For infants ages 6 through 11 months, consumption of food other than human milk (or other milk products prepared for infants) must be taken into consideration. But relevant information is scarce. The values for infants aged 0 through 5 months and/or those 1 through 2 years were extrapolated. For the method of extrapolation, refer to section (3-6) for the "basic approach of the extrapolation method."

3-5-2. Children

Very few studies are available that would be sufficient to set children's DRIs-J. When sufficient data were not extant, the values were estimated by employing the extrapolation method to those values of adults. A basic approach for extrapolation is shown in 3-6.

Because of the scarcity of information, it was often not able to set ULs. It should be noted that the absence of UL does not necessarily assure freedom from developing health problems when the intake becomes excessive.

3-5-3. Aged

For aged, weakening of their masticatory function, deterioration of digestive and absorptive fraction, and a reduction in food intake due to less physical activities exist. One characteristic of this age group is that their individual intake varies widely; another is that many aged individuals are affected by an illness. Sufficient attention should be directed not only to the age but also to individual characteristics.

3-5-4. Pregnant and Lactating Women

First, the DRIs-J for non-pregnant and non-lactating are computed for their specific age category, and then certain amount is added for pregnant and lactating women.

The typical duration of pregnancy was assumed to be 280 days and the cumulative effect for fetal growth was expressed in terms of volume per day. If it is necessary to divide the duration of pregnancy, the following 3 divisions were proposed: early stage (less than 16 weeks); mid-stage (16 to less than 28 weeks); and late stage (28 weeks and thereafter).

For the lactating stage, data on lactation is necessary; no reliable data for Japanese women were available; so the amount of maternal milk ingested by an infant (0.78 L/day)[6] was used as the daily volume of lactation.

Because of the paucity of data on UL for pregnant and lactating women, many nutrients are without UL. The absence of UL does not necessarily assure that one is free from developing health problems due to excessive intake. It is convenient as a rule to refer to the UL for non-pregnant or non-lactating women of comparable age; but a lack of any consideration about the effect of the fetus during pregnancy or the milk during the lactating period may be associated with a certain risk. A close attention should be paid to the UL for these women. Because the scientific basis related to these problems is not available, the quantitative reference was forced to be omitted.

3-6. Method for Extrapolation

The DRIs-J (EAR, RDA, AI, DG, and UL) were obtained through observation of certain gender and at certain age group. Thus they are called "references" and used as a basis for extrapolation. An extrapolation procedure is necessary to create DRIs-J for each genders and age group.

References for EAR and AI are often based on the intake per day (weight/day), while the reference for UL is obtained as a quantity per kg of body weight. Therefore extrapolation methods were prepared individually.

For RDA, the EAR for each gender and age level is computed by extrapolating from the reference value for EAR; then each resulting EAR was multiplied by the RDA computing coefficient shown in Table 2. For DG, the AI for both genders and all age levels was computed by extrapolating from the reference AI; then the corresponding DG were obtained by using each extrapolated AI and the median of the intake of the respective gender and age groups.

3-6-1. Extrapolation Methods of EAR and AI

3-6-1-1. Adults and Children

It is difficult to decide on the method of extrapolation with due consideration given to the characteristics of each nutrient. It has been noted that there is a significant correlation between efficiency in energy metabolism and body surface area. Formulas to estimate the body surface area from body height and/or body weight were developed and are now widely used.[7] There are a number of formulas and for the DRIs-J have adopted which was proposed by Kleiber, et al. in 1947 and uses 0.75th power of the weight ratio.[8] Further studies have been conducted in recent years and it has been reported that the method is useful in estimating the organ weights of a number of organisms (including cardiovascular and respiratory organs of mammals).[9]

When the reference for EAR or AI is given in intake per day (weight/day) and the representative value (median or mean) of the body weight in a given group of the study from which the reference has been obtained is clear-cut, extrapolation was effected by using the following:

$$X = X_0 \times (W/W_0)^{0.76} \times (1 + G)$$

Where

X = EAR or AI (intake per day) of the specific age group

W = reference weight of the specific age group

X_0 = Reference (intake per day) for EAR or AI

W_0 = mean or median representative weight of the studied subjects that provided EAR or AI reference

