

## Review Article

# Using DRIs as the basis for dietary guidelines

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Dietary Reference Intakes (DRIs) are nutrient standards that may be used to plan nutrient intakes. Thus, they are useful as the basis for formulating dietary guidelines. The guidelines are often presented to the public as a food guide that will promote nutrient adequacy without risk of excessive intake. Such guides typically use the Recommended Dietary Allowances (RDAs) as intake targets because intake at the RDA is associated with a high probability of nutrient adequacy for healthy persons. During the development of the MyPyramid food guide for the United States, several questions were addressed: (1) What energy levels will be covered by the specific food patterns within the food guide? Each pattern should promote nutrient adequacy for the targeted energy intake level, which may include different age and gender groups. (2) What nutrients will be targeted by the food patterns? They should promote nutrient adequacy while also ensuring that intakes are not excessive for food components such as sodium, saturated fat, and cholesterol. (3) What food groups will be included in the food patterns, and how will their nutrient profiles be determined? After these decisions have been made, then the recommended amounts of each food group can be determined. A unique approach has been used to develop Canada's Food Guide, which included a simulation of the effect of differing food choices within each food group. Dietary guidelines and food guides which are based on the DRIs have the potential to improve nutrient intakes for consumers who follow them.

**Key Words:** nutrient standards, dietary guidelines, Dietary Reference Intakes

## INTRODUCTION

Nutrient standards have been set by many countries for use in planning and assessing dietary nutrient intakes. For the US and Canada, the current nutrient standards are the Dietary Reference Intakes (DRIs). They were set by panels convened by the Institute of Medicine between 1997 and 2005. In addition, a subcommittee on the uses and interpretation of the DRIs made recommendations on how to correctly use the new DRIs. A summary report on the DRIs is now available.<sup>1</sup>

An important use of nutrient standards such as the DRIs is to guide the development of food based dietary guidelines (FBDGs) for health professionals and for the public.<sup>2</sup> To be effective, the broad guidance offered by dietary guidelines (e.g., eat a variety of fruits and vegetables) must be translated into a food guide, with specific food patterns that are suitable for different levels of energy consumption. If properly designed, these food patterns can help individuals choose diets that have a high probability of meeting their nutrient needs, and a low risk of adverse effects from excessive intakes.

Typically, food patterns are developed for individuals, not for planning intakes of population groups. Thus, the Recommended Dietary Allowance (RDA) is used as the target nutrient intake, because intake at the RDA has a low probability of inadequacy for an individual (2-3%).

The process of developing FBDGs was recently undertaken by the US, Canada, and Japan.<sup>3-5</sup> Although different criteria and methods were used by these three countries, the resulting recommendations were remarkably similar.<sup>6</sup> To help consumers, each country has developed a graphic

symbol of their food guide: a pyramid for the US, a rainbow for Canada, and a spinning top for Japan.

### *Approach used by the US to develop MyPyramid*

Designing food patterns for food guides is an interactive process involving several steps. The DRIs can contribute information at several points in the process. For the design of MyPyramid for the US, the following steps were used:<sup>7</sup>

*Establishing energy intake levels.* Energy needs vary by age, gender, and level of physical activity, so dietary guidance on food choices must cover a wide range of energy intake. Likewise, requirements for macronutrients and micronutrients vary by age and gender, and sometimes by physical activity level as well. Thus, it is helpful to design food patterns for various levels of energy intakes. Individuals can then estimate which energy intake level is most likely to be appropriate, and follow the food pattern for that level. For example, MyPyramid provides food patterns for 12 energy intake levels, ranging from 1000 kcal/d to 3200 kcal/d. Table 1 shows the patterns for 2000 and 3000 kcal/d. The pattern for 2000 kcal/d would be appropriate for sedentary women aged 19-30 years, and sedentary men aged 51 years and older, while the pattern for 3000 kcal/d

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would apply to men 19-35 years old who are active (equivalent to walking more than 3 miles per day at 3 to 4 miles per hour). The estimated energy requirements (EERs) were used to determine what types of individuals would be classified into each of the energy levels.

*Establishing nutritional goals.* For each energy intake level, nutritional goals were set using the DRIs and dietary guidelines. Goals were selected for macro-nutrients such as protein, fat, carbohydrate, dietary fiber, saturated fat, cholesterol, linoleic acid, and alpha-linolenic acid. The macronutrient goals included RDAs for protein and carbohydrate, Adequate Intakes (AIs) for dietary fiber, linoleic acid and alpha-linolenic acid, and acceptable macronutrient distribution ranges (AMDRs). Because DRIs were not set for cholesterol and saturated fat, levels from the US dietary guidelines<sup>8</sup> were used as the goals for these macronutrients. Micronutrient goals included the RDAs or AIs for 9 vitamins and 7 minerals. Sodium was a special case because the UL was used to set a level that should not be exceeded. Table 2 shows the goals for minerals that were selected for the 2000 kcal pattern.

