

## Appendix E-1: Major Conclusions

### SECTION 1: ENERGY BALANCE AND WEIGHT MANAGEMENT

#### Question 1: What Effects do the Food Environment and Dietary Behaviors Have on Body Weight?

##### Conclusion

An emerging body of evidence has documented the impact of the food environment and select behaviors on body weight in both children and adults. Moderately strong evidence now indicates that the food environment is associated with dietary intake, especially less consumption of vegetables and fruits and higher body weight. The presence of supermarkets in local neighborhoods and other sources of vegetables and fruits are associated with lower body mass index, especially for low-income Americans, while lack of supermarkets and long distances to supermarkets are associated with higher body mass index. Finally, limited but consistent evidence suggests that increased geographic density of fast food restaurants and convenience stores is also related to increased body mass index.

Strong and consistent evidence indicates that children and adults who eat fast food are at increased risk of weight gain, overweight, and obesity. The strongest documented relationship between fast food and obesity is when one or more fast-food meals are consumed per week. There is not enough evidence at this time to similarly evaluate eating out at other types of restaurants and risk of weight gain, overweight, and obesity. Strong evidence documents a positive relationship between portion size and body weight. Strong and consistent evidence in both children and adults shows that screen time is directly associated with increased overweight and obesity. The strongest association is with television screen time. Strong evidence shows that for adults who need or desire to lose weight, or who are maintaining body weight following weight loss, self-monitoring of food intake improves outcomes. Moderate evidence suggests that children who do not eat breakfast are at increased risk of overweight and obesity. The evidence is stronger for adolescents. There is inconsistent evidence that adults who skip breakfast are at increased risk for overweight and obesity. Limited and inconsistent evidence suggests that snacking is associated with increased body weight. Evidence is insufficient to determine whether frequency of eating has an effect on overweight and obesity in children and adults.

##### Implications

In order to reduce the obesity epidemic, actions must be taken to improve the food environment. Policy (local, state, and national) and private-sector efforts must be made to increase the availability of nutrient-dense foods for all Americans, especially for low-income Americans, through greater access to grocery stores, produce trucks, and farmers' markets, and greater financial incentives to purchase and prepare healthy foods. The restaurant and food industries are encouraged to offer foods in appropriate portion sizes that are low in calories, added sugars, and solid fat. Local zoning policies should be considered to reduce fast food restaurant placement near schools.

In addition, individuals can adopt a series of dietary behaviors:

- Individuals are encouraged to prepare, serve, and consume smaller portions at home and choose smaller portions of food while eating foods away from home.
- Children and adults are also encouraged to eat a healthy breakfast and to choose nutrient-dense, minimally processed foods whenever they snack.
- Children and adults should limit screen time, especially television viewing and not eat food while watching television. The American Academy of Pediatrics recommends no more than 1 to 2 hours per day of total media time for children and adolescents and discourages television viewing for children younger than age 2 years (AAP, 2001). A Healthy People 2010 objective is to increase the proportion of adolescents who view television 2 or fewer hours on a school day (HHS, 2000).
- Adults are encouraged to self-monitor body weight, food intake, and physical activity to improve outcomes when actively losing weight or maintaining body weight following weight loss. There is also evidence that self-monitoring of body weight and physical activity also improves outcomes when actively losing weight or maintaining bodyweight following weight loss (Butryn, 2007; Wing, 2006). In order to facilitate better self-monitoring of food intake, there needs to be increased availability of nutrition information at the point of purchase.
- Children and adults are encouraged to follow a frequency of eating that provides nutrient-dense foods within daily caloric requirements periodically through the day. Caution must be taken such that the frequency of eating does not lead to excess calorie intake but does meet nutrient needs.

## **Question 2: What is the Relationship between Maternal Weight Gain during Pregnancy and Maternal-Child Health?**

### **Conclusion**

Maternal weight gain during pregnancy outside the recommended ranges is associated with suboptimal maternal and child health. Women who gain weight excessively during pregnancy retain more weight after delivery, are more likely to undergo a cesarean section and to deliver large-for-gestational age newborns, and their offspring may be at increased risk of becoming obese later on in life. Women who gain weight below recommendations are more likely to deliver small-for-gestational age newborns.

### **Implications**

Women are encouraged to maintain a healthy weight before conception. Additionally, women are encouraged to practice sound dietary and physical activity practices to help them attain gestational weight gain within the guidelines outlined by the IOM.

### **Question 3. What is the Relationship between Breastfeeding and Maternal Postpartum Weight Change?**

#### **Conclusion**

A moderate body of consistent evidence shows that breastfeeding may be associated with maternal postpartum weight loss. However, this weight loss is small, transient, and depends on breastfeeding intensity and duration.

#### **Implications**

Transient weight loss has been associated with intensive breastfeeding. However, it is unlikely that breastfeeding currently plays a significant role in promoting more rapid postpartum maternal weight loss in the US given the small size of the effect, large inter-individual variability in maternal postpartum weight changes, and the fact that in the US, only one-third of women breastfeed exclusively at 3 months postpartum. Thus, breastfeeding should not be promoted as an effective maternal postpartum weight loss method.

### **Question 4: How is Dietary Intake Associated with Childhood Adiposity?**

#### **Conclusion**

Evidence suggests that certain aspects of dietary intake are associated with greater or lesser adiposity in children. Moderately strong evidence from recent prospective cohort studies that identified plausible reports of energy intake support a positive association between total energy (caloric) intake and adiposity in children. Moderately strong evidence from methodologically rigorous longitudinal cohort studies of children and adolescents suggests that there is a positive association between dietary energy density and increased adiposity in children. Moderate evidence from prospective cohort studies suggests that increased intake of dietary fat is associated with greater adiposity in children; however, no studies were conducted under isocaloric conditions. Strong evidence supports the conclusion that greater intake of sugar-sweetened beverages is associated with increased adiposity in children. Moderate evidence suggests that there is not a relationship between intake of calcium and/or dairy (milk and milk products) and adiposity in children and adolescents. A limited body of evidence from longitudinal studies suggests that greater intake of fruits and/or vegetables may protect against increased adiposity in children and adolescents. Limited and inconsistent evidence suggests that for most children, intake of 100 percent fruit juice is not associated with increased adiposity, when consumed in amounts that are appropriate for age and energy needs of the child. However, intake of 100 percent juice has been prospectively associated with increased adiposity in children who are overweight or obese. There is insufficient evidence that dietary fiber is associated with adiposity in children.

#### **Implications**

Strategies to prevent childhood obesity should include efforts to reduce surplus energy intake, especially energy from foods and beverages that provide empty calories from added sugars and solid fats. Total fat intake should not exceed the IOM acceptable ranges, and should consist primarily of mono- and polyunsaturated fats that promote heart health and provide essential fatty acids for growth and development. Increasing consumption of vegetables and fruits in childhood is an

important public health goal, not only from the perspective of increasing intake of “shortfall” nutrients, but also because diets high in a variety of vegetables and fruits tend to be lower in energy density, and therefore likely to improve energy balance and prevent obesity. When consumed in moderation as part of a nutrient rich, energy-balanced diet, 100 percent juice can be a healthy part of a child’s diet. Children should be encouraged to consume recommended servings of low-fat dairy products daily in order to meet recommended dietary intake levels for key nutrients, such as calcium. Children should also be encouraged to consume greater amounts and varieties of high-fiber foods in order to increase nutrient density, and promote healthy lipid profiles, glucose tolerance, and normal gastrointestinal function. Consumption of sugar-sweetened beverages in childhood should be discouraged (1) because of the positive association with increased adiposity; and (2) because of the need to replace empty calories with nutrient- rich energy for optimal growth and development.

## **Question 5: What is the Relationship between Macronutrient Proportion and Body Weight in Adults?**

### **Conclusion**

There is strong and consistent evidence that when calorie intake is controlled, macronutrient proportion of the diet is not related to losing weight. A moderate body of evidence provides no data to suggest that any one macronutrient is more effective than any other for avoiding weight regain in weight reduced persons. A moderate body of evidence demonstrates that diets with less than 45% of calories as carbohydrates are not more successful for long-term weight loss (12 months). There is also some evidence that they may be less safe. In shorter-term studies, low calorie, high protein diets may result in greater weight loss, but these differences are not sustained over time. A moderate amount of evidence demonstrates that intake of dietary patterns with less than 45% calories from carbohydrate or more than 35% calories from protein are not more effective than other diets for weight loss or weight maintenance, are difficult to maintain over the long term, and may be less safe.

### **Implications**

No optimal macronutrient proportion was identified for enhancing weight loss or weight maintenance. However, decreasing caloric intake led to increased weight loss and improved weight maintenance. Therefore, diets that are reduced in calories and have macronutrient proportions that are within the ranges recommended in the Dietary References Intakes (IOM, 2002/2005) (protein: 10%-35%; carbohydrate: 45%-65%; fat: 20%-35%) are appropriate for individuals who desire to lose weight or maintain weight loss. Diets that are less than 45 percent carbohydrate or more than 35 percent protein are difficult to adhere to, are not more effective than other calorie-controlled diets for weight loss and weight maintenance, and may pose health risk, and are therefore not recommended for weight loss or maintenance.

## **Question 6: Is Dietary Energy Density Associated with Weight Loss, Weight Maintenance, and Type 2 Diabetes Among Adults?**

### **Conclusion**

Strong and consistent evidence indicates that dietary patterns that are relatively low in energy density improve weight loss and weight maintenance among adults. Consistent but limited evidence suggests that lower energy density diets may be associated with lower risk of type 2 diabetes among adults.

### **Implications**

Dietary patterns relatively low in energy density that have been associated with beneficial body weight outcomes also may be associated with lower risk of type 2 diabetes. They are characterized by a relatively high intake of vegetables, fruit, and total fiber and a relatively low intake of total fat, saturated fat, and added sugars (Kant and Graubard, 2005; Ledikwe, 2006a; Ledikwe, 2006b; Lindstrom, 2006; Murakami, 2007; Savage, 2008b; Wang, 2008). Additionally, lower dietary energy density may be associated with a dietary intake pattern characterized by lower consumption of meat and processed meats and energy-containing beverages (Wang, 2008). The Committee's conclusion applies to the whole dietary pattern, not to individual foods, and recognizes that a beneficial low-energy density dietary pattern can include consumption of some energy-dense foods (e.g., olive oil and nuts) that have been associated with improved health outcomes (see *Part D. Section 3: Fatty Acids and Cholesterol*).

## **Question 7: For Older Adults, What is the Effect of Weight Loss Versus Weight Maintenance on Selected Health Outcomes?**

### **Conclusion**

Weight loss in older adults has been associated with an increased risk of mortality, but because most studies have not differentiated between intentional versus unintentional weight loss, recommending intentional weight loss has not been possible. Recently, however, moderate evidence of a reduced risk of mortality with intentional weight loss in older persons has been published. Intentional weight loss among overweight and obese older adults, therefore, is recommended. In addition, with regard to morbidity, moderate evidence suggests that intentional weight loss in older adults has been associated with reduced development of type 2 diabetes and improved cardiovascular risk factors. There are insufficient data on cancer to come to a conclusion. Weight gain produces increased risk for several health outcomes.

### **Implications**

Observational studies of weight loss, especially when intentionality cannot be rigorously established, may be misleading with respect to the effect of weight on mortality. Loss of weight is appropriate advice for elderly overweight/obese persons. Weight gain should be avoided.

## Question 8: What is the Relationship between Physical Activity, Body Weight, and Other Health Outcomes?

### Conclusion

Strong, consistent evidence indicates that physically active people are at reduced risk of becoming overweight or obese. Furthermore, there is strong evidence that physically active adults who are overweight or obese experience a variety of health benefits that are generally similar to those observed in people of ideal body weight. Because of the health benefits of physical activity that are independent of body weight classification, people of all body weight classifications gain health and fitness benefits by being habitually physically active.

In addition, strong and consistent evidence based on a wide range of well-conducted studies indicates that physically active people have higher levels of health-related fitness, lower risk of developing most chronic disabling medical conditions, and lower rates of various chronic diseases than do people who are inactive. The health benefits of being habitually active appear to apply to all people regardless of age, sex, race/ethnicity, socioeconomic status, and to people with physical or cognitive disabilities.

### Implications

Americans are encouraged to meet the 2008 Physical Activity Guidelines for Americans. Children and adults should avoid inactivity. Some physical activity is better than none, and more is better. Achieving energy balance and a healthy weight depends on both energy intake and expenditure.

## SECTION 2: NUTRIENT ADEQUACY

### Question 1: What Nutrients and Dietary Components are Overconsumed by the General Public?

#### Conclusion

Estimated intakes of the following nutrients and dietary components are high enough to be of concern:

- For adults: total energy intake, particularly energy intake from solid fats and added sugars; sodium; percentage of total energy from saturated fats; total cholesterol (in men); and refined grains.
- For children: energy intake from solid fats and added sugars; sodium; percentage of total energy from saturated fats; total cholesterol (only in boys, aged 12 to 19 years); and refined grains.

#### Implications

To lower overall energy intakes (see *Part D. Section 1: Energy Balance and Weight Management*) without compromising nutrient intakes, Americans should reduce consumption of calories from solid fats and added sugars (SoFAS). SoFAS generally provide few, if any, micronutrients. Intakes of SoFAS should be kept as low as possible across all age-sex groups, to less than the maximum limits

calculated for the USDA Food Patterns. Concentrated efforts are needed to lower total sodium intakes by all Americans (see *Part D. Section 6: Sodium, Potassium, and Water*). Likewise deliberate public health efforts are warranted to reduce intakes of saturated fats to meet dietary guidelines for optimal health. Males older than age 12 years also are encouraged to consume less total dietary cholesterol (see *Part D. Section 3: Fatty Acids and Cholesterol*). Intakes of refined grain are too high and at least half of all refined grains should be replaced with high-fiber whole grains (see *Part D. Section 5: Carbohydrates*).

## **Question 2: What Food Groups and Selected Dietary Components are Underconsumed by the General Public?**

### **Conclusion**

Currently reported dietary intakes of the following food groups and selected dietary components are low enough to be of concern:

- For both adults and children: vegetables, fruits, whole grains, fluid milk and milk products, and oils.

### **Implications**

Despite the evidence that health-promoting dietary patterns are those that include a variety of foods and combinations of foods from each of the basic food groups, many Americans make food choices that do not meet the characteristics of healthy dietary patterns (Bachman, 2008). A fundamental premise of the DGAC is that nutrients should come from foods. Often, nutrient intake shortfalls are an indicator of low intakes of certain food groups that provide specific nutrients. Hence, efforts are warranted to promote increased intakes of vegetables (especially dark-green vegetables, red-orange vegetables, and cooked dry beans and peas), fruits, whole grains, and fat-free or low-fat fluid milk and milk products (including calcium and vitamin D fortified soymilk) among all ages; substitution of oils for solid fats, regardless of age; and increased intakes of lean, heme-iron-rich meat, poultry, and fish by adult women and adolescent girls. Intake of nutrient-dense foods—that is, foods in their leanest or lowest fat forms and without added fats, sugars, starches, or sodium—should replace foods in the current American diet that contribute to high intakes of SoFAS and refined grains (see Question 1 on Nutrients and Dietary Components Overconsumed). Oils should only be substituted for solid fats rather than added to the diet. Substitutions and selection of nutrient-dense forms of vegetables, fruits, whole grains, and fluid milk and milk products to replace non-nutrient-dense forms of foods should be done in a manner such that total caloric intake falls within or below daily energy needs.

