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# Historical Overview of the Establishment of Dietary Reference Intakes for Japanese

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***Summary*** Although nutritional standards for Japanese were published by national organizations until the 1940s, the Recommended Dietary Allowances (RDAs) for Japanese was officially established in 1969 by the Ministry of Health and Welfare (presently Ministry of Health, Labour and Welfare). These RDAs were revised every five years until 2005, when they were established as Dietary Reference Intakes for Japanese (DRIs-J). The nutrients included in RDAs and DRIs-J were changed according to the health condition and eating habits of Japanese. The current version, DRIs-J 2010, comprises reference values for energy and 34 nutrients.

***Key Words*** dietary reference intakes, Recommended Dietary Allowances, history, Ministry of Health, Labour and Welfare

## *Historical Overview*

Many nutrients are presently recognized to play an important role in human nutrition not only because they are essential for growth and maintenance of health, but also because they play an important role in the reduction of risk of noncommunicable diseases. The values of nutrient intakes that make allowance for individual variation in requirements and provide a margin of safety above the minimal requirement to prevent deficiencies have traditionally formed the basis for the establishment of the Recommended Dietary Allowances (RDAs).

Preliminary values for nutrient requirements for Japanese were first described in 1926 in the book *Nutrition* by Dr. Tadasu Saiki (*1*), the founder of the National Institute of Nutrition (presently National Institute of Health and Nutrition) in Japan. The National Institute of Nutrition played a key role in conducting basic scientific studies and developing nutrient requirements for Japanese. In responce to food shortage resulting from World War II, some national organizations created nutritional standards independently for Japanese until around 1945. Since then nutritional standards for Japanese have been developed by the Prime Minister's Office (presently Cabinet Office, government of Japan) and the Science and Technology Agency (presently Ministry of Education, Culture, Sports, Science and Technology) to promote growth, to maintain health and physical strength, and to improve work efficiency.

From 1969, the Ministry of Health and Welfare became the presiding ministry to create RDAs in Japan (*2*). The RDAs used for the time period 1970–1975 were officially established by six committees. As shown in Table 1, RDAs was subsequently revised every five years until 2005 for the purpose of improving physique and corresponding to changes in population structure, economy or dietary habits (*2–8*). The concept of Dietary Reference Intakes was first introduced in the 6th revision of the RDAs (2000–2005) (*8*). In order to more comprehensively follow the approach used in devising the 6th revision of the RDAs, the 7th revision was established as the "Dietary Reference Intakes for Japanese (DRIs-J) 2005" by the Ministry of Health, Labour and Welfare (MHLW) (*9*). These DRIs-J were based on a systematic review of the evidence. The current version, "DRIs-J 2010," was created based on the Health Promotion Law by the MHLW (*10*).

DRIs-J expanded on the basic theories of the US/Canadian DRIs in order to create DRIs that are specific to the Japanese population. The DRIs-J were designed not only to prevent energy or nutrient deficiencies that may be caused by insufficient intake of energy or nutrients, but also for the primary prevention of lifestyle-related diseases caused by excess and/or imbalanced consumption of energy and nutrients. DRIs-J consists of six reference values (one for energy and five for nutrients) for the prevention of deficiencies, adverse effects by excess intake, and lifestyle-related diseases. In addition, the recommended dietary intake level is shown as a range rather than a singular value.

## *Historical Changes in Values for Energy and Nutrients*

In 1926, Dr. Saiki proposed the concept used as the basis of future Estimated Average Requirement (EAR), Adequate Intake (AI) or Estimated Energy Requirement (EER), and he calculated the energy requirement for Japanese. Since that time, national organizations decided to

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Table 1. History of the development of Dietary Recommendations in Japan by Ministry of Health, Labour and Welfare.

