InBody220

# Results Interpretation & Application

BIOSPACE

## Body Composition Analysis

### Things to keep in mind for the accurate measurement with InBody220

The accuracy of a test involving a body composition analyzer is dependent on the examinee and on the environment in which the test is conducted. As such, certain precautionary steps should be taken in order to assure accurate test results. Before conducting the test, please read the following rules carefully and make sure that the examinees have taken into account all the factors capable of affecting the test results and the accuracy of the testing.

### ■ Precautionary steps to be taken before conducting a test

1. Assure that the test is conducted before a meal
In cases where the examinee has already eaten, the test should be put off until two hours have elapsed since the last meal. This is because the mass of the food is counted as weight, and thus, may result in measurement errors.

2. Make sure to use the bathroom
Although not included in the body's compositional elements, the volume of urine and excrement is included in the weight measurement. This can result in biological errors.

3. Do not exercise right before conducting the test
Strenuous exercise or sharp movements can cause temporary changes in body composition.

4. Stand still for about 5 minutes
Conducting the test immediately after laying in bed or sitting for a long period of time might result in a slight change in the test results. This is because body water tends to move to the lower extremities of the body as soon as a person stands or gets up.

5. Do not conduct the test right after shower or the sauna
Sweating causes temporary changes in a person's body composition.

6. Do not take measurements during the menstrual cycle
Females experience increases in body water during their menstrual cycle.

7. Conduct the test at normal temperatures (20℃~25℃)
While the human body is stable at normal temperatures, body composition is susceptible to change in hot or cold weather.

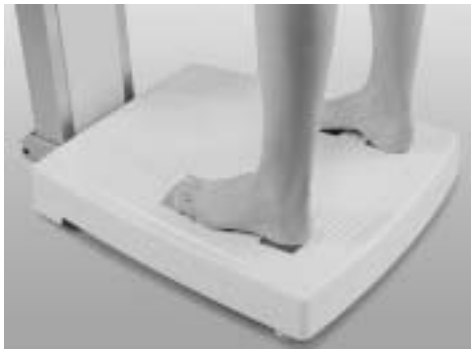
8. If a retest is carried out, make sure to conduct the test under consistent conditions
Identical conditions (i.e. wearing the same clothes, testing before eating or exercising etc.) should be maintained in order to assure the accuracy of the test results.

## ■ Posture guide for body composition analysis

**A Proper posture increases the accuracy of the test results.**

***Weight measurement and how to step on the footpads**

Please remember to remove your socks or stockings before stepping on the footpad. If at all possible wear light clothing to assure the accuracy of the test. Be sure to remove everything from your pockets and all accessories. When ready, place your feet on the footpads as the shapes of electrodes guide. A reading of your weight will first be conducted. Do not hold on to the handgrips while the body weight is being registered. Moreover, do not make any sudden moves during the weighing process.



** It is important to properly place your feet on the footpads. Please do not move during weighing.*

***Input of personal data and how to hold the handgrips**

Please enter your exact height. If not, test results will be inaccurate. The gender and age of the examinee should also be entered. Once you have entered your personal data, please take the proper posture. Put your thumb on the top of the handgrip, while holding the bottom of the handgrip with your other four fingers. Straighten out your elbows and leave some space between your armpits and body.

** If the handgrips are not properly held during the test, an incorrect estimation of the examinee's body composition may occur. Please assure that proper testing methods are maintained until the test is complete.*

## 1. I.D., AGE, HEIGHT, GENDER, DATE/TIME

Once the body composition analysis of the examinee is complete, the results are automatically printed.

| I.D. | AGE | HEIGHT | GENDER | DATE / TIME |
|---|---|---|---|---|
| GN0074 | 26 | 160cm | F | 2005.01.09/10:23:40(0009) |

**B. Hospital**
Doctor Lee

At the top of the results sheet, appear the I.D., age, height and gender of the examinee and the date and time when the test was conducted. The logo, registration number, and name of the hospital (or user) can also be recorded on the result sheet. This allows the user to indirectly advertise their company or institution.

1) Personal data such as gender, age, and height of the examinee should be entered as well.
2) The user's logo can be entered only using a software program provided by an external service provider. Therefore, the equipment provider's assistance will be required should the user desire to install his/her logo.

## 2. Body Composition Analysis

**Body Composition Analysis**

| | Values | Fat Free Mass | Weight | Normal Range |
|---|---|---|---|---|
| T B W (ℓ) Total Body Water | 28.0 | 38.3 | 60.3 | 27.4 ~ 33.5 |
| Protein (kg) | 7.4 | | | 7.3 ~ 9.0 |
| Mineral (kg) | 2.84 | | | 2.53 ~ 3.10 |
| Body Fat Mass (kg) | 22.0 | | | 10.8 ~ 17.2 |

▶ *Mineral is estimated.*

With regards to the analysis of body composition, InBody220 assigns a quantitative value to the various body compositional elements. These values demonstrate the weight of each body compositional element that makes up the examinee's total body weight. The estimated values are then compared with the standard values.

### 1) 4-compartment model

InBody220 analysis of body composition is based on the 4-Compartment Model[1]. This 4-Compartment Model assumes that body is composed of four different elements: total body water, protein, minerals, and body fat. Total body water is separated into intracellular and extracellular water by cellular membranes.