## **Question 3: What Nutrients are Underconsumed by the General Public and Present a Substantial Public Health Concern?**

### **Conclusion**

Reported dietary intakes and associated indices of nutrient status for the following nutrients are of public health concern:

- For both adults and children: vitamin D, calcium, potassium, and dietary fiber.

### **Implications**

Efforts are warranted to promote increased dietary intakes of foods higher in vitamin D, calcium, potassium, and dietary fiber for all Americans regardless of age. Recommended intakes of these nutrients of concern, in particular, and of all essential nutrients, in general, should be achieved within the context of flexible dietary intake patterns that balance energy intake with energy expenditure.

## **Question 4: What is the Relationship between Folate Intake and Health Outcomes in the US and Canada Following Mandatory Folic Acid Fortification?**

### **Conclusion**

Strong and consistent evidence demonstrates a large reduction in the incidence of neural tube defects (NTDs) in the US and Canada following mandatory folic acid fortification. A limited body of evidence suggests stroke mortality has declined in the US and Canadian populations following mandatory folic acid fortification. A limited body of evidence suggests that mandatory folic acid fortification has increased the incidence of colorectal cancer (CRC) in the US and Canada.

### **Implications**

Folic acid fortification in the US and Canada appears to be successful in the primary health objective of reducing the incidence of NTDs. Although some negative consequences appear to have occurred (i.e., possible increase in CRC), the evidence supports the continuation of folic acid fortification of flour and uncooked cereals at current levels (140 µg/100 g). Despite the increases in folic acid through fortification, about 22 percent of women of reproductive capacity still do not meet the Estimated Average Requirements. Women of reproductive capacity should continue to be counseled to select foods high in folate, and when necessary, take a folic acid supplement to meet their folate requirements. As a result of the increase in folic acid in food from fortification and because many adults take a supplement containing folic acid, approximately 5 percent of adults older than age 50 years now exceed the UL (1000 µg/day) for folic acid intake. To avoid exceeding the UL, adults over age 50 years should not supplement with folic acid in excess of 400 µg/day. Because whole grain foods are not always fortified with folic acid, individuals who consume mainly whole grains in their dietary patterns should ensure that some of these whole grains are fortified to achieve dietary folate recommendations.

## **Question 5: Is Iron a Nutrient of Special Concern for Women of Reproductive Capacity?**

### **Conclusion**

Substantial numbers of adolescent girls and women of reproductive capacity have laboratory evidence of iron deficiency.



## Implications

Efforts are warranted to increase dietary intake of heme-iron-rich foods and of enhancers of iron absorption by these special populations.

## Question 6: Are Older Adults Consuming Sufficient Vitamin B<sub>12</sub>?

### Conclusion

Recent evaluation of NHANES data shows that individuals older than age 50 years are consuming adequate intakes of vitamin B<sub>12</sub>, including B<sub>12</sub> found naturally in foods and crystalline B<sub>12</sub> consumed in fortified foods. Nonetheless, a substantial proportion of individuals older than age 50 years may have reduced ability to absorb naturally occurring vitamin B<sub>12</sub> but not the crystalline form.

### Implications

Although individuals older than age 50 years appear to be meeting their need for vitamin B<sub>12</sub>, they should be encouraged to consume foods fortified with B<sub>12</sub>, such as fortified cereals, or the crystalline form of B<sub>12</sub> supplements, when necessary. Practitioners should assess vitamin B<sub>12</sub> status in those older than age 65 years, using a low serum vitamin B<sub>12</sub> value of less than 300 pg/mL, high serum methylmalonic acid value of greater than 0.4 μmol/L, and serum total homocysteine level of greater than 15.0 μmol/L as evidence of vitamin B<sub>12</sub> deficiency.

## Question 7: Can a Daily Multivitamin/Mineral Supplement Prevent Chronic Disease?

### Conclusion

For the general, healthy population, there is no evidence to support a recommendation for the use of multivitamin/mineral supplements in the primary prevention of chronic disease. Limited evidence suggests that supplements containing combinations of certain nutrients are beneficial in reversing chronic disease when used by special populations; in contrast, certain nutrient supplements appear to be harmful in other subgroups.

### Implications

Although intake of a variety of multivitamin/mineral supplements increase blood levels of many nutrients, notably in individuals with suboptimal nutrient status before supplementation (Maraini, 2009), long-term effects on primary prevention of several chronic diseases has not been demonstrated. In this context, obtaining essential micronutrients from foods when possible is the optimal approach and reliance on multivitamin/mineral supplements is discouraged. At present, Americans are encouraged to meet overall nutrient requirements within energy levels that balance daily energy intake with expenditure. This can be accomplished through a variety of food intake patterns that include nutrient-dense forms of foods.

## **Question 8: What is the Relationship between Nutrient Intake and Breakfast Consumption, Snacking, and Eating Frequency?**

### **Conclusion**

Moderate evidence supports a positive relationship between breakfast consumption and intakes of certain nutrients in children, adolescents, and adults. A limited body of evidence supports a positive relationship between snacking and increased nutrient intake in children, adolescents, adults, and older adults, and inadequate evidence is available to evaluate the relationship between eating frequency and nutrient intakes.

### **Implications**

Americans are encouraged to eat nutrient-dense forms of foods for breakfast while staying within energy needs to facilitate achieving nutrient recommendations. Likewise nutrient-dense forms of foods are suggested for any snacks, if energy allowance permits this behavior without incurring weight gain.

## **SECTION 3: FATTY ACIDS AND CHOLESTEROL**

### **Question 1. What is the Effect of Saturated Fat Intake on Increased Risk of Cardiovascular Disease or Type 2 Diabetes, Including Effects on Intermediate Markers such as Serum Lipid and Lipoprotein Levels?**

#### **Conclusion**

Strong evidence indicates that intake of dietary saturated fatty acids (SFA) is positively associated with intermediate markers and end point health outcomes for two distinct metabolic pathways: 1) increased serum total and low-density lipoprotein (LDL) cholesterol and increased risk of cardiovascular disease (CVD) and 2) increased markers of insulin resistance and increased risk of type 2 diabetes (T2D). Conversely, decreased SFA intake improves measures of both CVD and T2D risk. The evidence shows that 5 percent energy decrease in SFA, replaced by monounsaturated fatty acids (MUFA) or polyunsaturated fatty acids (PUFA), decreases risk of CVD and T2D in healthy adults and improves insulin responsiveness in insulin resistant and T2D individuals.

#### **Implications**

As the evidence indicates that a 5 percent energy decrease in SFA, replaced by MUFA or PUFA, results in meaningful reduction of risk of CVD or T2D, and given that in the US population 11-12 percent of energy from SFA intake has remained unchanged for over 15 years, a reduction of this amount resulting in the goal of less than 7 percent energy from SFA should, if attained, have a significant public health impact. As an interim step toward this less than 7% goal, all individuals should immediately consume less than 10 percent of energy as saturated fats. This impact would not only be limited to a reduction in heart disease and stroke, but also in T2D, a disease currently rising in incidence and prevalence. This substitution of MUFA and PUFA for SFA assumes no change in energy intake. The age of onset of T2D is substantially younger than that of CVD and increasingly frequent in adolescence. Reduction in SFA in children and young adults may provide benefits

decades earlier than currently appreciated. The growing data to support a risk of T2D from SFA consumption supports the need for fat-modified diets in persons with pre-diabetes, including those with metabolic syndrome, and those with established diabetes. Early signs of atherosclerotic CVD are also seen in children and a number of studies indicate that the atherosclerotic process begins in childhood and is affected by high blood cholesterol levels. Therefore, reduction in SFA in children and young adults may provide benefits decades earlier than currently appreciated relative to both CVD and T2D incidence.

## **Question 2. What is the Effect of Dietary Cholesterol Intake on Risk of Cardiovascular Disease, Including Effects on Intermediate Markers such as Serum Lipid and Lipoprotein Levels and Inflammation?**

### **Conclusion**

Moderate evidence from epidemiologic studies relates dietary cholesterol intake to clinical CVD endpoints. Many randomized clinical trials on dietary cholesterol use eggs as the dietary source. Independent of other dietary factors, evidence suggests that consumption of one egg per day is not associated with risk of coronary heart disease (CHD) or stroke in healthy adults, although consumption of more than seven eggs per week has been associated with increased risk. An important distinction is that among individuals with T2D, increased dietary cholesterol intake is associated with CVD risk.

### **Implications**

Overall, the evidence shows that consumption of dietary cholesterol in the amount of one egg per day is not harmful and does not result in negative changes in serum lipoprotein cholesterol and triglyceride levels. Neither does consumption of eggs at this level increase risk of CVD in healthy individuals. Eggs also are a good source of high quality protein and numerous micronutrients. However, in individuals with T2D, egg consumption (at one egg/day) does have negative effects on serum lipids and lipoprotein cholesterol levels and does increase risk of CVD. Furthermore, consumption of more than seven eggs per week is not recommended for the general public. Overall, limiting dietary cholesterol to less than 300 mg per day, with further reductions of dietary cholesterol to less than 200 mg per day for persons with or at high risk for CVD and T2D, is recommended.

## **Question 3. What is the Effect of Dietary Intake of MUFA when Substituted for SFA on Increased Risk of Cardiovascular Disease and Type 2 Diabetes, Including Intermediate Markers such as Lipid and Lipoprotein Levels and Inflammation? And What is the Effect of Replacing a High Carbohydrate Diet with a High MUFA Diet in Persons with Type 2 Diabetes?**

### **Conclusion**

Strong evidence indicates that dietary MUFA are associated with improved blood lipids related to both CVD and T2D when MUFA is a replacement for dietary SFA. The evidence shows that 5 percent energy replacement of SFA with MUFA decreases intermediate markers and the risk of

CVD and T2D in healthy adults and improves insulin responsiveness in insulin resistant and T2D subjects.

Moderate evidence indicates that increased MUFA intake, rather than high carbohydrate intake, may be beneficial for persons with T2D. High MUFA intake, when replacing a high carbohydrate intake, results in improved biomarkers of glucose tolerance and diabetic control.

### Implications

At the current level of 11 to 12 percent of energy from SFA, healthy American adults would benefit substantially by replacing 5 percent of that total energy with MUFA (e.g., 12 percent SFA reduced to 7 percent SFA, 12 percent MUFA increased to 17 percent MUFA). Beneficial outcomes would include reduced rates of CVD and T2D as well as improved lipids and lipoproteins, inflammatory markers, and measures in insulin resistance. Persons with a predisposition to T2D or established T2D may especially benefit from a high MUFA diet, both as a substitute for SFA and as a substitute for carbohydrates. Given the high prevalence of T2D and the metabolic syndrome in the US, such benefits would have a large public health impact.

## Question 4. What is the Effect of Dietary Intake of *n*-6 Polyunsaturated Fatty Acids on Risks of Cardiovascular Disease and Type 2 Diabetes, Including Intermediate Markers such as Lipid and Lipoprotein Levels and Inflammation?

### Conclusion

Strong and consistent evidence indicates that dietary PUFA are associated with improved blood lipids related to CVD, in particular when PUFA is a replacement for dietary SFA or *trans* fatty acids. Evidence shows that energy replacement of SFA with PUFA decreases total cholesterol, LDL cholesterol and triglycerides, as well as numerous markers of inflammation. PUFA intake significantly decreases risk of CVD and has also been shown to decrease risk of T2D.

### Implications

All recommendations assume an isocaloric replacement of SFA or *trans* fatty acids with PUFA. In this setting, both CVD and, potentially T2D, may be reduced with PUFA replacement. The mechanisms of CVD reduction, including improvement in serum lipid levels and reduced markers of inflammation, may have additional health benefits. PUFA consumption in the US is lower than that of SFA or MUFA, although the only essential fatty acids are PUFA, so a reduction of SFA from 12 percent to 7 percent of energy through an increase in PUFA alone would increase PUFA from 7 percent to 12 percent of energy. This, or replacing SFA with some combination of PUFA and MUFA, should yield significant public health benefits.

## Question 5. What are the Effects of Dietary Stearic Acid on Low-density Lipoprotein Cholesterol?

### Conclusion

Moderate evidence from a systematic review indicates that when stearic acid is substituted for other SFA or *trans* fatty acids<sup>1</sup>, plasma LDL cholesterol levels are decreased; when substituted for carbohydrates, LDL cholesterol levels are unchanged; and when substituted for MUFA or PUFA, LDL cholesterol levels are increased. Therefore, the impact of stearic acid replacement of other energy sources is variable regarding LDL cholesterol, and the potential impact of changes in stearic acid intake on cardiovascular disease risk remains unclear.

### Implications

Since stearic acid is not known to raise LDL cholesterol, the DGAC is recommending that stearic acid not be categorized with known “cholesterol-raising fats,” which include C12, C14, C16 SFA and *trans* fatty acids. Foods that are high in stearic acid, such as dark chocolate and shea nut oil, need not be considered as problematic as foods high in other SFA or *trans* fatty acids. In addition, setting the recommended percent of energy from these cholesterol-raising fats to a less than 5 to 7 percent will help to maintain blood cholesterol at desirable concentrations.

## Question 6. What Effect does Consuming Natural (Ruminant) Versus Synthetic (Industrially Hydrogenated) Trans Fatty Acids have on LDL-, HDL- and Non HDL Cholesterol Levels?

### Conclusion

Limited evidence is available to support a substantial biological difference in the detrimental effects of industrial *trans* fatty acids (iTFA) and ruminant *trans* fatty acids (rTFA) on health when rTFA is consumed at 7-10 times the normal level of consumption.

### Implication

The level of daily intake of rTFA is quite small with the US adult population’s average daily intake approximating 1.2 g (1.5g for men and 0.9 g for women). This represents less than 2 percent of total daily energy intake. This is a relatively minor exposure in the diet regardless of its metabolic effect.

The very limited data available provide insufficient evidence to suggest rTFA and iTFA be considered differently in their metabolic effects. Total *trans* fatty acid intake should be considered the target for dietary change. Total elimination of rTFA would require elimination of red meat and dairy products from the diet. Although total elimination of iTFA may be desirable, the elimination of rTFA would have wider implications for dietary adequacy and is not recommended. It is best to avoid iTFA while leaving small amounts of rTFA in the diet. Overall, *trans* fatty acid levels in the US food supply have decreased dramatically following mandatory *trans* fatty acids labeling regulations, which went into effect in 2006. Continued reductions in iTFA are to be encouraged.

<sup>1</sup> *Trans* fatty acids as used in this Report refers to industrial *trans* fatty acids and is a term consistent with that defined by the US Food and Drug Administration for use in food labeling. See *Part D. Section 3: Fatty Acids and Cholesterol*.

## Question 7. What is the Relationship Between Consumption of Seafood *n*-3 Fatty Acids and Risk of CVD?

### Conclusion

Moderate evidence shows that consumption of two servings of seafood per week (4 oz per serving), which provide an average of 250 mg per day of long-chain *n*-3 fatty acids, is associated with reduced cardiac mortality from CHD or sudden death in persons with and without CVD.

### Implications

An increase in seafood intake to two servings per week at 4 oz per serving, is advised for high-risk (those with CVD) and average-risk persons, especially as the first presentation of CVD (myocardial infarction, stroke) is frequently fatal or disabling. The quantity and frequency of seafood consumption is important, but the type of seafood (those providing at least 250 mg of long-chain *n*-3 fatty acids per day) also is critical. Increased consumption of seafood will require efficient and ecologically friendly strategies be developed to allow for greater consumption of seafood that is high in EPA and DHA, and low in environmental pollutants such as methyl mercury. (See *Part D.8: Food Safety and Technology* for a detailed discussion of the risks and benefits of seafood consumption).

