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Prediction of physical activity intensity in various populations

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【Introduction】

The use of wearable devices has increasingly become common, and time-series data of physical activity intensity and energy expenditure can now be obtained. Most devices estimate accelerations or heart rates; however, these estimations are not very accurate[1,2]. Moreover, prediction equations for older adults or children are different than those for adults; thus, appropriate equations for each population are necessary.

Therefore, we have validated and developed prediction algorithms for various populations using accelerometers or heart rate monitors.

【Participants and Methods】

Participants in their 20s to 50s, 60 years or older, and of preschool age were asked to perform 10–20 daily activities for several minutes. They wore accelerometers and a heart rate monitor, and energy expenditure was evaluated with a mask and Douglas bag. The resting metabolic rate while sitting was also measured, and the metabolic equivalent for each activity was calculated using these measurements.

【Results】

Higher intensity activities were underestimated for participants aged over 60 years, different to that in those aged under 50 years (Figure) [3].

We found that even low-intensity activity can be predicted without large systematic errors using %Heart rate reserve, % of the difference between maximum and resting heart rate[4], although it has been suggested that physical activity intensity cannot be accurately estimated from heart rate without a predictive equation for each individual. Resting heart rate, BMI, and age were included because physical fitness affects the relationship between heart rate and physical activity intensity, but they did not have any significant contribution. We also proposed an algorithm involving the addition of heart rate to acceleration, which can relatively accurately predict the intensity of stair climbing[5].

We also developed algorithms to accurately predict the intensity of daily activities, including sedentary behavior, for preschoolers[6].

【Future direction】

We are validating methods for physical activity intensity and total energy expenditure for patients with diabetes or chronic obstructive pulmonary disease, using the doubly labeled water method. Based on the results, we are trying to improve wearable devices for accurate predictions.

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1) Murakami H, et al.: Accuracy of wearable devices for estimating total energy expenditure: comparison with metabolic chamber and doubly labeled water method. JAMA Intern Med 176: 702-703, 2016.

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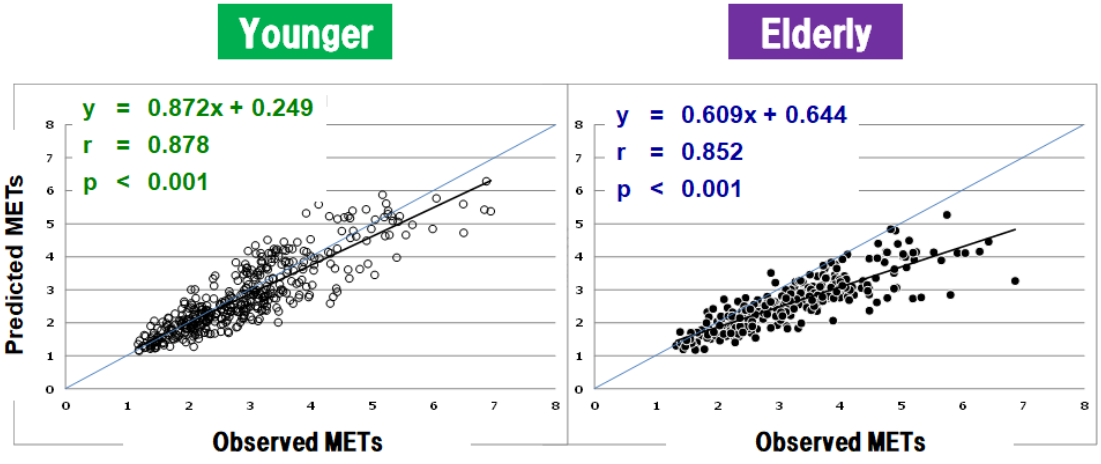
3) Nagayoshi S, et al.: Validity of estimating physical activity intensity using a triaxial accelerometer in healthy adults and older adults. BMJ Open Sport Exerc Med 5: e000592, 2019.

4) Caballero Y, et al.: Simple Prediction of Metabolic Equivalents of Daily Activities Using Heart Rate Monitor without Calibration of Individuals. Int J Environ Res Public Health. 17 pii: E216, 2019.

