RNI

Recommended Nutrient Intakes and Population Nutrient Intake Goals for the Caribbean

PAHO Pan American Health Organization
World Health Organization
Regional Office for the Americas

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This publication, of relevance to the population of the Caribbean, is the result of the collaborative effort of several persons who worked to ensure that it could become a reality.

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Dr. Dan Ramdath prepared the review papers that guided the discussions at the 2013 workshop, and which formed the basis for the report. Paula Trotter and Beverly Lawrence prepared the report. Dr. Asha Badaloo (University of the West Indies) and Dr. Ramdath reviewed the drafts. Dr. Andrea Wierenga (University of Oklahoma) and Dr. Audrey Morris (PAHO) finalized the report.

Introduction and Background

Recommended dietary allowances (RDAs) for the Caribbean were first published in 1978 and then revised in 1994. Since then, ongoing research relating to the health consequences of nutrient intakes, particularly with regard to diet-related noncommunicable diseases (NCDs), has provided new evidence on the inter-relationships between diet and health.

The current initiative to revise the existing RDAs began with a review of the most current available information as well as the recent approaches taken by other countries and agencies in updating RDAs. The review was carried out within the context of changes in the regional food and nutrition situation. These changes included a reassessment of food availability patterns, dietary and other lifestyle practices, a growing awareness of the need for nutrition standards and dietary guidelines, and the inclusion of food and nutrition-related policy actions in regional strategies addressing rising rates of obesity and NCDs and the strengthening of food and nutrition security.

In addition, a review was done of various terminologies related to nutrient requirements, including recommended dietary allowance (RDA), recommended nutrient intake (RNI), average reference intake (ARI), estimated average requirement (EAR), and upper tolerable limit. Recommendations were then made for use in the Caribbean.

The preliminary draft of the updated requirements and terminologies was reviewed by a group of health and nutrition personnel. Based on this review the recommendations were further refined and a working document prepared. This document was discussed in the review workshop held in Jamaica in December 2013, in which nutrition and biological science professionals, hereafter referred to as the Caribbean Dietary Guidelines Working Group (CDGWG), reviewed the suggested values and arrived at a consensus on the values for inclusion in the updated RDAs, deciding that the recommendations would be presented in the form of recommended nutrient intakes (RNIs).

Discussions in the workshop highlighted some of the most recent data on regional food consumption and availability trends and underscored the need for updated nutrient requirement data for the region. The more salient data were:

- Food availability trend data for the region suggested an excess supply of energy and excess consumption of fat and sugar in relation to population goals.
- Variations in estimated energy intakes: ranging from approximately 1700 calories (Barbados) to 2700 calories (Guyana) among females, and from 2002 (Barbados) to 3191 calories (Guyana) for males.
- Estimated protein intakes: ranging from 70 g (Barbados) to 83 g (Guyana) among females, and from 76 g (Trinidad) to 89 g (Guyana). A Jamaican study reported an overall mean of 102 g.
- Data on intakes of dietary fibre were available for two countries (Jamaica and Trinidad and Tobago) and were in the range of 18 g to 23 g for females and 23 g to 31 g for males.
- Comparisons of study findings with the population nutrient intake goals (PNIGs)for the Caribbean showed that for five countries, the mean intakes for fat and protein were in excess of the recommended goals, whereas the mean intakes for carbohydrate were below the goals.

Following the workshop, it was further considered that the finalization of the RNIs should take into account the availability of any later updated scientific information on nutrient functions and requirements. A further review was undertaken to ensure this.

This publication is the outcome of the entire process. The Recommended Nutrient Intakes and Population Nutrient Intake Goals for the Caribbean takes into account expert reports and updates on energy and nutrient requirements from the Food and Agriculture Organization/World Health Organization (FAO/WHO), Canada, the United Kingdom, and the United States. A major focus has been placed on global FAO/WHO recommendations, which are based on extensive review of the available evidence.

This publication provides current scientific guidance on the intake of a range of nutrients, as well as the recommendations for the PNIGs for the Caribbean. The PNIGs are meant to promote healthy dietary consumption patterns that satisfy the nutritional needs of the population while helping to reduce the risk of diet-related noncommunicable diseases. These serve as a useful adjunct to the RNIs in providing food and nutrition guidance at the population level for macronutrients and food groups in healthy well-nourished populations.

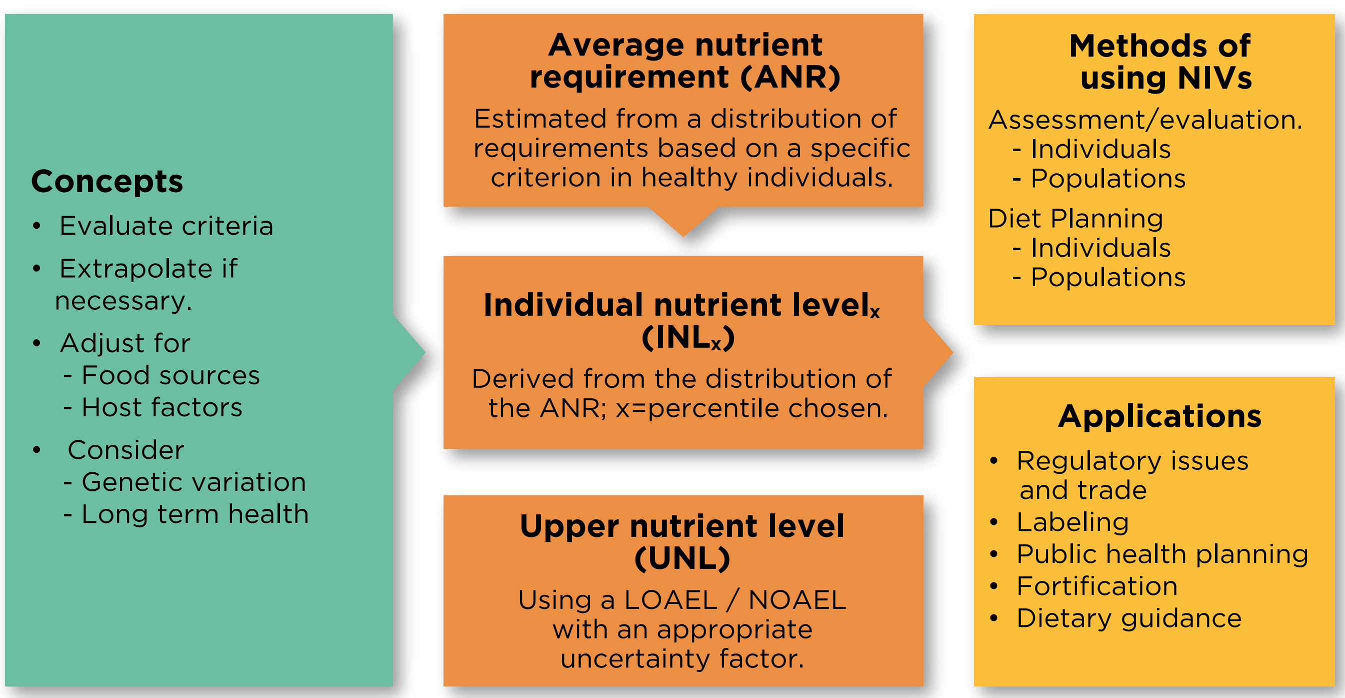
Terminologies

Different countries and regions have established recommended nutrient intakes using a statistical distribution of individual nutrient requirements derived from primary research data. From this is derived an estimated average requirement and a recommended nutrient intake value that is usually set at 2 SD (standard deviation) above the average requirement. The average requirement is referred to as the estimated average requirement (EAR) or average reference intake (ARI). The recommended intake level is variously called the recommended dietary allowance (RDA), reference nutrient intake (RNI), population reference intake (PRI), or recommended nutrient intake (RNI).

In December 2005, the United Nations University (UNU) Food and Nutrition Programme in collaboration with the FAO and the WHO Department of Nutrition for Health and Development convened an Expert Consultation to harmonize concepts and approaches (as opposed to deriving specific recommendations) for developing nutrient-based dietary standards *(1-12)*.

The Expert Consultation proposed that a common set of terms and definitions be used by all countries and regions, establishing nutrient intake values (NIVs) (see Figure 1). The Consultation recognized that the absolute values would probably differ among the various countries and regions, because differences in body size, bioavailability of food sources, and environmental conditions that affect nutrient needs (e.g., sunshine exposure or altitude) would influence the statistical distribution of nutrient requirements in a particular population.

Figure 1. Summary of WHO Recommendation for Deriving Nutrient Intake Values



Source: Reference 1

The two types of nutrient intake values (NIVs) are the average nutrient requirement (ANR) and the upper nutrient level (UNL). Other NIVs may be derived from these two values, i.e., the individual nutrient levelx (INLx), which is the ANR plus some percentile of the mean used for guiding individual intakes. The ANR and UNL are derived from estimates of amounts needed for a specific physiological criterion, e.g., tissue stores, metabolic balance, or a biochemical function. The NIVs are modified for population differences in the food supply, host factors such as infection, genetic variations, and needs for sustaining long-term health. The method of using NIVs to assess/evaluate intakes of individuals and populations differs from that used for planning diets for individuals and populations. NIVs are the basis for a number of policy applications. Examples include food labelling and fortification, food-based dietary guidance, planning public health nutrition programmes, and establishing food regulatory policies.

The following terminology was adopted by the Caribbean Dietary Guidelines Working Group (CDGWG):

Recommended nutrient intake (RNI)

The RNI is the daily intake that meets the nutrient requirements of almost all (97.5%) apparently healthy individuals in an age- and sex-specific population group. A statistical distribution of requirements is derived from primary data, and the RNI equals the mean requirement plus 2 SD.

Based on discussions held in the 2013 meeting, the CDGWG decided that the RNI would be used in this report, replacing RDA (recommended dietary allowances) as the accepted terminology.

Average nutrient requirement (ANR)

The ANR is the average or median requirement estimated from a statistical distribution of requirements for a specific criterion and for a particular age- and sex-specific group.

Individual nutrient level$_x$ (INL$_x$)

The INLx is the recommended nutrient level for all healthy individuals in a specific subpopulation. Often committees add 2 SD to ANR, which will cover the needs of most (i.e., 98%) of the population, assuming that the distribution is symmetrical. It is recommended that the Caribbean Dietary Guidelines be based on the ANR plus 2 SD. This approach has been used in Southeast Asia and provides a useful model for the Caribbean to derive guidelines *(13)*.

Upper nutrient level (UNL)

The UNL is the highest level of daily nutrient intake that is likely to pose no risk of adverse health effects for almost all individuals in a specified life-stage group. Ideally, it is based on an analysis of the statistical distribution of risk for high nutrient intakes. The UNL is usually set at a level where the risk of excessive intakes is close to zero. Also, the UNL is a level of intake that should be avoided on a long-term basis.

In addition, the CDGWG agreed to retain the WHO approach of setting population-level requirements in order to guide public health programmes aimed at reducing risk factors for chronic noncommunicable diseases.

Energy

Energy is the capacity to do work and in the diet it is provided by carbohydrate, fat, protein and alcohol. Food energy is used to meet the body's need for protein synthesis, maintenance of body temperature, cardiac output, respiration, muscular output, and storage and metabolism of food sources of energy.

According to the WHO, energy requirement is the amount of food energy needed to balance energy expenditure in order to maintain body size, body composition, and a level of necessary and desirable physical activity consistent with long-term good health *(14)*. Requirements are based on normative judgments about the levels of activity, growth rates, and body weight and body composition that are deemed to be desirable. After review of the existing data, the CDGWG decided to accept the WHO updated values for all life stages.

The recommended daily allowances for energy represent average requirements of the group or population. Prolonged insufficient energy intake results in malnutrition, while excessive energy intake and under-expenditure can result in obesity. Obesity is an independent risk factor for coronary heart disease (CHD); hypertension; type 2 diabetes; certain cancers such as cancers of the gall bladder, breast and cervix in women and cancers of the prostate and colon in men; and bone, joint, and skin disorders. Increased energy expenditure resulting from increased physical activity has been associated with an overall decreased risk of CHD. The report of the Joint FAO/WHO/UNU Expert Consultation on Human Energy Requirements (2001) provides the latest FAO/WHO/UNU recommendations on energy *(14)*. This is supplemented by collated expert evidence that served to inform the Expert Consultation *(15).* That Expert Consultation reiterated that energy requirement should be estimated on the basis of energy expenditure and not energy intake. The components of daily energy requirements in humans as explained included:

- basal metabolic rate (BMR) representing 45%-70% of daily energy expenditure;
- metabolic response to food (diet induced thermogenesis) at 10% of BMR;
- physical activity, which is the most variable factor and is the second largest component of energy requirements;
- growth; and
- pregnancy and lactation.

It reiterated that estimates of energy requirement refer to groups and not to individuals, and that the only fact concerning the individuals in the group is that there is a certain, but not quantifiable, probability that their individual energy requirements fall within the variance of the mean requirement of the group. It also reiterated that the requirement for energy refers to the mean requirement of the group or population, and represents the average of the needs of all individuals composing that specific group *(14)*.

The 2001 Expert Consultation supported the use of physical activity level (PAL) in the estimation of adult human energy requirements. PAL is defined as the total energy expenditure over 24 hours divided by the BMR over 24 hours, and is not recommended for use in infants and young children.

New concepts and recommendations proposed in the 2001 Expert Consultation *(14)* include:

- "Calculation of energy requirements for all ages, based on measurements and estimates of total daily energy expenditure and on energy needs for growth, pregnancy and lactation;
- In the light of new data, modification of the requirements and dietary energy recommendations for infants and for older children and adolescents, in order to correct previous overestimations for the former and underestimations for the latter;
- Proposals for differentiating the requirements for populations with lifestyles that involve different levels of habitual physical activity, starting as early as six years of age;
- Reassessment of energy requirements for adults, based on energy expenditure estimates expressed as multiples of basal metabolic rates;
- Classification of physical activity levels based on the degree of habitual activity that is consistent with long-term good health and maintenance of a healthy body weight;
- Recommendations for physical activity for children and adults to maintain fitness and health and to reduce the risk of developing obesity and co-morbid diseases associated with a sedentary lifestyle;
- An experimental approach for factorial estimates of energy needs during pregnancy and lactation;
- Distribution in the two last trimesters of pregnancy of the recommendations for additional dietary energy needs."

