Comparison of Nutrient Reference Values for Food Labeling in Japan with CODEX Recommendations, Based on DRIs and Nutrient Intake in Japan

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Summary To clarify the degree of consistency between the international recommendations and the national Japanese system, the nutrient reference values (NRVs) adopted by the CODEX were compared with current Japanese NRVs 2015, the dietary reference intakes for Japanese (DRIs-J) 2015, and actual nutrient intake levels by the Japanese population. The Japanese NRV for protein was high relative to CODEX NRV-R (i.e., NRV-Requirement). The Japanese NRVs for folate and calcium were low, and vitamin K was high, relative to each CODEX NRV-R. However, it was similar to the DRI-J values, and current intake levels for the Japanese population. For iron, calculation methods were different between the CODEX and Japan. Japanese iron NRV was calculated based on the RDA without menstruating women, whereas CODEX NRV-R was calculated based on the INL98 of all adult men and women. Actual intake levels of iron for the Japanese population were similarly low. The Japanese NRV for sodium was high and potassium was low based on DRI-J values, relative to the CODEX NRV-NCD. For nutrients that show large discrepancies between the CODEX and Japanese NRVs, the values should be discussed further.

Key Words nutrient reference values, CODEX, dietary reference intakes, nutrient intake, noncommunicable diseases

The CODEX Committee on Nutrition and Foods for Special Dietary Uses (CCNFSUD) discusses general principle proposals to determine Nutrient Reference Values (NRVs) for food labeling. The CODEX established the NRVs-R (i.e., NRVs-Requirement) for protein, vitamins and minerals, and NRVs-NCD (i.e., NRVs-Noncommunicable Diseases) for nutrients associated with the risk of non-infectious diseases. The CODEX NRVs-R are calculated based on recommended values (recommended dietary allowances, RDA, and individual nutrient level for 98% of the population, INL98). NRVs are set by CODEX, and regulatory bodies in many countries use these CODEX values to set national policy for recommended dietary intakes. Japanese NRVs 2005 were calculated based on the estimated average requirement (EAR), but were revised in 2015 based on the RDAs for the dietary reference intakes for Japanese (DRIs-J) 2015 (1). Whereas the INL98 and RDA values have been constructed from the same definition, the NRVs differ according to the nutritional status of each country (2). Additionally, several issues have been identified because of the differences in NRV calculations based on different methods and different types of nutrients in each country (3).

To revise future Japanese NRVs to be consistent with international viewpoints, it is important to examine whether CODEX NRVs should be used or these values should be recalculated using the next version of the DRIs-J. In this study, we compared the NRVs for food labeling, DRIs-J and the dietary intake levels by the Japanese population.

Materials and Methods Comparison between CODEX NRVs, Japanese NRVs, and DRIs-J. A comparative examination of the 2015 Japanese NRVs, DRI-J 2015 values, and Japanese nutrient intake levels was performed for the NRVs-R and NRVs-NCD as adopted by the CODEX.

DRI-J values used for comparison were calculated with a weighted mean, using demographic composition for each sex/age group obtained by the 2013 census, based on the EAR, adequate intake (AI), RDA, or dietary goals (DG) indicated by the latest Japanese dietary intake reference from 2015 (4). For Japanese, nutrient intake levels were calculated using raw data from the National Health and Nutrition Survey Japan (NHNS-J).

Data source of dietary intake for Japanese population. Data obtained from the NHNS-J 2012 was used with permission from the Ministry of Health, Labour and Welfare, Japan. The survey included 23,750 households (61,000 subjects) and involved all household members aged ≥1 y (5). For the purposes of our study, pregnant and lactating women, subjects <17 y old, and subjects who provided incomplete answers, were all excluded.

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Table 1. Comparison between the CODEX Nutrient Reference Values-Requirements (NRVs-R) and Japanese NRVs (18 and older).

