

December 2016

## Nutrition Across the Lifespan for Healthy Aging

### Proceedings of a Workshop—in Brief

On September 13–14, 2016, the National Academies of Sciences, Engineering, and Medicine's Food Forum convened a workshop in Washington, DC, to (1) examine trends and patterns in aging and factors related to healthy aging in the United States with a focus on nutrition; (2) examine how nutrition can sustain and promote healthy aging, not only in late adulthood, but beginning in pregnancy and early childhood and extending throughout the lifespan; (3) highlight the role of nutrition in the aging process at various stages in life; (4) discuss changes in organ systems over the lifespan, including the skeletal, muscular, and cardiovascular systems, and changes that occur with age related to cognitive, brain, and mental health; diet-related sensory preferences; oral health; and the microbiome; and (5) explore opportunities to move forward in promoting healthy aging in the United States.

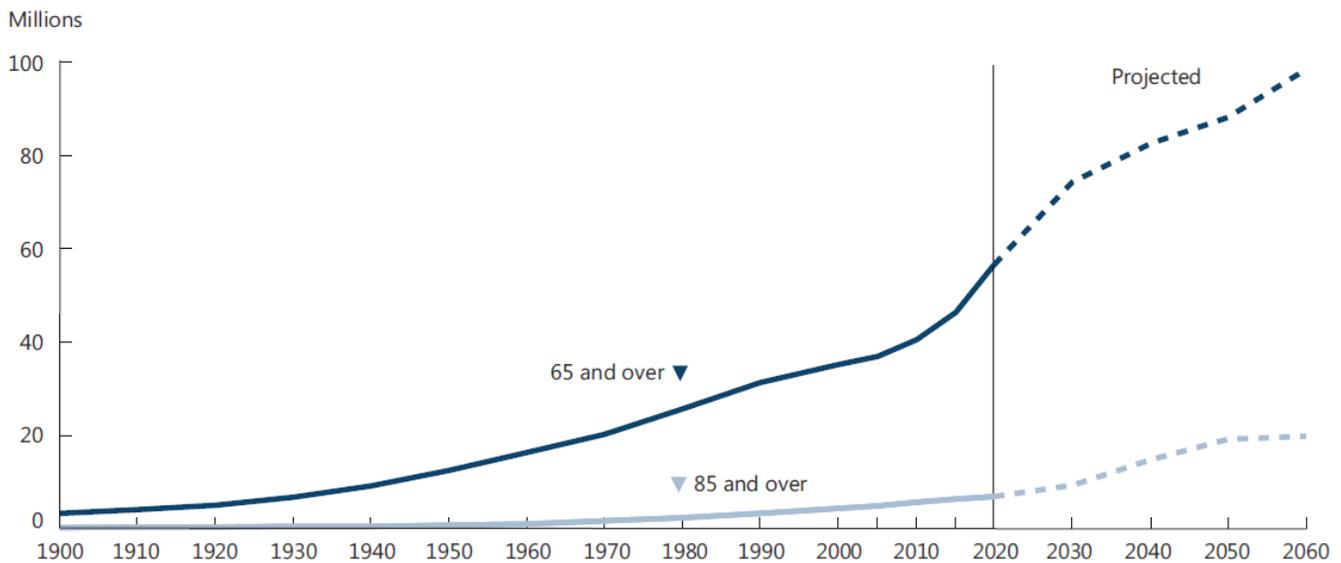
This Proceedings of a Workshop—in Brief summarizes key points of the workshop presentations and discussions. A comprehensive summary of the workshop will be publicly available in a forthcoming full-length Proceedings of a Workshop. The information and opinions presented during the workshop and highlighted here are those of individual workshop participants and should not be construed as consensus on the part of the Food Forum, the Health and Medicine Division of the National Academies, or any other group.

### **CHANGING LANDSCAPE: DEMOGRAPHICS, HEALTH STATUS, AND NUTRITIONAL NEEDS**

In the opening session, drawing on the most recent report issued by the Federal Interagency Forum on Aging-Related Statistics,<sup>1</sup> Jennifer Madans, National Center for Health Statistics, described trends in six categories of key indicators of well-being in the population of older adults: population, economic, health status, health risks and behavior, health care, and environment. More than 46 million people over the age of 65 years were living in the United States in 2014 and more than 70 million are predicted by 2060 (see Figure 1). Education, living arrangements, and other demographic characteristics of this older population are changing, with noted variability by sex and race/ethnicity. Health status indicators, including life expectancy and heart disease death rates, have shown improvement, as have economic indicators. Among health risks and behavior indicators, Madans observed that diet quality is poor and the proportion of older Americans meeting recommended physical activity levels is quite low. Finally, with respect to environmental indicators of well-being in the older population, the amount of time spent on leisure activities increases with age, and most leisure time among older adults is spent watching television.

