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Accuracy of InBody 770 device analysis

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Dedication

“

First, thank God for his blessings, I dedicate this work to the most precious people in my life, my MOTHER and FATHER. Thank you for all the support you gave me. To my dear brother, to my dear sisters, to all my family, to my dear friends and all my closest friends

”

Acknowledgement

“

Praise be to God, a lot of thanks and blessings on the occasion of completing my studies at the master's level at Kasdi Merbah University Ouarlge Algeria.

We extend our sincere thanks and appreciation of the Head of Department of Physics, Mr. Rabah Bouanane, and I would like to thank the medical physicist Kouadri Mostfaoui Abd Elkader an the specialist in Radiation Therapy Debba Essam.

I would like th thank supervisor Naam Amel for her framing and accompanying us. We also thank the board of examiners: President Mr. Zenkhri Djamel Eddine, and Examiner Mr. Bentouila Omar for their acceptance to judge our work.

”

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List of acronyms

BIA	Bioelectrical impedance analysis
MF-BIA	Multi-frequency bioelectrical impedance analysis
TBW	Total body water
LBM	Lean body mass
BMI	body mass index
DXA	Dual energy x-ray absorptiometry

General introduction

Medical test analysis is a critical aspect of healthcare as it furnishes healthcare professionals with essential information needed to diagnose and treat various medical conditions.

Blood test analysis and analysis from the InBody 770 device are fundamental components of comprehensive medical evaluations, each offering unique insights into an individual's health status.

Blood tests deliver valuable data on various biomarkers, like cholesterol, glucose, and liver function, facilitating the diagnosis and monitoring of medical conditions.

In contrast, the InBody 770 unit utilizes advanced technology to analyze body composition, such as fat, muscle, and water distribution, furnishing a detailed view of physical health. [1]

The relationship between medical test analysis and InBody 770 device analysis is symbiotic, with the combination providing a holistic understanding of an individual's well-being. By integrating information from both blood tests and InBody 770 analyzes, healthcare providers can tailor treatment plans, track progress, and optimize health outcomes.[2]

The purpose of our work is to prove the accuracy of Inbody 770 devise analysis. This work contains three chapters.

In the first chapter, we will present general information about the physical and biological system of Inbody, its meaning and the principle of direct segmental multi-frequency bioelectrical impedance analysis.

In the second chapter, we will mention the description of Inbody and the principles of this work of Inbody 770. To provide the accuracy of Inbody. We will present the most important steps of the measurement of body composition and compare it to other body composition analysis methods, ending a the description of the limitations of InBody 770.

The third chapter contains the practical work as will as the presentation of the results of Inbody 770 analysis with details.

Finally, we will finish with a general conclusion and perspectives.

Chapter 1

General information about bioelectrical impedance

1.1 Introduction

Any hospital, university, or professional organization that needs to validate health programs with a comprehensive examination of body composition and body water has to have the Inbody. This chapter will address the physical and biological principles of Inbody through an examination of the human body's resistance, conductor length, cross-sectional area, and impedance. We have focused on the physical and biological properties of the device.

1.2 Physical principle of Inbody

The hypothesis that body impedance can be used to measure total body water is based on the following principle: the impedance of simple geometric systems is a function of conductor length and configuration, conductor cross-sectional area, and signal frequency [3]. Using a fixed signal frequency and a relatively constant conductor configuration, the impedance becomes a function of conductor length and cross section, or conductor volume.

Electrical conduction in biological substances is ionic in type and is related to the free ion content of the various contained salts, bases, and acids, their concentration, mobilities, and conducting medium temperature. Assuming the signal frequency and conductor configuration to be constant, the impedance (Z) to the flow of current can be related to the size or volume of the conductor as follows:

$$Z = \rho L/A \tag{1.1}$$

where

- Z = impedance in Ω,
- ρ = specific resistivity in ohm centimeters,
- L = conductor length in centimeters, A = conductor cross-sectional area in square centimeters. Multiplying equation (1.1) by L/L gives

$$Z = \rho L^2/AL \tag{1.2}$$

in which AL is equal to volume (V). Rearranging gives

$$V = \frac{\rho L^2}{Z} \tag{1.3}$$

While there are many difficulties in applying this principle in a system with complex geometry, such as the human body, this relation (1.3) is presented as a background for the empirical relationship to be presented subsequently.

1.3 Biologic principle of Inbody

1.3.1 The human body and impedance

Bioelectrical Impedance Analysis (BIA) measures impedance by applying alternating currents to the human body

1.3.2 The concept of resistance

To better illustrate how this works, imagine the flow of cars in traffic [4]. Your car is the voltage source or current, and the highway you're.0 on is body water. If there were no other cars, you could zoom past the highway, just as if the human body were full of body water and nothing else; there would be no resistance.

But water is not the only element in the human body, just like you're not the only car on the freeway. As more cars get onto the freeway, the longer it takes for you to get through the path, creating resistance. Other elements, such as fat, muscle, bone, and minerals, create resistance to the electrical current that is going through your body.

In BIA, the more water that is in your body, the lesser the resistance. The muscle in your body contains water, unlike fat, so the more muscle you have, the more body water there is. And the more body water you have, the lesser the resistance to the electrical current.

Reactance, also known as capacitive resistance, is the opposition to the instantaneous flow of electric current caused by capacitance. Reactance helps measure the cell's ability to store energy and is an indirect measurement of cellular strength and integrity.

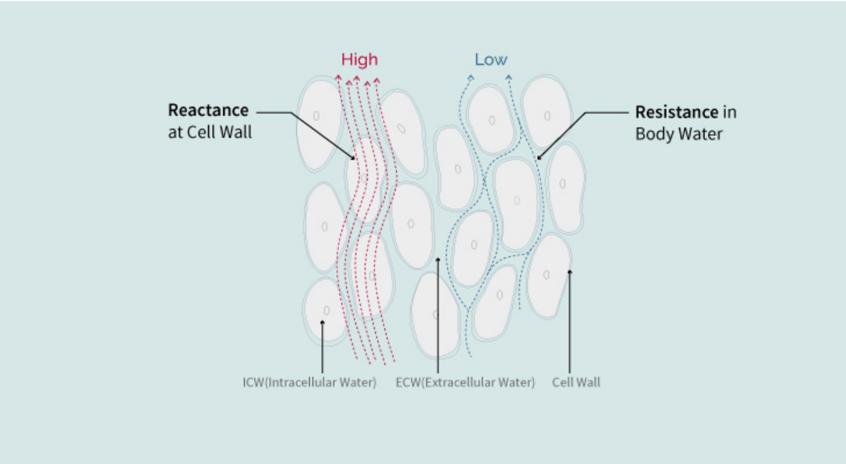

Figure 1.1: The resistance and reactance of the cell [6]

1.3.3 Putting it all together

Impedance is the vector sum of resistance and reactance and is the measurement BIA devices used to determine your body composition. BIA applies a cylinder model to the relationship between impedance and a human body.

Cylinder model in physics related to impedance would focus on understanding the impedance properties of cylindrical systems and how they influence the flow of alternating current through these structures.

Impedance is calculated by using two formulas:

1. Calculating the volume of a cylinder

$$V = L \times A \tag{1.4}$$

With :

- V: Volume ;
- L: Length ;

- A: Area

Characteristic of impedance: impedance is inversely proportional to cross-sectional area and directly proportional to length.

By knowing the impedance and the length of the cylinder, we can measure the volume of total body water.

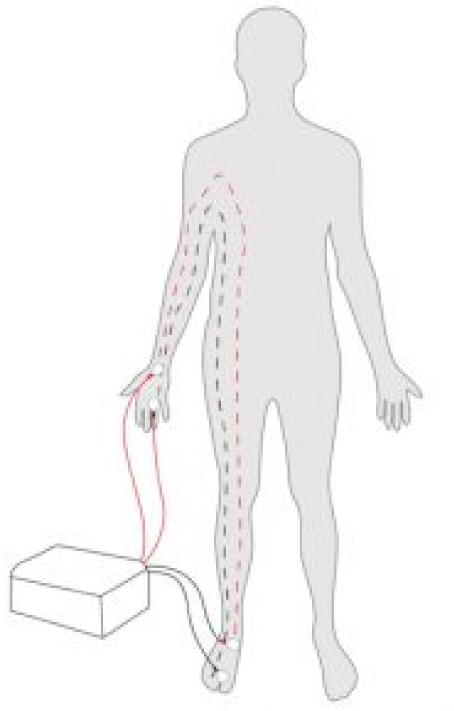

Figure 1.2: Measurement of total body water [6]

2. In the human body, the same formula applies, where the length would be the height of the person. Therefore, we can calculate the volume of the total body water just by knowing the impedance and the height of individuals. This is also why it is imperative to have an accurate height measurement.

Measuring impedance with electrodes creates contact resistance.
InBody accounts for this by strategically placing electrodes to accurately measure.
InBody provides independent measurements for the body's 5(five) cylinders:

- Left Arm
- Right Arm
- Left Leg

- Right Leg
- The Torso

InBody's BIA technology sets itself apart in several ways. Firstly, it uses multiple currents at varying frequencies to provide precise body water analysis, allowing for a more comprehensive assessment of body composition. Unlike traditional BIA devices, InBody does not rely on empirical estimations to calculate body composition, enhancing the accuracy of its measurements. Additionally, InBody measures impedance independently, ensuring that the results are not affected by factors such as age, ethnicity, or gender. This approach, known as Direct Segmental Multi-frequency Bioelectrical Impedance Analysis, allows for a more personalized and precise assessment of body composition, making it a valuable tool in various medical and health applications.

1.4 Direct segmental multi-frequency bioelectrical impedance analysis

Traditional BIA systems view the human body as a single cylinder of water, using whole-body impedance to determine total body water [5]. This method had a number of flaws, including the assumption that the distribution of lean body mass and body fat across all segments of the body is uniform and the fact that the shape and length of the arms, legs, and torso differ, so the body cannot be seen as just one cylinder but actually as five separate parts. In contrast, InBody provides independent measurements for each cylinder to provide accurate measurements for the direct-segmental multi-frequency bioelectrical impedance analysis. This approach allows for a more personalized and precise assessment of body composition, making it a valuable tool in various medical and health applications.