*Establishing food groupings.* Dietary guidance for food intake is almost always based on broad food groups, such as fruits or grains. The food groups should be easily interpreted by consumers, but also relatively homogeneous in their nutrient profiles. As shown in Table 1, the MyPyramid food groups include six major groups: fruits, vegetables, grains, meat/beans, milk, and oils. Because the foods within two of the groups vary substantially in their content of nutrients of concern, subgroups were also established. The grains group was divided into whole and refined grains, while the vegetables group was divided into 5 subgroups to reflect the large differences in nutrients such as a pro-vitamin A carotenoids and vitamin C.

*Identifying nutrient contributions from each food group.* Nutrient profiles were calculated for each of the food groups based on the food reported in a recent national survey of over 8000 individuals.<sup>9</sup> For example, the nutrient profile for the fruits group would be a weighted average of all the fruits reported on the dietary recalls collected as part of the survey. Fruits such as orange juice, apple juice, and bananas would be heavily weighted in this nutrient profile because they are commonly consumed. Fruits such as plums and grapefruit would contribute less as they are less frequently reported in the survey.

*Determining recommended amounts from each food group.* Once the nutrient profiles for each food group were determined, the recommended patterns could be selected by a trial and error process. Different intake levels of each of the food groups and subgroups were tried, and compared to the nutritional goals previously established. The goal was to find a pattern of food intake that would meet the nutrient recommendations for individuals at each of the energy intake levels, but remain realistic and practical for American consumers. This process was repeated until patterns were determined for each of the 12 energy intake levels.

**Table 1.** Examples of MyPyramid Food Intake Patterns<sup>1</sup>

	Daily Amount 2000 kcal/d	Daily Amount 3000 kcal/d
Fruit	2 c/d	2.5 c/d
Vegetables	2.5 c/d	4 c/d
Dark Green	3 c/wk	3 c/wk
Orange	2 c/wk	2.5 c/wk
Dry beans and Peas	3 c/wk	3.5 c/wk
Starchy	3 c/wk	9 c/wk
Other	6.5 c/wk	10 c/wk
Grains	6 oz eq/d	10 oz eq/d
Whole grains	3 oz eq/d	5 oz eq/d
Refined grains	3 oz eq/d	5 oz eq/d
Meat and Beans	5.5 oz eq/d	7 oz eq/d
Milk	3 c/d	3 c/d
Oils	27 g/d	44 g/d

<sup>1</sup> from reference 7. c=cups; d=day; wk=week; oz eq=ounce equivalents; g=grams; 1 ounce equivalent of grains=1/2 c cooked rice, pasta, or cooked cereal; 1 ounce dry pasta or rice; 1 slice bread; 1 small muffin (1 oz); 1 cup ready-to-eat cereal flakes. 1 ounce equivalent of meat and beans=1 ounce lean meat, poultry, or fish; 1 egg; 1/4 cup cooked dry beans or tofu; 1 tablespoon peanut butter; 1/2 ounce nuts or seeds

*An example of a MyPyramid food pattern.* As shown in Table 1, the pattern that was eventually selected for a 2000 kcal/d energy intake level included 2 cups of fruits, 2.5 cups of vegetables, 6 ounce equivalents of grains, 5.5 ounce equivalents of meat and beans, 3 cups of milk, and 27 grams of oils. The mineral content of this food pattern is shown in Table 2, along with the mineral intake goals for a sedentary man 51-70 years old. The food pattern exceeds the goals for calcium, phosphorus, iron, zinc, and copper, but is slightly below the goals for magnesium and potassium. The sodium content of the pattern is below the maximum recommended sodium intake.

The 2000 kcal/d food intake pattern would also be appropriate for many sedentary women between 19 and 30 years of age, but their nutrient goals would be different than those for a sedentary older man for calcium, magnesium, iron, and zinc. When compared to the women's goals for these nutrients, the 2000 kcal/d pattern exceeds their nutrient goals for calcium, magnesium, and zinc, and is close to the goal for iron (97%). When the vitamins in the 2000 kcal/d food pattern are compared to the nutrient goals for both of these age/gender groups, all are exceeded, with the exception of vitamin E, which is only 63% of the goal. It was not possible to increase the vitamin E content of the patterns because US consumers typically use soybean oil rather than oils that are richer in vitamin E (sunflower and safflower oils). Text in the dietary guidelines suggests increased use of foods that are rich in vitamin E.<sup>8</sup> Likewise, the macronutrient levels in the pattern are generally within the nutritional goals. For example, protein and carbohydrate intakes for a person following the pattern would exceed the RDA, and dietary fiber intakes would exceed the AI. Intakes of saturated fat

**Table 2.** Comparison of mineral content of the 2000 kcal/d MyPyramid food pattern to nutrient goals for a sedentary man, 51-70 years of age<sup>1</sup>