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<sup>1</sup> *Older Americans 2016: Key Indicators of Well-Being* ([www.agingstats.gov](http://www.agingstats.gov) [accessed September 19, 2016]).



**FIGURE 1** Population age 65 and over and age 85 and over, selected years, 1900–2014, and projected years, 2020–2060.

SOURCES: Presented by Jennifer Madans, September 13, 2016. U.S. Census Bureau, 1900 to 1940, 1970, and 1980, U.S. Census Bureau, 1983, Table 42; 1950, U.S. Census Bureau, 1953, Table 38; 1960, U.S. Census Bureau, 1964, Table 155; 1990, U.S. Census Bureau, 1991, 1990 Summary Table File; 2000, U.S. Census Bureau, 2001, Census 2000 Summary File 1; U.S. Census Bureau, Table 1: Intercensal Estimates of the Resident Population by Sex and Age for the U.S.: April 1, 2000, to July 1, 2010 (US-EST00INT-01); U.S. Census Bureau, 2011. 2010 Census Summary File 1; U.S. Census Bureau, Annual Estimates of the Resident Population for Selected Age Groups by Sex for the United States, States, Counties, and Puerto Rico Commonwealth and Municipios: April 1, 2010, to July 1, 2014 (PEPAGESEX); U.S. Census Bureau, Table 3: Projections of the Population by Sex and Selected Age Groups for the United States: 2015 to 2060 (NP2014-T3).

Mary Ann Johnson, University of Georgia, described healthy aging as not only living a long life, but also living in good health. In 2013, the average American life expectancy was 77 years, but average American “healthy life expectancy” was estimated at only 67 years. Whereas some may think of biomarkers as “things you can measure in your blood,” Johnson presented that there is an extensive range of biomarkers for healthy aging, from markers of disease onset, progression, and severity to what Johnson described as “functional markers” of physical capability (e.g., strength, balance) and cognitive function (e.g., memory, processing speed, executive function). The latter becomes increasingly important with aging. She provided an overview of the many ways researchers have been studying biomarkers of healthy aging. Regarding the role of nutrition in healthy aging, Johnson referred to Madans’s statistics on the low number of older individuals who meet current dietary recommendations, commented on the very large number of old people who are food insecure (more than 8 percent nationally and more than 50 percent in some subgroups), and noted the increasing prevalence of obesity among older adults. Additionally, she emphasized the need to think about how nutrition is integrated into care transitions experienced by older adults such as when someone is discharged from a hospital and sent home without meal support.

## THE SPECTRUM OF AGING AND HEALTH OVER THE LIFESPAN

In the second session, Janet King, Children’s Hospital Oakland Research Institute, emphasized the strong connection between in utero nutrition and outcomes later in life. Much of the early evidence for this connection comes from studies on the Dutch famine during World War II and from David Barker’s analyses of 1920s data collected in England and Wales. Since these initial studies, according to King, more than 100 additional studies have shown consistent associations between under-nutrition in utero and metabolic disorders later in life. Moreover, this increased risk for metabolic disease has been shown to be exacerbated by over-nutrition during early childhood. King suggested that DNA methylation likely plays a key role in the mechanism underlying the link between early nutrition and early health. She described evidence from studies in the Gambia showing that maternal diet can influence the methylation of genes in the newborn; noted the large literature on the relationship between DNA methylation and inflammation and oxidative stress, which may be precursors to aging-related metabolic diseases; and speculated on the role of improved nutrition in reducing the risk of metabolic disease.

