

Carbohydrate Dietary Guidelines from Around the World

E-Siong Tee

President

Nutrition Society of Malaysia

Kuala Lumpur

Malaysia

Introduction

One of the identified strategies of the World Declaration and Plan of Action for Nutrition, adopted at the International Conference on Nutrition (ICN) in 1992, was the promotion of appropriate diets and healthy lifestyles. Member countries were urged to provide dietary guidelines to the public, relevant for different age groups and lifestyles and appropriate for the country's population.¹ Following up on the ICN, the FAO/WHO jointly held an expert consultation on the preparation and use of food-based dietary guidelines in 1995.² Dietary guidelines (DGs) are sets of advisory statements that give dietary advice for the population to promote overall nutritional well-being. DGs relate to all diet-related conditions. The FAO/WHO Consultation emphasized that DGs should be clearly differentiated from dietary goals and recommended nutrient intakes (RNI, RDA, or RDI). DGs are broad targets for which people can aim, while RNI indicate what should be consumed on the average every day. Hence, dietary guidelines need to reflect food patterns rather than numerical goals. It is preferable that the messages to the public be in terms of foods, i.e., food-based dietary guidelines (FBDGs).

FBDCs are developed in a specific socio-cultural context, and need to reflect relevant social, economic, agricultural and environmental factors affecting food availability and eating patterns. Public health issues should determine the direction and relevance of dietary guidelines. These guidelines need to be positive and encourage enjoyment of appropriate dietary intakes. Countries around the world have developed and been using dietary guidelines for many years. The purpose of the above mentioned FAO/WHO Consultation was to establish the scientific basis and recommended process for the development and evaluation of FBDGs in various regions of the world.

This paper aims to highlight those aspects of dietary guidelines that are related to carbohydrate nutrition. Several sections of the FAO/WHO Consultation on Carbohydrates in Human Nutrition, 1997 are first highlighted.³ The recommendations of the Consultation on the role of carbohydrates (including dietary fiber) in human nutrition and its role in the maintenance of health and disease are summarized. The relevant parts of the WHO Monograph on Diet, Nutrition & Prevention of Chronic Diseases pertaining to carbohydrates and dietary fiber are also briefly mentioned.⁴ The main part of the paper examines the dietary guidelines of 18 selected countries around the world, including Asian countries, Australia, New Zealand, Canada, USA, South Africa and some European countries. The references used are mostly official dietary guidelines from the Ministries of Health

or equivalent authorities and also include guidelines by professional bodies, e.g., nutrition, dietetics and medical associations. Only guidelines for adults are considered in the paper although it is recognized that several countries have developed guidelines for specific population groups such as children and pregnant mothers. The focus shall be on carbohydrates and dietary fiber recommendations in these guidelines. The interesting array of pictorial presentations of dietary recommendations from these countries shall also be discussed.

FAO and WHO Carbohydrate Dietary Guidelines

FAO/WHO Joint Expert Consultation on Carbohydrates in Human Nutrition

The report of the FAO/WHO Joint Expert Consultation on Carbohydrates in Human Nutrition, 1997 (1997 Report) touched on several aspects of the subject, including the basic description and physiology of carbohydrates, their role in maintenance of health and causation of diseases, the role of glycemic index in food choice as well as goals and guidelines for carbohydrate food choices. Some of the recommendations that the Consultation made in the context of the role of carbohydrates in nutrition are summarized as follows:

- The many health benefits of dietary carbohydrates should be recognized and promoted.
- Carbohydrate foods provide more than energy alone.
- Energy balance should be maintained by consuming a diet containing at least 55% total energy from carbohydrate from various sources and engaging in regular physical activity.
- Carbohydrates, including carbohydrate-containing beverages, should not be consumed above optimum levels for recreational physical activity purposes. Higher carbohydrate intakes are only needed for long-term extreme endurance physical activities.
- A wide range of carbohydrate-containing foods should be consumed so that the diet is sufficient in essential nutrients as well as total energy, especially when carbohydrate intake is high. The bulk of carbohydrate-containing foods consumed should be those rich in non-starch polysaccharides and with a low glycemic index. Processed cereals, vegetables, legumes, and fruits are particularly good food choices.
- A nutrient-dense, high carbohydrate diet may be considered optimal for the elderly, but individualization is recommended because their specific nutritional needs are complex.

The 1997 Report also noted that excess energy intake in any form will cause body fat accumulation. Excessive intakes of sugars which compromise micronutrient density should be avoided. There is, however, no evidence of a direct involvement of sucrose, other sugars and starch in the etiology of lifestyle-related diseases.

WHO Monograph on Diet, Nutrition & Prevention of Chronic Diseases

The WHO Monograph on Diet, Nutrition & Prevention of Chronic Diseases also makes several references to the importance of carbohydrates and dietary fiber in human health.⁴ In the ranges of population nutrient intake goals tabulated in Table I, references have also been made to total carbohydrates, free sugar and dietary fiber. Population nutrient intake goals represent the population average intake that is judged to be consistent with the maintenance of health in a population. For carbohydrates, this goal has been recommended to be from 55% to 75% of the total energy intake.

whereas free sugars intake is to be less than 10%. A high daily intake of more than 400g of fruits and vegetables has been recommended. Total dietary fiber has been recommended to be more than 25 gram per day, of which more than 20 gram should be from non-starch polysaccharides (NSP). Whole grain cereals, fruit and vegetables are the preferred sources of NSP, of which the major components are the polysaccharides of the plant cell wall such as cellulose, hemicellulose and pectin.