| Versions | Periods of use | Date recommendations were made | Contents |
|---|---|---|---|
| RDAs 1st (*2*) | Apr. 1970–Mar. 1975 | Aug. 1969 | Energy+10 Nutrients |
| RDAs 1st revision (*3*) | Apr. 1975–Mar. 1980 | Mar. 1975 | Energy+9 Nutrients |
| RDAs 2nd revision (*4*) | Apr. 1980–Mar. 1985 | Aug. 1979 | Energy+12 Nutrients |
| RDAs 3rd revision (*5*) | Apr. 1985–Mar. 1990 | Aug. 1984 | Energy+13 Nutrients |
| RDAs 4th revision (*6*) | Apr. 1990–Mar. 1995 | Sep. 1989 | Energy+15 Nutrients |
| RDAs 5th revision (*7*) | Apr. 1995–Mar. 2000 | Mar. 1994 | Energy+16 Nutrients |
| RDAs 6th revision —DRIs— (*8*)[1] | Apr. 2000–Mar. 2005 | Jun. 1999 | Energy+28 Nutrients |
| DRIs-J 2005 (*9*) | Apr. 2005–Mar. 2010 | Oct. 2004 | Energy+34 Nutrients |
| DRIs-J 2010 (*10*) | Apr. 2010–Mar. 2015 | May 2009 | Energy+34 Nutrients |

RDAs, Recommended Dietary Allowances; DRIs, Dietary Reference Intakes.
[1] The concept of DRIs was introduced in the RDAs 6th revision.

include values for selected nutrients in the nutritional standards, based on the accumulation of new evidence from the scientific literature. Table 2 shows the historical changes to the established energy and nutrients that are included in the dietary recommendations in Japan by MHLW. Reference values for energy, protein, vitamin A, vitamin D, vitamin $B_1$, vitamin $B_2$, vitamin C, calcium and iron were included in all versions of the RDAs from the 1st to the current DRIs-J 2010. Although the 1st version of RDAs only included 10 nutrients (*2*), the current DRIs-J 2010 provides recommendations for 34 nutrients (*10*). Changes to nutrient reference values for the RDAs and DRIs-J are established based on changes in the health condition and/or dietary habits of Japanese at the time of revision. In particular, it was important that the nutritional problem in Japan expanded to include not only nutrient deficiency and improvement of physical strength but also excess and/or imbalanced consumption of energy and nutrients, lack of exercise, increase of overweight/obesity and chronic disease. In order to correspond to these problems, not only the results of an experimental studies but also epidemiological studies were added to evidence for DRIs-J creation.

Selection criteria for inclusion of nutrients in DRIs-J are 1) nutrients that are essential for life and the maintenance and/or improvement of health, and 2) nutrient intake values that are backed by scientific evidence or have achieved global consensus. Nutrient values that could not be established due to insufficient evidence are not included.

This paper describes an overview of the history and establishment of DRIs in Japan. Future revisions of DRIs-J must take into account the health condition and eating habits of Japanese in order to determine the kinds of nutrients that should be included.

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Table 2. Historical changes to the established energy and nutrients included in the Dietary Recommendations in Japan.

