CHAPTER 1: FOOD AND NUTRIENT INTAKES AND HEALTH: CURRENT STATUS AND TRENDS

1. Expand WWEIA participation to include more respondents from race/ethnic minorities and non-U.S. born residents.

   **Rationale:** Very little is known about the dietary habits of many of the cultural subgroups in the United States. This knowledge is essential to moving forward any nutrition programs for first and second generation immigrants. More data on the impact of acculturation also are needed on food and health behaviors. The number of participants in WWEIA using the derived acculturation variable was too small for any analysis. Finally, “Hispanic” is a very broad term and a better understanding is needed of the nutritional profiles (including shortfalls and excesses) across various Spanish-speaking people in the United States, who come from different cultural backgrounds with distinct eating patterns.

2. Include higher proportion of older Americans as respondents in WWEIA.

   **Rationale:** More data are needed on dietary intake of older adults; the sample sizes in WWEIA were too small for any meaningful analyses for those older than the age of 71 years. In addition to nutrient intake, additional information is needed on whether older adults are able to shop and cook, whether polypharmacy plays a role in nutritional adequacy, and whether co-morbidities, such as poor dentition, musculo-skeletal difficulties, arthralgias and other age-related symptoms, affect their ability to establish and maintain proper nutritional status.

3. Increase the number of pregnant women as respondents in WWEIA.

   **Rationale:** The number of pregnant women in WWEIA is currently too small to properly evaluate the status and trends in food and nutrient intake in pregnant women. Since good nutrition in pregnancy is critical to proper growth development of the infant it is critical to properly evaluate food and nutrient intake, which will inform recommendations and public policies for pregnant women.

4. Conduct research on nutrition transitions from childhood to shed light on how and why dietary intake changes so rapidly from early childhood through pre-adolescence and adolescence, and to identify the driving forces behind dietary intake change in these age groups and what programs are most effective at maintaining positive nutrition habits established in very young children.

   **Rationale:** Young children have better dietary intake than older children and adolescents. It is important to maintain the positive gains made in early childhood and identify factors...
responsible for the declines in intakes of fruit, dairy, and other food groups and increases in added sugars and refined grains as children become enter the elementary school age years, as poor eating patterns in elementary school seem to persist into adolescence and beyond.

5. Evaluate the effects of common variations in dietary patterns in small children on nutrient intakes.

**Rationale:** Children from 2 to 4 years of age have a highly variable diet and often do not fit readily into the USDA Food Pattern food groups diet pattern analyses. Further information is needed to understand the broad range of diets and supplement use in small children and how this relates to nutrient intake and growth. Research is needed to better characterize their diets so that appropriate guidance can be offered.

6. Increase the quantity and quality of food composition databases available for research.

**Rationale:** Accurate assessment of nutrient intake and trends over time in the U.S. population is dependent upon the quality of food composition data. Tens of thousands of foods are available for purchase and consumption in the United States, but accurate nutrient content data are available only for less than 10,000 foods and are almost non-existent for many ready-to-eat and restaurant-type foods. Analytic values from foods are needed on specific nutrients and components, such as vitamin D, fiber, added sugars, and sodium. Improved food composition data also is critical for needed research to better define, identify, and quantify total grain, whole grain consumption, and refined grain consumption in dietary studies.

7. Investigate the validity, reliability, and reproducibility of new biomarkers of nutrient intake and biomarkers of nutritional status.

**Rationale:** Limited biomarkers are available and some that are available are difficult to interpret due to other contributing factors to the biomarker measure (e.g., vitamin D is obtained in the diet and is also endogenously synthesized).

8. Evaluate effects of fortification strategies and supplement use on consumer behavior related to the intake of foods and supplements containing key nutrients, including calcium, vitamin D, potassium, iron, and fiber

**Rationale:** The intake of key nutrients of concern is considerably affected by the rapidly evolving marketplace of food fortification and supplementation. Understanding consumer behavior related to fortification and supplementation would be important in predicting the effects of interventions and marketplace changes in content of these nutrients. Special interest exists regarding fortification strategies of foods, including whole grains and yogurts, in allowing individuals to reach the RDA for vitamin D without using supplements. Data are needed on how supplements may help meet nutrients shortfalls and/or how use of
Appendix E-1: Needs for Future Research

supplements may place individuals at risk of overconsumption. Research on effective
c consumer guidance is needed.

9. Understand the rationale for and consequences of the use of supplements above the UL for
vitamins and minerals. Identify biochemical markers that would indicate the effects of high-
dose supplement use.

**Rationale:** Consumer use of high-dose supplements has increased. Understanding the
influences guiding this use would be helpful in considering how to educate consumers about
safe upper intake limits.

10. Develop a standardized research definition for meals and snacks.

**Rationale:** Multiple different criteria are used in studies to define a snack or meal occasion,
such as time of day, the types or amounts of food consumed, or subjective assessment by the
study respondent. Researchers should work toward a consensus on the use of standard
definitions.

11. Understand better the concept of dietary patterns and design approaches to quantify the diet
in large population-based studies.

**Rationale:** More methodological work on dietary patterns is needed. For example, food
frequency questionnaires, which are used in most diet assessment studies, do not capture data
on meal timing, meal frequency, or the types of foods consumed together. Studies using diet
recalls and records are better at capturing specific foods and their quantities consumed
(portion sizes) and the types of foods eaten together, but often these detailed assessment
methods are not feasible for large population-based studies. Quantification of food group
intake is needed. In addition, dietary patterns research encompasses a broader scope of issues
than can be addressed by diet scores and data drive approaches.

