Malnutrition status group belonged to <15th percentile (AUC=0.74, p<0.005). The PA measured by the BIA is the most accurate and appropriate method of nutritional evaluation. Furthermore, despite excess fluid, age and gender being important limitations in the application of BIA, PA can be adjusted for these factors and used accordingly.

### <Hemodialysis patients>


n-3 and n-6, such polyunsaturated fatty acids (PUFA), possibly affect muscle mass, so this study evaluated a relationship between the dietary ratio of n-3 and n-6 and the muscle mass of 69 Chinese HD patients with diabetes whose mean age was 63.0±10.4y. SMM was evaluated after dialysis by utilizing InBody S10. Patients’ dietary intakes were recorded for 3 days (a dialysis day, a non-dialysis day, a weekend).

Patients who had adequate intake(M:1.6g/d, F:1.1g/d) of n-3 had significantly higher SMM and ASM than did their counterparts. n-3/n-6 (dividing the n-3 by n-6) was positively associated with SMM; in particular, it showed significantly correlated with ASM(β=15.89, Table 2). n-6/n-3 showed inversely correlated with muscle mass. And n-6/n-3 and HOMA-IR were the independent risk determinants of ASM index(ASM, kg/m²) in patients with diabetes undergoing HD. (adjusted R²=0.72). Dietary n-3 and n-6 are modifiable contributors toward muscle wasting in patients with diabetes undergoing HD; high n-6/n-3 may be independently associated with a reduced muscle mass. Therefore, increasing n-3 quantities is an approach to normalizing a high ratio of n-6/n-3.

### <Peritoneal dialysis patients>


Under the assumption that MHBP (morning home blood pressure) is associated with the body fluids status and...
MHBP is beneficial to maintaining optimum blood pressure in peritoneal dialysis (PD) patients; this study evaluated whether MHBP is relevant with InBody S10 and body fluids status by echocardiography in 15 PD patients in Japan. The 15 patients had an mean age of 66.3 ± 7.7 years; a dialysis vintage of 28.3 ± 6.4 months; the average sMHBP (systolic MHBP) was 128 ± 13 mmHg; and average sOBP (systolic office BP) was 126 ± 15 mmHg. Both sOBP and sMHBP showed an association with body fluid parameters, such as TBW/height², renal function (renal Kt / V, serum creatinine), heart function (left ventricular mass index); and correlation coefficient for sMHBP and TBW/height² was highest, with sMHBP being the only independent predictor (r = 0.615). In addition, sMHBP showed a significant correlation with TBW, soft lean mass and PBF. Sodium intake was associated only with sMHBP.

Body fluids status by BIA, heart and renal function and sodium intake show better associations with sMHBP than sOBP; thus monitoring MHBP and body composition by BIA are beneficial the maintenance of body fluids status in PD patients.

<Older people>


Concepts of successful aging (SA), the usual aging (UA) and mild cognitive impairment (MCI) have been developed to identify older adults at high risk of Alzheimer’s disease; this study investigated risk factors of MCI by comparing the SA and UA, among 1993 Malaysians aged 60 years and above, in order to find the predictive risk factors of cognitive impairment. FFM and PBF were measured by utilizing InBody S10. 73% of the subjects were UA, 16% were MCI, and 11% belonged to the SA group. Three groups showed significant differences in FFM and PBF (p = 0.004, p = 0.002, FFM(kg) SA : 37.96 ± 7.41, UA : 36.52 ± 7.8, MCI : 37.77 ± 7.99/ PBF(%) SA: 37.11 ± 11.11, UA : 39.65 ± 10.20, MCI : 38.48 ± 10.72). Higher fasting blood sugar, hyperlipidemia, disability, low education level, not regularly involved in technical based activities, limited use of the modern technologies, low intake of fruits and not practicing calorie restriction, were the risk factors of poor cognitive performance, among them OR of decreased mechanical repairs and hyperlipidemia were 2.28 (p = 0.006), 1.78 (p = 0.000), respectively and a high risk factor poor cognitive performance.

