Original Article

Dietary Reference Intakes for Koreans (KDRIs)

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For more than 40 years, Recommended Dietary Allowances for Koreans (KRDA) were used as references for nutrient intake. In 2002, the Korean Nutrition Society organized a committee to revise the KRDA, which were transformed into the new Dietary Reference Intakes for Koreans (KDRIs) in 2005. KDRIs include Estimated Average Requirements (EAR), Recommended Intake (RI), Adequate Intake (AI) and Tolerable Upper Intake Level (UL) for protein, essential amino acids and micronutrients, Estimated Energy Requirement (EER) for energy and Acceptable Macronutrients Distribution Ranges (AMDR) for macronutrients. Evidence-based methods were used to determine the reference value (s) and the levels of nutrient intake for each nutrient. The KDRIs expanded significantly the number of nutrients and the basic concepts of nutrient recommendations compared to the previously used KRDA. In addition, a new food guide, depicted as Food Tower for Koreans, was developed and appended to the KDRIs publication. Continued efforts are needed to facilitate the application of KDRIs as well as to improve the understanding of the concepts. Additional modifications will be made as more scientific data become available.

Key Words: Dietary Reference Intakes for Koreans, dietary reference, Korean diet, food guide

HISTORY OF DIETARY RECOMMENDATIONS IN KOREA

Dietary recommendations provide science-based guides to target populations on diet and maintaining good health. Nutrient level recommendations serve to estimate the levels of specific nutrients that should be consumed and are a basic foundation that must be met while following forms of dietary recommendations. Recommended Dietary Allowances (RDA) were first established in the United States in 1941, and were used as nutrient recommendations until Dietary Reference Intakes (DRIs) were introduced in 1997.[1,2] Other countries adapted the concept for their populations. The initial KRDA was published in 1962 by the FAO Korean Office, and has been periodically revised. The Korean Nutrition Society (KNS) has been responsible for publishing the KRDA since the 6th revision in 1995.[3] During the process of publishing the 7th revision in 2000, there were discussions as to the relevancy of the concept of KRDA to the complex nutritional problems of the population within modern-day Korea. Whereas KRDA was established to provide guidelines for nutrient intakes to prevent deficiencies, beginning mid-20th century, dietary and lifestyle changes results in an increased prevalence of chronic diseases related to obesity. A few examples of the observed dietary changes included increases in intakes of dietary fat, increases of animal-based foods, and more intake of some micronutrients in the form of supplements, and decreases in intakes of complex carbohydrates and dietary fiber. Thus, in 2002, the KNS organized a committee to revise the KRDA. The committee decided to expand the recommendations to KDRIs in order to address the diverse problems related to nutrition. The KDRIs were officially published in November, 2005. [3]

THE PROCESS OF DEVELOPING KDRIs

Following the release of the 7th revision of the KRDA in 2000, discussions continued among the KNS members about the adequacy of the scope and contents of the KRDA. The purpose of the KRDA was, as the RDAs in other countries, to provide guidelines on the level of nutrient intake adequate to prevent deficiency diseases. However, economic growth and increased food availability subsequent to the 1970s changed the main nutritional concern in Korea to obesity and lifestyle-related chronic diseases. Therefore, there was great demand from the society to the KNS and other nutritionists to provide guidelines with more versatile uses. A new committee was formed in 2002 by the KNS to review the need and develop a process for revising nutritional guidelines. The committee held several workshops, both domestic and international, and reached a conclusion that the concept of DRIs should be introduced to Korea in order to meet the needs of modern nutritional guidelines.