G = growth factor (refer to Table 8 for data)

In some studies, the reference for EAR or AI may be given as a number per kg of body weight. If so, extrapolation was conducted as follows:

$X = X_0 \times W \times (1 + G)$

Where

X = EAR or AI (intake per day) of the desired age group

W = reference weight of the age group in question

X_0 = reference for EAR or AI (intake per kg body weight)

G = growth factor (refer to Table 8 for data)

For children, the following should be taken into consideration: (1) quantity that is needed for growth; and (2) the quantity that is accumulated in the body during the growth stage. For the growth factors for the DRIs-J, the values that have been adopted by WHO/UNA[10] and the United States/Canada in their dietary reference intakes were modified to suit the Japanese at each age group (Table 8).

Table 8 Growth factors used in setting the EAR or AI (age one year old and over)

Age groups	Growth factors
1-2 years	0.30
3-14	0.15
15-17 (boys)	0.15
15-17 (girls)	0
≥18	0

EAR, estimated average requirement; AI, adequate intake

3-6-1-2. Infants (ages 6 through 11 months)

Two methods for extrapolation were considered to the DRIs-J for infants 6 through 11 months: (1) extrapolate based on the value for infants (aged 0 through 5 months); and (2) use the median values of infants (aged 0 through 5 months) and those of 1 to 2-years-old. As a rule, it was decided that either of the following two formulas could be applied.

When extrapolating form infants 0 through 5 months' DRIs-J, the following formula has been suggested:[7)]

(reference weight of infants 6 through 11 months / reference weight of infants 0 through 5 months)$^{0.75}$

However, infants 0 through 5 months are in the growth stage and their DRIs-J probably make allowance for the growth factor. So the formula given above does not take the growth factor into consideration. When the weight of reference physique is substituted, the products for boys and girls are $(8.8/6.6)^{0.75}$ and $(8.2/6.1)^{0.75}$ or 1.24 and 1.25, respectively. This formula produces values for extrapolation that are slightly different for boys and girls. Therefore the mean of these values was computed and used as the common AI for both genders.

3-6-2. UL

Like EAR and AI, there are no methods for extrapolating UL that are logical and sufficiently reliable. For those age groups with insufficient evidence, computations were not made for those ages under 18 years. As a rule, either of the following two methods was used for those aged 18 years and over.

If the reference value for UL is given per kg of body weight:

$X = X_0 \times W$

Where X = UL (intake per day) for the specific age level

W = reference weight for the specific age group

X_0 = Reference for UL (intake per kg of body weight)

If the reference for UL is given as a value per day:

$X = X_0 \times (W/W_0)$

Where X = UL for the specific age level (intake per day)

X_0 = reference for UL (intake per day)

W = reference weight for the specific age group

W_0 = mean or median representative weight of the studied subjects that provided UL reference

3-7. Rounding

In view of the convenience of use and reliability of the values, EAR, RDA, AI, DG and UL were routinely rounded off according to the rule shown in Table 9. For children, adults, and aged, a single rule applied for each nutrient, regardless of their gender. For infants, pregnant and lactating women, the value to be added was rounded to the same number of digits as that used for the other gender or the corresponding age groups.

After the rounding operation, the numbers were smoothed if necessary to remove excessive ups and downs among age groups. Refer to the section on each nutrient for the method and practice of smoothing.

Also refer to the respective section for the nutrients for which the numbers were rounded by methods other than that shown here.

Table 9 Basic formulas for rounding numbers

Approximate median value	Method	The digit that is shown[1]
0.5	Rounded to the nearest tenth fraction.	0.X
1.0	Rounded to the nearest tenth fraction.	X.X
5	Rounded so that the 10th fraction will be 0 or 5.	X.Y
10	Rounded to the nearest whole number.	XX
50	Rounded so that the first digit will be 0 or 5.	XY
100	The first digit is rounded off.	XX0
500	Rounded off so that the second digit will be 0 or 5	XY0
1,000	Rounded to the nearest hundred.	X,X00
5,000	Rounded so that the third digit will be 0 or 5.	X,Y00

[1] (X or Y is replaced with a number: X, a number; Y, 0 or 5)

4. Basic Approach for Application

4-1. Individuals or Groups

The subjects to whom the DRIs-J are applied are, as a rule, healthy individuals or groups that is composed of healthy individuals. The healthy individuals here may include those who have some mild conditions such as hypertension, hyperlipidemia and hyperglycemia but enjoy a normal life and no specific dietary guidance is being given or diet therapy or diet restriction is imposed.