In addition to these recommendations, the fact that there is ample evidence of rising obesity rates in adults and an emerging prevalence of overweight/obesity in children was a consideration taken into account in determining the energy recommendations.

Energy requirements have been expressed in kilocalories (kcal) as these units have been used more commonly in the Caribbean subregion. They are also given in megajoules (MJ) or kilojoules (kJ) in the International System of Units in which energy is measured in joules (J).

1 kcal	=	4.184 kJ
1000 kcal	=	4.184 MJ
1 kJ	=	1000 joules
1 MJ	=	1 million joules
1 MJ	=	239 kcal

Carbohydrate and protein provide energy at the rate of 4 kcal or 17 kJ per gram; fat at 9 kcal or 38 kJ per gram, and alcohol at 7 kcal or 29 kJ per gram.

Recommended nutrient intakes are listed in Table 3 and in the Summary Table.

Infants aged 1 to 12 months

The average energy requirements proposed by the 2001 Joint FAO/WHO/UNU Expert Consultation were derived by combining the needs of breast-fed and formula-fed infants. Requirements were calculated using total energy expenditure (TEE) plus the energy needs for growth compared to the 1985 FAO/WHO/UNU report *(16)*, in which energy requirement was estimated from the observed intakes of healthy children growing normally, because there was insufficient information on total energy expenditure. Compared to the 1985 report, the average energy requirements proposed by the 2001 Expert Consultation were 12% lower for age 0-3 months, 17% lower for age 3-9 months, and 20% lower for age 9-12 months. The requirements for breast-fed infants are 17%, 20%, and 22% lower than the 1985 estimates at ages 0-3, 3-9 and 9-12 months, respectively.

Children and adolescents

Compared with previous estimates from 1985 (16), energy requirements proposed by the 2001 Expert Consultation are on average 18% lower for boys and 20% lower for girls under 7 years of age, and 12% and 5% lower, respectively, for boys and girls 7 to 10 years of age. From 12 years onwards, the proposed requirements are on average 12% higher for both boys and girls. The difference is related to using a larger data set on TEE by including data from minute-by-minute heart rate monitoring (HRM) in developing countries or poorer, largely rural societies, in addition to the previous data on doubly-labelled water (DLW) from industrialized countries or affluent societies used in the 1985 report *(16)*. This approach accounts for variation in physical activity effort in different countries. TEE derived from HRM in healthy well-nourished children is comparable with TEE measured using the reference methods of DLW or whole body calorimeter, enabling use in this age group of HRM data which are available from a wider spectrum of countries and societies.

For children aged 1 year and older, the Expert Consultation recommended that PAL be used to estimate energy reference values after adjusting for growth. This results in PAL values increasing from 1.43 at 1-2 years to 1.83 at 17-18 years for boys, and from 1.42 to 1.72 for girls at equivalent ages.

Adults

The FAO/WHO/UNU Human Energy Requirements report *(14, 15)* used factorial estimates of habitual total energy expenditure to derive energy requirements, i.e., BMR x PAL to estimate requirements with BMR calculated from Schofield equations *(17)* and with six PAL values ranging from 1.45 to 2.20. Daily average energy requirements are presented separately for men and women in age groups 18 to 29.9 years and 30 to 59.9 years. Although the Expert Consultation considered different predictive equations to replace the Schofield equations for BMR (14), they concluded that these were not robust enough to justify their adoption at present, and agreed to pursue a more thorough analysis of existing information or support a prospective study with broad global geographic and ethnic representation.

The 2001 Expert Consultation recommended that dietary energy intake of a healthy, well- nourished population should allow for maintaining an adequate BMI at the usual level of energy expenditure. At a population level, a median BMI of 21.0 has been suggested by the joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases *(18)*. It also provided strong recommendations for regular physical activity in order to maintain adequate body weight. It was suggested that habitual PAL of 1.70 or higher is associated with a lower risk of obesity and chronic non-communicable diseases.

Pregnancy

Requirements for pregnant women were derived using two-factorial approaches involving BMR and TEE. The 2001 report stated that dietary intake during pregnancy must provide the energy that will ensure the full-term delivery of a healthy newborn baby of adequate size and appropriate body composition by a woman whose weight, body composition, and PAL are consistent with long-term good health and well-being. It was argued that during pregnancy, the energy cost for growth is not equally distributed and that the rate of deposition of protein is 21% and 80% in the second and third trimesters, respectively. Similarly, the rate of fat deposition is 11%, 47%, and 42% in the first, second, and third trimester, respectively. As such, the respective calculated extra cost of pregnancy in first, second, and third trimesters are 85, 285, and 475 kcal/day. The previous 1985 FAO/WHO/UNU Expert Consultation *(16)* suggested that additional energy allowance could be lowered in women who reduce their physical activity level during pregnancy.

However, the 2001 Expert Consultation did not uphold this recommendation. Maternal obesity is also associated with a higher risk of maternal and foetal complications. A report by the March of Dimes *(19)* in 2002 found that the relative risks of neural tube defects, congenital malformations and preterm delivery are higher in overweight and obese women. Incidence of hypertension and gestational diabetes and the need for caesarean section operations are also higher than in women with normal weight. Based on this and prevailing trends in the region of relatively high levels of obesity in women, the recommended energy intake for pregnant women in the Caribbean is an additional 200 kcal/day across all trimesters.

Pregnancy in adolescence

Adolescents who become pregnant require additional energy to support their own ongoing growth requirements as well as those of their children. It is estimated that as much as 20% of total growth in stature can occur during adolescence *(20)* and therefore adequate dietary intake is vital to ensure that neither maternal nor foetal growth is comprised.

Lactation and breast-feeding

There is additional energy requirement during lactation and breast-feeding due to the energy cost of milk production. An additional 500 kcal/day is recommended for the first six months of lactation, and breast-feeding women who had experienced less than optimal weight gain during pregnancy should add 675 kcal/day during the first semester instead of the 500 kcal/day. In line with the issues raised for pregnant women and the increasing problem of obesity, the Caribbean recommendation is that women who gained weight at a normal rate during pregnancy should increase their energy intake by an additional 500 kcal/day during the first six months of lactation.

Protein and Amino Acids

Dietary protein provides amino acids and nitrogen for the maintenance and growth of the cellular protein mass, the major constituent of the soft tissues, and therefore the demand for amino acids determines the protein requirement. All amino acids are important, whether defined as indispensable or dispensable depending on the body's ability to make them. However, in determining protein requirement, special focus is placed on meeting the demand for those amino acids (indispensable) that must be provided in the diet, and which is a determinant of dietary protein quality. The maintenance component of the demand for protein includes the replacement of protein lost from skin, hair, and body secretions, and urinary and faecal nitrogen lost as a result of the obligatory metabolic utilization of amino acids in a variety of pathways. The growth component includes the demand for protein during normal growth and development and during pregnancy. Lactation also imposes a demand for protein.

Protein is widely distributed in foods. The major sources are food of animal origin (except butter, lard, and other meat/dairy fats), dried peas, beans, nuts, and cereals and their products. Other foods such as fruits and vegetables may provide significant amounts depending on the quantities consumed. Protein of high biological value is derived from meats and other food from animals and cereal/legume blends in a ratio of 1:1 or 2:1.

A deficiency of protein usually accompanies a deficiency of dietary energy and other nutrients, resulting from insufficient food intake. Where protein intake is exceptionally low, there are physical signs such as stunting, poor musculature, oedema, thin and fragile hair, and skin lesions. There are also biochemical changes that include low serum albumin and hormonal imbalances. Severe deficiencies in young children in the Caribbean have decreased considerably over the past several decades; however, mild to moderate deficiency rates of energy–protein malnutrition (EPM) in children persist in geographical "pockets" in some countries.

The relationship between protein intake and chronic diseases is complex. Some of the animal-derived foods that are major sources of protein, such as red meat and processed meat, have been found to be associated with increased incidence of colorectal cancer rel-

ative to protein from vegetable sources *(21)*. Also, an analysis of data from five prospective studies of vegetarians and non-vegetarians found that mortality from ischemic heart disease was 24% lower in vegetarians, possibly due to lowered blood cholesterol. However, no significant differences were found between vegetarians and non-vegetarians in mortality from several cancers (stomach, colorectal, lung, prostate, or breast) or cerebrovascular disease *(22)*.

Low protein intake leads to bone loss, but high dietary protein has been shown to increase urinary excretion of calcium. A doubling of protein intake can result in a 50% increase in urinary calcium *(23)*, which is a result of the effect of the acid–base balance on bone mineral content, as well as the increased calcium intake that often accompanies high protein intake *(24)*. Whether or not high intake of protein from animal sources increases the risk of kidney stones is inconclusive.

The most recent update on protein and amino acids is the report, published in 2007, of the Joint WHO/FAO/UNU Expert Consultation on Protein and Amino Acid Requirements in Human Nutrition, held in April 2002 *(21)*. In this report, estimates of the protein requirements in early infancy and from 6 months to adulthood are derived from a factorial model that includes growth, rates of protein deposition, and adjustment for estimated efficiency of dietary utilization of protein to provide for growth. Estimated requirements in the first six months are based on comparisons with breast milk intakes. In selecting values for maintenance and growth efficiency for ages greater than 6 months, the Expert Consultation considered that mixed diets consumed when complementary feeding is introduced are utilized less efficiently than breast milk.

Recommended nutrient intakes are listed in Table 3 and in the Summary Table.

Infants birth to <6 months

The report on the 2002 FAO/WHO Expert Consultation on Energy and Protein Requirements *(21)* indicated that the 1985 report *(16)* overestimated protein requirement for this age group. They reasoned that if the average protein requirement of breast-fed infants is equivalent to average protein intake, this implies that 50% of breast-fed infants are in deficit. In contrast, if it is assumed that nearly all breast-fed infants meet their protein requirements, then their average intake should be equal to requirement values at the upper limits of the overall range, i.e., somewhat above the safe level for protein intake. For this age group, the maintenance requirement is set at 93 mg nitrogen/kg body weight per day (equivalent to 0.58 g protein/kg body weight per day) with the efficiency of dietary utilization for growth set at 0.66. The safe level for this age group ranges from 1.77 to 1.14 g protein/kg body weight per day. The reference weights for this age group are 7.8 kg for boys and 7.2 kg for girls.

Infants and Children 6 months to 10 years

Maintenance requirements for protein intake for infants and children older than 6 months and up to 10 years of age was set at 0.66 g protein/kg per day with a factor of 0.58 to account for efficiency of dietary utilization for growth. The safe level for this age group ranges from 1.31 to 0.91 g protein/kg body weight per day.

Table 1: Reference Weights (kg) for Children Aged 1-10

Age (years)	Boys	Girls
1	10.2	9.5
1.5	11.5	10.8
2	12.3	11.8
3	14.6	14.1
4-6	19.7	18.6
10	28.1	28.5

Source: Joint FAO/WHO/UNU Expert Consultation on Protein and Amino Acid Requirements in Human Nutrition. Report of a joint WHO/FAO/UNU Expert Consultation, Geneva, WHO, 2002. Technical Report Series no. 935 (TRS 935). http://whqlibdoc.who.int/trs/WHO_TRS_935_eng.pdf

Adolescent boys and girls 11-18 years

Calculation of the protein requirements for this group was made in two steps: (i) requirement per kg was obtained according to the age range and (ii) this was multiplied either by actual weight or by the median weight for age to obtain the total requirement. Adjustment for protein quality according to age is also recommended. Maintenance for both girls and boys was set at 0.66 g protein/kg body weight per day with efficiency of dietary utilization for growth set at 0.58. The safe level for this age group is ~0.90 g protein/kg per day with 11-12 years girls having a higher requirement of 1.89 g protein/kg per day.

Table 2: Reference Weights (kg) for Children Aged 11-18 years

Age (years)	Boys	Girls
11-14	45	46.1
15-18	66.5	56.4

Source: Joint FAO/WHO/UNU Expert Consultation on Protein and Amino Acid Requirements in Human Nutrition. Report of a joint WHO/FAO/UNU Expert Consultation, Geneva, WHO, 2002. Technical Report Series no. 935 (TRS 935). http://whqlibdoc.who.int/trs/WHO_TRS_935_eng.pdf

Amino acid requirements for infants and children

For infants and children up to 2 years old, values are derived by using a new scoring pattern based on the amino acid requirements divided by the average protein requirement, rather than the safe requirement previously used *(16)*. After 2 years of age there is very little further change in amino acid requirement or pattern until adulthood is reached.

Adults

The previous report (1985) set a safe protein intake of 0.75 g/kg body weight per day which is 2 SD above the average requirement (0.6 g protein/kg per day) based on nitrogen balance studies with no allowance for miscellaneous losses. With the revision of nitrogen balance calculation and new isotopic data, the 2007 report recommends a 10% higher value of 0.66 g/kg per day of protein as the population average requirement for healthy adults. The safe level was identified as the 97.5th percentile of the population distribution of requirement, i.e., 133 mg nitrogen/kg per day, or 0.83 g/kg per day protein with a protein digestibility-corrected amino acid score value of 1.0. This score ensures adequate supply of the indispensable amino acids. No safe upper limit has been identified. As before, the protein requirement per kg body weight is regarded to be the same for both sexes, at all ages, and for all body weights within the acceptable range.

Amino acid requirements in adults

Amino acid requirements and the requirement pattern are calculated from average requirements for amino acids and protein (0.66 g/kg per day). With the exception of histidine, the sulfur amino acids, and tryptophan, all values for the indispensable amino acids are about twice as high as the values in the previous report. This is based on recalculated nitrogen balance data in addition to new data for the requirements of indispensable amino acids derived from isotopic balance studies.

Pregnancy and lactation

Additional protein of 1, 9, and 31 g protein/day is recommended for pregnant women in the first, second, and third trimesters, respectively. For lactating women, an average of 19 g protein/day is required, falling to 12.5 g protein/day after six months.

