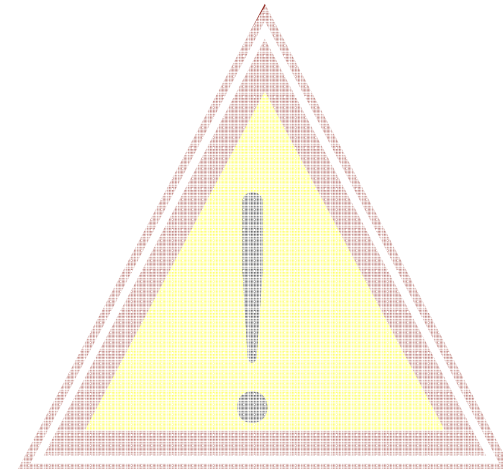


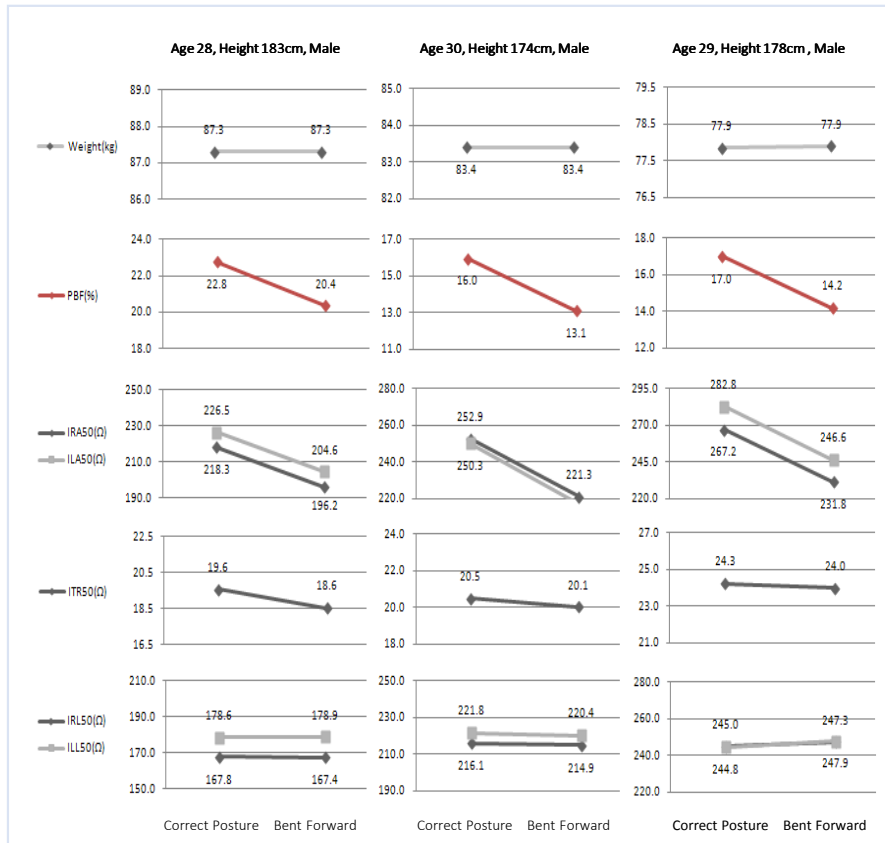
CONTENTS

- InBody should be tested **with arms straightened.**
- InBody should be tested **with the arms apart from the torso.**
- InBody should be tested **with bare feet.**
- InBody should be tested **prior to physical exercise.**
- InBody should be tested **at room temperature** to prevent changes in body temperature.
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- InBody should be tested **with an empty stomach.**
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- InBody **results may vary** if the **input height and weight differs.**
- Reason why **percent body fat varies before and after sleep.**



➤ InBody should be tested **with arms straightened.**

< PBF difference from posture change >



▲ Correct Posture (O)

▲ Wrong Posture (X)

▲ Wrong Posture (X)