Table 1. Ranges of population nutrient intake goals¹

Dietary factor	Goal (% of total energy)
Total fat	15-30%
Saturated fatty acids	<10%
Polyunsaturated fatty acids (PUFAs)	6-10%
n-6 Polyunsaturated fatty acids (PUFAs)	5-8%
n-3 Polyunsaturated fatty acids (PUFAs)	1-2%
Trans fatty acids	<1%
Monounsaturated fatty acids (MUFAs)	9-13%
Total carbohydrate	55-75%
Free sugars	<10%
Protein	10-15%
Cholesterol	<300 mg per day
Sodium chloride (sodium)	<5 g per day
Fruits and vegetables	≥400 g per day
Total dietary fiber	> 25 g per day
Non-starch polysaccharides (NSP)	> 20 g per day

The WHO Monograph also presents the strength of evidence on factors that might promote or protect against various chronic diseases.⁴ Those factors that are related to carbohydrates are extracted and presented in Table 2. Dietary fiber has been specified to have "convincing" evidence for being protective against obesity and "probably" beneficial for Type 2 diabetes and cardiovascular diseases (CVD). Wholegrain cereals are also probably protective against CVD. With regard to dental disease, the consumption of free sugars has been convincingly shown to promote the condition, whereas sugar-free chewing gum may have protective effect. There is no relationship between the consumption of starch and dental disease.

Table 2. Strength of evidence on carbohydrate factors that might promote or protect against chronic diseases⁴

	Obesity	Type 2 diabetes	CVD	Cancer disease	Dental porosis	Osteo-porosis
High intake of NSP (dietary fiber)	C↓	P↓	P↓			
Free sugars (frequency and amount)				C↑		
Sugar-free chewing gum				P↓		
Starch				C-NR		
Whole grain cereals			P↓			

Notes:

C, convincing

P, probable

NR, no relationship

Carbohydrate Dietary Guidelines in Southeast Asia

Malaysian Dietary Guidelines (1999)

The Malaysian dietary guidelines developed by the Ministry of Health Malaysia with the collaboration of an inter-sectoral, multi-agency committee³ include the following three messages that are relevant to this paper

- Enjoy a variety of foods;
- Eat more rice and other cereal products, legumes, fruit and vegetables, and
- Reduce sugar intake and choose foods low in sugar.

The aims of these messages are to ensure that an individual meets all of his nutrient needs by eating a wide variety of foods; to encourage balanced meals with emphasis on consumption of grain products, legumes, vegetables and fruits; and to highlight that sugars are devoid of other nutrients and tend to displace more nutritious foods from the diet.

In an elaboration of the first of the 3 listed main messages, the Guidelines explain the reason for eating a variety of foods. Obtaining the nutrients the body needs depends on the amount and variety of foods that an individual eats daily. All foods can be enjoyed as part of a nutritious diet. The best way to ensure that an individual meets all of his nutrient needs is to eat a variety of foods.

In an elaboration of the second message above, the Guidelines encourage a balanced meal with emphasis on consumption of grain products for example rice, corn, wheat, wheat products, oats, barley, legumes, vegetables and fruits. Cereal products, legumes, vegetables and fruits provide complex carbohydrates, vitamins, minerals, fibers and other components that are important for good health. It is further explained that complex carbohydrates, also known as polysaccharides include starch and fiber. The Guidelines also provide some brief notes on dietary fiber, its sources and importance to human health. The recommended intake for fiber is 20g to 30g per day. It is also pointed out that the approach should ensure that the diet is not only rich in fiber but also balanced in the other nutrients that the body needs.

The third message above highlights that sugars are devoid of other nutrients and tend to displace other more nutritious foods from the diet. The Guidelines also emphasize on the importance of looking out for "hidden sugars" in a variety of foods including desserts, ice cream, candies, pastries, cookies, soft and sweetened drinks, *kuih* and syrups.

While emphasizing the importance of looking out for "hidden sugars" in a variety of foods, the Guidelines further explain that complex carbohydrates, also known as polysaccharides, include starch and fiber. Brief notes on dietary fiber, its sources and importance to human health are also provided, with the recommended intake of 20g to 30g fiber per day.

Singapore Dietary Guidelines (2003)

The 2003 Singapore Dietary Guidelines by the Singapore Health Promotion Board⁴ include four messages that are related to carbohydrates:

- Enjoy a variety of foods using the healthy diet pyramid as a guide;
- Eat sufficient amounts of grains, especially whole grains;
- Eat more fruit and vegetables every day; and
- Choose beverages and food with less sugar.

The Singapore Food Pyramid places grains and grain products at the base of the pyramid as they are a major component of the diet. The Guidelines also encourage the consumption of whole grains or unpolished grains as they contain more vitamins, minerals, dietary fiber and phytochemicals than refined grains.

In addition to encouraging increased consumption of fruit and vegetables, the explanatory notes proceed to explain the beneficial health effects of soluble fiber and insoluble fibers found in fruit and vegetables, including lowering blood cholesterol, promoting healthy bowel function as well as lowering risk to diseases such as heart disease, stroke and certain types of cancers.

The Guidelines also highlight that sugars are found naturally in many foods such as milk, fruit and vegetables. Sugars are also added during food processing or preparation, and frequent consumption of sweet foods and drinks between meals promotes dental caries, especially if oral hygiene is neglected. The Guidelines recommend reduction in the intake of added sugar, to no more than 10% of dietary energy.