Luigi Ferrucci, National Institute on Aging, differentiated between chronological and biological aging. Phenotypic change over time occurs very quickly early in life, as newborns grow into young children, then stabilizes for a while until it accelerates again. This acceleration point, Ferrucci noted, is very different for different people. He explained how he has identified four domains of aging: changes in body composition, energy imbalance, homeostatic dysregulation,<sup>2</sup> and aging of the brain. He focused most of his talk on homeostatic dysregulation, specifically dysregulation of inflammation, which he said can have “devastating” effects, including impaired mobility. Regarding the impact of nutrients/nutrition in dysregulated inflammation, Ferrucci cited evidence suggesting connections between interleukin (IL)-6 and both fat and protein intake. Researchers have demonstrated that meals higher in saturated fats lead to significantly greater IL-6 levels within 2 hours post-consumption. Furthermore, it has been shown that greater protein intake is required to maintain muscle mass stability in individuals with higher IL-6 levels. These data support that the inflammatory status of an individual is a function of and impacted by diet, Ferrucci concluded.

The final speaker of this session, Gordon Jensen, University of Vermont College of Medicine, emphasized the existence of a large body of literature that obesity is a much stronger predictor of all-cause mortality at younger ages (in children and young adults) than at older ages. He also provided an overview of the growing body of data supporting the so-called obesity paradox, beginning with a 2013 review paper by epidemiologist Katherine Flegal and colleagues showing that, compared to a “desirable” body mass index (BMI) (i.e., normal weight), class II and III obesity were associated with significantly greater all-cause mortality, while in contrast, class I obesity was not associated with higher mortality, and overweight was associated with significantly lower mortality.<sup>3</sup> Flegal’s work, Jensen said, started a “raging controversy,” a key issue being how to interpret its findings for health professionals and the public. In Jensen’s opinion, the obesity paradox may be explained, at least in part, by body composition and a subset of what he described as “pretty robust healthy overweight and mildly obese older people”—as recent work from his research group has shown that overweight in older adults is protective only in patients with high muscle mass. He concluded by noting that it is safe to say that obesity does not generally confer mortality or health benefits, as such, rather than changing BMI guidelines for older persons, it is the use of the current guidelines that warrants re-evaluation.

## CHANGES IN ORGAN SYSTEMS OVER THE LIFESPAN

The third session’s speakers examined changes that occur with aging in the cardiovascular, skeletal, and muscular systems, in sensory and oral health, and in the gut microbiome; and the role of nutrition in these changes.

### The Cardiovascular System

Heart disease still leads cancer as the number one cause of death in the United States, Tamara Harris, National Institute on Aging, began with many other leading causes of death (e.g., stroke) connected to vasculature dysfunction. But separating cardiovascular disease from aging-related cardiovascular change is difficult, she remarked, as both can lead to the same end-stage heart disease. Harris listed the many cardiovascular changes that occur with aging (e.g., age-related stiffening of the arterial tree), their underlying mechanisms, and the consequences (e.g., reduced cardiac output during exercise, reduced ability to increase heart rate in response to stress). She highlighted two age-associated cardiovascular changes in particular: atrial fibrillation and hypertension. Both are common in old age and both have unsettled clinical issues. While most symptoms of atrial fibrillation are related to how fast the heart is beating, stroke is an influential complication. Whether people with risk factors for bleeding should be prescribed anticoagulants (i.e., to reduce the risk of stroke) remains controversial, according to Harris. One of the clinical challenges of high blood pressure in older adults, she remarked, is that it is primarily systolic blood pressure that is elevated, while diastolic is typically normal or low, which makes it difficult to control (i.e., lowering one lowers the other as well).

Penny Kris-Etherton, Penn State University, described atherosclerosis as a chronic condition that does not manifest until the fourth decade, but begins at birth. She described recent trends in several risk factors for cardiovascular diseases, including the slow, steady increase in obesity among both adults and children; the decreasing but still high cholesterol levels, again, in both adults and children; and the increase in type 2 diabetes in children. She then went on to describe evidence from several studies showing how these and other cardiovascular risk factors in children relate to cardiovascular risk later in life. “Even in young kids,” Kris-Etherton said, “these coronary risk factors take their toll later in life.” She stressed the connection between poor dietary habits and modifiable nutrition-related risk factors (e.g., dyslipidemia, obesity) and the significant potential for dietary change to improve cardiovascular health.

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<sup>2</sup> The disruption or impairment in the ability to maintain a stable equilibrium between interdependent elements within body systems or physiological processes.

<sup>3</sup> For adults, obesity is frequently subdivided into categories: Class I: BMI of 30 to <35; Class II: BMI of 35 to <40; and Class III: BMI of 40 or higher. BMI 18.5 to <25 is considered in the normal range. BMI 25.0 to <30 is considered in the overweight range.

