



Health and Nutrition News

No.62

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Effects of 1-year weight loss intervention on abdominal skeletal muscle mass in Japanese overweight men and women

Motohiko Miyachi, Department of Physical Activity Research

[Introduction]

Quantitative assessment of visceral fat mass and skeletal muscle mass is important from the viewpoint of lifestyle-related disease prevention. Recently, it has been suggested that fat cells and muscle cells interact in a reciprocal manner. In addition, the decrease in abdominal skeletal muscle due to aging is larger than that in extremity skeletal muscle, and it may be adversely affected by visceral fat accumulation.

[Purpose]

The purpose of this study was to examine 1) the relationship between visceral fat mass and abdominal skeletal muscle mass in obese subjects and 2) the effects of weight loss programs on abdominal fat mass and skeletal muscle mass.

[Method]

A total of 235 overweight Japanese men and women aged 40–64 years with a body mass index of 28.0 to 44.8 kg/m² participated in this randomized controlled intervention study. They were randomly divided into a lifestyle intervention group and control group.

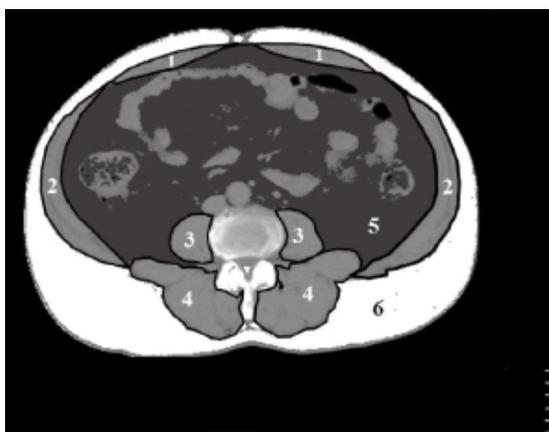


Figure 1. The CSAs of subcutaneous fat and abdominal skeletal muscles, i.e., the rectus abdominis 1, abdominal oblique 2, iliopsoas muscles 3, and erector spinae 4, were semi-automatically calculated by a well-trained measurer using CT images.

Before and after the one-year lifestyle intervention for weight loss, an abdominal transverse image was acquired using computed tomography. The cross-sectional areas (CSAs) of visceral fat, subcutaneous fat, and skeletal muscle of the rectus abdominis, abdominal oblique, iliopsoas, and erector spinae muscle were calculated.

[Results]

The body weight changed by approximately –5% in the intervention group. The corresponding values for subcutaneous fat and visceral fat CSAs were –10.8 to –17.5% in both sexes. The reductions observed in skeletal muscle CSAs were significantly less (–6.0% and –7.2% in the male and female intervention groups, respectively) than those in fat tissue CSAs. The CSA of each of the four skeletal muscle groups also significantly decreased; however, after adjustments for body weight at each time point, only reductions in the iliopsoas muscle in both sexes and abdominal oblique muscles in men remained significant.

[Conclusion]

The lifestyle weight loss intervention might reduce the relative amount of abdominal skeletal muscles especially iliopsoas muscles.

[Future direction]

It was suggested that measures to prevent a decrease in the abdominal skeletal muscle mass should be examined during weight loss intervention in obese individuals.

This report is part of the result of the Saku Obesity Control Program (SCOP), and details are published in the following two papers.

Tanaka et.al. *Asia Pac J Clin Nutr.* 2019; 28 (1): 72-78.

Tanaka et.al. *Obes Res Clin Pract.* 2018; 12 (4): 378-383.

How much energy are athletes expending?

Kazuko Ishikawa-Takata
Section of Dietary Guideline, Department of Nutrition and Metabolism

We studied energy expenditure using the doubly labeled water (DLW) method. Athletes will expend great amounts of energy compared with that expended by sedentary subjects because of participation in vigorous training. Physical activities during training vary; thus, it is difficult to assess energy expenditure using simple methods, such as using an accelerometer or based on questionnaires. The DLW method is an adequate method to assess physical activity levels among athletes.

[Subjects and method]

The subjects were bodybuilders and college students who were long- or intermediate-distance runners, swimmers, rhythmic gymnasts, lacrosse players, track and field sprinters, or Korean college tennis players. The athletes drank water including stable isotopes of hydrogen and oxygen, and urine samples were collected once a day for one week. We analyzed the stable isotope concentration in the urine samples.