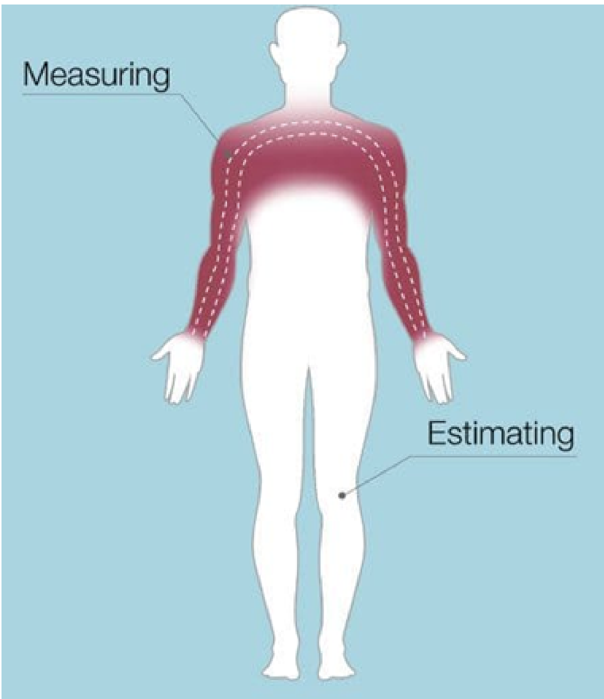

Figure 1.3: Handheld BIA device [6]

This method has a number of flaws, including:

- It assumes the distribution of lean body mass and body fat is constant.
- The shape and length of the arms, legs, and torso differ, so the body cannot be seen as just one but five separate parts.
- Impedance is based on length and cross-sectional area; the calculation of total body water (TBW) is inaccurate because each segment has a different length and cross-section.

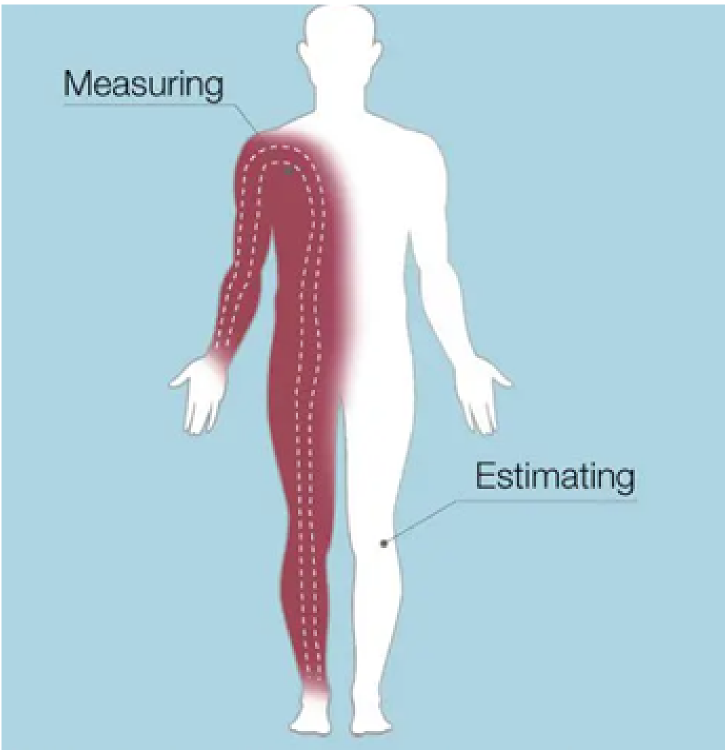

Figure 1.4: whole body impedance device [6]

The one-cylinder method for body impedance measurements presents a notable limitation due to its failure to account for torso measurements, a crucial aspect given the torso's unique characteristics. Despite encompassing approximately 50% of an individual's lean body mass (LBM), the torso's impedance is often disregarded in whole-body impedance measurements. This oversight is particularly critical considering the torso's distinct impedance profile, characterized by very low impedance values ranging from 10 to 40 ohms, attributed to its relatively shorter length and higher cross-sectional area. Given that the torso comprises a higher proportion of water and muscle compared to the limbs, even minor discrepancies in torso impedance, as small as 1-2 ohms, can result in significant errors in the determination of total body water (TBW). Without separate measurements of torso impedance, the potential for overlooking these discrepancies persists, undermining the accuracy and reliability of body composition assessments.

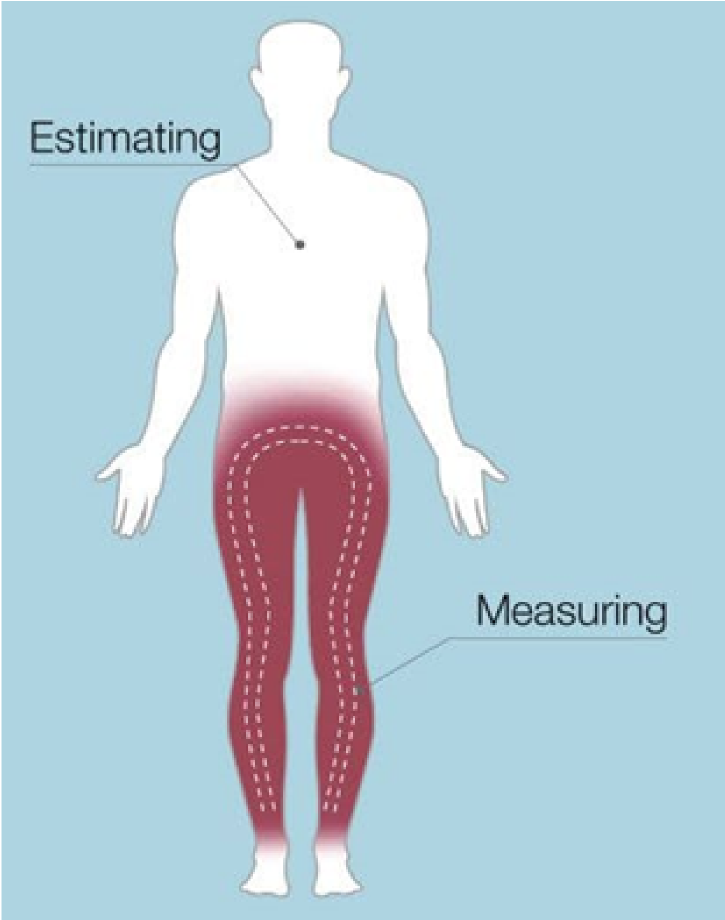

Figure 1.5: BIA foot scale [6]

Some BIA devices employ varying methodologies for measuring body impedance, with implications for the accuracy and reliability of their assessments. While certain devices only measure the impedance values of two cylinders and rely on estimations for the remaining segments, others may focus solely on specific body parts, such as the legs for BIA scales or the arms for handheld devices. Despite claims of whole-body measurement, some devices only assess one arm and one leg and extrapolate the rest, introducing potential inaccuracies. Therefore, the selection of a BIA device that directly measures the torso separately becomes paramount to minimize errors stemming from estimations. InBody devices stand out in this regard, employing Direct Segmental Multi-frequency BIA, which independently measures each body segment—right arm, left arm, torso, right leg, left leg without resorting to estimations. This meticulous approach enhances the precision of body composition assessments and mitigates the risk of significant errors commonly associated with estimation-based methodologies.

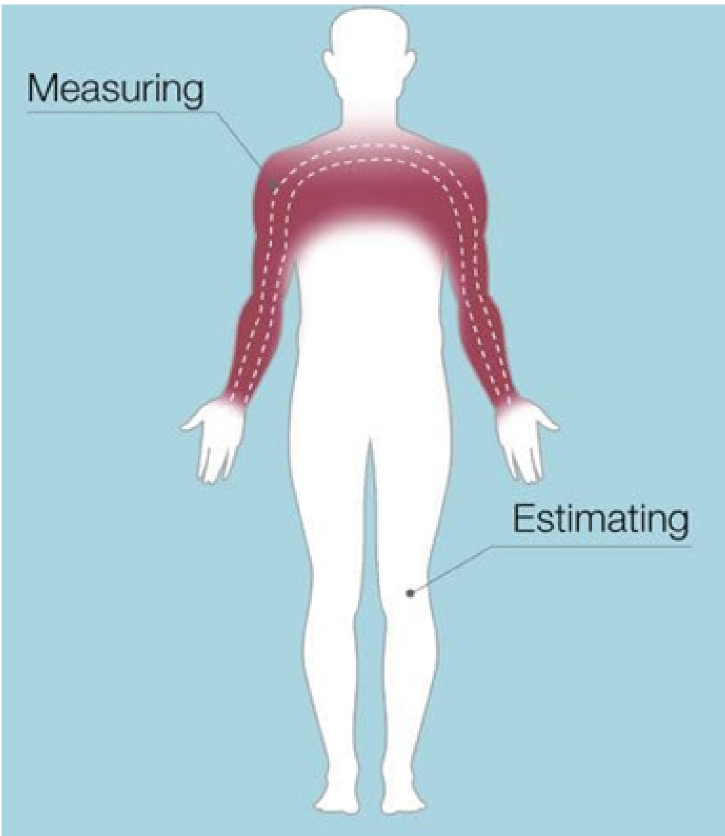

Figure 1.6: DSM-BIA (DirectSegmental Multi-frequency) [6]

1.5 Conclusion

In this chapter, we have explained in detail the relationship between the physical and biological properties of the device InBody by dealing with several points.

In the physical principle, we identify the impedance and the segmental multi-frequency bioelectrical impedance, and in the biological principle, we deal with extracelluele and intracelluele water concept

Chapter 2

Description of InBody 770

2.1 Introduction

The InBody 770 is a high-end body composition analyzer that has been recognized for its precision and reliability by top professionals in the fields of sports and healthcare. It has won the International Forum Design Award in 2015 and is considered a top-of-the-line body composition analyzer used in hospitals, medical research, patient monitoring, sports medicine, and sports science. The InBody 770 is equipped with advanced features and capabilities, including patented tactile tetrapolar electrodes with 8 touch points, distinct thumb and palm technology for reliable repeated analyses, and the ability to conduct 30 impedance measurements using 6 different frequencies, providing over 50 parameters related to body composition.