## **Skeletal and Muscular Systems**

While cardiovascular diseases are often thought of in the context of their impact on aging and quality of life, the impact of aging on the skeletal system can be equally if not more profound, described Connie Weaver, Purdue University. She stated, “the incidence of fracture dwarfs all these other diseases you are talking about.” Moreover, while heart disease, stroke, and many other diseases affect mortality, a hip fracture dramatically affects one’s mobility (temporarily or permanently) and causes considerable pain. Thus, in Weaver’s opinion, osteoporotic fractures in older adults warrant more attention. People acquire 40 to 50 percent of their adult bone mass during puberty, with a 10 percent difference in peak bone mass during this early period being associated with a 25–50 percent difference in hip fracture risk later in life. As people age, their bones thin (i.e., osteoporosis). According to the most recent statistics (National Health and Nutrition Examination Study [NHANES] 2005–2010), an estimated 10.2 million Americans have osteoporosis and another 43.4 million have low bone mass. There is no cure for osteoporosis. “That’s why prevention with diet and exercise is so important,” Weaver said. She suspected that dietary and exercise interventions may be more effective during periods of rapid bone mass turnover, that is, during puberty, but also during menopause for women (women lose up to 15 percent of bone mass in the first few years of menopause).

In addition to the skeletal system, the health and function of the skeletal muscular system is of great importance with age, described Roger Fielding, Tufts University. He began, “one of the important things that I am going to impress on you is that skeletal muscles actually really matter.” Skeletal muscles make up 45 to 50 percent of total body mass. Many of the problems that older adults have climbing stairs, getting out of chairs, and otherwise moving around are related to skeletal muscles. More specifically, they are related to skeletal muscle changes known as “sarcopenia,” which Fielding described as age-associated loss in muscle mass and function. Age-associated difficulties in mobility, specifically a decreased ability to walk one-quarter mile, have been associated not only with increased functional decline, but also increased hospitalization rates and health care costs. Fielding described recent efforts to develop diagnostic and treatment guidelines for sarcopenia and predicted that a future goal will be to link objective sarcopenia markers (e.g., grip strength, gait speed) with outcomes like falls, injurious fractures, and mortality. Fielding listed several dietary and physical activity interventions that have been studied as ways to slow or reverse the rate of muscle loss. He acknowledged the controversy around “appropriate” protein intake in older adults, but emphasized the clear central role of protein in skeletal muscles with age.

## **Sensory and Oral Health**

Nancy Rawson, Monell Chemical Senses Center, described how the brain receives both external, sensory inputs (“hedonic” inputs) and internal, metabolic inputs (“nutritional” inputs) and how this information is filtered through experience, health, and age. She emphasized the multi-sensory nature of food enjoyment, with smell arguably playing the most important role, but texture, vision, and hearing also contribute. Although the ability to detect odors decreases substantially as one ages, Rawson emphasized loss of smell sensitivity with age, noting that the degree and nature of loss can vary considerably between individuals. In work on olfactory neuron function, she and her research team have found that, from age 50 onward, sensitivities to different odors decline with age, as expected. She said she was surprised, however, when they also found that a higher percentage of cells were actually responding. Upon further investigation, they discovered that the responding cells were those with more broadly tuned odor sensitivities. Older adults are still able to smell, Rawson explained, but they have a harder time differentiating between odors.

“Previously, old age was ‘dentures.’ Not anymore,” Athena Papas, Tufts University School of Dental Medicine, began. People do not want to give up their teeth. Unfortunately, Papas said, the teeth that people keep are unhealthy, with root decay being among the most common diseases in older adults. Even with the loss of only a few teeth, it is difficult for older adults to increase consumption of recommended nutrient-filled foods and beneficial food components like green vegetables and fiber. “The nutrient quality of the diet significantly goes down as you lose teeth,” she said. This, in turn, increases the risks for cardiovascular disease and other adverse health outcomes. Loss of dentition has also been associated with increased mortality. Papas emphasized the bi-directional link between oral disease and diet. She described evidence showing that loss of teeth with aging is associated with bone loss and periodontal disease, which, in turn, is associated with lower fiber and vitamin C intakes. Oral disease in older adults has also been associated with medication use, in part due to the loss of saliva, or “dry mouth,” and root decay.

