Estimation of Food Portion Sizes Frequently Consumed by Children 3–6 Years Old in Japan

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Summary No study has documented Japanese children’s food portion sizes. Since this information is essential to establish valid measurement tools and effective education methods for dietary intake, we measured them using one-day, semi-weighed diet records (DRs) for 489 Japanese children aged 3–6 y. Each food’s frequency of appearance on the DRs was counted. If a child consumed a certain food more than once per day, an average weight for that food was calculated and used in the portion size calculation as that child’s representative value. In total, 67 food items were consumed by twenty or more children. We calculated the mean, standard deviation, median, minimum, and maximum portion size values for these food items. In addition to these 67 items, Chinese noodles and water were included in the analysis. The most frequently consumed food was well-milled rice (mean portion size for rice = 79 g), which was consumed by 350 children, followed by soy sauce (4 g), eggs (26 g), and carrots (9 g). Among the five most frequently consumed foods, portion sizes of rice and pork but not milk, eggs, or carrots significantly increased with age, height, and weight. In multivariate linear regression analysis, however, the significant relationships between rice portion size and age were not observed. Regarding pork, only the relationship with height was significant. A sex difference was detected in the rice and milk portion sizes. Most of portion sizes observed here were apparently smaller than those reported among United Kingdom children. This study provides important basic information for the implementation of quantitative nutritional research and educational efforts for Japanese preschool children.

Key Words food portion size, Japan, child, 3–6 y old, nutritional research

Food portion size information is essential for appropriate nutrition education and counseling, as well as nutritional food labeling. Although it is also crucial to estimate food and nutrient intake by using food frequency questionnaire, diet recall, or diet record methods, only one study so far has provided comprehensive data on food portion sizes in a Japanese population (1). Data on food portion sizes among Japanese children are lacking; this hampers the establishment of a valid measurement tool and an effective education method about nutrient intake for children. Although two food frequency questionnaires (FFQs) for Japanese young children have been validated and reported recently (2, 3), neither used portion sizes estimated from actual measured food weights to calculate food and nutrient intake.

The dietary habits formed in childhood affect those in adulthood (4–6). Childhood obesity, a consequence of excess energy intake, persists in adulthood (7, 8). Thus, it is necessary to describe children’s dietary intake precisely and improve its quality to promote health in an entire population. Here, we estimated typical food portion sizes from dietary records (DRs) from 489 children aged 3–6 y in Japan. In addition, we tried to detect the influence of age, sex, and body size (both height and weight) on portion sizes.

MATERIALS AND METHODS

Subjects. Apparently healthy children aged 3–6 y were recruited from eight nursery schools and one kindergarten that offered school lunch for the children in Tokyo, Saitama, and Yamanashi prefectures in 1998. All research areas were located in the inland, mid-latitude areas of Japan. Although the aim of the original study was to clarify how to combine dishes (9) (staple foods, main dishes, and side dishes, such as Nimono (boiled and flavored vegetables) or salad) into one meal for children, measure the portion size of each dish, and...
measure energy and nutrient intake per day, the present study was conducted independently to estimate the portion size of each food. The dietary intake data of 559 children were included in the original data set. From these subjects, 49 children were excluded from the analyses because of extremely high or low body mass index (BMI) (<13 kg/m² or >18 kg/m²) (10). Thirteen children were excluded due to insufficient DRs, and eight children were excluded due to missing weight and height data. In the present study, we analyzed the data from 489 subjects.

Before the start of the study, the researchers explained the study’s aim and procedure to school representatives and the children’s guardians. The survey was permitted as a part of the schools’ activities, and oral consent to participate in the study was individually obtained from all of the guardians. We did not obtain ethical approval because the study was conducted before ethical guidelines for epidemiologic research were enforced in Japan. However, the use of the data from this study was approved by the Ethics Committee of the Faculty of Medicine at The University of Tokyo (approval number: 10172, approved on July 8, 2013) and the study was implemented in accordance with the code of the ethics of the World Medical Association (Declaration of Helsinki). Before the analysis, new identification numbers, different from the original ones, were assigned to the subjects in the data set and the list to connect the two identification numbers were discarded. This guaranteed anonymity of the analyses.