## Question 8. What is the Relationship between Consumption of Plant *n*-3 Fatty Acids and Risk of CVD?

### Conclusion

Alpha-linolenic acid (ALA) intake of 0.6 - 1.2 percent of total calories will meet current recommendations and may lower CVD risk, but new evidence is insufficient to warrant greater intake beyond this level. Limited but supportive evidence suggests that higher intake of *n*-3 fatty acids from plant sources may reduce mortality among persons with existing CVD.

### Implications

Evidence is currently insufficient to make a formal guideline to increase *n*-3 intake from plant sources without additional evidence from randomized clinical trials and prospective observational studies among participants with a broad range of *n*-3 intake. As relatively little ALA converts to EPA and DHA, evidence is lacking that plant-derived *n*-3 fatty acids alone will provide the same cardioprotective effects as EPA and DHA consumed at the recommended level discussed above. This increases the need for efficient and ecologically friendly strategies to allow for greater consumption of seafood *n*-3 fatty acids, unless plant-derived sources of EPA or DHA can be developed.

## Question 9. What are the Effects of Maternal Dietary Intake of *n*-3 Fatty Acids from Seafood on Breast Milk Composition and Health Outcomes in Infants?

### Conclusion

Moderate evidence indicates that increased maternal dietary intake of long chain *n*-3 PUFA, in particular docosahexaenoic acid (DHA) from at least 2 servings of seafood per week, during pregnancy and lactation is associated with increased DHA levels in breast milk and improved infant health outcomes, such as visual acuity and cognitive development.

### Implications

There has been controversy and concern over the consumption of fish during pregnancy and lactation with regard to exposure of the fetus and infant to heavy metals during the most sensitive period of neurodevelopment. The current evidence, however, favors consumption of fish for pregnant and lactating women, particularly in the context of women making educated choices to consume seafood that is high in *n*-3 fatty acids and low in environmental pollutants. The benefits of fish consumption are maximized with fatty fish high in EPA and DHA but low in methyl mercury. These conclusions are consistent with those found in the discussion of seafood benefits and risks in *Part D.8: Food Safety and Technology*. The previously described modeling analysis of seafood identified scenarios of type and quantity of fish that provide 250 mg per day of EPA + DHA.

## Question 10. What are the Health Effects Related to Consumption of Nuts?

### Conclusion

There is moderate evidence that consumption of unsalted peanuts and tree nuts, specifically walnuts, almonds, and pistachios, in the context of a nutritionally adequate diet and when total calorie intake is held constant, has a favorable impact on cardiovascular disease risk factors, particularly serum lipid levels.

### Implications

Most nut consumption is in the form of peanuts, though tree nuts (walnuts, almonds, pecans, pistachios) are frequently used in cooking and as snack foods. Peanuts are also an important source of vegetable protein. Many nuts (e.g. peanuts, almonds, cashews) are sold with added salt as snack foods; thus, the recommendations for consumption are limited to unsalted nuts as a means to reduce sodium intake. It also is important to note that nuts should be consumed in small portions, as they are high in calories and can contribute to weight gain.

## Question 11. What are the Health Effects Related to Consumption of Chocolate?

### Conclusion

Moderate evidence suggests that modest consumption of dark chocolate or cocoa is associated with health benefits in the form of reduced CVD risk. Potential health benefits need to be balanced with caloric intake.

### Implications

Chocolate as currently consumed is a small component of the total diet, and benefits or risks will likely be minimal. Potential health effects need to be balanced with caloric intake, as chocolate is a calorie dense product. The predominant fat in chocolate is stearic acid, which has been shown to not raise blood cholesterol. Different formulations of chocolate vary in their content of dairy fat, with darker chocolate containing less dairy fat. Beneficial effects of chocolate have been attributed to polyphenolic compounds, in particular flavonoids. Many plant-based foods contain polyphenolic compounds and chocolate is a minor source. Formulations of chocolate are known to have different polyphenolic profiles, and, if this is the mechanism of chocolate's beneficial actions, different forms of chocolate may confer different benefits.

## SECTION 4: PROTEIN

### Question 1. What is the Relationship between the Intake of Animal Protein Products and Selected Health Outcomes?

#### Conclusion

Limited evidence from prospective cohort studies show inconsistent relationships between intake of animal protein products and CVD with somewhat more positive evidence for processed meats and CHD. Moderate evidence found no clear association between intake of animal protein products and blood pressure in prospective cohort studies. Limited inconsistent evidence from prospective cohort studies suggests that intake of animal protein products, mainly processed meat, may have a link to type 2 diabetes. Insufficient evidence is available to link animal protein intake and body weight. Moderate evidence reports inconsistent positive associations between colorectal cancer and the intake of certain animal protein products, mainly red and processed meat. Limited evidence shows that intake of animal protein products are associated with prostate cancer incidence. Limited evidence from cohort studies shows there is no association between the intake of animal protein products and overall breast cancer risk. However in subgroups of breast cancer patients, limited evidence suggested a relationship between the intake of animal protein products and risk of developing breast cancer.

#### Implications

Americans may choose animal products as part of their diet based on the body of evidence showing a general lack of relationship between animal protein consumption and selected health outcomes. However, attention should be given to quantity and preparation, as some forms of meat (well done



and processed) may be linked to specific cancers. In addition, animal protein products contain saturated fat and proportionately, a high calorie load, so serving sizes should be appropriate.

## **Question 2: What is the Relationship between Vegetable Protein and/or Soy Protein and Selected Health Outcomes?**

### **Conclusion**

Few studies are available, and the limited body of evidence suggests that vegetable protein intake does not offer special protection against type 2 diabetes, coronary heart disease, and selected cancers. Moderate evidence from both cohort and cross-sectional studies show that intake of vegetable protein is generally linked to lower blood pressure. Moderate evidence suggests soy protein intake may have small effects on total and low density lipoprotein cholesterol in adults with normal or elevated blood lipids, although results from systematic reviews are inconsistent. A moderate body of consistent evidence finds no unique benefit of soy protein intake on body weight. A limited and inconsistent body of evidence shows that soy protein intake does not provide any unique benefits in blood pressure control.

### **Implications**

Our review indicated that intake of vegetable protein is generally linked to lower blood pressure, but this could be due to other components in plant foods, such as fiber, or other nutrients. Individual sources of vegetable protein have no unique health benefits so choice of plant protein sources can come from a wide range of plant-based foods. Consumption of plant proteins of lower quality is generally fine as long as calorie needs are met and effort is made to complement the incomplete vegetable proteins. Consumption of lower-quality or incomplete protein is of greater concern when protein needs are high. Thus, consumption of lower-quality vegetable protein must be carefully considered during pregnancy, lactation, and childhood. Additionally, recommendations to lower calorie intake to combat obesity by increasing plant-based food intake must be linked to cautionary messages to maintain protein total intake of sufficient quality at recommended levels.

## **Question 3: How Do the Health Outcomes of a Vegetarian Diet Compare to that of a Diet which Customarily Includes Animal Products?**

### **Conclusion**

Limited evidence is available documenting that vegetarian diets protect against cancer. However, it suggests that vegetarian diets, including vegan, are associated with lower BMI and blood pressure. Vegan diets may increase risk of osteoporotic fractures. The effect of vegetarian diets on cardiovascular disease, stroke, and mortality is discussed further in *Part B. Section 2: The Total Diet: Combining Nutrients, Consuming Food.*

### **Implications**

Most people consume diets containing both animal and plant foods. Few studies exist on the nutritional or health status of vegetarians and/or vegans. Individuals who restrict their diet to plant

foods may be at risk of not getting adequate amounts of certain indispensable amino acids because the concentration of lysine, sulfur amino acids, and threonine are sometimes lower in plant than in animal food proteins. Nutrients of concern on vegan diets include calcium, iron, B<sub>12</sub>, zinc, and long-chain *n*-3 fatty acids. Vegetarian diets that include complementary mixtures of plant proteins can provide the same quality of protein as that from animal protein. Education is needed for those designing diets containing complementary proteins for consumers switching to a more plant-based diet. Additionally, individuals consuming vegetarian, particularly vegan, diets should ensure adequate intake of all nutrients.

## **Question 4: What is the Relationship Between the Intake of Milk and Milk Products and Selected Health Outcomes?**

### **Conclusion**

Strong evidence demonstrates that intake of milk and milk products provide no unique role in weight control. Moderate evidence indicates that the intake of milk and milk products is linked to improved bone health in children. Limited evidence suggests a positive relationship between the intake of milk and milk products and bone health in adults, but results are inconsistent due to variability in outcomes considered. Moderate evidence shows that intake of milk and milk products are inversely associated with cardiovascular disease. A moderate body of evidence suggests an inverse relationship between the intake of milk and milk products and blood pressure. Moderate evidence shows that milk and milk products are associated with a lower incidence of type 2 diabetes in adults. Limited evidence is available showing intake of milk and milk products are associated with reduced risk of metabolic syndrome. Insufficient evidence is available to assess the relationship between intake of milk and milk products and serum cholesterol levels.

### **Implications**

Currently, many children and adults are not consuming adequate amounts of milk and milk products. National Health and Nutrition Examination Survey (NHANES) 2005-2006 reported that the mean consumption of calcium does not meet the recommended Dietary Reference Intakes for any age group older than age 12. Research since 2004 shows that the under-consumption of milk and milk products may lead to an increase in cardiovascular disease and type 2 diabetes, as well as an increased risk for poor bone health and related diseases.

Consumption of the recommended daily amounts of low-fat or fat-free milk and milk products (2 cups for children ages 2 to 8 years, 3 cups for those ages 9 years and older) should be promoted. It is especially important to establish milk drinking in young children, as those who consume milk as children are more likely to do so as adults. Those who choose not to consume milk and milk products should include other foods in the diet that contain the nutrients provided by the milk and milk products group, protein, calcium, potassium, magnesium, Vitamin D, and Vitamin A.

## **Question 5: What is the Relationship between the Intake of Cooked Dry Beans and Peas and Selected Health Outcomes?**

### **Conclusion**

Limited evidence exists to establish a clear relationship between intake of cooked dry beans and peas and body weight. There is limited evidence that intake of cooked dry beans and peas lowers serum lipids. Limited evidence is available to determine a relationship between the intake of cooked dry beans and peas and type 2 diabetes.

### **Implications**

Legumes and soybeans, including dried beans and peas, are typically recommended foods because of their content of dietary fiber, protein, vitamins, and minerals (Mesina, 1999). Because soybeans are particularly high in isoflavones, a phytoestrogen, they have been more extensively studied than other legumes. Legumes are also promoted as a complementary protein source to grains since legumes are low in methionine and grains are low in lysine. Thus, legumes play an important role in vegan diets for enhancing protein quality. They may also provide a beneficial contribution to the general population in part to increase total vegetable consumption and dietary fiber intake.

## **SECTION 5: CARBOHYDRATES**

### **Question 1: What are the Health Benefits of Dietary Fiber?**

#### **Conclusion**

A moderate body of evidence suggests that dietary fiber from whole foods protects against cardiovascular disease, obesity, and type 2 diabetes and is essential for optimal digestive health.

#### **Implications**

Dietary fiber is under-consumed across all segments of the American population. The development of many risk factors that are associated with incidence of several highly prevalent chronic diseases could be reduced by increasing consumption of naturally-occurring plant-based foods that are high in dietary fiber, including whole grain foods, cooked dry beans and peas, vegetables, fruits, and nuts.

### **Question 2: What is the Relationship between Whole Grain Intake and Selected Health Outcomes?**

#### **Conclusion**

A moderate body of evidence from large prospective cohort studies shows that whole grain intake, which includes cereal fiber, protects against cardiovascular disease. Limited evidence shows that consumption of whole grains is associated with a reduced incidence of type 2 diabetes in large prospective cohort studies. Moderate evidence shows that intake of whole grains and grain fiber is associated with lower body weight.

## Implications

Currently most Americans are not consuming adequate amounts of whole grains, which are an important source of dietary fiber and other nutrients. Enriched and fortified grains provide important nutrients; hence, individuals are encouraged to consume grains as both fiber-rich whole grains and enriched grains. To ensure nutrient adequacy, especially for folate, individuals who consume all of their grains as whole grains should include some that have been fortified with folic acid.

Total grains servings are typically over-consumed in the US, so recommendations to consume more grains are not supported by this review. Advice should be to make more grain choices as fiber-rich whole grains, rather than eat more grains. The lack of standards for whole grain foods and measuring whole grain content of foods also make any recommendations difficult to implement.

## Question 3: What is the Relationship Between the Intake of Vegetables and Fruits, not Including Juice, and Selected Health Outcomes?

### Conclusion

Consistent evidence suggests at least a moderate inverse relationship between vegetable and fruit consumption with myocardial infarction and stroke, with significantly larger, positive effects noted above five servings of vegetables and fruits per day. Notwithstanding prior work on dietary patterns that emphasize vegetables and fruits, insufficient evidence published since 2004 is available to assess the independent relationship between vegetable and fruit intake and blood pressure or serum cholesterol. The evidence for an association between increased fruit and vegetable intake and lower body weight is modest with a trend towards decreased weight gain over 5+ years in middle adulthood. No conclusions can be drawn from the evidence on the efficacy of increased fruit and vegetable consumption in weight loss diets. Limited and inconsistent evidence suggests an inverse association between total vegetable and fruit consumption and the development of type 2 diabetes. Evidence also indicates that some types of vegetables and fruits are probably protective against some cancers.

### Implications

Vegetables and fruits are nutrient-dense and relatively low in calories. In order to meet the recommended intakes, Americans should emphasize vegetables and fruits in their daily food choices, without added solid fats, sugars, starches or sodium to maximize health benefits. Significant favorable associations between vegetable and fruit consumption and health outcomes appear to be linked to a minimum of five servings per day and positive linear effects may be noted at even higher consumption levels. While the impact of increased vegetable and fruit consumption per se is unclear for some chronic diseases and markers (blood lipids, glucose control, type 2 diabetes, and weight loss), improvements in preventing cardiovascular disease and certain cancers, especially cancers of the alimentary tract, may occur with increased consumption of these foods. Additionally, there is evidence that vegetables and fruits, when considered as part of a dietary pattern, are associated with improved weight and health outcomes (see *Part D. Section 2: The Total Diet: Combining*

*Nutrients, Consuming Food* for a discussion of dietary patterns and *Part D. Section 1: Energy Balance and Weight Management* for a discussion of energy density).

## **Question 4: What is the Relationship between Glycemic Index or Glycemic Load and Body Weight, Type 2 Diabetes, Cardiovascular Disease, and Cancer?**

### **Conclusion**

Strong and consistent evidence shows that glycemic index and/or glycemic load are not associated with body weight and do not lead to greater weight loss or better weight maintenance. Abundant, strong epidemiological evidence demonstrates that there is no association between glycemic index or load and cancer. A moderate body of inconsistent evidence supports a relationship between high glycemic index and type 2 diabetes. Strong, convincing evidence shows little association between glycemic load and type 2 diabetes. Due to limited evidence, no conclusion can be drawn to assess the relationship between either glycemic index or load and cardiovascular disease.

### **Implications**

When selecting carbohydrate foods, there is no need for concern with their glycemic index or glycemic load. What is important to heed is their calories, caloric density, and fiber content.

