

Appendix E-1: Needs for Future Research

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

38 responsible for the declines in intakes of fruit, dairy, and other food groups and increases in
 39 added sugars and refined grains as children become enter the elementary school age years, as
 40 poor eating patterns in elementary school seem to persist into adolescence and beyond.

- 41
 42 5. Evaluate the effects of common variations in dietary patterns in small children on nutrient
 43 intakes.

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

- 49
 50 6. Increase the quantity and quality of food composition databases available for research.

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

- 60
 61 7. Investigate the validity, reliability, and reproducibility of new biomarkers of nutrient intake
 62 and biomarkers of nutritional status.

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

- 66
 67 8. Evaluate effects of fortification strategies and supplement use on consumer behavior related
 68 to the intake of foods and supplements containing key nutrients, including calcium, vitamin
 69 D, potassium, iron, and fiber

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

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

79

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

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

86

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

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

92

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

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

103

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

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

110

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

114 **Rationale:** Current data on diabetes in adults cannot be stratified by disease type (type I or
115 type II), making it very difficult to monitor incidence and prevalence of type 2 diabetes.

116 Continued population surveillance is needed to effectively link nutritional factors with risk of
117 these diseases.

118
119

120 **CHAPTER 2: DIETARY PATTERNS, FOODS AND NUTRIENTS, AND** 121 **HEALTH OUTCOMES**

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

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

138

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

143 **Rationale:** Researchers are characterizing dietary patterns very differently and yet
144 sometimes use similar nomenclatures. This makes it difficult to compare results across
145 studies and as demonstrated in the NEL systematic reviews, can impair the grading of the
146 body of evidence as strong. The reason why researchers are not replicating others findings in
147 different populations may be a function of publication bias. It is important for editors of
148 scientific journals and peer reviewers to appreciate the replication of findings first and then
149 value a research group's methodological nuance that may improve the examination of the
150 association between dietary patterns and a health outcomes. Perhaps what should be stressed
151 is a harmonization of research methods across various cohorts or randomized trials, similar to
152 what is being done at the National Cancer Institute's Dietary Patterns Methods Project^{9, 220}
153 led by Drs. Krebs-Smith and Reedy. The use of Food Pattern Modeling as demonstrated in
154 Chapter 1 allows questions about the adequacy of the dietary patterns given specific food

155 constituents to be addressed and how modifications of the patterns by altering the foods for
 156 specific population groups or to meet specific nutrient targets can be achieved.

157

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

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

176

177

178 **CHAPTER 3: INDIVIDUAL DIET AND PHYSICAL ACTIVITY BEHAVIOR** 179 **CHANGE**

180 **Eating Out**

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

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

185

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

191 **Rationale:** Most groups in the U.S. population regularly consume meals that are prepared
 192 away from home and the landscape of fast food and other types of food procurement and

193 consumption venues is increasingly complex. The potential for eating out and/or take away
 194 meals to influence diet quality, energy balance, body mass and composition, and the risks of
 195 health-related morbidities across the life course among our diverse population underscores the
 196 importance of understanding this issue.

197

198 **Family Shared Meals**

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

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

205

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

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

215

216 **Sedentary Behavior**

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

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

227

228 6. Conduct prospective research to examine the effects and mechanisms of the quantity,
 229 patterns, and changes of sedentary behaviors on diet quality, energy balance, body weight,

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

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

237

238 **Self-Monitoring**

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

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

245

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

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

252

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

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

260

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

265 **Rationale:** Mobile health technologies have the potential to reach larger portions of the
266 populations than face-to-face interventions, but the effect sizes of mobile technologies may be
267 small and the attrition rates may be large. Larger, more representative study populations and

268 longer study periods will permit an assessment of the generalizability and sustainability of
 269 mobile health technologies.

270

271 **Food and Menu Labeling**

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

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

279

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

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

285

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

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

289

290 **Household Food Insecurity**

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

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

300

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

304 **Rationale:** The measurement error issues related to the use of self-reported weight have been

305 well documented in the literature. In order to conduct rigorous studies in this area that can be
 306 compared and evaluated as to the causal nature of the role of food insecurity on body weight,
 307 standard methodology is warranted both in the measurement of the exposure as well as the
 308 outcome.

309

310 **Acculturation**

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

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

322

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

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

332

333 **Sleep Patterns**

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

340 **Rationale:** While research associates short sleep duration and disordered sleep patterns with
 341 adverse differences and changes in food and beverage consumption, body weight, and indices
 342 of metabolic and cardiovascular health, less is known about the impact of potential modifying

343 lifestyle factors. This research will help delineate the role of sleep patterns, duration and
 344 quality, i.e., mediator or moderator, on diet and weight-related outcomes. Research in children
 345 shows that sleep deprivation and weight are related but this relationship is not apparent in adult
 346 studies. This may be due to the fact that energy intake increases during transition to short sleep
 347 duration, but levels off when short sleep duration becomes consistent.

348

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

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

355

356

357 CHAPTER 4: FOOD ENVIRONMENT AND SETTINGS

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

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

367

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

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

375

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

379 **Rationale:** Federal nutrition assistance programs reach individuals and populations with the
 380 greatest health disparities. Identifying and evaluating initiatives that integrate improvements

381 in the food environment with Federal programs will help ensure that Federal nutrition
382 assistance programs have as great an impact as possible.

383

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

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

404

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

414 **Rationale:** Although many of the studies included in these evidence reviews were
415 methodologically strong and were controlled studies, some were limited by small sample
416 size, lack of adequate control for confounding factors, and different outcome measures and
417 different tools used to measure the outcome variables.