**DRs and other data collection.** Between November and December 1998, the subjects’ guardians completed 1-d, semi-weighed DRs about the foods and drinks consumed outside of school. A comprehensive manual for this DR was prepared to share the aim of the study, all procedure of the DR, how to use the questionnaire, how to collect and check data sheets for DRs and questionnaires, and how to reply to questions from the guardians among the research staff. The research staff were faculties of a dietetics course in universities, registered dietitians, and graduate and undergraduate students in the dietetic courses. All of them were trained according to the manual (e.g. how to estimate the weight of consumed foods and beverages, how to communicate with guardians, or how to reply to their questions) for 3 h, then additional training sessions were held in each research area for more than 3 h.

Most meals were prepared and consumed at home, but a small number of the subjects went to restaurants. All foods and beverages were sketched by the guardians and each dish was weighed separately with a scale by the guardians. After the meal, the weights of remaining foods were measured and the difference between the weights before and after the meal was recorded by the guardians as the actual food weight consumed. The cooking methods, ingredients, and weights for each dish were recorded on the DR sheets by the guardians. Whenever possible, they recorded the weight of each of the ingredients (foods, seasonings) separately. Research staff checked the records, and if there were any unclear points, they asked the guardians about these points immediately after the survey. When the guardians recorded only the total weight of the dishes, a staff member interviewed them, and determined the weight of each food, the seasoning included in the dishes, and the cooking methods. Because all of the schools offered lunch for the children, the amount of food consumed at school was recorded by the research staff. To determine the consumed amount, each child received the same amount of lunch on a numbered plate or bowl and the weight of the leftover was subtracted from the served weight of the food. The research staff observed the children during lunch time, and performed all measurements of foods and beverages including leftovers.

Body height and weight of the children had been measured monthly by teachers in the nursery schools or the kindergarten as a part of the routine physical check-up. The values measured on the day closest to the study period were used in the analysis. BMI was calculated by dividing body weight (kg) by the square of height (m).

**Data analysis.** The portion sizes were calculated for the boys and girls together, because the basal metabolic rate difference between the boys and the girls was not obvious (40 kcal/d for the children 3–5 y old and 60 kcal/d for the children 6–7 y old) (11). The dietary intake data for the lunch and snacks offered by the nursery schools and the kindergarten were excluded from the analysis as it was thought that their amounts were too uniform to determine the actual portion sizes suitable for each subject. Thus, the portion sizes of the foods consumed outside of school (i.e., breakfast, snacks, and dinner) were used in this study. All foods were categorized by the item numbers given by the 2010 Standard Tables of Food Composition in Japan (12). The number of “item numbers,” namely, the number of foods and beverages appearing in DRs and included in the analysis was 395. Then, these items were categorized into 93 groups. The foods which appeared frequently in the DRs of many children (e.g. rice, milk, egg) were able to be classified into independent categories for each item number, but those which were consumed not so often (e.g. each portion of beef, each kind of fish) were categorized into gross groups including similar foods with different item numbers. The grouping of food items in the analysis was determined according to the categorization system of the food composition table (12) and similarity of food composition in each food. For example, all types of beef were classified into one “beef” category. The oily fish category included horse mackerel, common Japanese conger, Japanese pilchard, eel, sablefish, carp, mackerel, pacific saury, pacific herring, yellowtail, tuna (fatty meat), and gnomelfish, and non-oily fish included striped marlin, skipjack, right-eye flounder, Japanese whiting, chum salmon, Japanese sea perch, sea bream, bastard halibut, and tuna (lean meat). We counted the frequency of the appearance of each food on the DRs. When the subjects consumed a certain food twice or more per day, an average weight of the consumed food was calculated for that subject. This average was used to calculate a portion size for the subjects. This was done
to avoid the possibility of skewing the results due to subjects eating an atypical amount of food with an atypical frequency.

