

# California Agriculture



**The Golden State goes gray:**  
*What aging will mean for California*

## Time for reflection – time for action

In the last half of 2008, the Division of Agriculture and Natural Resources (ANR) began work on a new strategic plan that culminated in the April 2009 Strategic Vision 2025 ([http://ucanr.org/About\\_ANR/Strategic\\_Vision](http://ucanr.org/About_ANR/Strategic_Vision)). As part of that planning process, panels of experts from within and outside ANR synthesized the most up-to-date research available on expected trends for California. They analyzed California's future structure and considered the systems supporting agriculture and food, natural resources, health and nutrition, and human development.

To summarize, by 2025 California is expected to have 8.5 million more residents, a 22% increase from 2008 when our strategic planning began, making the state home to an estimated 47 million people. The population will be significantly older, with the proportion of seniors age 60 and older increasing from approximately one in seven to about one in five. The first of the baby-boom generation will reach 65 in 2011, and many projections indicate that, as a whole, California industries will face labor shortages in critical skills. Employment will likely shift from manufacturing and natural resources to service industries, and access to a stable agricultural workforce will continue to be uncertain. Unfortunately, the loss in science literacy in the K-12 population will continue, with expectations that only seven out of every ten students will graduate from high school in 4 years, and only one in four graduates will be ready for college.

Even as an aging population, workforce challenges and eroding science literacy affect California agriculture and its broader economy, the world population will increase by approximately 30% by 2025, creating significantly

**As I write this, we are hopeful that the final resolution of a state budget — including support for higher education — will allow us to recruit for a significant number of high-priority academic positions.**

greater demand for agricultural products including food, fiber and renewable biofuels. An aging farm population and the continued erosion of scientific expertise in food, and natural resource production, research and education, will challenge food-system sustainability — unless steps are taken to reverse the trend, including educating young people in this area.

Now, 18 months into our implementation of the Strategic Vision, it is an opportune time to reflect on aspects of the information that we have gathered and applied. In order to make the most of ANR's available resources, we have focused our initial attention on four of the nine initiatives outlined in the Vision ([http://ucanr.org/sites/anrstaff/Strategic\\_Initiatives](http://ucanr.org/sites/anrstaff/Strategic_Initiatives)).

All four of the initiative advisory panels are close to proposing initial areas of inquiry and best opportunities for focused research and education. Initiative leaders aim to focus on areas where significant impacts in limited time frames can be made by leveraging existing research and alternative sources of funding, and building collaborations with new UC and outside partners.

All four initiatives — sustainable food systems, healthy families and communities, endemic and invasive pests and diseases, and sustainable natural ecosystems — have identified cross-initiative areas such as water, science literacy and youth development, and initiative leaders are working together to incorporate these kinds of cross-disciplinary opportunities into their planning.

At the local level, current projections indicate that our county partners will face even more difficult budget constraints in the coming years. In response, we are examining opportunities to change our traditional county partnerships to ones with expanded boundaries and multicounty partnerships to release administrative resources, save county and UC dollars, and expand program support.

As the Division's current workforce retires, we will focus on allocating resources strategically, building on our breadth of expertise, and securing the essential capacities to discover and deliver new knowledge and policy-relevant science. As I write this, we are hopeful that the final resolution of a state budget — including support for higher education — will allow us to recruit for a significant number of high-priority academic positions.

This issue of *California Agriculture* looks at one aspect of importance in human and community development: our aging population. It reviews various issues that population change brings to California, and how ANR research and education efforts in these areas can provide information that makes a difference in the lives of California's citizens.

As our population ages, ANR has a tremendous opportunity, and, in fact, a duty to make a difference in educating young people for the future. In addition to the proven success of our 4-H and youth development programs, UC and ANR must focus our brightest minds and best ideas on the state's complex problems, and translate and deliver the best science available to California's entrepreneurs, industry leaders, land managers, policymakers and consumers, both young and old.

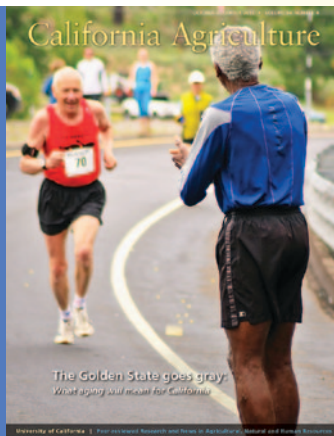


**Barbara Allen-Diaz**  
Associate Vice President,  
Academic Programs and  
Strategic Initiatives



# TABLE OF CONTENTS

OCTOBER–DECEMBER 2010 • VOLUME 64 NUMBER 4



**COVER:** The first of the baby boomers (born from 1946 through 1964) will reach age 65 in 2011. Aging research in this special issue seeks to improve the quality of life and wellness of older Californians. Two senior male runners participated in a relay race at Lake Tahoe in June 2009. Photo: Karin Hildebrand Lau/Shutterstock

**NOTE:** The research articles here focus on Californians over age 65, while the news stories look at those 60 and above.

## The Golden State goes gray: What aging will mean for California

### Research and review articles

- 167 **Research is needed to assess the unique nutrition and wellness needs of aging Californians**  
*Blackburn, Gillogy, Hauselt*  
Economics, literacy and other factors affect the nutritional status of elders, whose bodies metabolize food differently than younger persons.
- 189 **Cognitive and motivational factors support health literacy and acquisition of new health information in later life**  
*Miller*  
There is a pressing need to understand age-related changes in the processes underlying the ability to read, understand and use health information.

- 174 **Memory, brain and aging: The good, the bad and the promising**  
*Ober*  
Episodic is the only type of long-term memory that declines with age; other types improve or show no change.
- 195 **Limited-income seniors report multiple chronic diseases in quality-of-life study**  
*Blackburn*  
In a survey and forum, elders preferred the personal approach to learning how diet and activity can improve the management of their diseases.

### News departments

- 165 **Research update**  
Aging baby boomers to challenge Golden State  
  
Minority outreach and Alzheimer's disease

- 183 **Effects of stress on health and aging: Two paradoxes**  
*Aldwin and Yancura*  
Older adults can learn to be more resilient to stress, which may have long-term positive effects on their aging process.

- 201 **The need for caregiver training is increasing as California ages**  
*Barrett and Blackburn*  
Informal and formal caregivers are underpaid and undertrained, and stress puts them at considerable risk of ill health.

#### Thank you:

Beth A. Ober, UC Davis professor of human development, served as faculty chair for this special issue on aging.



- 206 **Long-term care is an important consideration in financial planning for later life**  
*Wooten Swanson and Varcoe*



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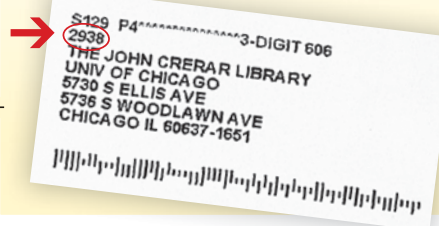
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— Editor





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## Aging baby boomers to challenge Golden State

California is about to be hit by an “age wave” of people 60 years and over. Elders are projected to account for an unprecedented one-fifth of the state’s population in just a decade, according to the 2009–2013 *California State Plan on Aging*, straining the already thinly-stretched services for senior citizens. UC research and outreach are helping Californians fulfill the promise of their golden years (see page 195).

### “Silver tsunami”

Driven by aging baby boomers and longer life spans, this “silver tsunami” is expected to swell the state’s elderly population by 40% to nearly 9 million by 2020 and to double it from the current 6.4 million to 11.5 million by 2030. Elders’ greatest needs will include transportation so they can maintain independence and avoid isolation, caregivers so they can stay in their homes (see page 201), and health care for the mental and physical ailments that can come with age. These needs can be exacerbated in rural areas. “As the elderly have to stop driving due to vision and health problems, how will they get to doctor appointments and senior centers?” asks Beth A. Ober, UC Davis professor of human development.

Within the elderly population, those 85 years and over are more likely to have severe disabilities and chronic conditions such as heart disease, diabetes and dementia. These so-called “old-old” will more than triple in California from the current roughly 600,000 to nearly 3 million by 2050, and more than three-fifths will be women due to their longer life expectancies. Other particularly at-risk elders include the 20% with limited English skills

(see page 189), the 30% living in or near poverty and the 50% with disabilities. In addition, Latino and black seniors may be at higher risk for Alzheimer’s disease (see box).

### Optimal aging

But getting older does not have to mean deteriorating mental and physical health. “The aging process is plastic,” says Carolyn Aldwin, former UC Davis professor of human development, who is now

### Minority outreach and Alzheimer’s disease

The risk of Alzheimer’s disease increases with advanced age and cardiovascular disease, and while the first is color blind, the second is not. Blacks are more likely to have high blood pressure (hypertension) and Latinos are more likely to have diabetes, which increases the risk of hypertension. But does this translate into a greater likelihood of Alzheimer’s disease?

Study results are mixed and researchers at the UC Davis Alzheimer’s Disease Center are investigating what relationship exists, if any. The most common form of dementia (or cognitive decline), Alzheimer’s disease causes memory loss, disorientation and personality changes.

“We study healthy aging and cognitive impairment in minorities,” says Charles DeCarli, Alzheimer’s Disease Center director. “Our goal is understanding their special needs.”

The Center conducts minority outreach throughout the Central Valley as well as in the Oakland area, taking the unique approach of sending representatives into communities rather than the typical approach of expecting residents to come to a clinic.

“If you go out into the community and talk to people, that breaks down barriers and they are more willing to come to the clinic,” DeCarli says. Latinos are among the fastest-growing segments of California’s elderly population, increasing the urgency of providing effective outreach to minorities.

Besides helping recruit a more representative sample for the Center’s study, this community outreach teaches minority elders and caregivers about dementia. “It’s good for the individuals attending and will ultimately benefit the whole population,” DeCarli says.

— R. Meadows

Seniors who exercise regularly are less susceptible to many common illnesses.



Administration on Aging



During UCCE's "Make Food Safe for Seniors" workshop for grandparents at the California Family Life Center in Hemet, a Glo-Germ Hand Washing Kit was used to demonstrate how well a participant cleaned her hands.

at Oregon State University, Corvallis. "Dementia, osteoporosis, cardiovascular disease and the like are not inevitable."

How we age is primarily affected by how we live. "Surprisingly, just a few factors affect aging in many different organ systems," says Aldwin, an editor of the 2007 book *Handbook of Health Psychology and Aging* (Guilford Press). The keys are not smoking, good nutrition and regular exercise:

- Smoking tobacco increases the risk of a host of illnesses from lung cancer and heart disease to osteoporosis and dementia. This is partly because smoking damages collagen, the primary protein found in connective tissue throughout our bodies. Besides being a health threat, collagen damage causes wrinkles that make people look more aged.
- Poor nutrition can lead to glucose intolerance and ultimately diabetes, which can cause high blood pressure, cardiovascular disease and nerve damage. In contrast, diets rich in whole grains, fruits and vegetables provide nutrients vital to organ function as well as antioxidants that protect against aging at the cellular level (see page 167).
- Exercise benefits lung and cardiovascular health, and may protect against colon cancer. In addition, seniors who exercise regularly are less susceptible to catching colds, and weight-bearing exercise helps counteract osteoporosis.