The original committee became a steering committee and a full committee was organized to include panels responsible for nutrients, and subcommittees to establish age and gender-based subgroups for establishment of nutrient standards, physical standards of each group,

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guidelines to determine the UL, application methods of the KDRIs and the new food groups to be used in food guide. Nutrients with similar functions were considered by the same Panel as work to derive the reference values was conducted. An evidence-based approach was used in the process of developing the KDRIs. Extensive review of literatures from Korean and international journals was performed following the guidelines set by the steering committee. Each panel reviewed the evidence and developed the KDRIs for nutrients assigned the panel for each age and gender subgroup. After all panels composed the first draft of the KDRIs, the review committee was convened to review the draft and forward suggestions to each panel for further revisions. The final draft was made available at an open hearing to receive comments from scientists and the general public. All the comments were reviewed and considered by the panels and committees as the final version was prepared. In total, ten workshops and one public hearing were held during the three-year process; invitees included experts from the United States and Canada. The KDRIs were officially announced at the International Symposium entitled "Reference Levels of Nutrient Intakes - National and International Perspectives," which was organized by the KNS and held in Gyeongju, Korea, in November, 2005.

MAIN COMPONENTS AND FEATURES OF KDRIs

Components

KDRIs include four components - Estimated Average Requirements (EAR), Recommended Intake (RI), Adequate Intake (AI), and Tolerable Upper Intake Level (UL) - applicable to protein, essential amino acids, and micronutrients. For energy and macronutrients, Estimated Energy Requirement (EER) and Acceptable Macronutrient Distribution Ranges (AMDR) were established.

Estimated Average Requirements (EAR) and Recommended Intake (RI) were determined when there were adequate information about the mean and standard deviations (SD) of the requirements of the nutrient. The RI was set at two SD above the mean requirements so that 97.5% of the population requirement would be below the recommended intake level.

Adequate Intake (AI) was set when there was inadequate information about the requirement of the nutrient to determine the mean and SD. AIs of nutrients represent the levels of nutrients adequate for health, i.e., higher than the level which would cause deficiency in significant proportion of the population and lower than the level below any adverse effects of excessive intake. They are derived in various ways depending on the type of information available. They may be adapted from the dietary intake levels of the healthy population, extrapolated from the results of animal studies, extrapolated from data of other age groups, or based upon very limited data. It is desirable to accumulate research data on the requirements of the nutrients with AI values to establish EARs and RIs in the future.

Tolerable Upper Intake Level (UL) was defined to be the highest level of daily nutrient intake without any known possible adverse effect. The UL was determined only when there were evidence from the literature for an adverse or toxic effect from excessive intake of the nutrient. For nutrients without UL values, a UL may be established later as evidence of adverse health effects are reported.

Estimated Energy Requirement (EER) is defined as the reference level of total energy intake for adults, while adjustments for biological characteristics were made for other groups. The EER for adults needs to be calculated according to the equation derived from the doubly-labeled water studies and is a function of the body size and physical activity level of the subjects.

Acceptable Macronutrient Distribution Ranges (AMDR) were developed to represent the ranges of percentages of energy from each of the three macronutrients compatible with good health in Koreans. The established AMDR for carbohydrate, lipid and protein for adults were set at 55-70%, 15-25%, and 10-20%, respectively.

Subgroups and Physical Standards

Age and gender subgroup categories, and physical standards of each subgroup were revised for the KDRIs. The new subgroups were proposed in order to harmonize with other national statistics including school age children, to accommodate the needs for major nutritional programs such as in school systems, and the growth and maturation rate of Korean children.

Physical standards were derived from the 2004 Agency for Technology and Standards survey data, according to the age and gender subgroups of the KDRIs. The survey is the most recent large scale government survey with a representative sampling of about 40,000 individuals of all age in both sexes. For each age and gender subgroups of KDRIs, except the subgroup above 75 years of age, median values of the height were selected as standard height. For the subgroups over 75 years of age, standard heights of the 65~74 year old groups were used for both sexes. For standard weight, several approaches were used depending on the age group; (1) for groups up to 19 years of age, median weight values of the group, (2) for groups 22~74 years of age, weight of BMI value 22 for standard height of the group, (3) for groups over 75 years of age, standard weight of 64~74 years of age group.

