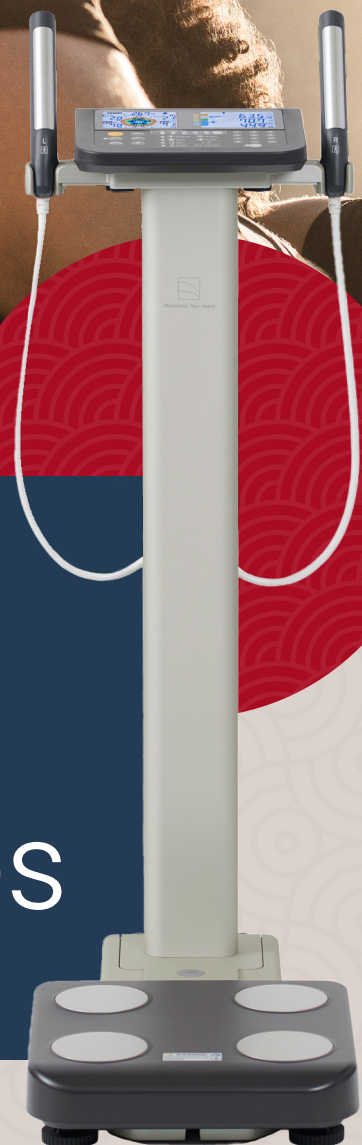


A practical guide to the applications of BIA with athletes





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TANITA is the global leader in BIA technology, with sales of more than 28 million professional and home-use BIA body composition scales.

Founded in 1923, TANITA Corporation is an ethical healthcare product manufacturer with international headquarters located in Tokyo, Japan. A European HQ in Amsterdam and a UK office in Manchester.

TANITA Advanced BIA technology is recognised as the most accurate and is further supported by on- going independent scientific research into obesity, physical activity and lifestyle diseases.

Going beyond body fat

'In sport science the assessment of body composition has different applications such as identifying individual's characteristics critical to performance, evaluating the effects of training programs, managing weight strategies in weight-category sports'

TANITA understands the challenges facing Sports Scientists:

- Not enough time with athletes.
- Ease of access to relevant data.
- Justifying your decisions.
- Demand to 'work athletes harder'.
- Personalising interventions for individual athletes.
- Empowering the athlete with relevant information about their body.

Time to test and intervene is precious.

Professionals from across Sports Science can utilise BIA to enhance their current practices, gain further insight into their athletes and save time.

Understanding human responses to sport and exercise and how performance can be monitored, analysed and enhanced are vital to helping sports fitness professionals maximise their athletes levels of performance. In this document we will guide you through the more advanced features of segmental, multi frequency BIA and how this can be utilised in specific roles.

A powerful use of TANITA BIA with athletes is the ability to individualise everything you do as a coach. This is a rare commodity and the ability to do it in a 30 second test is unique!

Body composition and bio-impedance analysis

How does it work?

From Single to Multi-frequency

Electrodes send a very low voltage, safe electrical current through your feet, legs and abdomen.

In segmental models you will also hold 4 electrodes and the signal is passed from arm to arm and a cross sectional hand to foot.

Historically BIA technology worked on a single frequency, however, recent upgrades now mean TANITA multi frequency technology is able to penetrate the cell membrane, offering a much more accurate interpretation of body composition.

What does it measure?

Resistance (R)

Resistance is the effect on an alternating current caused by the energy dissipating characteristics of the body.

Resistance is related to water in the body. Low resistance; indicating high conductivity, is due to large amounts of water in the body.

As fat-free mass within the body is approximately 75% water, resistance in the body is proportional to the amount of fat-free mass.

A low resistance is consistent with a high amount of fat-free mass.

A high resistance is consistent with a lower amount of fat-free mass.