12. Consistently report the nutrients, foods, and food groups that are used to evaluate dietary
patterns in published studies.

**Rationale:** The current scientific literature evaluating dietary patterns and health is
inconsistent in its provision of dietary patterns composition information. This makes it
difficult to compare, across studies, the components of healthful patterns that are associated
with health benefits.

13. Conduct population surveillance on the prevalence and trends of nutrition-related chronic
diseases including type 2 diabetes, cardiovascular disease, some cancers osteoporosis and
neurocognitive disorders.

**Rationale:** Current data on diabetes in adults cannot be stratified by disease type (type I or
type II), making it very difficult to monitor incidence and prevalence of type 2 diabetes.
Continued population surveillance is needed to effectively link nutritional factors with risk of these diseases.

CHAPTER 2: DIETARY PATTERNS, FOODS AND NUTRIENTS, AND HEALTH OUTCOMES

1. Conduct additional dietary patterns research for other health outcomes to strengthen the evidence beyond CVD and body weight in populations of various ethnic backgrounds and life course stages in order for future DGACs to draw stronger conclusions.

**Rationale:** The NEL systematic reviews demonstrated that considerable CVD research related to dietary patterns is available. However, it also is important to note, that unlike CVD, some of the other health outcomes are more heterogeneous and thus may require greater specificity in the examination of diet and disease risk. There is a clear need for all studies examining the relationship between dietary patterns and health outcomes to include the full age spectrum and to take a life course perspective (including pregnancy); insufficient research is being devoted to children and how diseases may evolve over time. An increased emphasis should be placed on understanding how the diets of all those in the U.S. population from various ethnic backgrounds may be associated with health outcomes, thereby broadening knowledge beyond Hispanics and African Americans to include the diversity that exists in the United States today. This may require our national nutrition monitoring programs to over-sample individuals from other national origins to conduct subgroup analysis.

2. Improve the understanding of how to more precisely characterize dietary patterns by their food constituents and the implications of the food constituents on nutrient adequacy through the use of Food Pattern Modeling. More precise characterization, particularly of protein foods, is needed.

**Rationale:** Researchers are characterizing dietary patterns very differently and yet sometimes use similar nomenclatures. This makes it difficult to compare results across studies and as demonstrated in the NEL systematic reviews, can impair the grading of the body of evidence as strong. The reason why researchers are not replicating others findings in different populations may be a function of publication bias. It is important for editors of scientific journals and peer reviewers to appreciate the replication of findings first and then value a research group’s methodological nuance that may improve the examination of the association between dietary patterns and a health outcomes. Perhaps what should be stressed is a harmonization of research methods across various cohorts or randomized trials, similar to what is being done at the National Cancer Institute’s Dietary Patterns Methods Project led by Drs. Krebs-Smith and Reedy. The use of Food Pattern Modeling as demonstrated in Chapter 1 allows questions about the adequacy of the dietary patterns given specific food...
constituents to be addressed and how modifications of the patterns by altering the foods for specific population groups or to meet specific nutrient targets can be achieved.

3. Examine the long-term cardio-metabolic effects of the various dietary patterns identified in the AHA/ACC/TOS Guidelines for the Management of Overweight and Obesity in Adults that are capable of resulting in short-term weight loss (see Question 2, above).

**Rationale:** Although the research to date demonstrates that to lose weight, a variety of dietary pattern approaches can be used if a reduction in caloric intake is achieved, the long-term effects of these diets on cardio-metabolic health are not well known. Emerging research is exploring health effects of variations of the low-carbohydrate, higher protein/fat dietary pattern. In some approaches (such as Atkins), the dietary pattern which emphasizes animal products, may achieve a macronutrient composition that is higher in saturated fat. Others may emphasize plant-based proteins and fats and may achieve a lower saturated fat content and may be higher in polyunsaturated fats and dietary fiber. Research is needed to determine the impact of these alternative approaches, and perhaps others, on CVD risk profiles as well as other health outcomes. As mentioned in the review of the literature associated with saturated fat and cardiovascular disease in Chapter 6: Cross-Cutting Topics of Dietary Guidance and Public Health Importance, substituting one macronutrient for another may result in unintended consequences. Careful consideration to the types of foods that are used in these diets and in particular the type of fat and amount of added sugars should be taken into account.

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**Eating Out**

1. Develop a standard methodology to collect and characterize various types of eating venues.

**Rationale:** This recommendation is fundamental to conducting rigorous research, evaluating findings from multiple studies, and developing policies to promote healthy eating among people who frequent eating out venues and/or consume take away meals.

2. Conduct rigorously designed research to examine the longitudinal impact of obtaining or consuming meals away from home from various types of commonly frequented venues on changes in food and beverage intakes (frequency, quantity, and composition), body weight, adiposity, and health profiles from childhood to adulthood in diverse (racial/ethnic, socioeconomic, cultural, and geographic) groups of males and females.

**Rationale:** Most groups in the U.S. population regularly consume meals that are prepared away from home and the landscape of fast food and other types of food procurement and
consumption venues is increasingly complex. The potential for eating out and/or take away meals to influence diet quality, energy balance, body mass and composition, and the risks of health-related morbidities across the life course among our diverse population underscores the importance of understanding this issue.