Summary

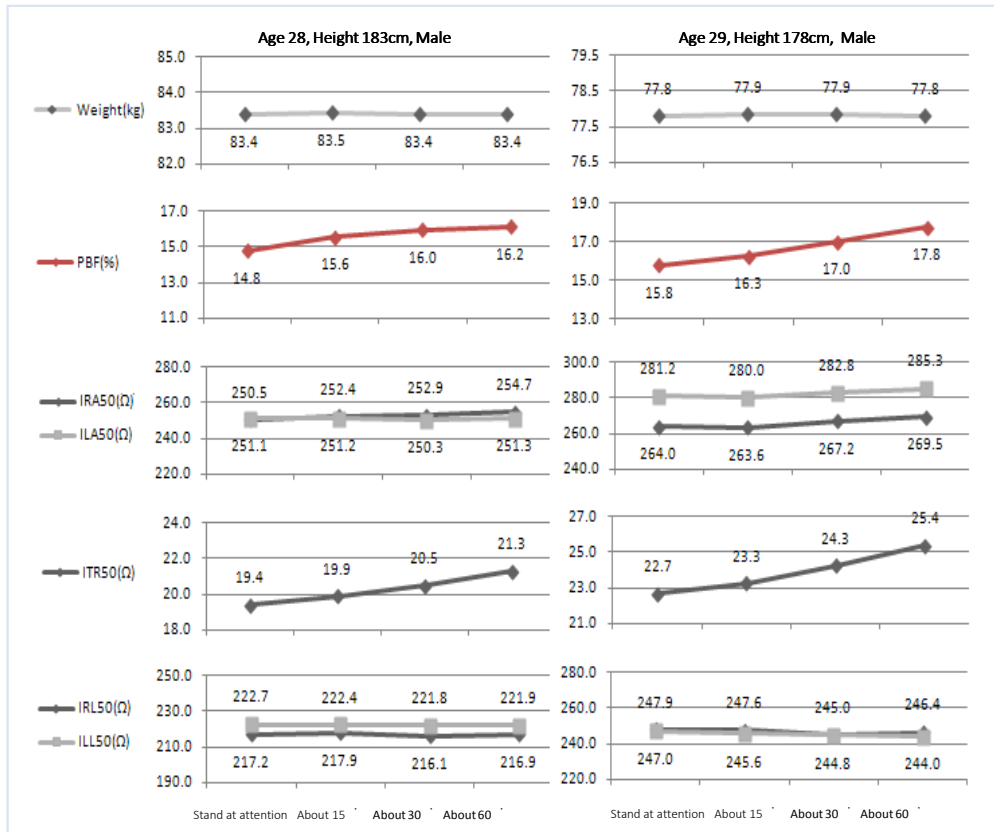
Impedance is affected by the cross-sectional area so the resistance value differs when current goes through a regular cylinder and bent cylinder.

If the arm or the leg is bent while testing InBody, the length of the cylinder (arm, leg), which the current passes, will decrease. This leads to impedance decrease in the bent area that results in decrease of PBF.

Experimental Results show that when InBody was tested with the arms bent, upper limb impedance decreased compared to testing while the arms were straightened. This caused underestimation of the percent body fat.

➤ InBody should be tested **with the arms apart from the torso.**

< PBF difference from angle between arms and torso >



▲ Correct Posture (O)



▲ Wrong Posture (X)

Summary

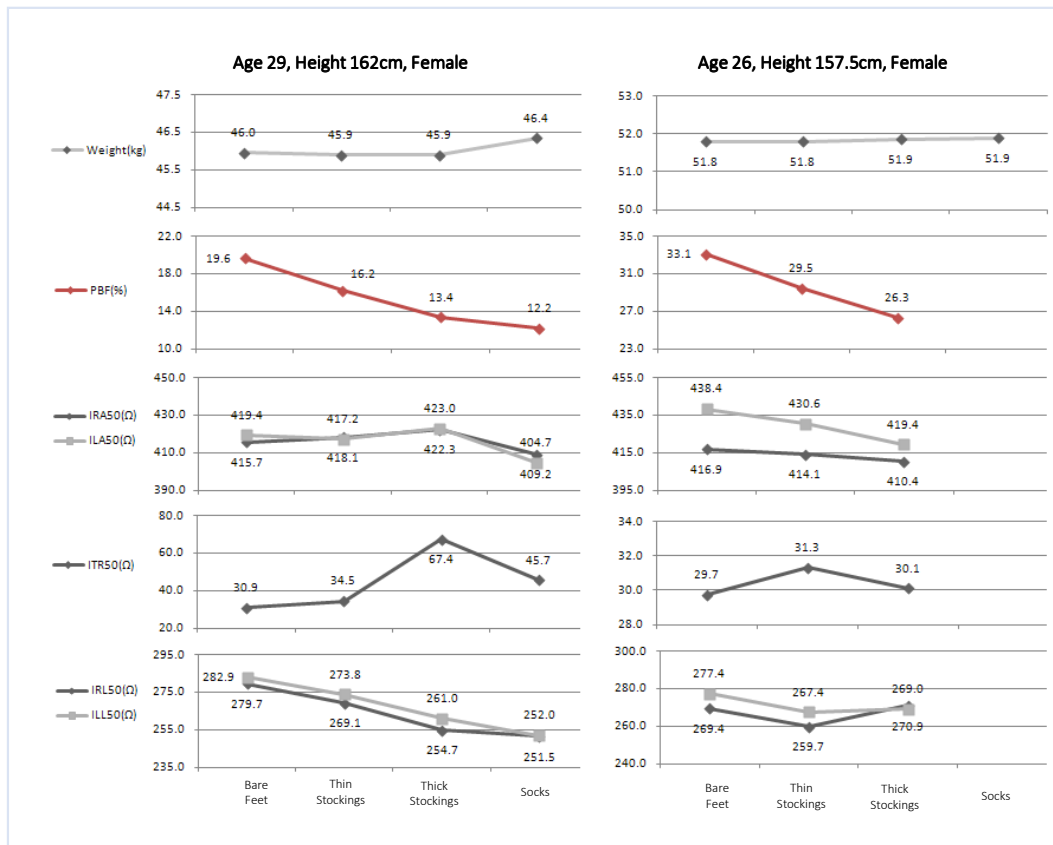
Impedance is a resistance that occurs when current flows. It is affected by the length and cross-sectional area of the conductor.