## **Question 5: In Adults, What Are the Associations between Intake of Sugar-sweetened Beverages and Energy Intake and Body Weight?**

### **Conclusions**

Limited evidence shows that intake of sugar-sweetened beverages is linked to higher energy intake in adults. A moderate body of epidemiologic evidence suggests that greater consumption of sugar-sweetened beverages is associated with increased body weight in adults. A moderate body of evidence suggests that under isocaloric controlled conditions, added sugars, including sugar-sweetened beverages, are no more likely to cause weight gain than any other source of energy.

### **Implications**

Added sugars, as found in sugar-sweetened beverages (SSB), are not different than other extra calories in the diet for energy intake and body weight. Thus, reducing intake of all added sugars, including sucrose, corn sweetener, fructose, high fructose corn syrup, and other forms of added sugars, is a recommended strategy to reduce calorie intake in Americans. Intake of caloric beverages, including SSB, sweetened coffee and tea, energy drinks, and other drinks high in calories and low in nutrients should be reduced in consumers needing to lower body weight. While still moderate, recent evidence is stronger than prior evidence available to assess the relationship between sugar-sweetened beverages and increased body weight.

## **Question 6: How are Non-caloric Sweeteners Related to Energy Intake and Body Weight?**

### **Conclusion**

Moderate evidence shows that using non-caloric sweeteners will affect energy intake only if they are substituted for higher calorie foods and beverages. A few observational studies reported that individuals who use non-caloric sweeteners are more likely to gain weight or be heavier. This does not mean that non-caloric sweeteners cause weight gain, but rather that they are more likely to be consumed by overweight and obese individuals.

### **Implications**

The replacement of sugar-sweetened foods and beverages with sugar-free products should theoretically reduce body weight. Yet many questions remain, as epidemiologic studies show a positive link with use of nonnutritive sweeteners and BMI. Additionally, whether use of low calorie sweeteners is linked to higher intake of other calories in the diet remains a debated question.

## **Question 7: What is the Impact of Liquid Versus Solid Foods on Energy Intake and Body Weight?**

### **Conclusion**

A limited body of evidence shows conflicting results about whether liquid and solid foods differ in their effects on energy intake and body weight except that liquids in the form of soup may lead to decreased energy intake and body weight.

### **Implications**

In general, if total calorie content is held constant, there is little support for any effects on energy intake and body weight due to the calories consumed either as liquid or solid. Some studies suggest that whole foods may be more satiating than liquid foods. Food structure, specifically a whole food (apple, carrots), plays a role in satiety and decreasing food intake at subsequent meals, yet fiber added to a drink is not effective in reducing food intake at subsequent meals. Soup as a preload decreases food intake at a subsequent meal. Thus, Americans are advised to pay attention to the calorie content of the food or beverage consumed, regardless of whether it is a liquid or solid. Calories are the issue in either case.

## **Question 8: What is the Role of Carbohydrate, Fiber, Protein, Fat, and Food Form on Satiety?**

### **Conclusion**

Many factors affect satiety and most studies are conducted in laboratory settings to control for variables. Thus results may not be generalized to the more complicated eating environment of the outside world. Foods high in dietary fiber generally are more satiating than low fiber foods, although some fibers added to drinks have little impact on satiety. Overall, small changes in the macronutrient content of the diet do not significantly alter satiety.

**Implications**

Intakes of caloric preloads, whether carbohydrate, protein, or fat, typically increase satiety. Protein and carbohydrate may be more satiating than fat, although studies are not consistent. Dietary fiber, especially from whole foods, appears to enhance satiety in studies. Not all fibers added to beverages or foods are equally satiating. In fact, some functional fibers show no effect on satiety.

**Question 9: What is the Role of Prebiotics and Probiotics in Health?****Conclusion**

Gut microflora play a role in health, although the research in this area is still developing. Foods high in prebiotics (wheat, onions, garlic) may be consumed, as well as food concentrated in probiotics (yogurt), within accepted dietary patterns.

**Implications**

The lack of epidemiologic studies that support a role for changes in gut microflora and health outcomes limits any specific dietary recommendations in this area. Foods high in prebiotics and probiotics are linked to health benefits. For example, fiber is a prebiotic linked to health benefits. Many probiotic-containing foods, such as dairy foods, also are linked to health benefits and are recommended for inclusion in the diet.

**SECTION 6: SODIUM, POTASSIUM, AND WATER****Question 1: What is the Effect of Sodium Intake on Blood Pressure in Children and in Adults?****Conclusion**

A strong body of evidence has documented that in adults, as sodium intake decreases, so does blood pressure. A moderate body of evidence has documented that as sodium intake decreases, so does blood pressure in children, birth to 18 years of age.

**Implications**

The projected health benefits of a reduced sodium intake are substantial and include fewer strokes, cardiovascular disease events, and deaths, as well as substantially reduced health care costs. In view of these potential benefits and the current very high intake of sodium in the general population, children and adults should lower their sodium intake as much as possible by consuming fewer processed foods that are high in sodium, and by using little or no salt when preparing or eating foods.

The current food supply is replete with excess sodium. Many foods contribute to the high intake of sodium. While some foods are extremely high in sodium, the problem of excess sodium reflects frequent consumption of foods that are only moderately high in sodium. The major sources of sodium intake among the US population are yeast breads; chicken and chicken mixed dishes; pizza;

pasta and pasta dishes; cold cuts; condiments; Mexican mixed dishes; sausage, franks, bacon, and ribs; regular cheese; grain-based desserts; soups; and beef and beef mixed dishes (NCI, 2010). Collectively, this group of foods contributes about 56 percent of the dietary sodium, or nearly 2000 mg per person per day.

A major new concern is the excessive sodium added to products such as poultry, pork and fish through injections or marination; efforts to quantify the amount of sodium from this type of processing are warranted. Finally, an important determinant of sodium intake is calorie intake. Hence, efforts to reduce calorie intake should also lower sodium intake.

In 2005, the DGAC recommended a daily sodium intake of less than 2,300 mg for the general adult population and stated that hypertensive individuals, Blacks, and middle-aged and older adults would benefit from reducing their sodium intake even further. Because these latter groups together now comprise nearly 70 percent of US adults, the goal should be 1,500 mg per day for the general population. Given the current US marketplace and the resulting excessively high sodium intake, it will be challenging to achieve the lower level. In addition, time is required to adjust taste perception in the general population. Thus, the reduction from 2,300 mg to 1,500 mg per day should occur gradually over time. A recent Institute of Medicine report has provided a roadmap to achieve gradual reductions in sodium intake. Because early stages of blood pressure-related atherosclerotic disease begin during childhood, both children and adults should reduce their sodium intake. Individuals should also increase their consumption of dietary potassium because increased potassium intakes helps to attenuate the effects of sodium on blood pressure.

## **Question 2: What is the Effect of Potassium Intake on Blood Pressure in Adults?**

### **Conclusion**

A moderate body of evidence has demonstrated that a higher intake of potassium is associated with lower blood pressure in adults.

### **Implications**

Increasing dietary potassium intake can lower blood pressure. A higher intake of potassium also attenuates the adverse effects of sodium on blood pressure. Other possible benefits include a reduced risk of developing kidney stones and decreased bone loss. In view of the health benefits of adequate potassium intake and its relatively low current intake by the general population, increased intake of dietary potassium is warranted. The IOM set the AI for potassium for adults at 4,700 mg per day. Available evidence suggests that Blacks and hypertensive individuals especially benefit from an increased intake of potassium.

## **Question 3. What Amount of Water is Recommended for Health?**

### **Conclusion**

Based on an extensive review of evidence, an IOM panel in 2004 concluded that the combination of thirst and usual drinking behavior, especially the consumption of fluids with meals, is sufficient to



maintain normal hydration. However, because water needs vary considerably and because there is no evidence of chronic dehydration in the general population, a minimum intake of water cannot be set.

### **Implications**

In order to prevent dehydration, water must be consumed daily. Healthy individuals who have routine access to fluids and who are not exposed to heat stress consume adequate water to meet their needs. Purposeful drinking is warranted for individuals who are exposed to heat stress or who perform sustained vigorous physical activity. Although uncommon, heat waves are one setting of extreme heat stress that increases the risk of morbidity and mortality from dehydration, especially in older-aged persons. In view of the ongoing obesity epidemic, individuals are encouraged to drink water and other fluids with few or no calories.

## **SECTION 7: ALCOHOL**

### **Question 1. What is the Relationship between Alcohol Intake and Weight Gain?**

#### **Conclusion**

Moderate evidence suggests that among free-living populations, moderate drinking is not associated with weight gain. However, heavier consumption over time is associated with weight gain.

#### **Implications**

Regardless of the alcoholic beverage, in general, all contain calories that are not a good source of nutrients and when consumed beyond an average of two drinks a day may lead to weight gain. Below this level of consumption, the results from most well designed large prospective studies suggest that individuals who drink in moderation do not gain weight at a faster rate than non-drinkers.

### **Question 2: What is the Relationship between Alcohol Intake and Cognitive Decline with Age?**

#### **Conclusion**

Moderate evidence suggests that compared to non-drinkers, individuals who drink moderately have a slower cognitive decline with age. Although limited, evidence suggests that heavy or binge drinking is detrimental to age-related cognitive decline.

#### **Implications**

Alcohol, when consumed in moderation, did not quicken the pace of age-related loss of cognitive function. In most studies, it was just the opposite—moderate alcohol consumption, when part of a healthy diet and physical activity program, appeared to help to keep cognitive function intact with age. Despite the potential benefit at moderate consumption levels, heavy drinking and episodes of binge drinking impairs short- and long-term cognitive function and should be avoided.

### **Question 3: What is the Relationship between Alcohol Intake and Coronary Heart Disease?**

#### **Conclusion**

Strong evidence consistently demonstrates that compared to non-drinkers, individuals who drink moderately have lower risk of CHD. Insufficient evidence was available to determine if any one single drinking pattern was predictive of lower or higher risk of coronary heart disease, although there was moderate evidence to suggest that heavy or binge drinking is detrimental.

#### **Implications**

An average daily intake of one to two alcoholic beverages is associated with a low risk of CHD among middle-aged and older adults. Binge or heavy irregular drinking should be avoided.

### **Question 4: What is the Relationship between Alcohol Intake and Bone Health?**

#### **Conclusion**

Moderate evidence suggests a J-shaped association between alcohol consumption and incidence of hip fracture; there was a suggestion that heavy or binge drinking was detrimental to bone health.

#### **Implications**

There is insufficient evidence from epidemiological data to make a strong conclusion related to patterns of alcohol intake and bone health. However, it is very likely that the increased risk of fracture among individuals who drink more than one to two drinks per day on average is due to injuries that follow heavier consumption. What further complicates the interpretation of the existing studies is that moderate and heavy drinkers frequently were combined in the same category, making it impossible to disentangle potential benefits and risks. In addition, many studies failed to control adequately for physical activity, an important lifestyle characteristic beneficially related to bone density.

### **Question 5: What is the Relationship between Alcohol Intake and Unintentional Injury?**

#### **Conclusion**

Strong evidence demonstrates that drinking in excess of current guidelines increases the risk of unintentional falls, motor vehicle crashes, and drowning. When alcohol is consumed in moderation, the evidence for risk of unintentional injury is less well established for activities such as driving, swimming, and athletic participation, but abstinence from alcohol is the safest.

#### **Implications**

Adverse effects, in terms of unintentional injury, can occur even at levels of moderate alcohol consumption.

**Question 6. Does Alcohol Consumption during Lactation have Adverse Health Effects? What is the Relationship between Alcohol Consumption and the Quality and Quantity of Breast Milk Available for the Offspring? What is the Relationship between Alcohol Consumption and Postnatal Growth Patterns, Sleep Patterns, and/or Psychomotor Patterns of the Offspring?**

**Conclusion**

Moderate, consistent evidence shows that when a lactating mother consumes alcohol, alcohol enters the breast milk, and the quantity of milk produced is reduced, leading to reduced milk consumption by the infant. Although limited, evidence suggests that alcohol consumption during lactation was associated with altered post-natal growth, sleep patterns, and/or psychomotor patterns of the offspring.

**Implications**

The benefits of breastfeeding to the infant are well established. A woman who chooses to breast feed, however, need not completely abstain from alcohol. Because the level of alcohol in breast milk mirrors the mother's blood alcohol content, after latch-on has been perfected and a pattern of consistent breastfeeding has been established (i.e., around age 2 to 3 months), a mother could wait 3 to 4 hours after a single drink (the time it would take to metabolize the ethanol) before breastfeeding and the infant exposure to alcohol would likely be negligible. It is not sufficient for a woman to express breast milk after alcohol consumption to prevent exposure to the infant because the concentration of alcohol in breast milk will remain at levels in the blood until all the alcohol is metabolized. Contrary to medical and cultural folklore, alcohol consumption does not enhance lactational performance and instead reduces milk production and decreases infant milk consumption in the 3 to 4 hours after alcohol is consumed. Finally, there is still insufficient evidence to conclude definitively that alcohol exposure to an infant during lactation affects the postnatal growth of the child, but nonetheless alcohol exposure to the breastfeeding infant by breastfeeding too soon after consuming a single drink should be avoided.

**SECTION 8: FOOD SAFETY AND TECHNOLOGY**

***BEHAVIORS MOST LIKELY TO PREVENT FOOD SAFETY PROBLEMS AND THE EXTENT TO WHICH US CONSUMERS FOLLOW THESE BEHAVIORS***

**Overarching Conclusion**

Evidence shows that proper hand sanitation techniques, proper washing of vegetables and fruit, prevention of cross-contamination, and appropriate cooking and storage of foods in the home kitchen are most likely to prevent food safety problems. Food safety behaviors least practiced by consumers are hand sanitation, cross-contamination prevention, and use of cooking, refrigerator, and freezer thermometers. Food safety knowledge of US consumers is not being translated into improved food safety practices at home.

## Implications

All segments of the US population could benefit from improved food safety education based on effective behavioral change theories. Food safety education is needed to not only improve consumers' knowledge, but also their attitudes and intentions toward reducing home-based food safety risks. In particular, consumers need to take more responsibility regarding food safety. Together, with sound government policies and responsible food industry practices, foodborne illness can be prevented.

Food safety behaviors that particularly need additional promotion are hand sanitation, use of cooking and refrigerator/freezer thermometers, and prevention of cross-contamination. Produce washing practices can vary significantly for different vegetables and this behavior needs to be substantially improved. Additional guidance is needed to provide detailed recommendations on the frequency of refrigerator cleaning to decrease pathogen growth and potential for cross-contamination. It is important to educate consumers on appropriate cooking temperatures and the reasons to avoid consuming raw or undercooked animal protein products. The consumption of certain risky foods (e.g., cookie dough containing raw eggs) is likely to occur at home, but the consumption of other foods (e.g., raw seafood) is more likely to occur outside the home. Thus, consumer food safety education in this area needs to address safe food practices in the different environments in which individuals are likely to consume the different products. Education should also address food safety issues that have emerged due to trends toward local- and regional-based food production.

Of subpopulations in the US, older adults may be at greater risk because of the age-related reduction in immunity. Pregnant women also have altered immune status which may render the fetus more susceptible to infection. Foodborne illnesses affecting pregnant women can have extremely serious consequences for the fetus as illustrated by the still births resulting from listeriosis. Foodborne illness outbreaks among college students have the potential to rapidly spread within the student body as a result of the group arrangements in which they often live.

## **Question 1. CLEAN: What Techniques for Hand Sanitation are Associated with Favorable Food Safety Outcomes and to What Extent Do US Consumers Follow Them?**

### **Conclusion**

Strong, clear, and consistent evidence shows that hand washing with plain soap for 20-30 seconds followed by proper hand drying is an effective hand hygiene technique for preventing cross-contamination during food preparation. Strong, clear, and consistent evidence shows that alcohol-based, rinse-free hand sanitizers are an adequate alternative when proper hand washing with plain soap is not possible. Moderate, consistent evidence shows that US consumers do not follow recommended hand sanitation behaviors.