If a food was consumed by ≥20 subjects (approximately 5% of all analyzed subjects), the mean, standard deviation, median, minimum, and maximum portion size were determined for that food (67 items). Although only 17 subjects consumed Chinese noodles, this item was included in the analyses because it is often consumed as a staple food in a meal. Water as a drink, consumed by 19 subjects, was also included. Seasonings such as salt, pepper, sugar, and granule seasoning mix and oils for cooking were not included in the analysis, because the amount used in a dish was too small to weigh or estimate precisely. In total, portion sizes for 69 foods and beverages were calculated. All calculations were performed using Microsoft Excel 2010 (Microsoft, Redmond, Washington). The calculated values were rounded at the first decimal place. If the calculation included the weights smaller than 0.1 g, they were rounded at the second decimal place in the calculation process.

After summarizing all of the portion sizes, the influence of age, sex, weight, and height on the portion sizes was examined. Five foods (rice, milk as a drink, pork, eggs, and carrots), which were consumed by a sufficient number of subjects, were selected for this analysis. The between-groups differences in the portion sizes were statistically analyzed by t-tests or an analysis of variance (ANOVA). Then, multivariate linear regression analysis was performed to examine which factor (age, sex, or constitution) had the largest effect on the portion sizes. Model 1 included age, sex, and height as independent variables, and model 2 included age, sex, and weight. These statistical analyses were performed using SAS version 9.3 (SAS Institute Inc., Cary, NC). All of the reported p values were two-tailed and were considered statistically significant at the 0.05 level.

## RESULTS

Table 1 shows the characteristics of the subjects. The height, weight, and BMI of the boys and girls were compared by using t-tests; no significant gender differences were detected.

The mean, standard deviation, median, minimum, and maximum portion sizes of the foods frequently consumed by the subjects are shown in Table 2. Well-milled rice, a staple food of most Japanese individuals, was consumed one or more times by 350 of the 489 children for breakfast and/or dinner on the survey day. Its mean portion size was 79 g (79 g without furikake (a seasoning powder sprinkled on the rice), and 83 g with furikake). The second and third most frequently consumed food was soy source and eggs, respectively.

The influence of age, sex, height, and weight on the mean portion sizes of well-milled rice, milk as a drink, pork, eggs, and carrots are shown in Table 3. All four factors affected the portion size of rice. A larger portion size was associated with older age, male sex, increased height, and increased weight. However, the effect of each factor was substantially different for the other foods. For example, age was not associated with milk portion size, but the milk portion size was larger for the boys than the girls. On the other hand, pork portion size did not significantly differ between the boys and the girls, but did significantly differ with respect to age. Age, sex, height, and weight had no significant effect on the portion sizes of carrots or eggs. However, the calculated

| Variables         | Class               | Boys (n=273) | Girls (n=216) | Total       |
|-------------------|---------------------|-------------|---------------|-------------|
| Age (y)           | mean±SD             | 4.6±0.9     | 4.6±1.0       | 4.6±1.0     |
|                   | 3                   | 33 (12.1)   | 31 (14.4)     | 64 (13.1)   |
|                   | 4                   | 94 (34.4)   | 64 (29.6)     | 158 (32.3)  |
|                   | 5                   | 94 (34.4)   | 71 (32.9)     | 165 (33.7)  |
|                   | 6                   | 52 (19.1)   | 50 (23.2)     | 102 (20.9)  |
| Height (cm)       | mean±SD             | 106.6±7.1   | 106.1±6.9     | 106.4±7.0   |
|                   | <100                | 50 (18.3)   | 45 (20.8)     | 95 (19.4)   |
|                   | 100–<107.5          | 108 (39.6)  | 77 (35.7)     | 185 (37.8)  |
|                   | 107.5–<115          | 77 (28.2)   | 72 (33.3)     | 149 (30.5)  |
|                   | 115≤                | 38 (13.9)   | 22 (10.2)     | 60 (12.3)   |
| Weight (kg)       | mean±SD             | 17.7±2.8    | 17.5±2.7      | 17.6±2.8    |
|                   | <15                 | 36 (13.2)   | 33 (15.3)     | 69 (14.1)   |
|                   | 15–<17.5            | 100 (36.6)  | 74 (34.3)     | 174 (35.6)  |
|                   | 17.5–<20            | 77 (28.2)   | 66 (30.6)     | 143 (29.2)  |
|                   | 20≥                 | 60 (22.0)   | 43 (19.9)     | 103 (21.1)  |
| Body mass index   | mean±SD             | 15.5±1.1    | 15.5±1.1      | 15.5±1.1    |