**Family Shared Meals**

3. Conduct studies in diverse populations that assess not only frequency of family shared meals, but also quality of family shared meals.

**Rationale:** Our understanding of the importance of family shared meals in terms of how they contribute in a positive way to body weight and overall health and well-being requires a rigorous examination of the dietary quality of these meals compared to other meals consumed by family members.

4. Conduct RCTs to isolate the effect of interventions that increase the frequency of family meals from other health and parenting behaviors that may be associated with dietary intake and weight status.

**Rationale:** Family shared meals are commonly implemented as one component of lifestyle interventions that include an array of other behavioral and parenting strategies for weight management. To improve our understanding of the causal pathway of how family shared meals contributes to maintaining or achieving a health weight, the specific contribution of family shared meals to weight outcomes independent of other behavioral strategies needs to be ascertained.

**Sedentary Behavior**

5. Develop improved and better standardized and validated tools to assess sedentary behaviors and activities that children, adolescents, and adults regularly engage in.

**Rationale:** Our understanding of the impact of sedentary behaviors on diet, energy balance, body mass, adiposity, and health is currently compromised by reliance on subjective assessments, including self-reports of daily activity patterns, and by inadequate techniques to document and quantify the array of sedentary activities people engage in (beyond TV viewing and (or) computer screen time). It also would be beneficial for researchers to document the potential benefits and implications of reducing one type of sedentary behavior (e.g. screen time) on other sedentary behaviors (e.g., reading for leisure, arts and crafts, listening to music) and indices of health (e.g. sleep quality and duration).

6. Conduct prospective research to examine the effects and mechanisms of the quantity, patterns, and changes of sedentary behaviors on diet quality, energy balance, body weight,
Appendix E-1: Needs for Future Research

adiposity, and health across the life span in groups within the U.S. population with diverse personal, cultural, economic, and geographic characteristics.

**Rationale:** Emerging, but limited, evidence implicates sedentary behaviors with adverse health-related outcomes, especially in children and adolescents as they transition into adulthood. However, an improved understanding of why these relationships exist will help in developing appropriate and effective approaches and policies to reduce the amount of time people spend engaging in sedentary behaviors.

**Self-Monitoring**

7. Evaluate the impact of different types, modalities, and frequencies of self-monitoring on body weight outcomes during both the weight loss intervention and maintenance periods.

**Rationale:** Self-monitoring is associated with improved weight management. However, the current practice of recommending daily self-monitoring may represent a barrier to its implementation and/or continued use. Hence, it is important to determine whether lower frequencies of self-monitoring can produce beneficial effects on weight outcomes.

8. Evaluate the comparative effectiveness of performance feedback from self-monitoring delivered through automated systems versus personal interactions with a counselor.

**Rationale:** Automated feedback derived from self-monitoring data and delivered electronically can produce beneficial changes on weight outcomes. However, the comparative effectiveness and cost efficiency of feedback delivered through non-personal modalities versus personal interactions has yet to be determined.

9. Test the effectiveness of self-monitoring on weight outcomes in understudied groups, including ethnic/racial minorities, low education, low literacy, and low numeracy populations, males, and subjects younger than age 30 years and older than age 60 years.

**Rationale:** Evidence regarding the effectiveness of self-monitoring has been derived largely from research conducted on well educated, middle-class, white women. Hence, it is important to determine whether the beneficial effects of self-monitoring on weight outcomes are generalizable to understudied groups.

10. Conduct RCTs based on sound behavioral change theories that incorporate self-monitoring, employ heterogeneous populations, and are powered for small effect sizes and high attrition rates, to test the short- (e.g., 3 months) and long-term (e.g., 12 months) effects of mobile health technologies on dietary and weight outcomes.

**Rationale:** Mobile health technologies have the potential to reach larger portions of the populations than face-to-face interventions, but the effect sizes of mobile technologies may be small and the attrition rates may be large. Larger, more representative study populations and
longer study periods will permit an assessment of the generalizability and sustainability of mobile health technologies.

### Food and Menu Labeling

11. Develop novel labeling approaches to provide informative strategies to convey caloric intake values on food items consumed at home and in restaurant settings.

**Rationale:** Menu labels can include different types of information in addition to calories. These include physical activity equivalents, and daily caloric needs. Very few studies have been designed to examine the optimal combination of menu label information to prevent excessive caloric intake. This will be very valuable evidence to inform the calorie label policy that has just been enacted by the FDA.

12. Compare labeling strategies across various settings, such as restaurants, stores, and the home to determine their efficacy in altering food selection and health outcomes, including weight.

**Rationale:** The great majority of menu labeling RCT's have been conducted under laboratory conditions. Given the recent FDA regulations, future studies will be able to impact the effectiveness of these polices across settings as accessed by diverse free living populations.

13. Evaluate the process and impact of recent FDA menu labeling regulation.

**Rationale:** The new FDA regulation provides a unique opportunity to understand the impact of menu labeling on consumers dietary behaviors in "real world" settings.

### Household Food Insecurity

14. Conduct prospective cohort studies that cover a wide age range and include children, families, older adults, and ethnically/racially diverse populations and describe potential effect modifiers such as gender, ethnic and cultural factors, family structure, area of residence (i.e., urban vs. rural), employment, and use of social support systems while examining the relationship between household food insecurity, dietary intake, and body weight.