5) Nakanishi M, et al.: Estimating metabolic equivalents for activities in daily life using acceleration and heart rate in wearable devices. Biomed Eng Online. 17: 100, 2018.

6) Tanaka C, et al.: Prediction of Physical Activity Intensity with Accelerometry in Young Children. Int J Environ Res Public Health. 16 pii: E931, 2019.



Relationship between observed and predicted MET values using an activity monitor in younger adults and elderly [3]

Efforts to improve fatty liver disease through intestinal microbiota by oral carbon adsorbents

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【Introduction】

The prevalence of nonalcoholic fatty liver disease (NAFLD) has been increasing in concert with the rising rates of obesity and metabolic syndrome, with a consequent increase in the incidence of liver cirrhosis and liver cancer worldwide [1].

Oral carbon adsorbents have been reported to promote the excretion of metabolites produced by the intestinal microbiota by changing the gut microbiota composition. However, whether or not oral carbon adsorbents improve fatty liver disease by changing the gut microbiota composition remains unclear.

【Methods】

Oral carbon adsorbents were administered to 6-week-old male *db/db* mice for 8 weeks. Body weight, blood glucose, and food consumption were examined. Hepatic lipid droplets and epididymal fat cell size were measured. Gut microbiota compositions were investigated in the feces and the cecum.

【Results】

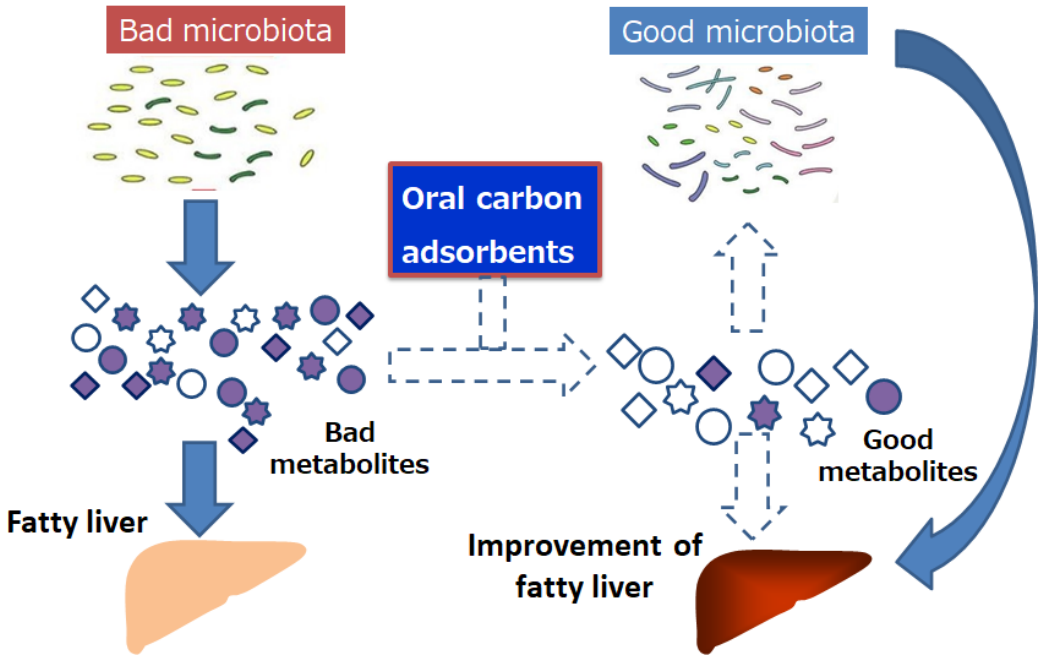
Treatment with oral carbon adsorbents inhibited liver weight and liver area occupied by lipid droplets in obese *db/db* mice. The Bacteroidetes to *Firmicutes* ratio (B/F ratio) in the feces was restored to normal after oral carbon adsorbent treatment in *db/db* mice. We also found a positive correlation between the B/F ratio and the area under the curve of the liver weight.

【Conclusion】

These data suggest that the oral carbon adsorbent treatment suppresses fatty liver formation by improving the B/F ratio. We believe that we will be able to develop new methods and drugs to prevent and improve fatty liver disease.