Another key to optimal aging is how we handle stress (see page 183). "Elders can be more vulnerable to stress physiologically," Aldwin says. "But people can also develop appraisal and

coping strategies that allow them to become more resilient with age." Good nutrition, regular exercise and reducing stress are also good for our brains as

we age, says UC Davis' Ober. Other ways to protect brain function and memory include having an active social life and keeping your mind active, for example by learning a new language (see page 174).

## Elder care

Outreach is key to helping elders age optimally, including teaching their caregivers what they need. Most elder caregivers are family members, but about one-fifth are registered with and paid for by In-Home Supportive Services (IHSS), state-funded county programs for low-income seniors. IHSS caregivers help with the essentials of daily living from housekeeping to meal preparation to personal care. "Unfortunately, there is no standardized training for registered caregivers," says Gloria Barrett, former director of UC Cooperative Extension (UCCE), Sacramento County

To help close this gap, IHSS and UCCE developed a training program based on a survey of about 1,000 registered caregivers in Sacramento. "Many are of limited income and education, and they represent diverse cultural and ethnic groups," Barrett says. A casualty of county budget cuts, the training was offered in English, Spanish, Hmong and Russian, and covered a wide range of needs, from promoting mental and physical health to identifying the signs of dementia to preventing falls, the leading cause of injury and death in elders. The curriculum includes basics such as how to prepare nutritious meals and remove spoiled food from refrigerators. "This program was fairly unique," Barrett says. "In other areas of the state, there may not have been any training at all."

And soon, there may also be a dearth of registered caregivers. "The state plans to cut or eliminate IHSS services," Barrett says. To close the \$18 billion dollar budget gap projected for 2010-2011, the Governor's office has proposed cutting the IHSS budget by \$750 million, according to the state Legislative Analyst's Office. This is about half of the program's current budget and would jeopardize services to hundreds of thousands of the seniors currently participating statewide.

Regardless of who provides the care, California's growing elder population will intensify the need for caregiver training. "We need to provide training even if family members take over most of the caregiving," Barrett says. "It's important that this type of work continue."

— Robin Meadows

### For more information

California Department of Aging  
<http://www.aging.ca.gov>

California State Plan on Aging 2009-2013  
[http://www.aging.ca.gov/legislation/California\\_State\\_Plan\\_on\\_Aging\\_AoA\\_2009-2013\\_06-30-2009.pdf](http://www.aging.ca.gov/legislation/California_State_Plan_on_Aging_AoA_2009-2013_06-30-2009.pdf)

### Optimal Aging

[http://groups.ucanr.org/elderly/documents/Aging\\_Issues5831.pdf](http://groups.ucanr.org/elderly/documents/Aging_Issues5831.pdf)



# Research is needed to assess the unique nutrition and wellness needs of aging Californians

by Mary L. Blackburn, Barbara Gillogy, and Peggy Hauselt

***Inadequate diet and nutrition can contribute to or exacerbate chronic and acute diseases, hasten the development of degenerative diseases associated with aging, and delay recovery from illness. No single segment of society can benefit more from improved diet and nutrition, and regular exercise, than the elderly. While links between diet, exercise and chronic-disease risks are well documented, more research is needed on how best to use quality-of-life approaches and perceived benefits as motivators for behavior change among the elderly. This report explores how physiological components affect the nutrition and wellness of seniors, puts into context the status of related research, and helps establish a framework to reassess UC Cooperative Extension priorities for applied research, education and outreach to California's elderly population.***

More than 50 years ago, the World Health Organization redefined health as more than merely the absence of disease, expanding it to include the physical, mental and social well-being of populations (Damron-Rodriguez et al. 2005). One of the goals of the National Guidelines for Health Promotion and Disease Prevention (the "Healthy People 2010" report published in January 2000 by the U.S. Department of Health and Human Services) was to "extend the years of 'healthy life' in a physical, mental and social context" (US DHHS 2000).

The number of older Americans is projected to double by 2030, and one in



A public health approach to aging would promote the conditions under which people can be healthy, with emphasis on increasing wellness rather than preventing disease.

nine baby boomers is expected to live until age 90. This will place tremendous demands on retirement income, and health and social services. The rapid expansion of the population 65 years and older has already had an economic impact on health-care budgets at all levels. The greatest use of the health-care system occurs during the last years of life (Chernoff 2001), and health experts have projected that at least 7 years of one's life will be spent in ill health (Economist 2000). The health-care expenditures of those over 65, who make up about 13% of the U.S. population, account for at least 30% of the nation's annual health-care costs. Hospital use by people over 65 is about three times that of younger people, and individuals in this group fill the majority of beds in skilled-care facilities (Weimer 1998).

The Institute of Medicine (2002) has called for a public health approach to promote the conditions under which people can be healthy, emphasizing health rather than disease, being proactive rather than reactive, and focusing on populations rather than individuals (Wallace 2005).

This report puts into context the status of research and development on the nutrition and wellness needs of aging Americans, particularly in California. It helps establish a framework in which UC Cooperative Extension (UCCE) priorities for applied research, and nutrition and wellness education for the elderly, can be reassessed. We used data from the 2001 U.S. Census and the 2001 California Health Interview Survey (CHIS) (Wallace et al. 2003) to show the status of major chronic-disease conditions among older Californians. We also conducted a literature review of scientific research on how physiological factors contribute to the nutrition and wellness status of seniors.

## Healthy aging becomes a necessity

The percentage of elders in California is growing faster than the rest of the country (Aldwin and Gilmer 2001). California's population of seniors 65 and over is about 4.1 million, or 11.2% of the total population, and county proportions vary (US Census Bureau 2010). The ethnic composition of seniors 65 and older is about 16% white, 10%

Sherrie Thai, Shaireproductions.com

Asian/Pacific Islander, 8% black, 7% American Indian, and 4% Latino (Lopez 2002).

Between 1990 and 2020, more than half of California counties were expected to double their proportion of seniors 65 and over (AOA 2003). Seniors 85 years and older will increase at the highest rate, more than 150% in 38 of California's 58 counties. The significance and impact of this oldest group will become more evident between 2030 and 2040, when the first wave of baby boomers reaches age 85 (CDA 2003).

This demographic shift has thrust health and quality-of-life issues during the oldest years into the public eye. With one in four families currently caring for a family member, the Institute of Medicine (2008) reported that some feel older people are unproductive, cost too much and cause intergenerational conflict. Health-care and other costs have forced aging issues into the institutional consciousness of the social, educational, economic, financial and medical/health-care systems. Promoting healthy aging is expected to become more important as the baby-boom generation places increasing demands on health care and other service systems (Albert et al. 2002).

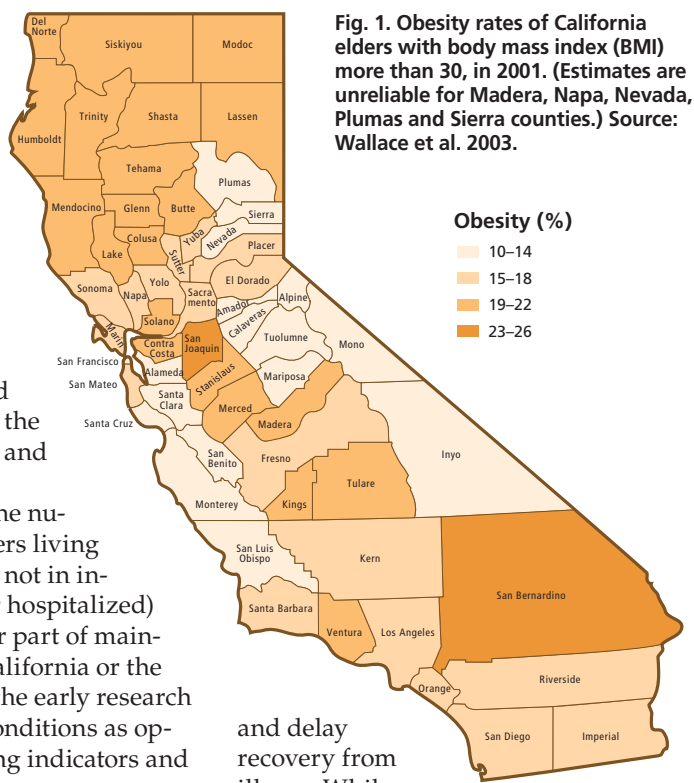
Three important aspects of healthy aging are physical health, mental health and active engagement with life (Rowe and Kahn 1997). The goal of Healthy People 2000 was to increase the span of healthy life, but Healthy People 2010 stresses quality of life and overall well-being, along with increasing life expectancy (US DHHS 2000). Adding life to years rather than years to life is a quality-of-life concept. Biological

scientists agree that optimal nutrition and physical activity contribute to the overall quality of life at any age, especially for older adults (Hughes et al. 2005). No single segment of society can benefit more from improved diet and nutrition and regular exercise than the elderly (Drewnowski and Evans 2001).

Studies to assess the nutritional needs of elders living independently (those not in institutional settings or hospitalized) have not been a major part of mainstream research in California or the nation, and much of the early research focused on disease conditions as opposed to healthy-living indicators and promotion.

### Nutrition and wellness risk factors

Several longitudinal studies now under way are examining the basis for good health in the very old, as well as the potential causes of frailty and common diseases (Ljubuncic et al. 2008). Chronic diseases that compromise their quality of life and well-being affect more than 90 million Americans. For example, obesity (a high-risk factor for diabetes) and other nutrition and lifestyle conditions are common nationwide. Based on a body mass index greater than 30%, 39.7% of California seniors over age 65 were overweight and 16.6% were obese in 2003 (fig. 1).

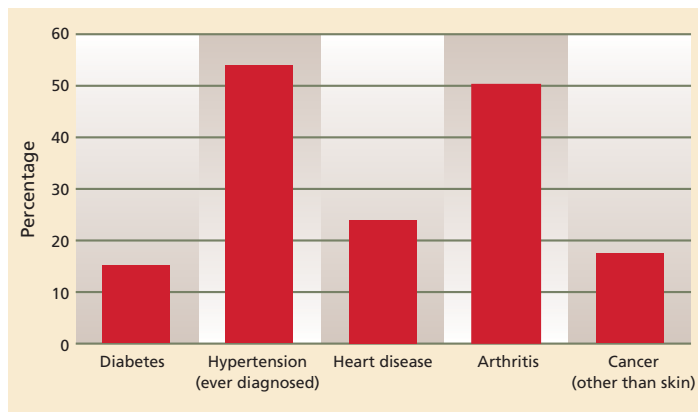


**Fig. 1. Obesity rates of California elders with body mass index (BMI) more than 30, in 2001. (Estimates are unreliable for Madera, Napa, Nevada, Plumas and Sierra counties.) Source: Wallace et al. 2003.**

and delay recovery from illness. While links between diet and exercise and chronic disease are well documented, more research is needed on how best to use quality-of-life approaches and perceived benefits as motivations for behavior change.

Changes in diet and activity patterns are most effective in preventing nutrition-related conditions when they are initiated early in life, but positive benefits can be achieved at any age. Nutrition, however, is not routinely integrated into the health care of older Americans, such as screenings for hypertension, cholesterol, hearing, vision, blood sugar and certain cancers (Chernoff 2001). Hypertension, which has major nutrition implications, is a risk factor for a number of other chronic diseases; prevalence rates among the elderly population in California counties range from 41% to 45%, to 60% to 63% (fig. 3).

