measuring range of 0 – 200 kg and precision of 50 g) wasused, with its five fitness levels (none, low, medium, high, very high) to obtain the %BF, %MM, %TBW and VF.

Also, the SKULPT CHISEL equipment was used in the "full" mode (requires 12 body measurements: forearm, biceps, triceps, shoulder, chest, upper and lower back, abdomen, buttocks, quads, hamstrings, and calf) on the right and left of body; and in the "fast" mode, which requires three measurements (triceps, abdomen and quadriceps) on the right sideof the body, obtaining the %BF.

Likewise, the OMRON HBF-306C analyzer (measuring range of 10 - 200 kg) was used, inthe "normal" mode and "athlete" mode, for the estimation of %BF.

The protocols and prevention measures against COVID 19 were followed before, during and after the procedures (20). Evaluators and participants wore medical masks throughout their stay in the clinic.

This study was reviewed and previously approved by the Investigators Committee of the Universidad Modelo and carried out at the Wellmedic Center Clinic, in Yucatan, Mexico. The subjects included in this study read and signed an informed consent form, which specified the objective of the research, as well as the advantages (known their body composition) and disadvantages (wear little clothing and shave some parts of the body if required) of participating. The study complied with the ethical guidelines of the Declaration of Helsinki and the ethical policies set by the Editorial Board (19).

Statistical Analysis

For the statistical analysis, the software SPSS version 25.0 and MedCalc version 18.2.1 were used. The Shapiro-Wilks test was used as a test for normality; from general characteristics of the population, means and standard deviations were used. The Student's t-test for independent samples and the Mann-Whitney test were used to compare the mean values of the parametric and non-parametric variables, respectively between men and women. A value of $p < 0.05$ was considered significant.

To know the concordance between the measurements of the equipment, using the author's cutoff points (<0.90 poor, 0.90-0.95 moderate, 0.95-0.99 substantial, >0.99 almost perfect) and establishing the intervals confidence at 95% (15) the Lin concordance correlation coefficient, was used. Bland-Altman were used to determine the degree of overestimation or underestimation between the measurements with the highest concordance, with their 95% confidence intervals.

RESULTS

A total of 28 subjects were evaluated, 15 (53.6%) men and 13 (46.4%) women. According to the estimates of the SECA mBCA 515 equipment, it was found that all the variables presented

a normal distribution except for the %MM, %MM of the left arm and the VF. Significant differences ($p<0.05$) were observed between men and women for weight, height, %BF, WC, %LM, %MM, %MM trunk, %MM left and right leg, %TBW and VF (see table 1).

Table 1. General characteristics of the total population and comparison by sex.

Variables	Total n=28 x̄ (SD)	Men n=15 x̄ (SD)	Women n=13 x̄ (SD)	Value p
Age (años)	24.9 (4.8)	25.5 (5)	24.3 (4.5)	0.507
Weight (kg)	58.2 (11.2)	63.8 (7.7)*	51.8 (11.5)	0.003
Height (cm)	162.9 (8.4)	167.9 (6.9)*	157.1 (5.9)	0.001
BMI (kg/m²)	22.1 (2.6)	22.6 (2.4)	21.5 (2.8)	0.276
Waist Circumference (cm)	72.4 (7.4)	76.2 (5.7)*	68 (6.9)	0.002
Body Fat (%)	20.6 (7.5)	16.3 (6.3)	25.5 (5.7)‡	0.001
Lean Mass (%)	79.4 (7.5)	83.6 (6.3)*	74.5 (5.7)	0.001
Muscular Mass (%)	37.5 (6.9)	40.3 (2.7)*	34.2 (8.7)	0.001
MM Right Arm (%)	5.9 (0.4)	6.1 (0.3)	5.9 (0.4)	0.189
MM Left Arm (%)	5.8 (0.4)	5.9 (0.3)	5.7 (0.4)	0.167
MM Trunk (%)	43.8 (3.3)	46.4 (1.6)*	40.9 (2)	0.001
MMu Right Leg (%)	22.3 (1.7)	20.9 (0.7)	23.8 (1.1)‡	0.001
MMu Left Leg (%)	22.1 (1.8)	20.7 (0.8)	23.8 (1.1)‡	0.001
Total Body Water (%)	57.1 (5.1)	60.1 (4.2)*	53.7 (3.7)	0.001
Extracelular Water (%)	23.2 (1.7)	23.3 (1.7)	23.1 (1.8)	0.707
Visceral Fat (index)	0.4 (0.4)	0.6 (0.5)*	0.2 (0.2)	0.041