**Rationale:** Understanding the temporal process of when and how long food insecurity occurs within a family/individual’s lifetime and their response to this economic stressor is critical to conducting rigorous research and comparing finding across studies in order to develop and implement intervention studies and policies to alleviate this public health problem.

15. Standardize research methodology, including developing a consistent approach to measuring food insecurity and use of measured height and weight to reduce the likelihood of responder bias.

**Rationale:** The measurement error issues related to the use of self-reported weight have been
well documented in the literature. In order to conduct rigorous studies in this area that can be compared and evaluated as to the causal nature of the role of food insecurity on body weight, standard methodology is warranted both in the measurement of the exposure as well as the outcome.

**Acculturation**

16. Conduct prospective longitudinal studies, including those that start in early childhood to track dietary intake, sedentary behaviors, body weight, and chronic disease outcomes across the life course. Include the diversity of ethnic/racial groups in the United States, including individuals and families of diverse national origins. Include comparison groups in countries of origin to rule out, among other things, the potential confounding by internal migration from rural to urban area within the country of origin.

**Rationale:** Acculturation is a time-dependent life course process that requires longitudinal studies to be properly understood. Because the impact of acculturation on dietary, weight and health outcomes can be expected to be modified by the life course stage of life when individuals migrate to the United States, prospective acculturation studies need to start following individuals from very early childhood.

17. Develop a standard tool to measure acculturation or validation of multidimensional acculturation scales in different immigrant groups and in different languages.

**Rationale:** Acculturation is a complex construct that is seldom measured with multidimensional scales that can capture the different paths that migrant scan take with regards to the acculturation process, including assimilation, integration, segregation, and marginalization. Although research in acculturation measurement has been conducted among Hispanic/Latinos, it has been predominantly based on Mexican American populations and little acculturation measurement research has been conducted among other groups, including individuals from Asia, Africa, Europe, and the Middle East.

**Sleep Patterns**

18. Conduct prospective studies that start in childhood (including transition to adulthood), to investigate the longitudinal effect of sleep patterns on diet and body weight outcomes while accounting for confounders, mediators, and moderators including: physical activity, socioeconomic variables (such as education, employment, household income), sex, alcohol intake, smoking status (including new smoker, new non-smoker), media use/screen time, and depression.

**Rationale:** While research associates short sleep duration and disordered sleep patterns with adverse differences and changes in food and beverage consumption, body weight, and indices of metabolic and cardiovascular health, less is known about the impact of potential modifying
lifestyle factors. This research will help delineate the role of sleep patterns, duration and quality, i.e., mediator or moderator, on diet and weight-related outcomes. Research in children shows that sleep deprivation and weight are related but this relationship is not apparent in adult studies. This may be due to the fact that energy intake increases during transition to short sleep duration, but levels off when short sleep duration becomes consistent.

19. Conduct studies to assess the effects of diet on sleep quality to examine the mechanism by which dietary intake, energy intake, and energy expenditure may impact sleep.

Rationale: Most research has focused on sleep quality and duration as modifying factors on diet, body weight, and health. A paucity of research exists on the potential impact of diet on sleep-related outcomes. This line of research would use diet as the means to improve indices of sleep, which in turn may subsequently improve health-related outcomes.

CHAPTER 4: FOOD ENVIRONMENT AND SETTINGS

1. Develop more valid and reliable methods for measuring all aspects of the food environment, including the total food environment of communities. These methods can then be used to assess the impact of the food environment on community health as well as on economic development and growth.

Rationale: The food environment has become more complex, with more and more retail outlets selling food and beverages. Having valid and reliable methodologies for a variety of food environments and settings (tools and new analytical approaches) will allow more meaningful inquiry into the contributions of various settings in supporting or hindering nutritional health.

2. Identify, implement, evaluate, and scale up best practices (including private-public partnerships) for affordable and sustainable solutions to improving the food environment and increasing food access, especially in those environments of greatest need.

Rationale: The environments in which people live, work, learn, and play greatly influence their food intake. To best guide efforts to improve the food environment, research is needed to identify and evaluate best practices to direct available resources to new programs and scale up.

3. Identify, implement, accelerate, evaluate, and scale up programs that improve access to healthy food and that can be integrated seamlessly with Federal nutrition assistance programs, such as SNAP, WIC and elder nutrition.

Rationale: Federal nutrition assistance programs reach individuals and populations with the greatest health disparities. Identifying and evaluating initiatives that integrate improvements
in the food environment with Federal programs will help ensure that Federal nutrition assistance programs have as great an impact as possible.

4. Conduct additional obesity prevention intervention research in child care settings (e.g., child-care centers, family child-care homes) to: 1) Identify the most potent components of the interventions and the optimal combinations for improving diet quality, physical activity, and weight outcomes; 2) Assess implementation and translation costs and benefits of the intervention, including impact, cost-effectiveness, generalizability and reach, sustainability and feasibility; 3) Develop and evaluate culturally appropriate and tailored interventions for preschool children in low-income and racial/ethnic communities, given the disproportionate impact of obesity in these groups; 4) Explore intervention strategies on how to use child care settings as access points to create linkages to parents, caretakers, and health care providers as partners in health promotion; 5) Evaluate the impact of Federal, state, and local policies, regulations, and support (e.g., provider training and technical assistance) for child care programs on the eating and physical activity practices and behaviors, and weight status of young children.

