i55

Body Composition Analyzer

Body Composition Result Interpretation

MEDIANA

About this manual

This user's manual is intended as a guide for user's precautions and proper interpretations of analysis results. You should read this manual carefully prior to operation and for more accurate body composition analysis.

Trademark

The name of the product in this manual may be the trademark or the registered mark of the company.

CE 2797

MEDIANA

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i55 Result Interpretation

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1. Precautions

The accuracy of BIA(Bioelectrical Impedance Analysis) varies significantly depending on user conditions (meal, exercise, clothes, drinking, bathing, urination, body temperature, etc.) Therefore, it is advised to remove any misleading factors prior to operation for improved analysis control.

WARNING

- BIA analysis should be approved by medical experts if you fall into any of the following user groups – pregnant women, or persons who have had surgical operation or ever been clinically diagnosed with any type of disease.
- BIA analysis should be consulted with doctors if you have injuries of either internal or external nature.
- Measurement is prohibited for the examinee with an internally implanted Pacemaker.

● Measurement should be taken on an empty stomach, as food intake may affect accurate measurement.

● Measurement should be taken prior to physical activity or exercise. Violent physical movement may cause temporary results change.

● Measurement should be taken prior to taking a bath. Bathing before measurement may cause slight, temporary change of total body water distribution & total body water percentage.

● Stand upright for about 3 minutes before you take the test for more reliable results.

● Excessively high or low body temperature may cause inaccurate measurement control. Human body maintains the most stable condition at normal temperature.

● Measurement should be taken after excretion or urination. Extra body waste may add up to result figures, resulting in inaccurate analysis.

● Wear light clothes and take off accessories. Wearing heavy clothes or accessories may cause the problem of adding extra weight on result.

● Menstruation may cause a temporary increase of body water, which could affect measurement results.

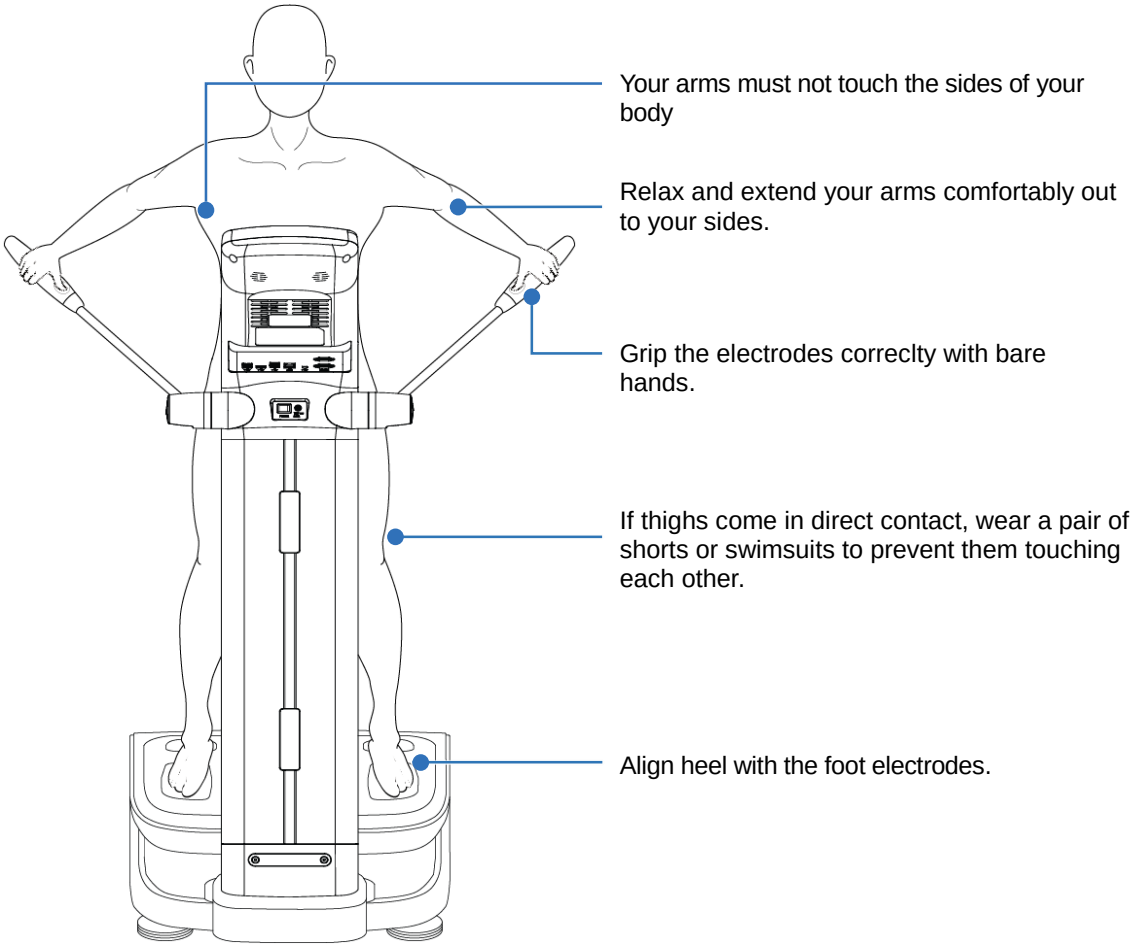
● If repeated measurements need to be taken over a specific period of time, make sure your tests have been taken under the same conditions for comparison of data results.

● Dry limbs or excessive callouses may hinder accurate measurement. Wet-wipe palm and sole prior to measurement.

● Large surgical scars or skin problems may hinder accurate measurement.

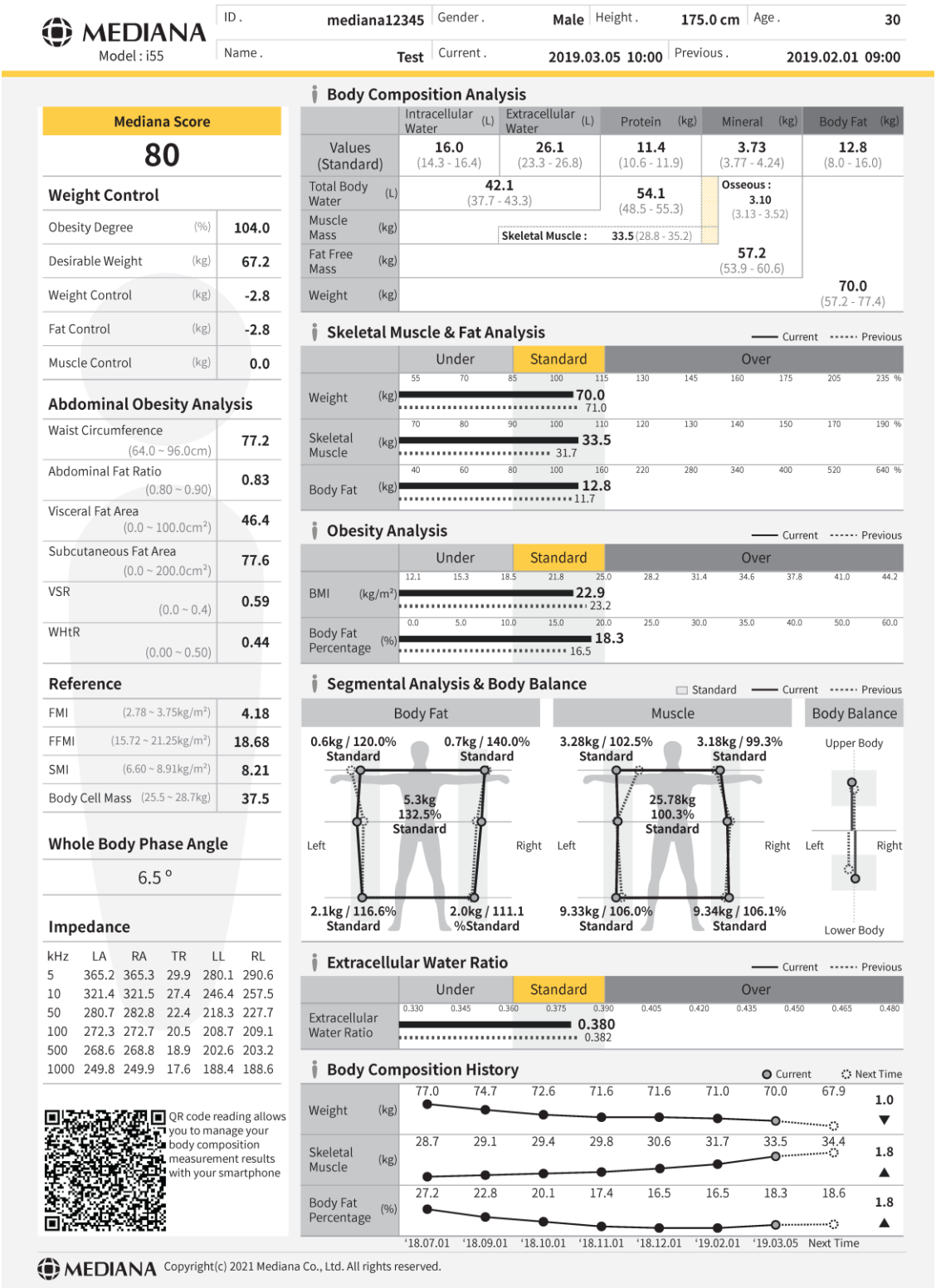
2. Measuring Posture

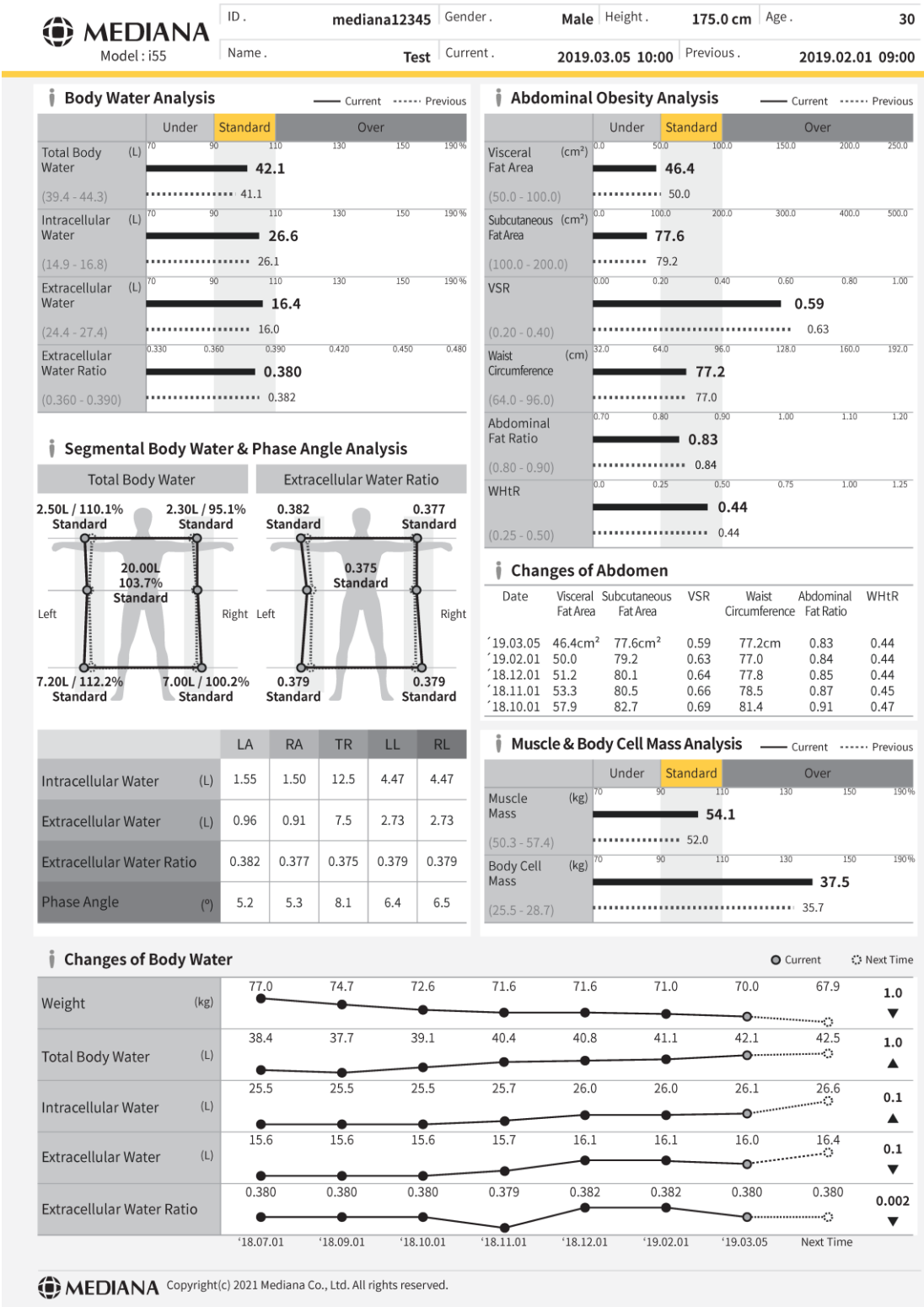
Take care of your posture. Incorrect posture may cause inaccurate measurement.



3. Result Analysis

[General Result Sheet]




MEDIANA
Model : i55
ID . mediana12345
Gender . Male
Height . 175.0 cm
Age . 30
Name . Test
Current . 2019.03.05 10:00
Previous . 2019.02.01 09:00
Body Water Analysis
Current
Previous
Under
Standard
Over
Total Body Water (L) 42.1 (39.4 - 44.3) 41.1
Intracellular Water (L) 26.6 (14.9 - 16.8) 26.1
Extracellular Water (L) 16.4 (24.4 - 27.4) 16.0
Extracellular Water Ratio 0.380 (0.360 - 0.390) 0.382
Abdominal Obesity Analysis
Visceral Fat Area (cm²) 46.4 (50.0 - 100.0) 50.0
Subcutaneous Fat Area (cm²) 77.6 (100.0 - 200.0) 79.2
VSR 0.59 (0.20 - 0.40) 0.63
Waist Circumference (cm) 77.2 (64.0 - 96.0) 77.0
Abdominal Fat Ratio 0.83 (0.80 - 0.90) 0.84
WHtR 0.44 (0.25 - 0.50) 0.44
Segmental Body Water & Phase Angle Analysis
Total Body Water
Extracellular Water Ratio
2.50L / 110.1% Standard
2.30L / 95.1% Standard
20.00L 103.7% Standard
Left
Right
7.20L / 112.2% Standard
7.00L / 100.2% Standard
0.382 Standard
0.377 Standard
0.375 Standard
0.379 Standard
0.379 Standard
Changes of Abdomen
Date Visceral Fat Area Subcutaneous Fat Area VSR Waist Circumference Abdominal Fat Ratio WHtR
´19.03.05 46.4cm² 77.6cm² 0.59 77.2cm 0.83 0.44
´19.02.01 50.0 79.2 0.63 77.0 0.84 0.44
´18.12.01 51.2 80.1 0.64 77.8 0.85 0.44
´18.11.01 53.3 80.5 0.66 78.5 0.87 0.45
´18.10.01 57.9 82.7 0.69 81.4 0.91 0.47
LA RA TR LL RL
Intracellular Water (L) 1.55 1.50 12.5 4.47 4.47
Extracellular Water (L) 0.96 0.91 7.5 2.73 2.73
Extracellular Water Ratio 0.382 0.377 0.375 0.379 0.379
Phase Angle (°) 5.2 5.3 8.1 6.4 6.5
Muscle & Body Cell Mass Analysis
Muscle Mass (kg) 54.1 (50.3 - 57.4) 52.0
Body Cell Mass (kg) 37.5 (25.5 - 28.7) 35.7
Changes of Body Water
Current
Next Time
Weight (kg) 77.0 74.7 72.6 71.6 71.6 71.0 70.0 67.9 1.0
Total Body Water (L) 38.4 37.7 39.1 40.4 40.8 41.1 42.1 42.5 1.0
Intracellular Water (L) 25.5 25.5 25.5 25.7 26.0 26.0 26.1 26.6 0.1
Extracellular Water (L) 15.6 15.6 15.6 15.7 16.1 16.1 16.0 16.4 0.1
Extracellular Water Ratio 0.380 0.380 0.380 0.379 0.382 0.382 0.380 0.380 0.002
´18.07.01 ´18.09.01 ´18.10.01 ´18.11.01 ´18.12.01 ´19.02.01 ´19.03.05 Next Time
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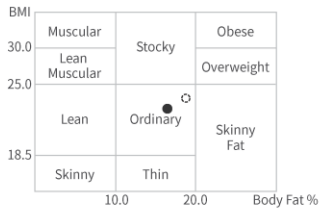
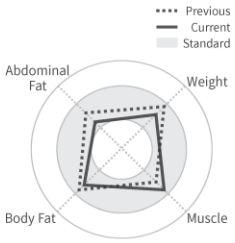
MEDIANA
Model : i55

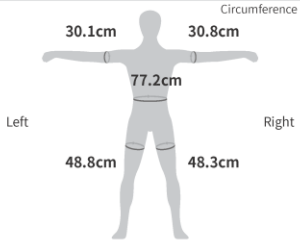
ID .	mediana12345	Gender .	Male	Height .	175.0 cm	Age .	30
Name .	Test	Current .	2019.03.05 10:00	Previous .	2019.02.01 09:00		

Classification of Body Type and Circumference of Body

Standard







Exercise Nutrition Guide

BMR : 1605 kcal	Total Energy Expenditure : 2434 kcal	Recommended Intake of Calories : 2389 kcal

Nutrients (kcal)	Breakfast	Lunch	Dinner	Sum	Representative Foods
Carbohydrate	434	460	420	1314 (55%)	[Carbohydrate 438kcal] : Oats 169g, White rice 138g, Flour 143g
Protein	142	151	138	430 (18%)	[Protein 143kcal] : Egg 289g, Chicken 149g, Beef 210g
Fat	213	226	206	645 (27%)	[Fat 215kcal] : Almond 108g, Walnut 75g, Cheese 252g
Sum	**788 (33%)**	**836 (35%)**	**764 (32%)**	**2389 (100%)**	Representative food is a reference, simply calclulated for each nutrient.