BMI=Body Mass Index, MM=Muscular Mass. Student's t-test for independent samples and Mann- Whitney test, significant p <0.05. *Significantly greater than women, ‡significantly greater than men.

Table 2. Concordance between the estimates of the different low-cost BIA analyzers with the Seca mBCA 515 analyzer in the total population.

EQUIPMENT OF BIA	%BF CCC (95% CI)	%MM CCC (95% CI)	%TBW CCC (95% CI)	VF CCC (95% CI)
Beurer mode 1	0.80 (0.62-0.90)	0.20 (0.05-0.35)	0.67 (0.48-0.80)	0.35 (-0.01-0.62)
Beurer mode 2	0.81 (0.63-0.91)	**0.34 (0.10-0.54)**	0.84 (0.70-0.92)	**0.38 (0.23-0.51)**
Beurer mode 3	**0.82 (0.66-0.91)**	0.33 (0.11-0.53)	**0.85 (0.71-0.92)**	**0.38 (0.23-0.51)**
Beurer mode 4	0.75 (0.56-0.87)	0.22 (0.05-0.38)	0.61 (0.43-0.75)	0.37 (0.22-0.51)
Beurer mode 5	0.64 (0.44-0.78)	0.06 (-0.06-0.17)	0.68 (0.50-0.80)	0.37 (0.22-0.51)
Skulpt full mode	0.80 (0.64-0.89)	-	-	-
Skulpt fast mode	0.76 (0.58-0.87)	-	-	-
Omron normal mode	0.73 (0.52-0.86)	-	-	-
Omron athlete mode	0.69 (0.46-0.83)	-	-	-

%BF=Body Fat Percentage, %MM=Muscle Mass Percentage, %TBW=Total Body Water Percentage, VF=Visceral Fat. CCC=Lin's Concordance Correlation Coefficient, CI=Confidence Interval at 95%. Interpretation of the result of CCC: <0.90 poor, 0.90-0.95 moderate, 0.95-0.99 substantial, >0.99 almost perfect.

All low-cost equipment had poor agreement (CCC<0.90) with SECA mBCA 515, for all estimates. In the total population, BEURER Bf1000 in mode 3 (medium fitness level), had the highest agreement for %BF (CCC=0.82; 95% CI=0.66, 0.91). For %MM, modality 2 (low fitness level) presented the highest agreement (CCC=0.34; 95% CI=0.10, 0.54). For %TBW, modality 3

was the most concordant (CCC=0.85; 95% CI=0.71, 0.92). While for VF, modalities 2 and 3 had the highest concordance (both CCC=0.23; 95% CI=0.23, 0.51) (see table 2).

Table 3. Concordance between the estimates of the different low-cost BIA analyzers with the Seca mBCA 515 analyzer in men.

BIA EQUIPMENT	%BF CCC (95% CI)	%MM CCC (95% CI)	%TBW CCC (95% CI)	VF CCC (95% CI)
Beurer mode 1	0.59 (0.19-0.82)	0.05 (-0.04-0.14)	0.44 (0.12-0.67)	0.24 (-0.25-0.63)
Beurer mode 2	0.62 (0.25-0.83)	0.22 (-0.11-0.50)	0.66 (0.29-0.86)	**0.31 (0.10-0.49)**
Beurer mode 3	0.62 (0.29-0.82)	**0.35 (-0.11-0.69)**	**0.74 (0.42-0.89)**	0.30 (0.09-0.49)
Beurer mode 4	0.53 (0.22-0.74)	0.11(-0.05-0.27)	0.50 (0.19-0.71)	0.29 (0.08-0.48)
Beurer mode 5	0.41 (0.13-0.63)	0.06 (-0.02-0.12)	0.56 (0.24-0.78)	0.30 (0.09-0.48)
Skulpt full mode	**0.73 (0.46-0.88)**	-	-	-
Skulpt fast mode	0.66 (0.36-0.84)	-	-	-
Omron normal mode	0.33 (-0.17-0.69)	-	-	-
Omron athlete mode	0.18 (-0.26-0.56)	-	-	-