	Nutrition content	Nutrient goal <sup>2</sup>	Present of goal
Calcium (mg)	1316	1200	110
Phosphorus (mg)	1740	700	249
Magnesium (mg)	380	420	90
Iron (mg)	17.5	8	219
Zinc (mg)	14.3	11	130
Copper (mg)	1.5	0.9	168
Sodium (mg)	1779	<2300	77
Potassium (mg)	4044	4700	86

<sup>1</sup>From reference 7. <sup>2</sup>Nutrient goals are RDAs for phosphorus, magnesium, iron, zinc, and copper; AIs for calcium and potassium, and the UL for sodium.

and cholesterol would be below the levels suggested by the dietary guidelines for Americans.<sup>8</sup>

In general, the MyPyramid food patterns at each level of energy provide nutrient intakes that meet the nutrient goals for each of the age, gender, and activity categories that fall within the energy intake level. More detailed information is provided in reference 7.

#### *An extension of the traditional approach for Canada's Food Guide*

The process similar to the one described for the development of the MyPyramid food patterns has been followed in the past in the US, and is also used in many other countries. It is a rigorous and transparent process, and does not rely on subjective judgments. However, it does assume that individuals who follow the food guides will choose a mix of foods within each food group that approximates the typical food choices that were reported during a national survey of food intakes. Thus, individuals who deviate significantly from these common food choices may not meet the nutritional goals even if they consume the specified amount of food from each of the food groups. For example, a person who never chose orange juice as a source of fruit might not meet the vitamin C goal. The patterns that were developed for Canada's Food Guide followed many of the procedures described for the US, but extended the approach to address this assumption.

To determine the recommended amounts from each food group within a pattern for Canada's Food Guide, a two-step modelling process was followed.<sup>4</sup> In the first step, a food pattern was selected that would approximately meet the nutrient goals. Then 500 simulated diets were generated, each of which followed the food pattern, but contained different mixes of specific foods within the food groups. For example, some of the simulated fruit groups might contain orange juice, and others might not. The nutrient profile of each of the simulated diets was then calculated and compared to the nutrient goals. If the goals were not achieved by a substantial proportion of the

simulated diets (typically, about 10% or more), then the patterns were revised and the simulations repeated.

One important advantage of the approach used in Canada was the assurance that the food patterns could be used by groups of individuals and would result in a low prevalence of nutrient inadequacy among those following the food patterns. Instead of comparing a single pattern to the RDA, it was possible to use the EAR cut-point approach to determine the prevalence of nutrient inadequacy among the 500 simulated diets.<sup>1</sup> If these diets represented 500 different people who were following a food intake pattern, then fewer than 10% of them would have inadequate dietary nutrient intakes.

#### SUMMARY

It is important to consider nutrient standards during the development of dietary guidelines. Although the process can be complex, the resulting guidance will help consumers select diets that are nutritionally adequate without exceeding guidelines for food components such as saturated fat and sodium.

#### AUTHOR DISCLOSURES

Suzanne P Murphy declares no conflict of interest for the work presented in this paper.

#### REFERENCES

1. Institute of Medicine. Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Washington DC: National Academies Press; 2006.
2. World Health Organization. Preparation and Use of Food-Based Dietary Guidelines. WHO Technical Report Series 880. Geneva: WHO, 1998.
3. Murphy S, Ed. Development of the MyPyramid Food Guidance System. *J Nutr Educ Behav.* 2006;38:S77-S161.
4. Katamay SW, Esslinger KA, Vigneault M, Johnston JL, Junkins BA, Robbins LG, Sirois IV, Jones-McLean EM, Kennedy AF, Bush MAA, Brulé D, Martineau C. Eating well with Canada's Food Guide (2007): Development of the food intake pattern. *Nutr Rev.* 2007;65:155-66.
5. Yoshiike N, Hayashi F, Takemi Y, Mizoguchi K, Seino F. A new food guide in Japan: The Japanese Food Guide Spinning Top. *Nutr Rev.* 2007;65:149-54.
6. Murphy SP, Barr SI. Food guides reflect similarities and differences in dietary guidance in three countries (Japan, Canada, and the United States). *Nutr Rev.* 2007;65:141-8.
7. Britten P, Marcoe K, Yamini S, Davis C. Development of food intake patterns for the MyPyramid Food Guidance System. *J Nutr Educ Behav.* 2006;38:S78-S92.
8. US Department of Health and Human Services, US Department of Agriculture. Dietary Guidelines for Americans 2005. Washington DC: US Government Printing Office, 2005.
9. Marcoe K, Juan WY, Yamini S, Carlson A, Britten P. Development of food group composites and nutrient profiles for the MyPyramid Food Guidance System. *J Nutr Educ Behav.* 2006;38:S93-S107.