| Nutrient        | CODEX NRVs-R | Japanese NRVs (2015) | Dietary reference intakes for Japanese 2015<sup>1</sup> (weighted mean value) | Intake levels<sup>2</sup> mean for Japanese population (median) (2012 national survey) |
|-----------------|--------------|----------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
|                 | EAR (or AI)  | RDA (or DG)          | UL                                                                              |                                                                                  |
| Energy (kcal)   | —            | 2,200 (EER)          | 2,191 (EER)                                                                 | 1,888 (1,835)                                                                    |
| Protein (g)     | 50           | 81 (mean intake level<sup>3</sup>) | 45                                                                 | 55 (RDA)                                                                                                                   |
|                 |              | 13–20% (DG)          | —                                                                                | 1.888 (1,835)                                                                 |
|                 |              | 69 (67)              |                                                                                  |                                                                                  |
| Fats            |              | 6.2 (mean intake level<sup>3</sup>) | 8.7 (AI)                                                                  | 69 (67)                                                                 |
| n-6 fatty acid (g) | —     | 9.0 (AI)             | 8.7 (AI)                                                                      | 9.3 (8.5)                                                                       |
| n-3 fatty acid (g) | —     | 2.0 (AI)             | 2.0 (AI)                                                                       | 2.2 (1.9)                                                                       |
| Carbohydrates   |              | 320 (DG (57.5%E))    | 50–65% (DG)                                                                   | 265 (257)                                                                       |
| Dietary fiber (g) | —     | 19 (DG)              | ≥ 19 (DG)                                                                    | 15 (14)                                                                         |
| Vitamins        |              |                      |                                                                                  |                                                                                  |
| Vitamin A (µg RAE) | 800 | 770 (RDA)            | 542                                                                 | 2,700                                                                            |
| Vitamin D (µg)  | 5–15         | 5.5 (AI)             | 5.5 (AI)                                                                      | 100.0                                                                            |
| Vitamin E (mg)  | 9            | 6.3 (AI)             | 6.2 (AI)                                                                      | —                                                                                |
| Vitamin K (µg)  | 60           | 150 (AI)             | 150 (AI)                                                                      | 243 (193)                                                                       |
| Thiamin (mg)    | 1.2          | 1.2 (RDA)            | 1.0                                                                             | 0.9 (0.8)                                                                        |
| Riboflavin (mg) | 1.2          | 1.4 (RDA)            | 1.1                                                                             | 1.2 (1.1)                                                                        |
| Niacin (mg NE)  | 15           | 13 (RDA)             | 11                                                                              | 15 (14)                                                                          |
| Vitamin B<sub>6</sub> (mg) | 1.3 | 1.3 (RDA)            | 1.1                                                                             | 12.1 (1.1)                                                                       |
| Folate (µg DFE) | 400          | 240 (RDA)            | 200                                                                            | 299 (275)                                                                        |
| Vitamin B<sub>12</sub> (µg) | 2.4 | 2.4 (RDA)            | 2.0                                                                             | 6.4 (4.2)                                                                        |
| Pantothenate (mg) | 5     | 4.8 (AI)             | 4.8 (AI)                                                                       | 5.4 (5.2)                                                                        |
| Biotin (µg)     | 30           | 50 (AI)              | 50 (AI)                                                                        | —                                                                                |
| Vitamin C (mg)  | 100          | 100 (RDA)            | 85                                                                              | 102 (81)                                                                         |
| Minerals        |              |                      |                                                                                  |                                                                                  |
| Calcium (mg)    | 1,000        | 680 (RDA)            | 563                                                                             | 2,500                                                                            |
|                 |              | 11 (30% dietary absorption) | 7.0                                                                            | 8.0 (7.7)                                                                      |
|                  |              | 14 (2.2% dietary absorption) | 8.8 (RDA)                                                                | 8.0 (7.7)                                                                      |
| Zinc (mg)       | 310          | 320 (RDA)            | 262                                                                             | 248 (236)                                                                        |
| Magnesium (mg)  | 700          | 900 (AI)             | 896 (AI)                                                                       | 975 (942)                                                                        |
| Phosphorus (mg) | 14 (15% dietary absorption) | 6.8 (RDA, no menstruation) | 315                                                                             | 7.7 (7.3)                                                                       |
| Iron (mg)       | 14 (15% dietary absorption) | 22 (10% dietary absorption) | 7.1 (15% dietary absorption, with menstruation) | 4.5 (7.3)                                                                       |
|                 |              |                      |                                                                                  |                                                                                  |
| Copper (mg)     | 0.9          | 0.9 (RDA)            | 0.6                                                                             | 1.2 (1.1)                                                                        |
| Manganese (mg)  | 3            | 3.8 (AI)             | 3.7 (AI)                                                                       | 11.0                                                                             |
| Iodine (µg)     | 150          | 130 (RDA)            | 95                                                                              | 3,000                                                                            |
| Selenium (µg)   | 60           | 28 (RDA)             | 22                                                                              | 388                                                                              |
| Molybdenum (µg) | 45           | 25 (RDA)             | 21                                                                              | 498                                                                              |

1 Calculated from weighted mean using demographic composition for each sex/age group obtained from the 2013 census, based on intake reference value for each nutrient indicated in the Japanese dietary reference intakes (DRIs-J 2015) (18 and older).

2 Calculated from the raw data of the National Health and Nutrition Survey (2012) (18 and older, excluding pregnant and lactating women).

3 Energy corrected values (the mean energy intake level of the National Health and Nutrition Survey (1,872 kcal) was corrected for NRV (2,200 kcal)).