## **Gastrointestinal Health and the Gut Microbiome**

Cindy Davis, Office of Dietary Supplements, National Institutes of Health, described evidence showing that the human gut microbiome can be modified through diet. For example, plant-based versus animal-based diets in humans have been shown to affect microbial gene expression and activity differently. She emphasized the two-way nature of the relationship, that is, the microbiome is not only impacted by diet, but it can also generate new metabolites from dietary components (e.g., equol from soy, butyrate from fiber). Many of these bacterial metabolites, in turn, have been associated with health effects. In addition to

their health benefits, gut bacteria can also produce metabolites with adverse effects on health. For example, dietary carnitine in meat can be metabolized by gut bacteria to trimethylamine, which is then converted in the liver into trimethylamine N-oxide, which has been associated with heart attacks, stroke, and death. Importantly, however, other studies have shown that certain nutrient–nutrient interactions can confer a protective effect. Davis speculated on the future of microbiota-based dietary interventions, specifically the possibility of personalized recommendations (i.e., based on an individual’s microbiome composition).

Sharon Donovan, University of Illinois at Urbana-Champaign, emphasized the importance of post-natal programming in development. In addition to breastmilk providing all the necessary nutrients for normal growth and development, Donovan explained, it also contains bioactive components that serve non-nutritional roles, including stimulating development of the gut microbiota. The early gut microbiota, in turn, has been shown to play a critically important role in “educating” the immune system and protecting not only against acute infections in early life (e.g., respiratory tract and gastrointestinal infections), but also longer-term immune-related diseases (e.g., asthma, inflammatory bowel disease). Using a non-invasive, fecal sampling method to examine microbiome composition in breastmilk-fed versus formula-fed human infants, she and her colleagues found that breastfed infants had significantly more Bacteroidetes than formula-fed infants, but significantly less Firmicutes. Donovan explained that previous research has shown that the relative abundance of certain bacteria in the gut, particularly a higher ratio of Firmicutes to Bacteroidetes, has been positively associated with obesity. Using the same non-invasive sampling technique, Donovan and her team have also found differential intestinal gene expression in breastfed versus formula-fed infants. She stressed the continuous interaction of the microbiome in early life, intestinal development, and immune development and opined that there is no reason to think that this does not continue throughout life.

### **Dietary Interventions for Health Aging**

In the last presentation of day 1, Rafael de Cabo, National Institute on Aging, sought to translate what has been learned about key pathways in aging in other animals into humans. “Aging is a universal process,” he said. In laboratory animals, scientists have been able to alter both the onset and progression of aging by restricting daily total caloric intake. These same studies have also shown reductions in age-related cancers, as well as other age-related phenotypes, according to de Cabo. But these lab-tested longevity interventions are life-long interventions. It would be very hard, de Cabo observed, to convince a human to eat 30–50 percent fewer calories every day for the rest of his or her life. Moreover, many factors have been shown to influence the effects of caloric restriction in laboratory animals, including sex, genetic background, diet composition, age, and the extent of caloric restriction (e.g., 20 versus 40 percent). However, a growing understanding of the mechanisms underlying the response to caloric restriction has led to the identification of molecular targets that potentially could be either activated or deactivated by pharmacological compounds (i.e., without any actual caloric restriction). In addition to the effects of caloric restriction on longevity, de Cabo elaborated on the extensive mouse model work by Mark Mattson and colleagues showing a connection between energy restriction and the maintenance of optimal brain function and resistance to injury and disease.

### **MOVING FORWARD**

Based on his experience working with geriatric patients, the first Session 4 speaker, David Reuben, David Geffen School of Medicine, University of California, Los Angeles, emphasized the heterogeneity of the older population not only with respect to health, but also in risks associated with malnutrition (e.g., being heavier may be beneficial for some older individuals), barriers to good nutrition (e.g., medications that interfere with appetite), and variation in nutritional health and problems among sub-populations (e.g., individuals who live in the community as opposed to in assisted living facilities or nursing homes). Reuben provided an overview of results from observational studies and clinical trials on three diets and their effects on health in older individuals: (1) the Mediterranean diet; (2) the Dietary Approaches to Stop Hypertension (DASH) diet; and (3) the Mediterranean-DASH Intervention for Neurodegenerative Delay (MIND) diet. All three diets have shown significant decreases in several adverse health outcomes, including cardiovascular disease and mortality, overall mortality, cancer, stroke, Parkinson’s and Alzheimer’s, and cognitive functioning. Additionally, Reuben summarized some of what is known about the relationship between nutritional supplements and disease outcomes in older individuals, with a focus on the inconsistency of results around calcium supplementation. Finally, he posed several questions for the field to consider, such as, when, if ever, is it reasonable to stop preventive nutritional measures in older individuals (i.e., limiting the types of foods they eat) because they are at a point where they just need the calories.