Target Body Fat Mass	10.1 (kg)	Recommended Intake of Water	2100 (ml)
˙Exercise Intensity	133~161 (HR/min.)	Recommended Intake of Protein	108 (g)
˙Calorie Consumption	490 (kcal/h)	Recommended Intake of Water before Exercise	350 ~ 490 (ml)
˙Estimated Completion	10 (Week)	Recommended Intake of Protein after Exercise	23 ~ 29 (g)

·Based on Jogging(1hour/day)

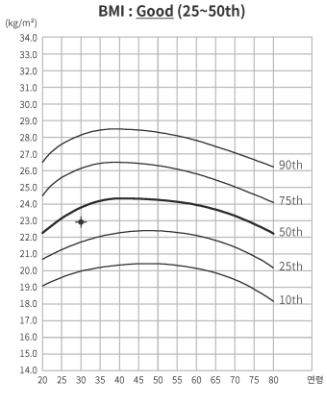
Calorie Consumption

kcal / 30 min (based on current weight)

Gateball	115	Table Tennis	140	Basketball	227	Aerobics	255	Football	280
Walking	122	Golf	168	Jogging	245	Tennis	255	Climb	280
Yoga	140	Badminton	192	Swimming	245	Bicycle	262	Jump rope	308

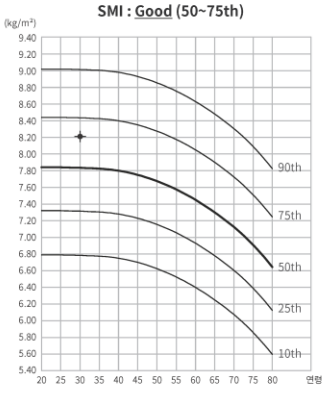
Age-Specific Assessment

BMI : Good (25~50th)



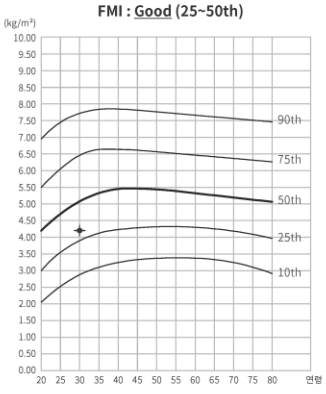
· Estimated BMI after 10 years: 23.8kg/m²

SMI : Good (50~75th)



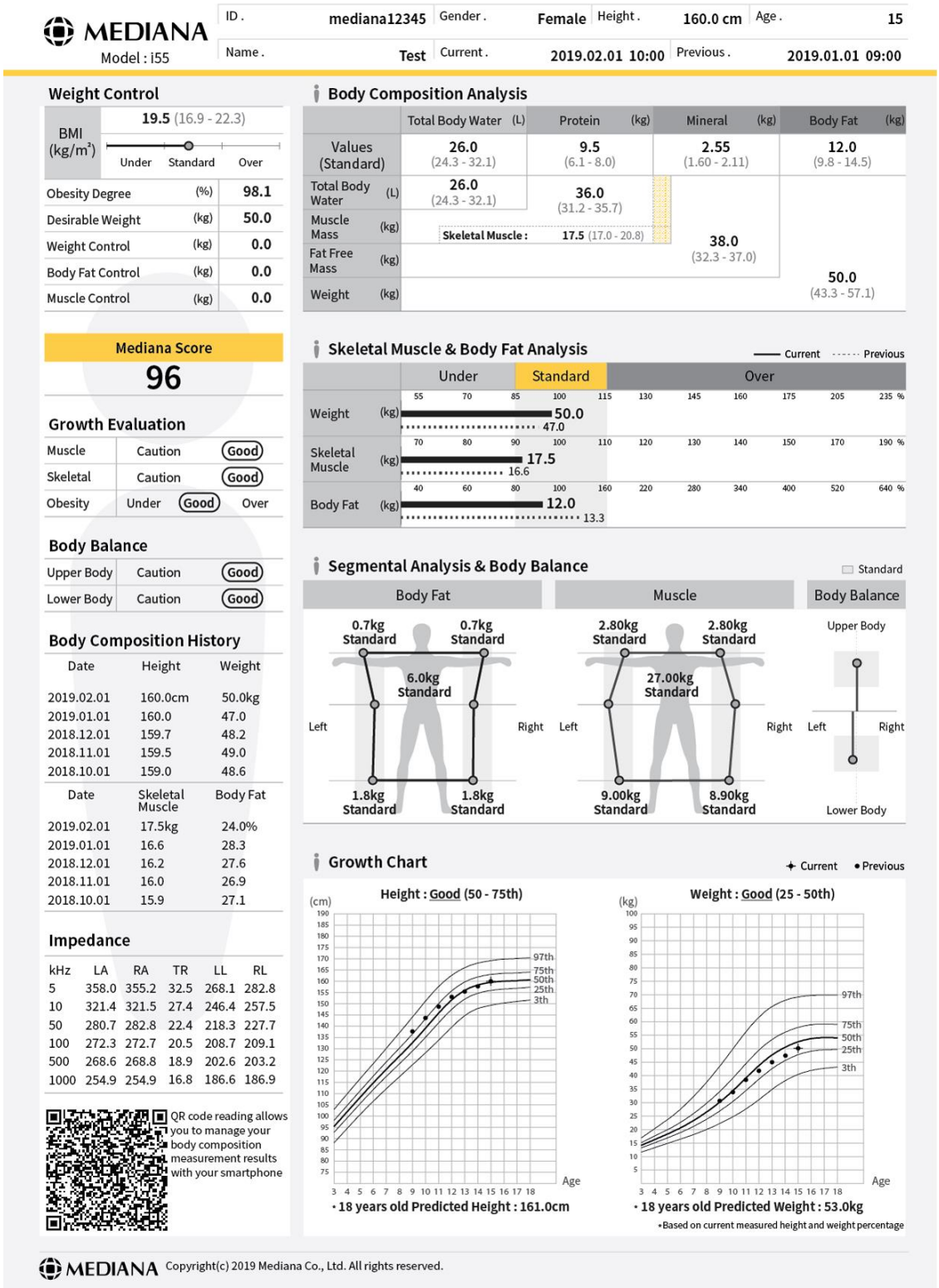
· Estimated SMI after 10 years: 8.32kg/m²

FMI : Good (25~50th)



· Estimated FMI after 10 years: 4.81kg/m²

[Children Result Sheet]



3.1. Personal information

On the top right of your analysis results sheet (on adult-use paper), you can find the date of measurement, and personal information such as ID, gender, height and age. It will give previous measurement date as well, if measurement was ever taken before.

ID .	mediana12345	Gender .	Male	Height .	175.0 cm	Age .	30
Name .	Test	Current .	2019.02.01 10:00	Previous .	2019.01.01 09:00		

3.2. Body composition analysis

Human body consists of four major components – body water, protein, body fat and minerals, comprising total body weight. Human body composition varies with age, gender, and personal body traits. You need to make sure each component is in proper balance, as it tells much about your current health condition. See below for reference the standard range of adult body composition.

As for child analysis, a different set of standards is recommended to use, as children's analysis results are highly subject to change during growth period.

<table>
<tr><th></th><th colspan="2">Intracellular Water (L)</th><th>Extracellular Water (L)</th><th>Protein (kg)</th><th>Mineral (kg)</th><th>Body Fat (kg)</th></tr>
<tr><td>Values (Standard)</td><td colspan="2">16.0
(14.3 - 16.4)</td><td>26.1
(23.3 - 26.8)</td><td>11.4
(10.6 - 11.9)</td><td>3.73
(3.77 - 4.24)</td><td>12.8
(8.0 - 16.0)</td></tr>
<tr><td>Total Body Water (L)</td><td colspan="3" rowspan="2">42.1
(37.7 - 43.3)</td><td rowspan="2">54.1
(48.5 - 55.3)</td><td rowspan="2">Osseous :
3.10
(3.13 - 3.52)</td><td rowspan="3"></td></tr>
<tr><td>Muscle Mass (kg)</td></tr>
<tr><td>Fat Free Mass (kg)</td><td colspan="3">Skeletal Muscle : 33.5 (28.8 - 35.2)</td><td>57.2
(53.9 - 60.6)</td></tr>
<tr><td>Weight (kg)</td><td colspan="5"></td><td>70.0
(57.2 - 77.4)</td></tr>
</table>

A. Weight

Total body weight is the sum of every body component value put together, and your standard range & value of body weight is calculated as in the following formula.

Standard weight(kg) = Height(m)^2 * BMI standard value

(Calculation Examples of Standard Weight)

- Standard weight of a male tester of 170.0 cm high = $(1.7)^2$ * 22.0 = 63.6kg
- Standard weight of a female tester of 165.0 cm high = $(1.65)^2$ * 21.5 = 58.5kg

[BMI Standard Range]

	BMI Standard Range(kg/m^2)	BMI Standard Value(kg/m^2)
Westerner(Default)	18.5 ~ 25.0	Male 22.0, Female 21.5
Asian	18.5 ~ 23.0	Male 22.0, Female 21.0

* Ref. WHO/IASO/IOTF.(2000) The Asia-Pacific perspective: redefining obesity and its treatment. Health communications Australia: Melbourne.
* The chart above is for adult use. Pre-teen children analysis requires another set of standards.
* Standard value and range of BMI are able to be changed in the device setting.

B. Body water

Body water takes up the largest share of body composition, carries oxygen and essential nutrition to cells, and removes waste materials out of the body. Even a minor loss of 20% of body water could cause a serious death risk. Therefore, it is vital to keep your body constantly hydrated for proper body functioning. The standard range of body water is calculated considering the proportion of current total body water percentage compared to standard weight.

* Ref. Nello et al.(1945) The Body Water and Chemically combined nitrogen content in relation to fat content.

C. Intracellular Water

Among the body water, intracellular water is the water located inside cell membranes and is one of the constituents of somatic cells. In patients with hydrops abdominis or edema that usually causes an abnormal body water increase, muscle mass may be overestimated by the increased body water. Intracellular water does not change largely, but it is common that extracellular water increases abnormally in the patients, so that it is good to check intracellular water when assessing muscle mass for accurate muscle analysis.

D. Extracellular Water

Among the body water, extracellular water is the water located outside cell membranes and consists of tissue fluid, lymph fluid and water in plasma. In general, extracellular water accounts for approximately 40% of the body water, but it may largely increase by disease such as edema.

E. Protein

Protein is one of the essential components of body composition, and is primarily used for formation of bone and muscle tissues, and even takes its part on the immune system and blood clotting. If your body ever seriously notices approaching dangers of nutritional deficiency, then protein would as soon start to “fuel” itself as an alternative energy source to keep the body running on. Therefore, to prevent protein from taking its toll on your health, it is advised to make appropriate diet and exercise plans. Considerable loss of protein in cancer patients, individuals with chronic disease or old people provides a clinically meaningful glimpse that their muscle is being “fueled” as an energy source to sustain their function on.

* Ref. Siri W.E.(1961)Body composition from fluid spaces and density_Analysis of methods.

F. Minerals

Human body consists of 5~6% of mineral. Minerals are essential for performing many different functions – from building bones, dental health and to maintaining hormonal circulation. Broadly speaking, minerals fall into two types: osseous and non-osseous. Osseous minerals are used for bone and tooth development. Non-osseous minerals are contained in total body fluid or muscle surrounding cells of the body, and are used to maintain main body functions, such as blood clotting, muscle contraction / relaxation.

Minerals are for the majority (82%) osseous, serving as a reliable indicator of bone density. Lack of minerals then debilitates skeletal function for support of the body, becoming all the more serious for senior or female patients who are under the effect of menopause, and highly prone to osteoporosis. The standard range of minerals is calculated through your standard mineral value against standard weight.

* Ref. Siri W.E.(1961)Body composition from fluid spaces and density_Analysis of methods.

G. Body Fat

Body fat mass refers to how much share is taken by body fat in total weight. Body fat is essential in body composition, and it falls into two types: essential fat & storage fat. Storage fat is mostly found over the subcutaneous layer of skin or around the stomach area, in order to protect internal organs from impact, or to reserve energy for later use. Essential fat is vital for survival and reproduction, and is found in a variety of important human organs, such as brain marrow, heart, lungs, liver, kidneys, muscle, or brain.

The standard range of body fat can be calculated through the standard body fat percentage against standard

Body fat does a lot of jobs, serving as a warehouse tank for surplus energy stock, used for body protection, normal body temperature, even to generate cell membranes as well. However, unlike every other body component that would eventually find its way out of the body, body fat typically persists to create obesity issues. Therefore, it is recommended to keep within the standard range of body fat.

H. Fat Free Mass

Fat Free Mass refers to the rest of body composition “minus” total body fat. The standard range of fat free mass is calculated through the standard percentage of fat free percentage against standard weight.

Standard range of fat free mass(kg) = Standard weight(kg) * Minimum standard fat free percentage ~ Standard weight(kg) * Maximum standard fat free percentage

[Standard Range of Fat Free Percentage]

	Asian	Westerner
Male	80 ~ 90%	80 ~ 90%
Female	72 ~ 82%	70 ~ 80%

* Ref. Lohman et al.(1997) Body fat measurement goes high-tech: Not all are created equal, ACSM's Health & Fitness Journal

I. Muscle Mass

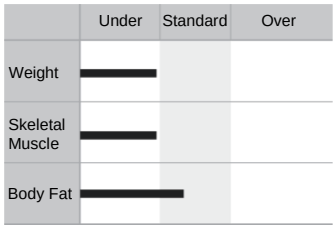
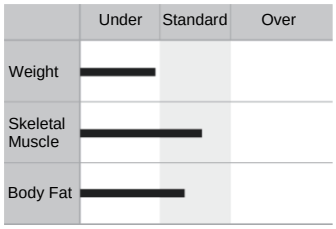
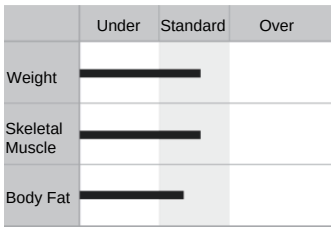
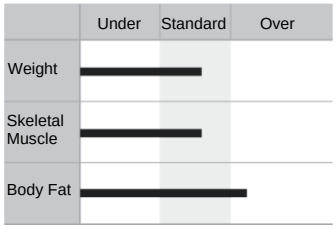
Muscle control is initiated by the nerve system to produce physical movement. Broadly speaking, there are three types of muscle – skeletal muscle for producing movement, cardiac muscle for heart operation, and visceral muscle for the digestive and intestinal system.

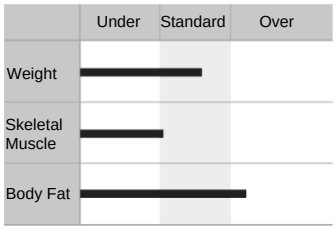
Extreme weight loss may cause muscle loss, so proper exercise regime needs to be followed with proper diet plans. Human body consists of 65~85% of muscle, and standard range of muscle mass is calculated through standard muscle percentage against standard weight.

3.3. Skeletal Muscle & Fat analysis

Weight scale is an easy way to measure obesity. However, even if you have low body fat, people with a lot of muscle can be assessed as obese, because the weight exceeds the standard range, so weight alone cannot accurately determine obesity. Therefore, in order to properly assess obesity, body fat percentage should be checked, which is the percentage of body fat in weight.

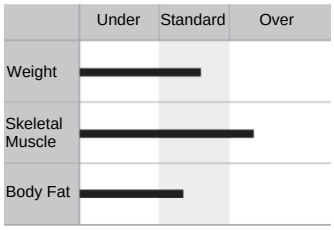
○ **Example of Skeletal Muscle & Fat analysis**

	[Underweight Weak] Both of your body weight and muscle mass fall far below standard. You need to gain weight by managing muscle mass, carefully controlling excessive body fat.
	[Underweight Muscular] Even though your total weight is below standard, your muscle mass still belongs to the standard zone, making you stay in muscular shape. If your fat mass level stays extremely low, you need to track your weight changes, so you would not lose more body fat. Extremely low fat mass may affect your immune system, resulting in chronic fatigue and hormonal changes.
	[Standard] Weight, muscle, body fat are all in proper balance. Constant management is needed.
	[Standard Weight Obese] Your weight and muscle are safely in the standard zone, only a little bit out of balance on your body fat. It may look normal, but excessive fat can cause health risks. So you may need to lose fat.



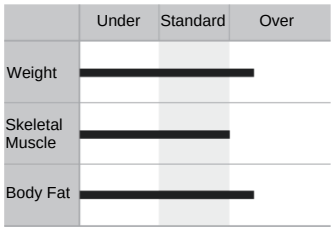
[Standard Weight Weak]

Your weight and muscle mass is standard, body fat being out of balance. Your physical performance presumably could have been affected by lack of muscle, so you need to gain strength through muscle development.