***Ref 1***. *Vivian H. Heyward, Applied Body Composition Assessment, Human Kinetics, p.9, 1996.*

## 2) Intracellular water( ICW), Extracellular water(ECW), Total Body Water(TBW)

InBody220 measures TBW by using a multi-frequency technique that separates TBW into ICW and ECW. Intracellular water (ICW) indicates the quantity of water within cellular membrane. Extracellular water (ECW) indicates the total quantity of water in the interstitial fluid and blood. In the case of a healthy body, the proportion of ICW and ECW should be maintained at about 3:2.

**Total Body Water (TBW) = Intracellular Water (ICW) + Extracellular Water (ECW)**

FAQ1

### How do you measure the amount of water in the intestine?

As microamperage current is limited in its ability to penetrate the walls of the intestine it is impossible to measure the amount of water in the intestine using a bioelectrical impedance analysis (BIA). This is why examinees are recommended to conduct the test before eating. For example, if a examinee uses the InBody220 after having taken in 1L of water, this water can cause an increase in body weight. Water that has not been accounted for is calculated as fat cells, thus increasing the Fat Mass. This can lead to measurement errors as it over-calculates the quantity of the Fat Mass. Therefore, examinees are recommended to remove their clothes and accessories, to avoid eating prior to the test, and to dispose of urine and excrement; all of which, while not being part of the body's composition, affect body weight.

***Ref 2**. Vivian H. Heyward, Applied Body Composition Assessment, Human Kinetics, p44-55, 1996*

## 3) Protein

Protein is a solid organic compound that consists of nitrogen and can be found in body cells. Protein is also the main component, along with body water, of Soft Lean Mass. Protein is directly related to intracellular water. Therefore, a lack of protein indicates a lack of intracellular water, which in turn implies poor cell nutrition.

## 4) Mineral

Minerals help the body preserve and play a core role in the human body. InBody220 analyzes two large groups of minerals: osseous minerals and non-osseous minerals. Osseous minerals are the minerals found in the bones while non-osseous minerals are those which are found in all other parts of the body. Osseous minerals account for about 80% of the body’s total minerals.

Mineral mass is closely related to soft lean mass. Thus, if you have more lean mass, the weight of bones will increase, which in turn raises the mineral mass accordingly.

According to BIA principle, the mineral mass cannot be calculated in a direct way. It can be obtained from DEXA, a bone density scanner. Therefore, the mineral mass presented by the InBody220 is an estimated value. However, a comparative experiment with DEXA shows a very high correlation so that it can be utilized as a primary screening data.

## 5) Body Fat Mass

Body Fat Mass refers to the total quantity of lipids that can be extracted from fat and other cells.
Body Fat Mass cannot be directly estimated using the BIA method, but rather is calculated by excluding Fat Free Mass (FFM) from body weight.

Body Fat Mass = Body Weight - Fat Free Mass(FFM)

Body Fat Mass is stored under the skin, as well as between the abdomen and muscles. When an examinee's body fat mass is outside of the standard range, he/she is diagnosed as being obese.

## 6) Soft Lean Mass

Soft Lean Mass can be calculated by excluding the mineral found in the bones from Fat Free Mass.

## 7) Fat Free Mass

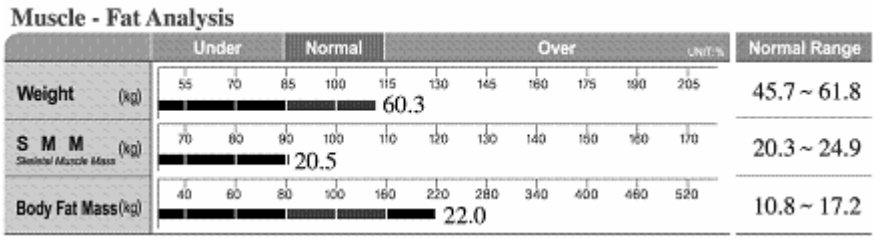
Fat Free Mass consists of the weight of the remaining components once Body Fat Mass has been excluded from body weight.

## 8) Weight

Weight consists of body water, protein, mineral and Body Fat Mass. Thus, body weight is the sum total of these four body components.

Weight = Total Body Water + Protein Mass + Mineral Mass + Body Fat Mass

## 3. Muscle - Fat Analysis




The Muscle-Fat Analysis consists of an estimation of the value of three elements, weight, skeletal muscle mass, and body fat mass. This analysis is also capable of carrying out relative comparisons of the above-mentioned body components using numbers and bar graphs.

The numbers shown in the bar graphs indicate the measured values for each element while the length of the graph demonstrates the percentage of the standard value for each item. Thus, a score of 100% would indicate a standard value, with the standard weight calculated using the examinee's height. Therefore, the examinee's body composition balance can be ascertained simply by looking at the graphs and seeing if they are longer or shorter than the standard value of 100%.

As a normal range is shown on the right side of the bar graph, you can compare it with your estimated value. If the lengths of bar graphs are alike, it means that your body composition is in balance.

### 1) Weight(kg)

The 100% standard weight refers to the ideal value for an examinee given his/her height. This is also calculated using the BMI standard weight calculation method.