[Results and discussion]

Our published results are summarized in the table (1-5). The maximum physical activity level (PAL= total energy expenditure/resting metabolic rate) was shown in long-distance runners (2.68) and minimum PAL was shown in Korean tennis players (1.97). Per the Dietary Reference Intake Japan 2015, the PAL for a moderately active adult is 1.75 and that for an active adult is 2.00. Most of the highly trained athletes showed equal or higher PALs than those in active adults. Westerterp KR suggested that a sustainable limit of the PAL for the general population is 2.5.

Highly trained athletes can maintain the energy balance between energy expenditure and intake as much as a PAL of 5.00. However, in that case, most athletes consume supplements to increase energy intake. It may be difficult to maintain energy balance only by consuming natural foods.

[Future research]

Compared with measuring energy expenditure using DLW methods, it is quite difficult to assess the adequacy of energy intake corresponding with energy expenditure. Estimating energy balance from the changes in body composition or body mass is also inappropriate because athletes are training to achieve desirable bodies. The assessment of energy balance is a problem to be solved.

[References]

- 1) Yamamoto S et al. Basal metabolic rate and physical activity level in bodybuilders, *The Japanese Journal of Nutrition and Dietetics*, 66, 195-200, 2008
- 2) Yosida A et al., Factors associated with reporting error for energy intake estimated by food record in female athletes, *The Japanese Journal of Nutrition and Dietetics*, 77, 305-315, 2012
- 3) Yoshida A et al., Self-consciousness in female sprinter is associated with reporting error for energy intake estimated from food records, *J Jpn Soc Nutr Food Sci*, 66, 101-107, 2013
- 4) Didace Ndahimana et al., Accuracy of dietary reference intake predictive equation for estimated energy requirements in female tennis athletes and non-athlete college students: comparison with the doubly labeled water method, *Nutr Res Pract*, 11, 51-56, 2017
- 5) Yoshida A et al., Validity of combination use of activity record and accelerometry to measure free-living total energy expenditure in female endurance runners, *J Strength Condition Res*, in press
- 6) Westerterp KR. Limits to sustainable human metabolic rate. *J. Exp. Biol* 204,3183,2001

| Sports | N | Total Energy expenditure (kcal/day) | Resting metabolic rate (kcal/day) | Physical activity level | Ref. |
|--|----|-------------------------------------|-----------------------------------|-------------------------|------|
| Body builder (men) | 7 | 3,432±663 | 1,687±178 | 2.03±0.23 | 1) |
| Long or middle distance runner (women) | 9 | 2,673±620 | 1,200±222 | 2.23±0.33 | 2) |
| Swimmer (women) | 10 | 3,077±346 | 1,300±209 | 2.45±0.41 | 2) |
| Rhythmic gymnastics (women) | 7 | 2,910±224 | 1,121±150 | 2.65±0.47 | 2) |
| lacrosse players (women) | 12 | 2,910±277 | 1,220±168 | 2.44±0.47 | 2) |
| Track and field sprinter (women) | 12 | 2,392±376 | 1,069±144 | 2.3±0.30 | 3) |
| Tennis player (women) | 8 | 2,780±430 | 1,407±170 | 1.97±0.17 | 4) |
| Long distance runner (women) | 8 | 3,032±344 | — | 2.68±0.37 | 5) |

External Quality Assessment Surveys of Food Nutrition Analysis in Japan

Jun Takebayashi, Section of Food Component Analysis, Department of Food Function and Labeling

[Introduction]

In Japan, under the Food Labeling Law enforced in 2015, all processed foods will be essentially labeled with the contents of nutrients from April 2020: namely, energy, protein, fat, carbohydrate, and salt equivalent values. Nutrient labeling is essential information that shows the amounts of invisible nutrients and helps consumers select suitable products. There are two types of nutrition declarations (Figure 1). One case is that in which calculated values from the Japanese food standard composition table or analytical values of a sample product are displayed. In these cases, note that "estimated value" or "this value is a rough indication" should accompany these values, indicating that the declared values might not always match the actual nutrient contents. The other case is that in which no such notices are displayed; the amounts of nutrients contained in each product are quality-controlled within the range of -20% to +20% of the declared values.*

Laboratory analysis is necessary to determine the correct amounts of nutrients. However, laboratory analytical values should include considerable errors. Therefore, we developed a method to assess the reliability of analytical laboratories for information regarding food nutrients.^{1),2)} We have provided external quality assessment surveys of food nutrition analysis in cooperation with the Food and Drug Safety Center since 2017.