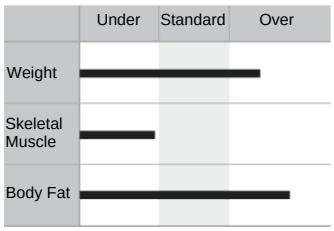
[Standard Weight Muscular]

Your weight safely sits on the standard zone; you are defined as muscular for your massive muscle bulk and controlled body fat. Being desirable in body frame, you only need constant management and care.



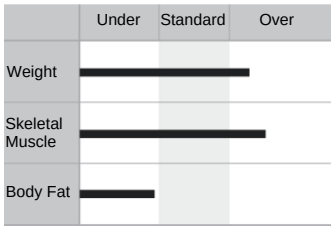
[Overweight Obese]

You are defined as obese: both of your weight and fat mass have got past the standard zone, with your muscle mass hanging at the edge of standard. This body type is mostly found in highly obese groups. You need to reduce your body fat level while maintaining your muscle mass.



[Overweight Weak]

Both body weight and fat are far above standard, while muscle mass falls far behind the standard zone. Due to lack of muscle mass compared to weight and fat, physical ability is below the standard level. Therefore, you need to gain strength through muscle development. You may also need to reduce total body fat to prevent obesity-related issues.



[Overweight Muscular]

You can be defined as athletic in your body frame: muscle mass above the standard and body fat kept under strict control at low levels. Your weight exceeding standard is because of your total muscle mass. Therefore, from a “purely body analytical” perspective, no extra effort to lose weight is required.

3.4. Obesity Analysis

A. BMI

BMI value can be derived by dividing weight by the square of your height. Even though prevalently used as a simple way to analyze obesity, BMI is limited for its inability to take separate results from subjects of same height and weight – it does not make research on fat mass level. Therefore, body fat measurement should be taken for more accurate obesity analysis.

$$BMI(kg/m^2) = Weight(kg) / Height(m)^2$$

	BMI Standard Range(kg/m^2)	BMI Standard Value(kg/m^2)
Asian	18.5 ~ 23.0	Male 22.0, Female 21.0
Westerner	18.5 ~ 25.0	Male 22.0, Female 21.5

* Ref. WHO/IASO/IOTF.(2000) The Asia-Pacific perspective: redefining obesity and its treatment. Health communications Australia: Melbourne.

* The chart above is for adult use. Pre-teen children analysis requires another set of standards.

○ **Children standard BMI**

Gender	Age	BMI Standard range(kg/m^2)	BMI Standard value(kg/m^2)
Male	3	14.1 ~ 16.8	15.3
	4	13.8 ~ 16.4	14.9
	5	13.7 ~ 16.3	14.7
	6	13.6 ~ 16.4	14.6
	7	13.5 ~ 16.6	14.7
	8	13.6 ~ 17.1	14.8
	9	13.7 ~ 17.6	15.1
	10	14 ~ 18.2	15.5
	11	14.3 ~ 18.9	15.9
	12	14.7 ~ 19.7	16.4
	13	15.1 ~ 20.4	17.0
	14	15.7 ~ 21.2	17.6
	15	16.2 ~ 22	18.3
	16	16.8 ~ 22.7	18.9
	17	17.3 ~ 23.4	19.6
	18	17.9 ~ 24.1	20.2

Gender	Age	BMI Standard range(kg/m^2)	BMI Standard value(kg/m^2)
Female	3	14.3 ~ 16.6	15.7
	4	14 ~ 16.2	15.3
	5	13.8 ~ 16.1	15.2
	6	13.7 ~ 16.3	15.2
	7	13.8 ~ 16.7	15.5
	8	13.9 ~ 17.3	15.8
	9	14.2 ~ 18	16.3
	10	14.5 ~ 18.7	16.9
	11	14.9 ~ 19.5	17.5
	12	15.4 ~ 20.2	18.1
	13	15.9 ~ 21	18.7
	14	16.4 ~ 21.7	19.4
	15	16.9 ~ 22.3	19.9
	16	17.4 ~ 22.9	20.5
	17	17.8 ~ 23.4	20.9
	18	18.2 ~ 23.8	21.3

* Ref. CDC(2000) Clinical Growth Charts

B. Body Fat Percentage

It refers to the proportion of body fat mass against total weight, and measured as in the following formula

Body Fat Percentage = Body Fat Mass(kg) / Weight(kg) * 100

[Standard Range of Body Fat Percentage]

	Asian	Westerner
Male	10 ~ 20%	10 ~ 20%
Female	18 ~ 28%	20 ~ 30%

* Ref. Lohman et al.(1997) Body fat measurement goes high-tech: Not all are created equal, ACSM's Health & Fitness Journal
* The above chart is for adult reference. A different set of standards should be used for pre-teen reference.
* Senior examinees may find themselves to have excessive body fat on adult standards, so need to adjust the standard range a bit higher for accurate analysis following the instructions of clinical experts.

[Standard Range of Body Fat Percentage of Children]

Gender	Age	Standard range of body fat percentage	Standard value of body fat percentage
Male	3	12 ~ 22	17
	4	11 ~ 21	16
	5	9 ~ 19	15
	6	9 ~ 19	14
	7	8 ~ 18	13
	8	8 ~ 18	13
	9	8 ~ 18	13
	10	8 ~ 18	13
	11	8 ~ 18	13
	12	9 ~ 19	14
	13	9 ~ 19	14
	14	10 ~ 20	15
	15	10 ~ 20	15
	16	10 ~ 20	15
	17	11 ~ 21	16
	18	10 ~ 20	16
Female	3	13 ~ 23	19
	4	12 ~ 22	17
	5	11 ~ 21	17
	6	11 ~ 21	16
	7	12 ~ 22	17
	8	13 ~ 23	17
	9	14 ~ 24	18
	10	15 ~ 25	20
	11	17 ~ 27	21
	12	18 ~ 28	22
	13	19 ~ 29	23
	14	20 ~ 30	25
	15	21 ~ 31	26
	16	21 ~ 31	26
	17	22 ~ 32	27
	18	22 ~ 32	27

* Ref. Fomon, S. J., Haschke, F., Ziegler, E. E., & Nelson, S. E. (1982)Body composition of reference children from birth to age 10 years. The American journal of clinical nutrition, 35(5), 1169-1175

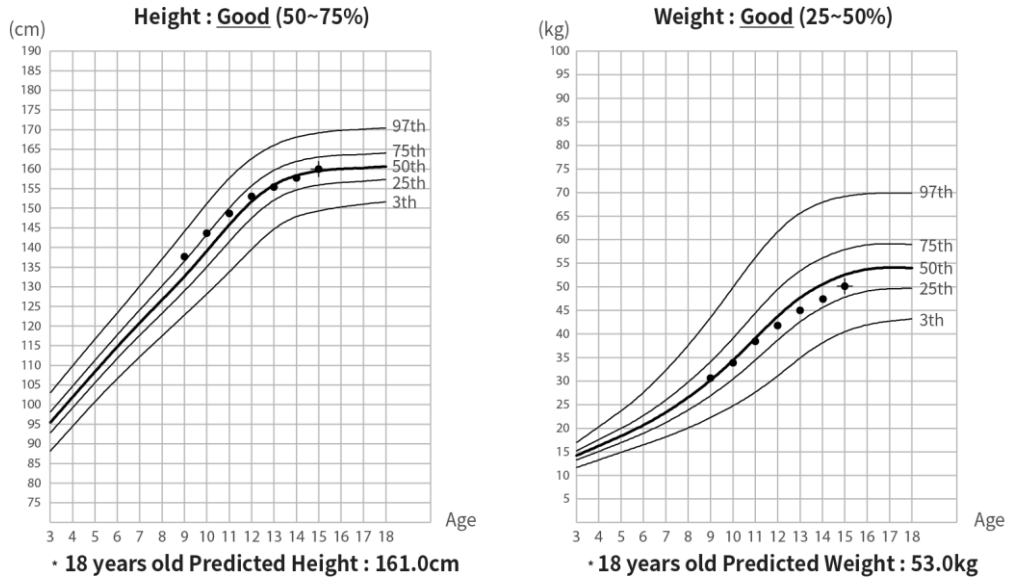
3.5. Growth Curve (Children)

Children results sheet predicts a child's future height and weight based on the current status of growth curve. It describes a form of relative weight and height from peer-age groups.

You may find a spot on the table, where x-axis (age) and y-axis (weight / height) overlap. You can learn the growth percentage depending on where this spot appears.

The spot approaches closer to the top with increasing height and weight values. If a child belongs in higher percentage zone, it suggests equally higher height & weight future growth potential.

Through the curve table, you can take a more relative, compared glimpse into the examinee's growth potential.



* Ref. CDC(2000) Clinical Growth Charts

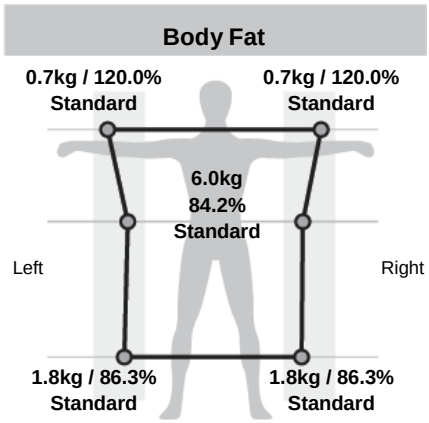
Children tend to experience more 'uneven', drastic hairpin turns during growth, so need constantly measured data results, rather than being partially judged on a single measurement.

This equipment, **I50**, provides year-long database, and marks symbols(✛, ●) reference for your growth transition in age-specific groups.

3.6. Segmental Analysis & Body Balance

A. Segmental Fat Evaluation

In segmental fat Evaluation, it gives analysis results for each separate body limb and trunk fat composition, enabling fat distribution analysis.



1) Segmental Fat Mass

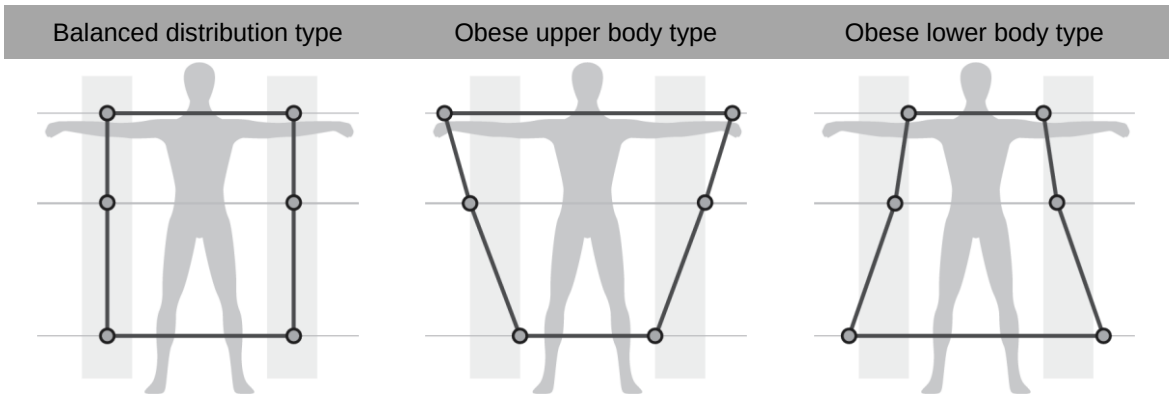
It refers to the weight taken by each segmental fat mass.

2) Segmental Fat evaluation

Segmental fat mass serves as an indicator of body fat distribution in comparison to the standard range. It shows the measurement value of each segment as a percentage of 100 (standard body fat). When the body fat lacks in a segment, it shows “under,” when it is appropriate, it shows “standard” and when it is excessive, it shows “over.”

3) Segmental Fat mass Graph

Segmental fat mass graphs grow outwards from the center of body with increasing fat mass. Trunk section is measured as a whole symmetrical cylinder, because trunk part has no specific need for left / right differentiation. In addition, analysis results are presented with graphs over the shaded zone, allowing you to intuitively compare your current status. It will define you as well balanced, if the six dots at every end of each indicator form a rectangular shape, while successfully staying within the standard range.

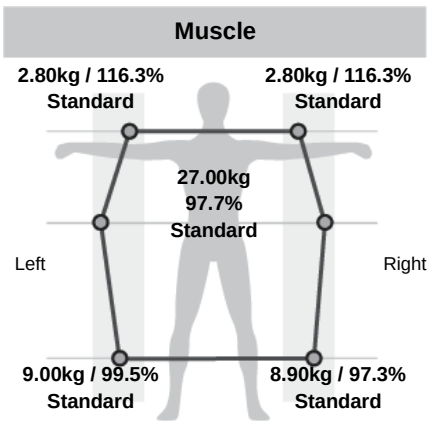


The standard percentage of segmental body fat mass is a standard value statistically calculated through DEXA data of the Korea National Health and Nutrition Examination Survey conducted by KCDC(Korea Centers for Disease Control and Prevention).

Identical body fat mass of two subjects does not necessarily suggest their body type is “equally identical” as well. Let’s suppose one of them has ‘above-the-standard-fat-level’ legs. His legs would appear much bigger than those of the other guy’s, even though they “statistically” do share the same body type. Likewise, if you have fattier arms, you would appear to have a bigger looking torso, even if you are officially standard on body weight.

B. Segmental Muscle Evaluation

In segmental muscle evaluation, it gives analysis results for each separate body limb and trunk muscle mass composition to check the development of muscle balance.



1) Segmental Muscle Mass

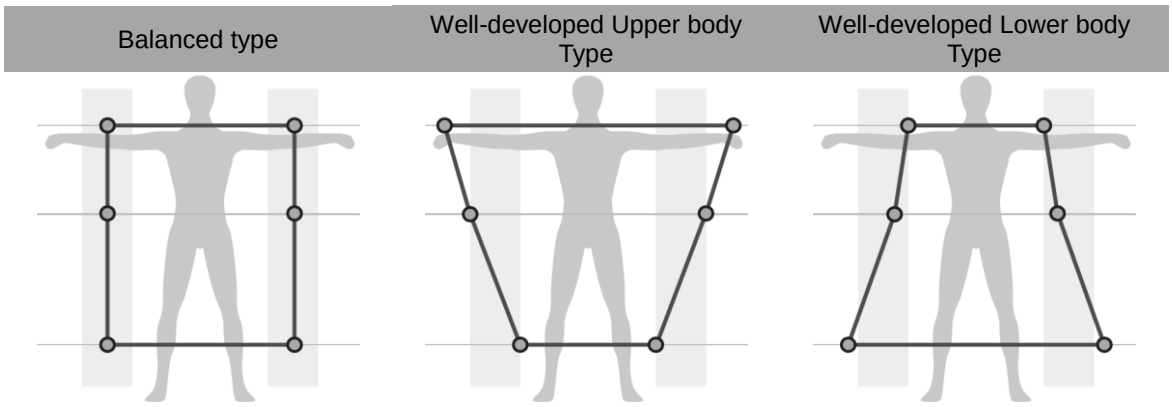
It refers to the weight taken by each segmental muscle.

2) Segmental Muscle Evaluation

Segmental muscle mass indicates how well developed every section of your body muscle is in comparison to the standard range. It shows the measurement value of each segment as a percentage of 100 (standard muscle mass). When the muscle mass in a segment does not meet the standard range, it shows “under,” when it is appropriately developed within the standard range, it shows “standard,” and when it is well developed beyond the standard range, it shows “over.”

3) Segmental Muscle mass Graph

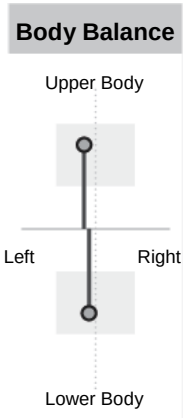
Segmental muscle mass graphs grow outwards from the center of your body with increasing muscle mass. Trunk section is measured as a whole symmetrical cylinder, since trunk part has no specific need for left / right differentiation. In addition, your analysis results are presented with graphs over the shaded zone, allowing you to intuitively compare current status. It will define you as well balanced, if the six dots at every end of each indicator form a rectangular shape, while staying within the standard range.



Standard range of segmental muscle mass is based on DEXA data of NHANES(The National Health and Nutrition Examination Survey) from CDC(Centers for Disease Control and Prevention).

Muscle imbalance caused by poor posture habits may lead to malformed body shape, or affected sense of balance. Therefore, it is necessary to track changes of your segmental muscle balance through constant analysis.

C. Body balance assessment



(General)

It allows you to intuitively compare your muscle balance in graph form. The tilt of each part of the graph informs which section of muscle would require more workout. If the bar indicators stay “within” the standard range (shaded area), it suggests sufficient muscle balance has been achieved.

Upper Body	Caution	Good
Lower Body	Caution	Good

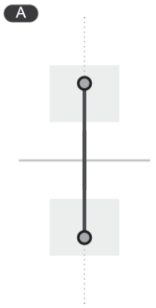
(Children)

Standard muscle mass can be calculated as in the below formula table, and 80 – 120% of muscle mass is defined as “standard”.