AI, adequate intake; DG, dietary goals; DRIs-J 2015, dietary reference intakes for Japanese 2015; EAR, estimated average requirement; RDA, recommended dietary allowances.
Results and Discussion

Comparative examination of CODEX NRVs-NCD, Japanese NRVs, DRI-J 2015 values, and Japanese nutrient intake levels

Table 1 and Figs. S1–S3 show CODEX NRVs-NCD, Japanese NRVs, DRI-J 2015 values, and Japanese nutrient intake levels.

The Japanese NRV for protein (81 g/d) was high compared with the CODEX NRV-R (50 g/d). Protein NRVs in the CODEX and other countries were based on the INL98 or RDA (2). In Japan, DRIs-J has 2 types of protein values, i.e., EAR/RDA for requirement (45 g/d, 50 g/d) and DG for prevention of life-style related diseases (13–20% energy). Japanese protein NRV was based on the concept of the DG. Furthermore, Japanese NRVs for macronutrients were also considered the current intake levels in Japan. Finally, protein NRV was decided based on the mean intake level for the Japanese population adjusted by energy NRV (2). The difference in the NRVs depends on differences in the calculation methods for protein between the CODEX and Japan.

Among the vitamins analyzed, the Japanese NRV for vitamin K (150 μg/d) was higher than the CODEX NRV-R (60 μg/d). The former Japanese NRV 2005 for vitamin K (70 μg/g) was similar to the CODEX NRV-R; however, the latest Japanese NRV 2015 increased AI to 150 μg. The AI value is determined by the median of the population intake level in Japan (6). Because there is a high intake of fermented soybeans, which are rich in vitamin K, the AI value for vitamin K in Japan is quite high compared with any other country (7). Thus, interpretation of the NRV is one of the factors that complicates the use of nutritional standard values in an area with peculiar eating habits. The Japanese NRV for folate (240 μg DFE/d) was lower than the CODEX NRV-R (400 μg DFE/d). It was based on low DRI values for folate in Japan (EAR: 200 μg DFE/d, RDA: 240 μg DFE/d).

Among the minerals analyzed, the Japanese NRV for calcium (680 mg/d) was lower than the CODEX NRV-R (1,000 mg/d). It was similar to the values from the DRIs-J (EAR: 563 mg, RDA: 673 mg), and Japanese intake level (mean: 490 mg, median: 447 mg). The Japanese NRV values for zinc, selenium and molybdenum were lower than the CODEX NRVs-R. These were decided based on low DRI values for these nutrients.

The Japanese NRV for iron (6.8 mg/d) was lower than the CODEX NRV-R (14 mg/d [15% dietary absorption] and 22 mg/d [10% dietary absorption]). Calculation methods for iron were different between the CODEX and Japan. The Japanese iron NRV was calculated based on the RDA without menstruating women, whereas the CODEX NRV was calculated based on the recommended values of all adult men and women. In this study, the Japanese RDA value with menstruation was 8.4 mg/d. Actual iron intake levels of the Japanese population were low relative to the CODEX NRV-R. Therefore, even if the CODEX NRV-R is applied to Japan, utilization may be difficult because it does not always provide feasible values.

Comparative examination of CODEX NRVs-NCD, Japanese NRVs, DRI-J 2015 values, and Japanese nutrient intake levels

Table 2 and Fig.S4 show CODEX NRVs-NCD, Japanese NRVs, DRI-J 2015 values, and Japanese nutrient intake levels.
levels.

The Japanese NRV for sodium (2,900 mg/d) was high relative to the CODEX NRV-NCD (2,000 mg/d). The Japanese NRV for sodium was decreased from 3,500 mg/d in the former Japanese NRV 2005 to 2,900 mg/d in the current Japanese NRV 2015; however, it remained higher than the CODEX NRV-NCD.

As for potassium, for which an NRV-NCD was determined, the current Japanese NRVs revised in 2015 (2,800 mg/d) adopted the DG of the DRIs-J 2015; these were rather low compared with the NRV-NCD selected by the CODEX (3,500 mg/d).

As described above, in 2015, Japanese NRVs were revised based on the latest DRIs-J 2015. There continue to be discrepancies between the CODEX NRVs and Japanese NRVs regarding recommendations for several nutrients. Consistency with international recommendations must be considered for these nutrients, while accounting for Japanese dietary habits and national disease patterns. Country-specific differences are important for the development pattern of the NCD in particular; thus, when deciding the NRV-NCD value, correspondence with original data is indispensable.

In conclusion, this study compared the NRVs for important vitamins and minerals across multiple systems, including international CODEX guidelines and Japanese national recommendations. The differences detected between the systems indicate that there is a need for more consistency within global guidelines, which must also continue to consider national epidemiology. Because of the discrepancies found between the national and international recommendations, future research should examine the feasibility of revisions to food labeling, with consideration of the dietary habits of the population and the disease patterns within each country.

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Supporting Information

Supplemental Online Material is available on J-STAGE.

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