**Rationale:** Early care and education settings are an important venue for interventions targeting young children. A strong evidence base is essential to identify and support evidence-based practices and policies that can be implemented at Federal, state, and local levels and to mobilize efforts to improve healthy eating and physical activity, leading to healthy weight development in these settings. Interventions found to effectively reduce risk of obesity in one setting need to be appropriately adapted for diverse groups and different settings.

5. Improve intervention research methods by the use of stronger study designs and the development of standardized assessments of body composition, weight status. Develop enhanced validated measures of diet quality, feeding and physical activity practices, and physical activity and eating behaviors and policies. Create standardized measures to assess the nutrition quality of meals and snacks in child care settings, as well as the food and physical activity environments. Create standardized methods for assessing the relationship of child care food, nutrition and physical activity-related measures to similar measures representing non-child care time are needed to provide greater consistency in determining the contributors to the development and progression of childhood overweight and obesity.

**Rationale:** Although many of the studies included in these evidence reviews were methodologically strong and were controlled studies, some were limited by small sample size, lack of adequate control for confounding factors, and different outcome measures and different tools used to measure the outcome variables.
6. Examine the effect of the recommended Child and Adult Care Food Program (CACFP) through ongoing periodic evaluations and fill gaps in the knowledge regarding participation, demand, food procurement and practices, nutrient intake, and food security.

**Rationale:** Improvements in school meals and the school food environment have been fostered by national data from periodic studies such as the USDA/FNS School Nutrition Dietary Assessment Studies (SNDA), the HHS/CDC School Health Policies and Practices Studies (SHPPS) and the HHS/NIH C.L.A.S.S. In contrast, considerably fewer periodic national studies are conducted of meals and dietary intake in child care settings and their relation to the child care food and physical activity environment.

7. Conduct new research to document the types and quantities of foods and beverages students consume both at school and daily outside of school, before, during, and after school-based healthy eating approaches and policies are implemented.

**Rationale:** Effective school-based approaches and policies to improve the availability, accessibility, and consumption of healthy foods and beverages, and reduce competition from unhealthy offerings, are central to improving the weight status and health of children and adolescents. Accurate quantification of the types and quantities of foods and beverages the students consume before, during, and after approaches and policies are implemented is fundamental to assessing effectiveness. However, many of the studies included in the systematic reviews and meta-analyses used by the DGAC to address this issue did not comprehensively measure or report dietary information. Although the USDA/FNS-sponsored School Nutrition Dietary Assessment (SNDA) series collects student dietary intake data every 10 years, the DGAC recommends more frequent and consistent data collection, especially before and periodically after implementation of school-based nutrition and physical activity policy and program changes.

8. Improve the quality of research studies designed to assess the effects of school-based approaches and policies on dietary behaviors and body weight control to reduce the risk of bias, with an emphasis on randomized controlled trials.

**Rationale:** Although the methodological quality of the systematic reviews and meta-analyses used by the DGAC to evaluate school-based approaches and policies on dietary intake and body weight outcomes was high, the authors of these reviews commented that the scientific quality of individual studies was generally poor and the risk of bias high. Many of the studies were done using quasi-experimental (with or without control), pre-post intervention, or cross-sectional designs. Future research should prioritize using prospective, repeated measures, randomized controlled trial experimental designs, with randomization at the individual, classroom, school, or school district level. Pilot feasibility studies also may be helpful to quickly identify promising novel approaches to improve dietary intake and weight control.
outcomes.

9. Conduct post-program follow-up assessments lasting longer than 1 year to determine the long-term retention of the changed nutrition behaviors as well as the usefulness of continuing to offer the programs while children advance in school grade. Also, conduct research is needed in adolescents (grades 9-12).

**Rationale:** Literature supports that eating and physical activity behaviors and body weight status of children predict changes over time as they progress into adolescence and adulthood. Ideally, improvements in dietary intake and weight status achieved due to a given school-based approach or policy would be sustained over time and progressive improvements would occur long-term. The vast majority of published research focuses on children in grades K-8, or ages 4-12 years, and new and improved data are needed on adolescents and the transition from childhood to adolescence.

10. Encourage a wider variety of school-based approaches and policies to develop and evaluate innovative approaches focused on increasing vegetable intakes.

**Rationale:** Consumption of non-potato vegetables is below 2010 Dietary Guidelines for Americans recommendations in both children and adolescents. Published research indicates that school-based approaches and policies designed to increase vegetable and fruit intakes are generally more effective at increasing fruit intake, except for school gardens and economic incentives, which increase vegetable intake among school-aged children. Some past public policies (e.g. the Basic 4) treated fruit and vegetables and as a single food group, which props the need for new research that uses prospective, repeated measures, and randomized controlled trial experimental designs to specifically target increased consumption of healthy vegetables.

11. Conduct assessments of the effectiveness of worksite interventions that emphasize obesity prevention and weight control among workers across racially/ethnically diverse populations, blue and white collar employees, and at-risk populations. Scientifically rigorous studies (especially randomized controlled trials) addressing the long-term health impact of worksite-based approaches and policies that improve employee diet, physical activity, and body weight control would have public health relevance.