*** BMI Ideal Weight Calculation Method**

**Ideal Weight(kg) = Ideal BMI × Height$^2$ (m$^2$)**

For both Asian and Western male adults a value of 22 is applied, while for Asian female adults this value is 21 and Western females 21.5. In the case of children under the age of 18, the standard weight is calculated based on standard BMI for their particular age group.

### 2) Skeletal Muscle Mass(kg)

100% standard Skeletal Muscle Mass refers to the ideal quantity of Skeletal Muscle Mass for an examinee's standard weight.

There are three types of muscle - cardiac muscle, visceral muscle and skeletal muscle. However, it is the quantity of skeletal muscle that is the most changed through exercise. As such, InBody220 displays Skeletal Muscle Mass separately from Soft Lean Mass. By comparing the percentage of Body Fat Mass and Skeletal Muscle Mass found in each body component, the level of obesity can be estimated in a more pro-active and exact manner.

### 3) Body Fat Mass(kg)

100% standard Body Fat Mass refers to the Body Fat Mass that an examinee should maintain for his/her standard weight. In general, the ideal Body Fat Mass is 15% for males and 23% for females.

The bar graph, which exhibits the current Body Fat Mass divided by standard Body Fat Mass in percent form, displays reasonable levels of body fat mass.

**Table 1. Standard body composition ranges**

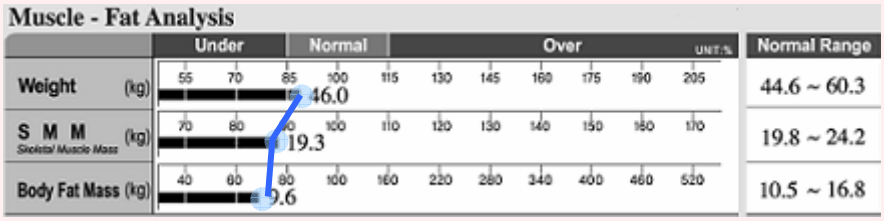
| Standard Rage | Males | Females |
|---|---|---|
| Weight | 85 ~ 115% of ideal weight | 85 ~ 115% of ideal weight |
| Skeletal Muscle Mass | 90 ~ 110% of ideal SMM | 90 ~ 110% of ideal SMM |
| Body Fat Mass | 80 ~ 160% of ideal BFM | 80 ~ 160% of ideal BFM |

** Unlike skeletal muscle mass, body fat percentage depends greatly on individual difference. Thus, it has a wider normal range than that of skeletal muscle mass.*

## TIP1. HOW TO APPLY THIS RESULT TO YOUR CLIENTS

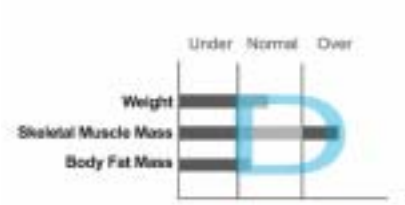
The test results have been designed in a manner that the examinee can easily understand and that facilitates his/her ability to follow the conductor of the test's instructions. The test conductor can use alphabetical shapes that are based on the length of the graphs to provide explanations to the examinees regarding their overall health.

**Relations among Weight, Skeletal Muscle Mass and Body Fat Mass**

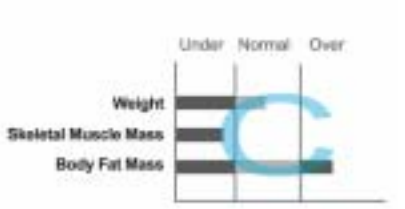



A person is identified as having an ideal body composition when the body composition graphs form a 'D' shape. In such cases, the SMM graph is longer than the weight and Body Fat Mass graph. On the other hand, if the SMM graph is shorter than the Body Fat Mass graph, the body composition graphs form a 'C' shape. Persons with such results should immediately begin taking weight control measures.

### 8 different body types, based on a balanced body composition

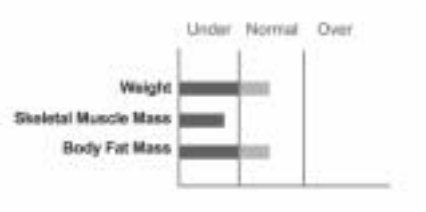



In the case of this body type, the body composition graphs form a slightly curved ‘D’. This is the ideal body composition state. Of course, it goes without saying that this healthy state should be continuously maintained. As such, the person conducting the test should mention to the examinee that the rate of increase of abdomen fat often increases as a person gets older, and emphasize the necessity for continuous monitoring to assure that this healthy state is maintained.

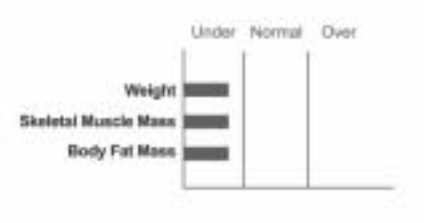



At the opposite end of the health spectrum, we find the following graph shape, a ‘C’ shape. In this case, the examinee’s weight is within the normal range. Although the examinee’s body weight may not be classified as obese, he/she is dissatisfied with the shape of his/her body. As they are experiencing difficulties managing the shape of their bodies through simple weight control measures, people who are in this category usually visit an obesity clinic. If a person who is diagnosed as this type, changes his/her body composition through exercise, he/she can maintain a satisfactory body shape without actually losing any weight. The conductor of the test can recommend that the examinee attempt to achieve a ‘D’ shape on his/her body composition graphs, by losing Body Fat Mass while gaining SMM. Many adults who are found to have a high level of Body Fat Mass are included in this type. Abdominal obesity can become a factor in the development of cardiovascular diseases for those within the standard weight range just as well as it can for those in the overweight range.