## **Question 2. CLEAN: What Techniques for Washing Fresh Produce are Associated with Favorable Food Safety Outcomes and to What Extent Do US Consumers Follow Them?**

### **Conclusion**

A limited body of evidence has shown that washing vegetables and fruit by running water over them at home or under laboratory simulation conditions is associated with reduced produce microbial loads. Moderate, consistent evidence shows that US consumers are not following recommended produce washing techniques at home.

## **Question 3. CLEAN: To What Extent Do US Consumers Clean Their Refrigerators?**

### **Conclusion**

Moderate, consistent evidence shows that US consumers do not clean their refrigerators following available guidance.

## **Question 4. SEPARATE: What Techniques for Preventing Cross-Contamination are Associated with Favorable Food Safety Outcomes?**

### **Conclusion**

Moderate, consistent evidence indicates that preventing cross-contamination in the home kitchen may reduce exposure to foodborne pathogens among US consumers. Techniques associated with favorable food safety outcomes for preventing cross-contamination include proper cleaning of food preparation surfaces and/or cooking utensils, particularly cutting boards and cutlery, accompanied by hand washing.

## **Question 5. COOK AND CHILL: To What Extent Do US Consumers Follow Adequate Temperature Control During Food Preparation and Storage at Home?**

### **Conclusion**

Strong, consistent evidence shows that the great majority of US consumers do not use food thermometers to properly assess the internal cooking temperature of meat and poultry while cooking. Moderate, consistent evidence shows that US consumers lack refrigerator and freezer thermometers in their homes.

## **Question 6. RISKY FOODS: To What Extent Do US Consumers Eat Raw or Undercooked Animal Foods?**

### **Conclusion**

Moderate, clear, and consistent evidence shows that the consumption of raw or undercooked animal-source food products is relatively common in the US, especially for eggs and egg-containing products, and ground beef products.

## **Question 7. To What Extent Do Specific Subpopulations Practice Unsafe Food Safety Behaviors?**

### **Conclusion**

Moderate available evidence, which focused on pregnant women, college students, and older adults, shows that these populations commonly practice unsafe food handling and consumption behaviors.

## ***FOOD SAFETY TECHNOLOGIES***

## **Question 8. To What Extent are Recently Developed Technological Materials that are Designed to Improve Food Safety Effective in Reducing Exposure to Pathogens and Decreasing the Risk of Foodborne Illnesses in the Home?**

### **Conclusion**

A limited body of inconsistent evidence describes and evaluates contributions to or advances of food safety modalities or practices in the home. These small studies indicate the correct usage of these kinds of products is critical for assessing proper cooking temperature and ensuring adequate reduction of microbial burden on food contact surfaces. Not all thermometers tested, wipes assessed, and sanitizers evaluated were accurate or effective in providing correct cook temperatures or assuring consistent safety against typical foodborne organisms.

### **Implications**

New and emerging technologies over the past 5 years can assist consumers in preserving and protecting foods while encouraging safe food handling practices in the home; however, appropriate techniques for using products is essential in the efficacy of decreasing the risk for foodborne illness. The evidence supporting emerging food safety technologies in the home is limited, despite the emergence of commercial tools and appliances intended to improve safe food handling and management practices in the home. Consumers should adhere to food safety fundamentals in the home, which will remain foundational, even with future introductions of food safety technologies.

## **SEAFOOD**

### **Question 9. What are the Benefits in Relationship to the Risks for Seafood Consumption?**

#### **Conclusion**

Moderate, consistent evidence shows that health benefits derived from the consumption of a variety of cooked seafood in the US in amounts recommended by the Committee outweigh the risks associated with methyl mercury (MeHg) and persistent organic pollutants (POPs) exposure, even among women who may become or who are pregnant, nursing mothers, and children ages 12 and younger. Overall, consumers can safely eat at least 12 oz. of a variety of cooked seafood per week provided they pay attention to local seafood advisories and limit their intake of large, predatory fish. Women who may become or who are pregnant, nursing mothers, and children ages 12 and younger can safely consume a variety of cooked seafood in amounts recommended by this Committee while following Federal and local advisories.

#### **Implications**

Seafood is a healthy food choice that can be safely promoted provided that the types and sources of seafood to be limited or avoided by some consumers are clearly communicated to consumers. Consumers may be able to eat safely more than 12 oz. per week of seafood if they chose to do so provided they choose the right mix of seafood that emphasizes the consumption of seafood species with relatively low concentrations of contaminants such as MeHg and POPs. Encouraging consumption of seafood in the US is justified, as consumption continues to be far below amounts recommended for health by the Institute of Medicine and by this Committee (see *Part D. Section 3: Fatty Acids and Cholesterol*).

Current Federal advisories on consumption of seafood species with high MeHg levels that vulnerable groups need to avoid are well justified by the scientific evidence. Regarding women who may become or who are pregnant, nursing mothers, and young children, there is emerging evidence that consumption beyond 12 oz. per week may be safe. However, additional benefit/risk modeling is needed taking into account the simultaneous presence of multiple contaminants in a shifting seafood supply. State and local agencies should continue to reach out to vulnerable groups and the population at large with advisories about the presence of diverse environmental contaminants in different water bodies. This is particularly relevant for seafood caught by consumers. The public also needs to be advised that eating a variety of seafood, as opposed to just a few choices, is likely to reduce their exposure to ‘single source’ contaminants. Clear, consistent evidence indicates that consumers will need access to publicly available user-friendly benefit/risk information to make informed seafood choices that maximize their health taking into account their seafood preferences.

## Appendix E-2: Glossary of Terms

The terms in this Glossary appear in multiple sections of the Report and are essential to understanding the major themes and concepts discussed throughout. Terms specific to individual sections are defined there. Definitions are taken from a variety of sources, including 2010 DGAC chapters, the 2005 DGAC Report, 2005 *Dietary Guidelines for Americans*, Institute of Medicine reports, USDA and HHS regulatory definitions, and published sources in the scientific literature.

**Added sugars**—Sugars, syrups, and other caloric sweeteners that are added to foods during processing, preparation, or consumed separately. Added sugars do not include naturally occurring sugars such as those in milk or fruits. Names for added sugars include: brown sugar, corn sweetener, corn syrup, dextrose, fructose, fruit juice concentrates, glucose, high-fructose corn syrup, honey, invert sugar, lactose, maltose, malt syrup, molasses, raw sugar, turbinado sugar, trehalose, and sucrose.

**Body mass index (BMI)**—A measure of weight in kilograms (kg) relative to height in meters (m) squared. BMI is considered a reasonably reliable indicator of total body fat, which is related to the risk of disease and death. BMI status categories include underweight, healthy weight, overweight, and obese. Overweight and obese describe ranges of weight that are greater than what is considered healthy for a given height, while underweight describes a weight that is lower than what is considered healthy. Because children and adolescents are growing, their BMI is plotted on growth charts for sex and age. The percentile indicates the relative position of the child's BMI among children of the same sex and age.

Body Weight Category	Children and Adolescents (BMI-for-Age Percentile Range)	Adults (BMI)
Underweight	Less than the 5th percentile	Less than 18.5 kg/m <sup>2</sup>
Healthy weight	5th percentile to less than the 85th percentile	18.5 to 24.9 kg/m <sup>2</sup>
Overweight	85th to less than the 95th percentile	25.0 to 29.9 kg/m <sup>2</sup>
Obese	Equal to or greater than the 95th percentile	30 kg/m <sup>2</sup> or greater

**Calorie**—Unit of energy that is required to sustain the body's various functions, including metabolic processes and physical activity. Carbohydrate, fat, protein, and alcohol provide all of the energy supplied by foods and beverages. Calories referred to in terms of dietary intake and expenditure are kilocalories, but are referred to as calories in this Report.

**Carbohydrates**—One of the three classes of macronutrients that includes sugars, starches, and fibers:

- **Sugars**—A simple carbohydrate composed of one unit (a monosaccharide, such as glucose and fructose) or two joined units (a disaccharide, such as lactose and sucrose). Sugars include white and brown sugar, fruit sugar, corn syrup, molasses, and honey.
- **Starches**—Many glucose units linked together. Examples of foods containing starch include vegetables, dry beans and peas, and grains (e.g., brown rice, oats, wheat, barley, corn).



- **Fiber**—Nondigestible carbohydrates and lignin that are intrinsic and intact in plants. Fiber consists of dietary fiber, the fiber naturally occurring in foods, and functional fiber, which are isolated, nondigestible carbohydrates that have beneficial physiological effects in humans.

**Cardiovascular disease**—Diseases of the heart and diseases of the blood vessel system (arteries, capillaries, veins) within a person’s entire body, including the brain, muscle, lungs, adipose tissue (or fat) or kidneys.

**Cholesterol**—A natural sterol present in all animal tissues. Free cholesterol is a component of cell membranes and serves as a precursor for steroid hormones (estrogen, testosterone, aldosterone), and for bile acids. Humans are able to synthesize sufficient cholesterol to meet biologic requirements, and there is no evidence for a dietary requirement for cholesterol.

- **Dietary cholesterol**—Cholesterol is found in foods of animal origin, including meat, fish, poultry, eggs, and dairy products. Biologically, a liver is required to produce cholesterol, thus plant foods, such as grains, vegetables and fruits, and oils contain no dietary cholesterol.
- **Serum cholesterol**—Cholesterol that travels in the blood as part of distinct particles containing both lipids and proteins ( lipoproteins). Three major classes of lipoproteins are found in the serum of a fasting individual: low-density lipoprotein (LDL), high-density lipoprotein (HDL), and very-low-density lipoprotein (VLDL). Another lipoprotein class, intermediate-density lipoprotein (IDL), resides between VLDL and LDL; in clinical practice, IDL is included in the LDL measurement

**Cross-contamination**—The spread of bacteria, viruses, or other harmful agents from one surface to another.

**Cup equivalent (cup eq)**—The amount of a food product that is considered equal to 1 cup from the vegetable, fruit, or milk food group. A cup eq for some foods may be less than a measured cup, because the food has been concentrated (such as raisins or tomato paste), more than a cup for some foods that are airy in their raw form and do not compress well into a cup (such as salad greens), or measured in a different form (such as cheese).

**Dietary Approaches to Stop Hypertension (DASH)**—A dietary pattern that emphasizes potassium-rich vegetables and fruits and low-fat dairy products; includes whole grains, poultry, fish and nuts; and is reduced in red meat, sweets, and sugar-containing beverages. As a result, it is rich in potassium, magnesium, calcium and fiber, and reduced in total fat, saturated fat, and cholesterol. It also is slightly increased in protein. This nutrient-rich diet has been shown to lower blood pressure and LDL-cholesterol and it meets each of the major nutrient recommendations set by the Institute of Medicine Dietary Reference Intake Committees.

**Dietary pattern**—A description of the types and amounts of foods and beverages consumed on average, over time. This may be a description of a customary way of eating, or a description of a combination of foods recommended for consumption. Specific examples include Dietary Approaches to Stop Hypertension (DASH), Mediterranean, and USDA patterns. Dietary patterns fall into several broad categories:

- **Omnivorous**—A pattern that includes both animal and plant products.

- **Plant-based**—A pattern in which the majority of protein sources come from plant products, though some animal products can be included.
- **Vegetarian**—A pattern that is exclusively or almost exclusively composed of plant foods. Some vegetarians may consume specified animal products, such as eggs, milk and milk products (lacto-ovo vegetarians), and processed foods containing small amounts of animal products.
- **Vegan**—A pattern that is exclusively composed of plant foods, containing no animal products.

**Dietary Reference Intakes (DRIs)**—A set of nutrient-based reference values that expand upon and replace the former Recommended Dietary Allowances (RDAs) in the United States and the Recommended Nutrient Intakes (RNIs) in Canada. They include:

- **Acceptable Macronutrient Distribution Ranges (AMDR)**—Range of intake for a particular energy source that is associated with reduced risk of chronic disease while providing intakes of essential nutrients. If an individual's intake is outside of the AMDR, there is a potential of increasing the risk of chronic diseases and/or insufficient intakes of essential nutrients.
- **Adequate Intakes (AI)**—A recommended average daily nutrient intake level based on observed or experimentally determined approximations or estimates of mean nutrient intake by a group (or groups) of apparently healthy people. This is used when the Recommended Dietary Allowance cannot be determined.
- **Estimated Average Requirements (EAR)**—The average daily nutrient intake level estimated to meet the requirement of half the healthy individuals in a particular life stage and sex group.
- **Recommended Dietary Allowance (RDA)**—The average dietary intake level that is sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and sex group.
- **Tolerable Upper Intake Level (UL)**—The highest average daily nutrient intake level likely to pose no risk of adverse health effects for nearly all individuals in a particular life stage and gender group. As intake increases above the UL, the potential risk of adverse health effects increases.

**Energy density**—The amount of energy per unit of weight, usually expressed as calories per 100 grams.

**Energy balance**—The balance between calories consumed through eating and drinking and those expended through physical activity and metabolic processes. Energy consumed must equal energy expended for a person to remain at the same body weight. Weight gain will result from excess calorie intake and/or inadequate physical activity. Weight loss will occur when a calorie deficit exists, which can be achieved by eating less, being more physically active, or a combination of the two.

**Enrichment**—The addition of specific nutrients (iron, thiamin, riboflavin, and niacin) to refined grain products in order to replace losses of the nutrients that occur during processing.

**Fast food**—Foods designed for ready availability, use or consumption and sold at eating establishments for quick availability or take-out. Fast food restaurants are also known as quick-service restaurants.

**Fats**—One of the three classes of macronutrients. (See **Solid Fats** and **Oils**.)

- **Monounsaturated Fatty Acids**—Monounsaturated fatty acids (MUFAs) have one double bond. Plant sources that are rich in MUFAs include nuts and vegetable oils that are liquid at room temperature (e.g., canola oil, olive oil, high oleic safflower and sunflower oils).
- **Polyunsaturated fatty acids**—Polyunsaturated fatty acids (PUFAs) have two or more double bonds and may be of two types, based on the position of the first double bond.
- ***n*-6 PUFAs**—Linoleic acid, one of the *n*-6 fatty acids, is required but cannot be synthesized by humans and, therefore, is considered essential in the diet. Primary sources are liquid vegetable oils, including soybean oil, corn oil, and safflower oil. Also called omega-6 fatty acids.
- ***n*-3 PUFAs**— $\alpha$ -linolenic acid is an *n*-3 fatty acid that is required because it is not synthesized by humans and, therefore, is considered essential in the diet. It is obtained from plant sources, including soybean oil, canola oil, walnuts, and flaxseed. Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are long chain *n*-3 fatty acids that are contained in fish and shellfish. Also called omega-3 fatty acids.
- **Saturated fatty acids**—Saturated fatty acids have no double bonds. Examples include animal products such as meat and dairy products, hydrogenated shortening and coconut or palm oils. In general, saturated fats are solid at room temperature.
- ***Trans* fatty acids**—As used in this Report *trans* fatty acids refers to industrial *trans* fatty acids and is a term consistent with that defined by the US Food and Drug Administration for use in food labeling. In this definition, *trans* fatty acids are unsaturated fatty acids that contain one or more isolated (i.e., nonconjugated) double bonds in a *trans* configuration produced by chemical hydrogenation. Sources of *trans* fatty acids include hydrogenated/partially hydrogenated vegetable oils that are used to make shortening and commercially prepared baked goods, snack foods, fried foods, and margarine. *Trans* fatty acids also are present in foods that come from ruminant animals (e.g., cattle and sheep) and are called “natural” or rTFA. Such foods include dairy products, beef, and lamb.