**Rationale:** In light of the high rates of obesity and overweight, worksite interventions targeting obesity prevention and weight control through enhanced dietary behaviors and increased physical activity among workers is important. The majority of the studies to date have been conducted for relatively short periods of time, and the long-term impact of these approaches and policies may prove beneficial.
CHAPTER 5: FOOD SUSTAINABILITY AND SAFETY

Dietary Patterns and Sustainability

1. Conduct research to determine whether sustainable diets are affordable and accessible to all sectors of the population and how this can be improved, including how policy strategies could influence the supply chain (all steps from farm to plate) to affect this improvement.

   **Rationale:** Ensuring that sustainable diets are accessible and affordable to all sectors of the population is important to promote food security.

2. Develop, conduct, and evaluate in-depth analyses of U.S. domestic dietary patterns and determine the degree to which sustainability practices, domestically and internationally, are important to food choice and how to increase public awareness of the impact of food choices on environmental outcomes.

   **Rationale:** Understanding consumer choice across demographic groups and the degree to which either health and/or sustainability is a significant decisional criterion as well as the degree to which choice theory can be used to improve choices will be important to helping drive change.

3. Develop a robust understanding of how production practices, supply chain decisions, consumer behaviors, and waste disposal affect the environmental sustainability of various practices across the USDA food components of MyPlate.

   **Rationale:** Developing sustainable production and supply chain practices for all parts of MyPlate, especially meat and dairy products will be important to reduce their environmental impact.

4. Determine the potential economic benefits and challenges to supply chain stakeholders in relationship to findings in Research Recommendation 3.

   **Rationale:** Experience demonstrates that many practices over the past few decades that improve the environmental footprint of, for example, production practices, also have led to improved profit (e.g., Integrated Pest Management to reduce pesticide use in many fruit and vegetables). It is important to know how changes will affect profit to help enable future policy in both the private and public spheres.
### Seafood Sustainability

5. Conduct research on methods to ensure the maintenance of nutrient profiles of high-trophic level farmed seafood and improve nutrient profiles of low-trophic farmed seafood concurrently with research to improve production efficacy.

**Rationale:** The evidence supporting healthfulness of seafood consumption is based on consumption of predominantly wild caught species. Many popular low-trophic level farmed seafood have nutrient profiles that depend on feeds. Efficient production of seafood with nutrient profiles that are known to be healthful should be emphasized.

6. Conduct research to develop methods to ensure contaminant levels in all seafood remain at levels similar to or lower than at present. Maintain monitoring of contaminant levels for capture fisheries to ensure that levels caused by pollution do not rise appreciably. This research should include developing effective rapid response approaches if the quality of seafood supply is acutely affected.

**Rationale:** Current research findings support the contention that contaminant levels are generally well below those that significantly alter the healthfulness of seafood. As industry naturally improves efficiency, feeds and environmental conditions should be monitored to maintain or reduce priority contaminants and insure significant new contaminants do not enter the seafood supply.

### Usual Caffeine/Coffee Intake

7. Evaluate the effects of coffee on health outcomes in vulnerable populations, such as women who are pregnant (premature birth, low birth weight, spontaneous abortion).

**Rationale:** Given the limited evidence of the effects of coffee/caffeine consumption on pregnancy outcomes, future studies need to establish safe levels of coffee/caffeine consumption during pregnancy.

8. Examine the effects of coffee on sleep patterns, quality of life, and dependency and addiction.

**Rationale:** Because coffee is a known stimulant, future research should examine the effect of coffee/caffeine on sleep quality, dependency, addiction, and overall quality of life measures.

9. Evaluate the prospective association between coffee/caffeine consumption and cancer at different sites.

**Rationale:** Large well-conducted prospective cohort studies that adequately control for smoking (status and dosage) and other potential confounders are needed to understand the association of coffee (caffeinated and decaffeinated) with cancer at different sites.
10. Examine prospectively the effects of coffee/caffeine on cognitive decline, neurodegenerative diseases, and depression.

**Rationale:** Neurodegenerative diseases affect millions of people worldwide and more than five million Americans are living with Alzheimer’s disease. Given the limited evidence of coffee/caffeine on neurodegenerative diseases, well-designed prospective studies should examine the association of coffee/caffeine consumption on cognitive decline, depression, and Alzheimer’s disease.

11. Understand the mechanisms underlying the protective effects of coffee on diabetes and CVD.

**Rationale:** Evidence for a biological plausibility for coffee on risk of type 2 diabetes and CVD stems primarily from animal studies. Randomized controlled trials in humans should evaluate the effect of coffee/caffeine on measures of glycemia, insulin sensitivity, endothelial dysfunction, and inflammation.

12. Understand the association between coffee and health outcomes in individuals with existing CVD, diabetes, cancer, neurodegenerative diseases, or depressive symptoms.

**Rationale:** Strong evidence supports a protective effect of moderate coffee consumption on chronic disease risk in healthy adults, but its association among those with existing diseases has been less studied. Given that a substantial number of people suffer from these chronic diseases, the role of coffee in preventing other health outcomes in such groups remains understudied.

**High-dose Caffeine Intake**

13. Define excessive caffeine intake and safe levels of consumption for children, adolescents, and young adults.

**Rationale:** Current research on caffeine and health outcomes has focused primarily on adults. Given the increasing prevalence of energy drink consumption among children, adolescents, and young adults, research is needed to identify safe levels of consumption in these groups.