1 The number of analyzed subjects was 489.

Age, height, weight, and body mass index did not significantly differ between boys and girls according to t-tests.
Table 2. Mean and median portion sizes (g) and minimum and maximum weight (g) of foods consumed by 489 children aged 3–6 y in Japan.

| Food group                        | n (%) | Mean | SD  | Median | Minimum | Maximum |
|-----------------------------------|-------|------|-----|--------|---------|---------|
| **Rice**                          |       |      |     |        |         |         |
| Well-milled rice, cooked, total   | 350 (71.6) | 79   | 34  | 80     | 6       | 220     |
| Well-milled rice, cooked, without furikake| 294 (60.1) | 79   | 34  | 80     | 10      | 220     |
| Well-milled rice, cooked, with furikake | 56 (11.5) | 83   | 36  | 79     | 6       | 189     |
| **Breads**                        |       |      |     |        |         |         |
| White table breads, sliced        | 95 (19.4) | 42   | 25  | 38     | 5       | 160     |
| Soft rolls                        | 37 (7.6) | 30   | 16  | 30     | 4       | 82      |
| Other breads                      | 54 (11.0) | 51   | 32  | 40     | 15      | 160     |
| **Noodles**                       |       |      |     |        |         |         |
| Udon noodles, boiled              | 39 (8.0) | 103  | 69  | 100    | 10      | 307     |
| Chinese noodles, boiled           | 17 (3.5) | 68   | 41  | 50     | 20      | 150     |
| Macaroni and spaghetti, boiled    | 56 (11.5) | 33   | 35  | 23     | 2       | 182     |
| **Milk and dairy products**       |       |      |     |        |         |         |
| Milk as a drink, full fat and high fat | 190 (38.9) | 128  | 55  | 120    | 10      | 364     |
| Milk as a drink, low fat          | 33 (6.7) | 111  | 47  | 114    | 10      | 225     |
| Lactic acid bacteria beverage     | 43 (8.8) | 75   | 37  | 65     | 10      | 182     |
| Yogurt                            | 61 (12.5) | 85   | 25  | 90     | 12      | 200     |
| Cheese                            | 58 (11.9) | 11   | 9   | 10     | 0.4     | 40      |
| Ice cream                         | 27 (5.5) | 64   | 43  | 50     | 10      | 210     |
| **Meat and meat products**        |       |      |     |        |         |         |
| Chicken, cooked                   | 99 (20.2) | 32   | 26  | 22     | 1       | 105     |
| Pork, cooked                      | 171 (35.0) | 24   | 18  | 19     | 2       | 110     |
| Beef, cooked                      | 60 (12.3) | 38   | 27  | 30     | 2       | 110     |
| Ham, raw and cooked               | 85 (17.4) | 12   | 9   | 10     | 0.5     | 40      |
| Sausages, raw and cooked          | 131 (26.8) | 27   | 19  | 20     | 3       | 112     |
| **Fish**                          |       |      |     |        |         |         |
| Fish consumed whole (bones and all), raw and cooked | 44 (9.0) | 7    | 8   | 4      | 0.08    | 34      |
| Salt-cured fish, cooked           | 76 (15.5) | 32   | 26  | 21     | 4       | 102     |
| Fish paste products, raw and cooked | 78 (16.0) | 17   | 14  | 14     | 0.2     | 60      |
| oily fish, raw and cooked         | 44 (9.0) | 29   | 23  | 23     | 3       | 100     |