Dietary Guidelines of Thailand (2001)

The Thai National Dietary Guidelines are jointly developed by the Institute of Nutrition, Mahidol University and the Ministry of Public Health.⁷ Four of these messages are relevant to carbohydrate nutrition:

- Eat a variety of foods from each of the 5 food groups and maintain proper weight;
- Eat adequate amount of rice or alternative carbohydrate sources;
- Eat plenty of vegetables and fruit regularly; and
- Avoid sweet and salty foods.

To provide a pictorial guide to the consumer in choosing the correct "portion", "quantity" and "variety" of foods required daily, Thailand has adopted the "Nutrition Flag" (See Table 3) which is conceptually similar to the food pyramid. The Guidelines note that fiber in vegetables and fruit helps the body to remove waste as well as eliminate cholesterol and some carcinogenic compounds. It is also highlighted that unpolished rice or home-pounded rice is more nutritious than milled rice as it contains substantial amounts of important nutrients such as protein, fat, dietary fiber, minerals and vitamins. The Guidelines further recommend that not more than 10% of a person's total food energy should be from sugar.

Dietary Guidelines of the Philippines (2000)

The official Dietary Guidelines of the Philippines, developed by the Food and Nutrition Research Institute (FNRI),⁸ has two messages that are relevant to carbohydrates:

- Eat a variety of foods everyday; and
- Eat more vegetables, fruit and root crops

The Guidelines provide information on each of the major nutrients required, food groups and the concepts of a balanced diet. Consumers are encouraged to consume more vegetables, fruit and root crops, such as potato, sweet potato, yam, cassava and taro, in order to tackle the micronutrient deficiencies that are prevalent amongst some segments of the population. Eating root crops will also add dietary energy to the meal. In addition, these foods also provide dietary fiber in the diet. The supporting notes in the Guidelines provide details of the nutritional value of vegetables, fruits and root crops.

The Dietary Guidelines booklet of FNR⁸ (2000) does not have a food guide pyramid. The Institute had, however, published a pyramid guide separately. The Philippines Association for the Study of Obesity (PASOO) also published a pictorial guide for healthy eating (See Table 3).

Dietary Guidelines of Indonesia (2003)

The Dietary Guidelines of Indonesia are developed by the Department of Health.⁹ Two of these messages are relevant to carbohydrate nutrition:

- Eat a variety of foods; and
- Consume carbohydrate foods to meet half of energy needs.

The Indonesian Dietary Guidelines have adopted the cone as a pictorial guide, which is in principle similar to the food pyramids used by several other countries. The Guidelines recommend that approximately 50% to 60% of the energy needs of an individual should be derived from complex carbohydrates such as rice, maize, tubers and sago. Consumption of sugars or simple carbohydrates should not exceed 5% of the total energy requirement of an individual.

The Guidelines do not include specific messages about dietary fiber. However, they emphasize the importance of having a balanced diet and sufficient dietary fiber intake (25 gram per day) to prevent or reduce risk of degenerative diseases such as coronary heart disease, hypertension and diabetes mellitus.

Dietary Guidelines of Brunei Darulssalam (2000)

The Brunei Ministry of Health Dietary Guidelines¹⁰ include four messages that are related to carbohydrate nutrition:

- Eat a variety of foods from each of the groups according to the amounts recommended;
- Eat 2 to 3 servings of vegetables and 2 to 3 servings of fruit everyday;
- Prepare dishes that are less salty and less sweet; and
- Enjoy more legumes and cereal foods.

As a pictorial guide to the consumer, Brunei Darulssalam has adopted the food trays, with four layers of different sizes. Conceptually, it is similar to the food pyramid and the largest tray is at the bottom, containing complex carbohydrate foods such as rice and rice products, wheat and wheat products and tubers. The smallest tray at the top, contains fats and oils, sugars and salt.

Dietary Guidelines of Vietnam (1997)

The Vietnamese Guidelines for appropriate food intake, jointly developed by the National Institute of Nutrition and the Vietnam Woman's Union,¹¹ has two key messages that are related to carbohydrate nutrition:



- Consume a small amount of sugar; and
- Increase the intake of vegetables, tubers and fruit.

Sugar has been specifically mentioned in the Guidelines, and it is recommended that a person should only consume an average of 500g of sugar per month. The Guidelines also provide recommended amounts of the other food groups that should be consumed per month.

Table 3. Carbohydrate (and dietary fiber) related key messages in the dietary guidelines of Southeast Asian countries

Country	Food Guide	Variety	Cereals and Grains, Root Crops (Legumes)	Fruit and Vegetables	Sugar
Malaysia (1999)		Enjoy a variety of foods.	Eat more rice and other cereal products, legumes.	Eat more fruit and vegetables.	Reduce sugar intake and choose foods low in sugar.
Singapore (2003)		Enjoy a variety of foods using the healthy diet pyramid as a guide.	Eat sufficient amounts of grains, especially whole grains.	Eat more fruit and vegetables every day.	Choose beverages and food with less sugar.
Thailand (2000)		Eat a variety of foods from each of the 5 food groups and maintain proper weight.	Eat adequate amount of rice or alternative carbohydrate sources.	Eat plenty of vegetables and fruit regularly.	Avoid sweet and salty foods.
Philippines (2000)		Eat a variety of foods everyday.	Eat more fruit, vegetables and rice crops.	Consume milk, milk products or other calcium rich foods such as small fish and dark green leafy vegetables everyday.	-
Indonesia (2003)		Eat a variety of foods.	Obtain about half of total energy from complex carbohydrate-rich food.	-	-

