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Science in body composition

AKERN'S TECHNOLOGY CITATION FORM

Recipients	All researchers and clinical users who publish or cite in peer-reviewed journals		
Purpose	How Akern's technologies should be cited to avoid misinformation or mis belonging/ownership of the application of bioimpedance.		
Revision status	3	**Issue date**	22/02/2023

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Device model	Life cycle	How to cite the technology in the materials and methods paragraph	Technology (current, frequency, resolution, CV%)
BIA 101	1998 Up to 2009	Whole body bioimpedance (BIA 101 AKERN, Florence, Italy) was performed using an alternating sinusoidal electric current of 800 microampere at an operating frequency of 50 kHz. The device was calibrated every morning using the standard control circuit supplied by the manufacturer with a known impedance [resistance (R) = 380 ohm; reactance (Xc) = 47 ohm. The accuracy of the device was 1% for R and 2% for Xc. For the BI measurement, each participant was supine with limbs slightly spread apart from the body. Disposable tab electrodes (Biatrodes™ Akern Srl; Florence, Italy) were placed on the right side at metacarpal and metatarsal sites of the right wrist and ankle [a].	800 µA current at 50 kHz (+-2%), resolution Rz: ±1%, Xc: ±2%, CV% <3,5%
BIA 101 New Edition	2010 Up to 2019	Whole body bioimpedance (BIA 101 new edition AKERN, Florence, Italy) was performed using an alternating sinusoidal electric current of 400 microampere at an operating frequency of 50 kHz. The device was calibrated every morning using the standard control circuit supplied by the manufacturer with a known impedance [resistance (R) = 380 ohm; reactance (Xc) = 47 ohm. The accuracy of the device was 1% for R and 2% for Xc. For the BI measurement, each participant was supine with limbs slightly spread apart from the body. Disposable tab electrodes (BIATRODES Akern Srl; Florence, Italy) were placed on the right side at metacarpal and metatarsal sites of the right wrist and ankle [a].	400 µA current at 50 kHz (+-1%), resolution Rz: ±1%, Xc: ±2%, CV% <2,8%
BIA 101 BIVA®	2019 up to 10/2020	Whole body bioimpedance (BIA 101 BIVA® AKERN, Florence, Italy) was performed by a phase sensitive device working with alternating sinusoidal electric current of 250 microampere at an operating frequency of 50 kHz (±1%). The device was calibrated every morning using the standard control circuit supplied by the manufacturer with a known impedance [resistance (R) = 380 ohm; reactance (Xc) = 42 ohm. The accuracy of the device was 0.1% for R and 0.1% for Xc. For the BI measurement, each participant was supine with limbs slightly spread apart from the body. Very low intrinsic	250 µA current at 50 kHz (+-1%), resolution Rz: ±1%, Xc: ±1%, CV% <1%

		impedance (<30 ohm) disposable electrodes (BIATRODES Akern Srl; Florence, Italy) were placed on the right side at metacarpal and metatarsal sites of the right wrist and ankle [a].	
BIA 101 BIVA® PRO	01/2021 – Today	**Whole body configuration:** Bioimpedance analysis was performed by a phase sensitive device (BIA 101 BIVA® PRO AKERN srl, Florence, Italy) working with alternating sinusoidal electric current of 245 microampere at an operating frequency of 50 kHz (±1%). The device was calibrated every morning using the standard control circuit supplied by the manufacturer with a known impedance [resistance (R) = 380 ohm; reactance (Xc) = 45 ohm. The accuracy of the device was 0.1% for R and 0.1% for Xc. For the BI measurement, each participant was supine with limbs slightly spread apart from the body. Very low intrinsic impedance (<30 ohm) disposable electrodes (Biatrodes™ Akern Srl; Florence, Italy) were placed on the right side at metacarpal and metatarsal sites of the right wrist and ankle [a]. **Regional configuration:** Bioimpedance analysis was performed by a phase sensitive device (BIA 101 BIVA PRO® AKERN srl, Florence, Italy) working with alternating sinusoidal electric current of 245 microampere at an operating frequency of 50 kHz (±1%). The device was calibrated every morning using the standard control circuit supplied by the manufacturer with a known impedance [resistance (R) = 345 ohm; reactance (Xc) = 32 ohm for left sensing channel and resistance (R) = 380 ohm; reactance (Xc) = 45 ohm for the right sensing channel . The resolution of the device was 0.1 Ω for Rz and 0.1 Ω for Xc in the full range of measurements For the regional bioimpedance measurement, each participant was supine with limbs slightly spread apart from the body. Very low intrinsic impedance (<30 ohm) disposable electrodes (BIATRODES™ Akern Srl; Florence, Italy) were placed on both side of the body at metacarpal and metatarsal sites of the right and left wrists and ankles [c].	250 µA RMS current at 50 kHz (±1%), Accuracy : Rz: ±0.1,Ω Xc: ±0.1 Ω CV% <1%
NUTRILAB™	2014–Today	Bioelectrical impedance was measured with a phase-sensitive touch screen impedance device (Nutrilab™, Akern, Florence, Italy), working with alternating sinusoidal electric current of 245 microampere at an operating frequency of 50 kHz (±1%). The device was calibrated every morning using the standard control circuit supplied by the manufacturer with a known impedance resistance (R) = 380 ohm; reactance (Xc) = 45 ohm	Serial number 2014–2019 : 425 µA current at 50 kHz (+–0.1%), resolution Rz: ±0.1%, Xc: ±0.1%, CV% <2%

