Body composition and measurement options

A testösszetétel és mérési lehetőségei

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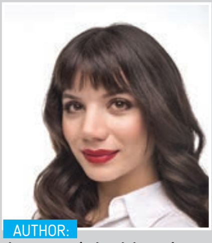

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ÖSSZEFOGLALÁS:

A tápláltsági állapot meghatározására mai napig a legszélesebb körben alkalmazott módszer a BMI (Body Mass Index, Testtömeg index, TTI). Tudományos szempontból, mivel csupán a testtömeget és testmagasságot veszi alapul, számos esetben félrevezető lehet, és csak korlátozottan alkalmas az egészségi állapot és a túlsúlyosság mértékének szakszerű megállapítására. Napjainkban már sokkal korszerűbb, pontosabb módszerek is léteznek.
A bioimpediancia elvén alapuló testösszetételt mérő rendszerek (BIA) részletes információkat adnak a testsúly, izom- és zsírtömeg, valamint víztartalom tekintetében. Az alkalmazott frekvencia tartományok és a mérési pontok nagyban befolyásolják a mérési adatok pontosságát, ebben a tekintetben kiemelkedő az Inbody termékcsalád.
A többi készülékkel szemben a zsírmentes testtömeget és a zsírtömeget képes végtagokra bontva is megadni. A tápláltsági állapotban bekövetkező változások előrejelzésként szolgálhatnak a betegségek kimenetelével kapcsolatban, így a testösszetétel-mérés eredménye széles körben felhasználható az egészségügy számos területén. Ilyen például a dietoterápia, elhízás kezelése, perioperatív ellátás, sporttáplálkozás, különböző terápiák kiegészítése (onkológia, nefrológia, diabetológia, kardiológia, stb.), rehabilitáció. Mindezeket figyelembe véve érdemes lenne szélesebb körben alkalmazni a BIA alapú készülékeket a primer prevenció területén is (pl. háziorvos, lakossági szűrések, oktatási intézmények, munkahelyi egészségfejlesztés, életmód orvoslás).
Kulcsszavak: testösszetétel, tápláltsági állapot, BMI, BIA, InBody

ABSTRACT:

The most commonly used method for determining nutritional status to date is the BMI (Body Mass Index). From a scientific point of view, as it is based only on body weight and height, it can be misleading in many cases and is of limited use for the professional assessment of health status and obesity. Today there are more modern and accurate methods. Bioimpedance-based body composition assessment (BIA) systems provide detailed information on body weight, muscle and fat mass and water content. The frequency ranges and measurement points used have a major impact on the accuracy of the measurement data, and the Inbody series excels in this respect. Unlike other devices, it can also provide lean body mass and fat mass broken down by limb. Changes in nutritional status can be used as a predictor of disease progression, so the results of body composition measurement have applications in many areas of healthcare. Examples include diet therapy, obesity management, perioperative care, sports nutrition, supplementation of various therapies (oncology, nephrology, diabetology, cardiology, etc.), rehabilitation. Considering all these factors, it would be worthwhile to extend the use of BIA-based devices to the field of primary prevention (e.g. general practitioners, population screening, educational institutions, workplace health promotion, lifestyle medicine).
Keywords: body composition, nutritional status, BMI, BIA, InBody

To this day, the most common method for determining nutritional status is the BMI (Body Mass Index) (Caballero, 2019). The BMI was developed between 1830 and 1850 by Adolphe Quetelet. Although it does not indicate the actual body fat percentage, it can be useful to determine the ideal body weight in relation to height. Because it is easy to calculate, BMI is often used to assess obesity in the general population, but it has several shortcomings. In particular, it is unable to determine the distribution of body fat, which would play an important role in characterising the health risk associated with obesity. Furthermore, it does not provide information on the amount of body fat mass and is therefore of limited use for the diagnosis of obesity. Finally, it does not provide insight into the genetic, metabolic, physiological or psychological causes of obesity, nor does it provide insight into the diversity of the disease (Bray, 2023). According to researchers, the body mass index can be misleading in many cases and is of limited use as a professional indicator of health status and the extent of obesity (Bosello - Vanso, 2021).