**Rationale:** Data on the sources (other than energy drinks) and doses of caffeine intake in children and adults are limited. Identifying the sources and safe levels of consumption will help in formulating policy and framing recommendations.
15. Examine the effect of excessive consumption of caffeine and energy drinks on health outcomes in both children and adults.

**Rationale:** Prospective studies of associations of excessive caffeine and energy drink intake with health outcomes in children and adults are necessary, as randomized controlled trials are not be feasible given ethical constraints.

16. Conduct observational studies to examine the health effects of alcohol mixed with energy drinks.

**Rationale:** In recent years, consumption of alcohol energy drinks by adolescents has resulted in emergency room admissions and deaths. No data exist on the prospective association between consumption of alcohol energy drinks and health outcomes in both adolescents and adults.

**Aspartame**

17. Examine the risks of aspartame related to some cancers, especially hematopoietic ones, and pregnancy outcomes.

**Rationale:** Limited and inconsistent evidence suggests a possible association between aspartame and risk of hematopoietic cancers (non-Hodgkin lymphoma and multiple myeloma) in men, indicating the need for long-term human studies. Additionally, limited and inconsistent evidence indicates a potential for risk of preterm delivery, which warrants further research.

**CHAPTER 6: CROSS-CUTTING TOPICS OF PUBLIC HEALTH IMPORTANCE**

1. Design and conduct studies with sufficient power to define the impact of improving dietary quality, including the lowering dietary sodium intake, on hypertension and relevant disease outcomes, including cardiovascular disease, stroke, peripheral vascular disease, kidney disease, and others. The interactions with patterns of therapeutic medication use (e.g., diuretics, antihypertensives, and lipid-lowering) should be considered.

**Rationale:** The current literature is incomplete, limited in power and durations, and often compromised by methodological challenges that must be addressed in well-designed studies with relevant clinical outcomes.

2. Assess the accuracy of 24-hour urine collections for sodium assessment in populations with different health conditions (e.g., diabetes, chronic kidney disease, heart failure, cardiovascular disease) and interactions with different patterns of medication use (e.g., diuretics, antihypertensives).
Rationale: If there is systematic error in sodium assessment because individuals with various co-morbidities who are taking medications systematically do not provide accurate urine collections, paradoxical findings between sodium and health outcomes may be observed.

3. Examine the effect of behavioral interventions, with novel approaches (e.g., flavorful recipes, cooking techniques) on adherence to dietary sodium recommendations.

Rationale: For decades, the population has exceeded dietary sodium intake recommendations. A public health approach that results in reformulation of commercially processed foods to lower sodium content should be the primary strategy for decreasing sodium intake in the U.S. population. However, individual support for public health policies will be needed to further document demand for changes in the sodium food environment. To this end, interventions that modify individual knowledge, attitudes, and behaviors around sodium intake should be evaluated.

4. Examine the effect of low sodium intake on taste preferences for sodium and healthy dietary patterns.

Rationale: It has been argued that populations desire higher levels of sodium intake and will inevitably revert to higher levels of sodium intakes after acute reductions in sodium intake. It has also been argued that after six weeks of reduced sodium intake, taste preferences are modified such that higher sodium is no longer desirable. Studies are needed to elucidate the effects of lowering sodium intake on diet preferences.

5. Document the relationship between portion size and sodium intake.

Rationale: These data are needed to inform whether dietary recommendations for sodium should be adjusted for caloric intake. It is known that the absolute amount of sodium intake is highly correlated with caloric intake. As a result, the absolute recommended amount of sodium is harder to achieve for a larger, high energy consuming person than for a smaller, low energy consuming person. The science to inform whether sodium density confers different risk than absolute intake of sodium is limited because of methodologic limitations in surveys where both calories and sodium intake can be calculated. Furthermore, the existing correlation between sodium and calories may be an artifact of the current food supply.

6. Determine the effects of replacement of saturated fat with different types of carbohydrates (e.g., refined vs. whole grains) on cardiovascular disease risk.

Rationale: Most randomized controlled trials and prospective cohort studies compared saturated fat with total carbohydrates. It is important to distinguish different types of carbohydrates (e.g. refined vs. whole grains) in future studies.
7. Examine the effects replacement of saturated fat with polyunsaturated fat vs. monounsaturated fat on cardiovascular disease risk.

**Rationale:** Most existing studies have examined the effects of substituting PUFA for saturated fat on cardiovascular disease risk. Future studies should also examine the potential benefits of substituting monounsaturated from plant sources such as olive oil and nuts/seeds for saturated fat on cardiovascular disease risk.

8. Examine lipid and metabolic effects of specific oils modified to have different fatty acid profiles (e.g. commodity soy oil (high linoleic acid) vs. high oleic soy oil).

**Rationale:** As more modified vegetables oils become commercially available, it is important to assess their long-term health effects. In addition, future studies should examine lipid and metabolic effects of plant oils that contain a mix of n-9, n-6, and n-3 fatty acids, as a replacement for animal fat, on cardiovascular disease risk factors.

9. Examine the effects of saturated fat from different sources, including animal products (e.g. butter, lard), plant (e.g., palm vs. coconut oils), and production systems (e.g. refined deodorized bleached vs. virgin coconut oil) on blood lipids and cardiovascular disease risk.

