

Step	Timing	Action / procedure	Operational implementation criterion
1	Before starting the measurement session	Verify BIA device function.	Inspect the analyzer, cables, connections, and measurement system according to the manufacturer's specifications. The device must pass the corresponding functional verification/calibration procedure before measurements begin.
2	24 h before	Send preparation instructions to the participant.	Ensure that the participant is informed in advance about the pre-measurement conditions and can report any non-compliance.
3	≥3 h before	Avoid large or heavy meals.	Perform the measurement at least 3 h after a heavy meal.
4	≥4 h before	Avoid intense physical activity.	Confirm the absence of intense exercise for at least 4 h before the assessment.
5	Hours before	Avoid caffeine and stimulant beverages according to the experimental protocol.	Record adherence. The study required abstinence during the preceding hours; however, the evidence synthesis does not establish a universal absolute restriction for moderate doses.
6	Before attending the assessment	Avoid lotions or body products on the measurement sites.	Contact sites should be free of creams, lotions, sweat, or cosmetics that may alter the skin-electrode interface.
7	Before attending the assessment	Wear light clothing.	In this study: sports shorts for men; shorts and a sports top for women.
8	Immediately before	Empty the bladder.	Ask the participant to use the restroom immediately before the procedure.
9	Upon arrival	Complete the pre-measurement checklist.	Confirm prior preparation and record recent alcohol intake, edema, diuretic use, injuries, medications, and other conditions that may affect the measurement or its interpretation.
10	Upon arrival	Check for implanted electronic devices.	Record the presence of pacemakers or other electrical devices. In this study, these participants were excluded for methodological standardization purposes, not as a statement of absolute contraindication.
11	Before measurement	Remove external objects.	Remove jewelry, watches, bracelets, rings, necklaces, glasses, shoes, and socks.
12	Before measurement	Assess body temperature.	Measure using an infrared thermometer. Postpone the measurement if body temperature is >37.8 °C.

13	Before BIA	Measure height.	Perform the measurement using cervical decompression and the Frankfurt plane according to ISAK procedures.
14	Before BIA	Measure body mass and waist circumference.	Record anthropometric measurements performed on the same day as BIA.
15	Measurement area preparation	Control environmental conditions.	Maintain a stable temperature. In this study, the room was set at 22 °C; the methodological synthesis recommends 22–28 °C, without drafts or abrupt thermal changes.
16	Measurement area preparation	Use a non-conductive surface.	Avoid participant contact with metal structures or surfaces that may create conductive pathways or grounding.
17	Before supine BIA	Place the participant in the supine position for 10 min.	Maintain a minimum 10-min rest period to facilitate redistribution of body fluids.
18	During the rest period	Keep the limbs separated from the trunk.	Keep the arms slightly separated from the trunk (approximately 45°), with no skin-to-skin contact between the arms and torso; the lower limbs should also remain separated.
19	Before electrode placement	Prepare the skin.	Clean the contact sites with gauze and 70% alcohol and ensure an appropriate skin condition before applying the electrodes.
20	Tetrapolar BIA	Place the electrodes on the right side.	Use the standard hand-to-foot configuration described in the manuscript and maintain the same geometry during repeated measurements.
21	Right hand	Place the distal current electrode.	Position it over the region corresponding to the second-third metacarpophalangeal joints.
22	Right wrist	Place the proximal sensing electrode.	Position it between the distal prominences of the radius and ulna.
23	Right foot	Place the distal current electrode.	Position it over the region corresponding to the second-third metatarsophalangeal joints.
24	Right ankle	Place the proximal sensing electrode.	Position it between the medial and lateral malleoli.
25	Electrodes	Check inter-electrode separation.	Maintain a minimum distance of 5 cm between the corresponding electrodes.
26	Supine measurement	Connect the participant and perform the measurement.	Keep the participant motionless and in the same position during data acquisition. Avoid unnecessary postural changes.
27	Supine measurement	Record raw bioelectrical variables.	Record resistance (R , Ω), reactance (X_c , Ω), and phase angle (PhA , $^\circ$) at 50 kHz.

			Record impedance (Z) when provided by the device and when relevant.
28	After supine BIA	Remove the electrodes and clean the contact sites.	In the study protocol, the contact sites were cleaned again with 70% alcohol before proceeding to the standing configuration.
29	Standing BIA	Perform the measurement using the standing configuration when applicable.	Use the same participant and record R, Xc, and PhA at 50 kHz with the standing system, following the manufacturer's instructions.
34	Final recording	Save raw data and measurement conditions.	At minimum, record R, Xc, PhA, frequency, device/configuration, evaluator, environmental conditions, participant preparation, and relevant events.

Supplementary Table S1. Step-by-step operational protocol for standardized bioelectrical impedance assessment.