**Food environment**—The collective group of settings from which a person can access food, including the home, food retail establishments, restaurants, schools, worksites, as well as the overall food supply.

**Food pattern modeling**—The process of developing and adjusting daily intake amounts from food categories or groups to meet specific criteria, such as meeting nutrient intake goals, limiting nutrients or other food components, or varying proportions or amounts of specific food categories or groups.

**Food security**—Access by all people at all times to enough food for an active, healthy life. Food security includes, at a minimum: (a) the ready availability of nutritionally adequate and safe foods and (b) an assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies).

**Food insecurity**—The limited or uncertain availability of nutritionally adequate and safe foods or uncertain ability to acquire acceptable foods in socially acceptable ways. Hunger is defined as the uneasy or painful sensation caused by a lack of food; the recurrent and involuntary lack of access to food.

**Foodborne disease**—Disease caused by consuming foods or beverages contaminated with disease-causing bacteria or viruses. Many different disease-causing microbes, or pathogens, can contaminate foods, so there are many different foodborne infections. In addition, poisonous chemicals, or other harmful substances, can cause foodborne diseases if they are present in food. The most commonly recognized foodborne infections are those caused by the bacteria *Campylobacter*, *Salmonella*, and *E. coli* O157:H7, and by a group of viruses called calicivirus, also known as the Norwalk and Norwalk-like viruses.

**Foodborne disease outbreak**—Illness that occurs when a group of people consume the same contaminated food and two or more of them come down with the same illness. It may be a group that ate a meal together somewhere, or it may be a group of people who do not know each other at all, but who all happened to buy and eat the same contaminated item from a grocery store or restaurant.

**Hypertension**—A condition, also known as high blood pressure, in which blood pressure remains elevated over time. Hypertension makes the heart work too hard, and the high force of the blood flow can harm arteries and organs, such as the heart, kidneys, brain, and eyes. If uncontrolled, hypertension can lead to heart attacks, heart failure, kidney disease, stroke, and blindness. In adults, hypertension is defined as systolic blood pressure of 140 mmHg or higher or diastolic blood pressure of 90 mmHg or higher. In children, hypertension is defined as systolic or diastolic blood pressure equal to or greater than the 95<sup>th</sup> percentile for sex-, age-, and height-specific blood pressure percentiles. In adults, prehypertension is defined as systolic blood pressure of 120-139 mmHg or diastolic blood pressure of 80-89 mmHg. In children, prehypertension is defined as systolic or diastolic blood pressure that is equal to or greater than the 90<sup>th</sup> percentile but less than the 95<sup>th</sup> percentile for sex-, age-, and height-specific blood pressure percentiles, or blood pressure that is greater than 120/80 but less than the 95<sup>th</sup> percentile.

**Isocaloric**—Having the same caloric values. For example, two dietary patterns that vary in macronutrient proportions but have the same calorie content are isocaloric.

**Metabolic syndrome**—Metabolic syndrome consists of a collection of risk factors for cardiovascular disease manifested in an individual. The syndrome is considered to be present if three of five risk factors are present: glucose intolerance or frank diabetes mellitus, high blood pressure, elevated triglycerides, low HDL cholesterol, and abdominal obesity. Persons with the metabolic syndrome often also manifest a prothrombotic and proinflammatory state.

**Moderate alcohol consumption**—Average daily consumption of up to one drink per day for women and up to two drinks per day for men, with no more than three drinks in any single day for women and no more than four drinks in any single day for men. One drink is defined as 12 fl. oz. of regular beer, 5 fl. oz. of wine, or 1.5 fl. oz. of distilled spirits

**NEL evidence-based systematic review**—A protocol-driven, transparent process used to assist the 2010 Dietary Guidelines Advisory Committee, which includes pre-defined criteria for searching and sorting the scientific literature; critical appraisal of methodological rigor of each included study; extracting, summarizing, and synthesizing the evidence; and grading the overall quality and consistency of the body of evidence.

**Nutrient-dense foods**—Foods that are naturally rich in vitamins, minerals, and phytochemicals, and are lean or low in solid fats and without added solid fats, sugars, starches, or sodium and that retain naturally-occurring components such as fiber. All vegetables, fruits, whole grains, fish, eggs, and nuts prepared without added solid fats or sugars are considered nutrient-dense, as are lean or low-fat forms of fluid milk, meat, and poultry prepared without added solid fats or sugars. Nutrient-dense foods provide substantial amounts of vitamins and minerals (micronutrients) and relatively few calories.

**Oils**—Fats that are liquid at room temperature. Oils come from many different plants and from fish. Some common oils include canola, corn, olive, peanut, safflower, soybean, and sunflower oils. A number of foods are naturally high in oils, such as: nuts, olives, some fish, and avocados. Foods that are mainly oil include mayonnaise, certain salad dressings, and soft (tub or squeeze) margarine with no *trans* fats. Most oils are high in monounsaturated or polyunsaturated fats, and low in saturated fats. A few plant oils, including coconut oil and palm kernel oil, are high in saturated fats and for nutritional purposes should be considered solid fats. Hydrogenated oils that contain *trans* fats should also be considered solid fats for nutritional purposes. (See **Fats**.)

**Ounce equivalent (oz eq)**—The amount of a food product that is considered equal to one ounce from the grain or meat, poultry, fish, eggs, and nuts food group. An ounce equivalent for some foods may be less than a measured ounce if the food is concentrated or low in water content (nuts, peanut butter, dried meats, flour), more than an ounce if the food contains a large amount of water (tofu, cooked beans, cooked rice or pasta).

**Persistent organic pollutants (POPs)**—Toxic chemicals that adversely affect human health and the environment around the world. Because they can be transported by wind and water, most POPs generated in one country can and do affect people and wildlife far from where they are used and released. They persist for long periods of time in the environment and can accumulate and pass from one species to the next through the food chain.

**Portion size**—The amount of a food served or consumed in one eating occasion. A portion is not a standardized amount, and the amount considered to be a portion is subjective and varies. (See **Serving size**.)

**Processed food**—Any food other than a raw agricultural commodity, including any raw agricultural commodity that has been subject to washing, cleaning, milling, cutting, chopping, heating, pasteurizing, blanching, cooking, canning, freezing, drying, dehydrating, mixing, packaging, or other procedures that alter the food from its natural state. Processing also may include the addition of other ingredients to the food, such as preservatives, flavors, nutrients, and other food additives or substances approved for use in food products, such as salt, sugars, and fats. Processing of foods, including the addition of ingredients, may reduce, increase, or leave unaffected the nutritional characteristics of raw agricultural commodities.

- **Minimally-processed food**—Food that is processed but retains most of its inherent physical, chemical, sensory and nutritional properties. Many minimally processed foods are as nutritious as the food in its unprocessed form.

**Protein**—One of the three macronutrients classes. Protein is the major functional and structural component of every cell in the body. Proteins are composed of amino acids, nine of which are indispensable, meaning they cannot be synthesized to meet the body's needs and therefore must be obtained from the diet. The quality of a source of dietary protein depends on its ability to provide the nitrogen and amino acid requirements that are necessary for the body's growth, maintenance, and repair. This ability is determined by two factors: digestibility and amino acid composition.

- **Animal protein** - Protein from animal products such as meat, poultry, seafood, eggs, and milk and milk products. Animal proteins tend to have higher protein quality based on their complete amino acid profile relative to human requirements and higher digestibility.
- **Vegetable protein** - Protein from plants such as legumes, dry beans, grains, nuts, seeds and vegetables. Vegetable proteins tend to have lower protein quality based on their incomplete amino acid profile relative to human requirements and lower digestibility.

**Refined grains**—Grains and grain products missing the bran, germ, and/or endosperm; any grain product that is not a whole grain. Many refined grains are low in fiber but enriched with thiamin, riboflavin, niacin, and iron, and fortified with folic acid as required by US regulations.

**Seafood**—All commercially obtained fish, shellfish, and mollusks, both marine and freshwater.

**Serving size**—A standardized amount of a food, such as a cup or an ounce, used in providing information about the food, such as on the Nutrition Facts label or in dietary guidance, or in making comparisons among similar foods. The portion size consumed may differ from the standard service size. (See **Portion size**.)

**SoFAAS**—Solid Fats, Alcohol, and Added Sugars. This term is used in the Healthy Eating Index 2005 and in other publications. The term SoFAS is preferred to SoFAAS when discussing intakes or limits for the total population, because many individuals do not consume calories from alcohol.

**SoFAS**—Solid Fats and Added Sugars. This term is used when calculating the number of calories that come from these two food components together. Limits for the amount of calories from SoFAS are included in the USDA food patterns.

**Solid fats**—Fats that are usually not liquid at room temperature. Solid fats are found in most animal foods but also can be made from vegetable oils through hydrogenation. Some common solid fats include: butter, beef fat (tallow, suet), chicken fat, pork fat (lard), stick margarine, and shortening. Foods high in solid fats include: many cheeses, creams, whole milk, ice creams, well-marbled cuts of meats, regular ground beef, bacon, sausages, poultry skin, and many baked goods (such as cookies, crackers, doughnuts, pastries, and croissants). Most solid fats contain saturated fats, cholesterol and/or *trans* fats, and have less or no monounsaturated or polyunsaturated fats. (See **Fats**.)

**Study design**—An experimental approach to address a specific question; it includes clinical trials, observational studies, and summary and quantitative analysis of numerous studies.

- **Case-control study**—A study that compares people with a specific disease or outcome of interest (cases) to people from the same population without that disease or outcome (controls), and which seeks to find associations between the outcome and prior exposure to particular risk factors. Case-control studies are usually retrospective, but not always.
- **Cohort study**—An observational study in which a defined group of people (the cohort) is followed over time. The outcomes of people in subsets of this cohort are compared to examine people who were exposed or not exposed (or exposed at different levels) to a particular intervention or other factor of interest. A **prospective** cohort study assembles participants and follows them into the future. A **retrospective** (or historical) cohort study identifies subjects from past records and follows them from the time of those records to the present.
- **Meta-analysis**—A quantitative method of combining the results of independent studies (usually drawn from the published literature) and synthesizing summaries and conclusions which may be used for several purposes, such as evaluating therapeutic effectiveness or planning new studies, with application chiefly in the areas of research and medicine.
- **Randomized controlled trial**—An experiment in which two or more interventions, possibly including a control intervention or no intervention, are compared by being randomly allocated to participants. In most trials one intervention is assigned to each individual but sometimes assignment is to defined groups of individuals (e.g. households) or interventions are assigned within individuals (e.g. in different orders). Also called a randomized clinical trial.
- **Systematic review**—A review of a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyze data from the studies that are included in the review. Statistical methods (**meta-analysis**) may or may not be used to analyze and summarize the results of the included studies.

**Sugar-sweetened beverages**—Liquids that are sweetened with various forms of sugars that add calories. These beverages include, but are not limited to, soda, fruit ades, and sports drinks. Also called calorically-sweetened beverages.

**Whole grains**—Grains and grain products made from the entire grain seed, usually called the kernel, which consists of the bran, germ, and endosperm. If the kernel has been cracked, crushed, or flaked, it must retain nearly the same relative proportions of bran, germ, and endosperm as the original grain in order to be called whole grain. Many, but not all, whole grains are also a source of dietary fiber.

## Appendix E-3: USDA Food Pattern Modeling Analyses

The 2010 Dietary Guidelines Advisory Committee (DGAC) identified specific questions that they felt could best be addressed through a food pattern modeling approach, using the USDA food patterns and the modeling process developed to address similar requests by the 2005 DGAC. Twelve modeling analyses were completed and provided as reports to four DGAC subcommittees. The food pattern modeling analyses conducted for the DGAC are listed below. Full reports for each analysis are available online at [www.dietaryguidelines.gov](http://www.dietaryguidelines.gov).

- E3.1 **Adequacy of the USDA Food Patterns.** How well do the USDA food patterns, using updated food intake and nutrient data, meet IOM and potential DG 2010 nutrient recommendations?
- E3.2 **Realigning Vegetable Subgroups.** What revisions to the vegetable subgroups may help to highlight vegetables of importance and allow recommendations for intake levels that are achievable, without compromising the nutrient adequacy of the patterns?
- E3.3 **Vegetarian Food Patterns.** How well do plant-based or vegetarian food patterns, adapted from the USDA food patterns, meet IOM and potential DG 2010 nutrient recommendations?
- E3.4 **Starchy Vegetables.** How do the nutrients provided by the starchy vegetable subgroup compare with those provided by grains and those provided by other vegetable subgroups? How would nutrient adequacy of the patterns be affected by considering starchy vegetables as a replacement for some grains rather than as a vegetable subgroup?
- E3.5 **“Typical Choices” Food Patterns.** What is the impact on caloric and nutrient intake if the USDA food patterns are followed but typical rather than nutrient-dense food choices are made?
- E3.6 **Milk Group and Alternatives.** What is the impact on nutrient adequacy (1) if no milk or milk products were consumed, (2) if calcium was obtained from nondairy sources or fortified foods, and (3) if more fluid milk and less cheese were consumed?
- E3.7 **Replacing all Non-Whole Grains with Whole Grains.** What is the impact on intake of folate and other nutrients if all recommended grain amounts are selected as whole grains rather than half whole and half nonwhole grains?
- E3.8 **Cholesterol.** What is the impact on food choices and overall nutrient adequacy of limiting cholesterol to less than 200 mg per day?
- E3.9 **Reducing Cholesterol-Raising Fatty Acids.** What is the impact on food choices and overall nutrient adequacy of limiting cholesterol-raising (CR) fatty acids to less than 7% of total calories and to less than 5% of total calories, with CR fatty acids operationalized as total saturated fatty acids minus stearic acid?
- E3.10 **Seafood.** What is the impact on nutrient adequacy of increasing seafood in the USDA food patterns to (1) 4 ounces per week of seafood high in n-3 fatty acids, (2) 8 ounces per week of seafood in proportions currently consumed, and (3) 12 ounces per week of seafood low in n-3 fatty acids?



- E3.11 **Sodium.** What would the sodium levels of the USDA food patterns be (1) using current patterns, (2) using “typical choices” patterns, and (3) using only low sodium and no-salt-added foods?
- E3.12 **Potassium.** What are the potassium levels in the USDA food patterns, in comparison to current consumptions and DASH diet levels, in absolute amounts, adjusted for energy intake, and as a ratio of sodium to potassium? How would potassium levels of the USDA food pattern change if current levels of coffee and tea intake were included?

## Appendix E-4: History of the Dietary Guidelines for Americans

In early 1977, after years of discussion, scientific review, and debate, the US Senate Select Committee on Nutrition and Human Needs, led by Senator George McGovern, recommended Dietary Goals for the American people (US Senate Select Committee, 1977). The Goals consisted of complementary nutrient-based and food-based recommendations. The first Goal focused on energy balance and recommended that, to avoid overweight, Americans should consume only as much energy as they expended. Overweight Americans should consume less energy and expend more energy. For the nutrient-based Goals, the Senate Committee recommended that Americans:

- Increase consumption of complex carbohydrates and “naturally occurring sugars;”and
- Reduce consumption of refined and processed sugars, total fat, saturated fat, cholesterol, and sodium.