Table 3 Carbohydrate (and dietary fiber) related key messages in the dietary guidelines of Southeast Asian countries (continued)

Country	Food Guide	Variety	Cereals and Grains, Root Crops (legumes)	Fruit and Vegetables	Sugar
Brunei Darussalam (2001)		Eat a variety of foods from each of the groups, according to the amounts recommended.	Enjoy more legumes and cereals.	Take 2-5 servings of vegetables, ulam and 3 servings of fruit every day.	Take foods that are less salty and less sweet.
Vietnam (1997)			Increase intake of vegetables, fruit, and tubers.	Increase intake of vegetable and fruit.	Consume a small amount of sugar.

Dietary Guidelines of China (1997)

Guidelines for the general population of the People's Republic of China has two messages which are related to carbohydrate nutrition:²⁸

- Eat a variety of foods, with cereals as the staple; and
- Consume plenty of vegetables, fruit and tubers.

The Dietary Guidelines released by the Chinese Nutrition Society emphasize the importance of maintaining the favorable traditional Chinese diet which comprises primarily of cereals. Additionally, the cereals in the diet should include a certain amount of coarse grains such as millet and corn, other than refined or milled rice and wheat flour. The Guidelines also emphasize the importance of consuming plenty of vegetables, fruits and tubers for the prevention of cardiovascular diseases, enhancement of immunity, reduction of risk of blindness and increased mortality in young children and even prevention of some cancers. Vegetables and fruit are rich in a variety of vitamins, minerals and dietary fiber. Besides vitamins and minerals, tubers are also rich in starch and dietary fiber.

To help consumers put the dietary guidelines into practice, the Food Guide Pagoda provides a visual guide to the types and amounts of foods to be consumed in order to achieve a balanced diet. Culturally more familiar to the Chinese people, the pagoda is nevertheless based on the same principles as the food pyramid, with the foods to be consumed most at the base of the pagoda and decreasing at the higher levels of the structure. Carbohydrate-rich and fiber-containing cereals and cereal products are at the base of the pagoda, whereas fats and oils are placed at the top. The amount to be consumed are given in weight (grams).

Dietary Guidelines of Japan (2000)

In the dietary guidelines for Japanese, proposed by the Ministry of Health, Labour and Welfare,⁷ four messages relate to carbohydrate nutrition:

- Eat well-balanced meals with staple food, as well as main and side dishes
- Eat enough grains such as rice and other cereals,
- Combine vegetables, fruit, milk products, beans and fish in your diet, and
- Take advantage of your dietary culture and local food products, while incorporating new and different dishes.

The Guidelines emphasize the importance of eating a variety of foods cooked in various ways. They also encourage individuals to combine home-made meals wisely with processed and prepared foods eaten out. Intake of sufficient grains such as rice and other cereals is encouraged to maintain adequate intake of energy from carbohydrates. The importance of consuming sufficient amounts of vegetables and fruit everyday to obtain enough vitamins, minerals and dietary fiber is further highlighted.

Dietary Guidelines of Republic of Korea (2002)

The Dietary Guidelines of Korea⁸ have two messages that are related to carbohydrate intake and emphasizes on rice consumption:

- Eat a variety of grains, vegetables and fruits, fish, meat, poultry and dairy products; and
- Enjoy a rice-based diet.

The Guidelines include action guides for adults and the elderly. A food pagoda is also used as a pictorial guide on food choices to the consumer.

Dietary Guidelines of India (1998)

The Indian Dietary Guidelines were developed by the National Institute of Nutrition in Hyderabad, India.⁹ Five of the key messages deemed relevant to carbohydrate nutrition, are listed below:

- A nutritionally adequate diet should be consumed through a wise choice from a variety of foods.
- Plenty of green leafy vegetables, other vegetables and fruit should be consumed; and
- Processed and ready-to-eat foods should be used judiciously. Sugar should be used sparingly.

The supporting notes for message 1 above, highlight the importance of consuming nutritionally adequate diet, providing all essential nutrients in the required amounts at any age throughout life. Daily intakes lower or higher than the body requirements can lead to under-nutrition (deficiency diseases) or over-nutrition (diseases of affluence), respectively. In a balanced diet, carbohydrates, preferably starch, should provide around 60% to 70% of total calories, proteins should provide about 10% to 12%, and fat should provide about 20% to 25%. In addition, a balanced diet should provide other non-nutrients such as dietary fiber, antioxidants and phytochemicals which provide positive health benefits. The required nutrients must be obtained through judicious choices and combination of a variety of foods.

Dietary Guidelines of Australia (2002)

The key messages in the official Australian Dietary Guidelines, developed by the National Health and Medical Research Council, include four messages that are related to carbohydrates nutrition¹⁶

- Enjoy a wide variety of nutritious foods.
- Eat plenty of vegetables, legumes and fruit.
- Eat plenty of cereals, preferably whole grains; and
- Consume only moderate amounts of sugars and foods containing added sugars

The food plate is used as a guide to the choice of types of food and the amounts of each to be consumed daily. Consumers are encouraged to consume plenty of vegetables, legumes (lentils, beans and peas) and fruit. Together with nuts and seeds, these foods provide the body with many of the essential nutrients needed daily. In addition, they also protect against the ageing process and common diseases such as high blood cholesterol, diabetes, cataracts in the eyes and even some forms of cancers. Cereals (including wheat, maize, rice, barley, sorghum, oats, rye and millet) form the foundation of the daily meals and are highlighted in the third key message above. These foods are eaten in relatively large amounts and provide half the energy and half the protein needs of communities. They are also excellent sources of B-group vitamins and contain useful amounts of vitamin E, essential fatty acids, minerals and dietary fiber. The Guidelines also recognize that sugar does provide extra calories in the diet without adding any other beneficial nutrients, and plays a significant role in tooth decay. Hence, the Guidelines recommend consuming only moderate amounts of sugars and foods containing added sugars.