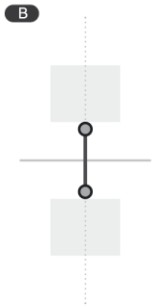
	Items	Formula
1	Standard weight	Height(m)^2 * Standard BMI
2	Standard muscle mass	Standard weight * Standard muscle mass percentage
3	Standard muscle mass of upper body	Standard muscle mass * (Standard muscle percentage of left arm + Standard muscle percentage of right arm)
4	Standard muscle mass of lower body	Standard muscle mass * (Standard muscle percentage of left leg + Standard muscle percentage of right leg)

* The standard percentage of segmental body muscle mass is a standard value statistically calculated through DEXA data of the National Health and Nutrition Examination Survey conducted by CDC(Centers for Disease Control and Prevention).

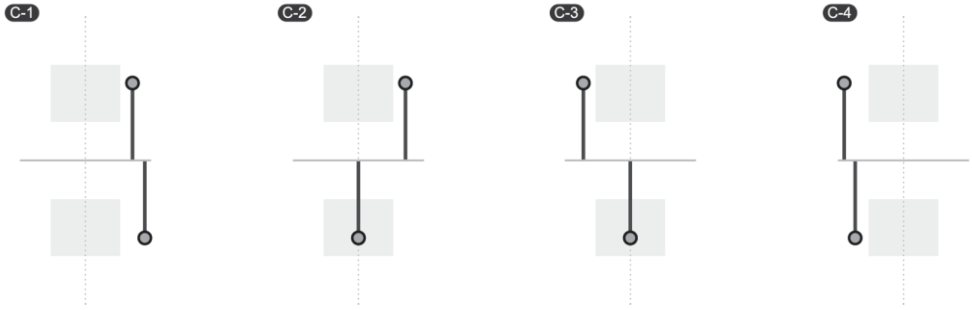
○ **Body balance Graph**



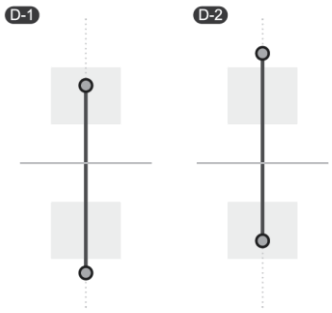
Sides of your body and both of upper / lower parts are all well balanced, with no visible signs of imbalance. You just need to keep up the consistent management.



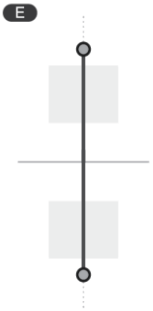
The arms and legs lack muscle. Upper and lower body parts need training so the balance indicators safely belong into the normal range.



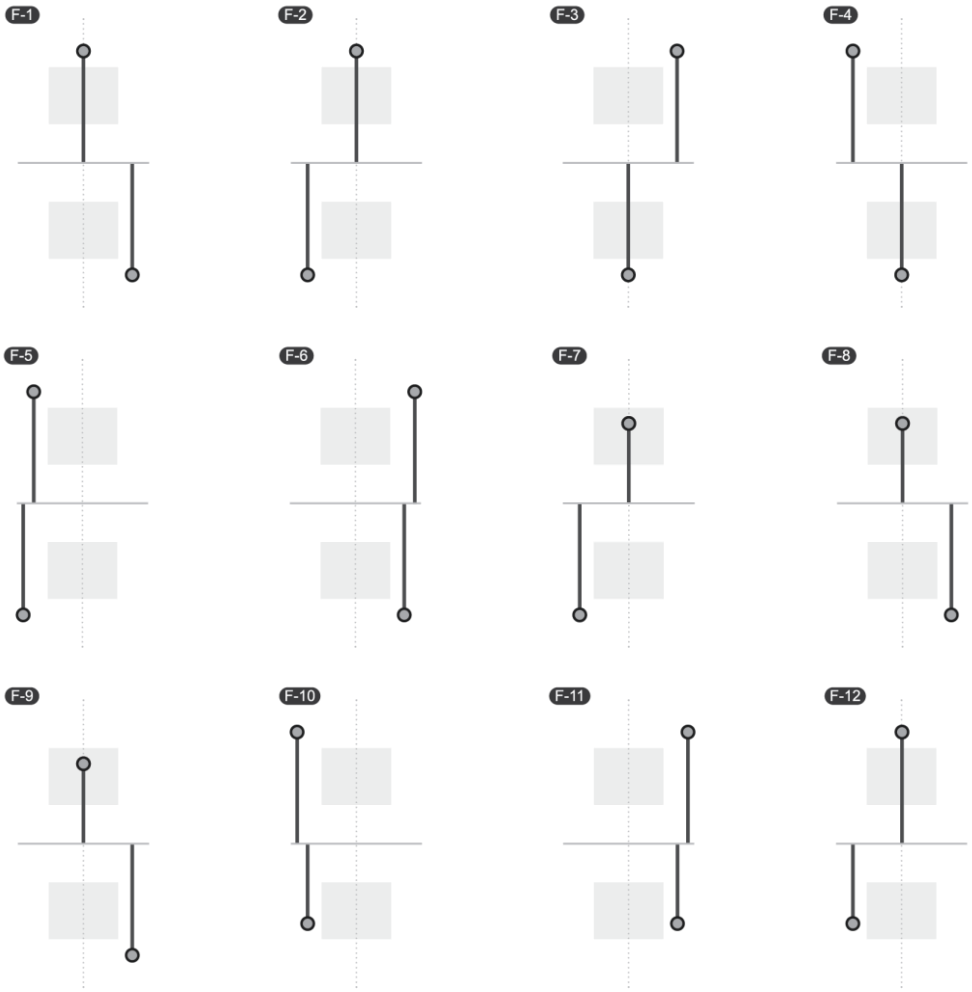
The balance of your upper / lower part of the body has been a little bit pulled aside out of its normal symmetry. After checking which section of limbs has over-grown out of balance, you need to work harder on the opposite part of your affected limbs to get back into normal symmetry.



This is typical of individuals who are overly focused on the upper or lower part of their body. It is advised to work on more less-muscled area.
In addition, if you are the type of hard trainer spending too much workout time on building up your legs or torso, you would then need to keep up the balance by working extra hard on the weaker area.



You may look a bit overweight and out of ordinary body proportion. This body type is mostly found in individuals who show a balanced use of both parts of the body. You just need to keep up the balance through constant management.



You may look a bit overweight and out of ordinary body proportion. The balance of your upper / lower part of the body has been a little bit pulled aside out of its normal symmetry. After checking which section of limbs has over-grown out of balance, you need to work harder on the opposite part of your affected limbs to get back into normal symmetry.

3.7. Extracellular Water Ratio

Extracellular water ratio is an indicator of the water balance in the body. It refers to the ratio of extracellular water to total body water.

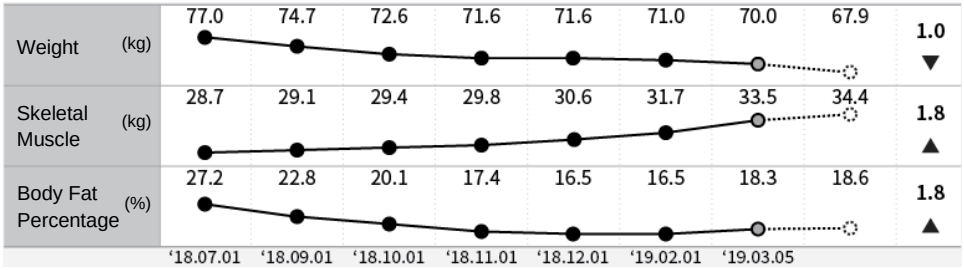
Extracellular Water Ratio = Extracellular Water / Total Body Water

Extracellular water refers to water present outside the cell membrane amongst total body water and is composed of substances such as tissue water, lymph water, and water within plasma. The extracellular water ratio of a healthy person is between 0.36~0.39, but when an edema occurs in the human body, the extracellular water ratio may exceed the standard range due to excessively increased extracellular water.

Edema is a phenomenon where the body's water distribution is unbalanced and the body gets swollen. Edema accompanies the progression of a disease but is not referred to as a disease in itself. Some of the disease that causes edema are heart disease, renal (kidney) disease, liver disease, endocrinopathy, etc. It can also be caused by malnutrition or aging, thus when the extracellular water exceeds the standard ratio, expert consultation or getting a detailed diagnosis is recommended.

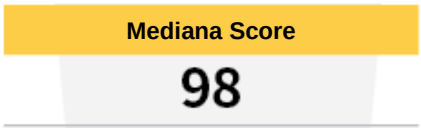
3.8. Body Composition History

When measuring, if you enter your ID and accumulate the measurement results, you can track changes in the main body composition values and prediction of next measurement results that you are likely to get based on the accumulated data.



3.9. MEDIANA score

MEDIANA score, utilizing the company's own technology, provides health issue analysis by combining body fat percentage and muscle mass. It gives high MEDIANA score to individuals who show a lot of workout behaviors, less body fat, heavier muscle bulk.



Even though you are somehow standard on your body fat percentage, it poorly scores you if you have a heavy accumulation of abdominal fat rate for possible risk factors of metabolism syndrome, diabetes, or cardiovascular symptoms.

It scores you from 0 even to over 100 points to the maximum. Since any scores are typically not supposed to reach beyond 100 points, it would come as 100 for anything exceeding the limit of 100 figure.

3.10.Abdominal Obesity Analysis

A. Waist Circumference

Waist circumference is closely related to visceral fat, and because of its convenient and inexpensive usage, it is widely used index in evaluating abdominal obesity. Refer to [B. Abdominal fat percentage] for precise location in measuring waist circumference.

Waist Circumference (69.3 ~ 84.8cm)	84.1

B. Abdominal Fat Ratio

Abdominal fat ratio is used to illustrate visceral fat distribution, measuring segmental impedance values of hip and waist circumference.

Abdominal Fat Ratio (0.80 ~ 0.90)	0.83

CAUTION

* Waist & hip circumference, which is used for measurement of Abdominal Fat Ratio, can be calculated through segmental analysis. The values may vary when taken with a measuring tape.

Abdominal Fat Ratio = Waist circumference / Hip circumference

The clinical position of waist & hip follows the standard of Size Korea.

Waist

Most indented area on the right side of waistline.

Hip

Most protruded part of the hip

According to surveys from WHO(World Health Organization), there are higher risks of metabolic syndrome if abdominal fat rate is above standard. Therefore, even though BMI and body fat mass values are inside the normal range, you are still subject to abdominal obesity risks due to high abdominal fat ratio.

[Abdominal Fat Ratio Standard Range]

	Male	Female
Asian	0.80 ~ 0.90	0.70 ~ 0.80
Westerner	0.80 ~ 0.90	0.75 ~ 0.85

C. Visceral Fat Area

Visceral fat refers to fat accumulated around the intraperitoneal mesentery and the periphery (a broad membrane striking the abdominal wall from the lower part of the stomach). Visceral fat area is the cross sectional area of the fat in between the 4th and 5th lumbar vertebrae. As visceral fat accumulates, insulin is excessively secreted and cardiovascular diseases tends to increase. Thus, it is imperative to be cautious with the accumulation of visceral fat.

Moreover, even if the body fat percentage of the body weight falls within the standard range, one should aim for a healthy diet if there is an excessive visceral fat accumulation (refraining from eating sugar rich food, fatty food, refined grains, etc.) It is also important to participate in cardiovascular exercise in preventing accumulation of excessive visceral fat.

Visceral Fat Area (0.0 ~ 100.0cm^2)	79.8

D. Subcutaneous Fat Area

The subcutaneous fat area is located between the dermis and fascia of the skin and represents fat that serves to store nutrients, block heat, absorb shock, etc. The subcutaneous fat area is measured by measuring the cross section between 4th and 5th lumbar vertebrae to the outside of the peritoneum. The subcutaneous fat has less association with diseases in comparison to the visceral fat but should be watched with caution as excessive accumulation may cause increase in weight, causing musculoskeletal disorders.

Subcutaneous Fat Area (0.0 ~ 200.0cm^2)	128.7

E. Visceral to Subcutaneous Fat Ratio (VSR)

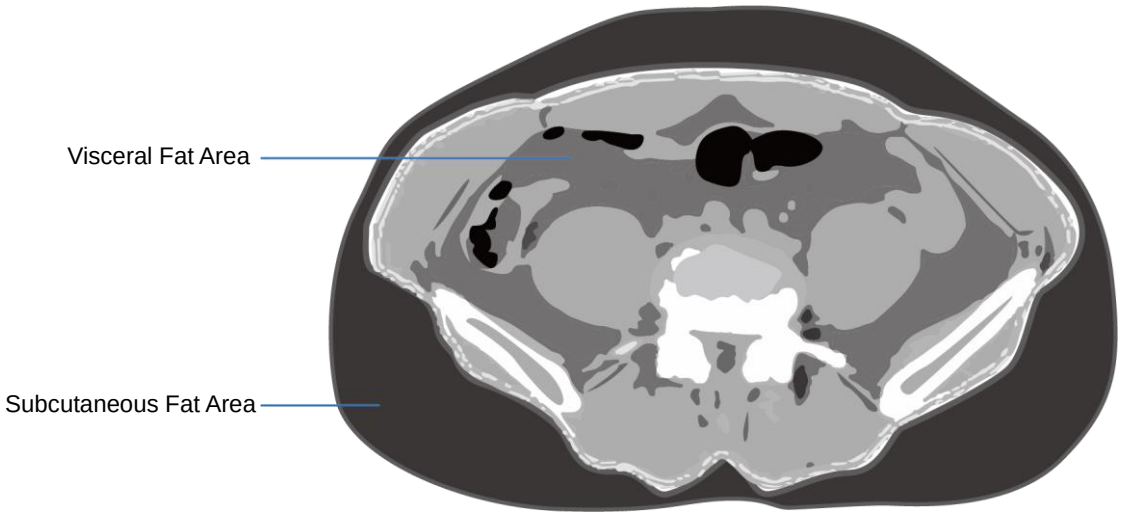
Visceral to Subcutaneous Fat Ratio (VSR) refers to the value of the visceral fat area divided by subcutaneous fat ratio.

Visceral to Subcutaneous Fat Ratio(VSR) = Visceral Fat Area / Subcutaneous fat Ratio

VSR (0.0 ~ 0.4)	0.62

Even if the fat percentage is identical, the degree of risk to health varies depending on the location of fat distribution. When fat accumulates in the abdomen and abdominal obesity occurs, it is vulnerable to type 2 diabetes, hyperlipidemia, high blood pressure, coronary artery disease. In particular, as the amount of visceral fat accumulates, there is a higher risk of getting the disease mentioned above. Visceral to Subcutaneous Fat Ratio (VSR) is one of the criteria in assessing the accumulation of visceral fat, with individuals with values of over 0.4 considered obese when it comes to intra-abdominal obesity.

Visceral fat is highly influenced by one's lifestyle and habits, and thus controlled diet and exercise alone can bring a lot of changes. Exercise therapy particularly plays a major role in the reduction of visceral fat, so if one's VSR is over 0.4, daily cardiovascular exercise of at least an hour is recommended.



F. WHtR(Waist to height ratio)

WHtR (waist to height ratio) is the waist circumference divided by body height.

WHtR = Waist Circumference(cm) / Height(cm)

WHtR	(0.00 ~ 0.50)	**0.44**

It is used as one of the indices to assess abdominal obesity and widely used as it is calculable using body height and waist circumference that are relatively easy to measure.

In addition, it indicates a significant correlation with the predictors of coronary heart diseases, so it is convenient to predict a risk of coronary heart diseases.

3.11.Weight Control

A. Obesity Degree

Obesity degree refers to the percentage of body weight against the standard range.

Obesity Degree	(%)	103.9

Obesity degree(%) = Weight(kg) / Standard weight(kg) * 100

For BMI, standard range is changeable with variety of age and race, whereas obesity degree has quite a stable value range between 90 – 110%, allowing for easier analysis of body weight.

B. Desirable weight & adjustments

Desirable weight analysis informs, based on your results, standard weight and how much muscle and fat needs to be gained or lost. [Desirable weight analysis] offers the patients the “accurate” muscle mass analysis, rather than merely being performed statistically – simply through the addition of height and weight of the patient.

Desirable Weight	(kg)	68.5
Weight Control	(kg)	-1.5
Body Fat Control	(kg)	-1.5
Muscle Control	(kg)	0.0

○ **Examples of Desirable weight Calculation**

	Subject A	Subject B	Remarks
Height(cm)	175.0	175.0	
Weight(kg)	73.3	73.3	
Muscle Mass(kg)	50.0	**60.0**	
Body Fat Mass(kg)	20.1	10.1	
Standard Weight(kg)	67.4	67.4	Male Standard BMI: 22.0 kg/m^2
Standard Muscle Mass(kg)	54.1	54.1	
Difference from standard	+4.1	-5.9	
Standard Body Fat Mass(kg)	10.1	10.1	Standard fat mass for male: 15.0% of standard weight
Muscle Control(kg)	**+4.1**	**0.0**	In case your muscle mass is below standard, it recommends more muscle mass gain. In case you are above-standard, it signals 0 as no such particular effort is required.
Body Fat Control(kg)	-10.0	0.0	
Desirable Weight(kg)	67.4	**73.3**	If your muscle mass is above standard, it automatically sums that extra muscle mass to your standard weight.

Standard weight is measurable through BMI; you can measure the standard weight of a man of 175.0cm high by applying the BMI value of 22.0kg/m^2.

Standard Weight(kg) = Height(m)^2 * Standard BMI = (1.75)^2 * 22.0 = 67.4 kg

As you can see from above, BMI is so simple and ready-to-use a way to take a quick look at how to control obesity.