Carbohydrates

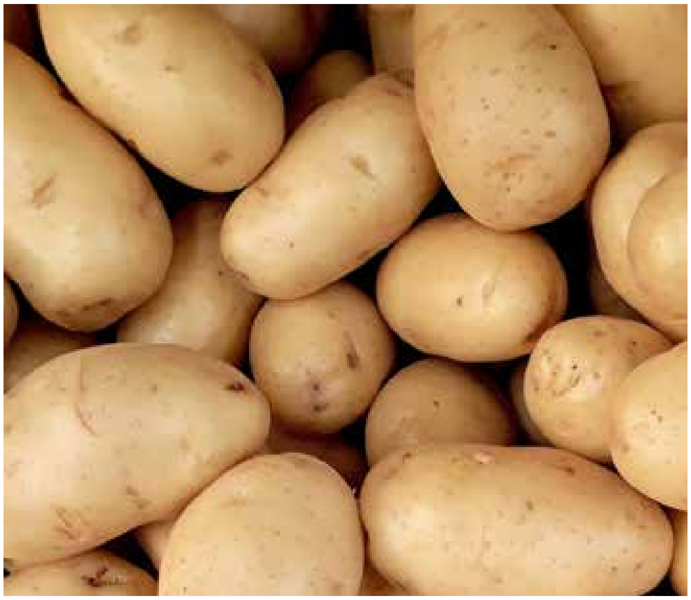
The main functions of dietary carbohydrates are to supply fuel/energy in the form of glucose, particularly to the brain, spinal cord, peripheral nerves, and red blood cells, and to permit the complete breakdown of fatty acids to water, carbon dioxide, and energy.

Most amino acids, the glycerol component of fat, and some organic acids can be converted to glucose. In the absence of carbohydrate in the diet, ketone bodies from the lipolysis of stored triglycerides and the oxidation of fatty acids accumulate, the breakdown of dietary and tissue protein accelerates, there is a loss of sodium, and there is dehydration.

The chief dietary sources of carbohydrates in Caribbean diets are cereals—wheat, rice, corn (maize) and oats; ground provisions/produce (starchy roots and tubers, such as yams, potatoes, dasheen, eddoe, coco (tannia), breadfruit, and green bananas/figs; sugar; dried peas and beans; fruits such as mangoes, oranges, and pawpaw/papaya; and vegetables. All the above except sugar (sucrose) are sources of complex carbohydrates, mainly starch and fibre.

Studies have demonstrated that ingestion of high levels of sugars may lead to decreased insulin sensitivity, decreased glucose tolerance, and increases in triglycerides and cholesterol, all of which are undesirable. The involvement of sugars, particularly sucrose, in dental caries is well recognized.

Fermentable carbohydrates in the diet contribute to caries formation but are not sufficient by themselves to cause dental caries. Oral microflora and appropriate host factors must also be present and must interact with the diet if caries is to form and progress. The cariogenic potential of carbohydrate-containing foods depends on their characteristics; for example, stickiness and the frequency and sequence of their consumption, and dental hygiene.



Caribbean people have been advised to increase their intake of complex carbohydrates, a major source of energy, at the expense of dietary fat. The foods rich in complex carbohydrates are also major sources of fibre and contribute significantly to protein, vitamin, and mineral intake. Studies have shown that populations eating diets high in complex carbohydrate usually have a lower prevalence of type 2 diabetes mellitus and CHD compared to populations eating lower-carbohydrate and higher-fat diets *(25)*.

The 2006 FAO/WHO Scientific Update on Carbohydrates in Human Nutrition *(25)* prefaced dietary recommendations with the need to accurately describe the techniques for defining carbohydrate components. This was also a recommendation in the 1997 Joint

FAO/WHO Expert Consultation on Carbohydrates *(26)*. One issue of concern was the lack of a coherent approach to accounting for energy derived from digestion of carbohydrates as opposed to fermentation in the large bowel. There was consensus on the need for agreement in the use of terminologies such as combustible energy, digestible energy, metabolizable energy, and net metabolizable energy, when considering carbohydrate requirements. The 1997 Expert Consultation recommended the reassessment of the energy value of all carbohydrates in the diet using modern nutritional and other techniques. It also recommended that for carbohydrates that reach the colon, the energy value should be set at 2 kcal/g (8 kJ/g) for nutrition and labelling purposes *(26)*.

The 2006 Scientific Update *(25)* agreed that altering the proportion of total carbohydrates in the diet was not an important determinant of energy intake but recommended a restriction on the consumption of beverages high in free sugars so as to reduce the risk of excessive weight gain and obesity. It supported the population nutrient intake goals on free sugars (i.e., <10% of total energy) that were recommended by the 2002 WHO/FAO Expert Consultation on prevention of chronic diseases *(18)*. The 2015 WHO Guidelines on sugar intake for adults and children emphasized the importance of this goal and issued a strong recommendation to reduce the intake of free sugars across all age groups, indicating that reduction of intake to below 5% of total energy intake could result in increased health benefits, particularly in relation to reduced risk of overweight and obesity and dental caries *(27)*.

The 2006 Scientific Update supported the previous recommendation that total carbohydrate should provide 55%-75% total energy and that fruits and vegetables should be >400 g/day. It recommended that whole-grain cereals, vegetables, legumes, and fruits should be the most appropriate sources of dietary carbohydrate and noted that failure to achieve this could result in lipoprotein-mediated risk of coronary heart disease. Many of the ground provisions which form a staple of the Caribbean diet are also regarded as appropriate sources of carbohydrates. The consensus of the CDGWG was that the 2002 WHO recommendation for >400 g fruit and vegetables and consumption of whole grain should be accepted since this has been shown to provide >25 g per day of total dietary fibre (a minimum daily intake of 20 g/day is recommended for persons >3 years).

The 1997 Expert Consultation *(26)* suggested an optimum diet of at least 55% of total energy from a variety of carbohydrate sources for all ages except for children under the age of 2. This was supported but the scientific update noted that a wide range of carbohydrate intakes are compatible with cardioprotection and that many western countries have average intakes that are below 55% of total energy intakes. It was concluded that a lower limit of around 50% total energy was acceptable.

Regarding the use of glycaemic index (GI), the scientific update suggested that perhaps it would be used most appropriately to guide food choices when considering similar carbohydrate-containing foods. However, caution was recommended regarding the use of the GI as the sole determinant of the quality of carbohydrate-containing foods.

The dietary reference intakes for carbohydrates in the United States *(28)* were calculated bearing in mind that the brain is the only organ that is completely dependent on carbohydrate, oxidizing glucose to carbon dioxide and water. Insufficient glucose available results in ketosis, where there is increased production of ketoacids by the liver, utilizing fatty acids for this purpose. These ketoacids are used as an alternative source of energy by the brain. Sustained high levels of ketosis can be dangerous to the body.

The CDGWG recommended that the 2010 United States–Canada EARs for carbohydrates should be adopted as the new ANRs for the Caribbean (0-6 months: 60 g/d; 7-12 months: 95 g/d; 1-70 years: 130 g/d; pregnancy: 175 g/d; lactation: 210 g/d). This was based on the assumption that these reference values covered the basic physiological, growth, development, and health needs of individuals in the different age groups; as well as individuals consuming acceptable levels of fat and protein.

The recommended amounts should also allow individuals to meet their minimum carbohydrate requirements for physical activity.

The Panel on Dietary Reference Intakes for Macronutrients *(28)* set the EARs for total carbohydrates at 100 g/day for adults. This is the amount sufficient to fuel the central nervous system cells without relying on ketoacids. The RNI for carbohydrate is set at 130 g/day, which is the EAR plus twice the coefficient of variation (CV) of 15%, as there are variations in brain glucose utilization. This is expected to meet the needs of 97% to 98% of adults aged 19 years and older.

The RNI for carbohydrate for children up to 18 years old is calculated using the glucose requirements for the brain. At birth, the brain weighs approximately 1000 g in boys and 980 g in girls. By age 5, brain weight has increased to approximately 1300 g in boys and 1150 g in girls, which is almost that of the adult brain. From age 2 years, the utilization of glucose in the brain of children is in the range of that for adults and the EARs and RNIs are the same as for adults. For infants, the calculation of adequate intake (AI) is based on the intake of carbohydrate from breast milk (0 to 6 months) plus complementary foods (7 to 12 months), and is set at 60 g per day from birth to 6 months and 95 g per day from 7 to 12 months.

The RNI for pregnancy was calculated taking into account the provision of glucose for the foetus's brain. It was set at a rounded figure of 175 g of carbohydrate per day, which was calculated from an EAR of 135 g per day and twice the CV of 15%.

During lactation, increased glucose from ingested carbohydrate is needed for the synthesis of the lactose secreted in human milk. This is calculated at 60 g/day. The EAR for carbohydrate for lactating women is calculated by adding this figure to the EAR for adolescent girls and women, which is at 100 g/day, for a total of 160 g/day. The RNI is calculated from the EAR plus twice a CV of 15%, and is calculated (rounded) at 210 g of carbohydrate daily.

Recommended nutrient intakes are listed in Table 3 and in the Summary Table.

Dietary Fibre

The 2006 scientific update recommended that the term "dietary fibre" be reserved for the cell wall polysaccharides of vegetables, fruits, and whole grains. As such, "dietary fibre" was defined as "intrinsic plant cell wall polysaccharides." The update agreed that the analytical distinction between soluble and insoluble forms of dietary fibre may not always be useful since these are pH dependent and the link with specific physiological properties is inconsistent.

Dietary fibre plays an important role in regulating gastrointestinal function and specifically aids in laxation. The most significant action of dietary fibre takes place in the large intestines where its fermentation products account for part of its physiologic effects. It is often overlooked as a source of energy, which is an end product of fermentation. Dietary fibre is the main source of prebiotics, which are defined as nondigestible food ingredients that specifically target the growth and activity of beneficial bacteria in the colon. Prebiotics are mainly non-α-glucan oligosaccharides that promote a balanced or healthy gut microbiota with significant numbers of lactobacilli and bifidobacteria. The benefits of prebiotics are being researched with findings of potential health benefits such as providing gut barrier function against infection, enhancing calcium absorption, and modifying lipid metabolism *(29)*. The structures in dietary fibre resistant to fermentation provide the mechanism for increasing faecal bulk, thus preventing constipation.

Dietary fibre is found mainly in whole-grain cereals, legumes, roots and tubers, vegetables, fruits, and nuts. The composition of fibre varies in different plant foods and is modified by the age of the plant. In addition, the preparation and cooking of many foods influence the quantity of food fibre. When foods are peeled, a considerable amount of the fibre is lost, and when they are finely ground the resultant particle size may alter the physiologic effects of the fibre.

An increase in intake of complex carbohydrates from a variety of sources will increase the intake of dietary fibre. A significant contribution to fibre intake would be made by substituting legumes for a portion of the meat and meat products consumed as a source of protein, especially in adults. Substantial increases of dietary fibre should be gradual and fluid intake should be increased accordingly.

Increasing the intake of dietary fibre may heighten the risk of reducing the absorption of zinc, calcium, and iron. These minerals might bind to the phytates commonly associated with such fibres. However, it is unlikely that these factors would be of any significance in the context of an adequate diet. It is not recommended that dietary fibre be obtained from a single source. Studies have shown that different sources of dietary fibre differ in their physical–chemical characteristics. In addition, the method of cooking tends to affect the digestibility of fibre.

The CDGWG accepted the 2002 WHO/FAO Expert Consultation *(18)* recommendation that intakes of >400 g fruits and vegetables and consumption of whole-grain foods are likely to provide >25 g per day of total dietary fibre. A minimum daily intake of 20 g of fibre is recommended.

The recommended intakes of dietary fibre for the United States as set by the Dietary Guidelines Advisory Committee (DGAC) *(30)* are based on an adequate intake (AI), and these recommendations were adopted by the CDGWG. Data from three large prospective studies *(31, 32, 33)* among others, showed a significant negative correlation between dietary fibre intake and risk of CHD. The correlation was stronger for cereals and weak for fruits and vegetables. Based on this information, the DGAC recommended an intake of 14 g of dietary fibre/1000 kcal. According to the DGAC, this amount of fibre is also expected to help to prevent or improve constipation and diverticular disease, provide fuel for colonic cells, and reduce blood glucose and lipid concentrations, as well as contribute to satiety. The AI for total fibre for each gender-specific age group was set by multiplying 14 g/1000 kcal by the median daily energy intake. The AIs for various population groups are shown in Table 3.

There is no AI for children under the age of 6 months, since exclusive breast-feeding is recommended for infants up to 6 months old, and human milk contains no dietary fibre. There is no information on which to base recommendation of fibre intake for infants between the ages of 7 and 12 months.

Recommended nutrient intakes are listed in Table 3 and in the Summary Table.

Table 3: Dietary Reference Values for Energy, Protein, Carbohydrate, and Fibre

	ENERGY (kcal/d)	PROTEIN (g/d)	CARBOHYDRATE (g/d)	DIETARY FIBRE (g/d)
Infants				
0-6 mo	515	12.5	60	No data
7-12 mo	765	14	95	No data
Children				
1-3 y	1165	15	130	19
4-8 y	1545	20	130	25
Males				
9-13 y	2220	42	130	31
14-18 y	2755	55	130	38
19-30 y	2550	56	130	38
31-50 y	2550	56	130	38
51-70 y	2380	53	130	30
>70 y	2100	53	130	30
Females				
9-13 y	1845	41	130	26
14-18 y	2110	45	130	26
19-30 y	1940	45	130	25
31-50 y	1900	45	130	25
51-70 y	1900	47	130	21
>70 y	1810	47	130	21
Pregnancy	+200	+6	175	28
Lactation	+500	+11	210	29

Sources: References 14, 15, 21, 28, 30

Water

Water maintains homeostasis in the body and allows for the transport of nutrients to cells as well as the removal and excretion of waste products of metabolism.

Caribbean Recommendations

The CDGWG decided that the United States/Canada guidelines should be adopted.