If InBody is tested without arms apart from the torso in topless or sleeveless clothes, the armpit will attach to the torso resulting in impedance decrease. Likewise, if the thighs attach to each other while wearing shorts, the lower limb impedance will decrease.

Experimental Results show that as the angle between arm and torso got smaller, the arm and torso attached to each other. This led to underestimation in PBF.

➤ InBody should be tested **with bare feet.**

<PBF difference from wearing socks and stockings>



▲ Correct measurement: Bare feet



▲ Incorrect measurement: Stockings, Socks

Summary

InBody uses a touch type method that makes the electrical connection by direct attachment of hands and feet to the electrode.

Contact Resistance is the degree of disturbance that occurs between two attaching conductors(i.e. the InBody electrode and skin). The contact resistance increases when the contact condition of the electrode and skin is bad.

Experimental Results show that there was impedance change when testing InBody wearing socks or stockings compared to bare feet. This led to maximum 6.8% of error in PBF.

➤ InBody should be tested **prior to physical exercise.**

< 29, 162cm, Female, PBF difference before and after exercise>

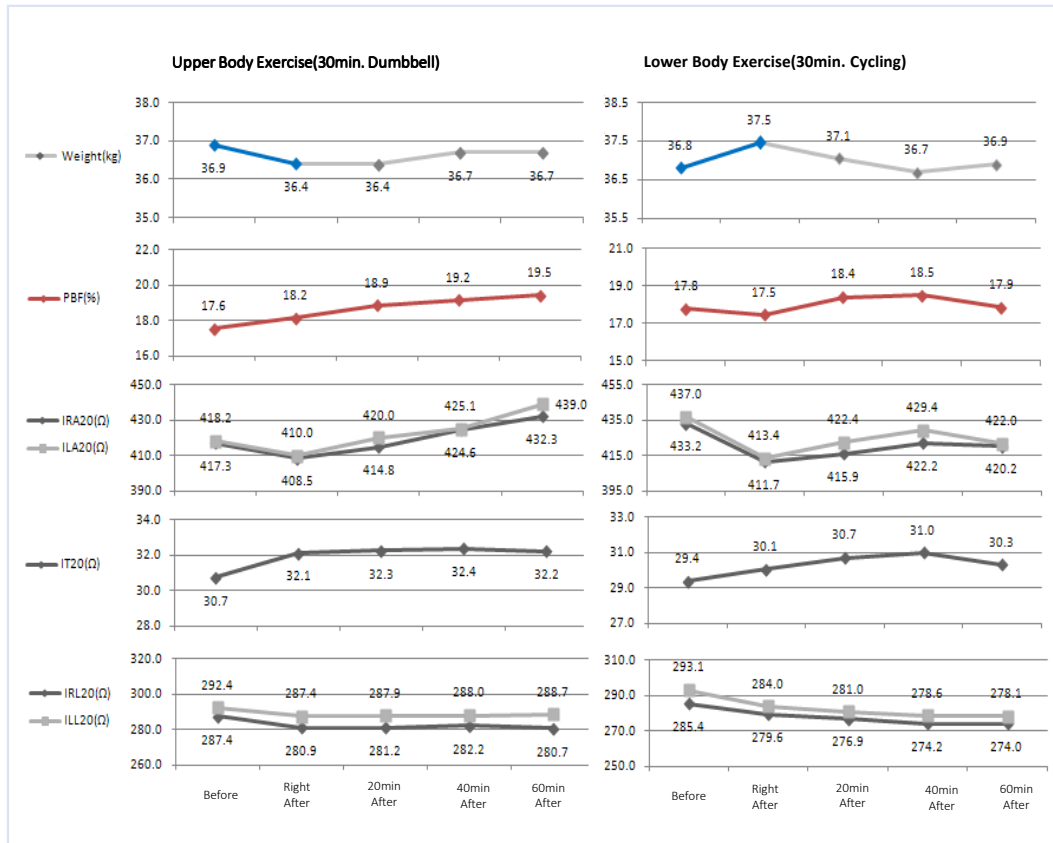


TABLE 2. ANOVA results for selected variables for preexercise (M₁), immediately post-exercise (M₂), and at 1-h postexercise (M₃).

	M ₁ (N = 30)	M ₂ (N = 30)	M ₃ (N = 24)
Weight (kg)	76.5 (11.9)	75.5 (12.2)	75.9 (13.0)
Total body water (l)	41.5 (6.2)	42.5 (6.4)	41.6 (6.2)
Triceps skinfold (mm)	11.3 (5.1)	11.3 (5.3)	11.3 (5.3)
BIA measures			
R (Ω)	477.4 (71.9)	461.8 (69.8)	479.9 (67.0)
Xc (Ω)	57.1 (7.4)	52.7 (6.6) ^a	57.7 (7.1)
S ² /R	66.9 (13.2)	68.8 (13.8)	66.3 (13.1)
Skin temperature (°C)			
Biceps	31.4 (0.94)	32.5 (1.28) ^{a,b}	31.2 (1.05)
Thigh	30.4 (1.22)	32.1 (1.60) ^{a,b}	30.2 (1.26)
Calf	30.5 (1.11)	31.8 (1.30) ^{a,b}	30.4 (1.03)
Chest	31.6 (1.08)	33.1 (1.74) ^{a,b}	31.8 (1.51)
Mean	31.1 (0.78)	32.4 (1.21) ^{a,b}	31.0 (0.83)

Values are means (SD).