However, conforming a “single” BMI formula to “two” individual subjects of the same height is undoubtedly problematic. Let’s take an example. One of the two subjects (Let’s call him A) is far short of total muscle mass by 4.1 kg from the standard of 54.1kg, even though BMI judges both of the two subjects as “statistically” of identical body type. The other guy (B) has total muscle mass of 60.0kg, far beyond the standard range of 54.1kg. It then would trigger a wrong interpretation that he (B) has to conform his total muscle mass to BMI standard. To prevent possible misinterpretation, excess muscle mass is not counted in desirable weight. Therefore, it is advisable to use desirable weight for more accurate measurement.

○ **Muscle Control**

Heavy muscle bulk facilitates various kinds of internal activity, and helps boost your BMR, thus preventing obesity. Muscle analysis, therefore, lets you see how much muscle gain you should make to make up total muscle mass. On the contrary, if your muscle mass is above standard, it will not turn up any advisory information, just adding that extra muscle mass to standard weight.

○ **Body Fat Control**

Excessive body fat can cause various kinds of metabolic syndrome, while body fat deficiency may seriously affect the immune system, causing chronic fatigue, or hormonal problems. Therefore, it is recommended to increase the amount of body fat if it is much lower than the standard, and reduce if it is more than standard. However, it should be advised that extreme weight loss over a short period of time will take its toll on your health, especially with following depression, hormonal imbalance, or you may rapidly return to your previous weight again. It’s better to consult with medical experts for longer-term diet plans.

- Weight Control Guidance Example (Male, Height 170cm)

Measured Weight(kg)	Standard Weight(kg)	Desirable Weight(kg)	Muscle Control(kg)	Body Fat Control(kg)
57.0	63.6	63.6	2.1	4.5

The subject above is standard in his weight and muscle mass, only a little bit below its targeted standard weight, while his fat mass falls far behind. When you find yourself too low in fat mass, it may cause the malfunction of immune system, chronic fatigue, and hormonal imbalance. For this reason, the subject would have to make more muscle & fat gain, each separately by 2.1 and 4.5kg, for more balanced body control.

- Weight Control Guidance Example (Male, Height 170cm)

Measured Weight(kg)	Standard Weight(kg)	Desirable Weight(kg)	Muscle Control(kg)	Body Fat Control(kg)
67.4	63.6	66.2	0.0	-1.2

The subject measured above is slightly “overweight” (63.6kg), which is effectively offset by his strictly controlled muscle mass. You do not need to make any extra effort for muscle control; only a bit of fat loss control is required.

* Muscle mass exceeding standard range does not necessarily need to be kept in control. If it is the case, the amount of muscle mass you need to adjust is shown as 0 kg. Also, the amount of exceeding muscle mass (2.6kg) is then added to desirable weight.

3.12.Reference

A. FMI and FFMI

FMI value is derived by body fat mass (kg) divided by height $(m)^2$. FFMI value is derived by fat free mass (kg) divided by height $(m)^2$.

FMI	(2.78 ~ 3.75kg/m²)	3.92
FFMI	(15.72 ~ 21.25kg/m²)	18.94

Due to BMI’s high association with body fat, its safety, and convenient usage, it is widely used as an index to predict body fat mass or body fat percentage in epidemiological and clinical studies. Nevertheless, despite having the same BMI value, body fat percentage may differ depending on race, gender, physical activity, disease status, etc. Thus, it is insufficient to assess one’s obesity based on BMI value alone.

FMI and FFMI are indexes to supplement BMIs, calculating body fat mass and fat free mass independently as opposed to the BMI which combines the two when calculating obesity. By separating and displaying each index, it is possible to distinguish whether the cause of the measured BMI is high or low due to body fat mass or fat free mass.

In addition, because FMI and FFMI have standardized values based on the height $(m)^2$, users can evaluate body fat mass and fat free mass regardless of their changes in height. This is especially useful for children, teenagers, or elderly as they face changes in height regularly.

○ **FMI and FFMI application example**

	Subject A	Subject B
Height(cm)	175.0	175.0
Weight(kg)	73.3	73.3
Body fat mass(kg)	11.0	21.0
Fat free mass(kg)	69.0	59.0
BMI (Standard Range)	26.1 (18.5~25.0)	26.1 (18.5~25.0)
FMI (Standard Range)	3.59 (2.78~3.75)	6.86 (2.78~3.75)
FFMI (Standard Range)	22.53 (15.72~21.25)	19.27 (15.72~21.25)

Both the Subject A and B have over the standard range BMI. In the case of Subject A, however, FMI falls within the standard range and the FFMI exceeds the standard range. In other words, Subject A's high BMI is caused by its developed muscle mass (FFMI), not by its fat mass (FMI). Thus, Subject A is not obese.

On the contrary, Subject B's FFMI is in standard but its FMI exceeds the standard range. Thus, we can deduce Subject B's high BMI comes from its excessive body fat mass. Therefore, we can categorize Subject B as "obese."

B. SMI

SMI is the limb muscle mass(kg) divided by the square of body height(m).

SMI	(6.60 ~ 8.91kg/m²)	8.21

Skeletal muscles that are attached to the skeleton and support the body and enable body movement are mostly developed in limbs, so they can be used to assess body muscle development.

Therefore, SMI, which is the standardized index using limb skeletal muscle mass and height, can be used to diagnose muscle atrophy. When the SMI falls excessively short of the standard range, a doctor's consultation or complete medical examination is advised.

C. Body Cell Mass

In human anatomy, all areas except for body fat are called lean body mass. Among the lean body mass, the sum of protein and intracellular water is called body cell mass.

Body Cell Mass	(25.5 ~ 28.7kg)	37.5

Body cell mass is a total sum of tissue constituent cells, including the cells in muscles and internal organs such as secreting glands of the nervous system, gastrointestinal system, myocardial blood, smooth muscles and musculoskeletal cells. It can be directly used to assess the nutriture of patients who lack both protein and caloric intake as all body metabolic processes are performed in the cells included in body cell mass.

In case of normal people, the nutriture can be assessed using BMI, lean body mass and muscle mass, but in case of patients, it may be hard to assess it accurately because their muscle mass is usually overestimated due to abnormally increased extracellular water by hydrops abdominis and edema. Therefore, it is recommended to use body cell mass except for extracellular water for more accurate nutritional assessment of a patient with hydrops abdominis or edema.

* Ref. Frankenfield, D. C., Cooney, R. N., Smith, J. S., & Rowe, W. A. (1999). Bioelectrical impedance plethysmographic analysis of body composition in critically injured and healthy subjects. The American journal of clinical nutrition, 69(3), 426-431.

3.13.Whole Body Phase Angle

This product uses bioelectrical impedance analysis (BIA) for body composition measurement. Bioelectrical impedance analysis calculates body composition using resistance (R), reactance (Xc) and impedance (Z) that are generated in the human body when a microcurrent is sent through the human body.

6.5°

Phase angle indicates the ratio of reactance to resistance and is proportional to reactance, so it serves as an index for health condition of cell membrane and cell in theory. In general, pure cell membrane has a phase angle of 90°, while pure electrolyte solution has a phase angle of 0° and it is directly proportional to body cell mass.

Namely, a low phase angle means a low ratio of reactance to resistance, which implies less cell mass and damaged cell membranes, while a high phase angle means a high ratio of reactance to resistance, which implies more cell mass and healthy cell membranes.

Therefore, phase angle can be used as an indicator of body cell mass, structural perfection of cells and physiologic function.

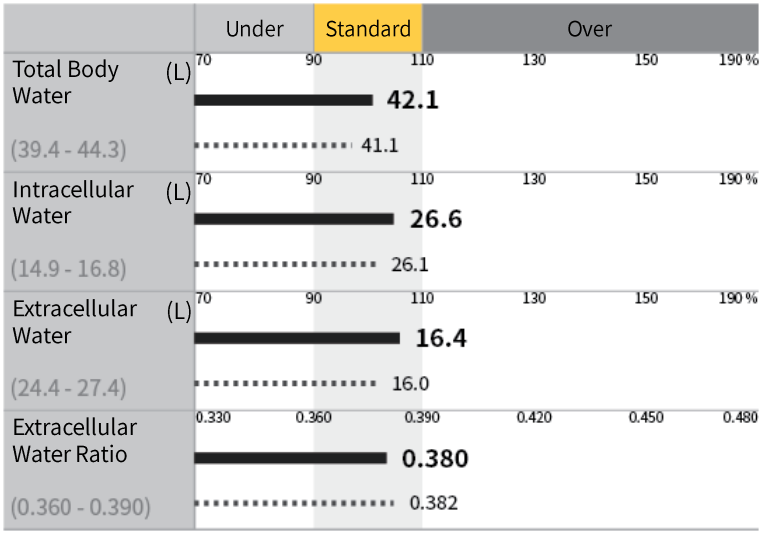
The range of phase angle appears to be 2-20° in adults and 6-8° in case of healthy adults, but it differs by race and gender and the normal range may differ by the type of used product, used frequency and measurement method. There is no standard established yet to date.

3.14.Impedance

Impedance is the resistance value that prevents the travelling of electric wave. Because electric wave travels faster on fluid, it is used for analysis of body composition. In addition, varying nature of impedance on different waves of frequency makes possible an accurate, more 'layered' analysis of body composition.

kHz	LA	RA	TR	LL	RL
5	365.2	365.3	29.9	280.1	290.6
10	321.4	321.5	27.4	246.4	257.5
50	280.7	282.8	22.4	218.3	227.7
100	272.3	272.7	20.5	208.7	209.1
500	268.6	268.8	18.9	202.6	203.2
1000	249.8	249.9	17.6	188.4	188.6

3.15.Body Water Analysis



1) Total Body Water

Body water takes up the largest share of body composition, carries oxygen and essential nutrition to cells, and removes waste materials out of the body. Even a minor loss of 20% of body water could cause a serious death risk. Therefore, it is vital to keep your body constantly hydrated for proper body functioning.

2) Intracellular Water

Among the body water, intracellular water is the water located inside cell membranes and is one of the constituents of somatic cells. In patients with hydrops abdominis or edema that usually causes an abnormal body water increase, muscle mass may be overestimated by the increased body water. Intracellular water does not change largely, but it is common that extracellular water increases abnormally in the patients, so that it is good to check intracellular water when assessing muscle mass for accurate muscle analysis.

3) Extracellular Water

Among the body water, extracellular water is the water located outside cell membranes and consists of tissue fluid, lymph fluid and water in plasma. In general, extracellular water accounts for approximately 40% of the body water, but it may largely increase by disease such as edema.

4) Extracellular Water Ratio

Extracellular water ratio is an indicator of the water balance in the body. It refers to the ratio of extracellular water to total body water.

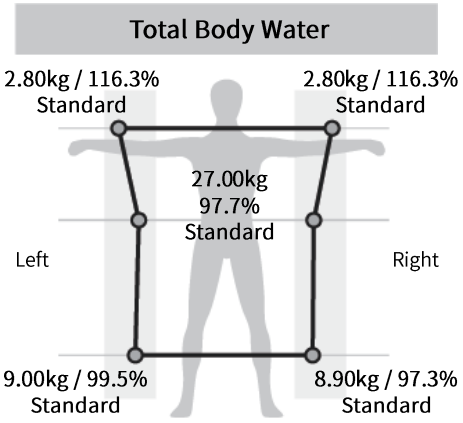
Extracellular water refers to water present outside the cell membrane amongst total body water and is composed of substances such as tissue water, lymph water, and water within plasma. The extracellular water ratio of a healthy person is between 0.36~0.39, but when an edema occurs in the human body, the extracellular water ratio may exceed the standard range due to excessively increased extracellular water.

Edema is a phenomenon where the body's water distribution is unbalanced and the body gets swollen. Edema accompanies the progression of a disease but is not referred to as a disease in itself. Some of the disease that causes edema are heart disease, renal (kidney) disease, liver disease, endocrinopathy, etc. It can also be caused by malnutrition or aging, thus when the extracellular water exceeds the standard ratio, expert consultation or getting a detailed diagnosis is recommended.

3.16.Segmental Body Water & Phase Angle Analysis

A. Segmental body water analysis

It shows the distribution of body water in left arm, right arm, trunk, left leg and right leg.



1) Segmental body water

It means body water in each segment. Muscles consists of approximately 70-80% of body water, so segmental body water tends to change in proportion to changes in segmental muscle mass.

2) Segmental body water analysis

Segmental body water is assessed by comparing the body water in each segment with the standard range. It shows the measurement value in each segment as a percentage of 100 (standard body water). When the body water lacks in a segment, it shows “under,” when it is appropriate, it shows “standard” and when it is excessive, it shows “over.”

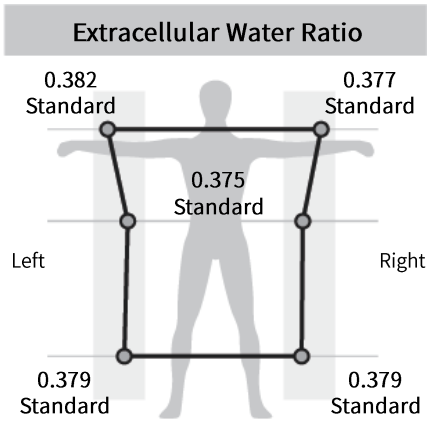
3) Segmental body water graph

It starts from the center of the body and increases outward as the body water increases. As the trunk is one part without division of left and right, the graph is drawn in bilateral symmetry.

Also, the standard range is shaded to show the satisfaction of the standard in each segment at a glance. When a figure connecting the end points of the graph comes within the standard range and is close to a square shape, it means that the distribution of body water is balanced.

B. Segmental extracellular water ratio analysis

It shows the extracellular water ratio and comparison with the standard of the left arm, right arm, trunk, left leg and right leg.



1) Segmental extracellular water ratio

It means the value of extracellular water divided by body water in each segment. Normal people show the extracellular water ratio at a constant ratio, but people with edema may show it off the standard range due to an excessive increase in extracellular water.

If the extracellular water ratio is within the standard range although segmental body water is over the standard range, it may be construed that there are many muscles in the segment.

However, if the segmental extracellular water ratio is over the standard range although the segmental body water is within the standard range, it may be associated with water control-related diseases and an expert's consultation or a complete medical examination is advised.

As above, the extracellular water ratio should be considered when assessing the segmental water ratio for accurate analysis.

2) Segmental extracellular water ratio analysis

It is assessed by comparing with the standard range of extracellular water ratio in each segment of body. When it is low, it shows "under," when it is appropriate, it shows "standard" and when it is high, it shows "over."

3) Segmental extracellular water ratio graph

It starts from the center of the body and increases outward as the body water increases. As the trunk is one part without division of left and right, the graph is drawn in bilateral symmetry.

Also, the standard range is shaded to show the satisfaction of standard in each segment at a glance. When a figure connecting the end points of the graph comes within the standard range and is close to a square shape, it means that the distribution of extracellular water is balanced.

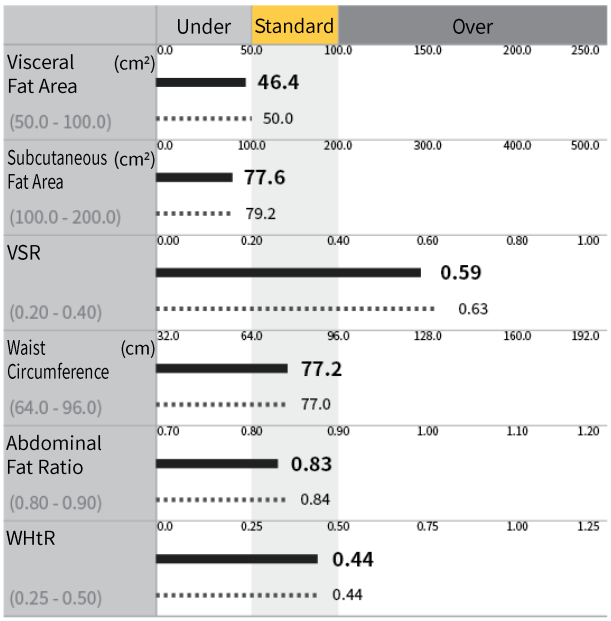
C. Segmental Body Water & Phase Angle

It shows intracellular water, extracellular water, extracellular water ratio and phase angle at a glance in a table.

	LA	RA	TR	LL	RL
Intracellular Water (L)	1.545	1.495	12.500	4.471	4.471
Extracellular Water (L)	0.955	0.905	7.500	2.729	2.729
Extracellular Water Ratio	0.382	0.377	0.375	0.379	0.379
Phase Angle (°)	5.2	5.3	8.1	6.4	6.5

3.17.Abdominal Obesity Analysis (Graph)

It shows the analysis indicators of abdominal obesity in a graphic at a glance. For a detailed explanation on each item, see section 3.10.