Which aspects of improved diet, nutrition and fitness contribute most to wellness and quality of life in the aging process is a crucial research question. Extrapolating values from younger adults for older adults is believed to be insufficient, as is defining adequate nutrition by the amount of particular nutrients needed to maintain blood serum levels (Saltzman and Russell 1998).



**Fig. 2. Top five chronic illnesses in California, 2001. Source: Wallace et al. 2003.**

In a national cohort study, dietary patterns were found to predict mortality (Kant et al. 2004). Inadequate diet and nutrition can contribute to or exacerbate chronic and acute diseases, hasten the development of degenerative diseases associated with aging (fig. 2),



The Dietary Guidelines for Americans, first published in 1980 as Recommended Dietary Allowances (RDAs), makes recommendations for a pattern of eating that is adaptable by the public. As updated in 2005, the guidelines acknowledge that consumers need good advice to make informed choices about diets that support longer, healthier and more active lives (US DHHS 2005a). However, there is limited science-based research delineating the nature of and quantitative requirements for healthy and active older Americans (Amarantos et al. 2001). Some biological scientists believe the Dietary Guidelines for Americans should consider the functional application of nutritional requirements for optimal aging from a health-promotion perspective.

Diverse approaches are needed for health professionals and clients to understand the causes and effects of under- and overnutrition on wellness, common diseases and frailty among the elderly. For example, adequate nutrients could be measured in terms of improvement in disease markers such as homocystine (an amino acid believed to increase the risk of heart disease at elevated concentrations), and the

prevention of chronic diseases such as osteoporosis (Wallace 2005).

### Physiological changes in seniors

Dietary intake and patterns can change with age, and there is some evidence of change in metabolic and absorptive functions. A review of cross-sectional and cohort data found a total energy decline of 1,000 to 1,200 kilocalories (kcal) among males and 600 to 800 kcal among females (Wakimoto and Block 2001). Reduced intake of most other nutrients ranged from one-fifth to one-third of established RDAs. However, the impact of these reduced intakes on the nutrition and wellness of independent-living, active, older Americans is not known.

A number of physiological reasons have been suggested for the decreased food intake observed among the aged (Morley 2001). It may be related to the adaptive relaxation of the bottom of the stomach (fundus), which occurs as we age, increasing the rate at which the stomach fills and leading to early satiation — the feeling of being full. The hormone cholecystikinin, produced in the walls of the small intestine, is secreted in the upper small intestine (duodenum). This hormone triggers the release of digestive enzymes and bile from the gallbladder, but it can also suppress hunger by acting on receptor sites located throughout the central nervous system. Cholecystikinin production increases in the elderly, and the higher levels may contribute to a number of physiological changes including the slowing of gastric emptying, suppression of appetite and reduction of food intake. If the reduction of food intake is severe, it can lead to malnutrition.

The elderly are also more sensitive to the appetite-suppressive effects of the hormone, which is believed to affect a range of metabolic responses in the stomach, gallbladder and small intestine, and lead to feelings of nausea.

Some mild or low-grade inflammatory disorders, and decreased activity of the hypothalamus (the portion of the brain that exerts



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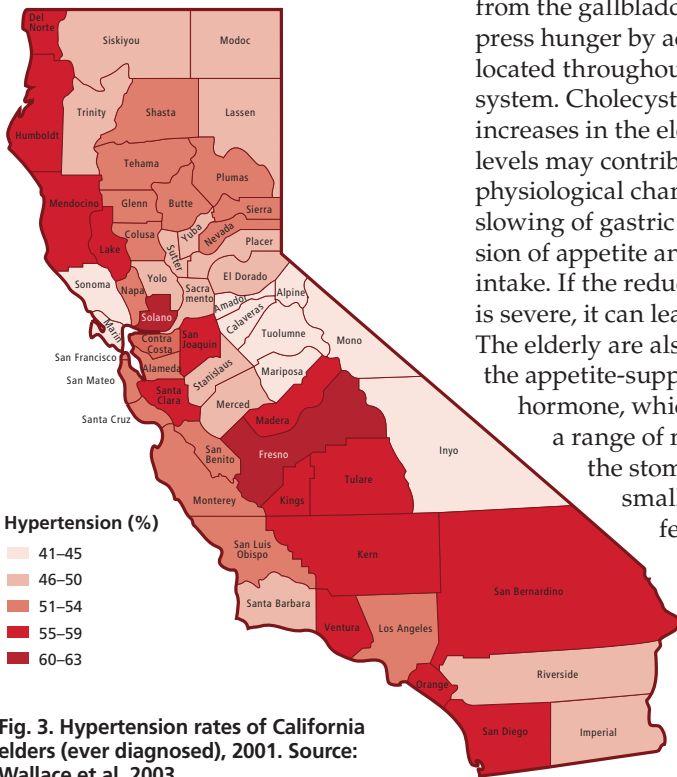
**Dietary intake changes with age, perhaps due in part to physiological changes in the digestive system that make older people feel full faster.**

control over visceral activities, water balance, temperature and sleep) may also result in reduced food intake. In older men, declines in the hormone testosterone and increases in the hormone leptin, which regulates hunger and energy expenditure, may also explain some of the decline in energy and food intake. Studies at UC Davis with senescent (aging) Fischer rats have documented shorter feeding times and smaller intakes, which may be suggestive of earlier satiation (Blanton et al. 1998).

In general, the small intestine undergoes few clinical and physiological changes in aging. However, about one-third of older adults suffer from an “aging gut,” which can lead to a reduction or inability of the stomach to secrete gastric acid (atrophic gastritis). The lack of gastric acid can lead to an overgrowth of bacteria in the small intestine and may have an impact on the absorption of micronutrients such as iron, folate, calcium, vitamin K and vitamin B-12 (Saltzman and Russell 1998). Lactose intolerance (the inability to digest milk), common among about 25% of elders worldwide, can lead to a restriction in the intake of dairy products and sometimes, the development of osteoporosis.

### Aging and nutrient intakes

Cellular senescence (aging) is described as the process in which normal, diploid, differentiated cells (those



**Fig. 3. Hypertension rates of California elders (ever diagnosed), 2001. Source: Wallace et al. 2003.**



The relationship between certain nutrients and particular diseases is well established, such as iron and anemia, and calcium and osteoporosis; but the role of aging in how the body processes nutrients is not well understood.

having two sets of chromosomes) lose the ability to divide and, therefore, die. Senescence of the whole organism is characterized by a decline in the organism's ability to respond to stress, homeostatic imbalance and an increased risk of diseases associated with aging, leading ultimately to death. Genetics may affect the natural rate of aging within species as seen in mice, which are elderly at about age 3, and some reptiles and fish, which age at a much slower rate. Life-span variation within species may be related to inherited differences in the organism's ability to slow the aging process, such as the efficiency of DNA repair, levels of antioxidant enzymes and rates of free-radical production, called the Gompertz-Makeham law of mortality (Gompertz 1860).

Among humans, however, variables such as gender, economics, poverty, environment, diet, public health and access to medical care affect the life span of populations in the United States and other countries and lead to differences between population groups. Thus, human life expectancy does not adhere to Gompertz's law of mortality after age 30 (Ekonomov et al. 1989; Pakin and Hrisanov 1984). However, life expectancy may be calculated starting with age-specific death rates and used statistically to summarize the health status of populations or groups (Lee and Carter 1992).

Historically, there are known relationships between some nutrients and disease processes, including scurvy and vitamin C, beriberi and vitamin B, vision-related disease and vitamin A, anemia and iron, and osteoporosis and calcium. If aging/senescence is technically defined as a progressive failure of genes to maintain and repair, which leads to a reduced capacity of biological systems to function in a homodynamic fashion, how does nutrition enter into the equation? What intercellular or biochemical responses associated with the biological processes of aging cells are nutrient driven? A theory related to evolution suggests that genes that increase fitness in early life may have negative affects in later life. For example, a gene that codes for the deposit of calcium in the bones in early life may have negative affects in old age if it promotes calcium deposits in the arteries (Williams 1957).

Some research questions relevant to the broader issues of nutrition and wellness concern the impact of selected nutrients on chronic diseases of aging. For example, sucrose and dietary carbohydrates (sugars and starches) are significant because type 2 diabetes is so prevalent, occurring in about 15% of Californians over age 65. We need to understand the role that these nutrients play in the disease's prevention, onset and management.

Basic animal research conducted at UC and other institutions has increased our understanding of cellular and whole-organism responses to selected nutrients during the onset or progression of the aging process. General research with Sprague-Dawley and Fischer rats, and in vitro studies at UC Davis, have examined a number of questions, including: rates of aging; alterations in food intake and body temperature; the interactions of dietary restriction, dietary carbohydrates and life span; the hypothalamic affect in the control of food intake during aging; and the cellular proliferation of brown adipose tissue (fat).

UC Davis researchers have published a number of relevant studies on issues such as the impact of age and diet on glucose tolerance; dietary sugars and lipid metabolism; and aging, meal patterns and reduced food intake. A client-centered report of relevant university studies on aging is needed to present a more detailed prospectus for the UC Division of Agriculture and Natural Resources (ANR) and its constituents. UCCE could develop user-friendly education briefs and/or fact sheets for use by the general public. An important objective of the report(s) should be how these findings can be used to develop a strategic plan of applied research, educational programs and intervention strategies to address the nutrition and wellness needs of California's elders.

### Physical components of nutrition

Many elders have trouble eating and accessing healthy foods. Their food choices may be partly based on factors other than nutrition knowledge (US DHHS 2005b). For example, an upset stomach may result in the avoidance of foods suspected of causing the problem, ultimately limiting the intake of fiber, vitamins, calcium and protein. Difficulty chewing may affect the consumption of meat, fresh fruits and vegetables. Food may seem to have no flavor or taste bad, and medicines can affect appetite.

Food availability may be affected if elders are unable to shop, drive, walk or stand for long periods of time. Cooking may be limited if they have problems standing or holding utensils, pots and pans, and so on. Poor appetite or lack



of appetite may plague elders who live alone, are lonely or do not feel like cooking, while the lack of funds to buy food affects food accessibility, availability, quality and variety.

Finally, low literacy may mean that some elders are unable to read or comprehend nutrition and wellness information. Poor vision can make it difficult to read nutrition labels and to control intakes of dietary sodium, sugar and fat, as well as to avoid foods to which one is sensitive.

### Role of socioeconomic factors

While chronic diseases and illnesses are more prevalent in older adults, poor health is not an inevitable consequence of aging. The annual decline in serious and less-serious chronic illness disability, ranging from 0.7% to 2.3% from 1982 to 1999 in a number of national studies, reveals a healthier group of older people than suspected, particularly those over 85. This decline in chronic illness and disability may be due to better nutrition, lifestyle and health care. This theory suggests that investments in health-care technology and nutrition could preserve human capital in the U.S. economy. (Crimmins et al. 1997; Ljubuncic et al. 2008).

Nonetheless, the diets of many older Americans do not provide the nutrient levels needed to maintain a healthy body (Weimer 1997). To understand functional impacts on the nutrition and health status of the aging population, factors such as education, finances, mobility, general health status, physiological needs, physical exercise and knowledge about nutrition, wellness and disease prevention must be taken into account.