**Rationale:** Different sources of saturated fat contain different fatty acid profiles and thus, may result in different lipid and metabolic effects. In addition, virgin and refined coconut oils have different effects in animal models, but human data are lacking.

10. Conduct gene-nutrient interaction studies by measuring genetic variations in relevant genes that will enable evaluation of effects of specific diets for individualized nutrition recommendations.

**Rationale:** Individuals with different genetic background may respond to the same dietary intervention differently in terms of blood lipids and other cardiovascular disease risk factors. Future studies should explore the potential role of genetic factors in modulating the effects of fat type modification on health outcomes.

11. Identify sources and names of added sugars and low-calorie sweeteners used in the food supply and quantify their consumption levels and trends in the U.S. diet.

**Rationale:** It is unclear whether all food and nutrient databases capture all added sugars because: 1) added sugars have varied and inconsistent nomenclature and may not be recognized as added sugars in nutrient analyses; and 2) many foods with added sugars have formulations considered proprietary by the manufacturers and for this reason actual added sugars content is difficult to obtain. Accurate assessment of added sugars in the U.S. diet is needed to quantify the population level exposure and subsequent health risks from added sugars. The lack of information on the various added sugars in the food supply hinders efforts to make policy about consumption.
12. Conduct prospective research with strong experimental designs and multiple measurements of the consumption of added sugars and low-calorie sweeteners on health outcomes, such as body weight, adiposity, and clinical markers of type 2 diabetes and cardiovascular disease.

**Rationale:** High heterogeneity exists among published research with regard to the types and forms of added sugars and low-calorie sweeteners-containing foods/beverages used for interventions, which precludes assessing the effects of specific added sugars and low-calorie sweeteners on body weight, adiposity, and cardio-metabolic health in adults and children. Many studies use single baseline measurements of diet to reflect usual patterns and quantities of intake over time. New research should emphasize assessments within the context of usual dietary intakes and patterns of food and beverage consumption in free-living populations, along with specific added sugars and low-calorie sweeteners, especially those that are currently understudied. Large prospective studies with repeated measurements of low-calorie sweeteners are needed to monitor their long-term effects on cancer and other health outcomes.

13. Design studies that emphasize assessments of relationships between the intakes of added sugars and low-calorie sweeteners and body weight, adiposity, and cardio-metabolic health in diverse sub-populations who are at high risk of obesity and related morbidities.

**Rationale:** Insufficient evidence exists to assess the impact of added sugars and low-calorie sweeteners contained in foods and beverages on individuals from diverse populations who have high risk for adverse health outcomes. These include (but are not limited to) different race/ethnicity groups; low income groups, especially those with food insecurity; groups who live in specific geographic locations with high prevalence of obesity (e.g. inner city, rural, and Southern regions of the United States); and age and sex groups (women, children, and elderly adults).

14. Assess and improve approaches and policies to reduce the amount of added sugars in the food and beverage supply as well as in school and community settings.

**Rationale:** Results from this research would assist policy makers and the private sector in establishing sustainable approaches and policies to limit the availability and consumption of added sugars. These approaches and policies would also be important for multi-component strategies to improve weight control and health among people living in the United States.

15. Conduct consumer research to identify and test elements of a standardized, easily understood front-of-package label.

**Rationale:** Research is needed to provide an evidence base to support the need and identify critical elements of a front of package label. This is particularly important to support the Food and Drug Administration in implementing a front-of-package labeling system.
CHAPTER 7: PHYSICAL ACTIVITY

1. Evaluate best practices in programming at the community and national level and identify which local and national policies in the public and private sector have demonstrated the greatest effect on increasing physical activity participation across the lifespan, especially in populations with the greatest health disparities.

   **Rationale:** Physical activity participation rates are exceptionally low across all age groups, and are especially low in individuals with the greatest health disparities. Many different initiatives are currently underway in the private and public sector to help increase physical activity on a population level. Understanding which programs and policies are having the greatest impact will help focus valuable resources and national recommendations for maximum public health benefit.

2. Identify the dose of physical activity needed to achieve health benefits, as well as appropriate growth and development, for children younger than age 6 years.

   **Rationale:** Until recently, very little effort has been focused on understanding the health benefits of physical activity for young children. Given that this is a critical age of growth and development, considerable research should be focused on this age group.

3. Evaluate the effects of various modes and doses of physical activity on health outcomes in older adults.

   **Rationale:** Older adults are the fastest growing segment of the population. They also have the greatest burden of disease and functional (mental and physical) limitations. To reduce burden of disease and related economic impacts, research regarding mode and dose of physical activity should be focused on this age group.

4. Further evaluate the importance of light activity, short bouts of physical activity (i.e., 10-minutes or less) and modes of activity on health outcomes across the lifespan.

   **Rationale:** The review of the evidence in the 2008 PAGAC Report focused primarily on moderate- and vigorous-intensity activity. Emerging research highlights the positive effects of light activity as well as shorter bouts of vigorous activity on health outcomes. Understanding the health impact of the full range of mode, intensity, duration, frequency, and setting will help to further refine the PAG to support maximum public health benefit.

5. Further investigate the effects of sedentary behaviors on health outcomes, including duration, frequency, and mode of sedentary activities.

   **Rationale:** Increasing evidence demonstrates the negative health consequences of sedentary behaviors. Clarity on the types and duration of sedentary behaviors that have the most negative health impact would help to identify meaningful evidence-based public health recommendations.