In athletes - with above-average lean muscle mass - the figure can be distorted and in unjustified cases indicate overweight. Quetelet already pointed out this correlation when he developed the formula. Since the 2010s, scientists have increasingly criticised the use of BMI (Nordqvist, 2022), but it is still the most commonly used measure of nutritional status in dietetic and clinical practise. There are now more sophisticated methods of assessing the degree of obesity that are more accurate and complex than actual fitness status. These include bioelectrical impedance analysis (BIA), densitometry: hydrodensitometry, whole-body plethysmography, infrared transmission measurements and other medical diagnostic methods such as ultrasound, MR, CT or DEXA (Duren et al.) Some of these more modern methods are based on

Figure 1 Segmented body

the principle of ionising radiation, such as DEXA and CT. These two methods also have a technical justification, as DEXA is the most modern method for measuring bone density. CT scans, like MR, are indispensable for the diagnosis of other pathologies and are subject to a waiting list, which makes their use for determining body composition superfluous. The most common instrument for measuring body composition in practice is the BIA. Compared to anthropometric methods, it provides a more accurate picture of body composition and has a lower measurement error. Unlike other medical diagnostic methods, BIA is available in a compact package and can be performed quickly and easily in terms of testing time, making it widely applicable and offering the advantage of no radiation exposure.

In the following, we will take a closer look at the BIA-based devices for measuring body composition InBody.

INBODY

The InBody is a non-invasive, fast and accurate body composition analyzer that provides detailed information on body weight, muscle and fat mass and water content. The device sends alternating low and high frequency electrical currents through the body during the measurement, using the body's water content as a conductive medium. This is passed through electrodes in contact with the skin of the palms of the hands and soles of the feet to measure the impedance of the various tissues.

ADVANTAGES OVER OTHER BIA DEVICES

Most BIA devices only use a frequency of 50 kHz to measure impedance, which cannot fully penetrate the cells of the body. This makes it impossible to accurately measure the water inside and outside the cell as well as the total body water. This knowledge would be crucial for identifying fluid imbalances that may be associated with acute inflammation or edema. By using different frequencies of the InBody, the device can take much more accurate measurements. In addition, it divides the body into 5 units (right and left arm, torso, right and left leg), whereas other BIA-based devices usually treat it as a single unit. Thus, it provides a much more detailed segmentation of lean body mass and body fat mass by limb (InBody Technology, 2023). Figure 1

FACTORS FOR A CORRECT MEASUREMENT

The accuracy of the measurement can be affected by a number of factors (temperature, food and fluid intake, exercise, body position, pregnancy, etc.), but the potential for error can be minimised by following certain rules. The manufacturer recommends performing the tests under identical conditions (e.g. the day before the test, make sure you drink enough fluids (avoid alcohol and coffee), and on the day of the test you should consume a maximum of 4.5-5 dl of water 45 minutes before the test, and it is recommended to eat 2-3 hours before the test. Heavy clothing, jewellery and large objects stored in pockets should be removed before the test. It is important that the bare soles of the feet and palms of the hands are in contact with the metal electrodes as much as possible. Conductivity can be improved by using wet wipes, but can also be affected by using various hand creams. It is recommended to wash immediately before application and to adopt a standing position for at least 5 minutes to ensure an even distribution of the liquid fields. However, bathing, sauna bathing and exercise within 3 hours of each other reduce the accuracy of the results. Contraindications for performing the test are wearing implanted heart rate regulators and the absence of limbs (Precautions for the InBody Test - The InBody Test and InBody Test Procedure, 2023).