[Subjects and Methods]

The survey was conducted among public analytical laboratories. In both 2017 and 2018, 54 participants were distributed sausages that were specially prepared for this survey. Each laboratory independently determined the amounts of nutritional components, and we compared the reported values among the laboratories. The criteria for good laboratory performance were as follows: i) the reported value is within the statistically acceptable range ($-3 < z\text{-score} < 3$) and ii) the reported value is within $\pm 20\%$ of the average value.

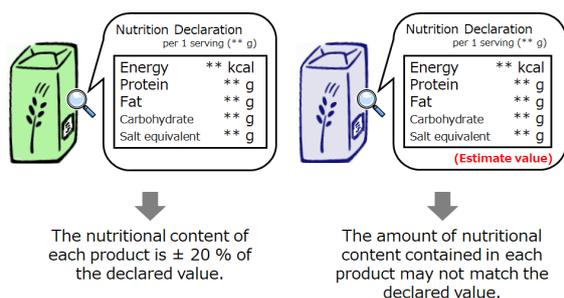


Figure 1. Two ways of nutrition declaration

[Results]

About 10% of the participants both in 2017 and 2018 reported unsuitable values for one or more mandatory nutrients (Table 1). In particular, the reported values for carbohydrate or salt equivalent values tended to be inappropriate.

[Future direction]

As of 2019, we are conducting an external quality control survey using a cereal product as the test food. The accuracy of laboratory analysis can be improved by repeatedly participating in external quality control surveys. We will continue researching the reliability of food nutrition declarations.

Note

* Each nutrient has specific tolerance ranges: energy, protein, fat, carbohydrate, and salt equivalent = -20% to +20%; minerals and fat-soluble vitamins = -20% to +50%; and water-soluble vitamins = -20% to +80%.

[References]

- 1) Jun Takebayashi, Teruki Matsumoto, Yoshiko Ishimi. Ensuring the Reliability of Nutrition Labeling Values: A Preliminary Study on the Establishment of a Methodology for Proficiency Testing of Laboratories for Nutritional Analysis. *The Japanese Journal of Nutrition and Dietetics*. 73, 8-15 (2015).
- 2) Jun Takebayashi, Teruki Matsumoto, Yoshiko Ishimi. Ensuring the Reliability of Nutrition Labeling Values: An Attempt at Proficiency Testing of Major Nutrients Analysis. *The Japanese Journal of Nutrition and Dietetics*. 75, 3-18 (2017).

Table 1. Number of the laboratories which reported suitable or unsuitable values in external quality assessment surveys in 2017 and 2018

| Subjects | 2017 | | 2018 | |
|-------------------------------|----------------|--------------|----------------|---------------|
| | Suitable | Unsuitable | Suitable | Unsuitable |
| Energy | 53 (98) | 1 (2) | 52 (96) | 2 (4) |
| Protein | 54 (100) | 0 (0) | 52 (96) | 2 (4) |
| Fat | 53 (98) | 1 (2) | 53 (98) | 1 (2) |
| Carbohydrate | 53 (98) | 1 (2) | 50 (93) | 4 (7) |
| Salt equivalent | 51 (94) | 3 (6) | 51 (94) | 3 (6) |
| Above-listed nutrients | 49 (91) | 5 (9) | 47 (87) | 7 (13) |
| Calcium | Not applicable | | 33 (85) | 6 (15) |
| Iron | Not applicable | | 36 (92) | 3 (8) |

Numbers in parentheses indicate percentages.

Global trends in the urban-rural difference in adult body mass index

Nayu Ikeda, Section of Population Health Metrics, International Center for Nutrition and Information

Mean body mass index (BMI) has increased gradually in most countries in parallel with a rise in the proportion of the urban population. This has led to a widely reported view that urbanization is one of the most important drivers of the global rise in the prevalence of overweight and obesity. However, a study of global trends in BMI by the Non-Communicable Disease Risk Factor Collaboration (NCD-RisC) reported that excessive weight is increasing more rapidly in the world's rural areas than in urban areas.