The U.S. Department of Agriculture Economic Research Service (USDA/ERS) continuing survey 1989–1991 found that education and income were positively related to the nutrient consumption of elderly heads of households. Elders at 130% of the poverty level tended to have lower nutrient intakes than those with higher incomes (Weimer 1998). In California, more than 28% of seniors over 65 live at 200% of the poverty level, and more than 8% live below the poverty level (fig. 4) (see box).

### Food security and limited incomes

Food security (social and economic access to sufficient, safe and nutritious food that meets dietary needs and food preferences) among the elderly is associated with food availability, affordability, accessibility and utilization. Along with Social Security income, the Food Stamp Program has made positive contributions to nutrient intake in some instances (Hama and Chern 1988). Compared to food-secure elders, food-insecure elders most often present multiple problems that prevent them from achieving nutritional well-being. They often seek out food assistance programs and have poorer nutritional and health status than food-secure elders (Frongillo and Jung 1999).

USDA's report of a 2000 study, *Low-Income Households' Expenditures on Fruits and Vegetables*, found that low-income households spent less per capita on these food items than higher income households (Blisard et al. 2004). In this report, Cornell University researchers examined

the factors associated with food insecurity among the elderly, their affect on nutritional and health status and the impact of food assistance programs on the needy. They found that low income, education levels, minority status and participation in food assistance programs were significantly related to food insecurity (see box).

### USDA/ERS 1989–1991 continuing survey findings

The USDA Economic Research Service conducts continuing surveys about every 3 years; the 1989–1991 survey assessed changes in dietary behavior. The dietary intake estimates were averages for 15,968 individuals of all ages (excluding breastfed children) who provided at least 1 day of information.

- Highly educated and higher income elders consumed more vitamin E, vitamin C, vitamin B6, niacin, calcium, phosphorus and magnesium.
- Low-income elders consumed significantly fewer calories and eight of 11 nutrients, except vitamin E, calcium and iron.
- Geographically, elders in the U.S. Northeast consumed more calories, fat, vitamin C, vitamin B6, niacin, phosphorous and magnesium.
- Urban elders generally were more deficient in iron than suburban or rural residents.
- Blacks consumed fewer calories, fat, vitamin E, vitamin B6, niacin, calcium, phosphorus, magnesium, iron and zinc than whites; Hispanics consumed more protein than whites.
- Women were more deficient in all nutrients than men, except vitamin C.
- Elders diagnosed with chronic diseases such as diabetes, cancer and heart disease tended to consume significantly less fat.

Source: Frongillo and Jung 1999.



In addition to food security issues, self-assessments of limited-income seniors ( $n = 377$ ) from 22 senior centers in Alameda County found that literacy was an important consideration in compliance with nutrition- and

### Nutrition recommendations for adults over age 50

- Achieve adequate nutrition within calorie needs from nutrient-dense foods, and limit saturated and trans fats, cholesterol, added sugars, salt and alcohol.
- Maintain body weight in a healthy range, and lose weight slowly.
- Participate in 30 minutes of moderate physical activities daily to reduce the functional decline of aging.
- Keep fat consumption between 20% and 35% of total caloric intake.
- Choose fiber-rich carbohydrates such as fruits, vegetables and whole grains.
- Limit sugar, caloric sweeteners and starch to prevent dental problems.
- Use no more than 2,300 milligrams sodium (1 teaspoon table salt) per day, and eat potassium-rich fruits and vegetables to reach 4,700 milligrams per day total salt.
- Middle-aged and older, hypertensive and black adults should reduce salt intake to 1,500 milligrams per day.
- Limit daily alcoholic beverages to two for men and one for women.
- Do not consume alcohol if it can interact with medications, or when medical conditions prohibit its use.
- To prevent food-borne illness, do not eat unpasteurized, improperly cooked or uncooked foods.

Source: US DHHS 2005a.

wellness-related prevention and management plans. Literacy level was a key factor in the participants' belief that they could comply with nutrition and lifestyle changes related to disease prevention and treatment. Many reported that they were confused by the volume and kinds of information they received from either the public, media or health-care providers (see pages 189, 195).

### Promoting improved quality of life

Quality of life includes physical and mental well-being as well as overall satisfaction and engagement with life; examples include close relationships with family members, active participation in religion or politics, and other relationships with the world (Wallace 2005). Interventions to promote quality of life are more effective if they can be integrated into a person's normal activities, such as easily available, low-cost fresh fruits and vegetables, or safe parks where people can exercise (IOM 2005). Good nutrition can help to improve the quality of life of older Americans by preventing malnutrition or dietary deficiencies, and promoting optimal body functioning (see box).

Reluctance to develop health promotion programs targeting independent-living older people has stemmed from the preconceived notion that individual seniors will not follow plans or change their lifestyle. However, not all seniors are stuck in their old ways (Amarantos et al. 2001). Chernoff (2001) studied reductions in salt and fat intake among older people and found that behavioral

changes were associated with the belief that a healthier diet would contribute to better health. A survey of men and women 51 years and older found that trying to follow a healthful diet was the most consistent reason given for the use of vitamin and mineral supplements (Sebastian et al. 2007). Higher levels of some nutrients were also associated with supplements (Archer et al. 2005).

The Food Marketing Institute's 2006 Shopping for Health Survey found an increased interest in health and nutrition across all age groups (Gorman 2007). However, some high-risk, older-adult audiences are still not being reached with messages about the relationship between nutrition and wellness, and quality of life.

Knowler et al. (2002) suggested that lack of profit motive may hamper the effective promotion of lifestyle changes to achieve improved states of wellness. For example, promoting exercise would improve the health of seniors, but companies are not likely to profit if older adults decide to walk around their neighborhoods each morning.

### Future prospects

If the goal of healthy aging is to add life to years, rather than years to life, then nutrition plays an important role — along with activity to enhance physical strength, stability, mobility, feelings of wellness and independence. Research by UC faculty and specialists has contributed significantly to basic knowledge of the aging process and the roles of selected nutrients. The University



Physical activity enhances strength, stability, mobility, and overall wellness and independence, but public health messages touting its benefits rarely target seniors.

iStockphoto/Wolfgang Amri



## The goal of healthy aging is to add life to years, rather than years to life.

is in a unique position to lead efforts to change the conditions under which elders live. For example, UCCE could facilitate partnerships among local growers and senior facilities to promote fruit and vegetable consumption. Likewise, local advisors and educators can help to increase nutrition and wellness knowledge in order to change voluntary health behaviors such as diet

or physical activity, and promote peer support. A collaborative group of basic and applied researchers, UCCE advisors and educators, and partners in local communities throughout California could develop, test and institute effective strategies for community-based, institutional and societal interventions to enhance healthy aging among Californians.

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# Memory, brain and aging: The good, the bad and the promising

by Beth A. Ober

*A large body of evidence converges on the conclusion that episodic memory (the recollection of personally experienced events) is the only long-term memory system that shows significant age-related deficits. Moreover, the brain regions most likely to show age-related volume loss are those most critically involved in episodic memory. Older adult brains may have much greater plasticity (capacity to change) than once believed; for example, neurogenesis (the birth of new neurons), increases in cognitive (including memory) performance, and increases in regional brain volume have all been shown to occur in older adulthood, as a result of physical or mental activity/training. The next wave of research will enhance our understanding of brain plasticity in adulthood and enable specific guidelines for lifestyle or pharmacological treatments that optimize brain and memory functioning well into late adulthood.*

When middle-aged or elderly adults discuss their health and well-being, one of the most commonly expressed worries is memory problems, including the fear of Alzheimer's disease. This is not surprising, given that memory functions are at the core of our day-to-day intellectual and social activities. Memory enables us to know who we are, as well as what our goals, values and beliefs are. Memory allows us to think about recent and remote events in our lives, and to plan for the future. Moreover, memory enables us to accumulate and make use of vast reservoirs of information about people, objects, places, social customs, language and individual domains of expertise (e.g., birds, wine, astronomy, neuroscience).



High levels of mental activity, such as playing games like bridge, are predictive of improved cognitive and brain outcomes in older adulthood.

Skills that we have acquired over our lifetimes, most of which can be executed in a fairly automatic manner (e.g., typing, driving, reading, swimming, knitting, playing a musical instrument) also depend on memory.

Adults over 65 years old comprise 11.2% (4.1 million) of Californians. Due in part to aging baby boomers, California's elderly population is expected to grow twice as fast as the total population to more than 8 million by 2020 (US Census Bureau 2010). Changes in memory function, or even the perception and interpretation of such changes by oneself or by others, can affect day-to-day functioning and well-being in a variety of contexts, including family, community and workplace. Each and every one of our actions, interactions, musings, decisions and plans critically depend on memory.

## Memory myths vs. reality

A number of myths persist about memory and aging.

**Myth: "Memory abilities will decline in older adulthood to a degree that will significantly affect day-to-day functioning."** Rather, about 85% of adults age 65 and older do not show significant declines in memory ability and are able to live independently.

**Myth: "Alzheimer's disease is inevitable in old age."** In fact, Alzheimer's disease, which accounts for about 50% of all dementia cases, occurs in 0.9%, 4.2% and 14.7%, of those 65, 75 and 85 years of age, respectively (Brookmeyer et al. 2007). Although the risk of Alzheimer's disease and other dementias increases with age, a minority of older adults are affected.

**Myth: "When memory problems occur in normal aging, they involve all aspects of memory."** Only one type of long-term memory, known as episodic or event memory, undergoes significant decline in normal aging; other types of long-term memory either remain unaffected or show improvement. ("Normal aging" indicates the absence of dementia or other brain disease, and the ability to live independently.) This misunderstanding reflects the lack of awareness of scientific evidence for several separable types of long-term memory function, each with separable brain underpinnings.

## Major types of long-term memory

Cognitive scientists define short-term memory as that which is available in consciousness (e.g., the sentence that was just spoken, the phone number just dialed), whereas long-term memory



encompasses any memories that are still available after a brief period (30 to 60 seconds) of distraction or disengagement. Information in short-term memory will only be encoded into long-term memory and be available for retrieval after a delay if one is motivated or interested in remembering it. Otherwise, it will quickly be forgotten. When information in short-term memory is manipulated in some way, for example in order to make linkages with information in long-term storage, or in the service of computations, this type of memory is referred to as working memory.

There is general agreement among cognitive psychology and neuroscience scholars on the broad outlines of the behavioral and brain aspects for the following three major types of long-term memory (Schacter and Tulving 1994; Schacter et al. 2000; Squire and Knowlton 2000).

**Episodic.** Episodic memory involves the conscious recollection of episodes or events, along with a personal context. Recalling a dinner party attended last week, including where the event took place, who was there, what you ate and what the conversations were about, exemplifies episodic memory.

**Semantic.** Semantic memory involves "world knowledge" in the broadest sense: languages, objects, places, spatial relationships, social norms, facts/trivia, and all sorts of concepts from domains in which one may or may not be an expert. The knowledge brought to the dinner party about the names, backgrounds and interests of the guests is part of semantic memory.

**Procedural.** Unlike both episodic and semantic memory, procedural memory is not easily accessible to conscious awareness or verbal description and evaluation. Procedural memory includes: (1) sensory-motor skills such as typing, bicycle riding and piano playing; (2) learning and memory for procedures, sequences and rules to solve tasks and puzzles; and (3) repetition priming, an increase in speed and/or accuracy when identifying a word or picture on repeated presentation as compared to its initial presentation, even when the item is degraded and the presentations are separated by many days (fig. 1). Driving skills used to get to



Fig. 1. Increasingly complete versions of a given object are shown until the object is identified. Source: Snodgrass et al. 1987; reproduced by permission from Life Science Associates.

the party exemplify the sensory-motor type of procedural memory.