【Reference】

1) Kubota N et al. Differential hepatic distribution of insulin receptor substrates causes selective insulin resistance in diabetes and obesity. Nat Commun 7:12977, 2016



The mechanisms of improvement on fatty liver by Oral carbon adsorbents (Hypothesis)

Concomitant Use of Dietary Supplements and Medicines Among Preschool and School-aged Children in Japan

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【Introduction】

Dietary supplement use is widespread among the general population, including children and adolescents. Previously, our institute reported that the prevalence of dietary supplements was 8.815.0% in preschool-aged children and 16.4% in school-aged children. The ingredients in dietary supplements, especially those concentrated as capsules or tablets, can interact with medicines and cause adverse events when patients take them concomitantly. However, the prevalence of concomitant use of dietary supplements and medicines in Japan among children remains unclear.

【Methods】

A nationwide internet survey was administered to about 55,000 mothers (25–60 years old) of preschool- or school-aged children (from 1-year-old children to high school age students) in Japan. In this survey, we defined dietary supplements as foods that were in the form of capsules, tablets, and powders, which were considered to have beneficial effects on children's health.

【Results】

Among them, 7.6% currently provide dietary supplements and 3.2% concomitantly provide dietary supplements and prescription or over-the-counter medicines to their children. The prevalence of dietary supplement use and concomitant use increased with the children's grade. Among 1,000 mothers with children who were concomitantly using dietary supplements and medicines, most mothers gave their children vitamin or mineral supplements, whereas some gave herbal supplements and others for the treatment of diseases. In addition, 4.9% of mothers recognized the adverse effects of dietary supplements in their children. Among concomitant users, 69.1% provided dietary supplements without physician consultation because they considered dietary supplements to be just food and therefore safe; they encouraged their children to take dietary supplements for the supplementation of nutrients.

【Future direction】

The health of preschool- or school-aged children are easily affected by dietary supplements and medicines, and the interactions between dietary supplements and medicines remain unclear in children. However, most mothers do not consult with physicians before administering supplements; thus, parental education about the safety of dietary supplements and potential risk of drug-supplement interaction is needed.

【References】

1) Etsuko Kobayashi et al. The prevalence of dietary supplement use among elementary, junior high, and high school students: A nationwide survey in Japan. Nutrients, 10(9): 1176, 2018

2) Etsuko Kobayashi et al. Concomitant Use of Dietary Supplements and Medicines among Preschool and School-Aged Children in Japan. Nutrients, 11(12), 2960, 2019

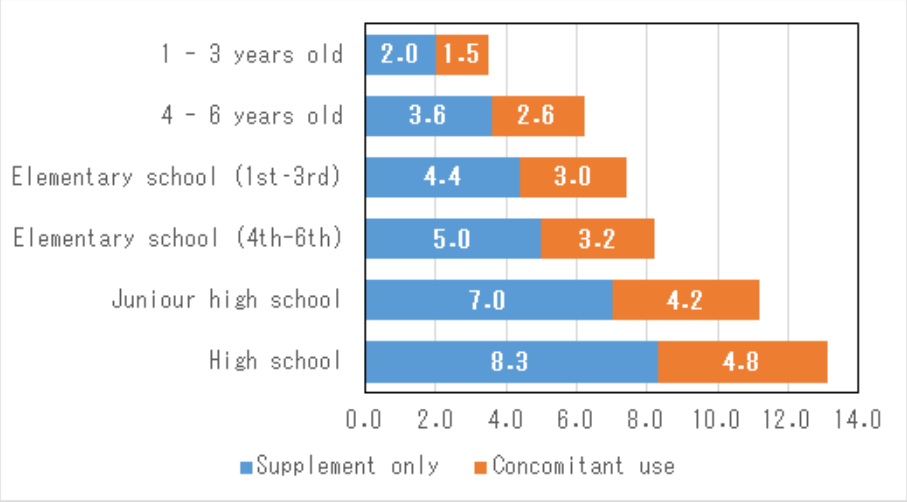

Figure. The ratio of concomitant use of dietary supplements and medicines among preschool and school-aged children (%)

Evaluation of policies on a healthy food environment using an international index

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Section of International Nutrition Strategy