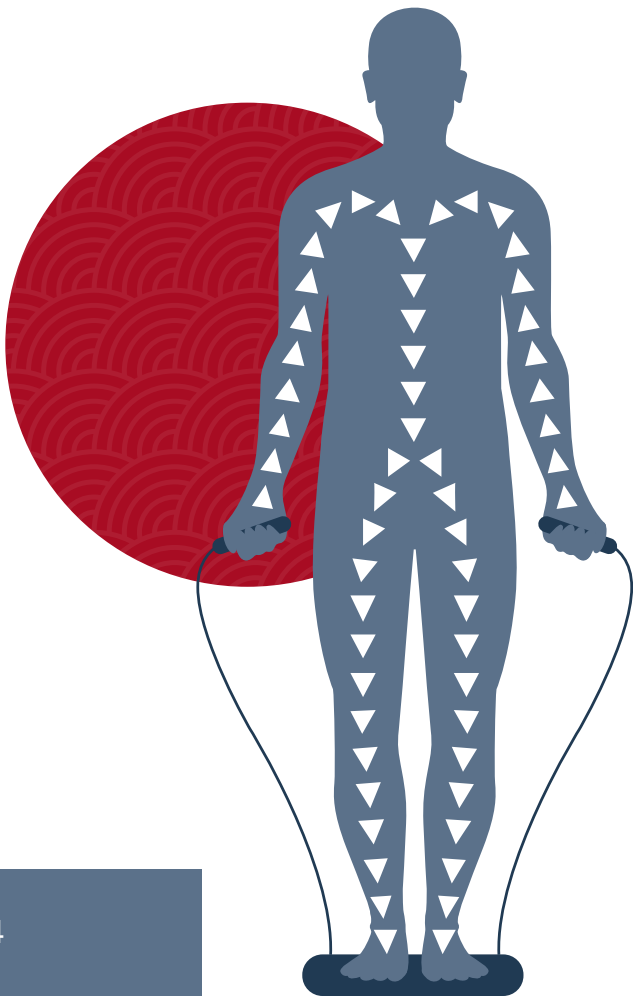
Reactance (X)

Reactance is the effect on an alternating current caused by the energy storage capacity of the body.

Healthy cells with good cellular integrity are better able to hold fluids, nutrients, and therefore, also an electrical charge, causing a lag in the current flow.

By measuring reactance (or lag), it is possible to determine the size and integrity of body cell mass.

A high reactance indicates large quantities of healthy cells with intact cellular membranes.



Measurements available



Weight



(BMI) Body Mass Index

Indicates the relationship between weight and height



Body Fat Mass

The weight of fat in the body



Body fat percentage

The percentage of total body weight which is fat



Visceral Fat Rating

Indicates the level of fat surrounding the vital organs. This type of fat contributes most to the risk of developing heart disease, diabetes and some cancers



Total Body Water

The total amount of water in the body as a percentage of body weight



Intracellular and Extracellular Water*

Indicates how much water is held within the cells versus water held outside of cells. A good indicator of cellular health and oedema



Muscle Mass (lean mass)

The weight of muscle within the body; Includes skeletal muscle, smooth muscle and cardiac muscle



Skeletal Muscle Mass

The weight of the skeletal muscle alone



BMR (Basal Metabolic Rate)

Number of calories the body needs at rest



Metabolic Age

Age the body is rated at according to the BMR value



Physique Rating

Assesses physique according to the ratio of body fat and muscle mass



Bone Mineral Mass

The weight of the bone mineral element of the skeleton



Segmental Body Composition*

Body fat and muscle are analysed segmentally in order to assess fat and muscle distribution



Muscle Mass Balance*

Illustrates any imbalance between muscle mass in the body



Leg Muscle Score*

Can be an early indicator of future frailty



Phase Angle*

Phase Angle is the direct measurement of the integrity of cell membranes and how well they function



Sarcopenic Index*

A risk indicator for the individual developing Sarcopenia.

How accurate is TANITA bio-impedance analysis?