The NCD-RisC is a worldwide network of health researchers and practitioners for studying the global trends and variations in risk factors for non-communicable diseases. I have collaborated with the NCD-RisC as part of my research funded by the Japan Society for the Promotion of Science for the past several years. I had an opportunity to contribute as a member of the Writing Group for a paper published in *Nature*.

We analyzed the height and weight data of more than 112 million adults to estimate trends in mean BMI from 1985 to 2017 by rural and urban place of residence for 200 countries and territories. The data included information provided from a number of national and local surveys in Japan, such as the National Health and Nutrition Survey.

The study found that from 1985 to 2017, BMI rose by an average of 2.0 kg/m² in women and 2.2 kg/m² in men globally. More than half of the global rise over these 33 years was attributable to increases in rural BMI. In some low- and middle-income countries, rural areas were accountable for over 80% of the increase.

Moreover, since 1985, mean BMI in rural areas has increased by 2.1 kg/m² in both women and men, while in cities, the increase was 1.3 kg/m² and 1.6 kg/m² in women and men, respectively.

These trends have led to noticeable changes in the geography of BMI over the past three decades. In 1985, urban men and women had a higher BMI than their rural counterparts in over three quarters of the countries. Over time, the difference between urban and rural BMI decreased or even reversed in many of these countries (Figure).

Policy implications

As economic growth and rural nutrition programs solve a caloric deficit in rural areas, the rural undernutrition disadvantage may be replaced by a more general and complex malnutrition that entails excessive consumption of low-quality calories. To avoid such an unhealthy transition, the fragmented national and international responses to undernutrition and obesity should be integrated, and the narrow focus of international aid on undernutrition should be broadened to enhance access to healthier foods in poor rural and urban communities.

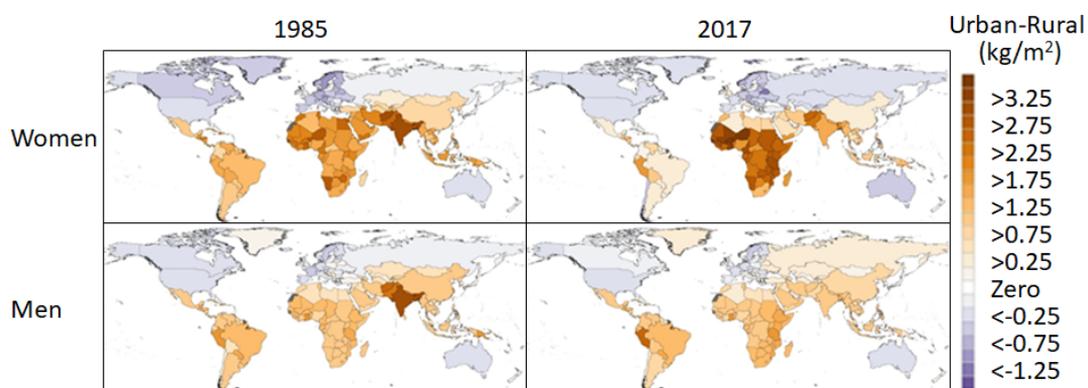
Acknowledgement

This study was funded in part by the Japan Society for the Promotion of Science (PI: Nayu Ikeda, grant numbers 15K08762 and 18H03063).

【Reference】

NCD Risk Factor Collaboration (NCD-RisC). Rising rural body-mass index is the main driver of the global obesity epidemic in adults. *Nature* 2019;569:260-264.

<https://www.nature.com/articles/s41586-019-1171-x>



Edited from *Nature* 2019;569:260-264. © 2019 NCD Risk Factor Collaboration

Figure. The difference between rural and urban age-standardized mean BMI

Role of Brain Insulin Receptor Substrate-1 (Irs1) in Growth and Glucose Metabolism

Takanori Hayashi, Section of Nutrition Therapy, Department of Clinical Nutrition

[Introduction]

In the recent years, the prevalence of type 2 diabetes has been considerably increasing worldwide. Hence, it is crucial and imperative to develop strategies for preventing the disease onset and minimize complications. Insulin receptor substrates (Irs) are activated by insulin and insulin-like growth factor (IGF)-1 receptors and allow docking of downstream effectors. Hence, they are essential for insulin and IGF signaling. In particular, Irs1 and Irs2 play a key role in glucose homeostasis. Our previous study demonstrated that Irs1 plays an important role in not only glucose homeostasis but also growth in whole-body Irs1-knockout mice. However, the underlying molecular mechanisms and tissues or organs responsible for Irs1-mediated growth are unclear.