Recommended intakes for water are based on median intakes of generally healthy U.S. individuals who are adequately hydrated *(34)*; individuals can be adequately hydrated at levels below as well as above the AIs provided.

The AIs provided are for total water in temperate climates, whereas the Caribbean is a tropical region. In young infants (0-6 months) the AI is based on breast milk at 0.7 L/day and for 7- 12 month-olds the AI is 0.8 L/day. For 1-3 and 4-8 year-olds the AI is 1.3 and 1.7 L/day, respectively. In males aged 9-13, 14-18, and >19 years the AI is 2.4, 3.3, and 3.7 L/day, respectively. In females aged 9-13, 14-18, and >19 years the AI is 2.1, 2.3, and 2.7 L/day, respectively. During pregnancy, the AI for water is 3.0 L/day and in lactation this is increased to 3.8 L/day.

Fats and Fatty Acids

The 2008 FAO/WHO Expert Consultation on Fats and Fatty Acids in Human Nutrition recognized that fatty acids, although broadly classified, have unique biological properties and health effects *(35, 36)*. It was also acknowledged that the intake of individual fatty acids differs across regions of the world, depending on the predominant food sources of fats and oils. The Expert Consultation recommended that the majority of the fat in the diet should come from plant oils, given that they are excellent sources of polyunsaturated (PUFA) and monounsaturated fatty acids (MUFA). The Expert Consultation agreed that there was convincing evidence that energy balance is critical to maintaining healthy body weight and ensuring optimal nutrient intakes, regardless of macronutrient distribution expressed in percentage of energy. The CDGWG agreed with these recommendations, including those (expressed as a percentage of total energy) for total fat, saturated fat, PUFA, and trans fatty acids (TFAs) for adults, infants, and children

Infants and Children

For infants 0-6 months, the recommended percentage of fat energy of 40%-60% is based on human milk. For children 6-24 months, the estimation (35%) is based on breast milk providing half of the daily energy needs with the assumption that the rest of the energy would come from complementary foods. For ages 6-12 months, the proposed fat intake of 35% is lower than the recommendation in the 1993 FAO/WHO Expert Consultation on Fats and Oils in Human Nutrition *(37)*, the primary reasons being concern over growing obesity rates and the redefined growth standards based on human milk-fed infants. In the age range 2-18 years, the recommendation is 25%-35% fat energy with 8% energy coming from saturated fatty acids (SFAs), 11% from PUFAs, and <1% from TFAs. Fat intakes of less than 25% energy can have adverse effects on growth and weight gain.

Adults

Minimum intake for most individuals should be 15% of energy intake to ensure adequate consumption of total energy, essential fatty acids, and fat soluble vitamins. For women of reproductive age and adults with BMI <18.5, the minimum energy intake should be 20% of total energy, especially in some developing countries where dietary fat may be an important factor in achieving adequate energy intake in malnourished populations. Intakes lower than this can increase the risk of inadequate intakes of essential fatty acids and fat-soluble vitamins. Such low-fat diets can also lead to unanticipated changes in the levels of triglycerides and HDL cholesterol.

Maximum total fat intake for adults is set at 30%-35% of total energy. For individuals with moderate physical activity levels, a maximum intake of 30% energy as fat is recommended. For individuals with high levels of physical activity, a maximum intake of 35% energy as fat is recommended. It should be considered, however, that high intakes of fat are usually accompanied by increased intakes of saturated fat and cholesterol.

For adults, the intake of SFA should not exceed 10% total energy to keep cholesterol levels in a normal range and to reduce the risk of CHD. MUFA intake is calculated by difference and can show a wide range depending on the total fat intake and dietary fatty acid pattern. The 2008 FAO/WHO Expert Consultation considered that there was convincing evidence showing that substituting SFAs with PUFAs reduces the risk of CHD. PUFA intake was recommended at 6%-11% of energy. On the basis that average TFA intake of men and women is about 1.2 g (or 0.5% of energy) the Expert Consultation reasoned that a similar average intake from industrially hydrogenated fat is acceptable, and recommended that TFA intake from all sources should be limited to 1% of energy.

Recommended intakes are listed in Table 4 and in the Summary Table.

Table 4: Recommended Intakes of Fats and Fatty Acids by Population Group

Population group	Measure	% energy
Total fat		
0-6mo	AMDR	40-60%
6-24 mo	AMDR	Gradual reduction to 35%
2-18 y	AMDR	25-35%
Adults	AMDR	20-35%
Saturated fatty Acids (SFA)		
Adults	MAL/U-AMDR	10%
2-18 y	U-AMDR	8%
Mono-unsaturated fatty acids (MUFAs)		
Adults	AMDR	By difference*
2-18 y	AMDR	By difference*
Polyunsaturated fatty acids (PUFA)		
Adults	AMDR	6-11%
6-24 mo	U-AMDR	<15%
2-18 y	U-AMDR	11%
TFA		
Adults		<1%
2-18 y		<1%

AMDR: Acceptable macronutrient distribution range;
L-AMDR: Lower level of acceptable macronutrient distribution range; U-AMDR: Upper level of acceptable macronutrient distribution range;
UL: Upper level; this term was developed for instances where biochemical indicators are needed to confirm any adverse effects, measurable with a probability of occurrence. In the case of fatty acids this only applies to TFA.

**MUFAs (%E) = Total fat (%E) – SFAs (%E) – PUFAs (%E) – TFAs (%E)*

Recommendation for further research

The Expert Consultation *(36)* noted that sufficient and adequate information on dietary fatty acid intakes are needed. The participants strongly recommended that countries monitor food consumption patterns of their population groups as well as data on country-specific fatty acid composition of foods, bioavailability of fatty acids from food sources and supplements, and biomarker levels in specific populations. The rationale was that in doing so it would be possible to design and monitor the impacts of national dietary guidelines, including the promotion of appropriate intakes of different dietary fats and oils. In addition, there should be a focus on energy balance in promoting recommendations for fat intake.

Vitamins - Fat-Soluble

Recommended intakes for these vitamins are listed in Table 5 and in the Summary Table.

Vitamin A

Retinol is essential for the formation of the pigment rhodopsin which is present in the retina of the eye, and for the growth, normal development, and maintenance of epithelial cells. It plays a well-established role in bone growth, vision, and reproduction. Diets that lack vitamin A lead to compromised immunocompetence and deficiency diseases, and when consumed for long periods, may be fatal.

The first specific clinical symptom of vitamin A deficiency in humans is night blindness attributed to reduced sensitivity of rod receptors in the retina. In more extreme cases of protracted deficiency, mucous-secreting epithelia in several locations in the body keratinize, become dry, and are more susceptible to infection. The epithelia of the cornea and conjunctiva are especially vulnerable. This damage to the surface of the eye, or xerophthalmia, is a serious condition which can involve irreversible damage leading to blindness, and is associated with high mortality and low resistance to infection.

Vitamin A is available to the body either as the preformed vitamin (retinol) which is solely of animal origin, or can be derived from plant pigments, carotenoids , that can be cleaved at the intestinal level to form retinol. The best sources of preformed vitamin A are liver and fish liver oils, and significant quantities are present in eggs, whole milk, and other dairy products. The carotenoids, predominantly β-carotene, are important sources of vitamin A in the Caribbean. Nutritionally active carotenoids are found in abundance in carrots; dark green leafy vegetables such as callaloo/amaranth/spinach/bhagi; dasheen leaves; green leaf lettuce; pumpkin; and yellow and orange varieties of sweet potatoes, as well as ripe papaya, mangoes, and peppers.

Dietary intakes of vitamin A are erratic in most individuals. Efficiency of absorption from the intestine is affected by cooking practices, the levels of fat and antioxidants in each meal, and diseases affecting the digestive system.

Liver vitamin A is a nutritional reserve because it can protect against deficiency during prolonged periods on a deficient diet. Vitamin A is released from the liver to the blood on a carrier, retinol-binding protein (RBP). The release of vitamin A is regulated so that the serum level is maintained relatively constant. Values fall with prolonged deprivation, and blood levels may increase slowly when dietary intakes are high. Measurement of serum vitamin A is therefore useful in a limited way for confirming an individual's vitamin A status. The vitamin A content of the liver is the best index of status. However, serum vitamin A is easily measured and is therefore frequently used in nutrition surveys. Serum distribution curves are useful to describe the magnitude of the at-risk population and to chart responses to nutrition interventions. It is difficult to induce deficiency in adults, because of the liver reserves, but deficiencies occur in infants and children under the age of 5 years.

Vitamin A intakes are reported in retinol equivalents, calculated from preformed vitamin A and the various provitamin A carotenoids, divided by their respective conversion factors. Food composition tables should now report β-carotene and other provitamin A carotenoids as mg/g edible portion. It is strongly recommended that weight or molar units be used instead of international units (IUs) to prevent confusion as well as to overcome limitations in the non-equivalence of the IU values for retinol and β-carotene.

The 2004 report on the Joint FAO/WHO Expert Consultation on Human Vitamin and Mineral Requirements (1998) *(38)* suggested a safe level of intake for vitamin A based on the amount required to permit adequate growth and other vitamin A dependent functions, and maintain an acceptable total body reserve of the vitamin. These values have been adopted by the Caribbean and slightly adapted in line with the age bands (see Table 5). For infants, 0-6 months, intakes are calculated from the vitamin A provided in human milk and the safe level is set at 375 μg retinol equivalents/day (RE/day). For older children (0.5-9 years) this is based on observational studies for children maintaining serum retinol levels of 0.70 μmol/L or higher while consuming diets providing 400-500 μg RE/day, which is the recommended safe level of intake. For adolescents (10-18 years) the safe level is 600 μg RE/day.

For adults, estimates for requirements and recommended safe intakes are extrapolated from those derived for late infancy. For adult females and males, the safe level of intake is 500 and 600 μg RE/day, respectively, and 600μg RE/day for women above 70 yrs. The safe intake level recommended during pregnancy is 800μg RE/day and 850 μg RE/day during lactation. The adapted values for the Caribbean are shown in Table 5.

The CDGWG noted that the recommendations from the Expert Consultation for future research include studies to examine:

- The interaction of vitamin A and iron with infections, as they relate to serum levels and disease incidence and prevalence;
- The relationship between vitamin A, iron, and zinc and their roles in the severity of infections;
- The nutritional role of 9-cis retinoic acid and the mechanism that regulates its endogenous production;
- The bioavailability of provitamin A carotenoids from different classes of leafy and other green and orange vegetables, tubers, and fruits as typically provided in diets (e.g., relative to the level of fat in the meal or diet); and
- Identification of a reliable indicator of vitamin A status for use in direct quantification of mean requirements and for relating status to functions.

Vitamin D

Vitamin D acts to maintain serum calcium and phosphorus at concentrations that will support bone mineralization, neuromuscular function, and various other cellular processes which are dependent on these elements. It has the properties of a hormone as well as a vitamin and is sometimes referred to as a prehormone.

The two main forms of vitamin D are ergocalciferol (vitamin D2) and cholecalciferol (vitamin D3). Ergocalciferol is derived by ultraviolet irradiation from sunlight of the ergosterol that is widely distributed in plants, fungi, and lower life-forms. Cholecalciferol is derived from a similar action of sunlight on 7-dehydrocholesterol in the skin of animals including humans, and is considered as preformed vitamin D. Usually, 30 minutes of exposure of the arms and face to sunlight can provide all the daily vitamin D needs of the body. This is considered the main source of vitamin D for most people in the Caribbean. Institutionalized, immobile elderly people and over-clothed infants kept indoors may not get adequate supplies of vitamin D through the action of sunlight.

Dietary sources of vitamin D include fatty fish such as herring, mackerel, sardines, and tuna; eggs; and fortified margarine and milk. Vitamin D compounds are found in the fat portion of milk. Skimmed milk is therefore devoid of vitamin D unless it is fortified. Estimates of the vitamin D potency of milk varies with the levels of fortification. Unfortified full cream milk is a significant source of vitamin D activity but the Canadian group specify "that it is not enough to assure the prevention of rickets in infants." There is no justification for the indiscriminate prescription of vitamin D preparations in the Caribbean.

The active form of vitamin D is 1,25-dihydroxyvitamin D [1,25-(OH)2D] also known as calcitriol or cholecalciferol. It is well known for its role in calcium and phosphate homeostasis, and in bone formation. However, recent studies have suggested that vitamin D possesses immunomodulatory properties that may alter responses to infections in vivo. This role was recently highlighted during the H1N1 pandemic *(39)*.

The absorption of vitamin D is similar to that of other lipids; that is, after emulsification with the aid of bile salts it is absorbed from the intestine and transported to the liver via the lymphatic system. Vitamin D and its metabolites circulate in blood plasma bound to a specific carrier, the vitamin D binding protein (DBP) and enter the cells via a specific intracellular receptor.

Recent studies have shown that breast-fed infants are particularly at risk for vitamin D deficiency because of the low concentrations of vitamin D in human milk *(40)*. Although unlikely in the Caribbean, a restriction in exposure to ultraviolet light for latitudinal, cultural, or social reasons could result in lower synthesis of vitamin D. The AI for vitamin D is 5 μg/day for ages 0-50 years, with no increase during pregnancy and lactation since calcium or vitamin D supplementation in lactating mothers does not result in an increased transfer of calcium or vitamin D in milk *(41)*.

It appears that in the ageing process, thinning of the skin reduces the efficiency of the synthesis of vitamin D and this may be associated with declining bone mass and increase the incidence of hip fractures *(42)*. As such, the RNIs for vitamin D for adults aged 51-65 and >65 years are 10 and 15 μg/day, respectively.

Issues to consider are: (i) skin pigmentation—the presence of darker pigments in the skin interferes with the synthetic process because ultraviolet light cannot reach the appropriate layer of the skin, and (ii) clothing—virtually complete covering of the skin for medical, social, cultural, or religious reasons leaves insufficient skin exposed to sunlight.

Caribbean Recommendations

The current Caribbean values for infants and young children of 10 μg/day should be retained but the higher WHO values should be adopted for adults aged 51-65 years and >65 years of 10 μg/day and 15 μg/day, respectively, and for pregnancy and lactation, 5 μg/day.