Table 4. Carbohydrate (and dietary fiber) related key messages in the dietary guidelines of other Asian countries and Australia






Country	Food Guide	Variety	Cereals and Grains, Root Crops (Legumes)	Fruit and Vegetables	Sugar
China (1997)		Enjoy a variety of foods	Use cereals as the staple food. Consume beans or bean products everyday.	Consume plenty of vegetables, fruit and tubers.	
Japan (2000)		<p>Eat well-balanced meals with staple food, as well as main and side dishes. Combine vegetables, fruit, milk products, beans and fish in your diet.</p>	<p>Eat enough grains such as rice and other cereals.</p>	<p>Eat enough of vegetables and fruit everyday to get vitamins, minerals and fiber.</p>	

Table 4. Carbohydrate (and dietary fiber) related key messages in the dietary guidelines of other Asian countries and Australia (continued)

Country	Food Guide	Variety	Cereals and Grains Root Crops (Legumes)	Fruit and Vegetables	Sugar
Republic of Korea (2002)			• Eat a variety of grains. Enjoy your rice-based diet.	• Eat a variety of vegetables and fruit.	
India (1998)		• Nutritionally adequate diet should be consumed through wise choices from a variety of foods.		• Green leafy vegetables, other vegetables, and fruit should be used in plenty.	• Processed and ready-to-eat foods should be used judiciously. Sugar should be used sparingly.
Australia (2002)		• Enjoy a variety of nutritious foods.	• Eat plenty of cereals, preferably whole grain; eat plenty of legumes.	• Eat plenty of vegetables and fruit.	• Consume only moderate amounts of sugars and foods containing added sugars.

Dietary Guidelines of the USA (2005)

The US Department of Health and Human Services and the US Department of Agriculture jointly released the new Dietary Guidelines for Americans in 2005. Three of the 10 chapters contain messages that are related to carbohydrate nutrition:²⁷

- Adequate nutrients within calorie needs (Chapter 2);
- Food groups to encourage (Chapter 5); and
- Carbohydrates (Chapter 7);

In Chapter 2, the Guidelines point out that many Americans consume more calories than they need without meeting recommended intakes for a number of nutrients. Hence, the Dietary Guidelines recommend that most people need to choose meals and snacks that are high in nutrients but low to moderate in energy content; that is, meeting nutrient recommendations must go hand in hand with keeping calories under control. Doing so offers important benefits - normal growth and development of children, health promotion for people of all ages, and reduction of risk for a number of chronic diseases that are major public health problems. The emphasis was to consume a variety of nutrient-dense foods and beverages within and among the basic food groups while choosing foods that limit intake of saturated and trans fats, cholesterol, added sugars, salt, and alcohol.

The dietary guidelines also emphasize that intake levels of the following nutrients may be of concern for adults: calcium, potassium, fiber, magnesium, and vitamins A (as carotenoids), C, and E. For children and adolescents, the following nutrients are important: calcium, potassium, fiber, magnesium, and vitamin E. For specific population groups (e.g., pregnant women and the elderly), vitamin B12, iron, folic acid, and vitamins E and D are important.

Chapter 5 of the Dietary Guidelines emphasizes the important health effects of increased intakes of fruit, vegetables, whole grains, and fat-free or low-fat milk and milk products. The consumer is encouraged to choose a variety of fruits and vegetables each day, particularly, dark green, orange, legumes, starchy vegetables, and other vegetables. An array of evidence points to beneficial health effects of increased intake of fruit and vegetables and reduced risk of chronic diseases including stroke and perhaps other cardiovascular diseases, Type 2 diabetes, and cancers in certain sites (oral cavity and pharynx, larynx, lung, esophagus, stomach, and colon-rectum). Diets rich in foods containing fiber, such as fruit, vegetables, and whole grains, may reduce the risk of coronary heart disease. Diets rich in milk and milk products can reduce the risk of low bone mass throughout the life cycle. The consumption of milk products is especially important for children and adolescents who are building their peak bone mass and developing lifelong habits. Although each of these food groups may have a different relationship with disease outcomes, the adequate consumption of all food groups contributes to overall health.

Chapter 7 emphasizes that carbohydrates are part of a healthful diet, contributing 45% to 65% of total calories. Dietary fiber is composed of nondigestible carbohydrates and lignin, intrinsic and intact in plants. Diets rich in dietary fiber have been shown to have a number of beneficial effects, including decreased risk of coronary heart disease and improvement in laxation. There is also interest in the potential relationship between diets containing fiber-rich foods and lower risk of Type 2 diabetes. Sugars and starches supply energy to the body in the form of glucose, which is the only energy source for red blood cells and is the preferred energy source for the brain, central nervous system, placenta, and fetus. Sugars can be naturally present in foods (such as the fructose in fruit or the lactose in milk) or added to the food. Added sugars, also known as caloric sweeteners, are sugars and syrups that are added to foods at the table or during processing or preparation (such as high fructose corn syrup in sweetened beverages and baked products). Although the body's response to sugars does not depend on whether they are naturally present in a food or added to the food, added sugars supply calories but few or no nutrients.