| Versions | | RDAs | | | | | | | DRIs-J | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1st | 1st revision | 2nd revision | 3rd revision | 4th revision | 5th revision | 6th revision —DRIs—[1] | 2005 | 2010 |
| Energy | | RDA | RDA | RDA | RDA | RDA | RDA | RDA | EER | EER |
| Protein | | RDA | RDA | RDA | RDA | RDA | RDA | RDA | EAR, RDA, DG | EAR, RDA |
| Fat | Total fat | — | — | RDA | RDA | RDA | RDA | RDA | DG | DG |
| | Saturated fatty acids | — | — | — | — | — | — | — | DG | DG |
| | *n*-6 fatty acids | — | — | — | — | — | — | — | AI, DG | AI, DG |
| | *n*-3 fatty acids | — | — | — | — | — | — | — | AI, DG | AI, DG |
| | Cholesterol | — | — | — | — | — | — | — | DG | DG |
| Carbohydrates | Carbohydrates | — | — | — | — | — | — | — | DG | DG |
| | Dietary fibers | — | — | — | — | — | target amount | target amount | AI, DG | DG |
| Fat-soluble vitamins | Vitamin A | RDA | RDA | RDA | RDA | RDA | RDA | RDA, UL | EAR, RDA, UL | EAR, RDA, UL |
| | Vitamin D | RDA | RDA | RDA | RDA | RDA | RDA | RDA, UL | AI, UL | AI, UL |
| | Vitamin E | — | — | — | — | target amount | target amount | RDA, UL | AI, UL | AI, UL |
| | Vitamin K | — | — | — | — | — | — | RDA, UL | AI | AI |
| Water-soluble vitamins | Vitamin $B_1$ | RDA | RDA | RDA | RDA | RDA | RDA | RDA | EAR, RDA | EAR, RDA |
| | Vitamin $B_2$ | RDA | RDA | RDA | RDA | RDA | RDA | RDA | EAR, RDA | EAR, RDA |
| | Niacin | RDA (nicotinic acid) | RDA (nicotinic acid) | RDA | RDA | RDA | RDA | RDA, UL | EAR, RDA, UL | EAR, RDA, UL |
| | Vitamin $B_6$ | — | — | — | — | — | — | RDA, UL | EAR, RDA, UL | EAR, RDA, UL |
| | Vitamin $B_{12}$ | — | — | — | — | — | — | RDA | EAR, RDA | EAR, RDA |
| | Folate | — | — | — | — | — | — | RDA, UL | EAR, RDA, UL | EAR, RDA, UL |
| | Pantothenic acid | — | — | — | — | — | — | RDA | AI | AI |
| | Biotin | — | — | — | — | — | — | RDA | AI | AI |
| | Vitamin C | RDA | RDA | RDA | RDA | RDA | RDA | RDA | EAR, RDA | EAR, RDA |
| Macrominerals | Sodium | RDA (sodium chloride) | — | target amount | target amount | target amount | target amount | — | EAR, DG | EAR, DG |
| | Potassium | — | — | — | target amount | target amount | target amount | RDA | AI, DG | AI, DG |
| | Calcium | RDA | RDA | RDA | RDA | RDA | RDA | RDA, UL | AI, DG, UL | EAR, RDA, UL |
| | Magnesium | — | — | — | — | target amount | target amount | RDA, UL | EAR, RDA, UL | EAR, RDA, UL |
| | Phosphorus | — | — | target amount | target amount | target amount | target amount | RDA, UL | AI, UL | AI, UL |
| Microminerals | Iron | RDA | RDA | RDA | RDA | RDA | RDA | RDA, UL | EAR, RDA, UL | EAR, RDA, UL |
| | Zinc | — | — | — | — | — | — | RDA, UL | EAR, RDA, UL | EAR, RDA, UL |
| | Copper | — | — | — | — | — | — | RDA, UL | EAR, RDA, UL | EAR, RDA, UL |
| | Manganese | — | — | — | — | — | — | RDA, UL | AI, UL | AI, UL |
| | Iodine | — | — | — | — | — | — | RDA, UL | EAR, RDA, UL | EAR, RDA, UL |
| | Selenium | — | — | — | — | — | — | RDA, UL | EAR, RDA, UL | EAR, RDA, UL |
| | Chromium | — | — | — | — | — | — | RDA, UL | EAR, RDA | EAR, RDA |
| | Molybdenum | — | — | — | — | — | — | RDA, UL | EAR, RDA, UL | EAR, RDA, UL |

RDA, Recommended Dietary Allowance; DRIs-J, Dietary Reference Intakes for Japanese; EAR, estimated average requirement; AI, adequate intake; EER, estimated energy requirement; UL, tolerable upper intake level; DG, tentative dietary goal for preventing lifestyle-related diseases.

Persons≧1 y old.

[1] The concept of DRIs was introduced in the RDAs 6th revision.

# Dietary Reference Intakes for Japanese 2010: Carbohydrates

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***Summary*** The Dietary Reference Intakes (DRIs) of carbohydrates and dietary fiber were determined for Japanese. The estimated average requirement (EAR) and recommended dietary allowance (RDA) for carbohydrates were not determined because of insufficient data. The tentative dietary goal for preventing lifestyle-related diseases (DG) for children aged 1 y and above was determined for carbohydrates (% energy). In addition, the DG for adults aged 18 y and above was determined for dietary fiber. Dietary fiber intake is associated with myocardial infarction; therefore, the DG was determined on the basis of the results of a meta-analysis and the median dietary fiber intake of Japanese. The DG for alcohol was not determined because of insufficient data.