TANITA BIA monitors have been extensively validated against alternative methods of assessing body composition ensuring precision, accuracy and **scientific excellence**.

Independent studies worldwide highlight TANITA as the BIA **Gold Standard** within the scientific community.

TANITA Medical Advisory Board (TMAB) ensures TANITA remains at the forefront of scientific advances.

TANITA invest in ground breaking research projects including the world's first child centiles for body fat and muscle mass, the health of older people and sarcopenic obesity.

Award winning Japanese manufacturing which guarantees the highest quality and meets strict international quality standards.

TANITA utilises 4C methodology in refining our algorithms and regression equations to ensure **the most accurate bio-impedance and body composition analysis available**.

A widely acknowledged limitation of BIA for athletes is the lack of appropriate regression formula, due to these being developed for 'norm populations'. To address this TANITA have created a formula specifically for athlete population, use '**Athlete Mode**' for optimal accuracy.



Welcome to the next level in **4c**curacy

Introducing the 4-Compartment measurement from TANITA

TANITA continues to offer the most accurate calculation of fat, lean mass (or muscle) and bone mineral density available, but with 4C monitoring we go even further, giving an unparalleled, 4-Compartment measurement.

Our new 4C method will enable you to fully assess levels of body fat, protein, bone mineral mass and water within the body.

What is the 4-Compartment (4C) model?

The 4C model divides **body weight** into **fat**, **water**, **mineral**, and **protein** using the **gold standard** method for measuring each element.

The 4C model involves the measurement of body mass or weight, total body volume (air displacement), total body water (D20), and bone mineral (DXA); however, specialized laboratory equipment is required minimizing the availability of the 4C method to many clinicians and researchers.

"The 4-Compartment model is a gold standard method to assess body composition in many conditions such as over and under nutrition, hydration, obesity and sarcopenia."

Professor Angelo Pietrobelli
Verona University Medical School
TMAB Member



Fat mass

97% ACCURACY

as compared with the 4C method⁽⁹⁾

Fat free mass

98% ACCURACY

as compared with the 4C method⁽⁹⁾

Muscle mass

98% ACCURACY

as compared with the 4C method⁽⁹⁾

Total body water

98% ACCURACY

as compared with the 4C method
(D20)⁽⁹⁾



Key terms

Phase Angle (PhA)

An indicator of cellular integrity. Many clinical applications, there is now an increasing use with athletes linking cellular stability with overtraining and fatigue.

Total Body Water/Intra & Extracellular water

Total Body water can now be broken down further into ECW & ICW for an enhanced analysis of hydration status.

Segmental Muscle Analysis

5 segment analysis for muscle mass, trunk, left/right arm, left/right leg.

Benefits of TANITA BIA technology for Strength & Conditioning Coaches

Applications of BIA

- Monitor changes to muscle and hydration to assist periodisation.^{3,4,5,7,11,12}
- Track segmental muscle development.^{6,7,11,12}
- Monitor stress and overload effects of training and competition, including overtraining syndrome.^{3,6,7,13,14}
- Pre/Post training hydration checks.^{4,5,11}
- Track youth team physical development.¹⁰
- Create and monitor optimal fat mass/fat free mass ratios for athletes in different disciplines.^{1,4,8,11,12}

Outcomes for the coach

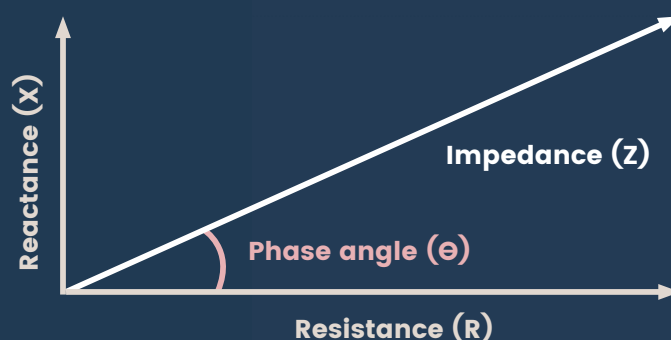
- Personalise & adapt training sessions to the individual athlete needs.
- Demonstrate the effectiveness of your interventions.
- More effective planning and periodisation through analysis of adaptations.
- Detailed athlete 'mapping' on an individual basis, make it specific to their needs and build a profile.
- Tangible data for impact of specific sessions e.g. hypertrophy.