In this chapter, we have presented a set of mean informations about Inbody 770:principle of work, importances and description.

2.2 History of InBody

The InBody medical device is a series of bioelectrical impedance analyzers (BIAs) designed to assess body composition accurately and efficiently. InBody devices have a significant history in the fields of medical diagnostics and fitness assessments.

Here's a brief overview of the historical development of InBody devices:

1. **Founding and Development:** InBody was founded in South Korea in 1996 by Dr. Kichul Cha, a pioneer in the field of body composition analysis. The company initially focused on developing bioelectrical impedance analysis technology for

medical and research purposes.

2. **Introduction of InBody Technology:** The first InBody device was introduced in 1998, marking the beginning of a new era in body composition analysis. Unlike traditional BIA devices, InBody analyzers utilize multiple frequencies and segmental analysis to provide more accurate and detailed assessments of body composition.

3. **Advancements in Technology:** Over the years, InBody has continued to innovate and improve its technology. The introduction of the InBody 3.0 in 2000 represented a significant advancement in BIA technology, offering enhanced accuracy and reliability.

4. **Expansion into Medical and Fitness Markets:** InBody devices quickly gained popularity in both medical and fitness settings due to their accuracy, ease of use, and non-invasive nature. Medical professionals began using InBody analyzers for a wide range of applications, including assessing nutritional status, monitoring changes in body composition, and evaluating the effectiveness of treatment interventions.

5. **Segmental Analysis:** One of the key features of InBody devices is segmental analysis, which allows users to assess body composition in different regions of the body independently. This capability has important clinical implications, particularly in fields such as sports medicine, orthopedics, and rehabilitation.

6. Global Recognition: InBody analyzers have received widespread recognition and accreditation from regulatory bodies and professional organizations worldwide. The devices are used in hospitals, clinics, research laboratories, fitness centers, and sports facilities in over 100 countries.

7. **Continuous Innovation:** InBody continues to invest in research and development to further improve the accuracy, usability, and functionality of its devices. Newer models, such as the InBody 770 and InBody 570, incorporate advanced features such as touchscreen interfaces, cloud connectivity, and personalized reporting options.

8. **Integration with Healthcare Systems:** InBody devices are increasingly being integrated into electronic medical record (EMR) systems and healthcare networks, facilitating seamless data management and analysis.

Overall, the historical development of InBody devices reflects the company's commitment to advancing the field of body composition analysis and providing healthcare professionals with reliable tools for assessing and managing patient health.

2.3 Principle of work

The InBody 770 is a bioelectrical impedance analysis (BIA) tool that measures body water and composition by fusing physical and biological characteristics. It provides an accurate examination of body fat, muscle, and water by measuring each body segment independently using Direct Segmental Multi-Frequency BIA technology. The gadget calculates body fat, muscle, and water by passing several small electrical currents through the body and producing up to six distinct impedance measurements. It measures variables ranging from extracellular body water to total body water using various frequency levels.

2.4 Importance in Inbody

Traditional BIA technology measures the human body as a single cylinder using one frequency, which increases the likelihood of inaccurate results.

Conventional BIA devices use empirical estimations based on factors like age and sex to help improve accuracy. While this may work for people with a standard body type, it is inaccurate for those who do not fit this mold, such as fit elderly adults.

Everyone has a unique body composition that's why InBody makes innovative technology tailored to the individual, not a group.

InBody's medical-grade body composition analyzers use four pillars of technology to provide accurate, precise direct segmental measurement and multi-frequency bioelectrical impedance analysis (DSM-MFBIA), extensively validated to gold-standard methods [7].

2.5 Description and definition of InBody 770

The InBody 770 is a bioelectrical impedance analysis (BIA) device used to measure body composition and water distribution in a non-invasive and user-friendly way. The device uses multi-frequency bioelectrical impedance analysis (MF-BIA) to estimate body composition by measuring the electrical impedance of biological tissues. The analysis of body composition with the InBody 770 only takes one minute, and the subject must stand barefoot on four electrodes, corresponding with the soles of their feet, and hold the handles in both hands, making contact with electrodes on the thumbs and palms. The device measures 30 impedance measurements at six frequencies at each of the five segments (right arm, left arm, trunk, right leg, and left leg) and provides standard outputs such as body composition analysis, body water composition, and body mass index (BMI). The InBody 770 is used in various medical practices, including clinical status monitoring, diagnosis of diseases, and large epidemiological studies.

Figure 2.1: InBody 770 is a bioelectrical impedance analysis. [8]

The InBody 770 differs from other InBody devices in several ways, including the range of measurements, the number of impedance measurements, and the specific features it offers. Here are the key differences:

1. **Measurements:**

   The InBody 770 provides a comprehensive analysis, including 30 different impedance measurements at 6 different frequencies, allowing for a detailed body composition assessment [9].

   It offers measurements such as dry lean body mass index, visceral fat level, overall fat loss, and weight loss, in addition to traditional measurements like percent body fat and skeletal muscle mass [9].

2. **Body water analysis:**

   The InBody 770 takes an in-depth look into body water, providing a dedicated result sheet for body water analysis [10].

3. **Impedance measurements:**

   The InBody 770 performs 30 different impedance measurements at 6 different frequencies, which is a more extensive analysis compared to other models [9].

4. **Additional features:**

   The InBody 770 is equipped with features such as an integrated voice guidance system, injury detection capabilities, and a 45-second test duration, making it a comprehensive and user-friendly body composition analyzer [9].

5. **Medical-Grade lineup:**

   The InBody 770 is part of the medical-grade lineup of products, emphasizing its suitability for clinical and medical applications [10].

Specifications:

Table 2.1: Specifications of InBody 770.

Frequencies	1, 5, 50, 250, 500, 1000 kHz.
Test Duration	60 seconds.
Dimensions	20.7 x 33.6 x 46.3 (L x W x H) : in Equipment Weight 83.8 lbs.
Database	100,000 results (if member ID is utilized).
Compatible Printers	Laser/Inkjet PCL 3 or above, SPL Wi-Fi/ Bluetooth Connectivity, Security Access Code.
Weight Range	22-595 lbs.
Age Range	3-99 years.
Height Range	3ft 1.4 in-7ft 2.6 in.
Measurements	30 impedance measurements 6 frequencies at each of the 5 segments (Right Arm, Left Arm, Trunk, Right Leg, Left Leg).

Figure 2.2: Differences highlight the advanced capabilities of the InBody 770. [8]

These differences highlight the advanced capabilities of the InBody 770, particularly in terms of the depth and detail of the body composition analysis it provides, making it a top-of-the-line option for those serious about health, wellness, and fitness [9].

2.6 How does Inbody 770 measure body composition

The InBody 770 measures body composition using a technique called bioelectrical impedance analysis (BIA). This non-invasive method sends a safe, low-level electrical current through the body using hand and foot electrodes. The impedance, or resistance, the current encounters are then measured and used to calculate body composition. The InBody 770 uses Direct Segmental Multi-Frequency BIA technology, which measures body segments separately, allowing for a more accurate analysis of body fat, muscle, and water [11].

The InBody 770 provides two types of results sheets: one for body composition and one for body water. The body composition results sheet includes measurements for fat mass, muscle mass, and body water, while the body water results sheet provides detailed information on extracellular water, intracellular water, and extracellular water to total body water ratios in each arm, leg, and trunk segment [12].

The InBody 770 also offers advanced features like segmental lean mass analysis, which identifies how many pounds of lean mass and fat are in each body segment, and segmental body water analysis, which measures the level of body water in each arm, leg, and trunk segment [13]. This allows for a more comprehensive understanding of body composition and helps track changes over time . InBody 770 is trusted by top professionals in various fields, including hospitals, universities, and professional sports teams, due to its precision, non-invasive nature, and ability to provide a detailed overview of body composition [12, 13].

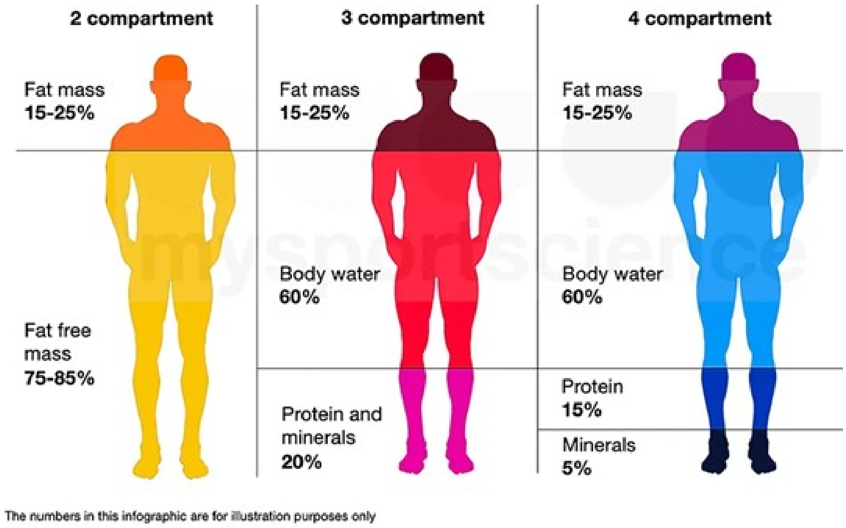

Figure 2.3: Measurement of body composition [14].

2.7 How does Inbody 770 compare to other body composition analysis methods

The InBody 770, a multi-frequency bioelectrical impedance analysis (MF-BIA) device, compares favorably to other body composition analysis methods, such as air displacement plethysmography (Bod Pod), dual energy x-ray absorptiometry (DXA), and single-frequency bioelectrical impedance analysis (BIA) devices.