| Non-oily fish, raw and cooked     | 58 (11.9) | 35   | 28  | 30     | 1       | 158     |
| Shellfish, raw and cooked         | 49 (10.0) | 15   | 9   | 12     | 1       | 44      |
| Prawns and shrimps, raw and cooked | 38 (7.8) | 13   | 11  | 10     | 0.8     | 60      |
| **Eggs**                          |       |      |     |        |         |         |
| Hen’s eggs                        | 316 (64.6) | 26   | 17  | 25     | 0.5     | 92      |
| **Soy beans and soy bean products** |       |      |     |        |         |         |
| Tofu                              | 173 (35.4) | 22   | 23  | 15     | 0.4     | 160     |
| Fried tofu ^1                      | 123 (25.2) | 6    | 9   | 4      | 0.5     | 70      |
| Natto (fermented soy beans)       | 77 (15.7) | 29   | 18  | 25     | 2       | 100     |
| **Potatoes**                      |       |      |     |        |         |         |
| Potatoes                          | 175 (35.8) | 27   | 25  | 20     | 2       | 189     |
| Sweet potatoes                    | 34 (7.0) | 36   | 39  | 19     | 3       | 192     |
| Other potatoes ^5                 | 44 (9.0) | 25   | 18  | 20     | 2       | 64      |
| **Vegetables**                    |       |      |     |        |         |         |
| Lettuces, raw                     | 73 (14.9) | 13   | 15  | 10     | 0.2     | 100     |
| Cucumbers, raw                    | 141 (28.8) | 12   | 14  | 8      | 0.2     | 100     |
| Tomatoes, raw and cooked          | 76 (15.5) | 23   | 17  | 20     | 0.2     | 94      |
| Spinach, cooked                   | 87 (17.8) | 18   | 18  | 13     | 1       | 114     |
| Broccoli, cooked                  | 57 (11.7) | 20   | 13  | 18     | 2       | 56      |
| Green sweet peppers, raw and cooked | 41 (8.4) | 7    | 6   | 5      | 1       | 30      |
| Carrots, raw and cooked           | 257 (52.6) | 9    | 9   | 7      | 0.2     | 65      |
| Pumpkin, cooked                   | 45 (9.2) | 31   | 30  | 21     | 1       | 145     |
| Cabbage, raw and cooked           | 118 (24.1) | 16   | 14  | 10     | 0.2     | 80      |
| Chinese cabbage, raw and cooked   | 77 (15.7) | 14   | 11  | 10     | 0.5     | 50      |
| Daikon (Japanese radish), raw and cooked | 169 (34.6) | 18   | 17  | 15     | 1       | 121     |
| Onions, salad and cooked          | 214 (43.8) | 12   | 10  | 10     | 1       | 80      |
| Welsh onions, cooked              | 141 (28.8) | 8    | 5   | 4      | 0.2     | 30      |
| Chinese chives, cooked            | 27 (5.5) | 6    | 4   | 5      | 2       | 15      |
| Pickles (all kind)                | 71 (14.5) | 19   | 18  | 15     | 1       | 100     |
mean carrot and egg portion sizes were larger for the taller children. The magnitude of effect of age, sex, and constitution (height and weight) on the portion sizes are shown in Table 4. Sex had a significant effect on the portion sizes of rice and milk. The effect of weight on the portion size of rice was significant, but that of height was marginal. However, taller height was significantly associated with larger portion size of pork. The effect of age on the portion sizes was not significant for any of 5 analyzed items.