【Introduction】

Our dietary habits are affected by various factors based on individual characteristics. Although no clear global definition is given, the food environment is known as the community food environment, nutritional food environment, or local food environment[1]. The food environment interacts with food industries, governments, and societies to create a physical environment, such as availability of food stores, and economic environments such as food prices, policy and socio-cultural environments. Personal characteristics interact with the food environment and shape individual diets[2]. Improvement in the food environment has been raised as one of the important policies for the second term of the National Health Promotion Movement in the 21st century (Health Japan 21 [the second term]). Currently, a healthy food environment is a global challenge as well as a national one. Swinburn et al.[2] developed the Healthy Food Environment Policy Index (Food-EPI) to assess the food environment comprehensively, and this tool has been used by approximately 15 countries[3]. According to a comparison between the 11 countries which conducted the Food-EPI survey from 2015 to 2018, the results of Australia, England, Chile, and Singapore revealed that their implementation levels of policy actions were "medium"[4]. Although the 11 countries above included five countries in Asia and the Pacific, there were no reports from East Asia, including Japan. Therefore, our study started to comprehensively evaluate the policies of the food environment in Japan, utilizing an internationally validated index.

【Participants and Methods】

The policy implementation level was rated by experts from the fields of public health nutrition and public health, national and local governments, non-governmental organizations, and private companies. The index comprises 13 domains (seven for policy and six for infrastructure support), including 47 common good practice indicators (Figure 1). According to the process of the survey shown in Figure 2, we have finished the online survey for rating of the policy implementation level.

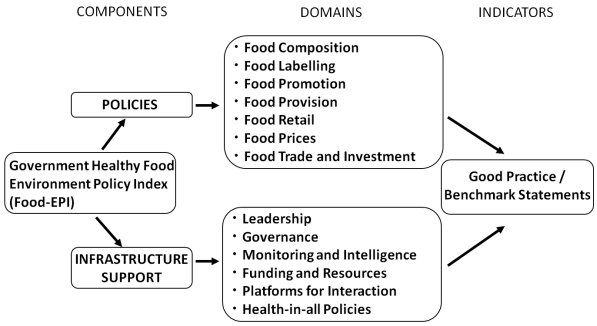

Figure 1. Components and domains of the Government Healthy Food Environment Policy Index (Food-EPI). Swinburn et al. 2013

【Future direction】

After receiving the ratings of the policy implementation level by the online survey, we will recruit experts for the workshop to discuss the prioritization of policies that should be implemented in the future (Figure 2). We will summarize the findings by quantitative analysis of the ratings of the policy implementation level and conduct qualitative analyses to summarize the prioritized policies in the workshop. We expect that this study will contribute to providing evidence for improving policies related to the food environment in Japan, one of the developed countries in East Asia.

【References】

1)National Center for Environmental Health, Centers for Disease Control and Prevention, General Food Environment Resources 2014. https://www.cdc.gov/healthyplaces/healthtopics/healthyfood/general.htm (Accessed January 8, 2020)

2) Swinburn B et al., Monitoring and benchmarking government policies and actions to improve the healthiness of food environments: a proposed Government Healthy Food Environment Policy Index. Obes Rev. Obes Rev.14 (1), 24-37, 2013

3)INFORMAS, International Network for Food and Obesity / Non-communicable Diseases. Public Sector Policies and Actions (Food-EPI) 2019. https://www.informas.org/modules/public-sector/ (Accessed January 8, 2020)

4) Vandevijvere S et al., An 11-country study to benchmark the implementation of recommended nutrition policies by national governments using the Healthy Food Environment Policy Index. 2015-2018. Obes Rev. 20(2), 57-66, 2019