^aP < 0.05 between M1 and M2; ^bP < 0.05 between M2 and M3.

M1: baseline value; M2: immediately postexercise; M3: at 1-h postexercise; R: resistance; Xc: reactance; S: stature; DSP: Doppler shift per photon.

Summary

When Exercising our body distributes more body water to the exercising part to quickly supply nutrients and remove body wastes.

After Exercise body water is retained in the exercising parts which makes it feel stiff. Body water distribution change by exercise can lead to measurement error in BIA technology.

Experimental Results show decrease in impedance right after 30 minutes of upper and lower body exercise which led to changes in PBF. PBF difference due to exercise differs by individual depending on exercise performance.

➤ InBody should be tested **at room temperature** to prevent changes in body temperature.

< 29, 162cm, Female, PBF difference by 30 minute exposure in hot and cold environment >

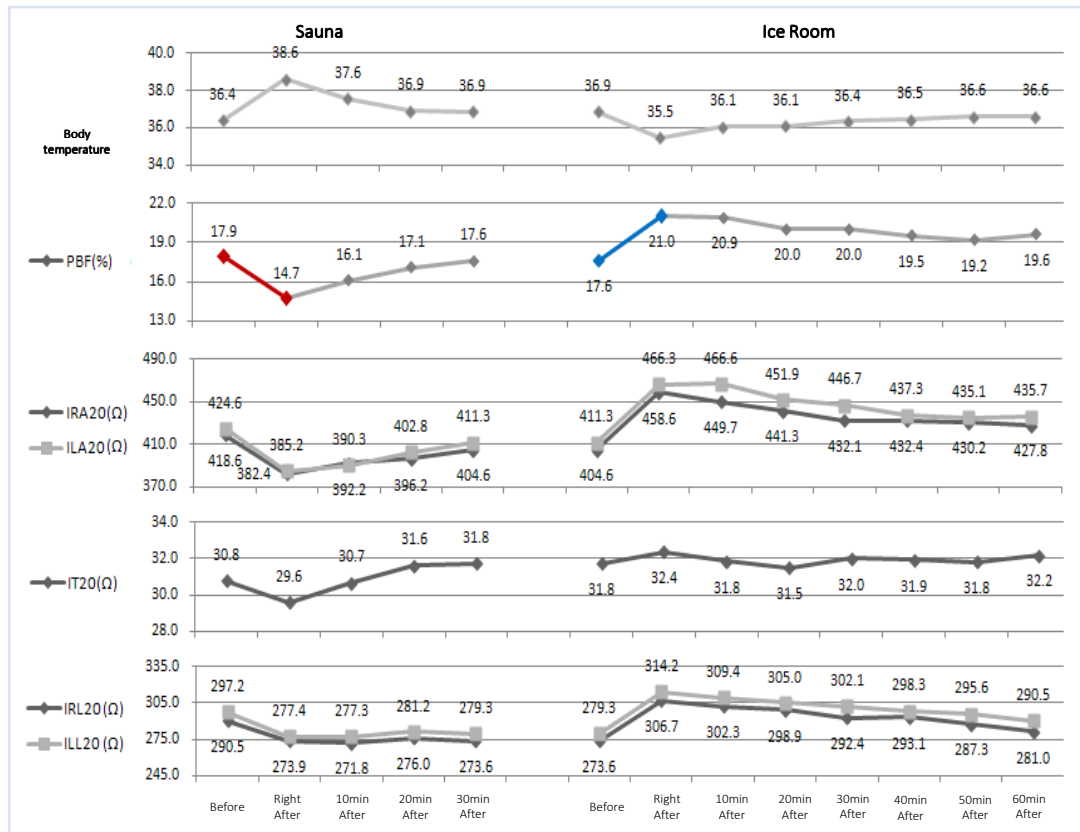


TABLE 1. Determination of resistance and estimation of body composition by bioelectrical impedance analysis.

Condition	Resistance (Ω)	Body Water (l)	Fat Mass (kg)	% Fat	Lean Mass (kg)
Cool					
Mean	461	47.4	11.0	14.4	64.5
±SD	48	5.5	3.4	2.7	7.9
Warm					
Mean	426	49.9	8.8	11.4	66.7
±SD	47	5.6	3.1	2.6	8.2
Paired t	10.13	3.88	9.22	9.90	9.22
P value	<0.01	<0.01	<0.01	<0.01	<0.01

Summary

Human Body shows changes in blood flow, body temperature and skin temperature when exposed in a hot or cold environment.

InBody and other body composition analyzers use BIA technology to measure body impedance. The impedance is affected by room temperature and skin temperature. (Generally, impedance and temperature have negative correlation)

Experimental Results show when 5 adults in their 20s were exposed in a cold environment, their PBF increased 1.3~4.2% while their average temperature dropped 1.1 °C. On the other hand, when exposed in a hot environment their PBF decreased 1.7~3.2% while their average temperature increased 1.7°C.