Vitamin E

Vitamin E is the major lipid-soluble antioxidant in the cellular antioxidant defence system and is exclusively obtained from the diet. The name vitamin E is a collective term used to describe eight fat-soluble compounds: alpha-, beta-, gamma-, and delta-tocopherol, and alpha-, beta-, gamma-, and delta-tocotrienol. Alpha- tocopherol (α-TE) is the form that meets human requirements.

Several studies in persons with CHD indicated that antioxidant supplements provided no measurable health benefits for these patients. Further, there is insufficient evidence to suggest that there are additional health benefits from intakes above those usually found in the diet. Dietary sources of vitamin E include vegetable oils, nuts, seeds, and vegetables such as spinach and broccoli.

The main consideration of the FAO/WHO Expert Consultation on vitamins and minerals *(38)* in making recommendations for RNI was the adequacy of vitamin E in preventing oxidation of PUFAs. However, diets high in PUFAs tend also to be high in vitamin E. As such, the recommended "safe" allowances for the United Kingdom (men 10 mg/day and women 7 mg/day) *(43)* and "arbitrary" allowances for the United States (men 10 mg/day and women 8 mg/day) *(44)* for vitamin E intakes approximate the median intake in those countries *(38)*.

Caribbean Recommendation

The CDGWG agreed to adopt the recommendation of the FAO/WHO Expert Consultation on vitamins and minerals, which determined that there was insufficient evidence to set guidelines for vitamin E.

The Caribbean group also concurred with the FAO/WHO Expert Consultation that there was no need to formulate recommendations for vitamin E intake for different age groups. The exception was premature newborn infants who may be vulnerable to oxidative stress because of low body stores of vitamin E, impaired absorption, and reduced transport capacity *(45)*. However, term infants achieve plasma vitamin E concentrations close to that of adults in the first week *(46)* and although the concentration of vitamin E in early human milk can be variable, after 12 days it remains fairly constant at 0.32 mg α-TE/100 mL *(47)*; thus a human-milk-fed infant consuming 850 mL would have an intake of 2.7 mg α-TE. As such, formula milk should not contain less than 0.3 mg α-TE/100 mL of reconstituted feed and not less than 0.4 mg α-TE/g PUFA.

Vitamin K

Vitamin K refers to a family of compounds that includes phylloquinone (vitamin K1) and a series of menaquinones (vitamin K2) with a common chemical structure of 2-methyl-1,4-naphthoquinone. It is a fat-soluble vitamin that occurs naturally in foods such as iceberg lettuce, spinach, and broccoli, as well as in oils such as soybean and canola oil. There is limited data on bioavailability of this vitamin, but data suggest that it is lower in plant sources than in fats and oils.

The best defined function of vitamin K is in the maintenance of normal coagulation. Dietary vitamin K is mainly in the form of phylloquinone. The intestinal microflora synthesizes large amounts of menaquinones, which are potentially available as a source of vitamin K *(38)*.

Vitamin K deficiency is rare but can occur in infants up to around 6 months of age due to low placental transfer of phylloquinone, low clotting factor levels, and low vitamin K content of breast milk. Deficiency is also rare in healthy adults and is usually due to disorders and/or drugs that affect its metabolism.

Caribbean Recommendation

The CDGWG adopted the recommendations of the FAO/WHO Expert Consultation on vitamins and minerals *(38)*, which agreed that requirements for vitamin K cannot be based on normal intakes of human milk and reasoned that adequate intakes can only be met via some form of supplementation. The adapted values for the Caribbean are shown in Table 5. The RNI for infants is 5 μg/day for the first six months (the greatest period of risk for vitamin K deficiency bleeding [VKDB]) and 10 μg/day during the second six months. These intakes are based on a daily intake of 1 μg/kg body weight of phylloquinone. The RNI for infants (7-12 months) and children ranges from 10-20 μg/day; for adolescents (10-18 years) the RNI is 35-55 μg/day; and for adults the RNI are 55 and 65 μg/day for women and men, respectively. There are no additional requirements for pregnant and lactating women *(38)*.

Table 5: Dietary Reference Values for Fat Soluble Vitamins

	Vitamin A (μg/d)	Vitamin d (μg/d)	Vitamin K (μg/d)
Infants			
0-6 mo	375	10	5
7-12 mo	400	10	10
Children			
1-3 y	400	10	15
4-8 y	450	10	20
Males			
9-13 y	600	5	35-55
14-18 y	600	5	35-55
19-30 y	600	5	65
31-50 y	600	5	65
51-70 y	600	10	65
>70 y	600	15	65
Females			
9-13 y	600	5	35-55
14-18 y	600	5	35-55
19-30 y	500	5	55
31-50 y	500	5	55
51-70 y	500	10	55
>70 y	600	15	
Pregnancy	800	5	55
Lactation	850	5	55

Vitamins - Water-Soluble

Recommended intakes for these vitamins are listed in Table 6 and in the Summary Table.

Vitamin C

Vitamin C or L-ascorbic acid is an antioxidant which is involved in several important metabolic functions in the body. These include the biosynthesis of neurotransmitters and collagen. Collagen is an important constituent of connective tissue and functions in supporting the healing of wounds. Vitamin C also potentiates the action of other antioxidants such as alpha-tocopherol (vitamin E).

Other functions of this vitamin include enhancing the absorption of non-haem iron from plant foods and supporting the immune system. Significant sources of vitamin C are citrus fruits and juices, kiwis, cantaloupes, red and green peppers, broccoli, callaloo, and tomatoes.

The FAO/WHO Expert Consultation on vitamins and minerals *(38)* concluded that there is no consistent evidence from population studies that heart disease, cancers, or cataract development are specifically associated with vitamin C status. The Expert Consultation agreed that this did not preclude the possibility that other components in vitamin C-rich fruits and vegetables provide health benefits.

The mean concentration of vitamin C in mature human milk is estimated to be 40 mg/L, but this probably reflects maternal dietary intake and not the infant's needs. The RNI for infants aged 0-6 months were therefore based on the intake required to prevent scurvy at 25 mg/day, and is gradually increased as children get older. For adults it was reasoned that an RNI of 45 mg would achieve 50% saturation in the tissues in 97.5% of adult males. No turnover studies have been done in women, but one would expect requirements to be lower; however, depletion studies have shown that plasma concentrations fell more rapidly in women than in men.

Caribbean Recommendations

The Expert Consultation recommended an extra 10 mg/day throughout pregnancy, which should enable reserves to accumulate to meet the extra needs of the growing foetus in the last trimester. Recommendation during lactation is based on the fact that 20 mg/day of vitamin C is secreted in milk and an assumed absorption efficiency of 85%. It was therefore recommended that the RNI should be set at 70 mg/day to fulfil the needs of both the mother and infant during lactation.

Thiamine

Thiamine (vitamin B1) facilitates energy metabolism and is found in the body as thiamine diphosphate (TDP) which is an essential cofactor for enzymes involved in glucose, amino acid, and lipid metabolism.

Thiamine from the diet is primarily in the phosphorylated form which is hydrolysed in the intestine before absorption. The remaining dietary thiamine can be absorbed directly.

Although thiamine is stored in the liver in small amounts, a continuous supply is required in the diet as it has a short half-life.

Requirements for thiamine traditionally have been expressed on the basis of energy intake, which can vary depending on activity levels. Deficiency results in beriberi, which exists in dry (paralytic) and wet (oedematous) forms. Beriberi has been identified in human-milk-fed infants whose nursing mothers were deficient, and has appeared in various isolated population groups. Persons at risk for thiamine deficiency are older adults, persons with alcohol dependence, HIV/AIDS, or diabetes, and those who have undergone bariatric surgery.

Research studies have not been able to definitively identify the role of this vitamin in the prevention or treatment of diabetes, heart disease, or Alzheimer's disease, but it is apparent that thiamine requirements are higher in persons with alcohol dependence.

The main food sources of thiamine are whole grains, meat (especially pork), and fish.

Caribbean Recommendations

The CDGWG adopted the recommendations of the FAO/WHO Expert Consultation *(38)*. RNIs for thiamine are based on adequate food intakes. In human breast milk the mean thiamine content is 0.21 mg/L or 0.16 mg/750 mL. The RNI for 0-6 months is 0.2 mg/day and increases by metabolic scaling to 0.9 mg/day in the 7-9 years group. For adolescents and adults the RNI is 1.1 and 1.2 mg/day for females and males, respectively. During pregnancy the RNI is 1.4 mg/day to account for additional energy intakes in the second and third trimesters. Similarly, for lactation an additional 0.1 mg (RNI = 1.5 mg/day) is needed.

Riboflavin

Riboflavin (vitamin B2) is a component of two major coenzymes, flavin mononucleotide (FMN, also known as riboflavin-5'-phosphate) and flavin adenine dinucleotide (FAD). More than 90% of dietary riboflavin is in the form of FMN or FAD, with the remaining 10% consisting of the free form and glycosides or esters. FMN and FND are critical in energy metabolism, cellular function, and the metabolism of fats, drugs, and steroids. Riboflavin influences the metabolism of other B vitamins, notably niacin, which requires FAD for its formation and for the activation of pyridoxal 5'-phosphate *(48)*.

Major food sources are eggs, organ meats (kidney and liver), lean meats, milk, and green vegetables.

Caribbean Recommendations

The CDGWG adopted the recommendations from the FAO/WHO Expert Consultation *(38)*, which concluded that no difference was seen in riboflavin status of women taking oral contraceptives when dietary intake was controlled in a 2-week acclimation period *(49)*. Impaired riboflavin status may result from abnormal digestion, such as lactose intolerance. This condition is highest in African and Asian populations and can lead to decreased intakes of milk, as well as an abnormal absorption of riboflavin. Among elderly persons, a lower fat–carbohydrate ratio may decrease the riboflavin requirements.

Based on riboflavin intakes from human milk (0.26 mg/750 mL of milk per day) the RNI for infants up to age 6 months is set at 0.3 mg/day with increasing amounts by metabolic scaling for older infants and young children. For adults the RNI is set at 1.0 and 1.3 mg/day for males and females, respectively. An additional riboflavin requirement of 0.3 mg/day for pregnancy is based on increased growth in maternal and foetal compartments. For lactating women the RNI is set at 1.4 mg/day.

Niacin

Niacin (nicotinic acid) has biochemical interrelationship with riboflavin and vitamin B_6, which are needed for the conversion of L-tryptophan to niacin equivalents (NEs), and insufficient intakes of these vitamins may also influence niacin requirements. Niacin is involved in the functioning of the digestive and nervous systems as well as in energy metabolism. Nicotinic acid has been used in the treatment of persons to regulate cholesterol and triglyceride levels.

Food sources include dairy products, eggs, fish, lean meats, legumes, nuts, and poultry.

Caribbean Recommendations

The CDGWG adopted the recommendations of the FAO/WHO Expert Consultation *(38).* Niacin content of human milk is approximately 5 mg NEs/L or 4 mg NEs/750 mL; as such, the RNI for 0-6 month-old infants is set at 2 mg NEs/day. As with other vitamins involved in energy metabolism, infants 6 months and older have progressively higher RNIs based on metabolic scaling. For adults, it is suggested that 12.5 mg NEs, which corresponds to 5.6 mg NEs per 4184 kJ, is minimally sufficient for niacin intake, and the RNI is set at 14 and 16 mg NEs/day for females and males, respectively. For pregnant women the energy cost of pregnancy puts the RNI at 18 mg NEs/day and for lactating women the RNI is set at 17 mg NEs/day.

Vitamin B_6

Vitamin B_6, is a generic name for six compounds including pyridoxine, pyridoxamine, pyridoxal, and their respective phosphate esters. These latter compounds are the coactive forms of the vitamin and are active in a number of enzyme functions, particularly in protein metabolism as well as carbohydrate and lipid reactions. Vitamin B_6 also functions in cognitive development in pregnancy and infancy, glucogenesis, glycogenesis, and in the maintenance of the immune system.

Hypovitaminosis B_6 is a growing concern and may occur as a result of deficiency of other B-complex vitamins. Women receiving oral contraceptives have decreased indicators of vitamin B_6 status, but this probably reflects hormonal stimulation of tryptophan catabolism rather than any deficiency of vitamin B_6 per se (50). Persons at risk for vitamin B_6 deficiency include those with impaired renal function, autoimmune disorders, and alcohol dependence. There is no evidence relating to the impact of this vitamin on cardiovascular disease or cancer. Major food sources are poultry, fish, and organ meats, as well as fruits (excluding citrus) and potatoes.

Caribbean Recommendations

The CDGWG adopted the recommendations of the FAO/WHO Expert Consultation (38).

The average intake of vitamin B_6 for infants based on human-milk content is 0.1 mg/750 mL/day. Extrapolation on the basis of metabolic body size, weight, and growth suggests 0.3 mg/day as an adequate intake for infants 6-12 months of age. This is increased accordingly in children up to age 9 years. For adolescents the RNI is set at 1.2 and 1.3 mg/day for females and males, respectively. For adult females and males aged up to 50 years, the RNI is 1.3 mg/day and above 50 years the RNI is 1.5 and 1.7 mg/day for females and males, respectively. The RNIs for pregnancy and lactation are 1.9 and 2.0 mg/day, respectively.

Pantothenic acid

Pantothenic acid is a component of CoA, a cofactor that carries acyl groups and is ubiquitous in metabolic pathways and functions in production of hormones and cholesterol.

Food sources include whole-grain cereals, white and sweet potatoes, organ meats, eggs, milk, poultry, legumes and lentils, broccoli, kale and other vegetables in the cabbage family, avocados, and yeast.

Caribbean Recommendations

The CDGWG adopted the recommendations of the FAO/WHO Expert Consultation *(38)*. Requirements for infants are based on the pantothenic acid content of human milk and suggest that 1.7 mg/day is an adequate intake by younger (0-6 months) infants. Taking into consideration growth and body size, 1.8 mg/day is extrapolated for older (7-12 months) infants. Metabolic studies in adolescents *(51)* suggest that intakes of less than 4 mg/day were sufficient to maintain pantothenate status; however, the RNI is set at 5.0 mg/day, which is the same for adults. For pregnancy and lactation, the RNI is set at 6.0 and 7.0 mg/day, respectively.