<Older people>


It is important for the elderly to maintain their skeletal muscle mass, which in turn helps to maintain physical functions. To clarify factors related SMM maintenance, this study investigated in 310 (male : 94, female : 216) elderly aged 75 years or older in Japan to obtain resistance value of the InBody S10 50kHz; and calculated SMM through a formula using the resistance of the Janssen. According to the measurement result, there was a significant difference of SMM in elderly men and women (men: 13.1 ± 1.9kg, women: 6.4 ± 1.4kg, p < 0.001), men’s SMM had significant difference depending on dental malocclusion, dysphagia and MNA-SF (Mini Nutritional Assessment Short Form (< 12, ≥ 11), and women’s SMM had significant difference depending on MNA-SF(< 12, ≥ 11), BI (Barthel Index, ≤ 55, ≥ 60) and BMI (<18.5, ≥18.5) According to the multiple regression analysis result, men’s SMM was significantly related with dental malocclusion and MNA-SF (p = 0.032, p = 0.049, Table 4), and women’s SMM was significantly related with MNA-SF (p = 0.002, Table 5). This study concludes that the dentures and dental treatment are useful for keeping SMM for men in particular.

* Janssen formula

$$\text{SMM} = 0.401 \times [\text{Ht}/\text{R}] + 3.825 \times \text{sex} - 0.071 \times \text{age} + 5.102$$

Table 4: Multiple regression analysis results in men

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized coefficient</th>
<th>Standardized coefficient</th>
<th>t value</th>
<th>p value</th>
<th>50.0% CI for B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>16.861</td>
<td>1.103</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of dysphagia</td>
<td>-1.125</td>
<td>0.175</td>
<td>-0.192</td>
<td>0.8477</td>
<td>-2.301 - 0.034</td>
</tr>
<tr>
<td>Presence of malnutrition</td>
<td>-1.500</td>
<td>0.368</td>
<td>-0.109</td>
<td>0.8014</td>
<td>-1.681 - 0.764</td>
</tr>
</tbody>
</table>

Dependent variable: skeletal muscle mass

Table 5: Multiple regression analysis results in women

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized coefficient</th>
<th>Standardized coefficient</th>
<th>t value</th>
<th>p value</th>
<th>50.0% CI for B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>8.372</td>
<td>0.543</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MNA-SF (&lt; 12, ≥ 11)</td>
<td>-0.500</td>
<td>0.191</td>
<td>-0.240</td>
<td>0.8037</td>
<td>-1.612 - 1.087</td>
</tr>
<tr>
<td>BI (≥ 80, &lt; 50)</td>
<td>0.000</td>
<td>0.000</td>
<td>0.099</td>
<td>0.9299</td>
<td>0.039 - 0.087</td>
</tr>
</tbody>
</table>

Dependent variable: skeletal muscle mass

< Older people>


The aim of this study was to investigate the association between dysphagia and sarcopenia. InBody S10 was used to measure SMM of 224 older adults aged 65 years or older in Japan, and SMI was calculated based on the measurements. Swallowing function was evaluated using FOIS®.

The multivariate analysis of the presence of dysphagia, after adjusting for confounding factors including sex, age, and nutritional status and activities of daily living, showed that activities of daily living (adjusted odds ratio [OR] 0.982, 95% CI 0.972–0.993) and sarcopenia (adjusted OR 5.911, 95% CI 1.648–21.199) were independent factors associated with dysphagia. In the subgroup, univariate analysis was carried out among the participants with a low SMI, and a decreased SMI (r = 0.40) for men, and a decreased SMI (r = 0.30) and hand-grip strength (r = 0.30) for women were found in participants with dysphagia. SMI of men and women without dysphagia were 5.94 ± 0.67 kg/m² and 4.64 ± 0.70 kg/m² respectively, and SMI of men and women with dysphagia were 5.15 ± 1.11 kg/m² and 4.17 ± 0.15 kg/m² respectively.

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Sarcopenia was an independent risk factor for dysphagia among older individuals and assessing sarcopenia can be useful in diagnosis of dysphagia in older adults.