4-2. Nutrient Sources

Nutrients sources include the energy and nutrients that are contained in substances normally taken in meals. They also include those energy and nutrients that are contained in tonic drinks, nutritional aids, food fortified with nutrients, specified health food, functional food, so-called "health food", and dietary supplements, which are not intended for the treatment of any specific disease but are used to promote one's general health. Note that the ULs for folic acid and magnesium were created only for sources other than normal food.

4-3. Habitual Intake

The DRIs-J give standards for habitual intake but do not constitute standards for meals taken over a short period (e.g., one day). This is because nutrient intake varies widely from day to day[12-15] and DRIs-J are references for habitual intake of energy and nutrients.

It is difficult to specify a duration for one's "habitual intake" but based on the results obtained from observations of daily variations in the intake of energy and nutrients,[12-15] approximately one month appears to be reasonable. Because of the difficulty associated with dietary surveys over extended periods, diet-recording or diet recall is employed for assessment. In such a case it is desirable that surveys be conducted for least 2 days (preferably 2 non-consecutive days) and use the mean of the results.

Except for vitamin C, there is no seasonal difference in intake for Japanese; [13, 16, 17] therefore there is no need for special consideration.

DRIs-J do not indicate the quantity that should be included in a specific meal for a day or that included in a particular meal (e.g., breakfast, lunch or dinner). If a specific meal (such as lunch) is to be supplied for a group, it is desirable that due consideration be given to the intake by the group at all meals and a plan made for the specific meal.

4-4. Basic Method of Application

4-4-1. Basic Concept of DRIs-J Use

DRIs-J are used for various purposes but its application may be roughly classified into the following: for the "assessment of the current state of nutrient intake" and "for designing dietary plans (including planning for dietary consultation, public nutrition and food service)." The application is further divided by whether it is for "individuals" or "groups."

Excluding energy requirements, basic handling of all nutrients is shown in Table 10 (dietary assessment) and Table 11 (dietary planning). In preparing these, the concept adopted in the dietary reference intakes of the United States and Canada was used as a reference.[19)]

It is essential that a dietary plan be prepared and implemented, based on a dietary assessment (not only the intake but also biochemical indices and physical measurements). It should be noted that the value indicated by the DRIs-J are not necessarily the amount that should be applied accomplished in real life.

For energy requirements, refer to the section (2-2) on energy.

Table 10 Concept of Dietary Reference Intakes for Japanese uses for dietary assessment (excluding energy requirements)[1-3]

	For an Individual	For a Group
EAR	If the habitual intake is less than EAR, the probability for deficiency is more than 50%: the probability increases as the habitual intake is reduced below EAR.	The percentage of those with a habitual intake less than EAR is generally equal to that suffering from insufficient intake.
RDA	When the habitual intake exceeds the EAR and approaches RDA, the probability for deficiency is reduced. When it reaches RDA, the probability becomes low (2.5%).	Not used.
AI	If the habitual intake exceeds AI, the probability for deficiency becomes very low.	When the median intake of the group is more than AI, the percentage of those suffering from a deficiency is small. If the median intake is less than AI, the percentage cannot be determined.
DG[4]	If the habitual intake has reached DG or within the range indicated, the risk for lifestyle-related disease[6] is very unlikely.	The percentage of those not achieving DG or those with an intake outside the range corresponds to those having a risk of developing a lifestyle-related disease.[6]
UL[5]	As the habitual intake exceeds the upper limit and continues to increase, the risk for developing a disease[6] related to excessive intake increases.	The percentage of those with habitual intake exceeding UL corresponds to the percentage of those having a risk for developing a disease[6] due to excessive intake.