Air displacement plethysmography (Bod Pod): A study comparing the Bod Pod, InBody 770, and DXA found no significant differences between the Bod Pod and InBody 770 for any measure of body composition. However, both the Bod Pod and InBody 770 underestimated percent body fat and overestimated fat-free mass compared to the DXA [15]. Dual energy x-ray absorptiometry (DXA): DXA is considered the gold standard for body composition analysis, but it is more expensive and time-consuming than MF-BIA devices like the InBody 770. DXA provides accurate measurements of body composition, including fat mass, fat-free mass, and bone mineral content [15].

Single-frequency bioelectrical impedance analysis (BIA) devices: Studies have shown that single-frequency BIA-derived equations may not provide accurate estimates of body composition, especially in populations with higher body fat percentages [16]. However, MF-BIA devices like the InBody 770 have been found to be valid estimators of lean body mass and fat mass in various populations [16].

In summary, the InBody 770 provides a comprehensive body composition analysis using MF-BIA technology, which is non-invasive, portable, and relatively quick. While it may not be as accurate as the gold standard DXA for some measurements, it offers a more cost-effective and accessible solution for assessing body composition

2.8 How does the accuracy of Inbody 770 compare to DXA

The accuracy of the InBody 770 in measuring body composition is comparable to that of dual-energy X-ray absorptiometry (DXA), which is considered the gold standard for body composition analysis. A study by the Mayo Clinic found that InBody scans were 98% accurate at measuring body composition, which is similar to the accuracy of DXA scans [17].

InBody scans utilize bioelectrical impedance analysis (BIA), while DXA scans use dual-energy X-ray absorptiometry to measure body composition. Both methods have their advantages and limitations. InBody scans are non-invasive, quick, and provide detailed information about body composition, while DXA scans are more invasive, time-consuming, and provide more accurate measurements of body composition, especially for fat-free mass and bone mineral density [17].

In a study comparing MF-BIA (InBody 770) and DXA, researchers found that the InBody 770 could predict changes in body composition (i.e., fat mass, fat-free mass, and percent body fat) similar to DXA, although it showed more variability in the measurements [20].

The InBody 770 is a reliable and accurate method for measuring body composition, with results that are comparable to those obtained using DXA. However, it is essential to consider the specific needs and goals of the individual or group being assessed when choosing between these two methods.

2.9 The limitations of InBody

The InBody 770 is a device that provides detailed comprehensive results about an individual's body composition by sending multiple mild electrical currents through the body, resulting in up to six different impedance readings that calculate body fat, muscle, and water. The device uses Direct Segmental Multi-Frequency BIA technology to measure body segments separately for an accurate analysis; bioelectrical impedance analysis (BIA) technology include the following:

- **Assumptions and empirical data:**

  BIA technology, including that used in InBody devices, may still have limitations in individuals with unique body compositions, such as those with amputations, edema, or other conditions that affect body water distribution [21].

- **Whole-body impedance measurement:**

  Traditional BIA systems, including some InBody devices, view the human body as a single cylinder of water, using whole-body impedance to determine total body water. However, this method has limitations as it assumes the distribution of lean body mass and body fat across all segments of the body are the same, which may not be the case [4, 22].

- **Segmental Impedance Measurement:**

  While InBody devices use direct segmental multi-frequency BIA, which measures impedance in the limbs and torso separately, the change of the body torso impedance is underestimated in the whole-body impedance measurement, as the torso comprises about 50% of an individual's lean body mass (LBM) [22].

- **Contact Resistance:**

  BIA technology, including that used in InBody devices, may be affected by contact resistance, which occurs when the electrodes do not have proper contact with the skin. InBody accounts for contact resistance by strategically placing electrodes to accurately measure [4].

- **Unique body types:**

  While InBody technology does not use empirical estimations in calculating values, it is important to note that BIA technology, in general, may have limitations in evaluating a wide range of body types, from extremely obese to elderly to athletic [4].

These limitations highlight the need for careful consideration when using BIA technology, including InBody devices, and the importance of interpreting the results in the context of an individual's unique characteristics and any potential limitations of the technology.

2.10 What are the advantages of using Inbody ?

The advantages of using InBody's bioelectrical impedance analysis (BIA) over other methods for measuring body composition include:

- Reliability and Precision: InBody BIA technology provides accurate and precise measurements of body composition, taking into account factors such as age, gender, and height, without relying on empirical assumptions based on age, sex, ethnicity, or body shape [19].
- Direct Segmental Measurement: InBody devices use direct segmental multi-frequency BIA, which measures impedance in the limbs and torso separately, yielding highly accurate results and providing a more comprehensive assessment of body composition [19].
- Individualized Feedback: InBody BIA technology provides individualized feedback for progress tracking, making it a valuable tool for individuals looking to achieve specific health and fitness goals [19].
- Non-Empirical Estimations: Unlike some other BIA devices, InBody measures body composition without relying on empirical assumptions based on age, sex, ethnicity, or body shape, producing accurate and precise results validated to gold standard methods [19].
- Comprehensive Analysis: InBody BIA technology offers a more comprehensive analysis, including the use of multiple frequencies and impedance measurements to improve the accuracy of body composition assessment [7].
- Segmental Measurement: The direct segmental measurement feature of InBody devices allows for the independent measurement of each body segment, providing a more detailed and accurate assessment of body composition [19].

These advantages position InBody's BIA technology as a reliable, precise, and individualized method for measuring body composition, making it a valuable tool in both clinical and non-clinical settings [18, 19].

2.11 Conclusion

The InBody 770 is a valuable tool for research and professional settings due to its accuracy, precision, and advanced insights into body composition. Its ability to provide detailed information on body composition and body water, as well as its ease of use and efficiency, make it a popular choice among top professionals in the fields of sports and healthcare.

Chapter 3

INBODY 770 analysis Accuracy

3.1 Introduction

The practical part showcases the innovative practices of Ada Health Clinic, a leading private healthcare facility dedicated to providing exceptional care to its patients. In this segment, we will delve into the operational excellence and patient-centric approach that define Ada Health Clinic's commitment to excellence in healthcare delivery. Throughout this practical part, we will explore the implementation of cutting-edge technologies, personalized patient care strategies, and the seamless integration of holistic wellness practices within a private clinic setting.

By examining these key aspects, we aim to highlight the unique value proposition of Ada Health Clinic and shed light on the transformative impact of its practices on patient outcomes and overall healthcare quality.

We focus on how the device works to give us the recommended weight, muscle mass, and fat mass for a balanced body composition. We have performed the examinations for three volunteers to show the accuracy that characterizes the IN BODY 770 device.

3.2 Ada clinic

Ada medical clinic is a healthcare facility focused on outpatient care, offering a range of medical services and staffed by healthcare professionals, with the goal of providing accessible and affordable care to patients.

Figure 3.1: Ada clinic

Figure 3.2: Ada clinic logo

This new health facility, which has a capacity of 38 beds and is equipped with the latest medical means, includes medical examinations in addition to surgical interventions related to various medical specialties such as ENT, radiography, scanners, obstetrics and gynecology, and digital radiology, as explained by the project manager.

This clinic will be ”an added value for the specialized medical care in this state from the southeast of the country through its great contribution to alleviating the trouble of financially costly movement of patients to distant health structures,” as explained by Dr. Mohammed Kamal Abbazi, a doctor specializing in ear, nose, and throat.

As for the ongoing training, this medical facility, which has a lecture hall with a capacity of 140 seats, will host medical meetings organized by specialized practitioners from different parts of the country and foreigners with the aim of exchanging experiences, knowledge, and cooperation among themselves, the speaker adds.

This clinic, which is located on a floor with a total area of 1,000 m^2 in Al Nasr neighborhood (the western suburb of Ouargle), was distributed as part of the investment promotion to several medical interests (examination, radiology, emergency, nursing, analysis, surgery, etc.) according to the technical card of the project.

Figure 3.3: Ada clinic localization

Regarding the social impact of this project, which is supervised by medical, paramedical, and administrative staff, it allowed the creation of 124 direct and indirect jobs, especially for the benefit of the local workforce.

3.3 InBody 770 – Ouargla

The "InBody 770" device is a very modern device that deals with a comprehensive and accurate reading of the body's water contents and balances, as well as how to distribute mind, fat, and muscles in various parts of the human body and how this negatively or positively affects the organic balances and functional capabilities of the same body.

Figure 3.4: InBody 770 presented in Ada clinic

This device is considered one of the modern scientific revolutions that scientifically accurately and definitely accompanies the work of many medical specialties in the follow-up of patients, in addition to the importance of the results of analytical studies of the InBody 770 device in the correction and assistance of functional and sports rehabilitation centers, as well as sports halls, bodybuilding, cosmetology, rehabilitation, and physical revitalization. In performing its work and following up with its users scientifically and accurately.

The price of the analysis of InBody 770 was between 2500 DA and 3000 DA.

3.4 How the device works

Here are the steps to perform analysis on an InBody 770 device:

1. Preparation: Make sure that the InBody device is correctly installed and calibrated. Also check that the user is ready to perform the analysis, wearing light clothing.

2. User Identification: Ask the user to enter their personal information, such as ID, age, gender, and height, into the InBody device.

Figure 3.5: Inbody 770 interface (age, gender and weight)

Figure 3.6: Inbody 770 Length scale

3. Positioning on the device: Ask the user to get on the scale or hold the handles of the device, depending on the model used. Make sure it is positioned correctly and stable.