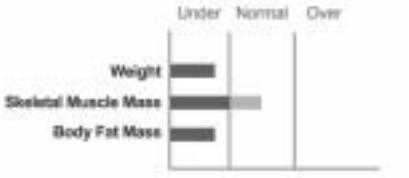
This type is exemplified by a person whose weight is within the standard range, but yet cannot be regarded as being in ideal health. For this type, the length of the SMM graph is shorter than the standard range, while the Body Fat Mass is within the standard range. An examinee of this type will also exhibit a ‘C’ shape on his/her body composition graphs. However, this type should be identified as a weak body type, and not as an obesity type. People who belong to this type have usually lost intestine and muscular protein; a situation caused by such potential factors as a lack of exercise, lack of proper protein nutrition, or an increased metabolism as a result of injuries or disease. Symptoms of this include edema, the decomposition of muscle cells, changes in nerve tissues, secondary infections, and stunted growth in children.



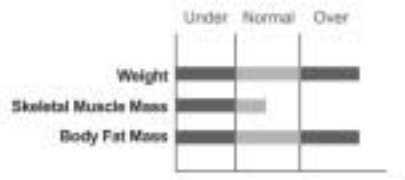

Those people who are diagnosed as belonging to the underweight weak body type, have a lower possibility of developing adult diseases. However, should this poor nutrition continue for a long period of time, many health problems can arise, such as a decrease in the body’s ability to absorb nutrition, poor nutrition caused by a loss of appetite, imbalanced nutrition due to a loss of intestinal protein, metabolic disorders, as well as other side effects.



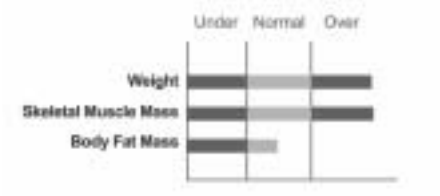

While the weight is below the normal range, it is of a robust build with well-developed skeletal muscle mass. However, body fat not only has an energy-storing function in our body but also assists the absorption of fat soluble vitamins, and maintains healthy skin and hair. In addition, it is an essential building block for cell membranes. Thus, it is necessary to be careful not to lose an excessive amount of body fat.




Obesity causes many diseases. People diagnosed as being obese run a higher risk of myocardial infarction, congestion, cardiac failure, and hypertension. In addition, there exists a correlation between obesity and diabetes(NIDDM). Moreover, obese people also run a higher risk of contracting large intestine cancer, rectal cancer, and in the case of males, prostatic carcinoma. Furthermore, other potential problems have been identified, such as a decrease in tolerance to exercise, osteoarthritis, as well as a decrease in lung function.

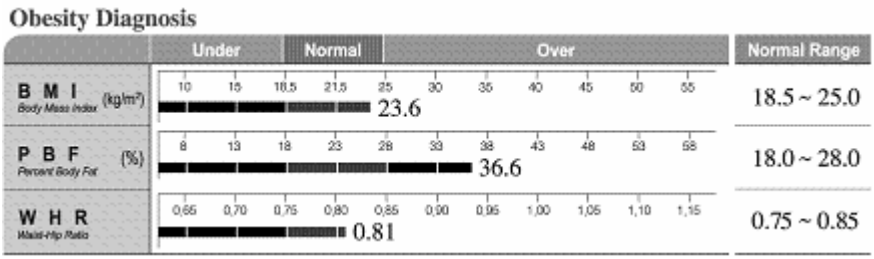


Athletes are usually included in the overweight muscle type. As such, such people can easily be included in the obese category when the BMI method is used. This type is deemed to be overweight because of the weight of their skeletal muscle. This type of person does not need to undertake weight control measures.




Most people who fall under the obesity type caused by an excess of weight are those that have been diagnosed as chronically obese. In such cases, the reason why SMM is measured to be over the standard range is not SMM has been developed through exercise but because a person has excessive body composition mass compared with the standard weight. Those diagnosed as being chronically obese need medical treatment. This type of people should follow a weight reduction program that is designed to decrease their Body Fat Mass, and on treating or preventing diseases that may accompany this condition, rather than focusing on improving the shape of their body.

## 4. Obesity Diagnosis




InBody220's obesity diagnosis function makes use of BMI(Body Mass Index) and PBF(Percent Body Fat) to determine obesity levels. By analyzing the examinee's weight using BMI and Percent Body Fat, InBody220 makes it possible to screen for sarcopenic obesity. People included in this sarcopenic obesity type fall within the standard range when it comes to weight, but are regarded as obese when their percentage of body fat is calculated.