3.18.Change of Abdomen

When measuring, you can check the change in the abdominal obesity analysis index if you cumulatively manage the measurement results by entering your ID

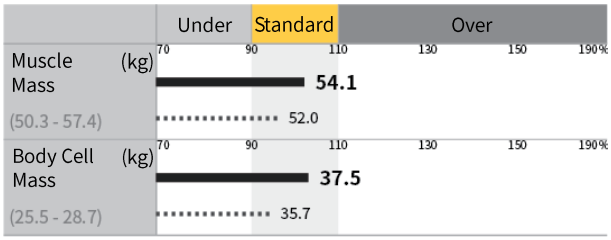
Date	Visceral Fat Area	Subcutaneous Fat Area	VSR	Waist Circumference	Abdominal Fat Ratio	WHtR
´19.03.05	46.4cm²	77.6cm²	0.59	77.2cm	0.83	0.44
´19.02.01	50.0	79.2	0.63	77.0	0.84	0.44
´18.12.01	51.2	80.1	0.64	77.8	0.85	0.44
´18.11.01	53.3	80.5	0.66	78.5	0.87	0.45
´18.10.01	57.9	82.7	0.69	81.4	0.91	0.47

3.19.Muscle & Body Cell Mass Analysis

In general, muscle mass can be used to assess body development and nutriture, but in patients with hydrops abdominis or edema, intracellular/extracellular water is usually out of balance due to an abnormal increase in extracellular water.

As muscles are approximately 70-80% water, body water increase is shown as muscle increase. Thus, muscle mass may be overestimated in patients with unbalanced intracellular/extracellular water and accurate analysis may be hard.

Therefore, in case of patients with unbalanced body water, it is recommended to use body cell mass in addition to muscle mass for accurate analysis.



3.20.Classification of Body Type

You can check your body type on Body Type Table and Graph.

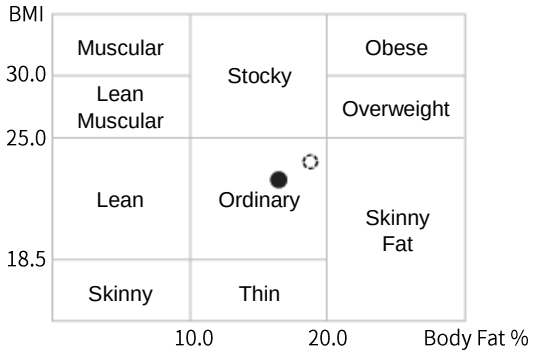
A. Body type table

Body type table helps define body type through BMI and body fat percentage.

BMI value can be derived by dividing weight by the square of your height, so higher BMI value naturally implies an equally bigger frame of body. In addition, lower body fat makes muscle figure to stand out more conspicuously from your fatty frame. Then, it is possible to predict the examinee's appearance by combining BMI value and body fat percentage together.

Based on these calculations, Body Type Classification Table evaluates outer appearance of the examinee, using easy and familiar terms.

"Standard" is where the standard range of both BMI and body fat percentage overlap. The body type indicator moves upwards with increasing BMI, and downwards with the decrease. It also moves to the left side with decreasing body fat percentage, and vice versa.



Body Type Table puts more emphasis on the user's physical appearance, so is not suitable for detailed body composition analysis.

So, users can, for more comprehensive insights, make use of the body type classification graph that will define your body type through body compositional balance.

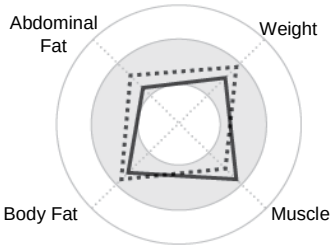
○ **Examples of Body Type Table Interpretation**

Body Type	Interpretation
Muscular	This body type is characterized by strictly controlled fat mass and heavy body frame, mostly found in body builders or hard trainers. They are well-built on their chest and have abdominal muscle packs, with square-wide-shoulder.
Lean Muscular	This body type is characterized by muscular frame of body, with above-standard body weight, mostly found in individuals who spend a lot of time working out.
Lean	This body type is characterized by standard body weight, lower body fat percentage, more focus on aerobic exercise, and a clearer muscle definition from low body fat.
Skinny	This body type is characterized by low body fat and weight, lack of physical activity and stamina, insufficient calorie consumption. Individuals in this type may look tired and even malnourished.
Stocky	This body type is characterized by standard body fat percentage and stronger, stout body frame, even though body weight is a bit above standard. This type is mostly found in individuals who practice anaerobic bulk-up exercise.
Ordinary	Weight and body fat are all within the standard range, and is found in the majority of ordinary people.
Thin	This body type is characterized by low body weight, with standard fat percentage. Lack of physical activity and insufficient calorie consumption are unique to this body type as well. Individuals in this type may look scrawny and weak.
Obese	This body type is characterized by being obese with very high body fat percentage. This type is mostly found in individuals whose amount of physical activity cannot outweigh the total calorie consumption. They are typically outlined in rounder, big body frame, with overabundance of abdominal fat.
Overweight	This body type is characterized by being overweight with high body fat percentage. This type is mostly found in individuals whose amount of physical activity cannot outweigh the total calorie consumption. They are typically outlined in curvy body frame, with no clear muscle definition.
Skinny Fat	Individuals in this body type do appear skinny, but they have body fat percentage over standard. Excessive visceral fat accumulation usually creates in them a big abdominal bulge around the stomach.

B. Body Type Graph

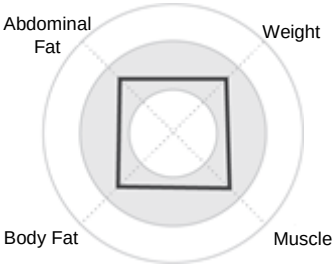
It presents your body type on a square table, each end point representing abdominal fat rate, weight, total body fat, and muscle. The closer its form gets to perfect square and belongs to the standard range, the more balance your body shape is in.

You can compare your current body composition result on the shaded zone defining the standard range.



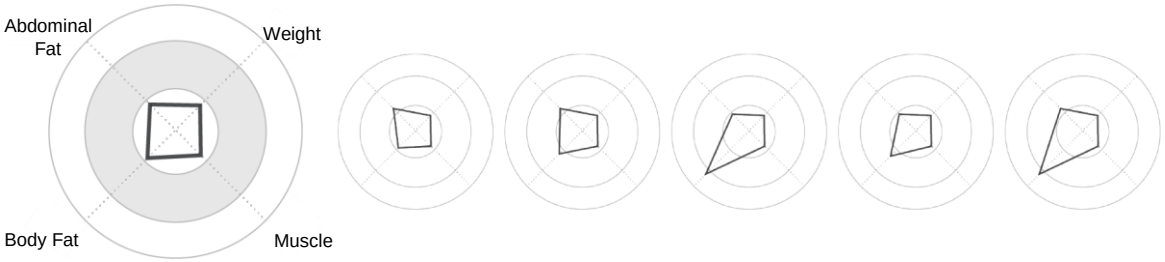
○ **Examples of Body Type Graph Interpretation**

[Standard]



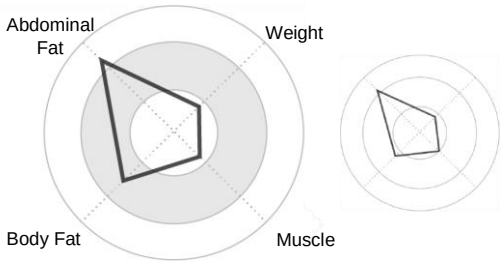
Weight, muscle, body fat, and abdominal fat ratio are all in proper balance. Constant management is needed.

[Underweight weak]



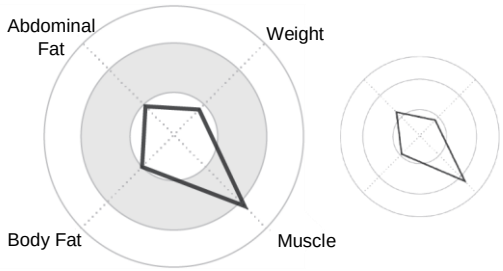
Your body weight and muscle mass both fall far below the standard. You need to gain weight by managing total muscle mass, carefully controlling excessive body fat.

[Underweight abdominally obese]



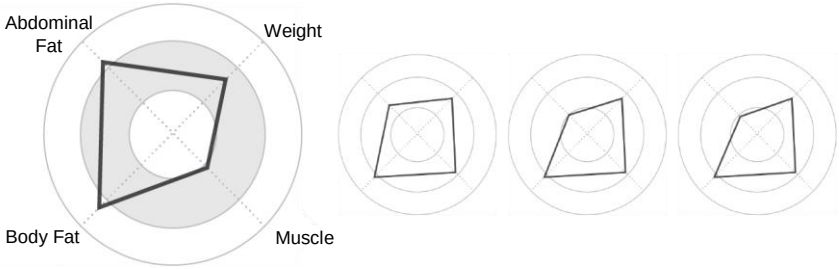
Your weight is below standard, but Abdominal fat ratio is far above the standard. Abdominal obesity may cause metabolic syndrome risks, diabetes and cardiovascular disease. So, more active hard work on reduction of your total body fat is required. In addition, lack of total muscle mass may have impaired your physical ability in general; it demands more muscle workout for balanced muscle development.

[Underweight Muscular]



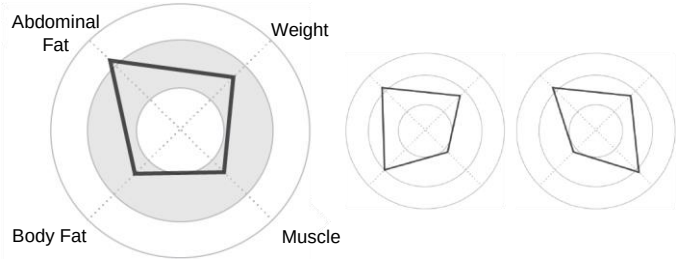
Even though your total weight is below standard, your muscle mass still belongs to the standard zone, making you stay in muscular shape. If your fat mass level stays extremely low, you need to track your weight changes, so you would not lose more body fat. Extremely low fat mass may affect your immune system, resulting in chronic fatigue and hormonal changes.

[Standard weight obese]



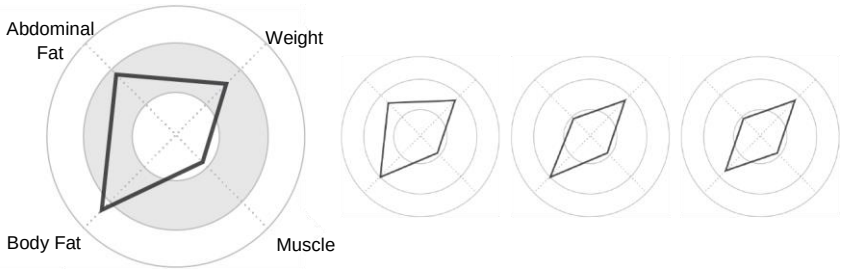
Your weight and muscle are safely in the standard zone, only a little bit out of balance on your body fat. It may look normal, but excessive fat can cause health risks. So you may need to lose fat.

[standard weight / abdominally obese]



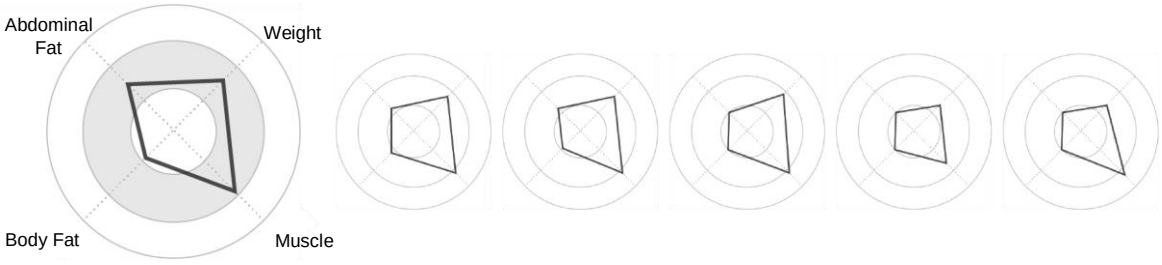
Your weight belongs to the standard, but Abdominal fat ratio is in overweight abdominal figure. Abdominal obesity causes metabolic syndrome risk, diabetes and cardiovascular disease. So fat reduction through aerobic exercise is required.

[Standard Weight Weak]



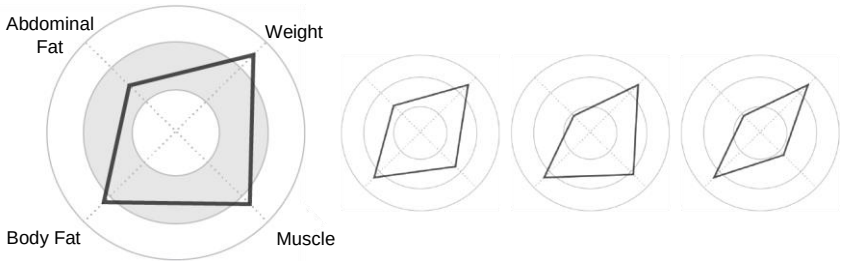
Your weight and muscle mass is standard, body fat being out of balance. Your physical performance presumably could have been affected by lack of muscle, so you need to gain strength through muscle development.

[Standard Weight Muscular]



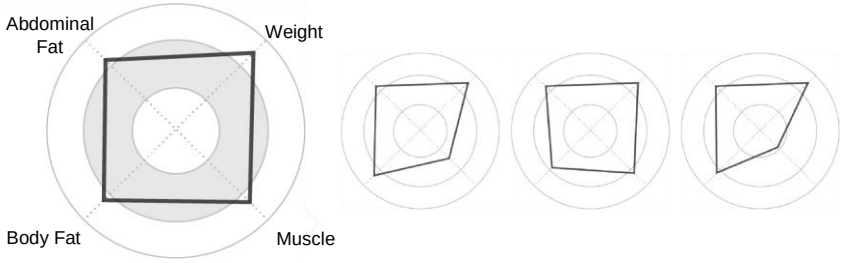
Your weight safely sits on the standard zone; you are defined as muscular for your massive muscle bulk and controlled body fat. Being desirable in body frame, you only need constant management and care.

[overweight obese]



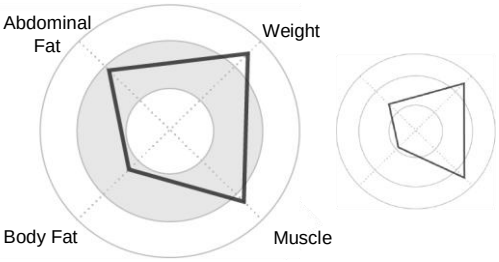
You are defined as obese: both of your weight and fat mass have got past the standard zone, with your muscle mass hanging at the edge of standard. This body type is mostly found in highly obese groups. You need to reduce your body fat level while maintaining your muscle mass.

[Overweight and abdominally obese]



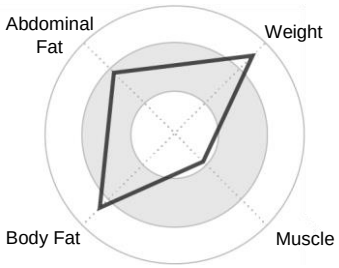
You are abdominally obese with weight and Abdominal fat ratio above standard. Abdominal obesity causes metabolic syndrome risks, diabetes and cardiovascular disease, so aerobic exercise is required.

[Overweight muscular]



You can be defined as athletic in your body frame: muscle mass above the standard and body fat kept under strict control at low levels. Your weight exceeding standard is because of your total muscle mass. Therefore, from a “purely body analytical” perspective, no extra effort to lose weight is required.

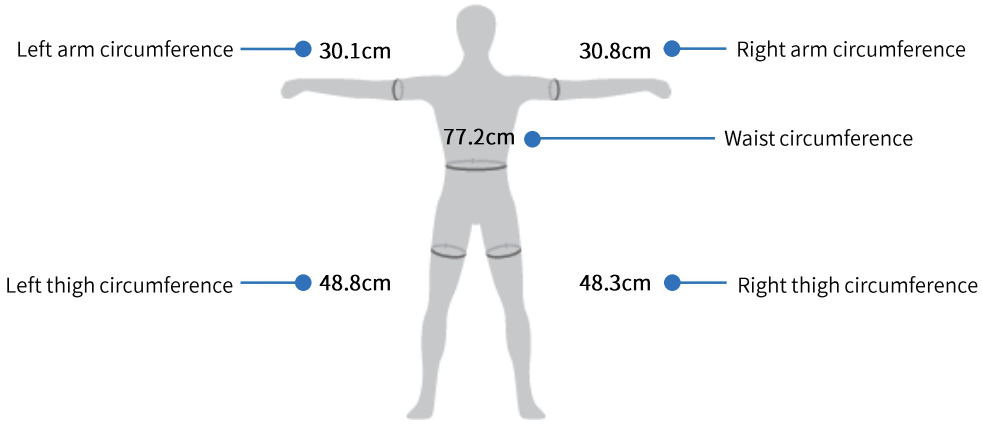
[Overweight weak]



You are a little bit extremely bipolarized on body composition: both body weight and fat are far above standard, while muscle mass falls far behind the standard zone. Due to lack of muscle mass compared to weight and fat, physical ability is below the standard level. Therefore, you need to gain strength through muscle development. You may also need to reduce total body fat to prevent obesity-related issues.

C. Segmental circumference

It shows the circumference of each segment predicted based on impedance measurements.



The circumference of each segment is measured at the following points with reference to the Korean Human Body Measurement Project of the Korean Agency for Technology and Standards.