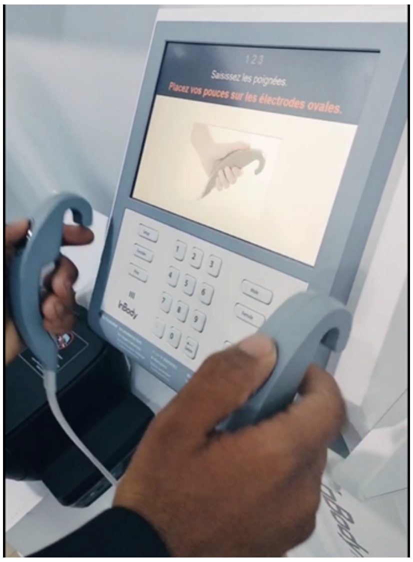

Figure 3.7: Inbody 770 hand electrods

Figure 3.8: Inbody 770 feet electrods

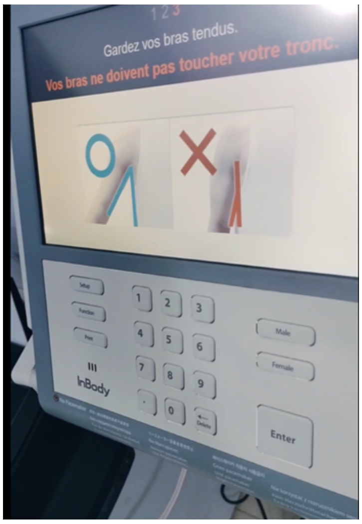

Figure 3.9: Inbody 770 interface

Figure 3.10: the first volunteer on Inbody 770

4. Starting the scan: Press the start button to start the scan. The InBody device will then send electrical signals through the user's body to measure various parameters such as body composition, muscle mass, fat mass, etc.

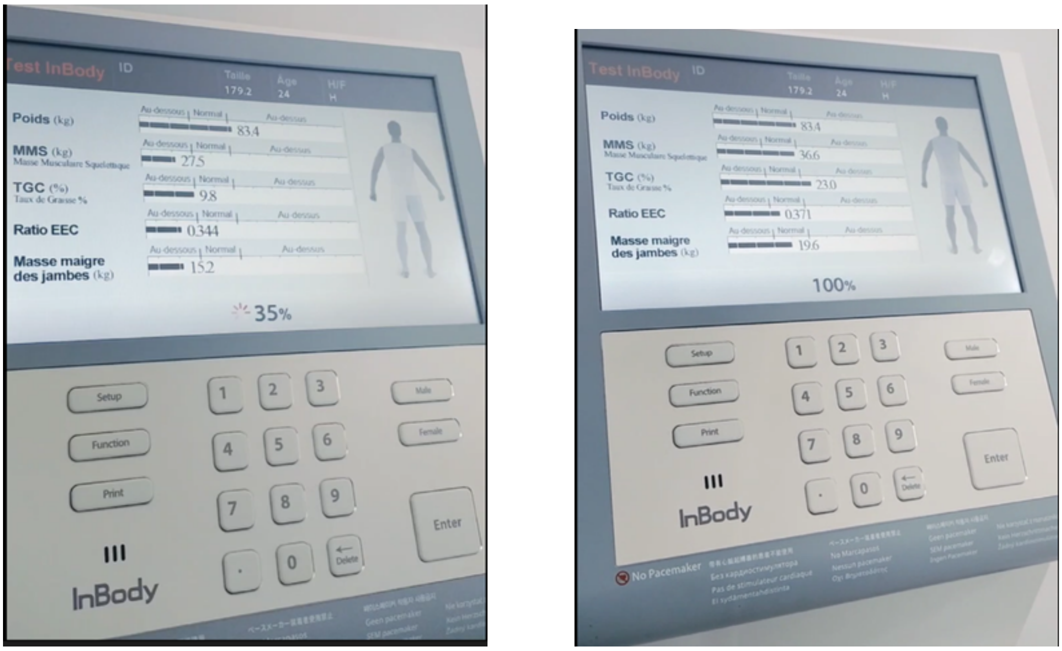

Figure 3.11: Inbody 770 interface results

5. Reading the results: Once the analysis is complete, the results will be displayed on the screen of the InBody device. You will thus be able to consult the different measurements carried out and interpret them according to the health or fitness objectives of the user.

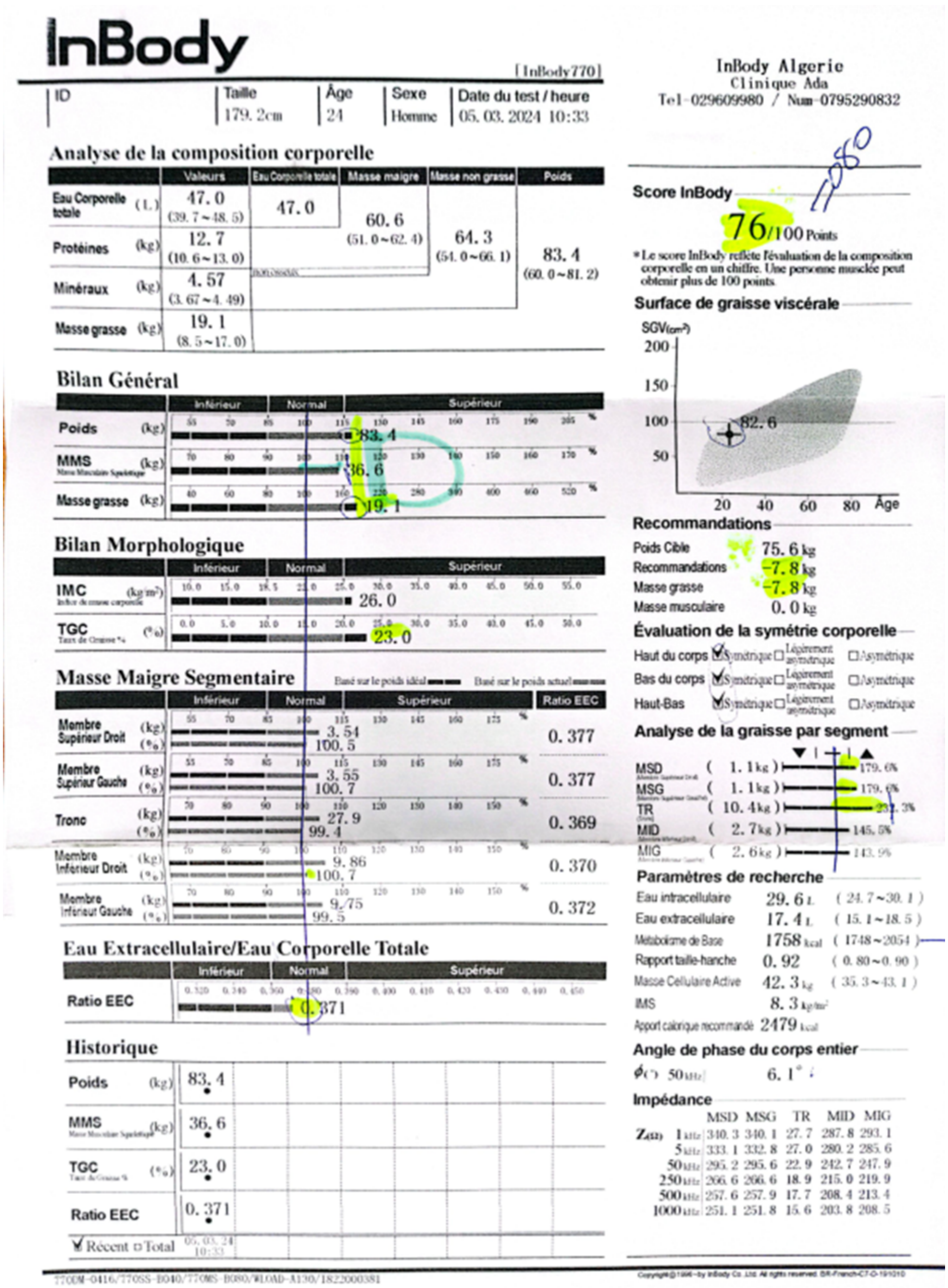

Figure 3.12: Result for the first volunteer.

6. Interpretation of the results: Explain to the user what the various parameters measured by the InBody device mean and how they can influence his overall health. Also offer him personalized recommendations based on the results obtained.

7. Monitoring and Readjustment: Regularly encourage the user to repeat analyzes on the InBody device to track their progress and adjust their training program or diet if necessary.

By following these steps, you will be able to efficiently perform accurate analyzes on an InBody device and help your clients achieve their health and fitness goals.

3.5 Interpretation of InBody 770 analysis results

3.5.1 First volunteer

3.5.1.1 General informations

Table 3.1: Informations about first volunteer.

Gender	Age	Weight	Height
Man	24	83.4	179 *cm*

3.5.1.2 Body composition analysis

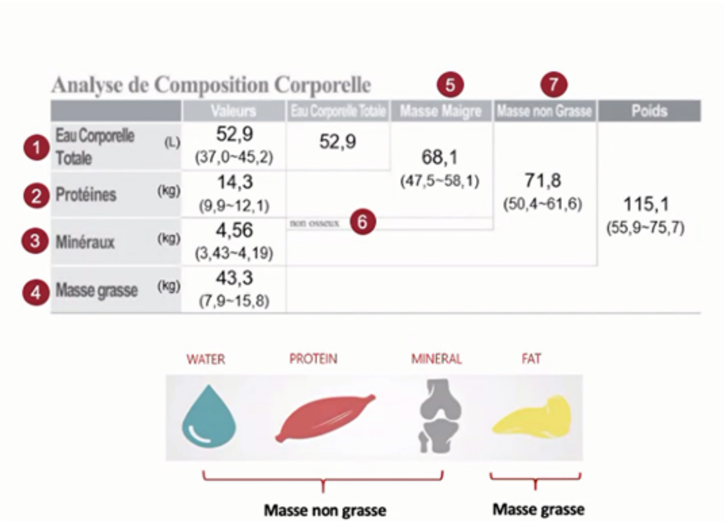

Figure 3.13: Body composition analysis

- **Total Body Water (ECT):** corresponds to the sum of extracellular and intracellular water
- **Proteins:** represent the muscle fibers
- **Minerals:** the weight of the bones, (excluding the skull). Index of bone strength.
- **Fat Mass:** the total amount of fat located in the body.
- **Lean mass:** corresponds to the sum of Total body water (ECT) + proteins + non-bone minerals.
- **Non-bone minerals:** include cartilages and tendons
- **Non-fat mass:** this is the total weight of the body excluding fat mass.