**Table 2. Standard ranges of body composition**

| | Males | Females |
|---|---|---|
| BMI | Standard range for adults in Asia : 18.5~22.9<br>Standard range for adults in Europe: 18.5~24.9 | Standard range for adults in Asia: 18.5~22.9<br>Standard range for adults in Europe: 18.5~24.9 |
| Percent Body Fat | 10~20% | 18~28% |
| Waist-Hip Ratio | 0.80 ~ 0.90 | 0.75 ~ 0.85 |

### 1) BMI(Body Mass Index, kg/㎡)

As we can see from the formula, BMI= Weight (kg)/Height$^2$ (m$^2$), BMI is used approximate obesity levels. The BMI method has been widely applied in the general medicine, dietary, and sports medicine fields as the main means of diagnosing obesity. However, this method is flawed in that it cannot be applied to adults with high levels of SMM, children, those over the age of 65, or pregnant females. Nevertheless, as the BMI has been the most commonly used index, many researches on using the BMI method to prevent adult diseases has been conducted. This is why InBody220 also includes BMI based information. Differences have emerged among researchers as to which standards should be used to determine the BMI of examinees of different ages and gender. InBody220 uses the WHO standards as the standard ranges for BMI(1998, Table3).

**Table 3. European weight classification based on the BMI method (WHO, 1998)**

| Classification | BMI (kg/㎡) | Danger of onset of accompanying diseases |
|---|---|---|
| Underweight | <18.5 | Low |
| Normal | 18.5~24.9 | Moderate |
| Overweight | >25 | |
| Dangerous weight level | 25~29.9 | Increased |
| 1st level obesity | 30~34.9 | Dangerous |
| 2nd level obesity | 35~39.9 | Advanced |
| 3rd level obesity | >40 | Very advanced |

** With regard to the BMI and Percent Body Fat of children, InBody220 applies children standards, not adult standards.*

## 2) Percent Body Fat (%)

Percent Body Fat indicates the percentage of body fat to body weight.

**Percent Body Fat (%) = Body Fat Mass(kg) / Body Weight(kg) × 100**

The standard Percent Body Fat is 15% for males and 23% for females[3,4] while the standard range of Percent Body Fat for males is 10-20%, and 18-28% for females.

* ***Ref3***. *Robert D. Lee, David C. Nieman, Nutritional Assessment 2nd, McGraw-Hill, 1998*
* ***Ref4***. *George A. Bray, MD. Contemporary Diagnosis and Management of Obesity, Handbooks in Health Care co., 1998*

When a person's Percent Body Fat is calculated as being beyond the standard range, he/she is regarded as being obese. When a person's Percent Body Fat falls below the standard range, he/she is regarded as having a low level of body fat. This low level of body fat can be separated into two types: The first is a person whose muscle type is deemed to account for a desirable proportion of the body composition. Such people's weight is regarded as being within the standard range or falling within the overweight range. The second type, the poor nutrition type, is one in which a person's body is deemed to be in an unhealthy state because of a lack of Body Fat Mass and SMM(Skeletal Muscle Mass). This type has a higher possibility of contracting clinical diseases.

**In case of children less than 18 years old, different standards are applied as it is necessary to consider the difference in physical characteristics from adults.*

## 3) Waist-Hip Ratio

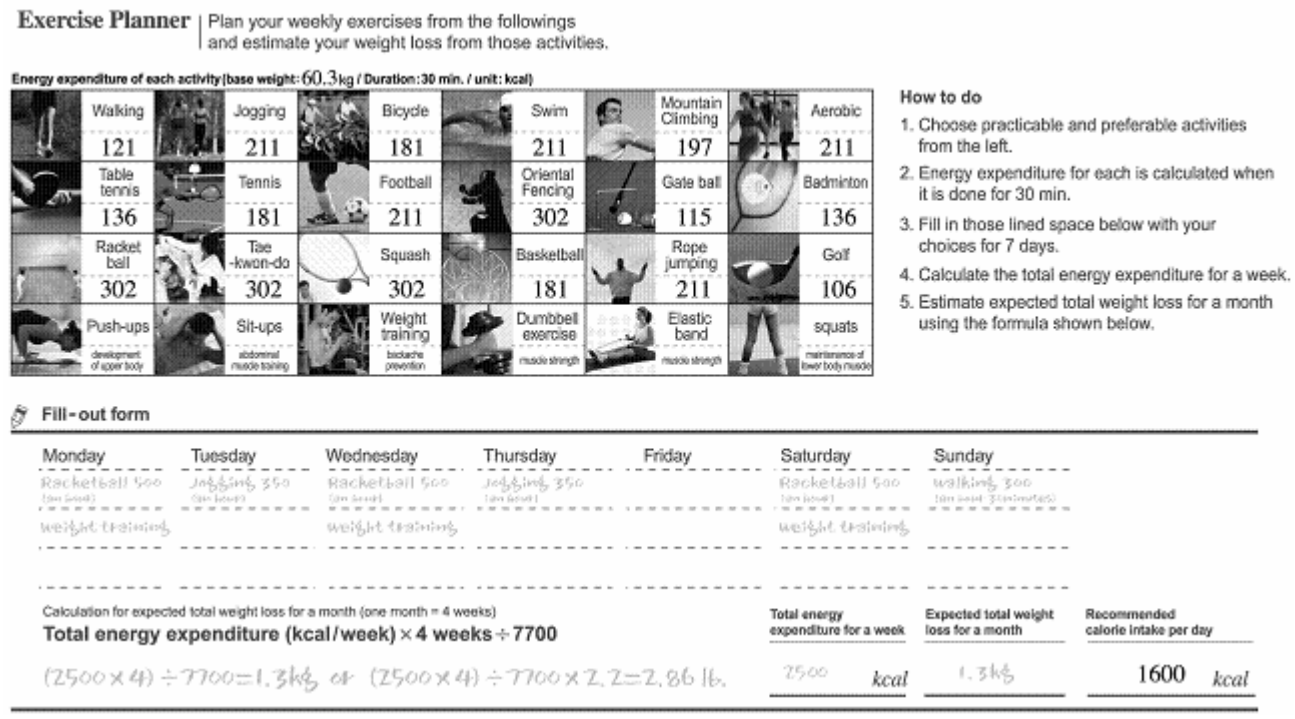
Waist-Hip ratio (WHR) [5,6] is determined by dividing the waist circumference from the navel line by the hip's maximum circumference. It is a useful indicator for comprehending the distribution of body fat. However, it causes the inconvenience of measuring the body and inaccuracy marked by the discrepancy in measurements taken by different measurers. Therefore, in reality, it is hard to measure it with measuring tapes for obesity treatment.