### Episodic recall and recognition

Laboratory tests of episodic memory generally involve a study phase for a set of to-be-remembered words (or pictures or sentences), followed by a test phase in which participants are asked to either recall or recognize the items that they recently studied. Recall tests can be either "free" (e.g., "Tell me everything you remember from the list") or cued (e.g., "Tell me all animals that you can remember from the list"). Age-related declines in episodic recall are well documented (fig. 2). Recognition tests typically require a "yes" versus "no" response as to whether an item was in the previously studied list. Older adults show little or no deficit in memory performance for recognition, in contrast to significant deficits for recall (fig. 3). This reduction has been attributed to environmental support, which reduces the effort needed for retrieval processes. The dissociation between recall and recognition is why we often fail to recall the name of a movie we saw or a person we met several days ago, whereas we can easily recognize the name as correct when it is presented to us either alone or as one of several options. The older we are, the more often we have failures of recall. However, when recognition is successful for a name that cannot be recalled, this shows that the name is at least partially available in memory but not readily accessible.

The differential susceptibility of recognition versus recall performance in normal aging is consistent

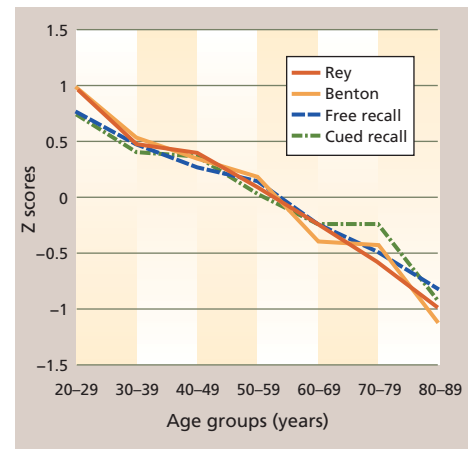


Fig. 2. Adult life span (cross-sectional) performance on four episodic memory tasks. "Benton" and "Rey" data are from clinical, pictorial, word-list learning tests named after the authors; "cued recall" and "free recall" data are from laboratory, word-list learning tasks created by the source author. Plotted Z scores are referenced to the entire age range, with an overall mean of zero; younger adults are above and older adults are below zero. Source: Park et al. 2002; © 2002 American Psychological Association.

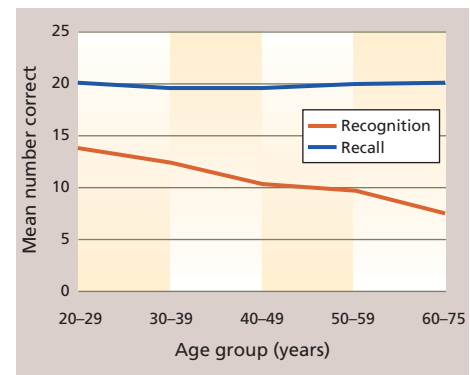


Fig. 3. Adult life span (cross-sectional) performance for free recall compared to recognition on a word-list learning, episodic memory task. Data source: Schonfield and Robertson 1966.

**As we progress through middle and older age we acquire larger vocabularies and more extensive knowledge about the world around us.**

with dual-process models of episodic memory — recollection and familiarity (Light et al. 2000). Recollection is a relatively slow and deliberate process that involves memory access for the desired item/episode in tandem with information concerning the context in which it was experienced, such as when or where the episode occurred, the emotions experienced at the time, and so on. Familiarity, in contrast, is a relatively automatic process that provides a quick indication of the strength of the memory for the item/episode, without any link to the context in which it was experienced. For example, when you realize that you know the woman in front of you in a store’s checkout line but cannot recall her name or where or when you met her, you are exhibiting successful familiarity-based memory, along with a frustrating lack of recollection-based memory. For both everyday and laboratory memory tasks, recollection plays a larger role in recall, whereas familiarity plays a larger role in recognition. Moreover, numerous studies indicate

that recollection is more negatively affected than familiarity, just as recall is more negatively affected than recognition, in aging. These two components of episodic memory may reflect neuroanatomically distinct memory processes, with recollection being more dependent on the brain’s hippocampus, and familiarity being more dependent on the nearby entorhinal cortex.

**Semantic memory improves with age**

In contrast to the steady declines in episodic memory across all decades of adulthood, semantic memory is not only preserved, but also shows improvement until around the eighth decade of life, after which a gradual decline can be observed. Vocabulary and general knowledge tests are most commonly used to evaluate semantic memory (fig. 4). There is evidence that as we progress through middle and older age we acquire larger vocabularies and more extensive knowledge about the world around us, which is certainly good news regarding memory and aging. Increased world knowledge presumably can compensate to some extent for decreased facility in episodic memory. For example, linking to-be-remembered items and events in a meaningful way with information stored in semantic memory increases the likelihood of successful memory retrieval for these items; this type of semantic encoding strategy benefits older as well as younger adults (Froger et al. 2009).

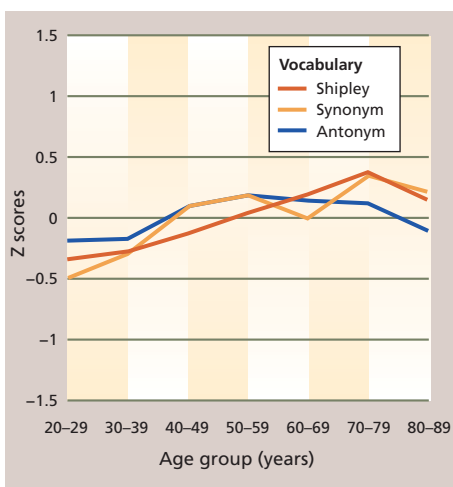
Although our vocabulary knowledge is relatively protected from age-related loss, the ease with which we retrieve words is not. We are all familiar with the “tip-of-the-tongue” (TOT) phenomenon in our everyday lives. It begins when we are attempting to come up with a word, generally a noun and sometimes a proper name, that we want to use in conversation. We fail to retrieve the desired word or name, and yet we are sure that we know the word, and sometimes can think of the first letter, the last syllable or some aspect of



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**While episodic memory (the ability to remember things that happened) declines with age, semantic memory (one’s store of general knowledge) continually increases until about the eighth decade of life.**

the word’s meaning. Sometimes, when we are not trying to retrieve the word, it simply “pops” into consciousness. TOTs have been studied with naturalistic diary studies as well as controlled laboratory methods (Burke et al. 1991; Heine et al. 1999). Findings indicate greater numbers of TOTs and longer resolution times for older compared to younger adulthood; however, without time pressure, older adults are as successful as younger adults in retrieving desired words. According to the widely favored incomplete activation (transmission deficit) hypothesis (Burke et al. 1991), TOTs occur when there is not enough activation from the semantic (meaning-based) knowledge about a desired word to lexical (word-based) and/or phonological (sound-based) knowledge, precluding the ability to retrieve the complete phonology for the desired word. This incomplete activation from semantics to phonology is more likely to happen for words and names encountered infrequently or not encountered recently, and for older as compared to younger adults. As frustrating as word-finding difficulties can be, the good news is that they are due to the slowing of access and retrieval, rather than the loss of knowledge.



**Fig. 4. Adult life span (cross-sectional) performance on three semantic memory tasks. “Shipley” data are from a standardized, clinical vocabulary test, whereas “synonym” and “antonym” data are from laboratory-based vocabulary tests. Plotted Z scores are referenced to the entire age range, with overall mean of zero. Performance improves until about age 70, followed by minimal decline. Source: Park et al. 2002; © 2002 American Psychological Association.**



Alternate methods of assessing semantic memory do not require word retrieval and therefore are not affected by aging-related word-retrieval difficulties. These are referred to as implicit methods because the person being tested need not be consciously aware of the nature of the semantic knowledge being evaluated. A research method called “semantic priming” capitalizes on the fact that we are faster to process an item that follows an associated, semantically related item versus an unrelated item. For example, the word “truck” is processed more quickly when it follows “car” than when it follows “lion”; in this case the related words share features common to vehicles. The task required of the participants is most commonly a “word” versus “nonword” button press for each of a large number of letter strings (e.g., peach, salicylate, car, truck). The timing of word presentation and recording of response times are computer controlled. The participant’s attention is focused on the required response, rather than possible linkages between adjacent words, especially if the number of semantic linkages within the list is low. A reduction in response time, when associative and semantic linkages are present versus absent, comprises the semantic priming effect. With semantic priming tasks, the preservation of a wide variety of semantic knowledge about objects and their relationships has been demonstrated, not only for healthy elderly adults but also for patients with Alzheimer’s disease (Ober 2002; Ober et al. 1991).

### Procedural memory preserved

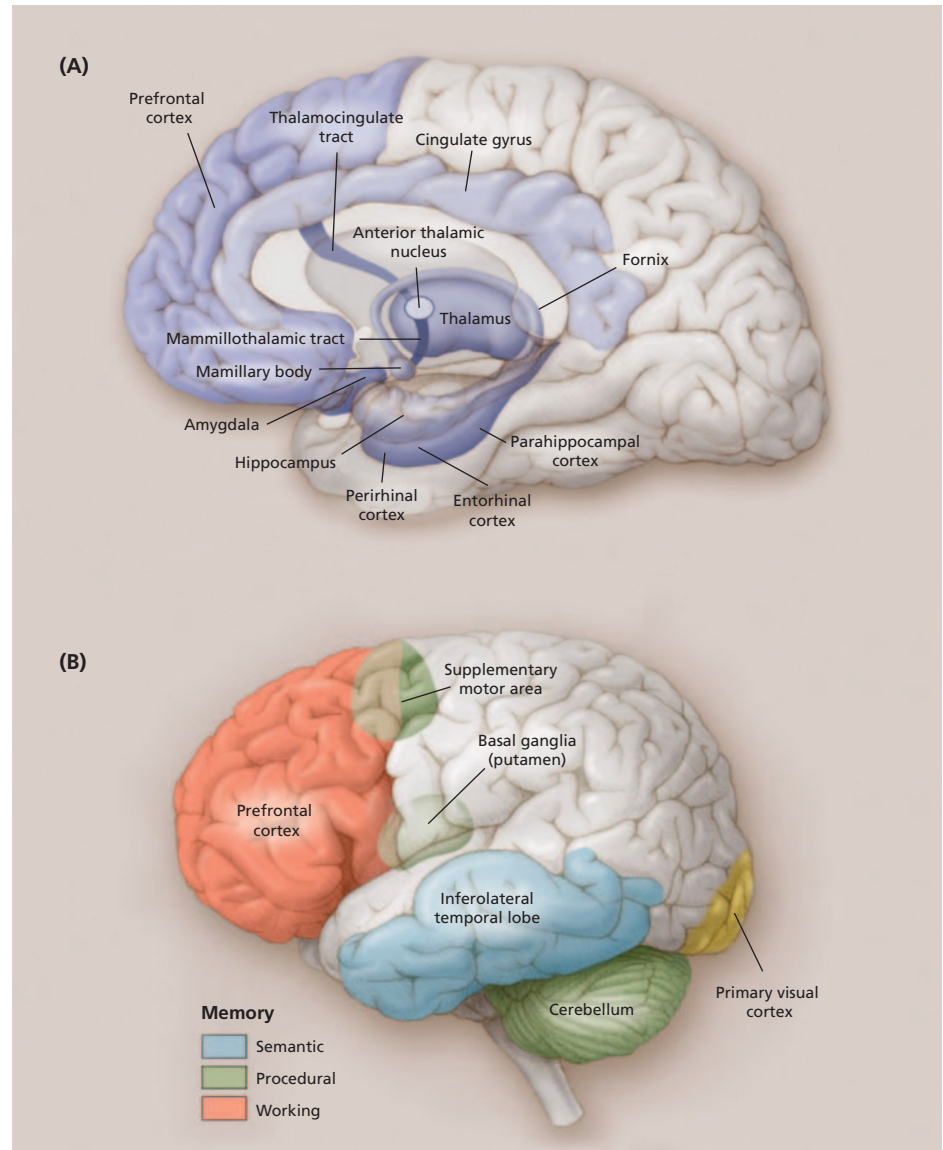
Procedural memory seems to be quite well preserved in normal aging. For sensory-motor tasks such as knitting or bicycle riding, although memory for sequential components is preserved these tasks may be performed more slowly and/or awkwardly due to motor performance issues associated with aging (e.g., arthritis, muscle weakness). For tasks that involve learning and memory for sequences or rules, but little or no motor skill, there is strong evidence for age-equivalent rates of learning and memory retention. Examples include card games such as bridge or solving Sudoku puzzles. Finally, for procedural-memory tasks