**DISCUSSION**

This is the first study to calculate the portion sizes of foods frequently consumed by Japanese children 3–6 y old and to determine the influence of growth variables and sex on the portion sizes of this age group. The sample size of the present study was large (i.e., 489 children). After the DRs were completed by the guardians, the research staff conducted careful and thorough interviews of the guardians about the DRs up to five times. This step ensured precise recording of the weights of the consumed foods, and allowed us to examine the influence of several factors on the portion sizes.

The influence of growth variables (i.e., chronological age, height, and weight) and sex on the portion sizes was very different depending on the type of food. Our results, based on a limited number of different types of foods, suggested that the portion sizes of staple food (rice) and those of foods used in main dishes (e.g., pork) tended to be affected by the growth variables and sex.

The linear regression analysis including these variables simultaneously showed that chronological age might have less effect on the portion sizes of some foods compared with body constitution and sex. Of course, since there is strong relationship between chronological age and constitution, multicollinearity should be considered. In other words, it was hard to detect the significant relationship between the portion sizes and age as well as constitution (height and weight), and the results should be interpreted with caution. However, these find-
Table 3. The effect of age, sex, height, and weight on portion sizes in Japanese preschool children aged 3–6 y.

| Food                  | Variables                     | n   | Portion sizes                                      |
|-----------------------|-------------------------------|-----|---------------------------------------------------|
|                       |                               |     | Mean | SD  | Median | Minimum | Maximum | p value | 1        |
| Well-milled rice, cooked | Age (y)                       | 3   | 45   | 66  | 30     | 70      | 10      | 112     | 0.0018   |
|                       |                               | 4   | 120  | 77  | 30     | 79      | 6       | 174     |
|                       |                               | 5   | 114  | 81  | 35     | 80      | 10      | 200     |
|                       |                               | 6   | 71   | 90  | 40     | 86      | 14      | 220     |
|                       | Sex                           |     |      |      |        |         |         |         |
|                       | Boys                          | 203 | 85   | 34  | 83     | 6       | 220     | 0.0009  |
|                       | Girls                         | 147 | 72   | 33  | 72     | 10      | 200     |         |
|                       | Height (cm)                   |     |      |      |        |         |         |         |
|                       | <100                           | 65  | 69   | 30  | 70     | 10      | 125     | 0.0018  |
|                       | 100–<107.5                    | 139 | 78   | 34  | 80     | 6       | 200     |
|                       | 107.5–<115                    | 107 | 83   | 33  | 82     | 14      | 200     |
|                       | 115≤                           | 39  | 94   | 40  | 90     | 20      | 220     |
|                       | Weight (kg)                   |     |      |      |        |         |         |         |
|                       | <15                            | 45  | 67   | 32  | 69     | 6       | 125     | 0.0051  |
|                       | 15–<17.5                      | 130 | 77   | 35  | 80     | 10      | 200     |
|                       | 17.5–<20                      | 102 | 81   | 34  | 80     | 20      | 200     |
| Milk as a drink, full fat and high fat | Age (y) | 3 | 27   | 126  | 67  | 105     | 10      | 340     | 0.9    |
|                       |                               | 4   | 72   | 126  | 52  | 120     | 30      | 364     |
|                       |                               | 5   | 60   | 133  | 57  | 118     | 45      | 300     |
|                       |                               | 6   | 31   | 128  | 50  | 120     | 30      | 210     |
|                       | Sex                           |     |      |      |        |         |         |         |
|                       | Boys                          | 118 | 136  | 59  | 126    | 30      | 364     | 0.016   |
|                       | Girls                         | 72  | 116  | 46  | 103    | 10      | 222     |         |
|                       | Height (cm)                   |     |      |      |        |         |         |         |
|                       | <100                           | 41  | 118  | 48  | 115    | 10      | 225     | 0.26    |
|                       | 100–<107.5                    | 75  | 127  | 58  | 116    | 30      | 364     |
|                       | 107.5–<115                    | 50  | 132  | 49  | 123    | 48      | 300     |
|                       | 115≤                           | 24  | 145  | 67  | 155    | 30      | 300     |
|                       | Weight (kg)                   |     |      |      |        |         |         |         |
|                       | <15                            | 33  | 127  | 69  | 120    | 10      | 364     | 0.19    |