Since recent evidence has revealed that insulin action in the brain contributes to the regulation of food intake and hepatic glucose production, it is now apparent that the brain, in addition to the liver, adipose tissues, and skeletal muscles, is an insulin-sensitive organ. However, the role of Irs1 in the brain remains unknown. Hence, the present study aimed to investigate the role of Irs1 in the brain.

[Subjects and Methods]

We generated brain-specific Irs1 knockout (NIrs1KO) mice and analyzed growth related parameters and metabolic factors.

[Results]

NIrs1KO mice showed decreased body weight and shorter body and bone length compared to control mice. Hypothalamic GHRH mRNA expression levels in NIrs1KO mice were significantly lower than those in the control mice. Moreover, NIrs1KO mice showed increased insulin sensitivity and enhanced glucose utilization.

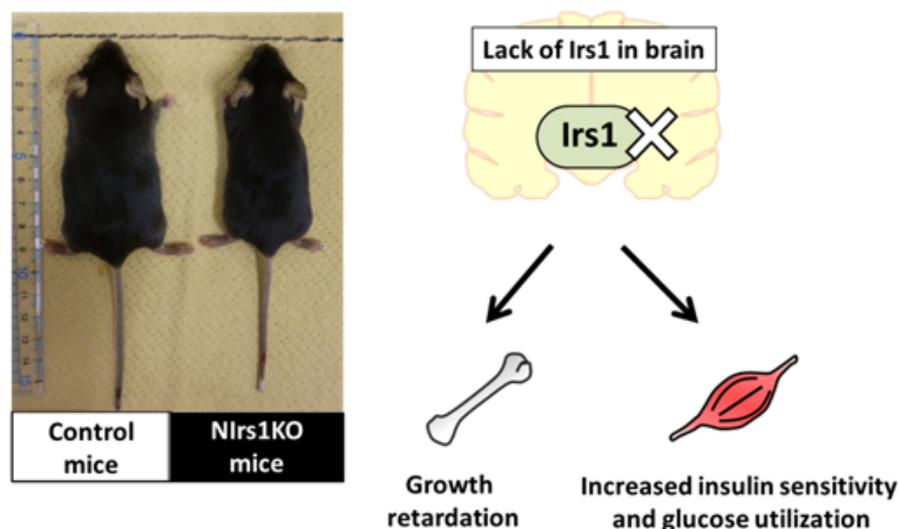
[Future Direction]

This study demonstrated that Irs1 in the brain regulates both somatic growth and glucose metabolism. Further research on these molecular mechanisms is necessary for the prevention and treatment of diabetes.

[References]

- 1) Tamemoto H et al. Insulin resistance and growth retardation in mice lacking insulin receptor substrate-1. *Nature*. 372 (6502): 182-6. 1994
- 2) Inoue H et al. Role of hepatic STAT3 in brain-insulin action on hepatic glucose production. *Cell Metab*. 3(4): 267-75. 2006

Figure. Role of Irs1 in brain



Association between the Portion Sizes of Traditional Japanese Seasonings—Soy Sauce and Miso—and Blood Pressure: the 2012 - 2016 Japan National Health and Nutrition Survey

Emiko Okada, Section of the National Health and Nutrition Survey, Department of Nutritional Epidemiology and Shokuiku

[Introduction]

Hypertension is an important global public health challenge. Risk factors for hypertension are known to be overweight, obesity, high salt intake, insufficient intake of fruits and vegetables, high alcohol consumption, and physical inactivity. Some previous studies has been shown that high salt intake was associated with higher blood pressure and higher risk of cardiovascular disease among Japanese population. In Japanese, seasoning are major sources salt intake. In particular, traditional Japanese seasonings—soy sauce and miso—have a high sodium content. It is important to consider food portion sizes (the amount of food consumed per dish) when assessing the health effects of food. Therefore, this study aimed to investigate the association between the portion sizes of soy sauce and miso and blood pressure.