%BF=Body Fat Percentage, %MM=Muscle Mass Percentage, %TBW=Total Body Water Percentage, VF=Visceral Fat. CCC=Lin's Concordance Correlation Coefficient, CI=Confidence Interval at 95%. Interpretation of the result of CCC: <0.90 poor, 0.90-0.95 moderate, 0.95-0.99 substantial, >0.99 almost perfect.

Table 4. Concordance between the estimates of the different low-cost BIA analyzers with the Seca mBCA 515 analyzer in women.

EQUIPMENT BIA	%BF CCC (95% CI)	%MM CCC (95% CI)	%TBW CCC (95% CI)	VF CCC (95% CI)
Beurer mode 1	0.70 (0.33-0.88)	0.18 (-0.06-0.40)	0.68 (0.37-0.85)	0.52 (0.25-0.82)
Beurer mode 2	0.66 (0.23-0.87)	**0.20 (-0.11-0.48)**	**0.86 (0.61-0.95)**	**0.54 (0.28-0.72)**
Beurer mode 3	0.73 (0.33-0.91)	0.19 (-0.09-0.45)	0.78 (0.48-0.91)	**0.54 (0.28-0.72)**
Beurer mode 4	0.61 (0.17-0.84)	0.14 (-0.08-0.36)	0.45 (0.18-0.66)	**0.54 (0.28-0.72)**
Beurer mode 5	0.47 (0.13-0.71)	-0.06 (-0.22-0.11)	0.53 (0.23-0.73)	**0.54 (0.28-0.72)**
Skulpt full mode	0.64 (0.29-0.84)	-	-	-
Skulpt fast mode	0.71 (0.34-0.89)	-	-	-
Omron normal mode	**0.85 (0.62-0.94)**	-	-	-
Omron athlete mode	0.75 (0.47-0.89)	-	-	-

%BF=Body Fat Percentage, %MM=Muscle Mass Percentage, %TBW=Total Body Water Percentage, VF=Visceral Fat. CCC=Lin's Concordance Correlation Coefficient, CI=Confidence Interval at 95%. Interpretation of the result of CCC: <0.90 poor, 0.90-0.95 moderate, 0.95-0.99 substantial, >0.99 almost perfect.

In women, OMRON HBF-306C, in "normal" mode, had the highest concordance with SECA for %BF (CCC=0.85; 95% CI=0.62, 0.94; difference between means=0.0%; 95% CI=- 5.5, 5.5%). For its part, BEURER, in modality 2, had the highest concordance for %MM (CCC=0.20; 95% CI=-0.11, 0.48) and %TBW (CCC=0.86; 95% CI=0.61, 0.95), observing a trend to overestimation (difference between means=-0.2%; 95% CI=-16.3, 15.9%) and underestimation (difference between means=0.7%; 95% CI=-3.0, 4.4%), of respective manner. In addition, modalities 2-5 were the most concordant for VF (all CCC=0.54; 95% CI=0.28, 0.72), observing underestimation in the measurements (difference between means=0.7%; 95% CI=-2.6, 3.9%) (see table 4).

DISCUSSION

In this work, the SECA mBCA 515 analyzer was used as a reference instrument, which isa BIA equipment that has 8 electrodes (i.e., octopolar: four that are held with the hands and four that have contact with the soles of the feet) and uses 20 frequencies (1-1000kHz), allowing the measurements of different body tissues. Although BIA is a doubly indirect method, SECA mBCA 515 has shown good agreement with more precise techniques to assess body composition (2,3). A study, financed by the brand, reported in a multiethnic sample of healthy euvolemic subjects, with a BMI of 18.7-34.4 kg/m2, a high concordance between this equipment, the four compartment model and other two compartment techniques (BOD POD, DEXA, deuterium dilution and sodium bromide), for the estimation of FM, FFM, TBW and ECW (differences between means=-0.5, 1.5kg); being higher in the Hispanic population (difference between means=-0.3, 0.4kg) (2).