|                       | 15–<17.5                      | 65  | 121  | 48  | 115    | 30      | 340     |
|                       | 17.5–<20                      | 55  | 127  | 52  | 120    | 30      | 300     |
| Pork                  | Age (y)                       | 3   | 15   | 17   | 15     | 2       | 60      | 0.023   |
|                       |                               | 4   | 52   | 19   | 15     | 2       | 55      |
|                       |                               | 5   | 68   | 27   | 21     | 20      | 2       | 110     |
|                       |                               | 6   | 36   | 26   | 17     | 20      | 5       | 78      |
|                       | Sex                           |     |      |      |        |         |         |         |
|                       | Boys                          | 99  | 25   | 20   | 18     | 3       | 110     | 0.29    |
|                       | Girls                         | 72  | 22   | 15   | 20     | 2       | 62      |
|                       | Height (cm)                   |     |      |      |        |         |         |         |
|                       | <100                           | 26  | 13   | 7    | 13     | 2       | 40      | 0.0053  |
|                       | 100–<107.5                    | 60  | 23   | 16   | 20     | 2       | 60      |
|                       | 107.5–<115                    | 65  | 26   | 21   | 20     | 2       | 110     |
|                       | 115≤                           | 20  | 29   | 18   | 23     | 3       | 78      |
|                       | Weight (kg)                   |     |      |      |        |         |         |         |
|                       | <15                            | 18  | 19   | 13   | 15     | 4       | 53      | 0.035   |
|                       | 15–<17.5                      | 60  | 20   | 14   | 15     | 2       | 60      |
|                       | 17.5–<20                      | 52  | 24   | 15   | 20     | 2       | 62      |
|                       | 20≤                            | 41  | 30   | 24   | 20     | 3       | 110     |
| Eggs                  | Age (y)                       | 3   | 44   | 25   | 17     | 25      | 0.5     | 60      | 0.41    |
|                       |                               | 4   | 98   | 23   | 18     | 20      | 0.5     | 92      |
|                       |                               | 5   | 107  | 27   | 18     | 25      | 2       | 69      |
|                       |                               | 6   | 67   | 27   | 16     | 27      | 0.5     | 65      |
|                       | Sex                           |     |      |      |        |         |         |         |
|                       | Boys                          | 173 | 26   | 17   | 25     | 0.5     | 66      | 0.78    |
|                       | Girls                         | 143 | 25   | 18   | 24     | 0.5     | 92      |
|                       | Height (cm)                   |     |      |      |        |         |         |         |
|                       | <100                           | 58  | 25   | 17   | 25     | 0.5     | 60      | 0.31    |
|                       | 100–<107.5                    | 122 | 25   | 17   | 21     | 0.5     | 92      |
|                       | 107.5–<115                    | 100 | 25   | 18   | 25     | 0.5     | 69      |
|                       | 115≤                           | 36  | 31   | 17   | 32     | 2       | 65      |
|                       | Weight (kg)                   |     |      |      |        |         |         |         |
|                       | <15                            | 41  | 24   | 17   | 25     | 0.5     | 60      | 0.49    |
|                       | 15–<17.5                      | 112 | 25   | 18   | 24     | 0.5     | 92      |
|                       | 17.5–<20                      | 98  | 25   | 17   | 23     | 0.5     | 66      |
|                       | 20≤                            | 65  | 28   | 18   | 30     | 1       | 69      |
ings seem reasonable since rice and pork contribute to energy intake, and energy requirements are higher in people with a larger body size. Actually, it has been shown that height is associated with protein intake in children (13). Although most of the previous studies reported that protein intake affected growth or health (13–16), the converse may be true. For instance, the protein intake in a child with a small body is less than that in a child with large body. Given the notion that body size can affect food intake, it is important to estimate nutrition intake precisely in a group of children at a certain age. On the other hand, foods in side dishes or used as a combination with other foods (e.g., eggs, carrots) might not be affected obviously by growth variables and sex. It was speculated that each child’s food preferences affect portion sizes, and this effect could be larger than that due to growth, particularly for vegetables. But this hypothesis should be evaluated in future studies. Because there is still scant information about the association between portion sizes and growth, it is necessary to implement studies with a larger number of subjects, especially for foods rarely consumed, and with a longer duration of diet record keeping to establish nutritional intake estimation methods suitable for children at every growth stage.