EAR, estimated average requirement; RDA, recommended dietary allowance; AI, adequate intake; DG, tentative dietary goal for preventing lifestyle-related diseases; UL, tolerable upper intake level

[1] The assessment based on intake is meant to be used for screening. To know the true nutritional state, it is necessary to obtain clinical information, results of biochemical determinations and physiological data.

[2] It has been reported in American and European studies that the energy intake (although the extent may vary in the method of survey or study subjects) is often underreported by 5 to 15%.[4)] Among Japanese, it is also known that the mean for a group be underreported by 8% than actual intake.[5)] The tendency is particularly notable when the subjects are obese;[20)] but the quantitative relationship has not been elucidated. For the nutrients, underreporting, such as seen for energy, is suspected but details are not known.

[3] It is desirable that the habitual intake be estimated as accurately as possible. (Refer to 4-3.)

[4] The nutrient intake and related risk for developing a lifestyle-related disease are ongoing events and should be regarded carefully. The "high" and "low" risks are relative concepts.

[5] There are some nutrients for which no UL is indicated because there is no sufficient scientific basis to determine the actual value. It by no means assures safety from excessive intake.

[6] The "risk" here means the probability of developing a lifestyle-related disease or disorder due to excessive consumption of the nutrient in question.

Table 11 Concept of Dietary Reference Intakes for Japanese uses for dietary planning[1] (excluding energy requirements)

	For an Individual	For a Group
EAR	Not used	The percentage of those with a habitual intake below EAR should be brought down to less than 2.5%
RDA	Those whose habitual intake is less than EAR should try to achieve the RDA.	Not used
AI	One should try to bring his/her habitual intake close to AI.	The goal is to bring the mean of the group to AI.
DG[2]	One should strive to bring his/her habitual intake close to DG or within the range indicated.	Reduced the percentage of those whose habitual intake is below DG or outside the range.
UL[3]	One should bring the habitual intake below UL.	The percentage of those whose habitual intake exceeds UL should be brought to zero (0)

EAR, estimated average requirement; RDA, recommended dietary allowance; AI, adequate intake; DG, tentative dietary goal for preventing lifestyle-related diseases; UL, tolerable upper intake level

[1] It is important to design and implement a plan tailored to the subject, based on a dietary assessment (using not only the dietary intake but also biochemical and physiological data). The numerical indices are not to be followed faithfully. The dietary assessment, which constitutes the basis of planning, is used for screening purposes. To understand one's true nutritional status, clinical information, results of biochemical tests and physiological data are needed.

[2] The nutrient intake and related risk for developing a lifestyle-related disease are ongoing events and should be regarded carefully. The "high" and "low" risks are relative concepts. The "risk" here means the probability of developing a lifestyle-related disease or disorder due to excessive consumption of the nutrient in question.

[3] There are certain nutrients for which no UL are indicated because there is no sufficient scientific basis to determine the actual value. It by no means guarantees safety from excessive intake.

4-4-2. Priority

DRIs-J show the standards for the intake of energy and nutrients but that do not mean that the reliability of presented indices or the importance in the use is necessarily same between nutrients.

For EAR, RDA, AI and DG, a high priority is placed on those nutrients that are essential to the maintenance of life and health and to promote healthy growth; and those nutrients that are selected to prevent lifestyle-related diseases are considered when the supply of those with a high priority is assured. Lower priority is assigned to those nutrients the deficiency of which is not

well-established in humans or the intake or supply of which cannot be estimated. Specific priority is given in the following order: (1) protein and energy, (2) carbohydrates (% energy) and total lipids (% energy); (3) other nutrients (those in which the DRIs-J are given as EAR, RDA or AI) with their content indicated in the Standard Tables of Food Composition in Japan, 5th Revised Edition,[21] as well as calcium and dietary fiber; (4) other nutrients (those with their dietary reference intake listed as DG) the nutritional content of which is listed in the aforementioned Standard Tables;[21] (5) those nutrients, the nutritional content of which is not listed in the aforementioned Standard Tables.[21]

4-5. Notes on Correlation with Food Composition Tables

In dietary assessment or planning, one may estimate the intake from the weight of the food consumed or determine the amount of food to be offered based on the nutrient content of that food. In such instances, the Standard Tables of Food Composition in Japan 5th Revised Edition[21] is used most frequently. For the definition of nutrients, however, there is a slight inconsistency in the DRIs-J and the aforementioned Standard Tables[21] that were published in 2000. Those nutrients that require special attention are listed in Table 12.