* ***Ref 5***. *Vivian H. Heyword, Ph D, Lisa M. Stolarczyk, Ph D, Applied Body Composition Assessment, p. 21-43, Human Kinetics, 1996*
* ***Ref 6***. *Rosalind S. Gibson, Principles of Nutritional Assessment, Oxford University Press, 1990.*

InBody220 uses its impedance index to provide a scientific estimation of the examinee's WHR. Given its high degree of reproduction and accuracy, InBody220's estimation of the ratio of abdominal fat can be used as an effective tool with which to treat obesity. Males and Females found to have 0.95 and 0.90 respectively in WHR are considered to suffer from abdominal obesity. An adult found to suffer from abdominal obesity is one who exhibits the excessive visceral fat mass that, by increasing free fatty acid levels in the blood than in subcutaneous fat, causes hypertension, heart disease, diabetes and various other clinical diseases.

** In the case of children, abdominal obesity refers to an subcutaneous fat type with little increase in visceral fat. However, WHR can increase as a result of the onset of morbid obesity, which in turn can lead to the development of clinical diseases among children, and thus should be closely monitored.*

## 5. Exercise Planner




Even if you receive an exercise prescription, you would still want to define how much exercise you need to do to have any significant effect on weight loss and for how long. The InBody220 can not only make a recommendation on the type of exercises you should do but also can assess the weight loss effect of the recommended exercises.

Select exercises to carry out with reference to the list of exercises on the test results. Draw up an exercise plan with the selected exercises on the fill-in form. Based on the rate of calorie consumption for the exercise, gauge your calorie consumption per week. For instance, if your weight is 60.3kg and you want to jog for an hour, the total calorie consumption for a 60.3kg person to spend 30 minutes is 211kcal. So for an hour, it will be 211 x 2 = 422 kcal. After calculating the sum of calorie consumption like that, calculate the expected weight loss for a month. If the sum of calorie consumption calculated is for one week, multiply the estimated calories by 4 to derive the monthly calorie consumption.

The total calorie to be consumed to lose 1kg of fat is 7700 kcal. Thus if you divide the calculated calorie consumption for four weeks by 7700, you can get the possible loss of fat during a month. As the subject can calculate his or her own weight loss based on the exercise prescription, it heightens his or her motivation to put the plan in practice with tangible goals.

To achieve the best results from your exercise, it is advisable to do exercise at the right intensity for you. If the exercise intensity is too low, it would not be very effective. On the other hand, a very high intensity would lead to adverse effects such as the risk of muscle, ligament, and bone injuries, or fatigue, etc. In general, exercise for the purpose of health-related benefits should be carried out between 50% to 85% intensity of your maximum exercise capacity for 20 to 60 minutes, 3 to 5 times a week.

To lose body fat, it is recommended to exercise at least 20 minutes a day. If you exercise for a short time span, your body will use glycogen, a form of carbohydrates, which is stored in muscle tissue in order to generate anaerobic energy. Only after these stored carbohydrates are completely consumed, your body fat will start to burn off. Therefore, any exercise aiming to get rid of body fat should be practiced for at least 20 minutes to reap a reward.

The following table shows types of exercise on the exercise plan table and different physical activities for recommended exercise types.

| Type of exercise | Effect of exercise | Exercise modalities offered by the InBody220 |
|---|---|---|
| Steady- state aerobic activity | An exercise that mostly relies on energy provided by aerobic metabolism | Walking, Jogging, Bicycle, Swim, Mountain Climbing, Aerobic |
| Aerobic interval workouts | An exercise wherein you alternate a training session with a rest. Though it is high intensity exercise, it is advantageous in that you can increase the exercise time. Caution should be taken as it can be too strenuous on your body parts. | Table tennis, Tennis, Football, Oriental Fencing, Gate ball, Badminton, Racket ball, Tae-kwon-do, Squash, Basketball, Rope jumping, Golf |
| Strength training | An exercise focusing on strengthening muscles is usually performed against resistance of the body parts. It is faster in transforming fat into lean muscle than aerobic exercise. | Push-ups, Sit-ups, Weight training, Dumbbell exercise, Elastic band, Squats |

**** Recommended calorie intake per day***

In the bottom right of the exercise plan, there is a recommended calorie figure for the subject. The recommended calories on the test result are based on the following standards.