* FOIS (functional oral intake scale): Daily oral intake of food and beverage is evaluated. Dysphagia is defined as 5 points or lower on the 7-point scale.

**Cardiovascular disease patients**

To clarify the clinical characteristics of sarcopenia and investigate the effects cardiac rehabilitation, **InBody S10** was used to measure TBW, FFM, FM of 322 CVD patients in Japan (mean age 72±12y). Before and after exercise, the average intake of total calories and nutrients, muscle strength and gait speed were evaluated based on the AWGS guidelines.

Gait speed is lower than <0.8 m/s or lower handgrip strength (<26kg in M, <18kg in F) together with a decrease in SMI(<7.0 kg/m² in M, <5.7 kg/m² in F), in these cases, the patients were diagnosed with sarcopenia. Aerobic, resistance, balance trainings were included in the exercise training protocol and were performed 20 to 40 minutes daily. 28% of the patients were in the sarcopenia group; and the sarcopenia group had higher proportion of incidence chronic heart failure and chronic renal failure; and the ages were significantly higher than other group. Protein intake significantly correlated with SMI, handgrip strength and gait speed. In non-sarcopenia group, SMI decreased after exercise but, there was no significant change in the SMI in sarcopenia group (Table 3). SMI was significantly associated with statin treatment and was highest in case of taking lipophilic Statins among Statin drugs (p<0.05). Futhermore, the ratio of peak VO₂/Wt and SMI was significantly higher in patients with statin treatment.

**Heart failure patients**

Based on the fact that achievement of dry weight without sign of clinical congestion at the time of discharge is considered a surrogate marker of successful treatment in acute heart failure(AHF), this study aimed to determine whether BIA could predict the dry weight of AHF patients. **InBody S10** was used to measure the ECW/TBW of 60 AHF patients in Japan. The weight before discharge was recorded as the dry weight, and the patients were divided into two groups; those who lost more weight during hospitalization more than the median (4.30kg), and those who lost less.

Mean ECW/TBW was 0.400±0.019, and ECW/TBW in higher weight reduction group was statistically higher compared with that in lower weight reduction group (0.406±0.021 vs. 0.394±0.015, p=0.012). Factors such as weight on admission, left ventricular ejection fraction, IVC diameter, and albumin were significantly different between groups. SBP, creatinine, and N-terminal pro-B-type natriuretic peptide were similar between the groups. Multivariate linear regression analysis revealed that male sex, IVC diameter on expiration, ECW/TBW, and weight on admission were significant independent predictors of required weight reduction. Model equations for predicting required weight reduction developed are as follows.

**[Multivariate model]**

Weight reduction (kg) = 6.0628-2.31 (if male) + 0.25 (IVC-20) + 100.62 (EI-0.39) + 0.13 (Weight-65)

"*IVC: inferior vena cava/ EI: Edema index=(ECW ratio-ECW/TBW)

Therefore, ECW/TBW is a useful predictor of the amount of weight reduction needed to reach dry weight in AHF treatment. Quantitative assessment of clinical congestion is helpful for avoiding excess volume reduction and persistent congestion in AHF.

**Diabetes**

Cardiovascular disease(CVD) is the leading cause of death in Type 2 diabetes, Metformin and SGLT2 (Sodium-glucose transporter 2) inhibitors reduce cardiovascular events, but this mechanisms of the cardio-protective effects of the two agents are unknown. In addition, BNP (B-type natriuretic peptide) increase with the left ventricular dysfunction or hypertrophy, which is useful for screening of type 2 diabetic patients with cardiovascular complications. This study examined changes in the plasma BNP following the administration of Metformin and SGLT2 inhibitors in 15 people and 7 people respectively with type 2 diabetes in...
Japan. Body composition was measured by utilizing InBody720, and VFA was measured by utilizing InBody S10. Plasma BNP in the patients significantly increased after 3 months from administration of Metformin and SGLT2 inhibitors (7.9±7.9pg/mL to 17±16.9pg/mL, p=0.012; 8.8±7.2pg/mL to 15.5±14.3pg/mL, p=0.018). The FM decreased significantly after 3 months in Metformin administration group (25.7±10.3kg to 23.0±11.4kg, p=0.046); and in SGLT2 inhibitors administration group, FM and VFA decreased 3 months after the administration of SGLT2 inhibitors in three patients(Figure 1).