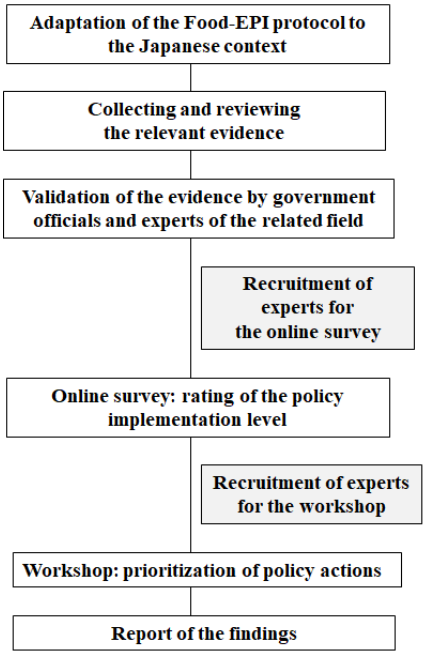

Figure 2. Process of the survey
Food-EPI: Healthy Food Environment Policy Index

Comparison between energy intake as estimated by self-reporting dietary assessment methods and total energy expenditure as measured by the doubly labeled water method: The Kyoto-Kameoka study

Tsukasa Yoshida, Section of Healthy Longevity Researches

【Introduction】

In population-based epidemiologic studies, dietary energy intake (EI) is commonly assessed using self-administered dietary assessment methods, such as dietary records (DRs) and food frequency questionnaires (FFQs). However, when evaluating EI using self-reporting dietary assessment methods such as DRs and FFQs, one cannot entirely avoid systematic or random errors. Park et al. reported total energy expenditure (TEE) as measured using the doubly labeled water (DLW) method; the EI estimated using DR and FFQs were underestimated by approximately 20% and 30%, respectively (Figure 1; orange bars)[1]. In this study, we aimed to examine the validity of the EI estimated by the DR and the 47-item FFQ against the TEE measured by the DLW method[2].

【Methods】

Participants were 109 Japanese older adults (50 women and 59 men) aged 65–88 years. The EI was evaluated using a DR and a 47-item FFQ over 1 year. This FFQ has been validated against 7-day DR for older adults aged ≥65 years[3]. We collected DR over 7 consecutive days, including both weekdays and weekends, during the DLW measurement period. TEE was measured by the DLW method for approximately 2 weeks.

【Results】

Among all participants, the mean TEE was 2,175 kcal/day, and EI estimated by DR and FFQ were 1,972 kcal/day and 1,774 kcal/day, respectively. Ratios of EI assessed by DR and FFQ against TEE were 0.91 and 0.82, respectively (Figure 1; light blue bars). TEE was significantly and moderately correlated with the EI estimated by the DR ($r = 0.45$, $p < 0.01$) and FFQ ($r = 0.37$, $p < 0.01$).

【Future Direction】

Recently, a prospective nutritional epidemiological study reported that EI is associated with the incidence of diabetes only when the EI is calibrated (Figure 2)[4]. We also developed a calibration equation to address self-reporting bias for EI estimated by FFQs[2]. In the future, the calibration technique using the DLW method for EI estimated by FFQs may be helpful in assessing the relationship between EI and the risk of mortality and long-term care in nutritional epidemiological studies.

【References】

1)Park et al. Comparison of self-reported dietary intakes from the Automated Self-Administered 24-h recall, 4-d food records, and food-frequency questionnaires against recovery biomarkers. Am J Clin Nutr. 2018; 107: 80-93.
2)Watanabe et al. Estimation of Energy Intake by a Food Frequency Questionnaire: Calibration and Validation with the Doubly Labeled Water Method in Japanese Older People. Nutrients. 2019;11: E1546.
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4)Tinker et al. Biomarker-calibrated dietary energy and protein intake associations with diabetes risk among postmenopausal women from the Women's Health Initiative. Am J Clin Nutr. 2011;94:1600-6.