Biotin

Biotin functions as a coenzyme within several metabolic pathways and is involved in one- carbon transfer reactions. Food sources for biotin include cereals, egg yolks, legumes, milk, nuts, pork, and yeast.

Caribbean Recommendations

The CDGWG adopted the recommendations of the FAO/WHO Expert Consultation *(38)*. Based on human-milk composition, the RNI derived for biotin for an infant consuming 750 mL/day of human milk is 5 µg/day during the first six months, and for older infants (7-12 months) 6 µg/day. Requirements for children and adults have been extrapolated via metabolic scaling and vary from 8 to 20 µg/day. For adolescents the RNI is 25 µg/day, and for adults, including pregnant women, 30 µg/day. During lactation the RNI is set at 35 µg/day to cover the losses due to breastfeeding.

Vitamin B_{12}

The FAO/WHO Expert Consultation *(38)* noted that although the nutrition literature still uses the term vitamin B_{12}, cobalamin is a more specific name. It exists in several forms, with methylcobalamin and 5-deoxyadenosylcobalamin being the forms active in human metabolism. Major functions include the formation of red blood cells, ensuring proper neurological function, and in the synthesis of deoxyribonucleic acid (DNA).

Humans derive dietary vitamin B_{12} almost exclusively from animal tissues or products. As such, individuals who consume diets completely free of animal products (vegan diets) are at risk of vitamin B_{12} deficiency since plants do not synthesize vitamin B_{12}. Food sources include beef liver, clams, fish, meat, poultry, eggs, milk, and dairy products.

Caribbean Recommendations

The CDGWG adopted the recommendations of the FAO/WHO Expert Consultation *(38)*.

The FAO/WHO Expert Consultation noted that the United States Food and Nutrition Board of the National Academy of Sciences (NAS), Institute of Medicine *(52)* had recently conducted an exhaustive review of the evidence regarding vitamin B_{12} intake, status, and health implications for all age groups, including the periods of pregnancy and lactation. The Expert Consultation felt it appropriate to adopt the same approach used by the NAS in deriving the RNIs for vitamin B_{12}; thus, based on the assumption that human milk contains enough vitamin B_{12} for optimum health, the RNI was set at 0.4 and 0.7 μg/day for infants aged 0-6 months and 7-12 months, respectively. The RNI for adolescents was set at the same level as adults and the elderly, 2.4 μg/day. For pregnant women an RNI of 2.6 μg/day was set and for lactation the RNI was set at 2.8 μg/day.

Folacin

Folates are involved in one-carbon reactions—i.e., they accept one-carbon units from donor molecules and pass them on via various biosynthetic reactions. It is thought that pregnant women are at risk for folate deficiency because pregnancy significantly increases the folate requirement, especially during periods of rapid foetal growth (i.e., in the second and third trimesters). There is also good evidence that an adequate intake of folic acid must be taken near the time of conception in order to reduce risk of neural tube defects in the newborn. Although red cell folate is used as an important index of folate status, plasma homocysteine has also been identified as a very sensitive indicator of folate status. Plasma homocysteine, if only moderately elevated, is an independent risk factor for cardiovascular disease and stroke *(53, 54)*. Consequently, when deriving folate requirements consideration must be given to the level of intakes that would reduce plasma homocysteine to a minimum level of less than 7.0 μmol/l.

Sources of folacin include dark green leafy vegetables, fruits and fruit juices, nuts, beans, peas, dairy products, poultry meat, eggs, seafood, and cereals.

Caribbean Recommendations.

The CDGWG adopted the recommendations of the FAO/WHO Expert Consultation *(38)*.

The Expert Consultation agreed that the values published in 1998 by the U.S. National

Academy of Sciences *(30)* were the best available estimates of folate requirements based on the current literature and adopted the RDAs of the NAS as the basis for the FAO/WHO RNIs for dietary folate. The RNI for young infants (0-6 months) is 80 μg/day, which is the same for those aged 7-12 months, and increases progressively to 300 in 7-9 year-olds. For adolescents, adults, and the elderly the RNI is 400 μg/day. In pregnancy and lactation the RNIs are set at 600 and 500 μg/day, respectively.

Table 6: Dietary Reference Values for Water-Soluble Vitamins

	Vit. C (mg/d)	Thiamine (mg/d)	Riboflavin (mg/d)	Niacin (mg/d)	Vit. B_6 (mg/d)	Panto-thenic Acid (mg/d)	Biotin (mg/d)	Vit. B_{12} (µg/d)	Folacin (µg/d)
Infants									
0-6 mo	25	0.2	0.3	2	0.1	1.7	5	0.4	80
7-12 mo	30	0.3	0.4	4	0.3	1.8	6	0.7	80
Children									
1-3 y	30	0.5	0.5	6	0.5	2.0	8	0.9	150
4-8 y	30	0.6	0.6	8	0.6	3.0	12	1.2	200
Males									
9-13 y	40	1.1	1.0	16	1.2	5.0	25	2.4	400
14-18 y	40	1.2	1.0	16	1.3	5.0	25	2.4	400
19-30 y	45	1.2	1.3	16	1.3	5.0	30	2.4	400
31-50 y	45	1.2	1.3	16	1.3	5.0	30	2.4	400
51-70 y	45	1.2	1.3	16	1.7	5.0	30	2.4	400
>70 y									
Females									
9-13 y	40	1.1	1.0	16	1.2	5.0	25	2.4	400
14-18 y	40	1.1	1.0	16	1.2	5.0	25	2.4	400
19-30 y	45	1.1	1.1	14	1.3	5.0	30	2.4	400
31-50 y	45	1.1	1.1	14	1.3	5.0	30	2.4	400
51-70 y	45	1.1	1.1	14	1.5	5.0	30	2.4	400
>70 y									
Pregnancy	55	1.4	1.4	18	1.9	6.0	30	2.6	600
Lactation	70	1.5	1.6	17	2.0	7.0	35	2.8	500

Minerals – Macro Minerals

Recommended intakes are listed in Table 7 and in the Summary Table.

Calcium

Calcium salts provide rigidity to the skeleton and calcium ions play important roles in many metabolic processes. The Joint FAO/WHO Expert Consultation on Human Vitamin and Mineral Requirements *(38)* noted that calcium allowances recommended for developed countries have been rising (and may still not have reached their peak) and also that the gap between recommended and actual calcium intakes in developing countries has widened. The Expert Consultation clarified that almost all of the available recommendations at that time were largely based on data derived from the developed world and were not necessarily applicable to countries with different dietary cultures, different lifestyles, and different environments for which different calculations may be indicated. Importantly, phytates in husks of cereals as well as in nuts, seeds, and legumes, can form insoluble calcium phytate salts in the gastrointestinal tract. Additionally, excess oxalates can precipitate calcium in the bowel but are not an important factor in most diets. Good food sources of calcium include milk, cheese, and yogurt; vegetables such as kale, broccoli, and Chinese cabbage; canned sardine and salmon.

Caribbean Recommendations

The CDGWG adopted the recommendations of the FAO/WHO Expert Consultation and agreed that the revision of Caribbean values should be based on the 2004 FAO/WHO updated values rather than the 2010 USA values, which are higher. Pregnant and lactating females under the age of 18 years should maintain intake (1000 mg) relevant to age group. An upper level of intake should be observed to prevent excess intake of calcium and the risk of lowered uptakes of phosphorus and zinc.

The Expert Consultation agreed that the most satisfactory way of calculating calcium requirement from current data is by using the intake level at which excreted calcium equals

net absorbed calcium, as this approach has the advantage of permitting separate analysis of the effects of changes in calcium absorption and excretion.

In setting the recommended allowance for infants (0-6 months) the Expert Consultation noted that calcium absorption from human milk is higher than that from cow's milk and set requirements at 300 and 400 mg/day, respectively, for each type of milk. The RNI based on human milk is met with a daily intake of 750 mL of breast milk.

For children 0.5 to 9 years the recommended allowance is based on a daily rate of calcium accumulation of about 120 mg and the average recommended intake is 600 mg/day, which is lower in the earlier years and somewhat higher for older children. For adolescents (10-18 years) the RNI is 1300 mg/day, particularly during puberty when there is a striking increase in the rate of skeletal calcium accretion.

The recommended allowance for males and premenopausal adult females is 1000 mg/day. This is increased to 1300 mg/day in postmenopausal women in order to account for increased urinary calcium excretion and to reduce the occurrence of osteoporosis. For men older than 65 years of age the recommended daily calcium intake is 1300 mg/day, while for pregnant and lactating women the recommended daily allowance is 1200 mg/day and 1000 mg/day, respectively.

The Expert Consultation's recommendations for adults are very close to those of Canada and the United States *(55)* but higher than those of Australia *(56)* and the United Kingdom *(43)*, which do not take into account insensible losses (water loss through lungs, skin, respiratory tract, and water excreted in the faeces), and higher than those of the European Union *(57)*, which assume 30% absorption of dietary calcium. The British *(43)* and European *(57)* values make no allowance for ageing or menopause. Recommendations for other high-risk groups are very similar in all five sets of recommendations, except for the rather low allowance for infants by Canada and the United States *(55)*.

Calcium metabolism and therefore its requirement is influenced by several dietary factors. For example, sodium administration raises calcium excretion, presumably because

sodium competes with calcium for reabsorption in the renal tubules. Additionally there is the positive effect of dietary protein, particularly animal protein, on urinary calcium. It has been suggested that a 40 g reduction in animal protein intake from 60 g to 20 g (roughly the difference between usual intakes in the developed and developing regions of the world) would reduce calcium requirement by the same amount as a 2.3 g reduction in dietary sodium. Vitamin D synthesis from sunlight is higher in many developing countries and this could reduce the requirement for calcium, hence there is need for studies of calcium metabolism in developing countries as well as investigation of the cultural, geographical, and genetic bases for differences in calcium intakes in different groups in developing countries. Additionally, there is need to study the relationship between latitude, sun exposure, and synthesis of vitamin D and intestinal calcium absorption in different geographical locations.

Phosphorus

Phosphorus is required for maintenance of pH, storage and transfer of energy, and for nucleotide synthesis. It is an essential element in the composition of bone and more than 85% (700 g) of phosphorus in the body is in the skeleton. In addition, it is involved (as phosphate ion) in numerous vital chemical reactions within the cell, including those from which energy is derived (the phosphate bond of adenosine triphosphate, ATP) and reactions involving the B vitamin group.

Caribbean Recommendations

The requirements quoted here are those reported in the United States dietary reference intakes (DRI) 1997 *(55)*. For infants 0-6 months and 7-12 months, an adequate intake is given as 100 and 275 mg/day, respectively. The RDA for young children 1-3 and 4-8 years is 460 and 500 mg/day, respectively; this increases substantially to 1250 mg/day for males and females (including pregnancy) aged 9-18 years. After age 19 years the RDA is 700 mg/day for both males and females, with no increased allowance for pregnancy or lactation. The CDGWG accepted these recommendations.

Magnesium

Magnesium functions as a cofactor of many enzymes that in turn regulate reactions such as protein synthesis, muscle and nerve function, blood glucose control, and blood pressure regulation. Magnesium is widely distributed in plant and animal foods; however, soya flour, corn flour, cassava flour, sago flour, and polished rice flour have extremely low magnesium content. Good sources of this mineral include legumes, nuts, seeds, whole grains, green leafy vegetables (such as spinach), milk, and yogurt.

The magnesium in human milk is absorbed with greater efficiency (about 80%-90%) than that of formula milk (about 55%-75%) or solid foods (about 50%) *(58)* and these differences must be taken into account when comparing differing dietary sources, especially for infants and young children.

The FAO/WHO Expert Consultation *(38)* assumes that demands for magnesium, plus a margin of approximately 20% (to allow for methodological variability), are probably met by allowing approximately 3.5-5 mg/kg body weight from preadolescence to maturity. Recommended intakes for magnesium therefore assume standardized body weights.

Caribbean Recommendations

The CDGWG advised that the updated U.S. Institute of Medicine recommendations *(55)* should be considered in the revision of recommendations for magnesium. Of major concern was that recommendations of the FAO/WHO Expert Consultation for magnesium were based subjectively on the absence of any evidence that magnesium deficiency of nutritional origin has occurred after consumption of a range of diets sometimes supplying considerably less than the United States RDA *(55)* or the United Kingdom RNI recommendations *(43)*. As implied, there are differences in the recommendations.

The RNI for infants aged 0-6 months and breast-fed is 30 mg/day. For 7 to 12 month-old infants the RNI is set at 75 mg/day and this progressively increases to 130 mg/day in the 4- 8 year-old group. The RNI for females 9-70 years ranges from 240 mg/day to 320 mg/day, and for males 9-70 year old from 240 mg/day to 420 mg/day.

Requirements for pregnancy and lactation are 400 mg/day and 360 mg/day, respectively.

Sodium

There are several regional initiatives in North America and Europe, and lately in the Caribbean, to reduce the population intakes of sodium. In 2013, the WHO issued guidelines relating to the impact of excessive sodium intake on prevention and control of heart disease and stroke *(59)*. These guidelines will support the ongoing initiatives in the Caribbean aimed at reducing the sodium content of food and promoting reduced sodium intake in the population. The WHO recommends intake of less than 2 g of sodium (5 g of salt) per day in adults, and a corresponding adjustment for children based on energy requirements.

Caribbean Recommendations

The CDGWG decided to adopt the 2010 United States values *(30)*.

The interim United States/Canada report on sodium agreed that a decrease in sodium intake toward 2300 mg sodium per 2000 kcal diet lowers blood pressure in adults and children. Since 70% of the population is hypertensive, the goal for most individuals should be 1500 mg per 2000 kcal diet. The amount of sodium consumed should be decreased from 2300 mg to 1500 mg by 2014. The recommended values published later in 2010 *(30)* are recommended for use in the Caribbean. An AI for sodium has been set for infants 0-6 months at 0.12 g/day based on breast-feeding. For 7-12 month-olds the AI is 0.37 g/day. This is increased to 1.0-1.2 g/day at 1-8 years. Above this until age 50 years the AI is 1.5 g/day for both males and females; this falls to 1.3 and 1.2 g/day after age 50 and 70 years, respectively. The AI during pregnancy and lactation is 1.5 g/day. This is consistent with WHO Guideline *(59)* on sodium intake for adults and children, which recommends a reduction to <2 g/day sodium in adults, adjusting downward for children, based on the energy requirements of children relative to those of adults.