Classification	Measurement points
Arms	Thickest point of arms bent 90 degrees when looking from the person's side
Waist	Hollowest point on the right waistline when looking at the person in front
Thigh	Center point between the kneecap and stickiest point on hip

3.21.Exercise Nutrition Guide

BMR : 1605 kcal			Total Energy Expenditure : 2434 kcal		Recommended Intake of Calories : 2389 kcal	
	Nutrients(kcal)				Representative Foods	
	Breakfast	Lunch	Dinner	Sum		
Carbohydrate	434	460	420	1314(55%)	[Carbohydrate] : Oats 169g, White rice 138g, Flour 143g	
Protein	142	151	138	430(18%)	[Protein] : Egg 289g, Chicken 149g, Beef 210g	
Fat	213	226	206	645(27%)	[Fat] : Almond 108g, Walnut 75g, Cheese 252g	
Sum	788(33%)	836(35%)	764(32%)	2389(100%)	Representative food (g) is a reference, simply calculated for each nutrient.	
Target Body Fat Mass			10.1 (kg)		Recommended Intake of Water	2100 (ml)
Exercise Intensity			133~161 (HR/Min.)		Recommended Intake of Protein	108 (g)
Calorie Consumption			490 (kcal/h)		Recommended Intake of Water before Exercise	350~490 (ml)
Estimated Completion			10 (Week)		Recommended Intake of Protein after Exercise	23~29 (g)

A. Basal Metabolic Rate

Basal Metabolic Rate refers to the minimum amount of energy required to maintain proper body function and physical homeostasis, and generally means energy consumption at rest with no particular muscle activity

Muscle takes up more oxygen than body fat, which means more influence on BMR as a result. So even among people with identical body frame and weight, the difference in BMR inevitably occurs depending on muscle mass. If people are under a very strict diet control, it will cause serious muscle loss, resulting in a decrease of BMR, which then also could cause an easier accumulation of body fat. Therefore, even when on diet, it is important to maintain BMR by maintaining muscle mass through proper muscle training.

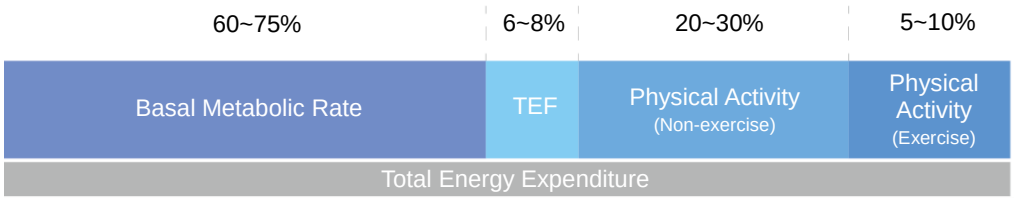
MEDIANA's BMR is calculated using the following formula that adopts fat free mass as a variable to reflect the increase and decrease of muscle mass.

$$REE(kcal) = 370 + 21.6 * Fat\ Free\ Mass$$

* Ref. Cunningham JJ.(1991) Body composition as a determinant of energy expenditure: a synthetic review and a proposed general prediction equation, Am J Clin Nutr. 1991 Dec;54(6):963-9.

B. Total Energy Expenditure

Energy is essential for survival. In general, energy is used for three purposes: basic metabolic rate, physical activity and Thermic effect of food. Total Energy Expenditure is the sum of energy consumed by these three parameters throughout the day.



* Basal Metabolic Rate: The minimum amount of energy required for proper body functioning
* Physical Activity: Energy used through everyday activity and exercise, including supporting the body, housework, work performance
* Thermic Effect of Food(TEF): energy used during the process of digestion.

If specific exercises are performed (1 hour of fast walking 3 times per week) while taking the calories of total energy expenditure, weight can be maintained by balancing energy consumed with energy used. And this balancing process can be referenced for personalized dieting plans.

C. Recommended Intake of Calories

Daily intake is a calorie needed to keep the current weight considering energy balance, while recommended intake is a calorie needed to control the weight to an appropriate level. Accordingly, it suggests a low-calorie intake for a heavy person and a high-calorie intake for a light person.

D. Nutrition and representative food

It suggests that the intake of 3 major nutrients in the following ratios based on the recommended calorie intake, along with the representative food high in the nutrients as a reference for your diet plan.

Classification	Ratio
Carbohydrate	55 ~ 65%
Protein	7 ~ 20%
Fat	15 ~ 30%

* Ref. 2015 Korean Nutrient Intake Standard, Korea Nutrition Society, Ministry of Health and Welfare

The amount of food displayed on the representative food means the amount required to intake 1/3 of the sum of calories by each nutrient.

As shown in the example below, if the sum of carbohydrate intake is 1,314 kcal, the representative carbohydrate food is displayed as 438 kcal intake, which is 1/3 of the sum of calories.

	Nutrients(kcal)				Representative Foods
	Breakfast	Lunch	Dinner	Sum	
Carbohydrate	434	460	420	1314(55%)	[Carbohydrate] : Oats 169g, White rice 138g, Flour 143g

In other words, it means that 169g of oats is needed to intake 438kcal of carbohydrates. This amount is simply calculated by considering only the calories of carbohydrates contained in oats, and may differ from the calories of the entire food.

E. Target Body Fat Mass

It shows the body fat aimed for exercise. The target body fat mass is calculated based on the standard body fat ratio. You can change it in the standard body fat ratio setting of the product.

F. Exercise Intensity

Standard exercise intensity is displayed. In general, the exercise intensity is indicated by the maximum oxygen intake (VO_2 max), but since maximum oxygen intake is difficult to measure and verify, the heart rate per minute is used to guide the exercise intensity.

G. Calorie Consumption of Exercise

It informs, based on your current total body weight, your expected calorie consumption after performing an hour of jogging. You can also refer to ‘calorie consumption table’ for reference of calorie consumption of other exercises.

H. Estimated Completion

Based on the assumption that the daily 1-hour exercise with the recommended intensity is performed, the expected period to achieve the target body fat percentage is given. Participating in a more calorie intensive exercise can lead to shortening the time frame in reaching the target body fat percentage.

I. Recommended Intake of Water

It is the amount of water recommended to take a day. Water is a main constituent of the body, accounting for approximately 60%. It carries nutrients and discharges impurities. Also, it regulates body temperature, lubricates with saliva, digestive fluid and mucus and protects the body from shock.

When 4% of the total body water is lost, muscle fatigue easily occurs. 12% loss causes torpor and 20% loss may lead to death. Therefore, appropriate water intake is necessary to keep the normal physiologic function and health of the body.

J. Recommended Intake of Protein

It is the amount of protein recommended to take a day. Protein deficiency stunts growth and increases the risk of disease infection. When it is not sufficiently taken in the growth period, late growth, brain deterioration and late sexual maturity may occur. In case of the elderly, insufficient intake of protein can accelerate muscle reduction, which causes various disabilities and death. Therefore, appropriate protein intake is necessary to keep the normal physiologic function and health of the body.

K. Recommended Intake of Water before Exercise

It is the amount of water recommended to take before exercise to prevent dehydration. It is recommended to drink slowly 2-3 hours before exercise to give the body time to control and discharge water appropriately.

L. Recommended Intake of Protein after Exercise

It is the amount of protein recommended to take in 3 hours after exercise. Right after exercise, muscle protein begins to break down, and it significantly worsens when nothing is eaten for 3 hours or more. To minimize the protein breakdown, appropriate protein intake is necessary after exercise.

3.22.Calorie Consumption of Exercise

Calorie consumption of exercise on results sheet represents expected consumed calories for 30 minutes of every exercise presented on the table. Calorie consumption of exercise is calculated using MET Value as in the following formula. MET(Metabolic Equivalent of Task) is a specific unit for your metabolic rate that increases with your physical activity.

Gateball	115	Table Tennis	140	Basketball	227	Aerobics	255	Football	280
Walking	122	Golf	168	Jogging	245	Tennis	255	Climb	280
Yoga	140	Badminton	192	Swimming	245	Bicycle	262	Jump rope	308

[Calorie Consumption of Exercise(kcal)]
= Met Value per each exercise * Weight(kg) * total hours of exercise spent(h)

* Ref. E.AINSWORTH et al.(2011) Compendium of Physical Activities: A Second Update of Codes and MET Values, American College of Sports Medicine

Examples of Calorie Consumption of Exercise(Weight 71.5kg)

30 minutes of yoga practice

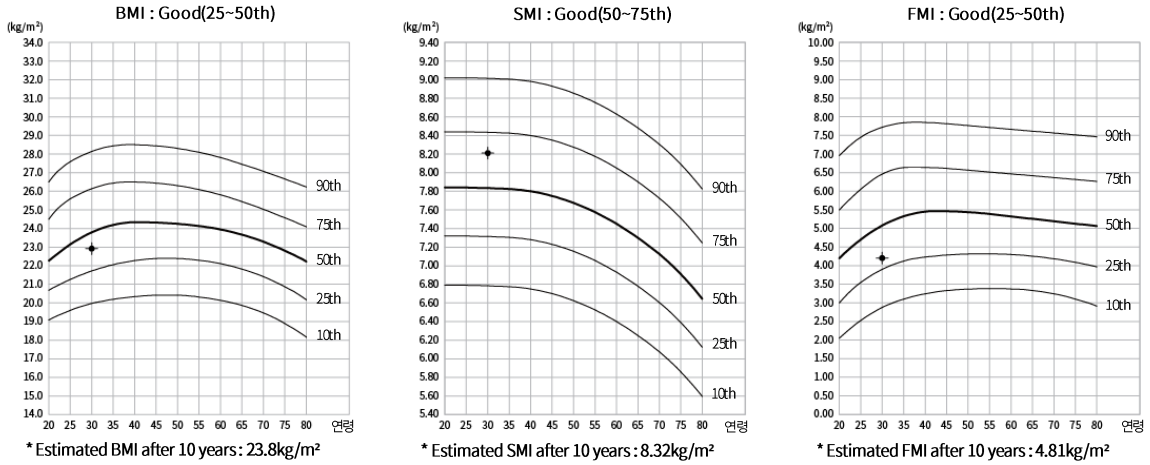
→ Calorie Consumption of Exercise(kcal) = 4.0 * 71.5 * 0.5 = 143kcal

○ **MET Table**

Exercise	MET(ml/kg*min)	Exercise	MET(ml/kg*min)
Typing	1.3	Wrestling	6.0
Standing	1.8	Basketball	6.5
Driving	2.0	Fast walking	6.5
Billiards	2.5	Marathon	6.5
Darting	2.5	Swimming	7.0
Crocket	3.3	Jogging	7.0
Gate ball	3.3	Scuba diving	7.0
Walking	3.5	Skiing	7.0
Strolling	3.5	Tennis	7.3
Trampoline	3.5	Aerobics	7.3
Bowling	3.8	Squash	7.3
Ping-pong	4.0	Cycling	7.5
Volleyball	4.0	Football	8.0
Yoga	4.0	Handball	8.0
Curling	4.0	Mountain climbing	8.0
Bowing	4.3	Rock climbing	8.0
Golfing	4.8	Stair climbing	8.0
Weight training	5.0	Rugby	8.3
Baseball	5.0	Rope jumping	8.8
Gym training	5.0	Martial arts	10.3
Fishing	5.0	Boxing	12.8
Badminton	5.5	Speed skating	13.3

3.23.Age-Specific Assessment

It shows the percentile curve of BMI, SMI and FMI with respect to the age and gender of user. The percentile rank is the value indicating the position of user within the same age group relatively. The predicted body composition value after 10 years is the value predicted on the assumption that the current condition is kept.



The measurement results are dotted where the horizontal axis indicating the age and vertical axis indicating the value meets and the percentile rank is determined based on the location of the dot.

The central point (50th) of the percentile curve indicates the average measurement value of the age group. Each item is a standardized index using the square of body height, so it has an advantage that it can assess body composition regardless of change in body height.

Classification	Explanation
BMI	BMI is the value of body weight(kg) divided by the square of body height(m). It is widely used to assess obesity as it is easily calculatable using body height and body weight.
SMI	SMI is the limb muscle mass(kg) divided by the square of body height(m). Skeletal muscles that are attached to the skeleton and support the body and enable body movement are mostly developed in limbs, so body muscle development can be assessed using the skeletal muscle index, SMI.
FMI	FMI is the value of body fat mass(kg) divided by the square of body height(m). BMI is widely used as it is easily measurable, but body fat mass may differ among people with the same BMI, so there is a limitation of the reduced accuracy in obesity analysis. Therefore, it is necessary to check the body fat mass index, FMI for accurate obesity analysis.

3.24.Physical Growth (Children)

It provides the assessment of children's growth status. Growth pace is highly individual. Therefore, getting outside the normal range of growth pace is not so serious an issue at early stage of physical development, needing caution only when it would begin to get off normal trajectory.

Muscle	Caution (Good)
Skeletal	Caution (Good)
Obesity	Under (Good) Over

A. Muscle Growth

It helps to check muscle growth through measurement of protein. You need to take caution if it's outside the normal range.

B. Skeletal Growth

It measures skeletal development based on osseous mineral content. Caution needs to be taken if it's outside the normal range.

C. Obesity Measurement

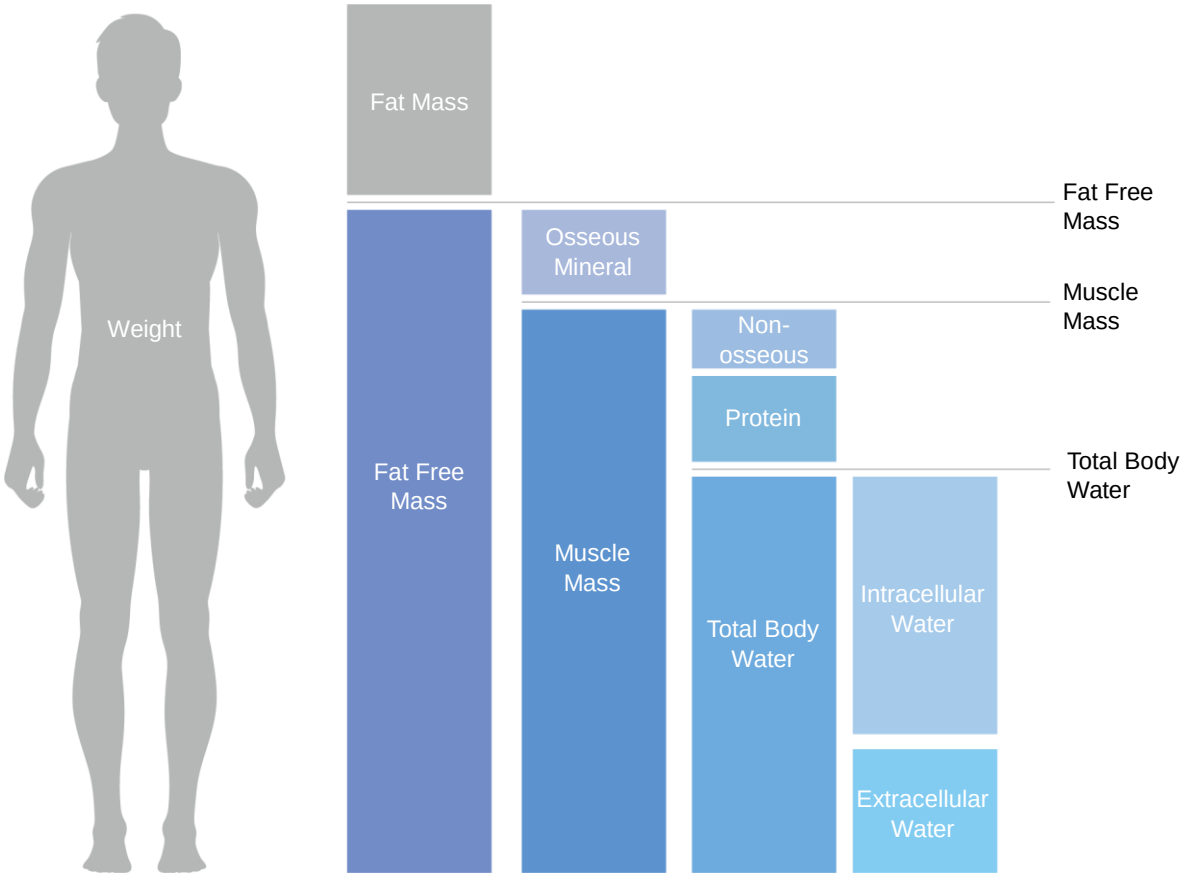
Body Fat Level is assessed as a standard of obesity analysis. Though accumulatively posing serious health risks, body fat is an essential component of the body. Therefore, it should be kept under tight control to stay within the normal range.

4. Body Composition Analysis

Body composition consists of four major components – protein, body water, fat and minerals, all adding up into total weight. Body composition varies greatly with age, gender, and physical traits, and so it has a very strong relationship with health issues. Body composition analysis helps you to see what you are composed of, and to manage your health through proper analysis of accurate body composition. You will be given analysis outputs regarding muscle development, nutritional balance and obesity degree. Body composition analysis provides a variety of clinical insights to consult for the correction of poor eating habits, or for disease prevention – and provides an equally useful basis for establishing diet plans and recovery of patients.

4.1. Body Composition Model

See below for body components modeling. You can see weight falling into two categories: fat mass and fat free mass, FFM once again classified into three sub-categories of minerals, protein and body water. They should all be in balanced proportion, and need to be kept in balance to stay in good health.



4.2. Body Composition and related symptoms

Healthy people typically succeed in maintaining the standard range of body composition. If the balance breaks down, it may lead to various kinds of disease, or the other way around is also possible.

Obesity issues usually get a fair share of our interest in terms of body composition. According to WHO (World Health Organization), obesity requires more clinical, internal approach, rather than simply considered as being large in outer shape. Obesity is of increasing clinical concern that is more to do with internal issues, such as adult and heart disease, high blood pressure and diabetes. Therefore, clinical discretion is needed to keep body far percentage under tight control.