Consequently, it is important to choose carbohydrates wisely. Foods in the basic food groups that provide carbohydrates - fruit, vegetables, grains, and milk - are important sources of many nutrients. Choosing plenty of these foods, within the context of a calorie-controlled diet, can promote health and reduce chronic disease risk. However, the greater the consumption of foods containing large amounts of added sugars, the more difficult it is to consume enough nutrients without gaining weight. Consumption of added sugars provides calories while providing little, if any, of the essential nutrients.

In 2005, the United States Department of Agriculture²⁸ released a new food pyramid to help consumers choose the appropriate types and amounts of foods. An online version of MyPyramid (www.mypyramid.gov) has been made available. MyPyramid makes recommendations for the amounts (given in cups and ounces) of each of the main food groups, namely grains, vegetables, fruits, milk

and meat and beans to be consumed daily, taking into consideration the activity level of the individual. For each food group, the Guidelines provide brief notes on the types of foods and the nutritional properties.

Dietary Guidelines of Canada (1997)

Canadian Dietary Guidelines were released by Health Canada, the Federal department responsible for helping Canadians maintain and improve their health a few years ago.¹⁹ Two of them relates to carbohydrates nutrition:

- Enjoy a variety of foods; and
- Emphasize cereals, breads and other grain products, vegetables and fruit.

The Guidelines recommend that the Canadian diet should provide 55% of energy as carbohydrate from a variety of sources. Eating patterns that are high in complex carbohydrate and fiber are associated with a lower incidence of heart disease and certain types of cancer. Canada's Food Guide to Healthy Eating promotes carbohydrates in a rainbow design that places grain products, vegetables and fruit in the outermost arcs and shows a wide range of foods in both groups. A larger number of servings are recommended for both grain products and vegetables and fruit. Consumers are also encouraged to choose dried peas, beans and lentils more often, as alternatives to meat.

The Food Guide also discusses the consumption of simple carbohydrates and sugars. Sugars occur naturally in foods like milk, fruit and vegetables, as well as fructose, dextrose, liquid invert sugar, molasses, honey and corn syrup. Examples of foods that are mostly sugars are soft drinks, candy and jams. All added sugars, including honey and molasses, contribute primarily energy and taste and have no other significant nutritional advantages. With the exception of dental caries, there is no conclusive evidence that sugars, when consumed at current levels, are hazardous to the health of the general public. However, people with lower energy needs may need to be more careful with their intake of foods that are high in sugar in addition to foods that are high in fat because they may not need to consume this extra energy.

Dietary Guidelines of the UK (2004)

The Dietary Guidelines of the Department of Health, UK has the following four key messages that relate to carbohydrate nutrition:²⁰

- Eat a variety of different foods;
- Eat plenty of foods rich in starch and fiber;
- Eat plenty of fruit and vegetables; and
- Don't have sugary foods and drinks too often.

The Balance of Good Health (BGH), a pictorial representation of the recommended balance of foods in the diet, is in the shape of a plate. It shows the types of foods and the proportion in which they should be eaten to have a well-balanced, healthy diet. BGH is based on five food groups. Choosing a variety of foods from the first four groups every day will provide the body with the wide range of nutrients needed. Foods in the fifth group - foods containing fat and foods containing sugar

- are not essential to a healthy diet but add extra variety, choice and palatability to meals. This group of foods should form the smallest part of the diet.

Dietary Guidelines for Adults in Greece (2000)

The Greek Dietary Guidelines, issued by the Hellenic Ministry of Health, also emphasize eating a variety of foods.²¹ As with the other guidelines reviewed so far, the emphasis is for the consumer to consume carbohydrate and dietary fiber-rich cereals and products, particularly non-refined ones. These foods, such as wholegrain bread, whole grain pasta and brown rice, etc., are placed at the base of the pictorial presentation of the food-based dietary guidelines, in the shape of a pyramid. Sweets are close to the top of the pyramid and are to be consumed weekly. The Guidelines encourage the consumption of fruits and nuts as snacks, instead of sweets or candy bars and water instead of soft drinks.

South African Food-Based Dietary Guidelines (2001)

There are 10 prime messages in the South African Dietary Guidelines,²² four of which are related to carbohydrates and elaborated below.

- Enjoy a variety of foods;
- Make starchy foods the basis of most meals;
- Eat plenty of fruit and vegetables; and
- Eat dry beans, split peas, lentils and soya regularly.

The key message of making starchy foods the basis of most meals is directly relevant to this paper. Starchy or high carbohydrate foods such as cereals, grains and some root vegetables, the main sources of dietary energy and valuable sources of micronutrients and dietary fiber when they are eaten in minimally processed forms. These foods also contribute protein to the diet. Foods rich in carbohydrates in the form of starch, resistant starch, sugars and non-starch polysaccharides or dietary fiber, influence health and prevent chronic diseases by various effects and mechanisms.