Potassium

Potassium maintains fluid volume inside and outside of cells and by so doing, normal cell function. It acts to blunt the rise of blood pressure in response to excess sodium intake and decrease markers of bone turnover and recurrence of kidney stones.

Caribbean Recommendations

The CDGWG decided that the 2010 United States values *(30)* should be adopted for the Caribbean.

In young infants (0-6 months) the AI is based on breast milk at 0.4 g/day and for those aged 7-12 months the AI is 0.7 g/day. For 1-3 and 4-8 year-olds the AI is 3.0 and 3.8 g/day, respectively; at ages 9-13 the AI increases to 4.5 g/day. From 14-70 years and during pregnancy the AI for potassium is 4.7 g/day;. During lactation the AI is 5.1 g/day. This is also consistent with the WHO Guideline on potassium intake for adults and children *(60)*.

Chlorine

Along with sodium, chlorine maintains fluid volume outside of cells and by so doing, normal cell function.

Caribbean Recommendations

The CDGWG decided that the 2010 United States values *(30)* should be used.

In young infants (0-6 months) the AI for chlorine is based on breast milk at 0.18 g/day and for infants aged 7 to 12 months the AI is 0.57 g/day. For 1-3 and 4-8 year-olds the AI is 1.5 and 1.9 g/day, respectively. For ages 9-50 years and during pregnancy and lactation the AI is 2.3 g/day; this is reduced to 2.0 and 1.8 g/day after age 50 and 70 years, respectively.

Table 7: Dietary Reference Values for Minerals

	Calcium (mg/d)	Phosphorus (mg/d)	Magnesium (mg/d)	Sodium (mg/d)	Potassium (g/d)	Chlorine (g/d)
Infants						
0-6 mo	300	100	30	120	0.4	0.18
7-12 mo	400	275	75	370	0.7	0.57
Children						
1-3 y	500	460	80	1000	3.0	1.5
4-8 y	650	500	130	1200	3.8	1.9
Males						
9-13 y	1300	1250	240	1500	4.5	2.3
14-18 y	1300	1250	410	1500	4.7	2.3
19-30 y	1000	700	100	1500	4.7	2.3
31-50 y	1000	700	420	1500	4.7	2.3
51-70 y	1000	700	420	1300	4.7	2.0
>70 y	1300	700	420	1200	4.7	1.8
Females						
9-13 y	1300	1250	240	1500	4.5	2.3
14-18 y	1300	1250	360	1500	4.7	2.3
19-30 y	1000	700	310	1500	4.7	2.3
31-50 y	1000	700	320	1500	4.7	2.3
51-70 y	1300	700	320	1300	4.7	2.0
>70 y	1300	700	320	1200	4.7	1.8
Pregnancy	1200	700	400	1500	4.7	2.3
Lactation	1200	700	360	1500	5.1	2.3

Minerals - Trace Elements

Recommended intakes are listed in Table 8 and in the Summary Table.

Iron

Iron is required for the formation of haemoglobin, myoglobin, cytochromes, and various enzymes. Iron deficiency anaemia is the most common nutritional deficiency in the world with infants, children, adolescents, and women of childbearing age, especially pregnant women, being at greatest risk. The weaning period in infants is especially critical because of the very high iron requirement needed in relation to energy requirement, and this may pose a major problem in many developing countries. The required amount of absorbed iron is estimated based on factorial modelling. However, the Joint FAO/WHO Expert Consultation on Human Vitamin and Mineral Requirements (38) concluded that iron requirements should be adjusted to different types of diets, especially in vulnerable groups. Using more recent studies, the Expert Consultation recommended that for developing countries it may be more realistic to use iron bioavailability values of 5% and 10% due to the fact that populations in developing countries are more likely to be consuming diets that are more plant based and therefore more dependent on iron from these sources. In populations consuming more Western-type diets, two levels would be appropriate—12% and 15%—depending mainly on meat intake.

In North America, the EAR *(61)* was determined by dividing the required amount of absorbed iron by the fractional absorption of dietary iron, estimated to be 18% for adults for the typical North American diet. The RDA for men and premenopausal women is 8 and 18 mg/day, respectively. The RDA for pregnant women is 27 mg/day *(61)*. These values are higher than those derived by the 2004 FAO/WHO Expert Consultation *(38)*. The Caribbean technical group recommended that the 2004 FAO/WHO values based on 10% bioavailability should be used to revise the Caribbean values. Key considerations for the Caribbean are prevailing anaemia rates, late introduction of haem-iron-rich foods in infancy, and current recommendations for proportion of energy from food from animals.

For age category 0-6 months, the AI of 0.27 mg/day should be adopted with the assumption that maternal intakes are adequate. Routine testing at 6-9 months is recommended to determine the iron status of infants and need for supplementation. Routine supplementation (based on WHO recommendations) of pregnant women and adolescent girls should continue to be promoted, based on the premise that teenage girls, like pregnant women, would not be able to meet >30 mg/day from diet alone.

Caribbean Recommendations

The CDGWG recommended the adoption of the FAO/WHO Expert Consultation values based on 10% bioavailability to revise Caribbean values *(38)*.

In deriving recommendations for the Caribbean, consideration was given to available dietary intakes to determine the extent to which the population consumes animal-based products and as such what iron bioavailability value should be used to form the base for recommendations. Assuming this was 10% then the RNI would be 9.3 mg/day for infants aged 0.5-1 year and 5.8 mg/day for children aged 1-3 years. For adolescent males the RNI peaks at ages 15-17 years (18.8 mg/day) and falls to 13.7 mg/day after age 18 years. In females the RNI is 32.7 mg/day for ages 11-14 years experiencing menarche and 31.0 mg/day for ages 15-17 years. For postmenopausal and lactating women the RNI is 11.3 and 15.0 mg/day, respectively. In pregnant women, iron absorption is increased significantly in the second and third trimesters. It was agreed that it would be impossible for the woman to cover her iron requirements from diet alone, even if her diet's iron content and bioavailability were very high. The FAO/WHO Expert Consultation *(38)* therefore recommended that iron supplements in tablet form, preferably together with folic acid, be offered to all pregnant women because of the difficulties in correctly evaluating iron status in pregnancy with routine laboratory methods. In the non-anaemic pregnant woman, daily supplements of 100 mg of iron (e.g., as ferrous sulphate) given during the second half of pregnancy are adequate. In anaemic women, higher doses are usually required.

WHO recommends universal supplementation of pregnant women where prevalence of iron deficiency anaemia is high, which is the case in many Caribbean countries.

Some of the relevant issues to be resolved are:

- Acquiring knowledge about detailed composition of common meals in the Caribbean and their usual variation in composition, to examine the feasibility of making realistic recommendations about changes in meal composition, taking into consideration the effect of such changes on other nutrients (e.g., vitamin A).
- The very high iron requirements, especially in relation to energy requirements, in the period during which complementary foods are being introduced make it difficult to develop appropriate diets based on recommendations that are effective and realistic. Alternatives such as home fortification of weaning foods should also be considered.

Iodine

Iodine is required for the synthesis of thyroid hormones by the thyroid gland; as such, the dietary requirement of iodine is determined by normal thyroxine (T4) production by the thyroid gland. Recent data indicate that the iodine content of human milk varies markedly

as a function of the iodine intake of the population. Based on intakes of human milk, the recommended intakes for premature infants and those aged 0-6 months are 30 and 15 μg/day, respectively. The daily iodine requirement on a body weight basis decreases progressively with age, and so children aged 1-6 and 7-12 years have recommended intakes of

6 and 4 μg/kg/day, respectively. The recommended intake for adolescents and adults is 2 μg/kg/day, and for pregnant and lactating women it is 3.5 μg/kg/day.

Iodine is routinely added to salt in most countries in the Caribbean; however, there is little empirical information about iodine levels in the population.

Caribbean Recommendations

The WHO (2007) recommendations from the Technical Consultation for the prevention and control of iodine deficiency in pregnant and lactating women and in children under 2 years old were used for the Caribbean *(62)*.

Zinc

Zinc is essential for normal tissue synthesis, enzyme function, and optimal immunity. Its absorption from solid diets varies depending on zinc content and diet composition. Although it has been suggested that competitive interactions between zinc and other ions with similar physicochemical properties can affect the intestinal absorption of zinc, the FAO/WHO Expert Consultation *(38)* agreed that at levels present in food and at realistic fortification levels, zinc absorption appears not to be affected by supplemental iron or copper, for example. In developing countries, high phytate containing diets may influence zinc absorption; however, the required studies have not been conducted to ascertain the level of zinc absorption from typical diets in these countries.

Caribbean Recommendations

The FAO/WHO Expert Consultation *(38)* values based on moderate bioavailability should be used to revise Caribbean values.

Based on zinc absorption studies of single meals or total diets, the Expert Consultation *(38)* derived three categories—namely high, moderate, and low zinc bioavailability—and applied these to the estimates of requirements for absorbed zinc to achieve a set of figures for the average individual dietary zinc requirements. Additionally, a standardized body weight is assumed in setting the RNIs for zinc. Assuming moderate bioavailability, the recommended intake for zinc in different groups are: 0-6 months 2.8 mg/day; 7-12 months and 1-3 years 4.1 mg/day; adolescent females 7.2 and males 8.6 mg/day; adult females 4.9 and males 7.0 mg/day. In pregnancy the recommended intakes are 5.5, 7.0, and 10.0 mg/day in the first, second, and third trimesters, respectively; and in lactation these are 9.5, 8.8, and 7.2 mg/day in months 0-3, 3-6, and 6-12, respectively.

Chromium

Chromium potentiates the action of insulin and helps to maintain normal blood glucose levels.

Caribbean Recommendations

The CDGWG recommended that the 2010 United States values *(30)* be used to establish the Caribbean values.

The United States 2000 Committee agreed that there was insufficient evidence to set an EAR for chromium *(61)*. Consequently, an AI was set based on estimated intakes of chromium derived from the average amount of chromium per 1000 kcal of balanced diets and average energy intake from NHANES III. The AI is 0.2 and 5.5 μg/day for infants aged 0-6 months and 7-12 months, respectively; 35 μg/day for young men and 25 μg/day for young women; this is increased to 30 and 45 μg/day in pregnancy and lactation, respectively.

Copper

Copper functions to catalyse the activity of many copper metalloenzymes that act as oxidases to achieve the reduction of molecular oxygen.

Caribbean Recommendations

The CDGWG recommended that the 2010 United States values *(30)* be used to establish the Caribbean values.

The method used to set an EAR for copper is based on the changes in a combination of biochemical indicators resulting from varied levels of copper intake *(61)*. The AI for young infants age 0-6 months is 200 μg/day, and 220 μg/day for age 7-12 months. The RNI is set at 700 μg/day for ages 9-13 years and is increased to 900 μg/day for men and women, as there were insufficient data to set a different EAR and RNI for each sex. For pregnancy and lactation the RNI is set at 1000 and 1300 μg/day, respectively.

Fluorine

Fluorine inhibits the initiation and progression of dental caries and stimulates new bone formation.

Caribbean Recommendations

The CDGWG recommended that the 2010 United States values *(30)* be used to establish the Caribbean values.

Data on the effect of fluoride on risk reduction of dental caries are strong, but the evidence upon which to base an actual requirement is scant, and therefore an AI is given *(55)*. Human breast milk fluoride is used to set the AI for infants 0-6 months at 0.01 mg/day; for 7-12 month olds the AI is 0.5 mg/day and this increases to 3 mg/day in 14-18 year olds. Adults aged 19 to >70 have an AI of 4 mg/day for males and 3 mg/day for females, with no increases in pregnancy and lactation.

Manganese

Manganese is involved in the formation of bone, as well as in enzymes involved in amino acid, cholesterol, and carbohydrate metabolism.

Caribbean Recommendations

The CDGWG recommended that the 2010 United States values *(30)* be used to establish the Caribbean values.

There were insufficient data to set an EAR for manganese. An AI was set based on median intakes reported from the U.S. Food and Drug Administration Total Diet *(61)*. The AI for 0-6 and 7-12 months is 0.003 and 0.6 mg/day, respectively. The RNI for ages 1-3 and 4-8 years is 1.2 and 1.5 mg/day, respectively; this increases progressively with age to 2.2 mg/day in the 14-18 age group. The AI for adult men and women is 2.3 and 1.8 mg/day, respectively. For pregnant and lactating women the AI is 2.0 and 2.6 mg/day, respectively.

Molybdenum

Molybdenum is a cofactor for enzymes involved in catabolism of sulfur amino acids, purines, and pyridines.

Caribbean Recommendations

The CDGWG recommended that the 2010 United States values *(30)* be used to establish the Caribbean values.

The AI for infants age 0-6 and 7-12 months is 2 and 3 μg/day, respectively *(61)*. The RNI for the 1-3 and 4-8 years groups is 17 and 22 μg/day, respectively; this increases progressively with age to 43 μg/day in the 14-18 age group in both males and females, and above 19 years the RNI remains constant at 45 μg/day. For pregnant and lactating women the RNI is set at 50 μg/day.

Selenium

The relationships between selenium status and indexes of deficiency require closer study in order to provide more reliable and earlier means of detecting a suboptimal status. This is important since suboptimal selenium status may have much wider significance in influencing disease susceptibility. Such studies should include the impact of selenium deficiency on protection against oxidative damage during tissue trauma and its genetic implication for viral virulence. The RNI provided by the FAO/WHO Expert Consultation on vitamins and minerals (38) for the following age groups are adjusted for weight: age 0-6 months 6 μg/day; 7-12 months 10 μg/day); adolescents aged 14-18 years at 26 μg/day for females and 32 μg/day for males; adult (19-65 years) females 26 μg/day and males 34 μg/day. In the second and third trimesters of pregnancy the RNI are 28 and 30 μg/day, respectively. During lactation, the RNI for the first and second six-month period are 35 and 42 μg/day, respectively.