		Impedance data are shown directly in a LCD touchscreen and stored into an internal memory. The CV% was evaluated in this cohort: the mean coefficients of variation for both parameters were <1 % intra-patient and <1% inter-operator.	Serial number > 2019 : 230 µA RMS current at 50 kHz (±1%), Accuracy: Rz: ±0.1Ω Xc: ±0.1 Ω CV% <1%
BIA 101 Anniversary	2010-2020	Whole-body impedance (BIA 101 Anniversary, Akern, Florence, Italy) is generated in soft tissues to oppose the flow of an injected alternate current and is measured from skin Ag/AgCl electrodes placed at fixed-distance (5 cm) on the hands and feet. The device generates an alternating sinusoidal electric current of 400 microamperes at an operating single frequency of 50 kHz (±0.1%). Resistance (R, Ω) is the opposition to the flow of an injected alternating current through intra and extracellular ionic solutions, while reactance (Xc, Ω) is the dielectric or capacitive component of cell membranes and organelles, and tissue interfaces.	425 µA current at 50 kHz (+-0.1%), resolution Rz: ±0.1%, Xc: ±0.1%, CV% <2%
CARDIO EFG - RENAL EFG	2009 - 2018	Bioimpedance vector analysis using tetrapolar impedance plethysmography that emitted 50 kHz alternating sinusoidal current (CardioEFG, Akern, Florence, Italy) of 400 microamperes. Resistance (R, Ω) is the opposition to the flow of an injected alternating current through intra and extracellular ionic solutions, while reactance (Xc, Ω) is the dielectric or capacitive component of cell membranes and organelles, and tissue interfaces. Data are shown directly in a LCD touchscreen and stored into a internal memory. The CV% was evaluated in (_) patients: the mean coefficients of variation for both parameters were 0.5% intra-patient and 1.6% inter-operator. Disposable proprietary low impedance electrodes (BIVATRODES Akern Srl; Florence, Italy) were placed on the right side at metacarpal and metatarsal sites of the right wrist and ankle [a].	400 µA current at 50 kHz (+-1%), resolution Rz: ±0.1%, Xc: ±0.1%, CV% <2%
EFG v.3	2005-2010	Whole-body impedance data were obtained using a tetrapolar impedance plethysmography (EFG V.3 Akern, Florence, Italy). The bioelectrical parameters of resistance and reactance were measured using an electric alternating current flux of 400 amperes and an operating frequency of 50 kHz. Whole-body impedance measurements were taken according to the standard protocol of Lukaski et al [a]	400 µA current at 50 kHz (+-2%), resolution Rz: ±1%, Xc: ±1%, CV% <2%
BIATRODES™	1998-present	Two pair of adhesive Ag/AgCl low impedance electrode (Biatrodes™, Akern Srl; Florence, Italy) were placed proximal to the phalangeal–metacarpal joint on the dorsal surface of the right hand and distal to the transverse arch on the superior surface of the right foot. Sensor electrodes were	

		placed at the midpoint between the distal prominence of the radius and ulna of the right wrist, and between the medial and lateral malleoli of the right ankle at a fixed distance of 5 cm each other.	
BIVATRODES™	2012-present	Two set adhesive Ag/AgCl low impedance electrode (Bivatrodes™ Akern Srl; Florence, Italy), designed for accurate and sensitive bioimpedance measurements were placed proximal to the phalangeal–metacarpal joint on the dorsal surface of the right hand and distal to the transverse arch on the superior surface of the right foot. Sensor electrodes were placed at the midpoint between the distal prominence of the radius and ulna of the right wrist, and between the medial and lateral malleoli of the right ankle.	
Bodygram 1.31	1998	Discontinued	na
Bodygram PRO	2008	Discontinued	
Bodygram® plus	2014	Discontinued	
Bodygram® dashboard	2020-today	Cloud based software for body composition components estimation and graphical representation of the parameters	
Bodygram® dashboard	2021-today	Stand alone , multi user , GDPR compliant software for body composition components estimation and graphical representation of the parameters	

MATERIALS and METHODS: sample paragraph

The impedance measurements were performed with a phase sensitive single frequency analyzer (MODEL (), Akern srl, Italy), which applies an alternating current of (___) μA at the frequency of 50 kHz. Measurements were made using tetrapolar configuration as described by Lukaski (1986) [a].
The subjects were in the supine position with a leg opening of 45° compared to the median line of the body and the upper limbs positioned 30° away from the trunk. After cleansing the skin with isopropyl alcohol, two Ag/AgCl very low-impedance electrodes (Biatrodes, Akern Srl, Florence, Italy) were placed on the back of the right hand and two electrodes on the corresponding foot, with a distance of 5 cm between each other [b]
To avoid disturbances in fluid distribution, subject was instructed to abstain from food and drink for >2h before the test. [c]

[a] Lukaski, Henry C., et al. "Validation of tetrapolar bioelectrical impedance method to assess human body composition." *Journal of applied physiology* 60.4 (1986): 1327-1332.

[b] Dunbar, Christopher C., et al. "Effects of small errors in electrode placement on body composition assessment by bioelectrical impedance." *Research quarterly for exercise and sport* 65.3 (1994): 291-294.

[c] Campa, F., et al. "Association of Regional Bioelectrical Phase Angle with Physical Performance: a Pilot Study in Elite Rowers." *Muscles, Ligaments and Tendons Journal* 11.3 (2021).