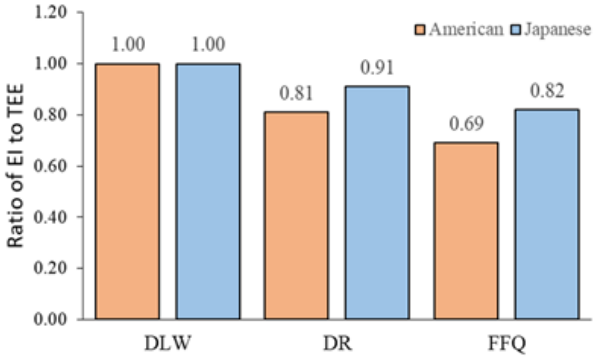

Figure 1. Ratios of EI assessed by DR and FFQ against TEE

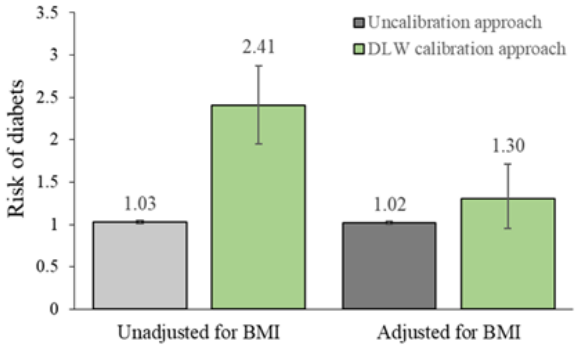

Figure 2. Association between incident of diabetes and EI with and without using biomarker-calibration approach.

Summary Results of the National Health and Nutrition Survey Japan, 2018

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【Introduction】

The National Health and Nutrition Survey Japan aimed to clarify the physical conditions, nutrient intake, and lifestyle of citizens based on the Health Promotion Act (Law No. 103, enacted in 2002) and to obtain basic data for the comprehensive promotion of their health. The 2018 survey was conducted with a focus on understanding socioeconomic status, such as income and lifestyle habits, in addition to the basic survey items evaluated every year.

【Participants and methods】

In the Comprehensive Survey of Living Conditions in 2018 (approximately 1,106 areas with 60,000 households and 146,000 family members), the participants were family members (aged 1 year and over as of November 1, 2018) who were residing in households of selected 300 areas, which were stratified and randomly extracted from the general census areas. This survey consisted of a physical examination, a dietary survey, and a lifestyle habits questionnaire survey. The survey items and target age were as follows:

①Physical examination: height/body weight (aged 1 year and over) and abdominal circumference/blood pressure/blood tests/medical interview (aged 20 years and over)

②Dietary survey: household status/meal classification/food intake (aged 1 year and over) and daily physical activity (the number of steps in a day, aged 20 years and over)

③Lifestyle questionnaire: eating habits, physical activity, exercise, resting (sleep), alcohol intake, smoking status, dental health, and socioeconomic status, such as household income (aged 20 years and over)

【Results】

A total of 3,268 households of 5,032 target households responded to the questions. The proportion of those who were eating balanced diets with staple dishes, main dishes, and side dishes twice per day or more "almost every day" tended to be lower in the younger generation (Figure 1). The proportion of those who were eating balanced diets with staple dishes, main dishes, and side dishes twice per day or more "almost every day" was also significantly lower in both men and women with a household income of less than 2,000,000 yen than in those with a household income of 6,000,000 yen or more (Figure 2).

【Future directions】

The survey results found that age and income may be factors related to the frequency of eating a combination of staple dishes, main dishes, and side dishes. "Increase the proportion of people eating a combination of staple dishes, main dish and side dish" is set as a target item in "Health Japan 21 (secondary)" implemented to promote the health of the people, but the situation toward achieving the goals is deteriorating. Further studies will be conducted to achieve this goal.

【Reference】

Ministry of Health, Labour and Welfare. The National Health and Nutrition Survey in Japan, 2018. https://www.mhlw.go.jp/content/10900000/000688863.pdf

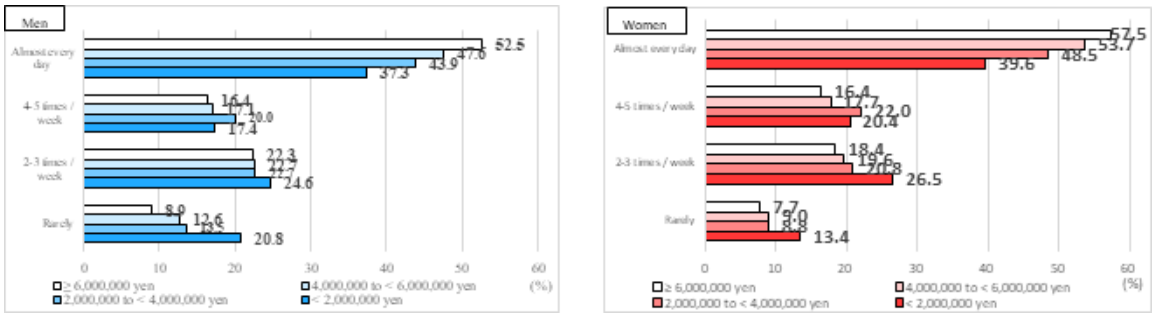

Figure 1 Frequency of eating balanced diets with staple dishes, main dishes, and side dishes (aged 20 years and over)