When the above recommendations are compared with those from WHO/FAO/IAEA *(63)*, European Union *(57)*, United Kingdom *(43)*, and United States *(64)*, the present proposals represent a significant decrease in the suggested need for selenium. The FAO/WHO Expert Consultation *(38)* gave the following reasons for this:

- Current recommendations are based on a high weight range that does not reflect realities in many developing countries.
- The decision, accepted by WHO, FAO, and IAEA *(63)*, that it is neither essential nor desirable to maintain selenium status at a level which fully saturates blood glutathione peroxidase activity when, based on current evidence, this is not an advantage for health.

Caribbean Recommendations

The CDGWG recommended that the 2010 United States values be used to establish the Caribbean values.

The RNIs for selenium *(64)* are as follows: age 0-6 months AI 15 µg/day; age 7-12 months 20 µg/day; adolescent (14-18 years) females and males 55 µg/day; adult (19-65 years) females and males 55 µg/day. No additional requirements are set for pregnancy, whereas during lactation an RNI of 70 µg/day is set.

Table 8: Dietary Reference Values for Trace Elements – Minerals

	Iron (mg/d)	**Iodine** (µg/d)	**Zinc** (mg/d)	**Copper** (µg/d)	**Fluorine** (mg/d)	**Manganese** (mg/d)	**Molybdenum** (µg/d)	**Selenium** (µg/d)
Infants								
0-6 mo		90	2.8	200	0.01	0.003	2	15
7-12 mo	9.3	90	4.1	220	0.5	0.6	3	20
Children								
1-3 y	5.8	90	4.1	340	0.7	1.2	17	20
4-8 y	6.3	90	4.8	440	1	1.5	22	30
Males								
9-13 y	14.6	120	8.6	700	2	1.9	34	40
14-18 y	18.8	150	8.6	890	3	2.2	43	55
19-30 y	13.7	150	7.0	900	4	2.3	45	55
31-50 y	13.7	150	7.0	900	4	2.3	45	55
51-70 y	13.7	150	7.0	900	4	2.3	45	55
>70 y	13.7	150	7.0	900	4	2.3	45	55
Females								
9-13 y	14.0	120	7.2	700	2	1.6	34	40
14-18 y	32.7	150	7.2	890	3	1.6	43	55
19-30 y	29.4	150	4.9	900	3	1.8	45	55
31-50 y	29.4	150	4.9	900	3	1.8	45	55
51-70 y	11.3	150	4.9	900	3	1.8	45	55
>70 y	11.3	150	4.9	900	3	1.8	45	55
Pregnancy	29.4	250		1000	3	2	50	
1st Trimester			5.5					
2nd Trimester			7.0					
3rd Trimester			10.0					
Lactation	15.0	250		1300	3	2.6	50	70
0-6 mo			9.5					
6-12 mo			7.2					

Population Nutrient Goals for the Caribbean

The WHO defines a population nutrient intake goal (PNIG) as the average dietary intake that is recommended for the maintenance of good health in a population *(18)*. Population nutrient intake goals differ from individual-based recommendations in that they are geared towards meeting the needs of most individuals (approximately 97%) within the population. They take into account the wide range of distributions of dietary requirements that are of benefit or risk to individual health. Most individuals fall within this range of distribution, but some may require more or less than the recommended PNIG.

A population approach to dietary recommendations is useful because there is usually insufficient comprehensive knowledge about the specific dietary requirements of every individual within a population, especially when requirements are influenced by a multitude of factors such as genetic composition and environment *(44)*. PNIGs are more far-reaching and therefore serve as general guidelines from which individual members of the population can make discrete dietary decisions.

The New Caribbean PNIGs promote healthy dietary consumption patterns that satisfy the nutritional needs of the English-speaking Caribbean population and reduce the risk for diet-related chronic noncommunicable diseases. The Caribbean PNIGs were published in a 2009 report *(65)*. Recommendations provided are based on empirical evidence that directly associate poor diet and lifestyle practices with the increased presence of overweight/obesity, diabetes mellitus, hypertension, cardiovascular diseases, and cancers—all of which are among the leading causes of morbidity and mortality within the subregion. The goals reflect an understanding of the recent trends in food availability and consumption, and define eating patterns that, when taken together, preserve and enhance health within this current environment.

The methodology used to create the PNIGs first addressed the need for new energy and macronutrient goals. The determination of the energy goal was based on determining the percentage energy requirement of each age group within the whole population and ultimately the energy requirement per person per day for the years 2000, 2010, and 2020.

The recommendation for daily total energy intake (which is an average estimate per unit of population) is 2250 calories.

New recommendations of 562 calories from total fat (25%), 225 calories from protein (10%) and 1463 calories from carbohydrates (65%) were made to achieve the new energy intake target. The PNIGs for macronutrients and energy are summarized in Table 9.

A second approach was used to determine the contribution of sugars and sweeteners, and the Caribbean food groups—fruits; vegetables; staples; legumes and nuts; foods from animals; and fats and oils—to the daily total dietary intake. The suggested daily energy contributions of each food group were used to determine the amount of calories to consume from each group (see Table 10). Following this procedure, a selection of common foods from each food group (except fats and oils) was used to determine the average calorie content per standard quantity of foods. Average fibre content per standard quantity was also determined for the food groups: fruits; vegetables; staples; and legumes and nuts. Average contents were then used to determine the number of grams that should be consumed from each food group to satisfy the recommended daily target of 2250 calories.

In general, the New Caribbean PNIGs recommend that the population adhere to the recommendations for daily total energy intake, and lower—rather than increase—total intakes. Also recommended is an increase in the consumption of: fruits; vegetables; legumes and nuts; and starchy roots and tubers (a subgroup of staples), in lieu of: foods from animals; fats and oils; and free sugars and sweeteners, along with an increase in legume production/availability.

Table 9: Population Nutrient Intake Goals – Macronutrients and Energy

Macronutrients	% of total calories	Kcal
Total Carbohydrates	65	14630
Total Fat	25	562
Protein	10	225
Total Dietary Energy	-	2250

Table 10: Caribbean Food Groups and Sugars and Sweeteners

Food groups	% total calories	Goal (kcal/person/day)	Grams
Staples	45	1013	512
Cereals	30	675	197
Starchy Fruits, Roots and Tubers	15	338	315
Fruits	4	90	257
Vegetables	6	135	386
Legumes and Nuts	10	225	63
Foods from Animals	20	450	198
Fats and Oils	7	157	17
Sugars and sweeteners	8	180	45

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Appendix

Summary Table – Recommended Nutrient Intakes for the Caribbean

LIFE STAGE	Energy (kcal/d)	Protein (g/d)	Carbohy-drate (g/d)	Dietary Fibre (g/d)	Vitamin A (µg/d)	Vitamin D (µg/d)	Vitamin K (µg/d)	Vitamin C (mg/d)	Thiamine (mg/d)	Riboflavin (mg/d)	Niacin (mg/d)	Vitamin B6 (mg/d)	Pantothenic Acid (mg/d)	Biotin (mg/d)	Vitamin B_{12} (mg/d)	Folacin (µg/d)
Infants																
0-6 mo	515	12.5	60	No data	375	10	5	25	0.2	0.3	2	0.1	1.7	5	0.4	80
7-12 mo	765	14	95	No data	400	10	10	30	0.3	0.4	4	0.3	1.8	6	0.7	80
Children																
1-3 y	1165	15	130	19	400	10	15	30	0.5	0.5	6	0.5	2.0	8	0.9	150
4-8 y	1545	20	130	25	450	10	25	30	0.6	0.6	8	0.6	3.0	12	1.2	200
Males																
9-13 y	2220	42	130	31	600	5	35-55	40	1.1	1	16	1.2	5.0	25	2.4	400
14-18 y	2755	55	130	38	600	5	35-55	40	1.2	1	16	1.3	5.0	25	2.4	400
19-30 y	2550	56	130	38	600	5	65	45	1.2	1.3	16	1.3	5.0	30	2.4	400
31-50 y	2550	56	130	38	600	5	65	45	1.2	1.3	16	1.3	5.0	30	2.4	400
51-70 y	2380	53	130	30	600	10	65	45	1.2	1.3	16	1.7	5.0	30	2.4	400
>70 y	2100	53	130	30	600	15	65	45	1.2	1.3	16	1.7	5.0	30	2.4	400
Females																
9-13 y	1845	41	130	26	600	5	35-55	40	1.1	1	16	1.2	5.0	25	2.4	400
14-18 y	2110	45	130	26	600	5	35-55	40	1.1	1	16	1.2	5.0	25	2.4	400
19-30 y	1940	45	130	25	500	5	55	45	1.1	1.1	14	1.3	5.0	30	2.4	400
31-50 y	1900	45	130	25	500	5	55	45	1.1	1.1	14	1.3	5.0	30	2.4	400
51-70 y	1900	47	130	21	500	10	55	45	1.1	1.1	14	1.5	5.0	30	2.4	400
>70 y	1810	47	130	21	600	15	55	45	1.1	1.1	14	1.5	5.0	30	2.4	400
Pregnancy	+200	+6	175	28	800	5	55	55	1.4	1.4	18	1.9	6.0	30	2.6	600
Lactation	+450	+11	210	29	850	5	55	70	1.5	1.6	17	2.0	7.0	35	2.8	500

LIFE STAGE	Calcium (mg/d)	Phosphorus (mg/d)	Magnesium (mg/d)	Sodium (g/d)	Potassium (g/d)	Chlorine (g/d)	Iron (mg/d)	Iodine (µg/d)	Zinc (mg/d)	Copper (µg/d)	Fluorine (mg/d)	Manganese (mg/d)	Molybden (µg/d)	Selenium (µg/d)
Infants														
0-6 mo	300	100	30	0.12	0.4	0.18		90	2.8	200	0.01	0.003	2	15
7-12 mo	400	275	75	0.37	0.7	0.57	9.3	90	4.1	220	0.5	0.6	3	20
Children														
1-3 y	500	460	80	1	3	1.5	5.8	90	4.1	340	0.7	1.2	17	20
4-8 y	650	500	130	1.2	3.8	1.9	6.3	90	4.8	440	1	1.5	22	30
Males														
9-13 y	1300	1250	240	1.5	4.5	2.3	14.6	120	8.6	700	2	1.9	34	40
14-18 y	1300	1250	410	1.5	4.7	2.3	18.8	150	8.6	890	3	2.2	43	55
19-30 y	1000	700	100	1.5	4.7	2.3	13.7	150	7	900	4	2.3	45	55
31-50 y	1000	700	420	1.5	4.7	2.3	13.7	150	7	900	4	2.3	45	55
51-70 y	1000	700	420	1.3	4.7	2	13.7	150	7	900	4	2.3	45	55
>70 y	1300	700	420	1.2	4.7	1.8	13.7	150	7	900	4	2.3	45	55
Females														
9-13 y	1300	1250	240	1.5	4.5	2.3	14	120	7.2	700	2	1.6	34	40
14-18 y	1300	1250	360	1.5	4.7	2.3	32.7	150	7.2	890	3	1.6	43	55
19-30 y	1000	700	310	1.5	4.7	2.3	29.4	150	4.9	900	3	1.8	45	55
31-50 y	1000	700	320	1.5	4.7	2.3	29.4	150	4.9	900	3	1.8	45	55
51-70 y	1300	700	320	1.3	4.7	2	11.3	150	4.9	900	3	1.8	45	55
>70 y	1300	700	320	1.2	4.7	1.8	11.3	150	4.9	900	3	1.8	45	55
Pregnancy	1200	700	400	1.5	4.7	2.3	29.4	250	5.5-10 *	1000	3	2	50	
Lactation	1000	700	360	1.5	5.1	2.3	15	250	9.5-7.2 **	1300	3	2.6	50	70

* RNI for zinc in pregnancy: 1st trimester 5.5 mg/day, 2nd trimester 7.0 mg/day, 3rd trimester 10.0 mg/day
** RNI for zinc during lactation period: 0-6 mo 9.5 mg/day, 6-12 mo 7.2 mg/day

Recommended dietary allowances (RDAs) for the Caribbean were first published in 1978 and then revised in 1994. Since then, ongoing research relating to the health consequences of nutrient intakes, particularly with regard to diet-related noncommunicable diseases (NCDs), has provided new evidence on the inter-relationships between diet and health.

The initiative to revise the existing RDAs began with a review of the most current available information as well as the recent approaches taken by other countries and agencies in updating RDAs. The review was carried out within the context of changes in the regional food and nutrition situation. These changes included a reassessment of food availability patterns, dietary and other lifestyle practices, a growing awareness of the need for nutrition standards and dietary guidelines, and the inclusion of food and nutrition-related policy actions in regional strategies addressing rising rates of obesity and NCDs and the strengthening of food and nutrition security. A review was done of various terminologies relating to nutrient requirements, including recommended dietary allowance (RDA), recommended nutrient intake (RNI), average reference intake (ARI), estimated average requirement (EAR), and upper tolerable limit, and recommendations were then made for RNIs for the Caribbean.

This report takes into account expert feedback and updates on energy and nutrient requirements from the Food and Agriculture Organization/World Health Organization (FAO/WHO), Canada, the United Kingdom, and the United States of America. A major focus has been placed on global FAO/WHO recommendations, which are based on extensive review of the available evidence. This publication provides current scientific guidance on the intake of a range of nutrients, as well as the nutrient recommendations for the Caribbean. The publication also includes the population nutrient intake goals (PNIGs) meant to promote healthy dietary consumption patterns that satisfy the nutritional needs of the population while helping to reduce the risk of diet-related NCDs. These serve as a useful adjunct to the RNIs in providing food and nutrition guidance at the population level for macronutrients and food groups in healthy, well-nourished populations.

PAHO Pan American Health Organization
World Health Organization REGIONAL OFFICE FOR THE Americas

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