3.5.1.3 Muscle-Fat Analysis

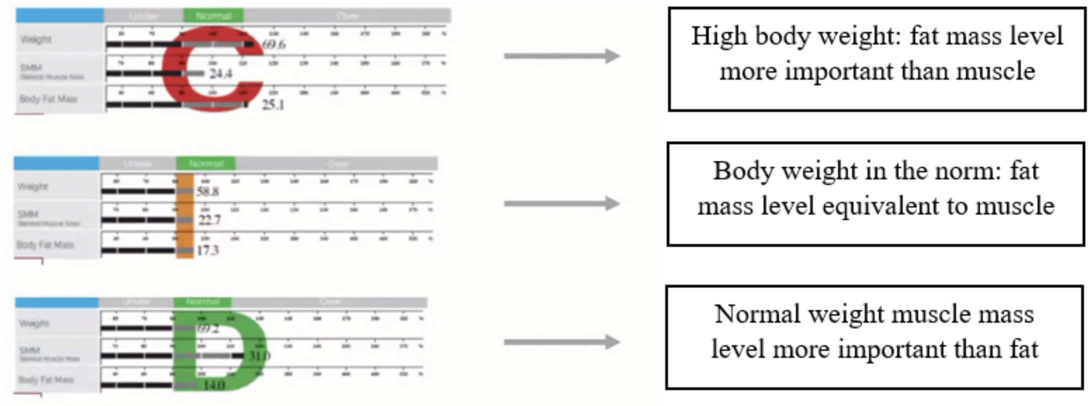

Figure 3.14: Interpretation of muscle-Fat Analysis

3.5.1.4 Morphological Assessment

- BMI remains a reference measure for many people. InBody believes that the interpretation of BMI alone is insufficient in the analysis of body composition. For this reason, the interpretation of the BMI at InBody is systematically done with the muscle-fat analysis for greater reliability.

  Thus, a BMI above does not necessarily mean obesity. Example attached.

- The TGC "body fat rate" is an index that allows body fat to be analyzed in % relative to the weight of the whole body.

  For a man, it should be between 10% and 20% (an average of 15%) For a woman, it is between 18% and 28% (an average of 23%).

  This index is complementary to the fat mass in kg. Attention: a TGC above, does not necessarily mean that the person has fat to eliminate in the body. But rather a lack in the non-fat mass.

3.5.1.5 Segmental analysis of lean mass

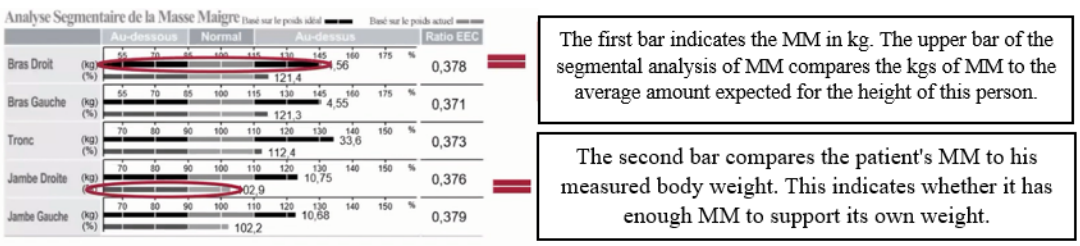

Figure 3.15: Interpretation of segmental analysis of lean mass

3.5.1.6 Analysis of the EEC ratio

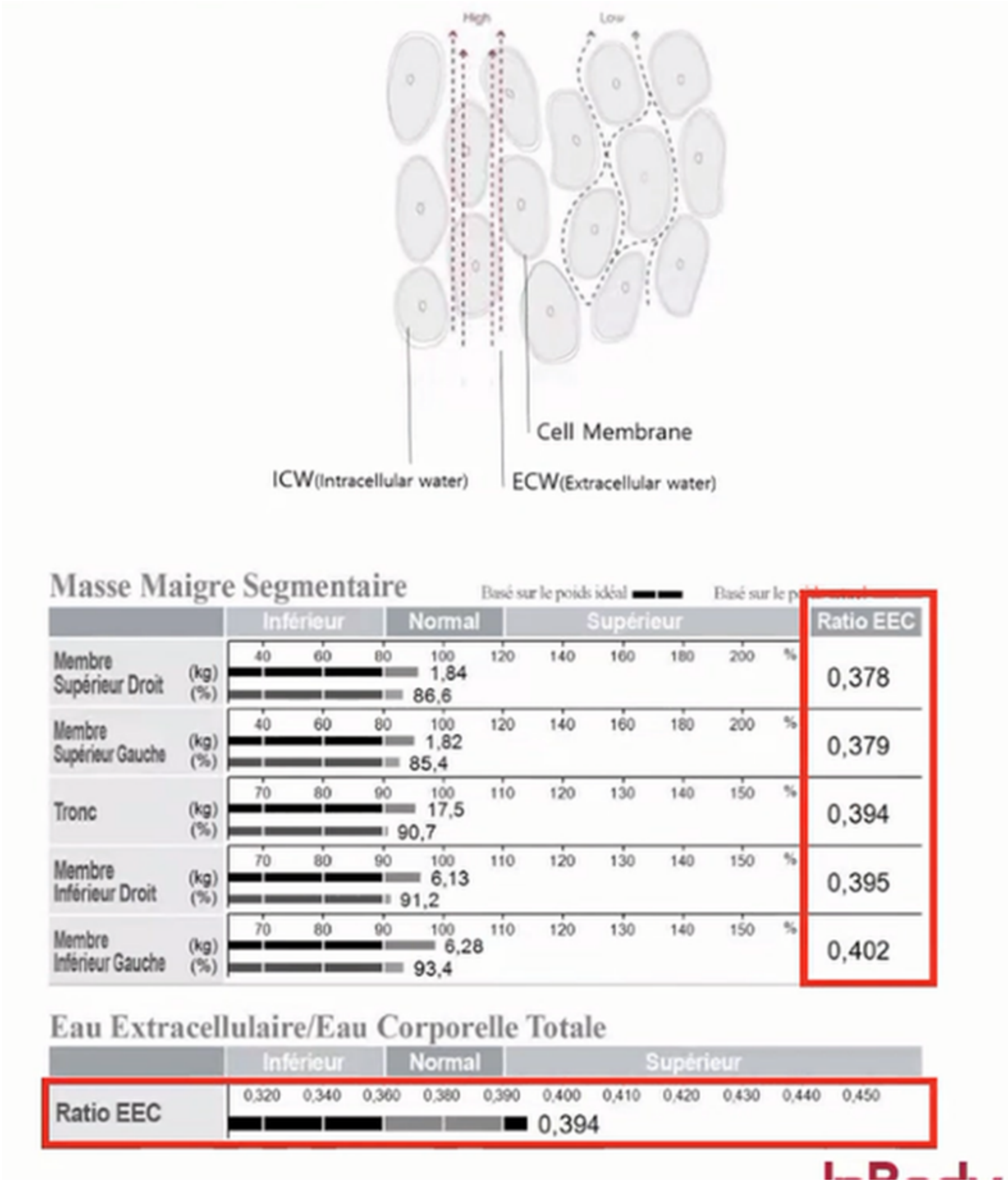

Figure 3.16: Interpretation analysis of the EEC ratio

A holy human body is composed of 38% extracellular water and 62% intracellular water.

Reminder:

- Total body water (ECT): is the sum of extracellular water (EEC) and intracellular water (EIC). The EEC ratio represents the % of extracellular water relative to the total body water. It is therefore an index that makes it possible to analyze the balance between EIC and EEC: Dehydration, Good hydration, or Water retention.

- Segmental EEC ratio: The InBody technology also makes it possible to analyze dehydration or water retention in a segmental way. In other words, thanks to InBody we can locate the edema. Good to know:

  Segmental fluid retention makes it possible to identify edema due to injury or following surgery.

The causes of an increase:

- Heat
- Local inflammation or injury
- Obesity (fat cells have less intracellular water than muscle cells)
- Malnutrition (the cells shrink and therefore relatively more water accumulates outside the cell)
- Sarcopenia or muscle loss and associated obesity
- The diet rich in salt
- Prolonged immobility (sitting or standing position)
- Hormonal imbalance (menstruation, pregnancy, menopause...)
- Certain medications (corticosteroid, antidepressant...)
- Certain diseases (heart, venous and renal insufficiency...)
- Poor blood circulation

The causes of a decrease:

- Dehydration
- Certain medications (Diuretics, NSAIDs, ...)
- High muscle mass

3.5.1.7 History of body composition

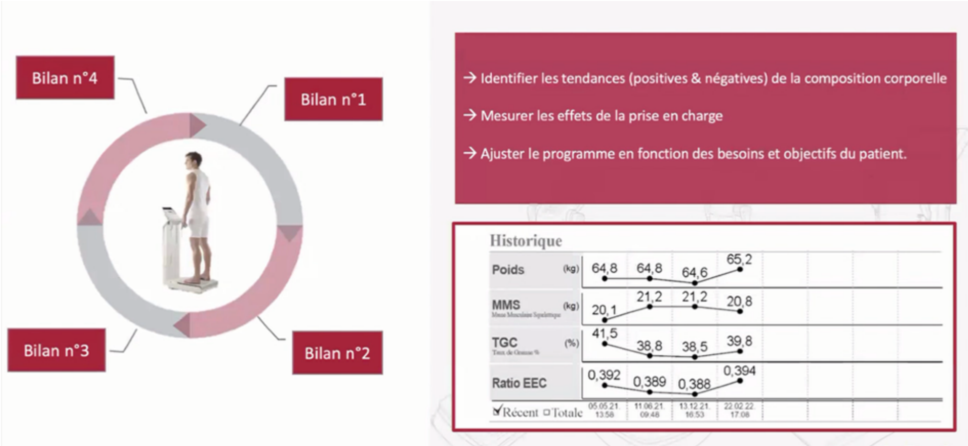

Figure 3.17: History of body composition

3.5.1.8 Score InBody

The InBody score is an index that reflects the evolution of body composition. This «cursor» expresses the balance between muscle mass and fat mass in the body by points out of 100. on the other hand, a muscular person can have more than 100 points.

80/100 represents the normal that each individual should achieve to be healthy.

Figure 3.18: Score InBody

3.5.1.9 Visceral fat surface

Visceral fat is the fat located in the visceral system around the organs, more precisely between the muscles and the abdominal cavity. It helps the functioning of vital organs (sympathetic system).