These results are similar to those reported by Day et al. (10) in subjects with 18 to 65 years, in whom they found a good concordance with DXA for FM (CCC=0.99; difference between means=0.320kg; 95% IC=-3.8, 4.4kg) and FFM (CCC=0.94; difference between means=-1.9kg; 95% CI=-8.2, 4.3kg), but poor concordance for VF (CCC=-0.02). This may be because more than 70% of the population was Caucasian and there were men with grade III obesity; meanwhile, the study financed by the SECA brand included only subjects with normal weight, overweight and grade I obesity; furthermore, DXA is not considered the reference standard for VF measurement.(12) In relation to the above, Bosy et al., (2) found in a multiethnic population, similar mean values for total MM (difference between means=0.3, 1.7 kg), appendicular MM (difference between means=-0.03, 1.94kg) and VF (difference between means=-0.1, 0.1 index) between SECA mBCA 515 and the NMR; Hispanics being the ones who had the lowest concordance, which can be explained by the higher BMI and WC they presented. The sample with which we worked was made up of Hispanics, normal weight, healthy, with a WC within normal values; in which there seems to be a good concordance between the SECA team and indirect methods of higher cost.

In addition, when comparing the low-cost devices with the SECA, it was shown that in men, SKULPT CHISEL in its complete modality had the highest concordance for %BF (CCC=0.73; CI 95%=0.46, 0.88%), with a tendency to overestimate (difference between means=-3.8%; 95% CI=-9.2, 1.7%). This equipment is the size of a mobile phone, has 12 sensors on the back, which are in direct contact with the skin of the subject and which implements Electrical Impedance Myography (EIM) for its estimates. EIM is a type of localized BIA analysis that quantifies the passive electrical behavior of the muscle, providing data on muscle health and %BF (7). It has been compared with indirect and doubly indirect techniques, finding different results. McLester et al., (18) found no significant differences in the mean values of %BF between SKULPT in its two modalities, with DXA, in a sample of normal weight and overweight subjects; in addition, it showed very similar concordance to that observed between another high-cost multifrequency hand-foot BIA analyzer (InBody 770) and DXA (difference between means=-0.10%; 95% CI=-6.48, 6.28% vs -0.12%; 95% CI=-2.78, 8.56%); however, subjects with less than 18 years were

included in their sample, and concordance analysis by sex was not performed. For their part, Wells et al., (22) compared this equipment with the HW in subjects between 20 and 24 years, reporting lower concordances for %BF (difference between means=-3.38%; 95% CI=0.92, 5.84%), making no distinction between men and women. In a previous study, this instrument was compared with the InBody 120 multifrequency hand-foot analyzer, in a sample of adolescent combat athletes (12-17 years old), finding poor concordances (CCC=0.88, CI 95%=0.75, 0.94) but with small differences for %BF (mean difference=-0.9%; CI 95%=-6.9, 5.1%), also observing a tendency to overestimate; however, due to the size of the sample, an analysis by sex could not be performed (13). Although, the measurements between SKULPT CHISEL and other higher precision BIA equipment are not interchangeable, a reported mean difference of between 0.1-3.8% for %BF, in men with characteristics like ours, seems to be acceptable for a device with a price less than $150 USD.

In women, OMRON HBF 306C in the "normal" mode had the highest concordance with SECA for %BF (CCC=0.85; 95% CI=0.62, 0.94) with no tendency to over or underestimate (difference between means=0.0%, 95% CI=-5.5, 5.5%). This equipment is a bipolar BIA analyzer (hand-hand electrodes), monofrequency (50kHz), capable of carrying out assessments of %BF and %FFM (indirectly), without making distinctions between the different compartments that constitute the latter. Esco et al., (11) compared an OMRON hand-hand analyzer (model HBF 300) with DXA, in a sample of normal weight college athletes, between 18-27 years, observing an underestimation for %BF (difference between means=-5.11% , 95% CI=-6.26, 3.95%) and an overestimation for FFM (difference between means=3.39kg, 95% CI=2.58, 4.21 kg).