Eve Stoady, Center for Nutrition Policy and Promotion, U.S. Department of Agriculture, emphasized that lifespan is at the core of the 2015–2020 *Dietary Guidelines for Americans* (DGA). She drilled down into each food group separately and compared average daily intakes across the lifespan for both sexes to recommended intakes; and emphasized that at certain stages of the lifespan, certain components of the diet are of greater concern compared to other stages of the lifespan. She observed that among both older adults (71 and older) and adolescents (14–18 years), vegetable and fruit intakes are low, while added sugars and sodium are not as great a concern in older adults as in adolescents. Total grains and protein intakes are near recom-

mended levels. With respect to the future 2020–2025 guidelines, while the DGA have traditionally included recommendations for Americans 2 years and older, Stoody stated that there has been a growing demand to expand the guidelines to cover the 0–24-month population and suggested that there might be other stages of life, including older adults, that similarly warrant more comprehensive guidance.

In Tim Morck's opinion, when someone asks what the food industry contributes to healthy aging, really the question is, "What are you as a consumer choosing from this panoply of options to meet your own needs?" Morck, of Spectrum Nutrition Consulting, Washington, DC, expounded on the complexity of the food industry and observed that during the past 5–10 years, the food industry has made significant progress toward supporting healthy eating, for example, by reducing sugar, fat, and calories and eliminating trans fat from the food supply. He described several drivers of the food industry, one being that the industry sells only products that people buy. People do not typically eat just to meet a physiological requirement, he observed. They eat for social and other reasons as well, with different people turning to different foods for these purposes. To engage food industry support in healthy eating, Morck called for compelling research outcomes with practical applications (i.e., develop products that can support healthy eating) and, when appropriate research is available, a cooperative and collaborative regulatory agency to approve validated product claims (i.e., communicate to consumers what they can expect from consuming the product). From the food industry, he called for support of relevant research, development, and marketing of products consistent with nutritional recommendations and collaboration with regulatory agencies on effective ways to communicate the value of products.

Representing the dietary supplement industry in particular, Douglas "Duffy" Mackay, Council for Responsible Nutrition (CRN), emphasized the need for people to eat more whole grains and vegetables. He also recognized the dramatic deficiencies in the American diet and practitioners' need for additional options (or approaches) to use with their patients to help them reach their nutritional targets. Mackay described several age trends in the 11 shortfall nutrients identified in the 2015–2020 DGA, most notably that a majority of men and women do not meet the estimated average requirements for calcium and vitamin D or the adequate intake for fiber. Next, he described results showing that when dietary supplement intakes are accounted for in addition to food intakes, compared to food intakes alone, a smaller percentage of the population falls below the recommended levels for several nutrients. Based on this evidence that significant proportions of the population have inadequate nutrient intakes, combined with evidence that nutrient supplementation can improve nutrient intake, Mackay argued that the supplement industry's role in supporting healthy aging is to promote the responsible use of dietary supplements in combination with a healthy diet as a way to ensure nutrient adequacy. He listed the several ways they fill this role, such as investing in health care cost analyses of savings associated with achieving targeted nutrient intakes.

Moderator Simin Meydani, Tufts University, opened the final discussion of the workshop by prompting the participants to reconsider, in light of the previous presentations and conversations, what healthy aging is and what markers should be utilized in developing strategies to promote it. She remarked on how the notion of successful, or healthy, aging has changed over time to encompass more than simply the absence of disease or functional impairment. Several recent studies have shown that multiple genetic, lifestyle, and environmental factors, including cognitive and physical capacity, as well as active participation in social activities, affect healthy aging. Meydani called attention to studies based on self-reported successful aging (i.e., a subjective measure of successful aging), which tend to yield higher percentages of successful aging compared to studies based on objective measures of successful aging. Meydani interpreted this trend to mean that, while most older people may not meet the objective definitions of successful aging, they may nonetheless think of themselves as having successfully aged. This raises the question: Who should define successful aging?

Following Meydani's presentation, the four panelists were asked to each present some final thoughts on healthy aging based on what they had heard over the course of the workshop.