[Methods]

Study participants were 25,738 Japanese aged ≥ 20 years registered in the 2012 - 2016 National Health and Nutrition Survey who had blood pressure measurements and not using blood pressure-lowering drugs. Portion sizes of soy sauce and miso were calculated the total weight of the soy sauce or miso consumed in all the meals of the day divided by the number of dishes that used soy sauce or miso. Hypertension was defined as SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg. Data analysis was used multiple logistic regression analysis for association between the portion sizes of soy sauce and miso and blood pressure.

[Results]

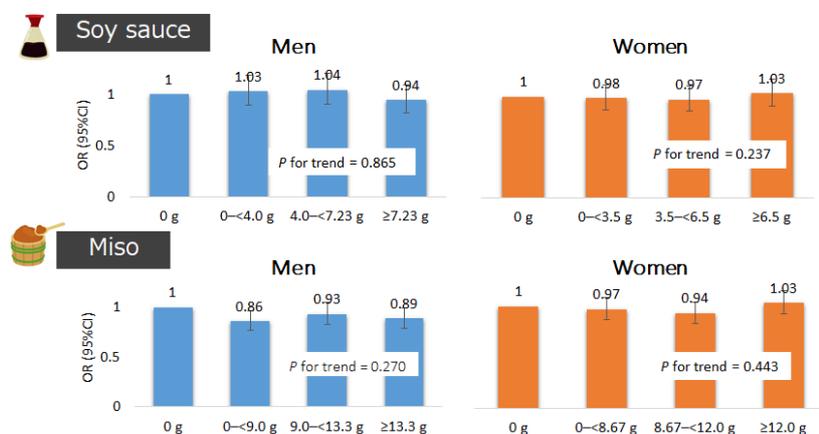
A total of 7,279 of the participants had hypertension. The median portion size values were 4.0 g for men and 3.5 g for women (soy sauce), and 9.0 g for men and 8.67 g for women (miso). Participants with a larger portion size of soy sauce or miso were older and had a higher intake of almost all foods and nutrients, but a lower intake of meat, milk, fats and oils, confectioneries, and fat. No significant association between the portion sizes of soy sauce or miso and hypertension were observed in the multivariate model after adjusted confounding factors in both sexes (figure).

[Future direction]

Our findings suggest that the portion sizes of soy sauce or miso are not associated with hypertension among Japanese adults. Participants with a larger portion size of soy sauce or miso had a diet with higher intake of vegetables, fruits, and fishes which contain higher potassium, is consider a factor. In addition to seasonings, salt is also taken from processed foods such as cup noodle, so various analyzes are required. Because low-salt soy sauce miso have become widespread in recent years, we plan to evaluate and examine these usage conditions.

[Reference]

Okada E, et al. Association between the Portion Sizes of Traditional Japanese Seasonings-Soy Sauce and Miso-and Blood Pressure: Cross-Sectional Study Using National Health and Nutrition Survey, 2012-2016 Data. *Nutrients*. 10(12). pii: E1865. 2018.



Multiple logistic regression analysis adjusted for age, BMI, smoking status, amount of alcohol intake, number of steps, and vegetable and fruit intake.

Figure. Association between portion size of soy sauce or miso and hypertension.

Welcome to the official website of our institute

Section of Research Collaboration and Partnership



The official website of the National Institute of Health and Nutrition (NIHN) is popular, with an access rate of up to 700,000 page views per month and more than 10,000 Facebook followers.

Since the website was launched in 1995, the original content, such as “National Health and Nutrition Survey Database” and “The safety and effectiveness of health foods (HFNet),” has been continuously maintained by professional researchers.

The Section of Research Collaboration and Partnership is in charge of establishing the framework of the entire website and provides comprehensive information on health and nutrition to a full range of visitors—from doctors and dietitians to elementary school students—through pages such as “Health and Nutrition Forum,” which provide information in simple language.

The main contents of the current website are listed below.

The Section of Research Collaboration and Partnership will be supporting all content to deliver accurate and up-to-date information to our visitors. We look forward to your return to our website.



Health Japan 21 (the second term)
Analysis and Assessment Project



The safety and effectiveness of health foods
(HFNet)



Health and Nutrition Forum



LINK de DIET