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Changes in Dietary Guidance: Implications for Food Composition Tables

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New Dietary Reference Intakes (DRIs) for the United States and Canada have recently been set for both macronutrients and micronutrients, and are likely to be of interest to health professionals in Korea as well. DRIs are now available for nutrients that did not have Recommended Dietary Allowances set in the past (amino acids, *n*-3 and *n*-6 fatty acids, total fiber, added sugar, choline, boron, nickel, and vanadium). Furthermore, the units for the DRIs do not always match those traditionally carried on food composition tables (FCTs). FCT developers will also need to consider carrying new variables to allow the calculation of folate intake in μg of dietary folate equivalents, vitamin E intake as mg of α-tocopherol (not as mg of α-tocopherol equivalents), and vitamin A intake as μg of retinol activity equivalents (not as μg of retinol equivalents). Because the new recommendations for upper levels of intake sometimes refer to a specific form or source of a nutrient, nutrients occurring in foods must be separated from added or supplemental forms for vitamin E, niacin, and folate; pharmacological magnesium must be carried as a separate variable; and preformed vitamin A must be separated from vitamin A from carotenoids. For more information on the DRIs, see: www.nap.edu.

Key words : Dietary reference intakes, Food composition tables, Macronutrients, Vitamins, Minerals

INTRODUCTION

In order to use food composition tables (FCTs) to assess whether nutrient intakes are adequate or excessive, or to plan diets that are nutritionally adequate, it is crucial that the FCT variables are expressed in the same form and units as the most current dietary recommendations. The Dietary Reference Intakes (DRIs) are nutrient-level recommendations for the United States and Canada, and are set by the Food and Nutrition Board of the Institute of Medicine.[1] These recommendations will be of interest to health professionals in Korea as well, because they are based on a thorough compilation of available research on nutrient needs.

The DRIs are being released in a series of reports, each addressing a specific group of nutrients. Reports for calcium and related bone nutrients,[2] B-vitamins and choline,[3] antioxidants,[4] micronutrients,[5] and macronutrients[6] have been published. For several nutrients, not only have recommended intake levels changed, but the active forms, and their bioavailability, have been reassessed. In addition, recommendations are being set for a number of nutrients that did not previously have recommended intakes in the US. Some of these changes will impact the variables that are carried on FCTs. Previous reviews[7,8] have examined the issues related to FCTs that were raised in the first four DRI reports.[2,3,4,8] The current review summarizes these issues and adds information on macronutrients from the recently released DRI macronutrient report.[6]

The DRIs include several types of nutrient intake reference values. The **Estimated Average Requirement (EAR)** is the average daily nutrient intake level sufficient to meet the requirement of half the healthy individuals in a particular life stage and gender group. The **Recommended Dietary Allowance (RDA)** is the average daily nutrient intake level sufficient to meet the requirement of nearly all (97 to 98%) healthy individuals in a particular life stage and gender group; it is derived from the EAR. An **Adequate Intake (AI)** is a recommended intake value based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of healthy people that are assumed to be adequate; it is used when an EAR and RDA cannot be determined. The **Tolerable Upper Intake Level (UL)** is the highest daily average nutrient intake level likely to pose no risk of adverse health effects to almost all individuals in the general population. As intake increases above the UL, the risk of adverse effects increases. For energy intake, an **Estimated Energy Requirement (EER)** can be calculated from a person's age, gender, height, weight, and activity level. For the macronutrients that supply energy in the diet

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(protein, carbohydrate, total fat, and *n*-3 and *n*-6 fatty acids), **Acceptable Macronutrient Distribution Ranges (AMDRs)** have been set. These ranges indicate the percent of energy that should come from each of these dietary components. No nutrient has all of these DRIs–by definition, an AI is not set if there is an EAR and RDA. Some nutrients do not have a UL, while others have only a UL. The EER applies only to energy intake, and the AMDRs apply only to macronutrient intakes. More information on the correct uses of these DRIs appears in *Applications in Dietary Assessment*,[9] and *Applications in Dietary Planning*.[10]

HOW WILL THE NEW DRIs FOR MACRONUTRIENTS AFFECT FCTs?