Nutrients included

The nutrients included in the KDRIs and the components determined for each nutrient for groups of 1 year old or above are shown in Table 1 and Table 2. Considering the fact that the previously used KRDA included 15 nutrients with one value for each nutrient, KDRIs represents great expansion in scope and complexity for such recommendations. The nutrients that required more in depth discussions among the members to reach the conclusion include, but are not limited to, dietary fiber, calcium, iron, iodine and sodium. It is beyond the scope of this paper to go into the details of these discussions. The most controversial issue was whether to determine the UL for sodium. The final decision was to define an 'Intake Goal' for sodium of 2,000 mg/day for adults, which is the suggested level by WHO/FAO for the prevention of chronic diseases.[4]

Table 1. Nutrients Included in the KDRIs

Subcommittee	Nutrients Included
Energy & Macronutrients	*Energy*, Protein,* Essential amino acids, dietary fiber, Water, AMDR, for carbohydrate, lipid and protein
Fat soluble Vitamins	*Vitamin A*, *Vitamin D, Vitamin E,* Vitamin K
Water-soluble Vitamins	*Vitamin C, Thiamin, Riboflavin, Niacin, Vitamin B_6, Folate,* Vitamin B_{12}, Pantothenic acid, Biotin
Major Minerals	*Ca, P,* Mg, Na, Cl, K
Trace Minerals	*Fe, Zn*, Cu, F, I, Mn, Se, Mo

*Nutrients in *italic* letters were included in the KRDA, 7th revision.

Table 2. Components of the KDRIs Established for Each Nutrient for age groups 1 year and above

Nutrient	EAR	RI	AI	UL
Energy*	EER			
Total Fiber			√	
Protein	√	√		
Essential Amino Acids	√	√		
Water			√	
Vitamin A	√	√		√
Vitamin D			√	√
Vitamin E			√	√
Vitamin K			√	
Vitamin C	√	√		√
Thiamin	√	√		
Riboflavin	√	√		
Niacin	√	√		√
Vitamin B6	√	√		√
Folate	√	√		√
Vitamin B12	√	√		
Pantothenic acid			√	
Biotin			√	
Ca	√	√		√
P	√	√		√
Mg	√	√		√
Na			√	**
K			√	
Cl			√	
Fe	√	√		√
Zn	√	√		√
Cu	√	√		√
Se	√	√		√
Mn			√	√
F			√	√
I	√	√		√
Mo				√

* AMDR for distribution of energy among macronutrients.
** Intake Goal

Uses and Applications of KDRIs

The KDRIs are intended to be used for dietary assessment and dietary planning. Dietary assessment estimates the probability of risk of deficiency or excess intake of the individuals or groups based on their usual intake. For assessment of individuals, EAR and RI can be used to estimate the level of probability that the usual intake of the individual is adequate. For nutrients with AI, we can only say the intake of the individual is adequate when the usual intake level is above AI. If the usual intake of the individual exceeds the UL, there is possibility of adverse health effects. For group assessment, the possibility of inadequacy can be estimated by the percentage of the population whose average usual intake is below the EAR. For a nutrient with AI, if the average of usual intake of the population exceeds the AI, the risk of inadequacy in the group is low. At risk population for adverse health effects from excessive intake can be estimated by the population with average usual intake above the UL.

For dietary planning, the goal should be set to have usual intake above the RI or close to the AI, and below the UL for individuals. For groups, it should be aimed to minimize the proportion of the group with usual average intake below the EAR and above the UL. For nutrients with AI, median intake of the group should be at the level of the AI.

Food Guide depicted as Food Tower:

Korean food guide depicted as a Food Tower in Figure 1 is appended to the KDRIs. The food guide includes five food groups which are modified from the previous version (in which the main difference was the separation of fruits and vegetables). The main food groups are (1) grains and starches, (2) vegetables, (3) fruits, (4) meat, fish, eggs, and beans, (5) milk and milk products, and (6) oils, nuts, and sugar. Serving sizes and nutrient compositions of representative food items in each food groups are determined to be used to formulate food group patterns for dietary planning. Sample menus are presented for several energy intake levels.