THE INBODY RESULT

You can also use an InBody Scorecard to analyse the results, which summarises the various data. Some of these indicators are of particular importance for characterising the state of the body. These include body weight, muscle and fat mass (and their breakdown at the endothelial level), body fat

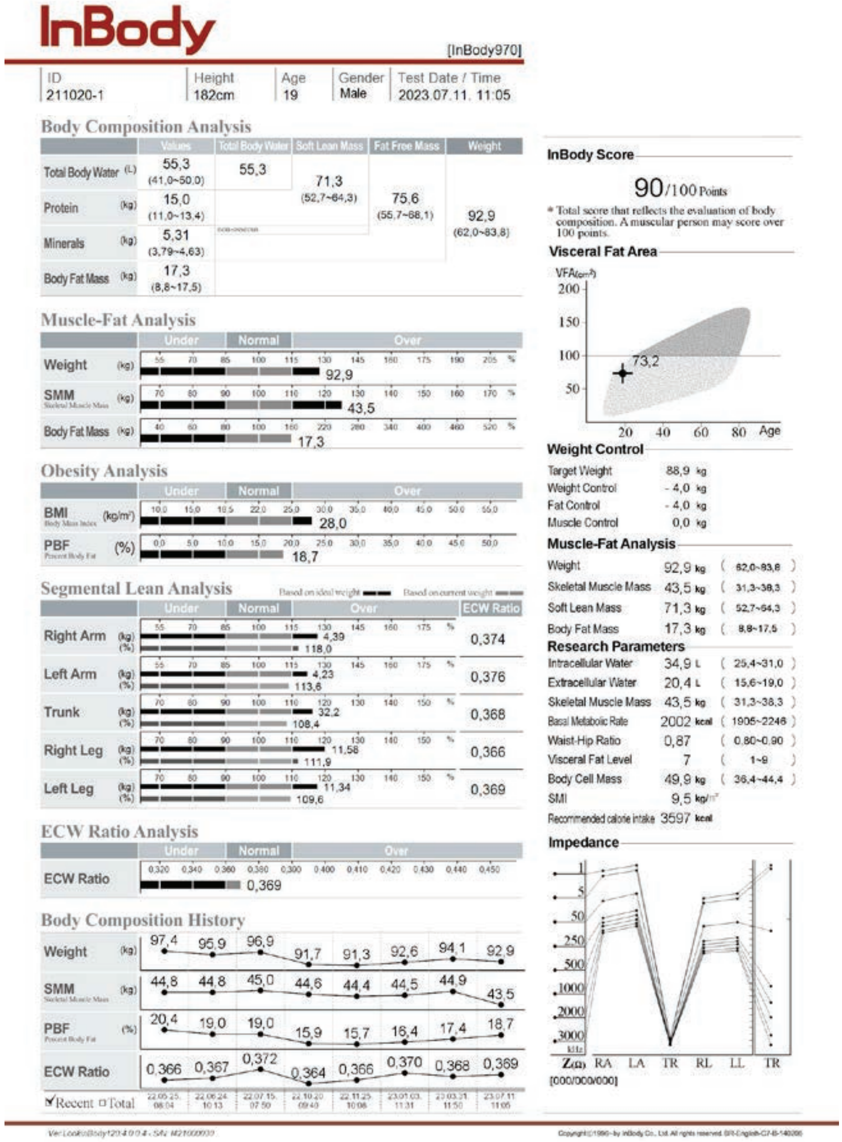

Figure 2 InBody results sheet

percentage, visceral fat, water spaces, mineral content, resting basal metabolic rate, estimated calorie requirements and phase angle. The most important parameters of the previous measurements are displayed in a line graph so that changes in body composition can be easily tracked. In addition, the tool's database provides you with a wide range of other data, results and their various interpretations (770 Results sheet interpretation). For an even more detailed analysis, software (LookInBody) is available that provides more detailed data on the entire measurement and transmits the summarised results electronically to the attending physician, the client or other persons involved in the treatment or lifestyle programme after the measurement. Figure 2

USE IN CLINICAL PRACTICE

Measuring body composition is an important element of dietetic work.