Table 12 Nutrients that are divergent and their details according to Dietary Reference Intakes for Japanese (DRIs-J) and Standard Tables of Food Composition in Japan, 5th Revised Edition (edited by The Resources Council of the Science and Technology Agency of Japan, November 22, 2000)

Nutrients	Cause for inconsistency		Notes when the intake or the amount given is estimated by using the Standard Tables of Food Composition in Japan, 5th Revised Edition and compared against the DRIs-J
	DRIs-J	Standard Tables of Food Composition in Japan, 5th Revised Edition	
Vitamin A	1/12 is used for the coefficient of β-carotene equivalent in computing retinol equivalents.	For the coefficient of β-carotene equivalents, 1/6 is used in computing retinol equivalent.	(Retinol + carotene/12) is used in computing the retinol equivalents.
Vitamin E	This is meant to be α-tocopherol only.	The α-tocopherol equivalent computed by using α-, β-, γ- and δ-tocopherol.	The total vitamin E (α-tocopherol equivalent) is interpreted to be α-tocopherol. (Neither β-, γ-, nor δ-tocophenol is converted to α-tocopherol; therefore α-tocopherol equivalent is not used.)
Niacin	Niacin equivalents (Nicotinamide [mg] +nicotinic acid [mg] +tryptophan [mg]/60) is used for niacin equivalents.)	Nicotinic acid equivalent is indicated (niacin that is synthesized in the body from tryptophan is not included).	This is expressed in the form, Niacin [mg] + protein (mg)/6,000. It is not accurate in a strict sense but the assumption that the quantity of tryptophan in food roughly amounts to 1/100 of protein does not appear to cause a problem in the application.

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II. PARTICULAR TOPIC

[ENERGY]

1. Basic Points

The role of energy [unit: kcal or MJ (M joule), 1.00 kcal = 4/18 kJ, M (mega)=10^6] in an adult is to provide basal metabolism—synthesis and degradation of body components, maintenance of body temperature, and minimal conservation of organ activities—and to resynthesis of adenosine triphosphate that is consumed in association with muscular activities during physical activity. In adults with no changes in body weight, energy expenditure and energy intake are equal. The energy that has not been consumed accumulates in the form of fat, mainly in fat cells. In the musculoskeletal system, the energy is stored as glycogen and triglyceride but the amount stored in the system is very scarce than that stored in the fat cells. A proliferation of fat cells takes the form of obesity, which constitutes a risk factor for many lifestyle-related diseases. If energy expenditure exceeds energy intake, on the other hand, the amount of fat that has accumulated in one's fat cells and the proteins in one's muscles are depleted, resulting in a deterioration of physical functions and quality of life. Therefore it is desirable for adults to take in the amount of energy that corresponds to the amount that is consumed.

Children and infants who are in the growth stage require energy not only to meet their daily needs but also to form tissues for their growth. Estimated Energy Requirement (EER) should be determined with the consideration. Pregnant and lactating women need energy for themselves, as well as for the growth of the fetus or production of milk.

2. Estimated Energy Requirement

2-1. Definition of the Estimated Energy Requirement (EER)

The concept of Dietary Reference Intakes for Japanese (DRIs-J) that is used for other nutrients cannot be applied to determine the dietary reference intakes for the energy. Like the practice in the United States and Canada in preparing their dietary reference intakes,[1, 2] the concept of Estimated Energy Requirement (EER) is applied. Therefore, the concept of EER was applied which is also the concept used in the United State and Canada's dietary reference intakes. EER is defined as "the energy intake that is estimated to have the highest probability for energy balance (for adults, energy expenditure – energy intake) to become zero (0)." Unlike the DRIs-J for other nutrients, the probability of achieving the appropriate energy balance is lower whenever the energy intake is excessive or insufficient. In other words, when the energy intake exceeds the EER for the specific gender or age group, the probability for weight gain increases; if the intake is inadequate, the probability for weight loss increases.