Future of KDRIs

The KDRIs introduced several significant changes to the previously used KRDA. These changes included expansion of the concept for the derivation of the recommendations from prevention of deficiency to the promotion of optimum health; expansion of nutrients included; and specific attention to its uses and applications. The KDRIs received great attention from the public at their release; however, continuous efforts should be made to educate nutritionists, dietitians, and other health professionals about the new concepts, meanings of the different components, and correct applications of the recommendations. The KNS continues to hold workshops and has published a short leaflet about KDRIs.

The KDRIs have been used as reference for the recently published 2005 National Health and Nutrition Survey in Korea. The KDRIs was also used as reference in several programs, such as healthy foods for children by the Korean Food and Drug Administration, dietary intake evaluation in cohort subjects by the Korean Center for

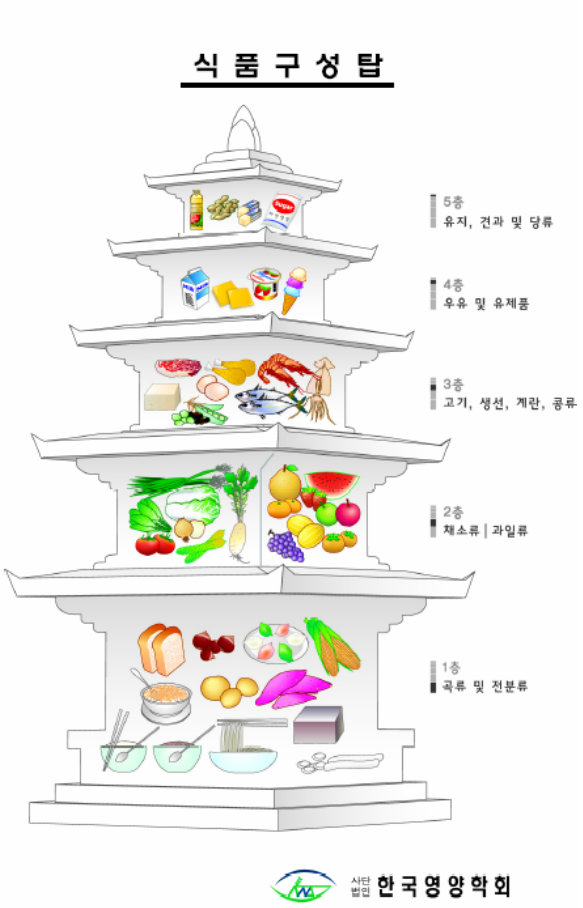

Figure 1. Food Tower for Food Guidance for Koreans
(Source: the Korean Nutrition Society, 2005, p.347)

Disease Control, and by school lunch programs. Further, continued efforts are needed to fully benefit from the new KDRIs in promoting optimum diet and health of Koreans, especially in health programs, hospitals, etc.

The KDRIs include many nutrients which were not included in KRDA. However, they are only useful when the intake levels can be estimated with adequate nutrient databases. The current widely used nutrient database in Korea does not include most of the newly added nutrients. Additionally, supplement use has been increasing in recent years and will contribute significantly to the nutrient intake of the population. Developing and maintaining a valid nutrient database for food and nutrient supplements require a major commitment of scientists and policy makers. Considering the importance of nutrition in the health of the population, significant efforts need to be made to improve the quality and completeness of Korean food and supplement nutrient databases.

The KDRIs were developed using evidence-based approaches. Currently, however, limited research data are available on nutrient requirements and the relations between diet and health in Korean population. The diet pattern of Koreans is distinct from those of Western and other Asian countries and consequently limits extrapolation of data from other countries. Dietary recommendations should be developed and applied to the diet of the target population. Thus, further research should be conducted using the Korean diet in the Korean population.

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AUTHOR DISCLOSURES

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