InBody offers you a graph with a security cloud. The ideal is to be in this cloud. It is better to be in the light part than in the dark part, in other words it is ideally necessary to be below 100 cm^2 to maintain the proper functioning of the automatic functions of the organism.

Causes:

- Excessive consumption of processed (industrial) foods.
- Increased stress level.
- Lack of physical activity.
- Sleep disorders.

Tips:

- Eating fresher, healthier and natural foods.
- Do physical activity (focus on cardio and / or endurance)
- Reduce the level of stress (relaxation and breathing exercise, Pilates, yoga...)
- Get enough sleep between 7 and 10 am.

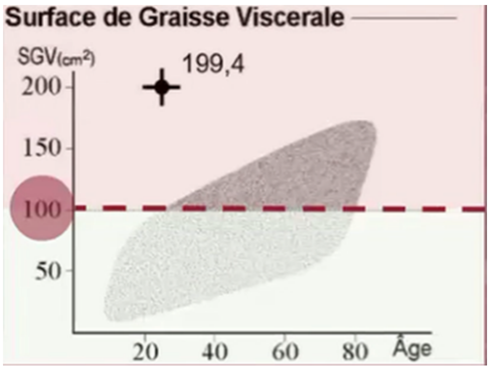

Figure 3.19: Chart positions of visceral fat surface

3.5.1.10 Weight control

Indicates the recommended weight, muscle mass and fat mass for a balanced body composition. The sign means to take, and the sign - means to lose.

Weight control is the sum of fat mass control and muscle control.

This is a very important part of the assessment to set the goal to be achieved to be healthy.

Weight Control will never recommend muscle loss, on the other hand it may be necessary to recommend a fat gain. Here the expertise of professionals comes into play to judge it.

3.5.1.11 Segmental analysis of the fat mass

The segmental analysis of the fat mass makes it possible to observe the distribution of fats in the body by segment (BD, BG, TR, JD, JG), to locate excess fat, and to restore a balance in relation to the norm.

The data is analyzed in %. Thus the value of 100% represents the norm.

In the attached example, we can see an excess of fat in the trunk of +44.1% compared to normal. The person will be able to accurately follow the evolution of this excess in relation to his goals.

NB: Insufficient body fat can cause growth disorders and increase the risk of chronic diseases. If the insufficient intake of lipids is also accompanied by an insufficient intake of carbohydrates and proteins and therefore energy, this can lead to malnutrition.

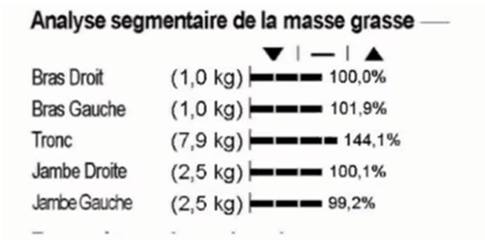

Figure 3.20: Segmental analysis of the fat mass

3.5.1.12 Search parameters

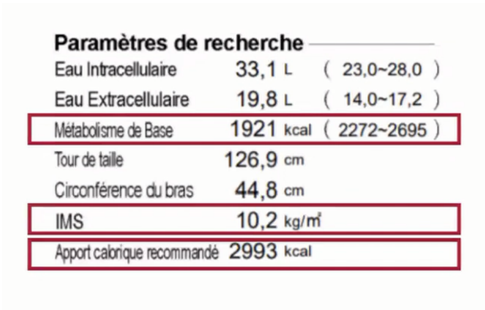

Figure 3.21: Search parameters

Basic metabolism:

Corresponds to the minimum daily energy expenditure needs allowing the body to survive in a resting situation, in other words to keep its functions active (heart, brain, breathing, digestion, maintaining body temperature).

The body of a person with a low basal metabolism will tend to store fat because his metabolism does not burn enough calories in a resting situation and therefore the body will tend to store calories not consumed.

Generally, a metabolism below normal is a sign of sedentary lifestyle. The person concerned will have to do more physical activity, prioritizing in the majority of cases an increase in muscle mass.

The consultation of an endocrinologist may be considered necessary to prevent any type of disease related to metabolism.

IMS: Skeletal muscle mass index: The IMS is an index that makes it possible to detect cases of sarcopenia. It must be > 5.5kg/m2 for a woman and > $7kg/m^2$ for a man. Recommended calorie intake:

Corresponds to the recommendation of daily consumption of an individual in $Kcal$ taking into consideration his daily activity and his weight goal advised by InBody.

3.5.1.13 Phase angle

The phase angle, a measure of how cells react to the electrical currents used to measure body composition, reflects the integrity of the cell membrane. It has been associated with survival in several oncological populations. When the cells are healthy, they are better able to withstand the currents used by InBody, which gives a higher phase angle. The phase angle makes it possible to assess the general state of fitness of a person. This state of form depends on 3 factors:

- Physical activity
- Sleep
- Nutrition

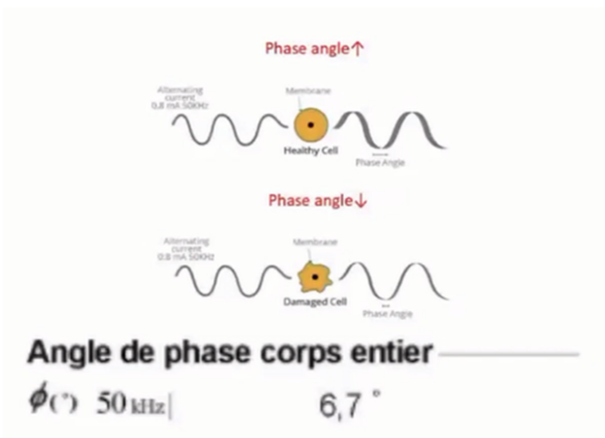

Figure 3.22: The phase angle

Analysis:

- =< 2: Criticism
- 2 < phase angle <4: Bad (interpretation depends on age)
- >= 4: good

Women are usually found between 5 and 6, men between 6 and 7 Higher than 8 is quite rare.

3.5.2 Second volunteer

3.5.2.1 General informations

Table 3.2: Informations about second volunteer.

Gender	**Age**	**Weight**	**Height**
$Women$	28	54.9	154.8 cm

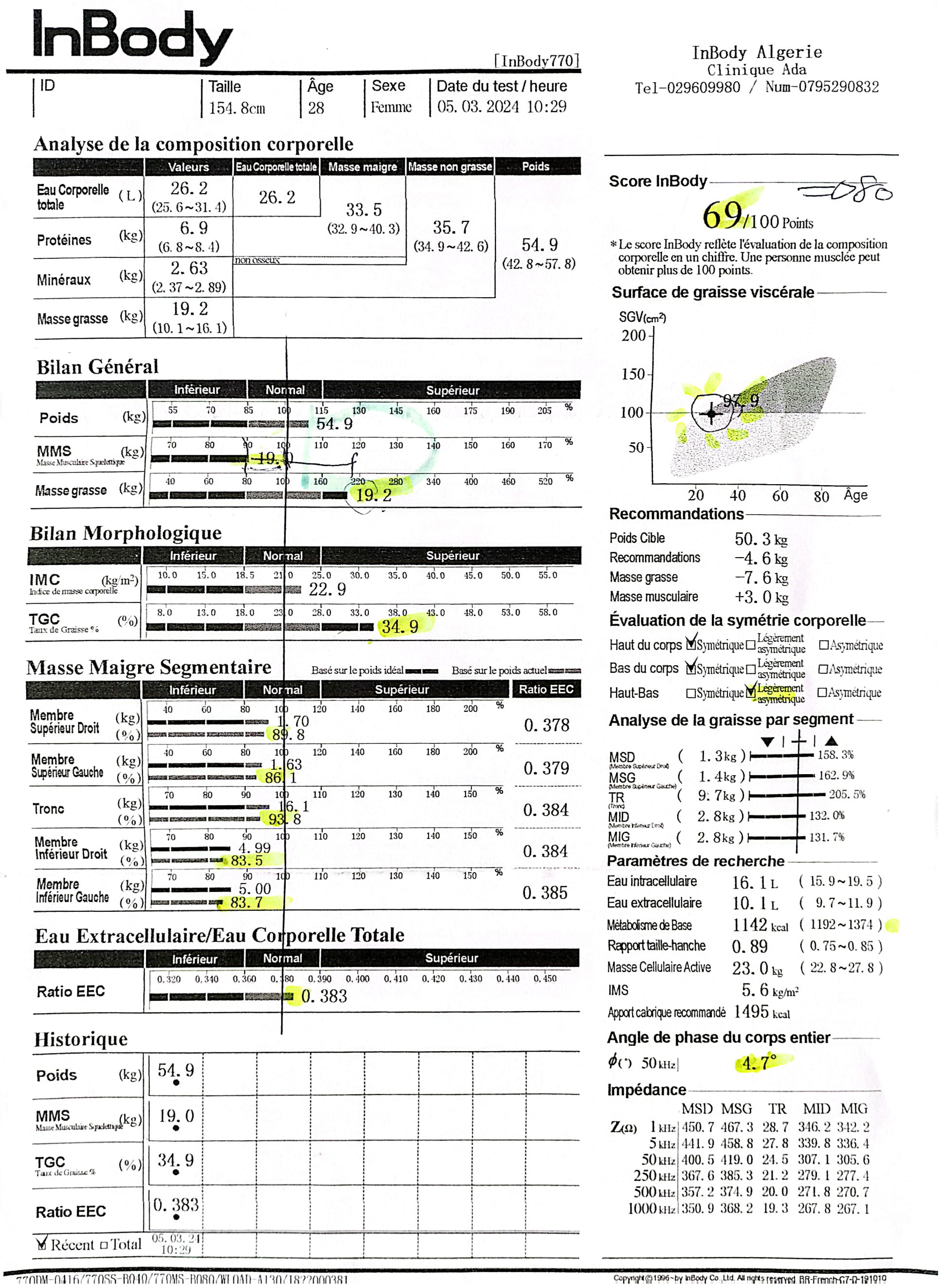

Figure 3.23: Result for the second volunteer.