that are more perceptual, such as picture or word identification (e.g., from an incomplete picture; fig. 1), older and younger adults show equivalent increases in speed and accuracy in identifying previously experienced pictures or words as compared to new ones.

### Brain and memory

Multiple regions of the brain are involved in memory, with particular

regions playing key roles in particular types of memory (figs. 5A and 5B). The episodic memory system depends critically on the medial temporal lobes (including the hippocampus and adjacent entorhinal and parahippocampal regions). Evidence for the hippocampus’s critical role in episodic memory has come from neuroimaging studies of amnesia patients (e.g., post-stroke) showing damage to the hippocampus,



**Fig. 5. (A)** Areas of the brain significantly involved in episodic memory, shown from a midline view of the brain. The medial temporal lobes, including the hippocampus and parahippocampal cortex, are critical for normal episodic memory functioning, as are other brain regions highlighted in blue. **(B)** Areas of the brain significantly involved in semantic, procedural and working memory as shown from a lateral (external) view of the brain. Temporal lobe areas involved in semantic memory are different from those involved in episodic memory. Brain regions involved in procedural memory do not overlap with those involved in either episodic or semantic memory. The prefrontal cortex is involved in working memory and, in turn, encoding information into, and retrieving information from, long-term episodic and semantic memory. Source: Budson and Price 2005; © 2005 Massachusetts Medical Society. All rights reserved.

as well as dementia patients with prominent episodic memory deficits (Alzheimer's disease).

Even damage to a very small section of the hippocampus (such as can occur after CO<sub>2</sub> poisoning or cardiac arrest) can result in significant episodic memory problems (Hopkins et al. 1995; Zola-Morgan et al. 1986). The hippocampus is part of the limbic system, and when a lesion occurs in particular limbic structures (e.g., mammillary body, fornix, anterior thalamic nucleus; fig. 5A) episodic memory dysfunction may occur. The prefrontal cortex (the large, anterior portion of the frontal lobes) is another important brain area for episodic memory; the hippocampal region needs to "work with" the frontal lobes (involving working memory processes). The hippocampal-frontal collaboration enables effective episodic encoding and retrieval, particularly for source (e.g., location, person, place) and time-related aspects of to-be-remembered events.

The semantic memory system is *not* dependent on the hippocampus or related structures, and world knowledge acquired prior to brain injury or disease is generally intact in amnesics. There is ample evidence that the visual features of objects are stored in the visual processing centers of the brain, auditory features are stored in the auditory processing centers of the brain, and so on, such that the complete knowledge representations of objects are distributed throughout the cortical regions involved in object perception. Additionally, specific regions of the left prefrontal cortex and bilateral anterior temporal cortex seem to be involved in retrieving, maintaining and selecting semantic information (Badre and Wagner 2002; Oliver and Thompson-Schill 2003).

Procedural memory, like semantic memory, is not dependent on the hippocampus or related structures; indeed, amnesic patients do not show impairments in the various types of procedural learning and memory tasks described earlier. The brain areas involved (e.g., motor cortex, visual cortex, prefrontal cortex and cerebellum; fig. 5B) are varied, and depend on the particular type of procedural learning and memory task.



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**Certain parts of the brain show volume reductions with age, especially the prefrontal cortex and hippocampus. Both are important to the functioning of episodic memory, which plays a critical role in remembering past events.**

### Structural brain changes

Based on autopsy data and low-resolution (in vivo) CT scans, the gross structural brain changes associated with normal aging include: overall shrinkage of the cortex (brain atrophy due to tissue/cell loss), enlargement of the cerebral ventricles (structures in the center of the brain filled with cerebral spinal fluid), and increasing size of the cortical sulci (convolutions of the cerebral cortex that form "hills" [gyri] and "valleys" [sulci]). High-resolution magnetic resonance imaging (MRI) has enabled increasingly precise quantification of not only general brain changes, but also age-related volume changes for particular brain regions and structures.

Raz et al. (2005) summarized structural brain changes in normal aging. This cross-sectional study of adults ranging from about 20 to 80 years old also had a longitudinal component in that subjects were measured initially and after five years. For brain-volume changes both within individuals and across individuals of different ages, the hippocampus and subregions of the prefrontal cortex showed sizable reductions with age, whereas the entorhinal cortex and primary visual cortex showed minimal or no such reductions (fig. 5). The differential loss of volume for hippocampal versus entorhinal

cortex is in keeping with evidence for greater dependence of recollection aspects of episodic memory (impaired in aging) on the hippocampus, versus greater dependence of familiarity aspects of episodic memory (relatively preserved in aging) on the entorhinal cortex; however, the entorhinal cortex does show volume loss among 70-plus-year-olds. When the integrity of white matter tracks (bundles of axons, which are parts of nerve cells that transmit electrical signals to other neurons) is specifically evaluated, either via MRI or diffusion tensor imaging (a high-resolution imaging tool specifically targeted to white matter), the greatest deficiencies for older compared to younger adults are in the frontal lobes rather than the more posterior lobes (Head et al. 2004; Wen and Sachdev 2004).

To summarize, the structural brain changes associated with normal aging consist of declining brain tissue volume, with the prefrontal cortex and hippocampus particularly affected. The hippocampus plays an essential role in episodic memory functioning, and also must "work with" the prefrontal cortex in order for episodic encoding and retrieval to work effectively. Moreover, among the three types of long-term memory, only episodic memory is negatively affected in normal aging.



## Brain function and plasticity

Although there is ample evidence for decreases in tissue volume during the course of normal aging, three important facts greatly mitigate this bad news.

**Atrophy.** First, older adults are quite heterogeneous and some will have minimal brain-tissue loss over time. The degree of brain atrophy in normal aging may have been overestimated in previous research, because subjects with preclinical dementia were not excluded due to lack of long-term follow-up evaluation. Burgmans et al. (2009) began a longitudinal study with cognitively healthy adults (52 to 82 years old), and after three years an MRI brain scan accompanied cognitive testing. The subgroup of participants who had shown cognitive decline over the past three years exhibited a significant age-related decrease in brain tissue volume (for parahippocampal, cingulate gyrus and prefrontal cortex), but the subgroup who remained cognitively stable showed no age-related decreases. This promising finding will hopefully be replicated and extended.

**Plasticity.** Second, brain plasticity, which enables changes in brain structure and function due to experience and learning, occurs even in older adults. The brains of older as well as younger animals (rats and nonhuman primates) show increases in the number of neural synapses (by which neurons communicate with one another), neurotransmitter activity, number of glial cells (which support neuronal functions) and capillary vascularization (blood supply for neurons and glial cells) as a function of “enriched environments” or specific learning experiences (Kramer et al. 2004; Markham and Greenough 2004). Using methodologies appropriate to human subjects (functional MRI), researchers have demonstrated long-lasting changes in regional brain activation patterns as a result of “targeted” behavioral training.

The most exciting research on brain plasticity, however, provides evidence for neurogenesis (the “birth” of new neurons), not only in adult nonhuman animals, but in older, as well as younger, adult human brains, as a function of new learning (Kempermann 2006). The brain areas where

neurogenesis has been reliably demonstrated are the hippocampus, olfactory bulb (where primary odor processing occurs) and caudate nucleus (near the center of the brain and involved in feedback-related aspects of learning and memory). Hippocampal neurogenesis is especially good news, given the critical role of the hippocampus in laying down new episodic memories, and given that the hippocampus is one of the most vulnerable brain areas in terms of cell loss associated with normal aging (and to a much greater extent, with Alzheimer’s disease).

**Bilaterality.** Third, brain function and the cognitive functions dependent upon it may not be in “lock-step” with decreases in brain tissue volume, due to age-related changes in the patterns of brain activation that are associated with particular types of cognitive tasks. One such age-related change is the increased bilaterality (activation in both hemispheres) of prefrontal activations in older as compared to younger adults (Park and Reuter-Lorenz 2009). In younger adults, verbal memory tasks result in focal activations in the left prefrontal cortex, whereas visual/spatial memory tasks result in right prefrontal activations. This strong laterality is not seen in older adults; instead, activation in the “appropriate” side of the brain is reduced, while activation in the “inappropriate” side is increased. Increased bilaterality has been widely observed and it seems to be compensatory, enabling improved performance: older adults who engage both the left and right prefrontal cortex on memory tasks have higher performance than those who don’t show bilateral activation (the improved performance is closer, but not equal to, that seen for younger adults).

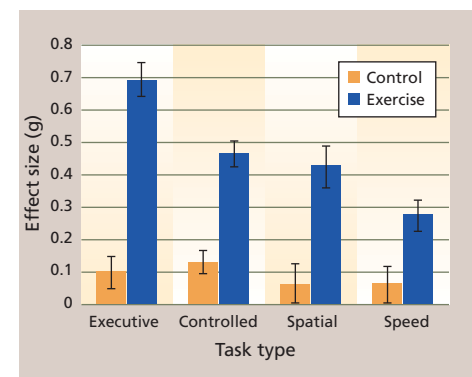
## Maintaining brain function

The question of how to maintain brain function into older age has captured the attention of many thousands of biological and behavioral scientists nationally and internationally, who are obtaining large amounts of research funding from government sources, industry and private foundations. In fact, UC scientists authored 1,885 articles on human brain aging and/or cognitive aging from 2000 to 2009, per the Web of Science (an online academic citation

index by Thomson Reuters). As the older adult population continues growing at the state, national and global levels, there is increasing interest in interventions to minimize brain atrophy, maximize brain functioning, and maintain adequate memory and other cognitive functions throughout later adulthood. The extent that memory and other cognitive functions can be maintained, or at least minimally impaired, will have positive effects on day-to-day functioning and life satisfaction for older adults, as well as reduce caregiving costs and extend the years of independent living (i.e., fewer years in a nursing home).