"Successful aging is living," Frank Busta, University of Minnesota, began. "Even if you have an illness and disease, you bypass that, and you live." As a microbiologist, he was delighted to hear that the microbiome is being examined over the lifespan and suspected that this knowledge will have a tremendous influence on healthy aging in the near future. He observed that he did not hear much about behavior modification at this workshop, yet in his opinion, it is "terribly significant." People know what they should be eating, but there is so much associated with food (e.g., socializing, entertainment) that behavioral change is, he said, a "tremendous challenge."

Johnson opined that physical function (as measured by walking speed, strength, etc.) and living independently (as measured by social engagement) are two aging process markers of particular practical significance. Additionally, while inflammatory markers may not indicate what is wrong, they indicate that something is wrong. As such, in her opinion, they serve as integrative markers that cut across multiple domains. In addition to her comments on markers, she encouraged thinking about how to be partners with and influence the health care system and find ways, for example, to integrate nutrition services into care transitions so that older adults are not readmitted to hospitals so quickly.

A workshop message that reverberated for King was the complexity of the aging process. Aging does not begin at 50, 70, or 90 years, rather it starts in utero. As such, in her opinion, thinking about healthy aging requires thinking about the lifespan from the very beginning. Moreover, people age differently, some faster than others. When thinking about interventions, she stressed the importance of keeping in mind the socioeconomic context of aging and suggested identifying key targets that are simple and easy to comprehend. For example, maintaining a certain walking gait, in her opinion, is something that everyone can understand (e.g., being able to walk 1 mile in 15 minutes).

The fourth and final panelist, Reuben, suggested that older people are “painted” as adults with gray hair and wrinkles. “In fact, they are not,” he said. If someone’s goal is for his or her 90 to be “the new 70,” then the traditional biomarkers of successful aging are the right targets on which to focus. However, he argued, it takes a lot of work to be 70 at 90, and many people do not want to work that hard. Rather than geriatricians telling people “this” is how they should be at 90 or at 85, he said, “it’s really about what you [the patient] think you should be at 90 or 85.” He commented on the body of literature that exists on the topic of goal setting and goal attainment and suggested that it may be a useful resource.

Meydani agreed with Reuben that seeking input from older adults about what matters to them is important. However, she also stressed the need to come up with tangible markers of successful aging that span multiple domains and uses. In her opinion, health care providers need markers of aging that can be used to identify at-risk people and know when intervention is appropriate; governments need markers of nutritional intakes or other lifestyle changes that can be used specifically to guide the development of recommendations for older people; and the food industry needs markers of aging that can be used to validate the efficacy of products in specific target groups.

In the open discussion following these remarks, other topics addressed included public use of the DGA (e.g., who uses them, how they are used); the role of behavioral intervention in healthy aging; and the present opportunity to collect baseline data and begin long-term, longitudinal studies on nutrition and aging in the baby boomer population.

In closing, Meydani asked the panelists if any markers for healthy aging could be utilized now and, if not, what the next step should be to compiling a set of markers for healthy aging. In Reuben’s opinion, yes, there are some existing as well as some soon-to-be physiological and psychological markers. Additionally, he emphasized a third category: personalized markers based on individuals’ perceptions of their own healthy aging. Johnson agreed with Reuben on the need to identify markers based on what older adults themselves consider to be important. She suggested, additionally, that markers also need to be developed based on what is perceived by programs and payers to be important. King encouraged thinking about early determinants of inappropriate aging processes, for example, inflammation. Finally, Busta said, “I think the marker of successful aging is being proud of how old you are.”◆◆

**DISCLAIMER:** This Proceedings of a Workshop—in Brief was prepared by **Leslie Pray** as a factual summary of what occurred at the meeting. The statements made are those of the rapporteur or individual meeting participants and do not necessarily represent the views of all meeting participants, the planning committee, or the National Academies of Sciences, Engineering, and Medicine.

The National Academies of Sciences, Engineering, and Medicine’s planning committees are solely responsible for organizing the workshop, identifying topics, and choosing speakers. The responsibility for the published Proceedings of a Workshop—in Brief rests with the institution.

**REVIEWERS:** To ensure that it meets institutional standards for quality and objectivity, this Proceedings of a Workshop—in Brief was reviewed by **Catherine Kwik-Urbe**, Mars, Inc.; **Pamela Starke-Reed**, U.S. Department of Agriculture; and **Mary E. Worstell**, U.S. Department of Health and Human Services. **Lauren Shern**, National Academies of Sciences, Engineering, and Medicine, served as the review coordinator.

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