A similar comprehensive summary of the food portion sizes in children was reported by Wrieden et al. from the United Kingdom (17). Body constitution (height and weight) are almost the same for children aged 3–6 y in the UK and those analyzed in this study (18, 19). Due to the different food culture, there were substantial differences between the United Kingdom and Japan in the foods listed as frequently consumed by children. However, for some foods that were sufficiently comparable between the two countries, all of the portion sizes were smaller in Japan than in the United Kingdom. Although the United Kingdom study excluded the weight data from the portion size calculation if it was less than 1 g, all weight data were included in the present study. This different criterion for data exclusion partially accounts for the differences in the results of the two studies. Other aspects of the method to calculate portion sizes in the present study were the same as Wrieden’s (17).

Another possible reason for the differences may be the difference in food culture. For example, in Japan, dairy products such as cheese were uncommon 150 y ago (before the Meiji era). Although the consumption of dairy products has gradually increased in Japan, much less is consumed in Japan than in Western countries (20). In 2009, the food supply quantity of milk excluding butter was 248.5 kg/capita/y in the United Kingdom and 73.9 kg/capita/y in Japan (20). Although the total amount of consumption likely has a larger influence on the frequency of consumption than on the portion size per meal, this might partially explain the difference in portion sizes for dairy products. In addition, not only the total amount of consumption but also differences in daily meal recipes might be the reason for the differences in portion sizes between the two countries. The difference was relatively small for the foods consumed without cooking, such as milk as a drink (the median portion size is 153 g in the United Kingdom and 120 g in Japan), teas (the median portion size is 108 g in the United Kingdom, 96 g for green tea in Japan, and 110 g for roasted barley tea in Japan), and apples (53 g in the United Kingdom and 47 g in Japan). On the other hand, the difference was obvious for the foods usually cooked before consumption, such as pasta (84 g in the United Kingdom and 23 g in Japan), eggs (50 g in the United Kingdom and 25 g in Japan), and carrots (28 g of raw carrots in the United Kingdom, 34 g of boiled carrots in the United Kingdom, and 7 g of carrots in Japan).

### Table 3 (continued)

| Food Variables | n | Portion sizes |
|----------------|---|---------------|
|                |   | Mean | SD | Median | Minimum | Maximum | p value<sup>1</sup> |
| Carrots, raw and cooked Age (y) | 3 | 30   | 9  | 8      | 8       | 2       | 40 | 0.11  |
|                 | 4 | 87   | 8  | 5      | 6       | 0.3     | 25 |        |
|                 | 5 | 87   | 11 | 12     | 7       | 1       | 65 |        |
|                 | 6 | 53   | 10 | 7      | 10      | 0.2     | 30 |        |
| Sex            | Boys | 146 | 10 | 9      | 7       | 0.3     | 65 | 0.32  |
|                | Girls | 111 | 9  | 7      | 8       | 0.2     | 48 |        |
| Height (cm)    | <100 | 45  | 8  | 7      | 6       | 0.3     | 40 | 0.17  |
|                | 100–<107.5 | 100 | 8  | 8      | 7       | 1       | 65 |        |
|                | 107.5–<115 | 77  | 10 | 10     | 6       | 0.2     | 56 |        |
|                | 115≤ | 35  | 12 | 8      | 10      | 2       | 45 |        |
| Weight (kg)    | <15  | 30  | 11 | 9      | 9       | 2       | 40 | 0.72  |
|                | 15–<17.5 | 97  | 9  | 9      | 7       | 0.3     | 65 |        |
|                | 17.5–<20 | 74  | 9  | 9      | 6       | 0.2     | 48 |        |
|                | 20≤  | 56  | 10 | 8      | 8       | 2       | 45 |        |

<sup>1</sup>Between-group differences were calculated by t-tests for sex and ANOVAs for age, height, and weight.

Diet record data from 489 Japanese preschool children were analyzed. The numbers of the subjects who were included in the analysis of each food were 350 for rice, 190 for milk, 171 for pork, 316 for eggs, and 257 for carrots.
To the best of our knowledge, the cooking method differences, the combination of dishes into one meal, or recipes as a part of a food culture difference between Asian and Western countries had not been described comprehensively and quantitatively. However, this aspect warrants more attention, because we usually have meals as a combination of several dishes or foods and interactions between nutrients must have an effect on our health condition (21, 22). Some other studies reported the portion sizes among children for a limited number of foods (23, 24). However, it is difficult to compare their results with those of the present study because of differences in the foods listed.

Some limitations should be mentioned for this study. First, since the frequency of the appearance of snacks (e.g., candies, chocolates, cookies, and rice crackers) on DRs was low, we could not calculate the portion sizes for them. Second, since this research was conducted in limited areas (Tokyo, Saitama, and Yamanashi prefectures), the generalizability of the results was not ideal. Third, the frequency of fish consumption and the number of consumed fish species was low in the analyzed popu-
Food Portion Sizes among Japanese Children

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