**Physical activity.** There is increasing support for the hypothesis that exercise as well as general physical fitness can improve cognitive (including memory) and brain function across the adult life span. Initial evidence was based mainly on observational studies. One particularly impressive correlational study (Erickson et al. 2009) showed that higher cardiovascular fitness significantly predicted greater MRI-measured hippocampal volume, as well as performance on an episodic memory task, in a large sample of 59- to 81-year-olds, even after controlling for age, sex and years of education.

In recent years, a number of exercise intervention studies have enabled the evaluation of causal links between exercise and cognition. These studies



**Fig. 6. Effect sizes of mean differences in cognitive-task performance between older adults in an aerobic fitness program and those who were not (control).** Executive = planning and scheduling of mental processes; controlled = inhibiting one response in order to “deliver” the desired response; spatial = remembering visuospatial information; and speed = low-level reaction time. Source: Colcombe and Kramer 2003; © 2003 Assoc. Psychological Science. Reproduced by permission of SAGE Pubs.



A recent study showed that higher cardiovascular fitness among 59- to 81-year-olds was correlated with greater volume in the brain's hippocampus and better performance in an episodic memory task.

involve the random assignment of participants to an exercise or control (no exercise) group. Both before the start and at the end of treatment, various aspects of cognitive functioning are assessed. Most, but not all, individual studies have shown that exercise benefits cognition. Fortunately, several meta-analyses have been carried out, which involve the calculation of exercise (vs. control) effects for many individual studies (meeting predetermined criteria) and then obtaining overall effect sizes for cognitive measures shared across stud-

### The “use it or lose it” hypothesis is that increasing amounts of mental activity enable higher levels of cognitive functioning in middle and late adulthood.

ies. The upshot is that exercise positively affects cognitive functioning in adults 55 and older, even those with early dementia (Kramer and Erickson 2007).

Overall effect sizes in these meta-analyses tend to be around 0.5, which is moderately robust, as in Colcombe and Kramer (2003) (fig. 6). For each of four cognitive tasks, the effect was statistically significant for the exercise but not

control participants; episodic memory tasks were part of the “visuospatial” task domain. Additional findings included: a larger effect of exercise training when the program duration was greater than 6 months, as opposed to 1 to 3 or 4 to 6 months; a much larger effect for training sessions that were more than 30 minutes, as opposed to 15 to 30 minutes long; a somewhat larger effect for training that combined cardiovascular and strength training, as opposed to cardiovascular training alone; and finally, much larger training effects for the older age groups (66 to 70, or 71 to 80 years) as compared to the younger age group (55 to 65 years).

“Use it or lose it.” The “use it or lose it” hypothesis is that increasing amounts of mental activity enable higher levels of cognitive functioning in middle and late adulthood; in other words, mental activity can counteract the effects of normal aging. Early research on mental activity was dominated by correlational, observation-based studies. These studies involve the collection of self-report data from large numbers of older adults regarding their engagement in activities presumed to be mentally stimulating (e.g., reading books, playing bridge, solving crossword puzzles), with follow-up over varying periods of time to assess cognitive status. The findings strongly support a positive correlation of mental

activity at baseline with overall cognitive function, including a reduced risk of Alzheimer’s disease, at follow-up evaluations spanning five or more years. For example, Wilson et al. (2007) found that a low mental activity group was 2.5 times more likely to develop Alzheimer’s disease than a high mental activity group over 5 years. Another example is a report by Valenzuela et al. (2008) that older adults’ scores on a lifetime mental activity questionnaire were significantly predictive of MRI-assessed hippocampal atrophy over the following 3 years; that is, there is less atrophy with higher mental activity scores. Although encouraging, the correlational nature of these findings does not permit us to conclude that mental activity causes improved cognitive or brain outcome. It could be that more mentally active adults have healthier brains and/or have been more mentally active in the years prior to the start of the study than the less mentally active adults.

Increasing numbers of studies directly manipulate cognitive activity via training sessions designed to improve episodic memory and other cognitive functions (Hertzog et al. 2009). There is ample evidence for the ability of older adults to show improvement on episodic memory tasks (as well as many other cognitive tasks) with practice or training, especially when training in the use of strategies is involved. Evidence is limited and at times conflicting regarding how long-lasting the effects of training are, the degree to which it can be generalized to non-trained but similar tasks, and whether the training is actually resulting in a reduction of age-related deficits on the trained task (as opposed to benefitting older and younger adults equally, thus maintaining the same degree of age-related deficits).

Among the “gold standard” type of cognitive intervention, the most ambitious is the ACTIVE (Advanced Cognitive Training for Independent and Vital Elderly) project, a multisite study in which 2,802 adults over 65 years of age were randomly assigned to a no-training (control) group or one of three cognitive training groups, with training taking place over 10 twice-per-week sessions. Each training group focused on one of the following: memory (episodic



list-learning), reasoning or speed of processing. All participants were tested in all three cognitive domains at the end of the training period, and yearly thereafter. Each of the three types of cognitive training yielded improved performance in the cognitive domain being trained (e.g., memory training improved memory performance); however, there was no transfer of these training effects to cognitive domains that were not trained (Ball et al. 2002). The largest training effects occurred for speed of processing, and the smallest were for memory. Five-year follow up data showed that the initial training benefits were still present, albeit much reduced (Willis et al. 2006).

Salthouse's (2006) review of the mental activity literature concluded that although cognitive interventions can improve performance, there is a dearth of evidence for the transfer of training to untrained tasks (even within the same cognitive domain, such as episodic memory), or for long-lasting benefits. Based on a meta-analysis of randomized control trials of cognitive intervention, many of which included memory training, Papp et al. (2009) also concluded that there was no evidence for the generalizability or long-term benefits of training, with the important caveat that few studies have incorporated long-term follow-up. However, the vast majority of cognitive intervention studies have entailed fewer than 10 training sessions; it is possible that with a larger number of training sessions, significant, long-term benefits could be obtained.

On a more positive note, an intriguing experimental field study on cognitive training by Stine-Morrow et al. (2008) provided evidence that older adults who are immersed in a 6-month program of group-based, creative problem-solving ("Senior Odyssey," modeled after the international "Odyssey of the Mind" program for children and young adults) show positive changes in fluid cognitive abilities (i.e., the processing and manipulation of information) that were not explicitly trained via the Odyssey program. More specifically, the Odyssey participants showed significant increases in performance in comparison to controls for post-test (7 to 8 months after the start of

the Odyssey program) compared to pre-test (prior to the start of the program) assessments of the speed of information processing, inductive reasoning and divergent thinking (e.g., generating word associations or coming up with alternate/unusual uses of objects). The authors acknowledge that these improved cognitive abilities may not be maintained over a longer period of time in the absence of further engagement in the Odyssey or some similar program. Nonetheless, these findings demonstrate the transfer of cognitive training/engagement to thinking and reasoning skills that were not specifically trained.

Further work is needed to determine whether memory skills, especially episodic memory (not assessed in the Stine-Morrow [2008] et al. study) could also be improved by the type of group-based, intensive, cognitive training exemplified by the Odyssey program.

### Understanding memory, brain and aging

During the past 10 to 15 years, major advances have been made in our understanding of the nature of memory changes that occur in normal aging, as well as the brain underpinnings for these changes. There have also been major advances in our understanding

## Tips for maintaining and, perhaps, improving brain and memory functions in middle-to-older adulthood

- Get regular medical checkups and make it a lifelong goal to maintain healthy blood pressure, weight and cholesterol levels.
- Remind yourself, regularly, that "What is good for my heart is also good for my brain."
- Engage in challenging and interesting cognitive activities (e.g., start learning, or re-learning, a second language).
- Exercise regularly (e.g., 30 minutes of brisk walking daily).
- Participate in social activities, via community organizations, special-interest clubs, etc.
- Take up dancing (this activity has physical, mental and social components) or some other "multicomponent" activity.
- Eat a well-balanced diet with plenty of fruits and vegetables (supplying vitamins and minerals that are important for brain function).
- Eat fish that is high in omega-3 fatty acids (e.g., salmon and trout) several times per week, or take a daily supplement for omega-3 fatty acids.
- Keep stress levels as low as possible (meditation, yoga and exercise can all help with stress reduction).
- Get 7 to 8 hours of sleep per night.



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of the variability in neurocognitive aging, including, on the positive end of the continuum, documentation of older adults who show no brain or cognitive changes over several years (Burgmans et al. 2009). Evidence for brain plasticity in late adulthood continues to grow; this includes findings of neurogenesis as well as age-related changes in patterns of brain activation that are associated with improved cognitive performance.

Generally, age-related increases in brain activations (e.g., frontal lobes) are interpreted as compensating for shrinkage in numerous brain structures (e.g., hippocampus) and declines in some

aspects of cognition (e.g., episodic memory). Indeed, the Scaffolding Theory of Aging and Cognition is based on compensatory scaffolding, that is, the recruitment of additional neural networks to support declining networks whose functions have become inefficient and/or noisy (Park and Reuter-Lorenz 2009). The challenge going forward is to further advance our understanding of the biological as well as psychological aspects of memory functioning in normal aging, such that specific lifestyle (such as exercise regimen and dietary supplements) and pharmacological treatments can be recommended to middle-aged and older adults, with a high likelihood

of these treatments leading to satisfactory memory performance and relatively independent living well into the ninth and tenth decades of life. Successful treatments would presumably be those that result in increased brain scaffolding, made possible by the multiple mechanisms of neural plasticity that continue to function in older adulthood.

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## Effects of stress on health and aging: Two paradoxes

by Carolyn M. Aldwin and Loriga A. Yancura

**Although older adults are thought to experience more stress and to be more vulnerable to its adverse effects, they often report less stress than younger adults and sometimes show more resilience. Paradoxically, while stress sometimes has long-term positive effects on well-being, studies differ as to whether this increases or decreases with age. We conclude that older individuals have learned to appraise and cope differently with stress. This protects them in spite of their increased physiological vulnerability and may also increase the possibility of stress-related growth and optimal aging.**

Over the past century, remarkable changes have occurred in the life expectancy and quality of life of older adults. Individuals born in the United States in 1900 had an average life expectancy of 47.3 years; those born in 2004 are expected to live 77.8 years on average (NCHS 2006). Life expectancy projections for residents of California are even higher than national estimates: individuals born in 2004 are expected to live 80.2 years (Springborn 2006).

These increases do not come without costs; they are accompanied by corresponding increases in both the incidence (new cases) and prevalence (current cases) of chronic health conditions, most commonly cardiovascular disease, arthritis, diabetes and cancer. These chronic health problems may greatly influence older adults' well-being and productivity, as disability rates increase dramatically after age 65. One quarter (25.5%) of U.S. adults over age 65 report that their daily activities are limited by one or more chronic health condition, but 43.9% of those over age 75 report similar limitations (NCHS 2006). However, many older adults are in good or excellent health



Administration on Aging

**As people age their health trajectories tend to diverge, with some developing multiple chronic conditions and others maintaining good health; stress may play a role in this aspect of aging.**

(Rowe and Kahn 1998). In California, older adults are often actively engaged in farming, golfing, skiing — and even running marathons.