➤ **InBody should be tested prior to taking a shower or bath.**

< 29, 162cm, Female, PBF difference before and after taking a shower >

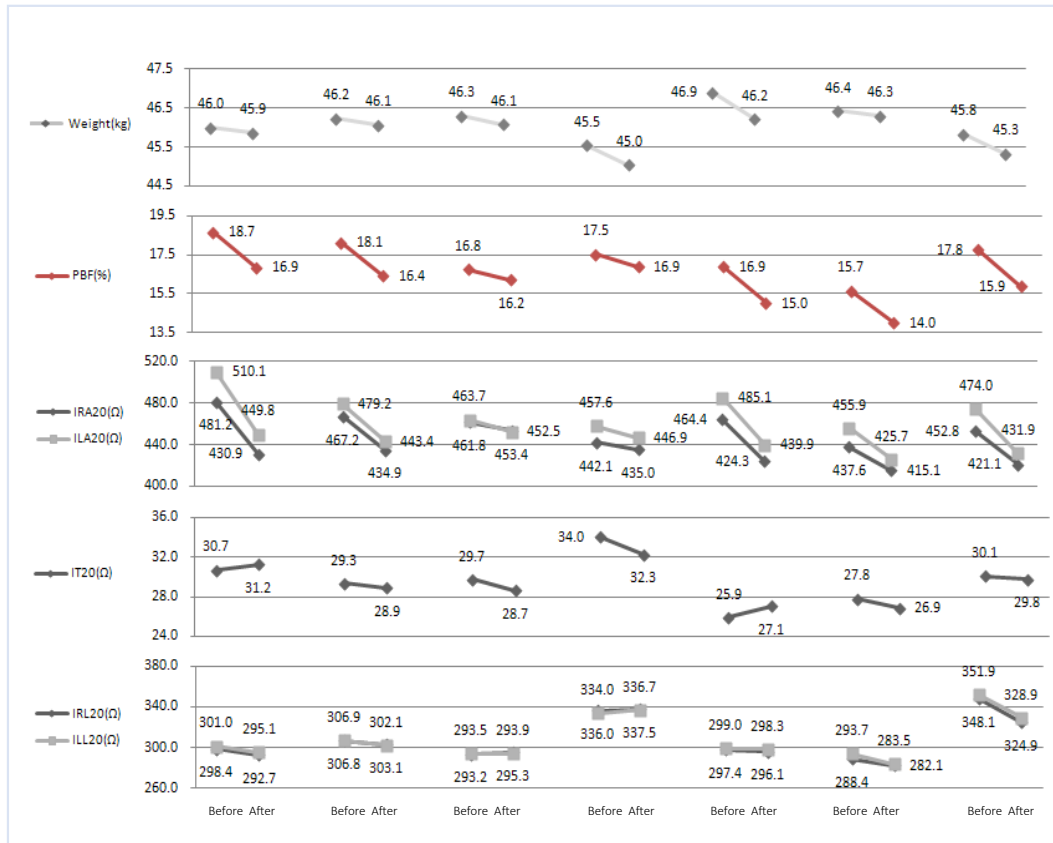


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Summary

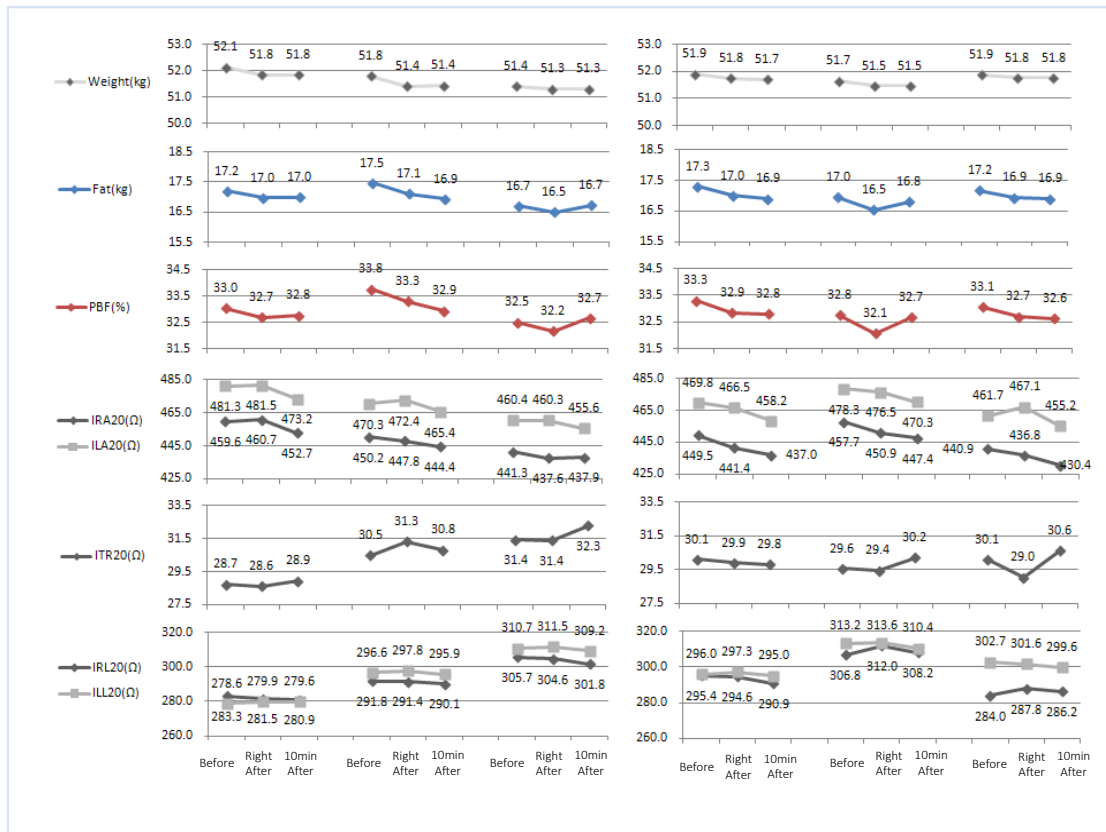
Taking a shower or bath leads to changes in body temperature. This leads in control of the blood flow in the skin surface in order to maintain body temperature homeostasis.