For the food-based Goals, the Committee recommended that Americans:

- Increase consumption of fruits, vegetables, and whole grains;
- Decrease consumption of:
  - refined and processed sugars and foods high in such sugars;
  - foods high in total fat and animal fat, and partially replace saturated fats with polyunsaturated fats;
  - eggs, butterfat, and other high-cholesterol foods;
  - salt and foods high in salt; and
- Choose low-fat and non-fat dairy products instead of high-fat dairy products (except for young children).

The issuance of the Dietary Goals was met with considerable debate and controversy, as industry groups and the scientific community expressed doubt that the science available at the time supported the specificity of the numbers provided in the Dietary Goals. To support the credibility of the science used by the Committee, the US Department of Agriculture and US Department of Health and Human Services (then called the Department of Health, Education, and Welfare) selected scientists from the two Departments and obtained additional expertise from the scientific community throughout the country to address the public’s need for authoritative and consistent guidance on diet and health.

In February 1980, the two Departments collaboratively issued *Nutrition and Your Health: Dietary Guidelines for Americans*, a brochure that, in describing seven principles for a healthful diet, provided assistance for healthy people in making daily food choices (USDA/HHS, 1980). These Guidelines were based, in part, on the 1979 *Surgeon General's Report on Health Promotion and Disease Prevention* (DHEW/PHS, 1979) and reflected findings from a study on the relationship between dietary practices and health outcomes (ASCN, 1979). Ideas for incorporating a variety of foods to provide essential nutrients while maintaining recommended body weight were a focus. The brochure also provided guidance on limiting dietary components such as fat, saturated fat, cholesterol, and sodium, which were beginning to be considered risk factors in certain chronic diseases. Both the Dietary Goals and the first Dietary Guidelines for Americans were different from previous dietary guidance in that they reflected the emerging scientific evidence and changed the historical focus on nutrient adequacy to also identify the impacts of diet on chronic disease. These documents discussed the concepts of moderation as well as nutrient adequacy.

Even though the recommendations of the 1980 Dietary Guidelines for Americans were presented as innocuous and straightforward extrapolations from the science base, they, too, were met with a fair amount of controversy from a variety of industry and scientific groups.

The debate about the 1980 Dietary Guidelines for Americans led to Congressional report language that directed the two Departments to convene an advisory committee that would ensure that outside advice, both formal and informal, was captured in developing future editions of the Dietary Guidelines. A Dietary Guidelines Advisory Committee composed of scientific experts outside the Federal sector was established shortly after that directive and was very helpful in the development of the 1985 *Nutrition and Your Health: Dietary Guidelines for Americans* (USDA/HHS, 1985). The Departments made relatively few changes from the first edition, but this second edition was issued with much less debate from either industry or the scientific community. The 1985 Dietary Guidelines were widely accepted and were used as the framework for consumer nutrition education messages. They also were used as a guide for healthy diets by scientific, consumer, and industry groups.

In 1989, USDA and HHS established a second scientific advisory committee to review the 1985 Dietary Guidelines and make recommendations for revision. The basic tenets of earlier Dietary Guidelines were reaffirmed, and the 1990 *Nutrition and Your Health: Dietary Guidelines for Americans* (USDA/HHS, 1990) promoted enjoyable and healthful eating through variety and moderation, rather than dietary restriction. For the first time, the Guidelines also suggested numerical goals for fat and saturated fat, though they stressed that the goals were to be met through dietary choices made over several days, not through choices about one meal or one food.

The 1980, 1985, and 1990 editions of the Dietary Guidelines were issued voluntarily by the two Departments. With the passage of the 1990 National Nutrition Monitoring and Related Research Act (Section 301 of Public Law 101-445, 7 U.S.C. 5341, Title III) (US Congress, 1990), the 1995 edition of *Nutrition and Your Health: Dietary Guidelines for Americans* became the first Dietary Guidelines report mandated by statute. This Act directed the Secretaries of USDA and HHS to jointly issue at least every 5 years a report entitled *Dietary Guidelines for Americans*. A Dietary Guidelines Advisory Committee was established to assist in the preparations of the 1995, 2000, 2005, and now 2010 versions of the *Dietary Guidelines for Americans* (HHS/USDA, 1995a; HHS/USDA, 1995b; USDA/HHS, 2000a; USDA/HHS, 2000b; HHS/USDA, 2004; HHS/USDA, 2005a; HHS/USDA, 2005b).

Since 1980, the Dietary Guidelines have been notably consistent in their recommendations on the components of a healthful diet, but they also have changed in some significant ways to reflect emerging science. In keeping with renewed emphasis on data quality, the 2005 Committee used a systematic approach for reviewing the scientific literature in developing its recommendations. This systematic review of the evidence has been further expanded for the 2010 revision cycle. USDA has established the Nutrition Evidence Library, a comprehensive evidence-based review process, to support the 2010 Dietary Guidelines Advisory Committee (see **Part C. Methodology** for additional information about the Nutrition Evidence Library).

Over the past two decades, *Nutrition and Your Health: Dietary Guidelines for Americans* has evolved to become a broadly accepted, evidence-based document that serves as the basis for Federal nutrition policy from which nutrition education materials and activities are developed. The Dietary Guidelines have presented advice for healthy Americans, ages 2 years and older, about making food choices that promote health and help prevent disease. As new data emerge about the role of diet in utero and from birth on, it will be important also to consider those ages 2 years and younger. Nutrition and health professionals actively promote the Dietary Guidelines as a means of encouraging Americans to focus on eating a healthful diet and being physically active throughout the entire lifespan.

## Development of the Dietary Guidelines – A Chronology

- 1977** *Dietary Goals for the United States* (the McGovern report) was issued by the US Senate Select Committee on Nutrition and Human Needs (US Senate Select Committee, 1977). The *Dietary Goals* reflected a shift in focus, from obtaining adequate nutrients to avoiding excessive intake of food components linked to chronic disease. These goals were controversial among some nutritionists and others concerned with food, nutrition, and health.
- 1979** The American Society for Clinical Nutrition formed a panel to study the relationship between dietary practices and health outcomes (ASCN, 1979). The findings, presented in 1979, were reflected in *Healthy People: The Surgeon General's Report on Health Promotion and Disease Prevention* (DHEW/PHS, 1979).
- 1980** Seven principles for a healthful diet were jointly issued by the then US Department of Health, Education, and Welfare (now HHS) and the US Department of Agriculture (USDA) in response to the public's desire for authoritative, consistent guidelines on diet and health. These principles became the first edition of *Nutrition and Your Health: Dietary Guidelines for Americans* (USDA/HHS, 1980). The 1980 Guidelines were based on the most up-to-date information available at the time and were directed to healthy Americans ages two and older. The Guidelines generated some concern among consumer, commodity, and food industry groups, as well as some nutrition scientists, who questioned the causal relationship between certain guidelines and health.
- 1980** A US Senate Committee on Appropriations report directed that a committee be established to review scientific evidence and recommend revisions to the 1980 *Nutrition and Your Health: Dietary Guidelines for Americans* (US Senate, 1980).
- 1983** A Federal advisory committee of nine nutrition scientists was convened to review and make recommendations in a report to the Secretaries of USDA and HHS about the first edition of the Dietary Guidelines (USDA/HHS, 1985a).
- 1985** USDA and HHS jointly issued the second edition of *Nutrition and Your Health: Dietary Guidelines for Americans* (USDA/HHS, 1985b). This edition was nearly identical to the first, retaining the seven guidelines from the 1980 edition. Some changes were made for clarity, while others reflected advances in scientific knowledge of the associations between diet and chronic diseases. The second edition received wide acceptance and was used as the basis for dietary guidance for the general public as well as a framework for developing consumer education messages.
- 1987** Language in the *Conference Report of the House Committee on Appropriations* indicated that USDA, in conjunction with HHS, “shall reestablish a Dietary Guidelines Advisory Group on a periodic basis. This Advisory Group will review the scientific data relevant to nutritional guidance and make recommendations on appropriate changes to the Secretaries of the Departments of Agriculture and Health and Human Services” (US House of Representatives, 1987).

- 1989** USDA and HHS established a second Federal advisory committee of nine members, which considered whether revisions to the 1985 Dietary Guidelines were needed and made recommendations for revision in a report to the Secretaries (USDA/HHS, 1990a). The 1988 *Surgeon General's Report on Nutrition and Health* (HHS/PHS, 1988) and the 1989 National Research Council's report *Diet and Health: Implications for Reducing Chronic Disease Risk* were key resources used by the Committee (NAS/NRC, 1989).
- 1990** USDA and HHS jointly released the third edition of *Nutrition and Your Health: Dietary Guidelines for Americans* (USDA/HHS, 1990b). The basic tenets of the 1990 Dietary Guidelines were reaffirmed, with additional refinements made to reflect increased understanding of the science of nutrition and how best to communicate the science to consumers. The language of the new Dietary Guidelines was positive, was oriented toward the total diet, and provided specific information regarding food selection. For the first time, numerical recommendations were made for intakes of dietary fat and saturated fat.
- 1990** The 1990 National Nutrition Monitoring and Related Research Act (Section 301 of Public Law 101-445, 7 U.S.C. 5341, Title III) directed the Secretaries of the USDA and HHS to jointly issue at least every 5 years a report entitled *Dietary Guidelines for Americans* (US Congress, 1990). This legislation also required review by the Secretaries of USDA and HHS of all Federal publications containing dietary advice for the general public.
- 1993** The HHS Charter established the 1995 Dietary Guidelines Advisory Committee.
- 1994** An 11-member Dietary Guidelines Advisory Committee was appointed by the Secretaries of HHS and USDA to review the third edition of the Dietary Guidelines and determine whether changes were needed. If so, the Committee was to recommend suggestions and the rationale for any revisions.
- 1995** The report of the Dietary Guidelines Advisory Committee to the Secretaries of HHS and USDA was published (HHS/USDA, 1995a).
- 1995** Using the 1995 report of the Dietary Guidelines Advisory Committee as the foundation, HHS and USDA jointly released the fourth edition of *Nutrition and Your Health: Dietary Guidelines for Americans* (HHS/USDA, 1995b). This edition continued to support the concepts from earlier editions. New information included the Food Guide Pyramid, Nutrition Facts Label, boxes highlighting good food sources of key nutrients, and a chart illustrating three weight ranges in relation to height.
- 1997** The USDA Charter established the 2000 Dietary Guidelines Advisory Committee.
- 1998** An 11-member Dietary Guidelines Advisory Committee was appointed by the Secretaries of USDA and HHS to review the fourth edition of the Dietary Guidelines to determine whether changes were needed and, if so, to recommend suggestions for revision.
- 2000** The Committee submitted its report to the Secretaries of USDA and HHS (USDA/HHS, 2000a). This report contained the proposed text for the fifth edition of *Nutrition and Your Health: Dietary Guidelines for Americans*.

- 2000** The President of the United States spoke of the Dietary Guidelines in his radio address after USDA and HHS jointly issued the fifth edition of *Nutrition and Your Health: Dietary Guidelines for Americans* earlier in the day (USDA/HHS, 2000b). Earlier versions of the Guidelines included seven statements. This version included 10—created by breaking out physical activity from the weight guideline, splitting the grains and fruits/vegetables recommendations for greater emphasis, and adding a new guideline on safe food handling.
- 2003** The HHS Charter established the 2005 Dietary Guidelines Advisory Committee.
- 2003** A 13-member Dietary Guidelines Advisory Committee was appointed by the Secretaries of HHS and USDA to review the fifth edition of the Dietary Guidelines to determine whether changes were needed and, if so, to recommend suggestions for revision.
- 2003-2004** In keeping with renewed emphasis on data quality, the Committee used a systematic approach to reviewing the scientific literature to develop its recommendations. Committee members initially posed approximately 40 specific research questions that were put through an extensive evidence-based search and review of the scientific literature. Issues relating diet and physical activity to health promotion and chronic disease prevention also were examined. Other major sources of evidence used were the Dietary Reference Intake (DRI) reports prepared by expert committees convened by the Institute of Medicine (IOM) as well as various Agency for Healthcare Research and Quality (AHRQ) and World Health Organization (WHO) reports. USDA completed numerous food intake pattern modeling analyses and the Committee analyzed various national data sets and sought advice from invited experts.
- 2004** The Committee submitted its technical report to the Secretaries of HHS and USDA (HHS/USDA, 2004). This 364-page report resulted in a detailed analysis of the science and was accompanied by many pages of evidence-based tables that were made available electronically. After dropping some questions because of incomplete or inconclusive data, the Committee wrote conclusive statements and comprehensive rationales for 34 of the 40 original questions.
- 2005** Using the Committee’s technical report as a basis, HHS and USDA jointly prepared and issued the sixth edition of *Dietary Guidelines for Americans* in January 2005 (HHS/USDA, 2005a). This 80-page policy document was prepared from the DGAC Report. It was the first time the Departments prepared a policy document that was intended primarily for use by policy makers, healthcare providers, nutritionists, and nutrition educators. The content of this document included nine major Dietary Guidelines messages that resulted in 41 Key Recommendations, of which 23 were for the general public and 18 for special population groups. The report highlighted the USDA Food Guide and the DASH Eating Plan as two examples of eating patterns that exemplify the Dietary Guidelines. This publication continues to serve as the basis for Federal nutrition policy until the next policy document is released in 2010. A companion, 10-page brochure called *Finding Your Way to a Healthier You* (HHS/USDA, 2005b) was released concurrently with the Dietary Guidelines to provide advice to consumers about food choices that promote health and decrease the risk of chronic disease. Shortly thereafter, USDA released the MyPyramid Food Guidance System, an update of the Food Guide Pyramid, which included more detailed advice for consumers to follow the Dietary Guidelines.

- 2008** The USDA Charter established the 2010 Dietary Guidelines Advisory Committee.
- 2008** A 13-member Dietary Guidelines Advisory Committee was appointed by the Secretaries of USDA and HHS to review the sixth edition of *Dietary Guidelines for Americans* to determine whether changes were needed and, if so, to recommend suggestions for revision.
- 2009** USDA established a Nutrition Evidence Library (NEL) for use in reviewing the scientific literature for answering approximately 130 of the 180 scientific questions posed by the Dietary Guidelines Advisory Committee. This was the most rigorous and comprehensive approach ever used for reviewing the science in order to develop nutrition-related recommendations for the public. When a full systematic review of the evidence was not needed, other methods for answering scientific questions were used. These included brief updates to substantial sources of evidences already completed in the past such as the 2005 DGAC Report and IOM Reports. Food pattern modeling using USDA's MyPyramid Food Guidance System and the review of various data analyses were also used in formulating answers for some of the questions posed. An elaborate public comments database was developed and successfully served to accept comments and attachments from the public in one central location. This database served to encourage public participation and supported a collection of more than 800 public comments related to the DGAC process.
- 2010** The Committee submitted its report to the Secretaries of USDA and HHS. This report will serve as the basis for preparing the seventh edition of *Dietary Guidelines for Americans*. USDA and HHS will jointly issue the seventh edition of the *Dietary Guidelines for Americans*. This publication will continue to serve as the basis of Federal nutrition policy. Additional consumer communication materials will be developed to provide advice to consumers about food choices that promote health and decrease the risk of chronic disease.



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## Appendix E-5: Public Comments

As a government advisory panel, the Dietary Guidelines Advisory Committee (DGAC) is required by the Federal Advisory Committee Act (FACA) to conduct an open process in which the public may participate. The public does this through submitting written and oral comments to the Committee.

The first public comment was submitted to the public comments database on October 17, 2008. Thereafter, the Committee received written comments from the public continuously and at a steady pace throughout their deliberations. Comment submissions increased noticeably in response to each call for public comments. These calls were released through six Federal Register notices announcing upcoming public DGAC meetings.