Outcomes for the athlete

- More appropriate training to their needs as an individual.
- Increased engagement and motivation.
- Decreased injury risk.
- Improved performance.

Phase Angle (PhA) at baseline is associated with the best maximal mean power.³

Phase Angle (PhA) decreased significantly throughout the days of competition.²



$$Z = \sqrt{R^2 + X^2}$$

$$\theta = \tan^{-1} \frac{X}{R}$$

Benefits of TANITA BIA technology for Physiotherapists

Applications of BIA

- Rehabilitation tool – muscle mass return to pre injury levels.^{6,7,8,11,12}
- Prehabilitation and Injury prevention checks – monitor segmental muscle balance to help prevent injuries.^{7,8,11,12}
- Monitor ECW post trauma injury.^{4,5,11}
- Pre-assessment of athletes to check for biomechanical inefficiencies.^{6,7,8,11,12}
- Ability to monitor the physiological impact different injuries have on individual athletes.^{1,7, 8,11,12, 13,14}

Outcomes for the physio

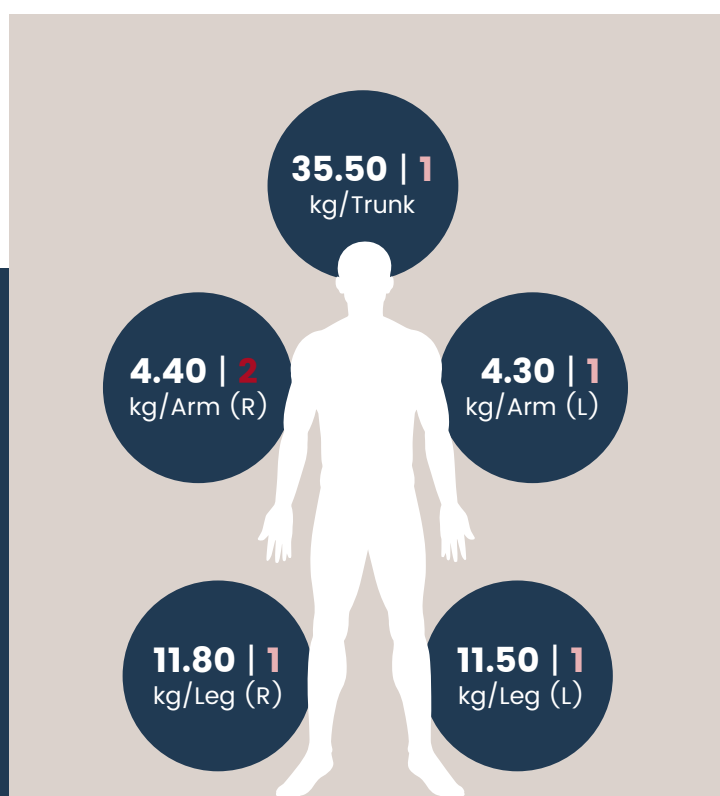
- Increased understanding of the physiology of all athletes.
- Personalised injury 'mapping' for each athlete. Flag injury potential before it happens.
- Tangible data to monitor rehabilitation from injury.
- Demonstrate the effectiveness of your interventions.

Outcomes for the athlete

- Faster return from injury.
- Safer return from injury.
- Individualised prehabilitation and recovery strategies, improve performance and prolong career.
- Better understanding of their bodies leading to greater engagement in prehab and recovery protocols.