Table 1 shows the DRIs that have been set for macronutrients. The primary impact of the macronutrient DRIs on FCTs will be the need to carry additional nutrients. For example, not all FCTs currently contain the essential amino acids, which now have specific EARs and RDAs. In the past, amino acid patterns were specified for healthy diets, but RDAs were not set. Likewise, because there are now recommendations for *n*-3 and *n*-6 fatty acid intakes, there will be more interest in being able to estimate intakes of these nutrients using FCTs. The dietary fiber recommendation is more specific than it was in the past, and thus also may be of more interest in dietary assessment and planning. Furthermore, it will be necessary to ensure that added (functional) fibers, which are now included in the definition of total fiber, are also included in the dietary fiber values on FCTs.

Table 1. Macronutrients with DRIs

Macronutrient	Type of DRI
Energy	Estimated Energy Requirement (EER)
Protein	Estimated Average Requirement (EAR) Recommended Dietary Allowance (RDA) Acceptable Macronutrient Distribution Range (AMDR)
Amino acids	Estimated Average Requirement (EAR) Recommended Dietary Allowance (RDA)
Carbohydrate	Estimated Average Requirement (EAR) Recommended Dietary Allowance (RDA) Acceptable Macronutrient Distribution Range (AMDR)
Total fat	Acceptable Macronutrient Distribution Range (AMDR)
n-3 fatty acids	Adequate Intake (AI) Acceptable Macronutrient Distribution Range (AMDR)
n-6 fatty acids	Adequate Intake (AI) Acceptable Macronutrient Distribution Range (AMDR)
Total fiber	Adequate Intake (AI)
Added sugar	Guideline (below 25% of energy)

The new recommendation (which is not called a DRI) for added sugar is to limit intake to no more than 25% of energy intake. If diets are to be compared to this recommendation, it will be necessary to carry added sugar on FCTs. In the US, the FCT used to evaluate intake data from the national nutrition surveys contains added sugar.[11] Information on added sugar for commercial products was obtained from the food companies or calculated from the nutrient label on the products.

HOW WILL THE NEW DRIs FOR VITAMINS AND MINERALS AFFECT FCTs?

DRIs have been set for four nutrients that did not have specific dietary recommendations in the past: choline, boron, nickel, and vanadium (see Table 2). For the three minerals, only a UL was set. To compare intakes to these new DRIs, it will be necessary to add these nutrient values to FCTs.

As previously described,[7,8] the new DRIs for vitamins and minerals affect FCTs because new units or availability factors have been recommended for EARs and RDAs for several nutrients. In addition, new forms and units are also used for the UL, and in some cases, the form of the nutrient for the UL differs from the form for the EAR/RDA/AI for the same nutrient.

Table 2. Nutrients with DRIs that did not previously have recommended intakes.

Nutrient	Type of DRI (for persons over 1 year of age)
Choline	Adequate Intake (AI) Tolerable Upper Intake Level (UL)
Boron	Tolerable Upper Intake Level (UL)
Nickel	Tolerable Upper Intake Level (UL)
Vanadium	Tolerable Upper Intake Level (UL)

New Units are Being Used for Recommended Intakes

As shown in Table 3, dietary recommendations for three nutrients (folate, vitamin E, and vitamin A) are expressed differently than in the 1989 RDAs.[12] The recommendations for folate intake are now expressed in μg of dietary folate equivalents (DFE), rather than in μg of folate. One μg of folate that is naturally occurring in food is equal to 1.0 DFE. However, one μg of folate in a supplement is equal to 2.0 DFE because the monoglutamate form used for supplements is more bioavailable. Folate added to food as fortification is also more active than folate naturally occurring in food, but slightly less active than folate taken as a supplement. Thus, one μg of fortification folate is equal to 1.67 DFE. For diets containing fortification or supplemental folate, intakes in μg DFE will be higher than

intakes in μg folate. In order to perform these calculations, FCTs will need to contain separate variables for fortification folate, naturally-occurring folate, and folate from supplements.

The recommendations for vitamin E intake are now expressed as mg of α-tocopherol, rather than as mg of α-tocopherol equivalents (α-TE). Forms of vitamin E other than α-tocopherol are now assumed to have no vitamin activity. Furthermore, the vitamin E activity of synthetic α-tocopherol (fortification and supplemental forms of α-tocopherol) has been reduced by 50%. As with folate, FCTs should carry separate variables for α-tocopherol that occurs naturally in foods and synthetic forms of α-tocopherol. Nutrient calculation programs can then be modified to calculate vitamin E activity.