(1) Children (less than 18 years old)

Normal children | The normal children's diets are derived from age and gender specific RDA (Recommended Dietary Allowance).

Obese children | As for obese children, it is important not to overdo the dieting considering their growth rates. So it is suggested to use calories similar to those in RDA (Recommended Dietary Allowance)

(2) Adult (19~64 years old)

Normal adults | For adults whose BMI is in or below the normal range but with a normal or sub-normal body fat percentage, prescribe calories based on BMR x 1.31 (activity factor, light activities)

Obese adults | As for obese adults, provides calories based on BMR. A severe restriction on calorie intake would result in various undesirable results such as a decrease in immune function, decline in basic metabolism,

fall in the lean body mass, mineral and electrolyte imbalance, amenorrhea, the loss of nails and hair. Thus, in order to prevent such adverse effects, one should meet a minimum calorie intake requirement.

### (3) Elderly (More than 65 years old)

Normal elderly | Elderly with a normal body fat percentage will be prescribed calories based on Korean RDA (Recommended Dietary Allowance).

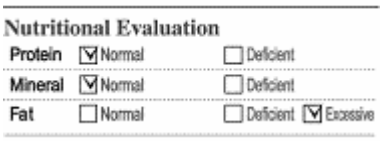
Obese elderly | In case of the obese elderly over 65 years old, the same principles with that of obese adults will be applied. During old age, as BMR falls relatively steeply than before, physical activities will decline accordingly. However, since the meal amount usually remains the same, it often leads to obesity. Therefore, while the recommended calorie of obese elderly is based on BMR as is the case of adults, it is imperative to be prescribed by a specialist for it may cause various age-related nutritional intake problems.

## 6. Various Comprehensive Evaluation

This function makes it possible to easily evaluate the results of the body composition examination. Positive evaluations are written on the left side of the readout in blue, while negative ones are written in red on the right. Therefore, if most V marks are on the blue area, you are in a healthy state. On the other hand it you have many V marks in the red area, you need to take care of your health.

### 1) Nutritional Evaluation

The body's nutritional state is evaluated based on the protein, fat and mineral components. Although protein, minerals and fat represent nutritional elements which a person acquires from food, these are considered to be part of the body's composition during the Body Composition Analysis.



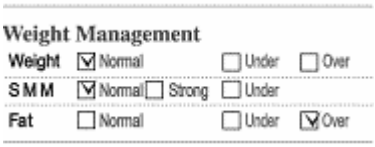

Protein | An examinee found to have less than 90% of the desired protein level is considered to suffer from protein deficiency, a common occurrence among underweight people. Such a score is also indicative of a lack of muscle mass or poor nutrition.

Mineral | Minerals are estimated based on their ratio to weight. When minerals account for less than 3.5% of the person's weight based on his body composition, age and gender, he/she is deemed to suffer from mineral deficiency. A lack of minerals increases the risk of arthritis, bone fractures or osteoporosis.

Fat | The amount of body fat is identified as deficient, normal, or excessive after having been compared with muscle mass. In general, in excess of 160% body fat is considered to be excessive, while 80% or less is considered to be deficient, and anywhere between these two numbers is considered to be normal.

### 2) Weight Management

A weight management program is used to evaluate the person's weight, skeletal muscle and body fat mass.



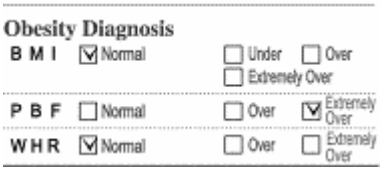

Weight | Anywhere between 85 to 115% of the standard value is regarded as being appropriate, while 85% of the standard value or less is regarded as underweight and 115% or more as overweight.

SMM | Anywhere between 90 to 110% of the standard value is regarded as being appropriate, 90% or less as a low muscle mass type, and 100% or more as a high muscle mass type.

Fat | Anywhere between 80 to 160% of the standard value is regarded as being appropriate, 80% or less as insufficient, and 160% or more as excessive.

### 3) Obesity Diagnosis

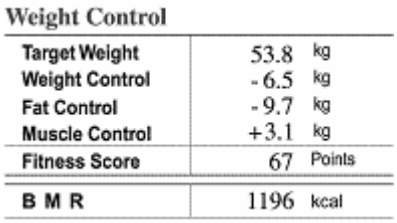
BMI | A BMI of 18.5 to 24.9 is considered to be normal, while persons with BMI of 18.5 or less are considered to be underweight, 25 ~ 30 overweight, and 30 or more excessively overweight.




PBF | In case of males, persons with a body fat rate of 10 ~ 20% are considered to be 'normal', 20 ~ 25% of body fat are considered as 'over', and those with 30% or more as 'extremely over'. In the case of females, persons with a body fat rate of 18 ~ 28% are considered to be 'normal', while those with 28 ~ 33% of body fat are considered as 'over', and those with 33% or more as 'extremely over'.