2-2. Basic Approach in Computation

As a rule, EER is computed as follows:

Basal Metabolic Rate (BMR, kcal/day) x PAL

Energy deposition is added for children considering increases of body tissue due to growth.

For pregnant women, the energy required for changes in tissue of the fetus and maternal body is added. For lactating women, the energy needed for lactation is added.

The BMR is computed as follows:

Reference BMR (kcal/kg weight/day) x reference weight (kg)

The BMR is measured early in the morning (before breakfast) while the subject is resting in the supine position in a comfortable indoor environment. A representative value for BMR per kg is based on a number of reports. This is called the reference BMR.

The adequacy of the reference BMR (Table 1) adopted by the 6th revision was reevaluated. Specifically, the reference BMR was compared against those in recent 5 reports (on 6 groups) where the determinations were known to be accurate (Table 2).[4-8] It was confirmed that the mean (kcal/day) of the "reference BMR" or the "reference BMR x reference weight" of Table 1 is within –5.5 ~ +4.2% of the mean of the "BMR per kg weight" or the "BMR (kcal/day)" given in the aforementioned 5 reports (Table 2). Therefore it was decided that the basic metabolic rate of Table 1 that was used in the previous revision was used as it is in the current revision.

The Physical Activity Level (PAL) is an index derived by subtracting the BMR per day from the energy expenditure per day.[9-11] The daily energy expenditure of a subject who engages in normal daily activities is determined most accurately by a doubly labeled water (DLW).[1, 2, 10] Based on the reports that accurately determined the energy expenditure (by DLW method) and the BMR, the reference value for PAL was established as follows.

2-3 Adults

Using the data (from "2003 project to estimate energy consumption by DLW method" the National Institute of Health and Nutrition) to determine the PAL of Japanese adults (n=139, 20 to 59 years), the group was divided into 3, using the 25th and 75th percentile values (1.60 and 1.90, respectively) (Table 3). Based on the results of stratification, the groups were labeled starting from the lowest activity level as level I (low, physical activity representative value = 1.50); level II (normal, physical activity representative value = 1.75); and level III (high, physical activity representative value = 2.00). According to this classification, the numbers of individuals allocated to each level were roughly represented by ratios of 1: 2: 1.

According to the previous revision, the intensity of life activities was stratified into 4 levels. In the DRIs-J, however, we considered the fact that only a few exhibited a very high physical activity level (e.g., engaging in intense physical training or employed in work that require heavy

physical exertion) and chose a 3-level classification omitting the fourth, heavy physical activity level. The United States and Canadian's dietary reference intakes, which is referenced frequently,[1,2] has 4 physical activity levels - 3 levels generally corresponding to the results of the current reversion plus a level for a "very low physical activity for those who rarely leave the house."

As shown in Table 3, the mean ± standard deviation (SD) for the physical activities of all subjects was 1.75 ± 0.22. The representative value (or mean) for Level I generally corresponds to "the mean − 1 x SD" for the entire group and the representative value (or mean) for Level III, "the mean + 1 x SD."

The results of studies on physical activities of relatively sedentary Japanese adults by employing a highly reliable method were compared against those of recent studies on Chinese and Americans. The outcome of these comparisons is shown in Table 4.[1, 5, 6, 12] Among the studies on Japanese, one had a special emphasis on the life activities of people who spent most of their time sitting[5] and was therefore excluded from the comparisons. The weighted average of the PAL for the remainder of the studies was 1.78 for men and 1.77 for women. According to the dietary reference intakes in the United States and Canada,[1] the corresponding figures were 1.75 for men and 1.78 for women (19 to 70 years). Furthermore, according to the record on the urban population in China (33 men and 40 women), the figures were 1.69 for men and 1.65 for women.[12] In addition to these statistical results, the data that have been reported[1, 10, 13] led to an estimate of the representative value for PAL for both men and women: 1.75, which corresponded to the mean for the subjects shown in Table 3.

Compared with the younger subjects, the PAL is lower in older people (aged 70 years and over), the mean being around 1.50 (SD, 0.2).[14-17] Considering such reductions in PAL due to aging, values of 1.3, 1.5, and 1.7, were set for those over 70 years (Table 5).

EER was computed for each PAL that has been described above.