Protein is, in nutrition, closely related to one's nutritional status. If nutrients necessary for survival are not taken properly, it may cause nutrition issues in the body. To be specific, muscle cells are broken down to be used as an alternative source of energy, damaging your health. Excessive diet control can also destroy protein and muscle tissues.

A typical symptom associated with mineral issues is osteoporosis, which is very common in women groups experiencing post menopause. Osteoporosis is usually caused by lack of minerals in the bone, and can be determined by a professional bone density meter such as DEXA. Loss of minerals in the bone is also closely related to muscle mass, and maintaining proper muscle mass with proper workout plans can help prevent osteoporosis.

4.3. Obesity and body composition analysis

One way to determine obesity is by analyzing the relationship between height and weight, like BMI. This method, based on given information of one's height and weight, has been traditionally adopted as a simpler way to diagnose obesity. But for individuals in certain body types, it can be hard to precisely determine obesity this way only. Let's take for example an athletic gym trainer. He weighs a lot heavier than ordinary people, yet the heavy composition is mostly composed of muscle mass. In this case, it is technically confusing if he is defined as 'overweight'. In addition, elderly people – who are rarely active – may be obese and have a higher risk of body fat issues despite their being thin in external body shape. Since it is nearly impossible to determine how obese a person is at face value, systematic composition analysis is required for accurate analysis results.

4.4. Junior and Senior Body Composition Analysis

Teen / Pre-teen examinees go through a lot of variations in body composition as they grow, such as a sudden increase of minerals percentage, or decrease of body water. As a result, if you try to conform children standards into those for adults, you may get wrong results values. Therefore, it is required to perform children composition analysis for teen groups under 19.

On the other hand, bone density and muscle mass of elderly people tend to decrease significantly with age, which also means another significant decrease of FFM such as protein, body water, and minerals.

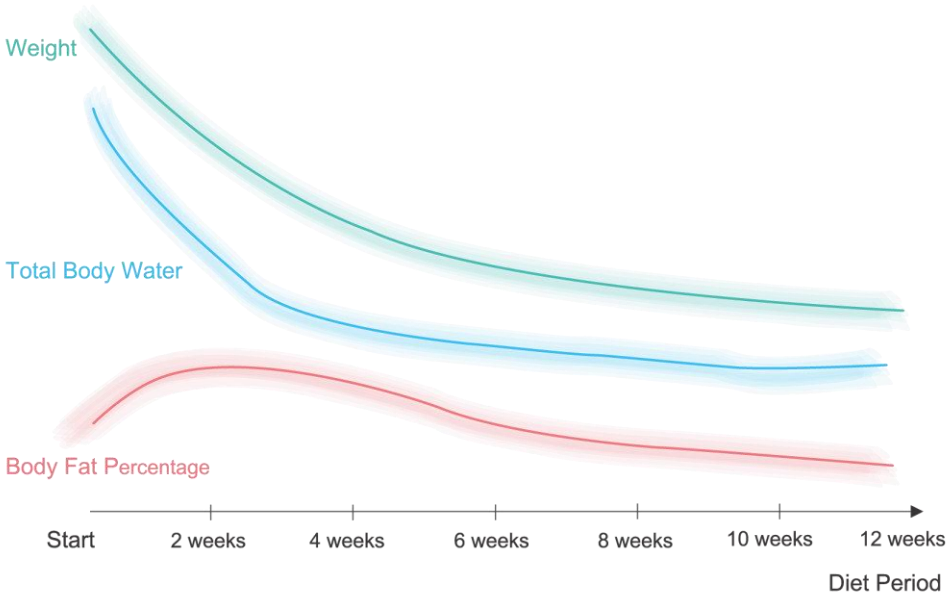
This decrease in FFM leads to weight loss. In this case, even if there seems to be no obvious change in body fat mass, the total body fat increases, because body fat percentage is the ratio of body fat mass to weight. For this reason, muscle mass may be underrepresented, and body fat could be overrepresented, if standards for adult would be applied to senior body composition analysis.

However, aging process is highly individual, so it is difficult to provide personal analysis values for elderly people. Therefore, it is necessary for them to track their changes for more effective composition management.

4.5. Weight Loss and Body Compositional Change

The most basic principle of obesity management is to reduce body fat and maintain total weight through constant adjustment of muscle mass. Correlations between diet, exercise, and body composition are already very well documented, so your understanding of how weight loss is actually made is the most important for a successful diet plan.

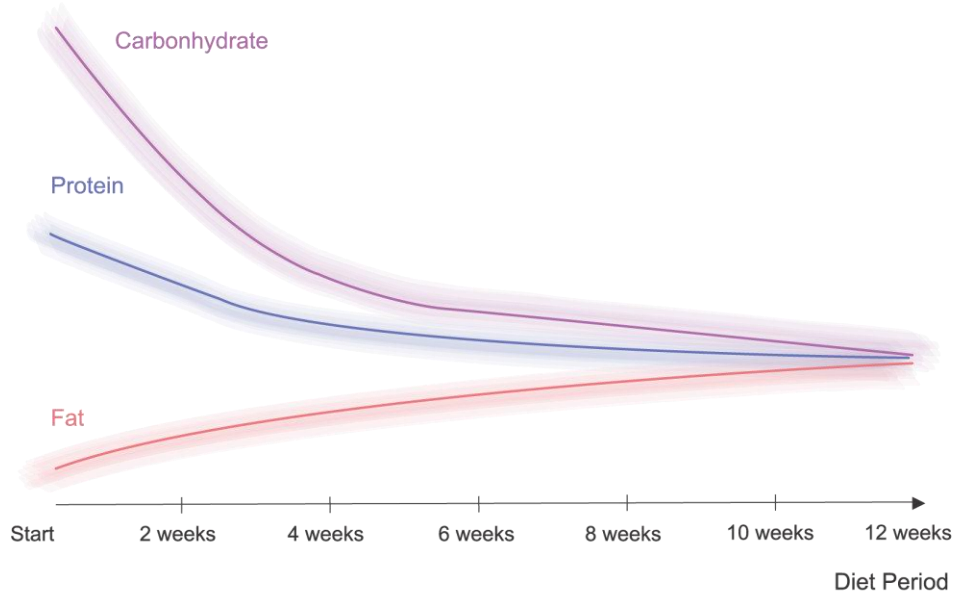
[Body Composition Change Curve]



Carbohydrate is stored in the body being combined with a large amount of water. When you get on a diet, your body quickly begins to divert carbohydrate into an energy source. As a result, at an early stage of your weight loss progress, fluids are lost quickly and you and experience actual weight loss. But, despite a very common misconception that you are losing significant body fat during this stage, you would find it simply increasing. This is because you are containing a higher percentage of body water than fat, with fat feeling “relatively” minimal than body water as a result. This would increase the ratio of body fat against total body weight, which then leads to an increase in body fat percentage.

Body fat percentage = Body fat mass / Weight * 100

[Nutrition Consumption Curve]



After carbohydrate is used up as an energy source, your body then begins to turn to protein as an alternative. However, alternative use of protein for physical operation disables some of beneficial muscle tissues in the body, harming health in general. So, you need to do extra muscle workout in order to cushion the muscle loss. Protein, like carbohydrate, contains a lot of water inside, which helps you lose weight more quickly even at the middle stage of the progress. As you may get closer to the final stages of weight loss plan, your body eventually begins to burn up body fat. Whereas carbohydrate or protein is able to supply 4 kcal by 1g, body fat works in twice higher efficiency of using 9 kcal by 1g. In addition, fat tissues contain less water. So, even though you have successfully had your body fat tissues broken down in sufficient amounts, they release much less water than protein and carbohydrate, - which means equally much less weight loss when added in total sum. But, this is where “actual weight loss” is taking place, making a real body change for your fat percentage. Typical signs of rapid weight loss are seen as a temporary physical reaction to sudden loss of body fluids, so cannot be considered as the process of obesity treatment. If the loss is to become “actually” meaningful towards your weight loss, you need to take a more soft, step-by-step approach to cushion the shock.

4.6. Glossary of Confusing terms

A. Muscle & Skeletal Muscle Mass

Muscle mass is largely composed of three parts - Skeletal Muscle, Cardiac Muscle and Visceral Muscle. Skeletal Muscle refers to muscle parts that support or produce movement of bones, variable through how much muscle workout has been made.

B. Mineral & Bone & Osseous Mineral

Body composition analysis provides analytical results of mineral mass for proper bone health management. Many different confusing terms are presently in use to express body mineral representation such as “bone mass”, or “osseous mineral mass”, “mineral mass”.

First of all, “mineral mass” is a generic term for encompassing every type of minerals in the body, not merely for one making up the bone mass. The term “mineral mass” does not fit perfectly in the strictest sense, but since minerals are for the most part (82%) osseous, you can take a general view of your current bone health.

As for bone mass, it refers to total weight of the bone tissues that contain many different components other than minerals, such as protein or water. Therefore, bone mass might be an incorrect term for precisely expressing bone components.

Finally, “osseous mineral mass” is the most accurate term for expressing the total amount of minerals in our bones. Osseous mineral mass is only measurable through DEXA method among the three frequently confused terms, and is the most suitable indicator for checking your bone health

5. Accuracy of body composition analysis

5.1. Golden Standard

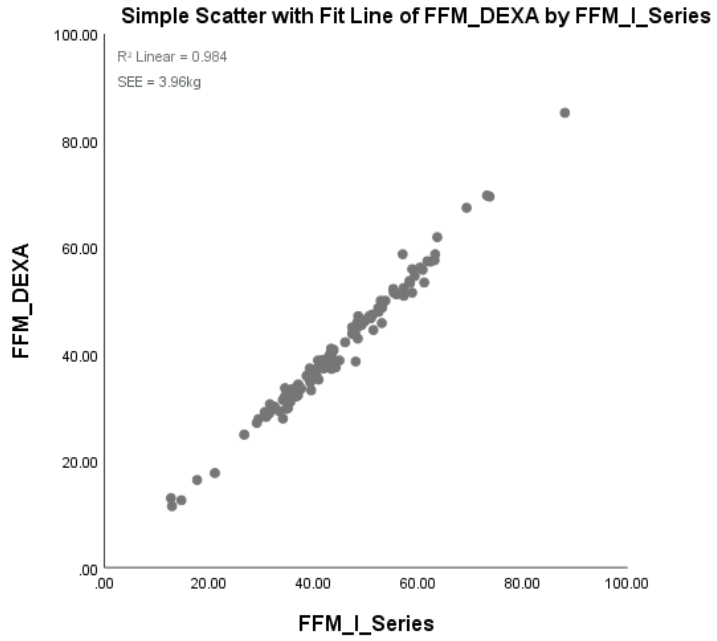
Golden Standard serves best for accurate analysis of body composition, but not cost and time effective

○ **DEXA(Dual Energy X-ray Absorptiometry)**

DEXA method irradiates human body with X-ray waves of high and low energy. X-ray penetrates through human body, and as it travels in the body, the power and rate at which it runs through the body would be reduced with factors such as body components, density, and thickness.

DEXA method is regarded as Golden Standard, and serves best for accurate analysis of body composition: FFM, body fat mass and muscle mass. DEXA also provides segmental analysis results, thus serving as a perfect barometer for the accuracy of BIA. The result of comparison between DEXA and **I50** is as follows:

○ **DEXA vs I Series(FFM)**

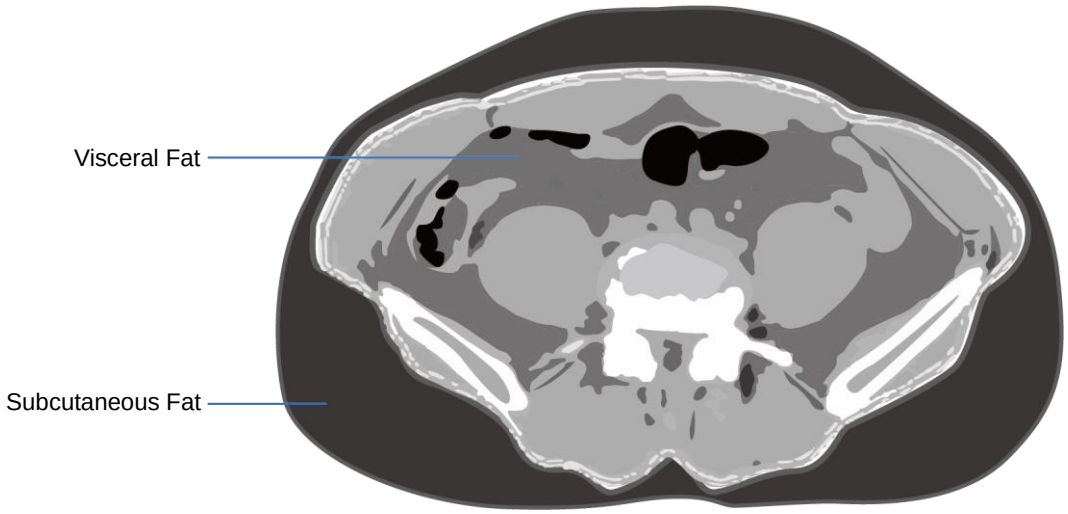


R^2 value refers to the credibility of its regressive equation. The more inaccurate results the equipment produces, the closer it gets to 0, and vice versa. Our equipment, **I55**, shows the figure of 0.984 closer to the DEXA standard, which means high accuracy.

○ **CT(Computerized Tomography)**

Visceral fat level of I series body composition analyzer is based on CT clinical test data. CT or computed tomography makes use of many X-ray measurements taken from different angles to produce cross-sectional images of a scanned object. As all sections of human body are different in density, while the radiation passes through internal organs, it has to travel through a wide range of density, which would then be presented in the distinctly graded shade for clear visualization.

CT shows very high accuracy in measurement. But, because of its radiation exposure problems and high cost, its use is strictly limited to segmental analysis of body sections like abdomen. As for abdominal CT, it is able to scan visceral fat area and subcutaneous fat, allowing for accurate abdominal obesity analysis.



○ **Isotope Dilution**

A lot of clinical trial tests for Isotope Dilution have been conducted for I Series body composition analyzer in order to take more accurate body water measurement. Isotope dilution is a method of measuring body water by analyzing the concentration of isotopes. First, clinical trial subjects need to administer isotope which then would evenly spread over the body. Then, sample body fluids are taken from the subjects to check the concentration. Isotope dilution is highly accurate in measurement, but impractical as it takes too much time to test, highly prohibitive, and thus hard to take repeated measurement.

5.2. Bioelectrical Impedance Analysis(BIA)

BIA is a method of measuring impedance(resistance) value of the body by sending out several weak waves of electricity through the body. BIA is best known for its high accuracy, reproducibility and convenient usability, especially when considering how cost-effective and convenient it is. It only requires direct electrode contact, and just takes only a few seconds to finish the measurement. It is also non-invasive, safe and easy to use, without you having to give your blood, or get anything inserted into your body. However, BIA value can occasionally vary with one's physical condition or measurement errors, then adding up to a bigger difference. That is why it is necessary to follow correct instructions, and take repeated measurements under the same conditions.

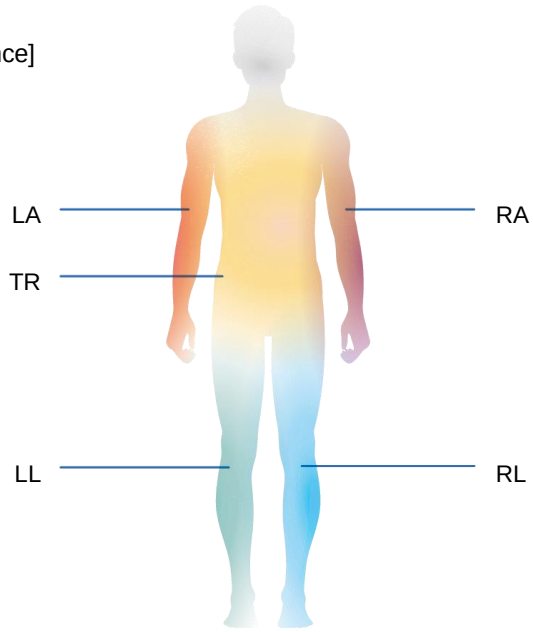
A. Principles

Bioelectrical Impedance refers to the resistance value that prevents electrical current from flowing freely through the body. As muscle contains higher volumes of water than fat tissue, the current flows much faster. Then, people with large bulk of muscle experience small impedance, whereas individuals with a lot of fat mass suffer from higher impedance. MEDIANA's body composition analyzers, based on this principle, measure impedance for body composition analysis.

B. Segmental analysis

Segmental Measurement Method measures the impedance of human body, assuming big five cylinders of body segments combine to form a whole single human body. Segmental analysis is able to take more accurate measurement, because it can evenly spread its measuring focus on all body parts, rather than just seeing it as a single piece of cylinder. In particular, it makes possible to make segmented distribution analysis of body fat, muscle mass, and body water for more effective analysis of subjects.

[Division of Segmental Impedance]



C. Multi-frequency BIA measurement

Cell membranes are nearly impassable to low frequency waves, whereas the travel of high frequency waves is rarely resisted. Therefore, both use of low and high frequency waves makes possible a more separate analysis of body cells. Every length of frequency wave is applied to its designated body areas for improved equation accuracy. Therefore, it is necessary to measure the impedance using a lot different waves of frequency for accurate composition measurement.

I series has high accuracy using multi-frequency method for body composition analysis.