The recommendation to eat dry beans, peas, lentils and soy regularly is one of the key messages in the South African dietary guidelines. Also known as legumes, these foods are rich and economical dietary sources of good quality protein, carbohydrates, soluble and insoluble dietary fiber components and a variety of minerals and vitamins. In addition, soya beans also contribute significantly to polyunsaturated fatty acid intake, including α -linolenic acid, an n-3 fatty acid not commonly found in plant foods. Legumes are excellent foods to increase dietary fiber consumption and most individuals can incorporate legumes into their diet without difficulty. Including legumes in a health-promoting diet is important to meet the major dietary recommendations to improve the nutritional status of undernourished as well as to reduce risk for chronic diseases such as cardiovascular disease, diabetes mellitus, cancer and osteoporosis.

Dietary Guidelines of Argentina (2000)

The dietary guidelines developed by the Argentine Dietitian and Nutritionist Association has 10 recommendations for healthy living; three of them refer to carbohydrates (and fiber) consumption:²³

- Consume a variety of breads, grains and cereals, pasta, flour, starches and legumes (dry beans);
- Reduce the consumption of sugar and salt, and
- Consume a variety of vegetables and fruit each day.

Grains in these Dietary Guidelines include rice, maize, wheat, oat, barley and rye, whereas legumes include lentils, peas and soya bean. The Guidelines also encourage the consumption of whole grain products. Calories from carbohydrate is recommended to contribute 50% to 60% of total daily energy requirement. An intake of 25g to 30g of dietary fiber a day is recommended.

The Guidelines also recommend reducing consumption of sugar and limiting food and beverages with added sugar for occasional situations. With regards to fruit and vegetables, five portions of these are recommended each day. It is also encouraged to consume raw vegetables and fruit at least once a day. For cooking, large pieces of vegetables with their skin are recommended to be steamed or boiled in a small amount of water.

Instead of a pyramid, the Argentine Dietary Guidelines have adopted the use of an oval pictorial with the graphics of six food groups, starting with water.

Table 5. Carbohydrate (and dietary fiber) related key messages in the dietary guidelines of other countries






Country	Food Guide	Variety	Cereals and Grains, Root Crops (Legumes)	Fruit and Vegetables	Sugar
United States of America (2005)		Consume a variety of nutrient-dense foods and beverages within and among the basic food groups.	Choose fiber-rich fruits, vegetables, and whole grains often.	Choose a variety of fruit and vegetables each day. In particular, select from all five vegetable subgroups (dark green, orange, legumes, starchy vegetables, and other vegetables) several times a week.	Choose and prepare foods and beverages with little added sugars or caloric sweeteners.
Canada (1997)		Enjoy a variety of foods.	Emphasize cereals, bread, other grain products.	Emphasize vegetables and fruit.	
United Kingdom (2004)		Eat a variety of different foods.	Eat plenty of foods rich in starch and fiber.	Eat plenty of fruit and vegetables.	Do not have sugar-containing foods and drinks too often.

Table 5. Carbohydrate (and dietary fiber) related key messages in the dietary guidelines of other countries (continued)

Country	Food Guide	Variety	Cereals and Grains, Root Crops (Legumes)	Fruit and Vegetables	Sugar
Greece (2000)		Food variability (variety of foods).	Cereals, potatoes, pulses.	Vegetables and fruit.	Sugars.
South Africa (2000)		Enjoy a variety of foods.	Make starchy foods the basis of most meals; eat dry beans, peas, lentils and soya often.	Eat plenty of fruit and vegetables.	
Argentina (2000)			Consume a variety of breads, grains (rice, maize, wheat, oat, barley, rye, etc) especially whole grains and cereals, pasta, flours, starches and legumes (dry beans)	Consume a variety of vegetables and fruit each day.	Reduce the consumption of sugar.

Discussions and Conclusions

The dietary guidelines of 18 countries across seven regions of the world have been reviewed in this paper. Two key expert consultation reports of the FAO and WHO have also been reviewed and the relevant information discussed.²⁴ The key messages of each of the country guidelines were examined and those messages related to carbohydrates (including dietary fiber) were listed out and discussed. It is evident that there is a great deal of similarity across the countries surveyed.

Guidelines of some of the countries also emphasized nutrient-dense foods and beverages. All but one of the countries (India) support the consumption of cereals, grains and root crops to provide carbohydrate (starch) as the main source of energy for daily activities, as well as dietary fiber, vitamins, minerals and phytochemicals that are important for health. Several countries, namely Malaysia, Thailand, Korea, Japan and Argentina, focus specifically on rice as one of the recommended cereals. A few countries - Singapore, Australia, USA and Argentina - further encourage consumption of whole grains for their dietary fiber content.

Although not specifically mentioned in the key messages, all guidelines reviewed stated the importance of dietary fiber to human health in their supporting notes. This mention of dietary fiber can be in conjunction with consuming cereals and grains and legumes, as well as with increasing intake of fruits and vegetables. Several countries specifically mentioned the association of fiber consumption and lowering risk of chronic diseases. The amount of dietary fiber recommended for daily consumption is not specifically mentioned in most of the dietary guidelines with the exception of 2 countries - Malaysia (20g to 30g per day) and Indonesia (25g per day). In the WHO (2003) nutrient intake

goals,* the recommended total dietary fiber per day is more than 25g, of which more than 20g should be from non-starch polysaccharides. WHO (2003) has indicated dietary fiber as having "convincing" evidence for being protective against obesity and "probably" beneficial for Type 2 diabetes and cardiovascular diseases (CVD). Whole grain cereals are also probably protective against CVD.