WHR | Males with a WHR of less than 0.90 are considered to be 'normal', while those with WHR of 0.90 ~ 0.95 are considered to be 'over', and those with 0.95 or more are seen as 'extremely over'. Females with a WHR of 0.85 or less are considered to be 'normal', while those with WHR of 0.85 ~ 0.90 are considered to be 'over', and those with WHR of 0.90 or higher as seen as 'extremely over'.

## 7. Weight Control




This weight control function is offered as a means of optimizing the examinee's body composition rather than simply increasing or decreasing his/her weight. The target weight set by the InBody220 is different from the standard weight calculated according to one's height. This is because an ideal weight only considers the height, whereas appropriate weight also takes into account soft lean mass and body fat mass.

'+' refers to the amount of mass that must be increased, while '-' refers to the mass which should be decreased. These unique indexes offered by InBody220, show how for example an examinee "should lose 00kg body fat mass and gain 00kg of muscle mass through exercise." The reality is that two people of the same height and weight who have different body compositions will have different target weight.

For example, although two people may be of the same height and weight, the person with a larger muscle mass will have a higher target weight than someone who has more Body Fat Mass. This is because a person with a larger muscle mass does not have to lose any muscle, even when it is beyond the 100% level.

Some people who undergo treatment for their obesity simply give up halfway when they see that they have not lost any weight. This is because muscle increases in inverse proportion to the fat that is decreased during the treatment of obesity, thus making it difficult to see any change in weight.

The InBody220 allows examinees to clearly see how their treatment brings about changes in their fat and muscle mass and helps them to monitor their obesity diagnosis and treatment process, which serves to increase the patient's faith in the treatment.

***Fitness Score**

The Fitness Score is an index used to help the examinee easily understand the state of his/her body composition.

| | |
|---|---|
| 70 or less | weak or obese type that need exercise and diet control |
| 70~90 | Normal, Healthy Type |
| 90 or more | Robust type with well-developed muscle |

As an examinee's body composition begins to improve, he/she can see his/her score improving as their body fat mass get closer to the standard range, and their muscle mass increases.

*** BMR( Basal Metabolic Rate)**

Basal Metabolic Rate (BMR) indicates the minimum energy required for sustain vital functions while at rest. InBody220 makes it possible to estimate BMR using a known regression equation based on FFM. FFM is known to be closely related to BMR.

BMR is usually calculated using indirect Calorimetry, which in turn, employs oxygen demand. However, InBody220 calculates BMR based on Fat Free Mass as follows:

**REE = 21.6 x FFM(kg) + 370 (FFM=Fat Free Mass, kg)** [7,8]

*****Ref 7***. *John J. Cunningham. Body composition as a determinant of energy expenditure: a synthetic review and proposed general prediction equation. Am J Clin Nutr. Vol. 54, 963-969, 1991.*

*****Ref 8***. *Eric Ravussin and Clifton Bogardus. Relationship of genetics, age, and physical fitness to daily energy expenditure and fuel utilization. Am J Clin Nutr. Vol. 49, 968-975, 1989*

For example, if the examinee gained FFM during the weight control program, BMR would also increase. This is a desirable result in any weight management program, as it indicates that Fat Mass stored in the body has been decreased as a result of the increase of BMR.

FAQ2

**When can I use BMR?**

1.Obesity Treatment

Despite having similar weight conditions, examinees found to have more FFM also have higher BMR. Therefore, the weight management programs for obese individuals should be focused on maintaining FFM, and promoting BMR while decreasing only Body Fat Mass. In addition, when a examinee undergoes a weight management program, if the amount of exercise is increased while the food intake level remains the same, that is, under a person's standard BMR range, the Body Fat Mass stored in the body is used as an energy source, thus, eventually resulting in weight loss.

2.Daily Reference Value

When individuals prepare the menu for their diets, the necessary daily amount of energy should be calculated. In this regard, InBody220's BMR function can be very useful.

***Daily Reference Value = BMR ✗ Activity factor***

In the case of patients, multiply them by injury factor to figure out a daily energy requirement.

Activity Factors Used Account for the Thermic Effect of Exercise

| | |
|---|---|
| Confined to bed | 1.2 |
| Ambulatory, low activity | 1.3 |
| Average activity | 1.5 ~ 1.75 |
| Highly activity | 2.0 |

Injury Factor

| | |
|---|---|
| Minor surgery | 1.0 - 1.1 |
| Serious surgery | 1.1 - 1.3 |
| Minor infection | 1.0 - 1.2 |
| Moderate infection | 1.2 - 1.4 |
| Severe infection | 1.4 - 1.8 |
| Degree of burn <20% Body surface area | 1.2 - 1.5 |
| Degree of burn 20~40% Body surface area | 1.5 - 1.8 |
| Degree of burn >40% Body surface area | 1.8 - 2.0 |

## 8. Impedance

Impedance is the vector sum of resistance and reactance, in other words the body's resistance. InBody220 offers segmental impedance indexes within the ranges of 20 and 100kHz.

Impedence

| Z | RA | LA | TR | RL | LL |
|---|---|---|---|---|---|
| 20 kHz | 458.0 | 474.9 | 27.5 | 284.2 | 290.6 |
| 100 kHz | 422.5 | 441.2 | 24.5 | 257.2 | 263.3 |