When Temperature rises, our body increases blood flow by expanding skin blood vessels in order to increase the body heat release. On the other hand, when body temperature drops, our body decreases blood flow by contracting skin blood vessels in order to decrease body heat release. The blood flow from temperature change leads to impedance change that results in PBF error.

Experimental Results show when a 27 year old woman tested InBody before and after 15 minutes of hot water shower, PBF decreased minimum 0.5% to maximum 1.9%.

➤ **InBody should be tested after going to the bathroom.**

< 26, 157.5cm Female, PBF difference before and after going to the bathroom >



Summary

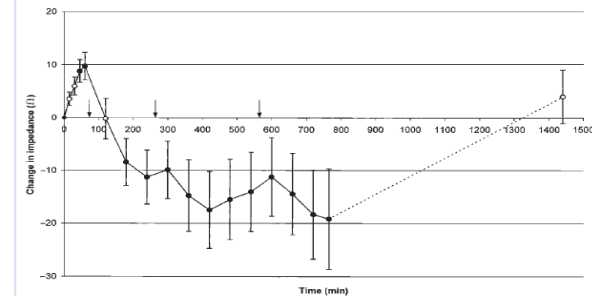
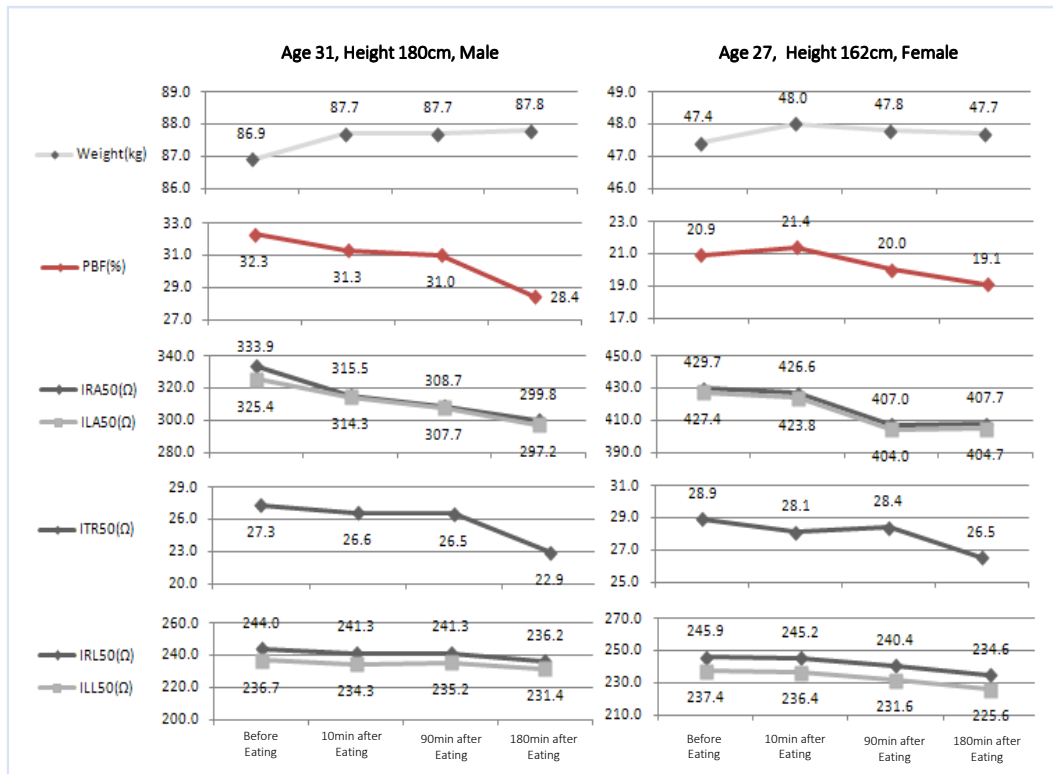
When **Body Composition** is classified by 2-compartment model, it can be divided into **Fat Free mass** and **Fat mass**. BIA principle calculates fat mass by subtracting fat free mass from weight which is the total of whole body composition.