Plasma BNP increased because of FM loss caused by treatment with Metformin and SGLT2 inhibitors could reduce the risk of CVD by exerting cardioprotective effects through elevated BNP in patients with type 2 diabetes.

**<Pediatric Surgery patients>**


This study examined whether BIA measurements are useful for estimation of the hydration status as indicated by TBW, ICW or ECW during the perioperative period in children. One hundred children (3–12 y) living in Korea were enrolled in the study, whose body fluids (ICW and ECW) were measured using the InBody S10 in free intake period before surgery(baseline), fasting just before surgery, and immediately after surgery in supine position. Hartmann solution or normal saline was administered while the children were fasted before surgery.

The mean fasting time before surgery was 13.3 h. The averaged administered fluid volume during fasting period was much lower than the requirement of fluids (320 vs. 934 mL). The measured baseline ICW and ECW was lower than the estimated values as calculated by body weight (10.4 vs. 12.6 L in ICW, 6.6 vs. 7.9 L in ECW). Preoperatively, measured ICW and ECW were 10.4 and 6.5 L, respectively and also both values were lower than estimated values, exhibiting dehydration despite fluid infusion. The ICW showed a weak positive correlation (Pearson correlation coefficient=0.254, P=0.010) and the ECW showed a stronger positive correlation (Pearson correlation coefficient=0.359, P=0.001) with the fluid deficit* during the fasting period. Immediately postoperatively, the measured ICW and ECW were 10.5 L vs. 6.5 L and still lower than estimated values, exhibiting dehydration in spite of fluid treatment during operation. Some children underwent long preoperative fasting periods and become slightly dehydrated despite fluid administration, resulting in assessing fluid status with BIA. BIA may be an alternative method for estimating the perioperative fluid status in children and determining details of fluid administration.

**<Cardiac Surgery patients>**


The aim of this study was to determine whether PA is a marker of malnutrition and postoperative morbidity in patients undergoing cardiac surgery. InBody S10 was used to measure PA and body composition of 342 low operative risk patients in Lithuania, aged 20-79y. The nutritional status of the patients was evaluated using InBody one day prior to surgery. After stratifying the PA measurements by age and gender, the patients were classified into low and normal PA groups in accordance with the 15th percentile value.

A positive correlation between values of low PA and FFMI (fat-free mass index, kg/m²) was determined (r=0.515, p<0.001). The low FFMI is a marker of malnutrition. The rate of post-surgery morbidity was 21.3% (normal PA: 10.7%, p=0.023), and the odds ratio of post-surgery morbidity was 2.50

A low preoperative PA is an accurate marker of malnutrition and an independent predictor of adverse postoperative outcomes after low operative risk cardiac surgery. Therefore, measuring PA and body composition could be useful in determining malnutrition and adverse outcomes after cardiac surgery.
Several other studies have determined higher seating pressures in persons with spinal cord injury (SCI) than in able-bodied subjects. In this study, 20 SCI patients (mean age: 53.6±17.95y) and 20 healthy people (mean age: 27.5±2.54y) in Korea were included and their body composition measured utilizing InBody S10 to show effects of body composition and cushion type in seat-interface pressure. The seat-interface pressure was measured in a sitting posture on a wheelchair with three kinds of seat cushion and without a seat cushion. The SMM of the trunk was similar in both group, but in the healthy people group, SMM, lower extremities of SMM and TBW were significantly higher than SCI group, and FM was significantly higher in SCI group (Table 1). All body composition measured in the two groups didn’t show significant relationship with the seat-interface pressure, the SCI group’s seat-interface pressure was significantly high regardless cushion type or sitting posture. In addition, seat-interface pressure showed a significant difference depending on the type of the cushion, but there was no significant difference depending on the position. Body composition did not impact the seat-interface pressure; but SMM and TBW reduction may affect pressure ulcers, so monitoring of SMM and TBW utilizing InBody, is required to decrease the seat-interface pressure.