Monitor the demands of training and competition on the body.⁶

Significant correlation between PhA and muscle strength.⁷



Benefits of TANITA BIA technology for Dietitians & Nutritionists

Applications of BIA

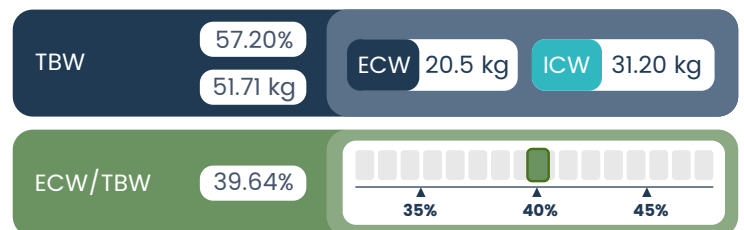
- Track effectiveness of nutritional programmes on an individual level.^{1,2,9}
- Monitor hydration pre & post training, including competition on an individual level.^{4,5,11,12}
- Monitor the impact of supplements on fluid balance and body composition.^{4,5,11}
- Monitor changes to body composition following dietary adaptations – e.g. vegan.^{9,11}
- Greater impact on the athlete by providing regular feedback. Encouraging them to 'buy in' to the required lifestyle adaptations that help improve performance.^{1,13}

Outcomes for the dietitian

- Track more than changes in weight.
- Provide detailed feedback to athletes.
- Build individual nutrition guidelines for each athlete based on their needs.
- Ability to monitor the impact of dietary alterations on a individual level.

Outcomes for the athlete

- Increased engagement from detailed feedback
- Healthier and improved energy systems.
- Improved performance.
- Prolonged career.



Monitor progress of an hydration strategy.⁴

BIA can be used to prevent dehydration.⁴

Changes in body fluid can be tracked.⁵



For every step of an athlete's career



Junior

- Focus on health and development.
- Monitor healthy body composition.
- Detailed analysis of developing muscle mass is possible by utilising TANITA muscle mass centiles.¹⁰

Youth

- Monitor muscle/fat ratio, specific to the developing athlete and sport.
- Utilise TANITA Muscle Mass centiles.¹⁰
- Individualise athlete data as you start to personalise nutritional and S&C programming.
- Allows for regular feedback to help motivation and engagement of young athletes as they adopt a 'professional athlete lifestyle'.
- Help developing bodies recover better by monitoring individual responses to training and competition.

Senior

- Enhanced individualised programming that is regularly monitored.
- Individualise Prehab, Rehab & Recovery to the athlete not the team or sport.
- Help to create engagement from athletes into their personalised plans, they can clearly see adaptations 'off the pitch', removing excuses or the reasons they don't follow any plan.
- Build data into your portfolio as a professional to demonstrate your impact on the athlete.
- Save time and share accurate data within your performance team.
- Utilise the technology for the wider staff base, contributing to a healthier workplace.

Professional football

TANITA spent a week testing 12 first team professional footballers in the UK.

By utilising this data staff were able to adapt training sessions and develop individualised prehab and recovery strategies. Ensuring players were in optimal condition for matches.

Whilst many sport scientists will see the below data 'as expected', it is not something that is consistently monitored on a daily basis.

As we know individual athlete responses differ, they recover at a different rate. The only true way to individualise is to monitor and adapt what we do as coaches. Utilising TANITA technology allows you to do this, maximising the performance potential of each individual athlete.

- **75%** of players showed a loss of weight in at least one training session
- **67%** of players showed a loss of Total Body Water
- **83%** of players showed a decreased Phase Angle
- **67%** of players showed a reduction in Intracellular water levels
- **10%** of players showed decreased weight, Total Body Water, Intracellular water and Phase Angle in every training session



During his time at Notts County FC, Dietician Matt Lawson utilised TANITA technology.

"Our teams scored more late goals in the last 15 minutes of games than in the history of the club. Players were ultra fit and fed a high quality diet with intense monitoring that they loved because it made them successful."

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