On the one hand, it provides a starting point for the beginning of a nutritional intervention and, on the other, it enables more precise tracking during the process. It can also be used in many other areas of healthcare to complement and support various therapies, e.g. oncology, nephrology, diabetology, cardiology, perioperative care, bariatric surgery, occupational medicine, rehabilitation, physiotherapy, lifestyle medicine, etc.

Japanese researchers have published several studies on changes in body composition. These have

Figure 3 InBody product rangre

been conducted in the context of resection surgery or oncologic treatments involving different sections of the alimentary canal, as nutritional status is the most important clinical determinant of recovery after such procedures. However, further research is needed to clarify whether nutritional intervention contributes to the reduction of postoperative morbidity (Kiyama et al. 2005; Ida et al. 2014; Mikamori et al. 2016).

INBODY PRODUCT RANGE

The Inbody range includes several body composition scales on the market that operate at different heights and frequencies (Inbody 270, 570, 770 and 970). The more frequencies the scale uses, the more accurate the measurement data it can provide (Yi et al, 2022). In addition, there are other measuring devices (e.g. stadiometer, blood pressure monitor, body water analyzer, visceral fat analyzer, InBodyBAND bracelet) that can be synchronised with each other via the LookInBody software.

Type of InBody device	Frequency (kHz)
270	20, 100
570	5, 50, 500
770	1, 5, 50, 250, 500, 1000
970	1, 5, 50, 250, 500, 1000, 2000, 3000

Table 1 InBody product rangre

BIA VS. CT

Several studies have compared the results of BIA and CT measurements and found that there is a significant correlation between muscle mass and visceral fat (Ogawa et al. 2011; Kim et al., 2019).

INBODY VS. DEXA

A 2019 study compared InBody 770 and DEXA in terms of changes in body composition in trained men and women after a 4-week program. The researchers found that the device was able to show similar changes to DEXA in fat mass, fat-free mass and percentage body fat. InBody has a lower margin of error due to its multiple frequencies and is an excellent method for estimating total body composition (Antonio et al. 2019).

In a study published in the British Journal of Nutrition 2022, the accuracy of the DSM-BIA (InBody 770) was compared to other methods of measuring body composition (DEXA, ADP, BIS) in 110 participants of different races and ethnic backgrounds. The study found that, in addition to DEXA and ADP, the InBody device measured “excellent to ideal” percent body fat and “ideal” fat-free mass relative to criterion. The devices have the potential to provide valid body composition results for different population groups (Blue et al. 2022).

TESTING WATER

According to a 2018 study, InBody showed a high level of agreement with the D20 total body water (TBW) measurement, the gold standard for measuring body water. In addition, its low cost, rapid results and field calibratability make it a useful method for clinical TBW measurements (Ng et al., 2018).

RESTING METABOLISM

In a study from 2018, Salacinski and colleagues investigated the significance of the InBody520 in determining resting metabolic rate (RMR) compared to the results of the Metabolic Cart. There was no significant difference between the values estimated by InBody and those measured by the Metabolic Cart (Salacinski - Howell - Hill, 2018).

SUMMARY

To date, the most widely used method for determining nutritional status is the BMI (Body Mass Index). From a scientific point of view, as it is based on body weight and height alone, it can be misleading in many cases and has limited usefulness for professional assessment of health status and obesity. BIA-based devices are widely available, easy to use and have no adverse health effects. They provide detailed information on body weight, muscle and fat mass and water content. Frequency ranges and measurement points have a major impact on the accuracy of the measurement data, and the Inbody range excels in this respect. Unlike most devices, it can also provide fat-free body mass and fat mass broken down by limb. Changes in nutritional status can be used as a predictor of disease outcome, making body composition measurement results widely applicable in many areas of medicine, sports science and nutrition. Examples include diet therapy, obesity treatment, perioperative care, sports nutrition, adjunct to various therapies (oncology, nephrology, diabetology, cardiology, etc.), rehabilitation.

In view of all these factors, it would be worthwhile to extend the use of BIA-based devices to primary prevention (e.g. general practitioners, population screening, educational institutions, health promotion in the workplace, lifestyle medicine).

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