418

- 419 6. Examine the effect of the recommended Child and Adult Care Food Program (CACFP)
 420 through ongoing periodic evaluations and fill gaps in the knowledge regarding participation,
 421 demand, food procurement and practices, nutrient intake, and food security.

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

- 428
 429 7. Conduct new research to document the types and quantities of foods and beverages students
 430 consume both at school and daily outside of school, before, during, and after school-based
 431 healthy eating approaches and policies are implemented.

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

- 444
 445 8. Improve the quality of research studies designed to assess the effects of school-based
 446 approaches and policies on dietary behaviors and body weight control to reduce the risk of
 447 bias, with an emphasis on randomized controlled trials.

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

457 outcomes.

458

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

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

470

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

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

482

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

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

494

495 **CHAPTER 5: FOOD SUSTAINABILITY AND SAFETY**496 **Dietary Patterns and Sustainability**

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

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

502

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

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

511

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

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

518

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

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

526

527 **Seafood Sustainability**

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

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

- 535
 536 6. Conduct research to develop methods to ensure contaminant levels in all seafood remain at
 537 levels similar to or lower than at present. Maintain monitoring of contaminant levels for
 538 capture fisheries to ensure that levels caused by pollution do not rise appreciably. This
 539 research should include developing effective rapid response approaches if the quality of
 540 seafood supply is acutely affected.

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

546

547 **Usual Caffeine/Coffee Intake**

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

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

553

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

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

558

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

561 **Rationale:** Large well-conducted prospective cohort studies that adequately control for
 562 smoking (status and dosage) and other potential confounders are needed to understand the
 563 association of coffee (caffeinated and decaffeinated) with cancer at different sites.

564

565 10. Examine prospectively the effects of coffee/caffeine on cognitive decline, neurodegenerative
566 diseases, and depression.

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

572

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

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

578

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

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

586

587 **High-dose Caffeine Intake**

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

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

594

595 14. Determine the prevalence of excessive caffeine intake in children and adults beyond intake of
596 energy drinks.

597 **Rationale:** Data on the sources (other than energy drinks) and doses of caffeine intake in
598 children and adults are limited. Identifying the sources and safe levels of consumption will
599 help in formulating policy and framing recommendations.

600

601 15. Examine the effect of excessive consumption of caffeine and energy drinks on health
602 outcomes in both children and adults.

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

606

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

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

613

614 **Aspartame**

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

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

622

623

624 **CHAPTER 6: CROSS-CUTTING TOPICS OF PUBLIC HEALTH** 625 **IMPORTANCE**

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

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

634

635 2. Assess the accuracy of 24-hour urine collections for sodium assessment in populations with
636 different health conditions (e.g., diabetes, chronic kidney disease, heart failure,
637 cardiovascular disease) and interactions with different patterns of medication use (e.g.,
638 diuretics, antihypertensives).

639 **Rationale:** If there is systematic error in sodium assessment because individuals with various
 640 co-morbidities who are taking medications systematically do not provide accurate urine
 641 collections, paradoxical findings between sodium and health outcomes may be observed.

642

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

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

652

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

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

660

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

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

671

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

674 **Rationale:** Most randomized controlled trials and prospective cohort studies compared
 675 saturated fat with total carbohydrates. It is important to distinguish different types of
 676 carbohydrates (e.g. refined vs. whole grains) in future studies.

677

- 678 7. Examine the effects replacement of saturated fat with polyunsaturated fat vs.
679 monounsaturated fat on cardiovascular disease risk.

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

- 684
685 8. Examine lipid and metabolic effects of specific oils modified to have different fatty acid
686 profiles (e.g. commodity soy oil (high linoleic acid) vs. high oleic soy oil).

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

- 691
692 9. Examine the effects of saturated fat from different sources, including animal products (e.g.
693 butter, lard), plant (e.g., palm vs. coconut oils), and production systems (e.g. refined
694 deodorized bleached vs. virgin coconut oil) on blood lipids and cardiovascular disease risk.

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

- 698
699 10. Conduct gene-nutrient interaction studies by measuring genetic variations in relevant genes
700 that will enable evaluation of effects of specific diets for individualized nutrition
701 recommendations.

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

- 706
707 11. Identify sources and names of added sugars and low-calorie sweeteners used in the food
708 supply and quantify their consumption levels and trends in the U.S. diet.

709 **Rationale:** It is unclear whether all food and nutrient databases capture all added sugars
710 because: 1) added sugars have varied and inconsistent nomenclature and may not be
711 recognized as added sugars in nutrient analyses; and 2) many foods with added sugars have
712 formulations considered proprietary by the manufacturers and for this reason actual added
713 sugars content is difficult to obtain. Accurate assessment of added sugars in the U.S. diet is
714 needed to quantify the population level exposure and subsequent health risks from added
715 sugars. The lack of information on the various added sugars in the food supply hinders efforts
716 to make policy about consumption.

717

718 12. Conduct prospective research with strong experimental designs and multiple measurements
719 of the consumption of added sugars and low-calorie sweeteners on health outcomes, such as
720 body weight, adiposity, and clinical markers of type 2 diabetes and cardiovascular disease.

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

732

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

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

743

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

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

750

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

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

756 **CHAPTER 7: PHYSICAL ACTIVITY**

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

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

767
 768 2. Identify the dose of physical activity needed to achieve health benefits, as well as appropriate
 769 growth and development, for children younger than age 6 years.

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

773
 774 3. Evaluate the effects of various modes and doses of physical activity on health outcomes in
 775 older adults.

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

780
 781 4. Further evaluate the importance of light activity, short bouts of physical activity (i.e., 10-
 782 minutes or less) and modes of activity on health outcomes across the lifespan.

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

788
 789 5. Further investigate the effects of sedentary behaviors on health outcomes, including duration,
 790 frequency, and mode of sedentary activities.

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