The message on sugar is less consistent for all the countries surveyed. Eleven of the 18 countries (Malaysia, Singapore, Thailand, Brunei, Vietnam, India, Australia, USA, UK, Greece and Argentina) have a key message recommending consuming less sugar or less sweet foods. These foods are generally placed at the tip of the pyramid or comprise the smallest portion of the food plate. Even for those countries with key a message on sugar or sweet foods, the supporting information on this message is not consistent. The message is generally to reduce intake of sugars, and the amount is not stipulated. A few countries do recommend reduced intake of added sugar to no more than 5% (Indonesia) or 10% (Singapore and Thailand) of dietary energy. The WHO (2003) population nutrient intake goals⁴ have recommended daily free sugars intake to be not more than 10% of total energy intake.

Dietary guidelines should remain as important educational tools in promoting healthy eating amongst the community. There should be greater efforts amongst all relevant parties to make these truly effective tools. FAO and WHO should continue to play leadership roles in making dietary guidelines as one of the effective strategies for the promotion of appropriate diets and healthy lifestyles.

References

1. FAO/WHO (1992). *World Declaration and Plan of Action for Nutrition*. Food and Agriculture Organization, Rome.
2. FAO/WHO (1998a). *Preparation and Use of Food-Based Dietary Guidelines Report of a joint FAO/WHO Consultation*. WHO Technical Report Series 880. World Health Organization, Geneva.
3. FAO/WHO (1998b). *Carbohydrates in Human Nutrition*. FAO Food and Nutrition Paper 66. Report of a Joint FAO/WHO Expert Consultation, Rome, 14-18 April, 1997. Rome.
4. WHO (2003) *Diet, Nutrition and the Prevention of Chronic Diseases. Report of a Joint FAO/WHO Expert Consultation*. WHO Technical Report Series 916. World Health Organization, Geneva.
5. NCCFN (1999). *Malaysian Dietary Guidelines. National Coordinating Committee on Food and Nutrition*. Ministry of Health Malaysia, Kuala Lumpur.
6. HPB (2003). *Dietary Guidelines 2003 For Adult Singaporeans (18-65 years)*. Health Promotion Board, Singapore.
7. MIU & MPH (2001). *Food Based Dietary Guidelines for Thai*. Institute of Nutrition, Mahidol University and Nutrition Division, Department of Health, Ministry of Public Health, Thailand.
8. FNRI (2000). *Nutritional Guidelines for Filipinos*. Food and Nutrition Research Institute, Department of Science and Technology, Manila, Philippines.
9. DHRI (2003). *Pedoman Umum Gizi Seimbang (Panduan Untuk Petugas) (General Guide for Balanced Diet)*. Community Health Development Directorate-General, Community Nutrition Directorate, Department of Health, Republic of Indonesia.
10. MOHBD (2002). *Panduan Pemakanan Kebangsaan (National Dietary Guidelines)*. Ministry of Health, Brunei Darulssalam.

11. NIN & VWU (1997). *Ten recommendations for appropriate food intake*. National Institute of Nutrition and the Vietnam Women's Union, Vietnam.
12. CNS (1999). *Dietary guidelines and the food guide pagoda for Chinese residents. balanced diet, rational nutrition and health promotion*. Adopted by the Standing Board of the Chinese Nutrition Society. April 10, 1997. The Chinese Nutrition Society. *Nutrition Today* 34(3): 106-115
13. MHLWJ (2000). *Dietary Guidelines for Japanese*. Ministry of Health, Labour & Welfare, Japan
14. MHLWRK (2002). *Revision of Dietary Guidelines for Koreans (2002: with action guides for adults and the elderly)*. Korea Health Industry Development Institute. Ministry of Health and Welfare, Republic of Korea.
15. NIN (1998). *Dietary Guidelines for Indians - A Manual*. National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, India.
16. NHMRC (2002). *Food for Health. Dietary Guidelines for Australians. A Guide to Healthy Eating*. National Health & Medical Research Council, Canberra, Australia. Accessed from: www.nhmrc.gov.au/publications/_files/n31.pdf
17. USDHHS & USDA (2005). *Dietary Guidelines for Americans 2005*. U.S. Department of Health and Human Services and U.S. Department of Agriculture, Washington, DC. Accessed from: www.health.gov/daydietaryguidelines/dayga2005/dayocument/pdf/dayGA2005.pdf
18. USDA (2005). *My Pyramid. Steps to a Healthier You*. United States Department of Agriculture. Accessed from: www.mypyramid.gov
19. HC (1997). *Canada's Food Guide to Healthy Eating*. Health Canada. Accessed from: www.hc-sc.gc.ca/in-an/nutrition/index_e.html
20. DHUK (2004). *Wired for Health - Guidelines for Healthy Diet*. Department of Health, United Kingdom. Accessed from: www.wiredforhealth.gov.uk
21. HMOH (2000). *Dietary Guidelines for Adults in Greece*. Hellenic Ministry of Health. Accessed from www.nut.uoa.gr/english/Greekguid.htm
22. SAWG (2001). *South African Food-based Dietary Guidelines*. South African Working Group. *SA J Clin Nutr* 14(3): S2-S77. Accessed from: www.sahealthinfo.org/publications/publ.htm
23. ADNA (2000). *The Argentine Dietary Guidelines*. Argentine Dietitian and Nutritionist Association. Accessed from www.aadynd.org.ar

ROLE OF CARBOHYDRATES IN HEALTH & DISEASE: EVALUATING SCIENTIFIC EVIDENCE FOR DIETARY GUIDANCE

Editor

Rodolfo F. Florentino



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