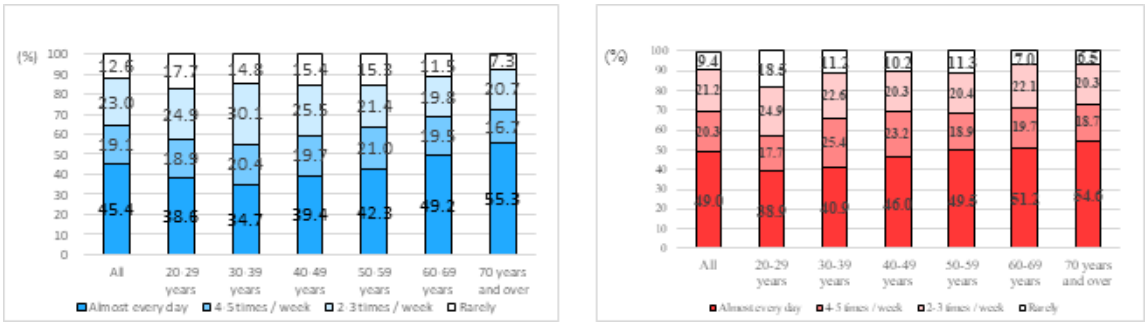

Figure 2 Income and frequency of consuming balanced diets composed of sstaple dishes, main dishes, and side dishes (aged 20 years and over)

Metabolic equivalents of body weight resistance exercise with slow movement in older adults using indirect calorimetry

Takashi Nakagata, Section of Behavioral Physiology
Department of Physical Activity Research

The load of body weight resistance training (BWRE), such as squat or heel-raise cannot be expressed as work kg lifted, and the relative intensity is expresses as %1RM or number of RM to failure (e.g. 10RM). We examined the exercise intensity (Metabolic equivalents, METs) of BWRE with slow movement based on oxygen consumption (VO_2) in older adults using indirect calorimetry. Thirteen men and seven women (mean age, 70.8 ± 4.8 years) participating in this study performed 4 exercises (squat, knee push-up, crunch, and heel-raise). Both the concentric and eccentric phase were set to 3 sec for slow movement methods. A total of 3 sets (10 repetitions) with 30 sec rest between sets were performed for each exercise. The METs intensity of BWRE-slow determined by aerobic component of VO_2, which is ranged from 2.0 to 3.8 METs, and there were no significant differences between sex (except for knee push-up). Squat was categorized 3.6 to 3.8 METs, whereas knee push-up, crunch, and heel-raise were categorized 2.1 to 3.2 METs based on aerobic energy expenditure. In conclusion, the METs intensity for BWRE-slow ranged from 2.0 to 3.8 METs in older adults.

【References】

1) Nakagata et al. 2019. Metabolic equivalents of body weight resistance exercise with slow movement in older adults using indirect calorimetry. Appl. Physiol. Nutr. Metab. 44 (11) : 1254-1257.
2) Nakagata et al. 2018. Metabolic equivalents of body weight resistance training with slow m ovement: Implications for exercise prescription and health promotion. J. Exerc. Physiol. Online 21 (5) : 29-38

Table. METs intensity during body weight resistance exercise.

Exercise	Older men	Older women	Young men [2)]
Squat	3.8 ± 0.6	3.6 ± 0.3	3.7 ± 0.5
Push-up#	3.2 ± 0.5	2.6 ± 0.5	3.5 ± 0.4
Crunch	2.0 ± 0.3	2.1 ± 0.4	2.3 ± 0.4
Calf-raise	2.1 ± 0.3	2.1 ± 0.3	1.8 ± 0.2

The underline means that significantly different versus young men.[2)] From Nakagata et al.(JEPonline, 2018)

With regards to the push-up exercise, unlike the young men, all older adults performed knee push-ups. Thus, we did not perform statistical