In the past, retinol equivalents, in μg, were calculated as μg of retinol, plus μg of β-carotene divided by 6, plus μg of α-carotene and β-cryptoxanthin divided by 12. Now, however, the new DRI values for vitamin A assume a 50% lower conversion of provitamin A carotenoids in foods into the active form. When calculating the vitamin A activity of a food, the amount of β-carotene should be divided by 12, and the amount of other provitamin A carotenoids should be divided by 24. As a result, the activity of plant sources of vitamin A will be only half of the previous estimates. To reduce confusion with the terminology, the term "retinol equivalents (RE)" has been replaced by "retinol activity equivalents (RAE)". The RDA for vitamin A is now given in μg of RAE (e.g., the RDA for adult women is 750 μg RAE). FCT developers who now carry a variable for μg of RE may wish to add a variable for μg of RAE. To facilitate recalculations of this type, FCTs should contain values for retinol in foods, as well as values for each of the individual carotenoids. It may be preferable to omit both RE and RAE from the FCT, and add an algorithm for vitamin A activity to the nutrient calculation programs that use the FCT.

Table 3. Vitamins with new units for requirements

Vitamin	Unit for DRIs	Unit for 1989 RDAs
Folate	μg dietary folate equivalents (DFE)	μg folate (all forms)
Vitamin E	mg α-tocopherol	mg α-tocopherol equivalents
Vitamin A	μg retinol activity equivalents (RAE)	μg retinol activity (RE)

Units for the UL May Differ from Units for EARs and RDAs

Table 4 shows the nutrients with ULs that are to be applied only to intakes of fortification or supplemental forms of the nutrient. For magnesium, the UL applies only to intake in the form of magnesium salts. The UL for adults is 350 mg/d, which is lower than the RDA for men 31-50 years of age (420 mg/d). Diarrhea is a potential adverse effect if intake of magnesium salts exceed 350 mg/d, but no such effect is believed to exist from magnesium in foods. Thus, to allow comparison of intakes of magnesium to the UL, FCTs must separate magnesium salts in supplements from food magnesium.

Table 4. Vitamins and minerals with ULs that are only for fortification and supplemental forms of the nutrient

Vitamin/Mineral	Sources that are used to determine the UL
Magnesium	Magnesium salts (mg)
Vitamin E	All α-tocopherol isomers from fortification/supplements (mg)
Folate	All folate from fortification/supplements (μg)
Niacin	Niacin from fortification/supplements (mg)

For three other nutrients (niacin, folate, and vitamin E) the UL is for intake of supplemental or fortification sources of the nutrient. Intakes from these two sources must be accumulated before comparison to the UL. Thus, separate variables for naturally occurring and fortification plus supplemental sources must be carried on the FCT for these three nutrients.

For vitamin A, the UL is applied only to intakes of preformed vitamin A (retinol), as adverse effects such as hepatotoxicity are not seen even at high intakes of provitamin A carotenoids. The calculation of retinol activity equivalents is not appropriate for comparing intakes with the UL. Only the intake of preformed vitamin A should be considered. Thus, FCTs must carry retinol as a separate variable if users wish to compare calculated intakes with the UL.

Because many nutrients now have a UL, there will be increasing interest by FCT users in examining whether intake is excessive. Thus, the ability to combine intake from foods and supplements becomes more urgent, and FCT developers may wish to extend their databases to include supplement composition data. Then it will be possible to perform a more comprehensive assessment of dietary adequacy (by comparing total intake to the EAR, RDA, or AI) as well as dietary excess (by comparing total intake to the UL).

SUMMARY

To take full advantage of the new DRIs when assessing and planning diets, FCTs must be modified to include all nutrients with DRIs, and to carry nutrients with appropriate units. Specific changes will be needed for most current FCTs:

Add macronutrients (essential amino acids, *n*-3 and *n*-6 fatty acids, total fiber, and added sugar) and micronutrients

(choline, boron, nickel, and vanadium) that did not previously have dietary recommendations.

Change the units for vitamins A, E, and folate.

Carry separate variables for fortification and supplemental forms of niacin, folate, vitamin E, and magnesium.

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