***Key Words*** carbohydrate, dietary fibers, alcohol, lifestyle-related diseases

## *Introduction*

A carbohydrate comprises either a monosaccharide or its polymer (*1*). Carbohydrates play an important nutritional role as an energy source; digestible carbohydrates (i.e., sugars and starches) contain approximately 4 kcal of energy/g. Although there is no internationally standardized definition, dietary fiber is usually considered an indigestible component in the diet, many of which are carbohydrates. Indigestible carbohydrates are fermented by intestinal bacteria, theoretically providing 0–2 kcal/g (*2*). Dietary fiber is an important nutrient, not as an energy source, but because of its relationship with lifestyle-related diseases attributable to physiological functioning.

Alcohol was included in this chapter considering that it has several effects on health and affects nutritional status and energy production.

## *Carbohydrates*

*Basic concept*

The primary role of carbohydrates is to supply glucose to tissues that can ordinarily only use glucose as an energy source, such as the brain, nervous tissue, red blood cells, renal tubules, the testes, and oxygen-deficient skeletal muscle. It is estimated that the daily glucose requirement of these tissues is at least 100 g/d (*3*); however, this value is not the true minimal glucose requirement, because gluconeogenesis occurs in the liver. According to the National Health and Nutrition Survey in Japan (*4*, *5*), almost all Japanese consume the minimum requirement.

The dietary goal for preventing lifestyle-related diseases (DG) for carbohydrates was determined as the difference between the energy derived from proteins and lipids and the estimated energy requirement (EER), provided that sufficient proteins and a suitable amount of lipids are being ingested. Thus, the DG of carbohydrates is expressed as a percentage of energy. Since the indigestible carbohydrates in ordinary diets have almost no energy, they are considered to be carbohydrates. Furthermore, the energy derived from carbohydrates is not strongly influenced if the energy derived from ordinary amounts of alcohol consumption is included (*6*). However, this does not mean that alcohol can be used as a substitute for carbohydrates.

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Table 1. Dietary Reference Intakes for carbohydrates (% energy).[1]

| Sex | Males | Females |
|---|---|---|
| Age | DG (range) | DG (range) |
| 0–5 mo | — | — |
| 6–11 mo | — | — |
| 1–2 y | 50≦, <70 | 50≦, <70 |
| 3–5 y | 50≦, <70 | 50≦, <70 |
| 6–7 y | 50≦, <70 | 50≦, <70 |
| 8–9 y | 50≦, <70 | 50≦, <70 |
| 10–11 y | 50≦, <70 | 50≦, <70 |
| 12–14 y | 50≦, <70 | 50≦, <70 |
| 15–17 y | 50≦, <70 | 50≦, <70 |
| 18–29 y | 50≦, <70 | 50≦, <70 |
| 30–49 y | 50≦, <70 | 50≦, <70 |
| 50–69 y | 50≦, <70 | 50≦, <70 |
| ≧70 y | 50≦, <70 | 50≦, <70 |
| Pregnant women (amount to be added) | | — |
| Lactating women (amount to be added) | | — |

DG, tentative dietary goal for preventing lifestyle-related diseases.
[1] Including energy derived from alcohol.

Table 2. Dietary Reference Intakes for dietary fibers (g/d).

| Sex | Males | Females |
|---|---|---|
| Age | DG | DG |
| 0–5 mo | — | — |
| 6–11 mo | — | — |
| 1–2 y | — | — |
| 3–5 y | — | — |
| 6–7 y | — | — |
| 8–9 y | — | — |
| 10–11 y | — | — |
| 12–14 y | — | — |
| 15–17 y | — | — |
| 18–29 y | ≧19 | ≧17 |
| 30–49 y | ≧19 | ≧17 |
| 50–69 y | ≧19 | ≧17 |
| ≧70 y | ≧19 | ≧17 |
| Pregnant women (amount to be added) | | — |
| Lactating women (amount to be added) | | — |

DG, tentative dietary goal for preventing lifestyle-related diseases.