Carrión et al., (6) used a hand-hand BIA very similar to ours (OMRON model HBF 306 INT) and compared their estimates with those of an InBody 770, in a population of athletes with 18-52 years and a BMI of 18.32-35.69. kg/m2; observing poor concordance (CCC=0.89) for %BF in the total population, being lower in women (CCC=0.80 vs 0.68); also, a greater underestimation than that reported by us (difference between means=- 3.9%; 95% CI=-8.9, 1.1%), which may be because adolescents were included in their study. Interestingly, the "athlete modality" was the second most concordant with SECA, for %BF (CCC=0.75; 95% CI=0.47, 0.89%). OMRON classifies people as "normal" or "athletes", according to an index determined by the frequency (days per week), intensity and duration (minutes per day) of physical activities performed. The population was made up of subjects with an index greater than 60, for what that can be considered as athletes. In the case of men, the OMRON equipment had the lowest concordances with the SECA analyzer for %BF (CCC=0.33, 95% CI=-0.17, 0.69% "normal" mode; CCC=0.18, 95% CI=- 0.26, 0.56%, "athlete" mode). This can be explained, to a certain extent, because the hand- hand BIA equipment only assess the body composition of the upper part of the body, assuming a homogeneous distribution of FM and FFM throughout the body; being relevant in the male athletes of this study, who presented almost 60% of the MM in the trunk and arms (9,16). Like SKULPT, OMRON HBF 306C appears to be a device that performs %BF assessments in women, with characteristics similar to the population in this study, close to those of higher precision BIA equipment; furthermore, this is again relevant considering that it was the lowest cost equipment used (less than $60 USD).

Finally, the BEURER BF1000 was the low-cost analyzer with the highest price point (approximately $415 USD). This equipment has 8 electrodes (octopolar: two for the hands and two for the feet), capable of assessing different body compartments; however, the type and number of frequencies implemented for its estimates are not specified. It has 5 different modalities according to the level of physical fitness, being determined by the intensity, duration and frequency of the physical activities that are carried out. According to the above, the sample consisted of subjects with a physical fitness level of 5 (very high: intensive physical exercises, intensive training or exhausting body work, daily, at least 1 hour a day). Interestingly, in this modality the lowest concordances were presented for the %BF (CCC=0.41, 95% CI=0.13, 0.63%; CCC=0.47, 95% CI=0.13, 0.71%; in men and women, respectively) and for the most other compartments (%MM, %TBW and VF) with SECA. In fact, the modalities corresponding to a low-medium fitness level presented the highest concordance with the SECA team, both in men and women, not being consistent with the characteristics of the evaluated population.

Our findings can help sports professionals make more objective investments when buying a body composition analyzer. Many companies claim that their BIA equipment produces accurate and reliable results, however, they lack empirical evidence to back up these claims.

In addition, the importance of acquiring BIA equipment that has been designed and validated, based on populations similar to those we assess in daily clinical practice, in order to make more reliable diagnoses and more timely treatments, is highlighted. Likewise, it reminds us of the errors and limitations that BIA equipment can present, allowing a more objective interpretation of the data that they present to us.

Our results are limited by the type of subjects (classical and modern dancers) included in the sample, so our conclusions cannot be extrapolated to populations with different ages, physical conditions and/or sports disciplines. Furthermore, the COVID-19 pandemic was constantly changing the number of eligible subjects, so the study was underpowered.

Of the three low-cost analyzers, SKULTP CHISEL and OMRON HBF 306 showed the highest concordance with SECA mBCA 515 for %BF. Likewise, the BEURER BF 1000 equipment, with the fitness level corresponding to that of our population, presented the lowest agreements for all estimates. These data suggest that there is no direct correlation between the price of low-cost BIA equipment and its concordance with estimates of high- precision BIA equipment.

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