Comment submissions were collected through a newly developed electronic database designed for this purpose and located at [www.dietaryguidelines.gov](http://www.dietaryguidelines.gov). The motivation for developing this database was to help reduce the burden on the public for submitting comments, especially cumbersome paper submissions; to provide a central place for storing all comments; to allow continual public access to all comments; and to allow the DGAC to have full access to comments and accompanying reports, research, and other support material. This database is the most efficient, open, and transparent public comment collection system to date.

Each comment submitted to the database was categorized within one or more of 14 key topic areas. This allowed anyone interested in a particular topic to efficiently navigate to the selected topic area and view comments assigned to that section without having to spend time combing through all the comments. A query function on this “filing” system also allowed staff to generate topic-specific reports of public comments for various time periods. This report feature proved valuable for the DGAC members, who could easily access and review comments about a certain key topic area that pertained to their subcommittee’s work.

The 14 topic areas were: alcoholic beverages, carbohydrates, eating patterns, energy balance/physical activity, evidence-based review process, fats, fluids and electrolytes, food groups, food safety, minerals, nutrient density/discretionary calories, protein, vitamins, and “other.” Most of these key topic areas were further categorized into subtopics. For example, under carbohydrates, additional category selections included added sugars, fiber, whole grains, glycemic index, and low carbohydrates. This function allowed staff to generate reports on specific issues within topic areas.

Although comments could be submitted continually, each Federal Register notice announcing an upcoming DGAC public meeting included a final date for comment submissions. This ensured timely transmission of comments to the DGAC before the meeting. In general, the ending submission date was set at close of business 6 calendar days before each DGAC meeting date. This

allowed all comments to be posted and comment reports to be generated and sent to Committee members with sufficient time for comments to be reviewed before the meeting. Comments that were submitted later than the time specified in the Federal Register notice were considered by the Committee for the following public meeting date. Public comment reports by key topic area were made available to Committee members before each DGAC meeting and more frequently during the large time spans between the third and fourth DGAC meeting and the fourth and fifth DGAC meeting. Comment submission for the sixth meeting ended 13 days before the May 12, 2010 meeting because the Committee needed additional time to consider the comments before completing their chapters for their DGAC Report.

When organizations or individuals submitted comments to the electronic database, they were required to complete three fields—organization type, key topic, and summary comment. Comments could not exceed 2,000 characters. Other fields were optional. Submitters also were able to upload an attachment for comments that exceeded 2,000 characters or for other support material the submitter desired to share with the Committee. Disclaimers were posted in multiple places alerting the submitter to heed copyright laws.

A small team of staff reviewed each comment submission. Comments that were offensive in nature were not posted. Comments that were inappropriately categorized in a key topic area(s) were correctly categorized. Duplicate submissions that were obvious errors in the submission process also were not posted. Of the nearly 1,000 comments received over the 1½ year DGAC period, 774 comments were posted. Of these comments, large numbers addressed food groups and eating patterns, specifically plant-based diets and a focus on the total diet approach. Many comments suggested that the Dietary Guidelines emphasize physical activity and energy balance, and that they should focus on calorie density, weight, and the impact of obesity on health. Examples of other comments included those on sugar, sodium, potassium, fats, individual vitamins and minerals, and offered suggestions for best food safety practices, ways to communicate the guidelines, and how messages could affect policy. All public comments will continue to be available on the Dietary Guidelines website at [www.dietaryguidelines.gov](http://www.dietaryguidelines.gov).

In addition to written comments, oral comments were solicited; 51 of the 58 organizations or individuals who registered to present oral testimony, delivered 3-minute presentations on the first day of the second DGAC meeting, which was held January 29-30, 2009. These comments are summarized in the January Public Meeting Minutes found at [www.dietaryguidelines.gov](http://www.dietaryguidelines.gov).

All of the oral and written comments provided by the public were valuable in that they helped the Committee gather background information and understand consumer perceptions. They also highlighted and ensured consideration of topics deemed to be important by the submitters of comments from a variety of backgrounds and focus areas.

## Appendix E-6: Biographical Sketches of the 2010 Dietary Guidelines Advisory Committee Members

### **Linda V. Van Horn, PhD, RD, LD, Chair**

Dr. Van Horn is a Professor in the Department of Preventive Medicine, and the Associate Dean for Faculty Development at the Feinberg School of Medicine at Northwestern University, Chicago. Dr. Van Horn received her doctorate from the School of Public Health at the University of Illinois, Chicago and her master's in exercise physiology from the University of Pittsburgh. Her undergraduate degree is in dietetics, from Purdue University, West Lafayette. She also is a registered and licensed dietitian.

Dr. Van Horn's expertise extends across many areas of nutrition research, medical nutrition education and public health policy relevant to the work of the Dietary Guidelines Advisory Committee. She is a clinical nutrition epidemiologist who has conducted population level research and clinical trials in the prevention and treatment of cardiovascular disease, obesity, and breast cancer. She specializes in research on women and children and is currently the principal investigator in the Women's Health Initiative Extension Study and the Dietary Intervention Study in Children follow-up study. Her research focuses on the benefits of a fat-modified diet that is high in fruits, vegetables, and fiber-rich whole grains as part of a low risk lifestyle to prevent cardiovascular disease, obesity and cancer. In addition to her comprehensive nutrition expertise, she has demonstrated successful leadership through multiple research teams.

### **Naomi K. Fukagawa, MD, PhD, Vice Chair**

Dr. Fukagawa is a Professor of Medicine, the Acting Director of Gerontology, and the Associate Program Director for the Clinical Research Center at the University of Vermont and Fletcher Allen Health Care. She received her medical degree from Northwestern University and her doctorate in nutritional biochemistry and metabolism from the Massachusetts Institute of Technology. She is a board-certified pediatrician, but has focused her research on age-related issues.

Dr. Fukagawa is an expert in nutritional biochemistry and metabolism. Her expertise spans several areas including protein and energy metabolism; oxidants and antioxidants; and the role of diet in aging and chronic diseases, such as diabetes mellitus. She has chaired the National Institutes of Health Clinical Research Centers' Committee and is currently a member of the National Institutes of Health Integrative Physiology of Diabetes and Obesity Study Section.

### **Cheryl Achterberg, PhD**

Dr. Achterberg is the Dean and Professor of the College of Education and Human Ecology at The Ohio State University. She received her doctorate in nutrition from Cornell University and her master's in human development from the University of Maine at Orono.

Dr. Achterberg is an expert in health behavior research. Her studies have evaluated consumer understanding of the dietary guidelines as well as the impact of behavior on the dietary patterns of varying groups, including low-income, young children and elderly Americans. She has served as a Panel member for World Health Organization for setting international guidelines for Developing Food Based Dietary Guidance. She has been a resource to Institute of Medicine as an invited

panelist for numerous workshops. She has also worked with the United Nations as an expert in nutrition education and community interventions.

**Lawrence J. Appel, MD, MPH**

Dr. Lawrence Appel is a Professor of Medicine, Epidemiology, and International Health (Human Nutrition), Division of General Internal Medicine, and Director of the ProHealth Clinical Research Unit at the Johns Hopkins Medical Institutions. Dr. Appel received his medical degree from the New York University School of Medicine and his master's of public health from Johns Hopkins University. He is also a practicing internist and a certified specialist in hypertension.

The focus of Dr. Appel's career has been to conduct research pertaining to the prevention of hypertension, cardiovascular disease, and kidney disease, typically through lifestyle modification. His research evaluates the health effects of dietary patterns, macronutrient intake, weight loss, and dietary electrolytes, such as sodium and potassium. He has a strong interest in research methods, particularly the evaluation of scientific evidence. Dr. Appel served on the 2005 Dietary Guidelines Advisory Committee where he was a member of the science review subcommittee and was the Chair of the electrolytes subcommittee. In addition, he has served on several committees for the Institute of Medicine, including the Dietary Reference Intake Panel for electrolytes and water, which he chaired.

**Roger A. Clemens, DrPH**

Dr. Clemens is the Associate Director of Regulatory Science and an Adjunct Professor of Pharmacology and Pharmaceutical Science at the University of Southern California. In addition, he is the Vice President of Science & Technology for PolyScience Consulting LLC (consultants) and consulting Scientific Advisor for E.T. Horn (sales organization of raw materials and ingredients). He received his doctorate of public health in nutrition and biological chemistry and his master's of public health in nutrition at the University of California, Los Angeles.

Dr. Clemens has extensive experience at the interface of nutrition, food science and technology, and health. He has expertise in food toxicology and food safety, as well as practical knowledge of food production and food regulations. He is a spokesperson for the American Society for Nutrition and the Institute of Food Technologists.

**Miriam E. Nelson, PhD**

Dr. Nelson is the founder and Director of the John Hancock Research Center on Physical Activity, Nutrition, and Obesity Prevention and an Associate Professor at the Friedman School of Nutrition Science and Policy at Tufts University. She is an Adjunct Professor in the Tisch College of Citizenship and Public Service. Dr. Nelson received her doctorate and master's degrees in nutrition from Tufts University.

Dr. Nelson recently served as Vice Chair of the first Physical Activity Guidelines for Americans Advisory Committee (PAGAC) chartered by HHS. She is a leading authority on physical activity and energy balance. Her work with the PAGAC provides continuity by bridging the work of the PAGAC and the Dietary Guidelines Advisory Committee.

**Sharon (Shelly) M. Nickols-Richardson, PhD, RD**

Dr. Nickols-Richardson is an Associate Professor and Coordinator of the Graduate Program in Nutrition in the Department of Nutritional Sciences at The Pennsylvania State University. She received her doctorate and her master's in foods and nutrition at The University of Georgia. She is also a registered dietitian.

Dr. Nickols-Richardson's expertise focuses on dietary and physical activity determinants of bone density. She also has expertise in dietary intervention for obesity and nutrition over the lifecycle from child nutrition to older adults. She served the Institute of Medicine as a consultant on the Dietary Reference Intake book *The Essential Guide to Nutrient Requirements*.

**Thomas A. Pearson, MD, PhD, MPH**

Dr. Pearson is the Senior Associate Dean for Clinical Research and the Albert D. Kaiser Professor in the Department of Community and Preventive Medicine and Director of the Rochester Clinical and Translational Science Institute at the University of Rochester School of Medicine and Dentistry. He received his medical degree, his doctoral degree in epidemiology, and his master's in public health from Johns Hopkins University.

Dr. Pearson is an epidemiologist specializing in lipid metabolism and the prevention of cardiovascular disease. He contributed significantly to the American Heart Association's guidelines for prevention of heart disease and stroke. His public health interests include investigating the impact of these guidelines on Americans. His expertise spans both nationally and internationally, as is evident in his contributions as current Chair of the National Forum for Heart Disease and Stroke Prevention.

**Rafael Pérez-Escamilla, PhD**

Dr. Perez-Escamilla is a Professor of Epidemiology and Public Health and the Director of the Office of Community Health at the Yale University School of Public Health. He is also the Director and Principal Investigator of the Connecticut NIH EXPORT Center of Excellence for Eliminating Health Disparities among Latinos (CEHDL). Dr. Perez-Escamilla received his doctorate in nutrition and his master's in food science from the University of California at Davis.

Dr. Perez-Escamilla is a nationally and internationally recognized scholar in the area of community nutrition for his work in food safety, obesity, diabetes, and food security. He has specialized experience with Latinos and low-income Americans, as well as numerous international populations. Dr. Pérez-Escamilla was a member of the 2009 Institute of Medicine/National Academy of Sciences Pregnancy Weight Gain Guidelines Committee and has served on editorial boards of the *Journal of Nutrition*, the *Journal of Human Lactation*, and the *Journal of Hunger and Environmental Nutrition*. Dr. Pérez-Escamilla is a trustee of the Pan American Health and Education Foundation based in Washington DC, has been a senior advisor to a number of community nutrition programs as well as household food security measurement projects, and has been a major advisor to master's and doctoral students from all over the world.

**F. Xavier Pi-Sunyer, MD, MPH**

Dr. Pi-Sunyer is Professor of Medicine at Columbia University College of Physicians and Surgeons and Chief of the Division of Endocrinology, Diabetes, and Nutrition at St. Luke's-Roosevelt Hospital. He received his medical degree from Columbia University and his master's of public health from Harvard University.

Dr. Pi-Sunyer has expertise in obesity, type 2 diabetes, carbohydrate and lipid metabolism, and general medicine with over 350 research papers on these topics. He chaired a National Heart Lung and Blood Institute obesity treatment and prevention guidelines committee and is now on the NHLBI's task force on Combined Heart Disease Prevention Guidelines. He has served on the Institute of Medicine Dietary Reference Intake Panel on macronutrients. He has also served on the Food and Drug Administration's Science Board Advisory Committee to the Commissioner. He was also a member of the 2005 Dietary Guidelines Advisory Committee.

**Eric B. Rimm, ScD**

Dr. Rimm is an Associate Professor of Medicine at Harvard Medical School and an Associate Professor of Epidemiology and Nutrition at the Harvard School of Public Health. In addition, he is the Director of the Program in Cardiovascular Epidemiology. Dr. Rimm received his doctorate in epidemiology at the Harvard School of Public Health.

Dr. Rimm is a nutritional epidemiologist who studies the impact of lifestyle factors, particularly diet, that relate to the risk for obesity, diabetes, heart disease, and stroke. He has published extensively on the health effects of moderate alcohol consumption, whole grains, fatty acids, dietary fiber, antioxidants, Vitamin D, and the B vitamins. He has published more than 400 peer-reviewed manuscripts and previously served on the Institute of Medicine Dietary Reference Intake Panel for macronutrients. He serves as an Associate Editor for the *American Journal of Clinical Nutrition* and the *American Journal of Epidemiology*.

**Joanne L. Slavin, PhD, RD**

Dr. Slavin is a Professor in the Department of Food Science and Nutrition at the University of Minnesota. She received her doctorate and master's in nutrition science at the University of Wisconsin.

Dr. Slavin is an expert in carbohydrates and dietary fiber, and has published more than 150 articles in her field. Her research focuses on the impact of whole grain consumption in chronic diseases, such as cancer, cardiovascular disease, and diabetes, as well as the role of dietary fiber in satiety. Because of her expertise in the area of whole grains, she was an invited presenter to the 2005 Dietary Guidelines Advisory Committee.

**Christine L. Williams, MD, MPH**

Dr. Williams is Vice President and Medical Director of Healthy Directions, Inc., a non-profit organization dedicated to the health and nutrition of children and families. She was formerly a Professor of Clinical Pediatrics, and Director of the Children's Cardiovascular Health Center in the Department of Pediatrics and Institute of Human Nutrition at Columbia University, College of Physicians and Surgeons. Dr. Williams earned her medical degree from the University of Pittsburgh,



and a master's of public health from Harvard University. She is a board certified pediatrician and is also board certified in preventive medicine and public health.

Dr. Williams' expertise includes nutrition in cancer prevention and preventive cardiology, especially hypercholesterolemia in children. She has knowledge of dietary requirements of children, particularly dietary fiber and fat. She also has expertise in obesity and public health. In addition, she has received the prestigious Preventive Cardiology Academic Award from the National Heart Lung and Blood Institute for her work in preventive cardiology for children.

## Appendix E-7: Dietary Guidelines Advisory Committee Report Acknowledgments

### Outside Expert Speakers to the DGAC

Pat Crawford, DrPH, RD

Adam Drewnowski, PhD

Michael Hamm, PhD

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