*Determining the Dietary Reference Intakes*

*DG (Tentative dietary goal for preventing lifestyle-related diseases)*

*Adults/children.* The DG for carbohydrates was determined for children aged 1 y and above. The DG was determined according to the intake of carbohydrates (60–72% energy), assuming that the subject is consuming their EER (physical activity level II), lipids within the DG, and the recommended dietary allowance (RDA) of protein. Although a lack of sufficient evidence, considering cases in which a person's protein intake is greater than the RDA and that EER differs with respect to physical activity level, the DGs for adults and children were set at 50–70% of energy intake.

DRIs values for carbohydrates are listed in Table 1.

### *Dietary fiber*

*Basic concept*

Dietary fiber intake is associated with various lifestyle-related diseases. Many studies report negative relationships between dietary fiber intake and the incidence of myocardial infarction, myocardial infarction-related deaths (*7*), the incidence of diabetes (*8*), blood pressure (*9*), and low-density lipoprotein cholesterol (*10*). There are also many reports showing a correlation between dietary fiber intake and obesity (*11*, *12*). However, the associations between dietary fiber intake and cancer and its effect on bowel habits (e.g., constipation) are not well identified (*13*, *14*).

The lifestyle-related disease with the clearest connection to dietary fiber intake is myocardial infarction (*7*). Therefore, the DG was determined on the basis of the results of a meta-analysis (*7*) as well as the current intake levels of dietary fiber in Japanese.

*Determining the Dietary Reference Intakes*

*Tentative dietary goal for preventing lifestyle-related diseases*

*Adults.* The results of a meta-analysis of the correlation between dietary fiber intake and myocardial infarction revealed that the mortality rate decreases with a daily intake level of at least 24 g/d and increases with a daily intake level less than 12 g/d (*7*). According to the National Health and Nutrition Surveys Japan in 2005 and 2006 (*4*, *5*), the median dietary fiber intakes of male and female adults are 12.3–16.3 and 11.8–16.1 g/d, respectively.

The DG for dietary fiber was determined on the basis of the intermediate value (i.e., 18 g/d) between the 2 values indicated in the meta-analysis (*7*) although a lack of scientific basis. Furthermore, taking into account the age and body weight of the research subjects and the difference in standard body weight between Japanese men and women, the DG was determined to be 19 and 17 g/d for men and women, respectively.

DRIs values for dietary fiber are listed in Table 2.

### *Alcohol*

*Basic concept*

In Japan, 7.1 kcal/g is used as the amount of available energy from alcohol (ethanol) (*15*, *16*). However, the energy utilization efficiency of alcohol varies according

to a variety of conditions including alcohol consumption levels, the ability to metabolize alcohol, dietary intake levels, and physical condition.

The range of "moderate alcohol consumption" (*17*) is thought to be in the order of 20 g/d pure alcohol equivalent. In this range, there would be no problem using 7.1 kcal/g to calculate the amount of energy from the perspective of maintaining body weight.

Epidemiological studies show that alcohol intake is correlated with death and the incidence of cardiovascular disease, cancer, and other lifestyle-related diseases (*18–21*). Western and Japanese have very different genetic backgrounds with respect to the metabolic enzymes of alcohol (*22*). Thus, it is possible that the health effects of alcohol in Japanese are different from those in Western people. The exact level of alcoholic intake that affects the total mortality rate is still controversial among cohort studies in Japan. Some studies report that the risk of mortality is lowest among subjects who consume less than 21 g alcohol/d (*23*), while others report that the risk is only high with a consumption of more than 43 g/d (*24*). Furthermore, other reports indicate that the risk increases gradually with increasing alcohol consumption (*25*). However, in all cases, it is clear that heavy alcohol consumption increases the risk of mortality.

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