**<Myopathy patients>**

This study aimed to investigate the overall nutritional status of Korean myopathy patients through BIA with InBody S10. 75 participants over the age of 10 participated in this study and they were divided into age groups of 10-19y, 20-29y, 30-39y, and over 40y. The information of general characteristics and dietary habits of subjects was collected through a survey and a nutritional assessment and biochemistry tests were conducted.

BMI showed a negative correlation with PA (r=-0.288, p<0.05) while total protein showed a positive correlation with PA (r=0.235, p<0.05). PA in which most people is said to be between 3-15°. But the mean PA of all of the subjects was found to be 2.49±0.93°, which was below the cutoff value. In the nutritional assessment, energy, dietary fiber, calcium, and magnesium intakes of all of the subjects were found to be insufficient. PA is an indicator that reflects the seriousness of myopathy patients. Therefore, Nutritional assessment with PA could be useful for the nutrition management of myopathy patients.

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**<Healty young people>**

In a study about respiratory muscles in elderly people, it is complicated to control for a number of variables, such as many respiratory disease. This study investigated the relationships between respiratory muscle strength and sarcopenic indices such as SMM and limb muscle strength in 89 healthy young adults (age: 20-39y) in Korea as a preliminary study. SMM was measured by utilizing InBody S10 and SMI (Skeletal muscle mass (kg)/Height (kg) x 100) was calculated using SMM. In addition, PEF (peak expiratory flow), MIP (maximal inspiratory pressure), MEP (maximal expiratory pressure), HGS (hand grip strength), and KES (knee extensor strength) were measured.

In relationship to SMI and muscular strength, MIP showed positive correlation with SMI (r=0.457 in M, r=0.646 in F, Table 2). In relationship to respiratory muscle and limb muscles, MIP only showed a significant correlation to KES and HGS. PEF and MEP had no significant correlations with these sarcopenic variables. According to multivariate regression analysis, MIP was the only independent factor related to SMI (p<0.01).

---

### Table 1. General characteristics and body mass composition in SCI and control groups

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>SCI group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex (male/female)</td>
<td>13.7</td>
<td>13.7</td>
</tr>
<tr>
<td>Age (y)*</td>
<td>53.6±17.95</td>
<td>27.5±2.54</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>165.1±9.64</td>
<td>169.6±8.85</td>
</tr>
<tr>
<td>Body weight (kg)</td>
<td>64.7±9.06</td>
<td>65.3±11.83</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>24.3±3.36</td>
<td>22.5±3.04</td>
</tr>
<tr>
<td>Body fat (%)*</td>
<td>19.6±7.30</td>
<td>15.0±15.09</td>
</tr>
<tr>
<td>Skeletal muscle mass (kg)</td>
<td>Total*</td>
<td>24.3±26.16</td>
</tr>
<tr>
<td></td>
<td>Trunk</td>
<td>20.7±34.1</td>
</tr>
<tr>
<td></td>
<td>Lower extremity*</td>
<td>13.37±3.73</td>
</tr>
<tr>
<td>Segemontal body water (L)</td>
<td>16.26±3.34</td>
<td>17.49±2.40</td>
</tr>
<tr>
<td>Lower extremity*</td>
<td>10.46±2.89</td>
<td>12.88±3.33</td>
</tr>
</tbody>
</table>

### Table 2. Pearson correlation coefficients (r) among respiratory muscle strength, limb strength, and skeletal muscle mass

<table>
<thead>
<tr>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMI</td>
<td>KES</td>
</tr>
<tr>
<td>PEF</td>
<td>0.112</td>
</tr>
<tr>
<td>MIP</td>
<td>0.477</td>
</tr>
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<td>MEP</td>
<td>0.268</td>
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