3.5.3 Third volunteer

3.5.3.1 General informations

Table 3.3: Informations about third volunteer.

Gender	Age	Weight	Height
Man	33	97.4	180 *cm*

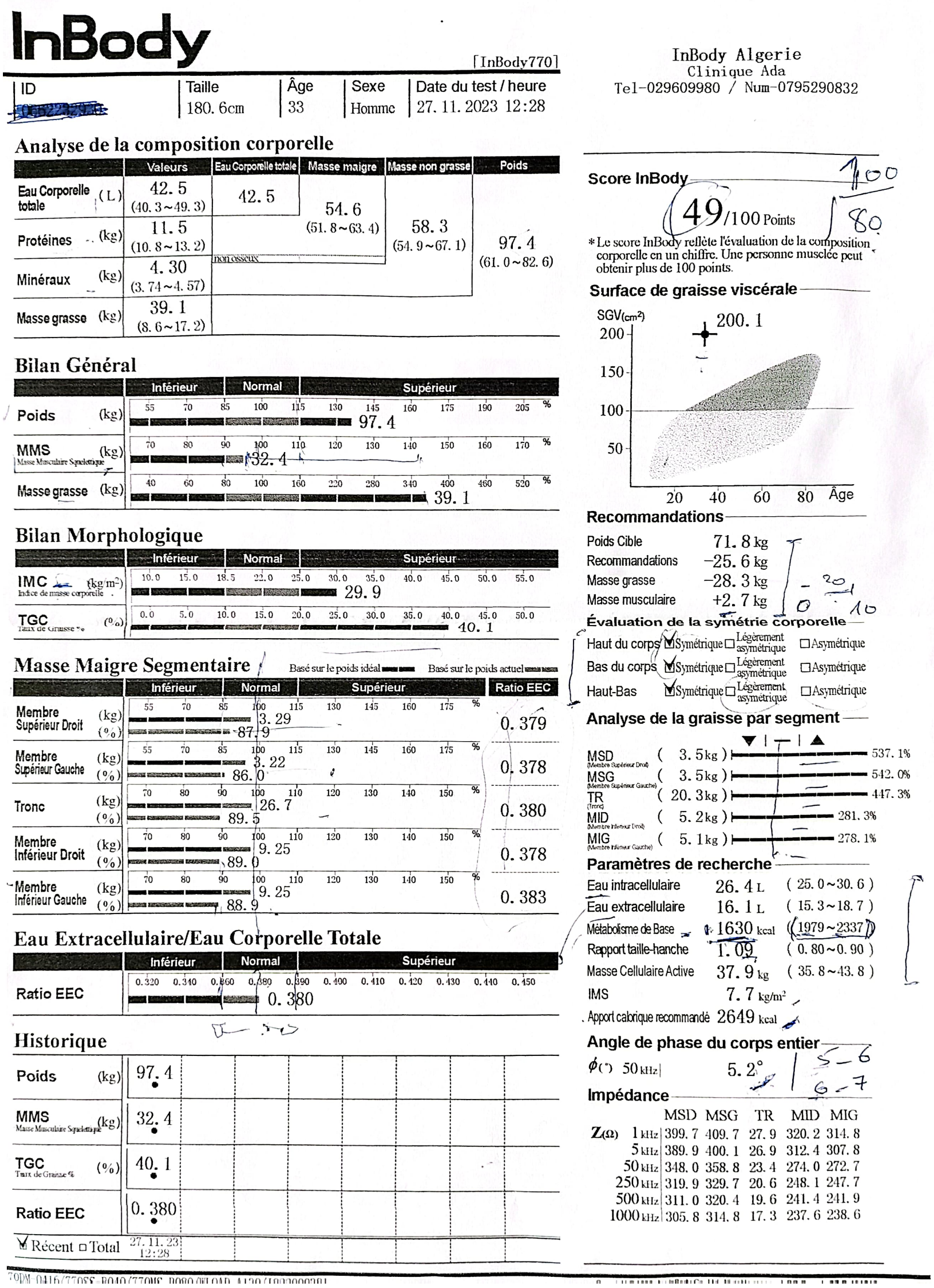

Figure 3.24: Result for the third volunteer.

3.6 Recommendations and contraindications

3.6.1 Recommendations

1. Before the measurement, spread your arms slightly apart.
2. Before each measurement, use an Anios-type wipe to clean the electrodes on the feet and hands.

3. Before each test, roughly clean the palms of your hands and the soles of your feet with a wipe before taking the test in order to moisten the skin and allow better conduction.

4. The measurement must be done barefoot

5. Not having practiced physical activity before the measurement

6. Not having taken a bath or shower before the measurement

7. Do not drink or eat before the analysis

8. Go to the bathroom before taking the test

9. Avoid the period of menstruation

10. Perform the measurement at room temperature to avoid a change in body temperature

3.6.2 Contraindications

- The only contraindications to the use of InBody concern implantable Defibrillators and Pacemaker wearers.

- Pregnant women?

  Impedance measurements are safe for pregnant women. However, the measurements will be distorted due to the peculiarity of their condition (the fetus will be considered a fatty mass).

3.7 Conclusion

The practical part has demonstrated the InBody 770's potential to revolutionize body composition assessment, providing healthcare professionals and, non-invasive, and comprehensive tool to support promoting health, fitness, and overall wellness.

General conclusion

In conclusion, the integration of medical analysis tests, particularly blood tests, with InBody 770 device analysis offers a comprehensive approach to understanding an individual's health status.

The InBody 770 device provides detailed body composition analysis, including body fat, muscle, and water distribution, enhancing insights into a patient's inner health. Moreover, the device's accuracy and precision, as evidenced by studies comparing it to the gold standard models, make it a reliable tool for healthcare professionals.

The InBody 770's ability to measure extracellular and intracellular fluid separately for each limb, along with phase angle measurements, adds a layer of depth to health assessments. Looking ahead, future work could focus on refining the accuracy of InBody 770 device analysis further, exploring its applications in different healthcare settings, and potentially integrating it with other diagnostic tools to enhance overall health monitoring and treatment strategies.

Overall, the search results indicate that the InBody 770 device has the potential to play an increasingly important role in various healthcare settings, from personalized patient care to military and research applications, as healthcare providers continue to seek innovative, data-driven solutions to improve patient outcomes.

In the first chapter, the body's physical and biological systems, their meaning, and the fundamentals of direct segmental multi-frequency bioelectrical impedance measurement have all been covered in general.

In the second chapter, the description of In body and the guiding principles of Inbody 770 have been discussed. to supply In body's precision. To wrap up our explanation of InBody 770's limitations, we will outline the key components of the body composition assessment process and contrast it with other body composition analysis techniques.

The practical work and a detailed description of the Inbody 770 analysis results are included in the third chapter.

We have given insightful information about a person's general health and well-being. Because of its well-known accuracy and precision, the InBody 770 gadget is a trustworthy instrument for confidently evaluating general health status and tracking alterations in body composition. The combination of cutting-edge body composition analysis using the InBody 770 with conventional blood testing improves the precision and breadth of medical assessments, which in turn results in more individualized and efficient healthcare interventions.

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Abstract

The InBody 770 device analysis utilizes bioelectric impedance analysis (BIA) to measure body composition, including resistance, providing a detailed assessment of muscle, fat, and water distribution. This method offers accurate, efficient, and rapid analysis, enabling healthcare professionals to quickly evaluate a patient's health status. By leveraging the precise data from the InBody 770, medical practitioners can detect subtle changes in body composition that may indicate early signs of cancer. This advanced technology not only streamlines the diagnostic process but also enhances the ability to monitor and address potential health concerns promptly, ultimately contributing to more effective cancer diagnosis and treatment strategies.

Keywords: InBody 770, bioelectrical impedance analysis (BIA), body composition, resistance, muscle, fat, water distribution, healthcare professionals, advanced technology.

Résumé

L'analyse de l'appareil InBody 770 utilise l'analyse d'impédance bioélectrique (BIA) pour mesurer la composition corporelle, y compris la résistance, fournissant une évaluation détaillée de la distribution des muscles, des graisses et de l'eau. Cette méthode offre une analyse précise, efficace et rapide, permettant aux professionnels de la santé d'évaluer rapidement l'état de santé d'un patient. En tirant parti des données précises de l'InBody 770, les médecins peuvent détecter de subtils changements dans la composition corporelle pouvant indiquer des signes précoces de cancer. Cette technologie de pointe simplifie non seulement le processus de diagnostic, mais aussi améliore la capacité de surveiller et de traiter rapidement les problèmes de santé potentiels, contribuant ainsi à des stratégies de diagnostic et de traitement du cancer plus efficaces.

Mots clés: InBody 770, analyse d'impédance bioélectrique (BIA), composition corporelle, résistance, muscle, graisse, distribution d'eau, professionnels de santé, technologie avance.

ملخص

يستخدم تحليل جهاز إنبودي 770 تحليل المقاومة الكهربائية الحيوية لقياس مكونات الجسم ، وتوفير تقييم مفصل لتوزيع العضلات والدهون والماء. تقدم هذه الطريقة تحليلا دقيقا وفعالا وسريعا ، مما يسمح للمهنيين الصحيين بتقييم الحالة الصحية للمريض بسرعة. من خلال الاستفادة من البيانات الدقيقة من إنبودي 770 ، يمكن للأطباء الكشف عن التغيرات الطفيفة في تكوين الجسم التي قد تشير إلى علامات مبكرة للسرطان. هذه التكنولوجيا المتطورة ليست فقط لتبسيط عملية التشخيص، ولكن أيضا لتحسين التشخيص بسرعة وعلاج المشاكل الصحية المحتملة، وبالتالي المساهمة في تشخيص السرطان أكثر فعالية ودقة.

الكلمات المفتاحية: إنبودي 770 ، تحليل المعاوقة الكهربائية الحيوية ، تكوين الجسم ، المقاومة ، العضلات ، الدهون ، توزيع المياه ، المتخصصين في الرعاية الصحية ، التكنولوجيا المتقدمة.