Feces and Urine is inside the organs so it can not be a path for electricity flow according to BIA principles. However, because these affect the body weight, it is known that these two are considered as body fat mass.

Experimental Results show when three female tested InBody before, right after and 10 minutes after going to the bathroom, their PBF differed. When InBody was tested right after going to the bathroom, the decreased weight from excretion resulted in decrease in PBF. However, there were no certain pattern in PBF change after 10 minutes.

➤ InBody should be tested **with an empty stomach.**

<PBF difference due to food ingestion>



Summary

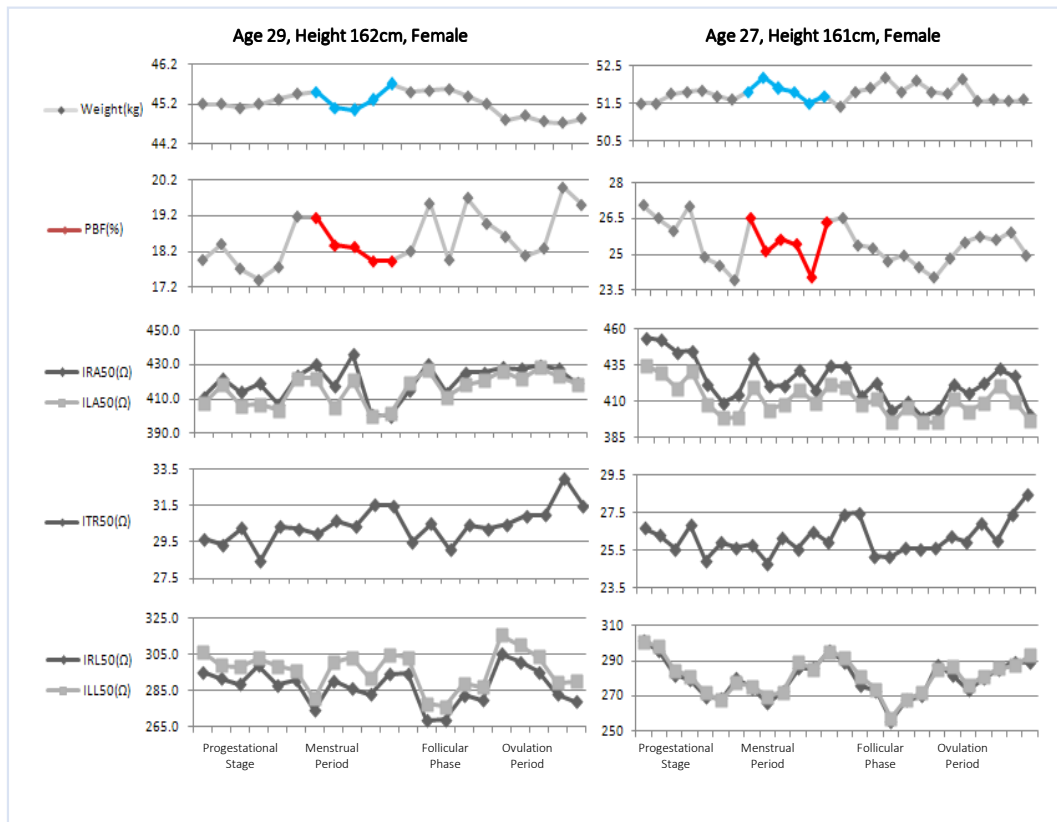
Food Ingestion increases weight and is therefore known to increase percent body fat following the BIA principle. However, in truth ingesting food decreases impedance and can lower percent body fat.

After eating food, blood is intensively supplied to the digestive organs increasing the peristalsis, secretion rate and absorption rate of the digestive tract along with the blood flow. This status lasted about 2~4 hours before stabilizing.

Experimental Results show that PBF of 2 male and female subjects gradually declined for 3 hours after dinner. Impedance of 5 subjects in the additional experiment decreased right after breakfast, lunch and dinner but there was no certain pattern on the change of PBF.

➤ InBody **should not** be tested during **menstruation** for precise results.

<PBF difference by menstrual cycle>



Summary

Women have temporary weight and body composition change by their menstrual cycle due to influence of hormone.

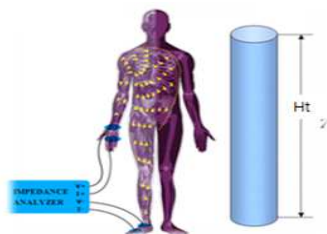
In Progesterational Stage, there is a tendency of weight gain due to body water retention. However, in InBody measurement the accumulated water is considered as fat free mass so the PBF decreases. On the other hand, there are cases where PBF increases due to increased appetite and eating patterns such as preference in salty and sweet food.

Experimental Results in a three months follow up in 2 female showed up and downs un their PBF in premenstrual and menstrual period. The tendency differed by month even in the same person. In other words, body composition change by menstrual cycle differs by people so it can not be predicted. However, biggest difference occurs in progesterational and menstrual stage so it is recommended to avoid testing in this stage.

➤ **InBody results may vary if the input height and weight differs.**

<29, 162cm, Female, PBF difference due to Height and Weight difference>

Items	Changes in height				Changes in body weight			
	Standard	-2cm Decrease	+1cm Increase	+3cm Increase	Standard	-2kg Decrease	+1kg Increase	+3kg Increase
Height(cm)	162	160	163	165	162	162	162	162
Weight(kg)	44.4	44.3	44.3	44.3	46.4	44.4	47.4	49.4
SLM(kg)	34.3	33.8	35	35.8	34.8	34.3	35.1	35.2
Body Fat(kg)	8.1	8.5	7.2	6.4	9.5	8.1	10.2	11.9
PBF(%)	18.2	19.1	16.3	14.4	20.4	18.2	21.5	24.1



$$\text{Impedance Index} = c \frac{\text{Height}^2}{\text{Impedance}}$$

$$\text{Total Body Water} \propto a \frac{\text{Height}^2}{\text{Impedance}} + b$$

Summary

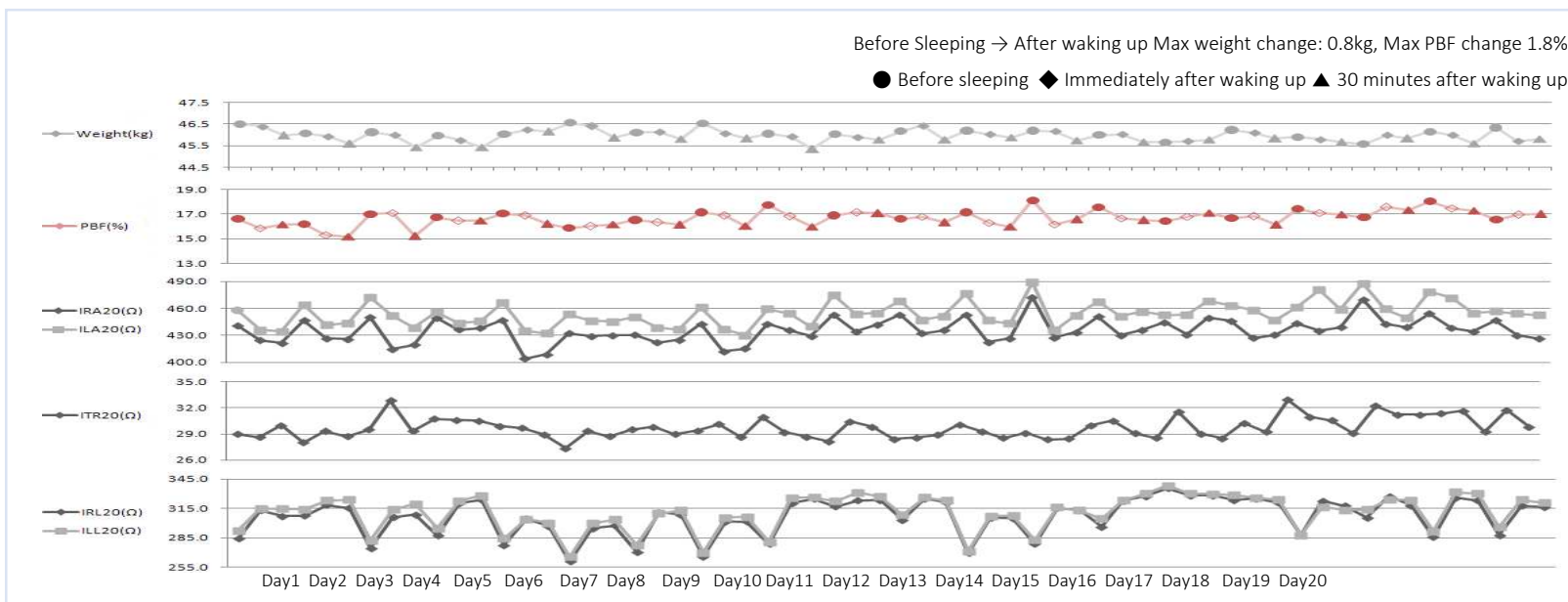
InBody calculates body water by **Impedance Index** which is the value of height(m) square divided by resistance. As we can see in the TBW equation, height is positively correlated with TBW so if the input height increases, the TBW also increases resulting in PBF decrease.

Also when Body Composition is classified by 2-compartment model, it can be divided into Fat Free mass and Fat mass. So if weight increases without any change in fat free mass, the increased weight will result in increase of fat mass.

In other words, height and weight are a very important variable in BIA principle so when monitoring InBody results, it is important to wear light clothes and enter your exact height.

➤ Reason why percent body fat varies before and after sleep.

<27, 162cm, Female, PBF difference between before sleeping, immediately after waking up and 30min after waking up>



Summary

Sleeping and Waking up occurs with a posture change which results in body water redistribution leading in segmental impedance change. Impedance change due to posture change occurs for over 15 minutes after posture change, and body water distribution stabilizing time gets longer when the same posture was lasted longer. Generally, average sleeping hours in bed are about 6-7 hours. So certain amount of time is needed to stabilize the body water distribution. In other words, testing InBody right after waking up is not recommended.