Individual health differences increase with age, and these differences are thought to be greater in late life than any other phase of the life span. Over time, people have increasingly different patterns of health trajectories. Aldwin et al. (2001) examined patterns of change, then clustered or grouped individuals by both intercept (baseline level) and the shape of the curve. Those in Cluster 1 began with the lowest symptom levels, which increased only slowly with age (fig. 1). Individuals in this cluster can be thought of as

optimally aging. In contrast, people in Cluster 0 started out with the highest symptom levels, which increased rapidly, while other people showed various nonlinear patterns. Another study using this sample suggested that individuals — in this case combat veterans who had also experienced subsequent civilian traumas like serious car accidents — had rapid increases in physical symptoms (Schnurr et al. 1998). This sparked our interest in the effects of stress on the aging process.

### Effects of stress on health

Until the 1970s, medical researchers were skeptical about the effects of stress on health. With thousands of

studies conducted, the impacts of stress and physiological processes are now widely recognized, although showing that specific illnesses stem from stress is somewhat difficult (Aldwin 2007). Not only our minds but also our bodies respond to stressors, which may be physical (such as temperature) or psychosocial (such as a trauma, life event, daily stressor or chronic stressor).

The stress response begins when the individual appraises a situation as involving a threat, harm/loss or challenge (Lazarus and Folkman 1984). The appraisal and its attendant negative emotions activate the sympathetic nervous system to bring more energy to the body for a fight/flight response. The immediate reaction is that the sympathetic neurons release catecholamines (adrenaline and noradrenaline) directly to the heart and other organs. This increases the heart rate, blood pressure and respiratory rate so the individual can run faster or think more clearly. This reaction can be sustained by the sympathetic-adrenal-medullary (SAM) system, which is also involved in the release of catecholamines from the adrenal medulla, or center of the adrenal gland (fig. 2).

Adrenaline in large amounts can be toxic, so for sustained stress responses, the hypothalamic-pituitary-adrenal (HPA) axis becomes activated (fig. 2). Cortisol and other glucocorticoids are released from the adrenal cortex, which mobilize resources to sustain action. These include changes in metabolism (increased blood glucose and lipid

## Glossary

**Chronic stressors:** Enduring problems, especially in social roles, such as living in poverty or caring for a seriously ill family member.

**Daily stressors:** Problems of everyday life such as commuting or minor arguments with a spouse.

**Life events:** Major changes such as divorce or being laid off from work.

**Trauma:** Stressors that involve mortal threats such as combat or natural disasters.

levels), the cardiovascular system (increased heart rate and blood pressure) and the immune system (changes in circulating T cells, B cells and lymphocytes). In the short term, these resources are useful in helping the body deal with stressors. For example, increases in blood glucose levels provide more fuel for the muscles and brain, and increases in certain immune cells can facilitate blood clotting in response to an injury. In the long run, however, elevated blood glucose and lipids (cholesterol) in the blood can lead to chronic illnesses such as diabetes and cardiovascular disease, and the immune system can become suppressed. This is why chronic stress may contribute more to the development of chronic illnesses than life events per se (Friedman and McEwen 2004).

A wide range of stressors can evoke physiological responses. We know that stress induced by public speaking results in increased cortisol levels (Feldman et al. 2004), and driving buses in urban settings increases catecholamine levels (Evans and Carrère 1991). We also know that family caregivers for people with Alzheimer's disease appear to have less-efficient immune profiles than those who are not experiencing chronic caregiving stress (Kiecolt-Glaser et al. 2002). While these findings provide evidence that stress influences parameters in several physiological systems, they do not necessarily prove that stress causes discrete illnesses.

## The progression of illnesses

A recent review of the literature on psychological stress and disease (Cohen et al. 2007) concluded that there is considerable support for a link between stress and certain illnesses such as depression, cardiovascular disease and the progression of AIDS. There is also growing evidence for the role of stress in the incidence and progression of other diseases such as upper respiratory tract infections, asthma, autoimmune diseases and delayed wound healing. Research using animals provides strong evidence for a link between stress and cancer, but in humans this link is much weaker.

In humans, stress may have more influence on the progression, rather than the occurrence, of these diseases. For example, a woman who has experienced a great deal of chronic stress



Fig. 1. Patterns of individual differences in symptom change over time. Source: Aldwin et al. 2001.

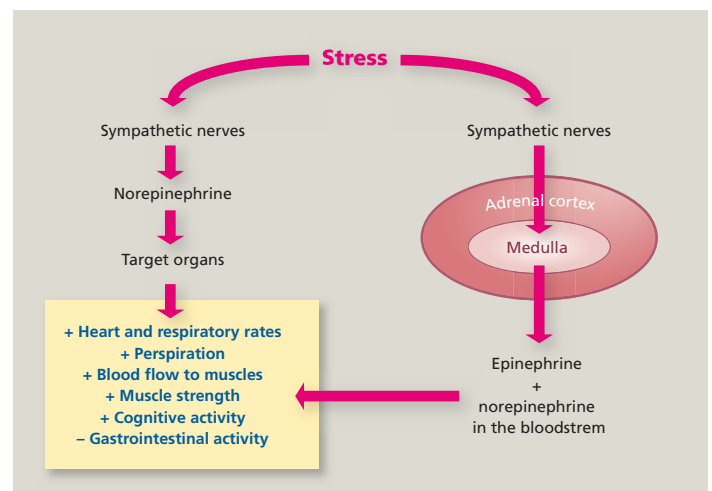


Fig. 2. Two pathways in the stress activation of the sympathetic nervous system. Source: Aldwin et al. 2007a.





Adults often face multiple challenges as they age — such as providing full-time care for grandchildren — but on the whole they report less stress than younger adults.

might have the same odds of getting breast cancer as a woman who has not. However, if both women get cancer, it might progress more quickly in the one with the high level of chronic stress.

Despite the indisputable fact that stress has adverse effects on health, it is by no means assured that stressed individuals will always get sick, or that sickness will come only to individuals who are stressed. Indeed, the correlations in naturalistic field studies are modest for self-reported health outcomes, and weaker even than that for biomedical outcomes such as elevated cholesterol levels (Aldwin 2007). Nonetheless, stress may play a role in the different trajectories of health across the life span, and may partially account for the increase in individual health differences in later life (age 65 and older).

### Stress paradoxes

Our laboratory has carried out studies of two major stress paradoxes. The first paradox concerns some surprising findings about the relationship between age and stress — that older adults report less stress, often despite poorer objective circumstances such as chronic illness, bereavement and reduced income. Further, there is disagreement in the research literature as to whether older adults are more or less vulnerable to psychosocial stressors than younger adults. The second paradox addresses the positive aspects of stress — that,

under certain conditions, stress can have positive, or toughening, effects on physical health (Dienstbier 1989).

We have been investigating these paradoxes in two major longitudinal studies, the Normative Aging Study (NAS) and the Davis Longitudinal Study (DLS). The original sample in the NAS was 2,280 men aged 22 to 80, mostly veterans, who were screened for good health in the mid-1960s. They have been followed ever since through a series of biomedical examinations, surveys and interviews that include measures of personality, stress, coping strategies and other factors.

The DLS is composed of UC Davis alumni from the classes of 1967 to 1969, 1979, 1989 and 1999, split roughly equally between men and women. Started by Professor Mary Reagan in the mid-1960s, the study's original focus was the impact of education on value systems. By 1990, though, the focus had shifted to stress and health. Funded largely through Hatch funds from the Agricultural Experiment Station, DLS participants responded to surveys of stress, coping and health in 1990, 1996 and 2001.

### Older people and life events

For decades it was a truism that stress increased in later life. After all, older people are more likely to develop chronic illnesses, become widowed, lose friends and loved ones, experience

decreased status and income with retirement, and live alone. But an early review of the literature showed that older adults report fewer life events than do young adults (Rabkin and Streuning 1976). If older adults face so many challenges in their lives, why do they report less stress?

Early life-event scales focused on events that mainly affect young people, such as graduation, marriage, divorce or being jailed. As a postdoctoral scholar at UC Irvine, the first author lived briefly in a large retirement community and spent much of her time simply observing and chatting with individuals, which yielded a glimpse of the problems that older adults were facing. This informal research was the basis for the Elders Life Stress Inventory (ELSI), which included more of the types of events faced by middle-aged and older adults. These included deaths of family members and friends as well as “network stressors” such as their child’s divorce or indebtedness. Preliminary studies found few age differences in the number of stressful life events between middle-aged men and older men in the NAS on the ELSI (Aldwin 1990), although subsequent research suggested a slightly nonlinear relationship, with the number of life events increasing until about 65 and decreasing thereafter (Yancura et al. 1999).

Nonetheless, studies using the DLS data showed that there are age differences in the types of problems reported as “low points” by young versus



In standardized stress inventories, middle-aged adults reported family issues such as their parents’ health as stressors, while older adults reported that their own health problems and “daily hassles” were stressful.

middle-aged adults (Shiraishi and Aldwin 2002). Middle-aged adults were more likely to list family problems, parents' health and other health problems, reflecting their position as the "sandwich" generation, while young adults were coping with work problems and "angst," a general category that included problems with one's identity or mental health. The number of major problems does not seem to decrease much, if at all, with age, but the types of problems may change, as stressors are often linked to our social roles. Young adults struggle to establish their own careers, while in middle adulthood and late life, individuals often have more generative concerns about taking care of their families and older relatives.

The increase in social responsibilities, however, does not seem to lead to an increase in hassles, or daily stressors. In the NAS, older adults reported fewer daily stressors (Aldwin, Sutton, Chiara, et al. 1996). Not surprisingly, the types of problems reported also varied by age: middle-aged men reported more daily stressors with work and family life, while older adults reported more problems with health and "daily hassles," a category that included activities such as home maintenance and volunteering. Despite extensive questioning, nearly 20% of individuals 80 and older could not come up with a single problem in the past week.

### Dealing with problems

Given that older adults have more health difficulties and losses, why don't they report more problems? The answer seems to be in how they appraise problems. Older adults are less likely to perceive their problems as stressful. This does not seem to be due either to personality changes with age, or to the types of problems they face. Rather, we

### Older adults are less likely to perceive their problems as stressful.

believe that older adults' greater experience with many types of problems gives them a more balanced perspective on their daily stressors (Boeninger et al. 2009).



FEMA, Andrea Booher

Some studies have shown that older adults are more resilient and less susceptible to the psychological impacts of stressful life events. Above, a senior was displaced by a Southern California earthquake.

How vulnerability to stress changes with age is more complex. We know that both infants and older adults are more vulnerable to physical stressors, such as temperature extremes or massive population dislocations. These two groups are more likely to contract influenza or die in refugee camps. Neither group regulates body temperature well, so they are more likely to die of heat stroke. For example, thousands of older adults died during heat waves in Chicago and Europe a few years ago.

However, there is a controversy over whether the health of older adults is more or less vulnerable to psychosocial stressors than that of younger adults. While many assume that older adults are more vulnerable due to impaired immune function and chronic illnesses, some studies have found that those who survive into late life may be fairly resilient and less vulnerable to stress. For example, we have known for many years that older adults who are widowed have higher mortality rates in the following year. However, Johnson et al. (2000) found that middle-aged adults who lost their spouses had higher mortality rates than bereaved older adults.

In part, this may be due to survivor effects. For example, people in higher socioeconomic status groups have lower

mortality rates than poorer individuals with less education and thus are less likely to survive to late life (Marmot et al. 1991). Also, personality affects mortality: individuals who have a high degree of hostility are more likely to die in midlife (Krantz and McCeney 2002).

There may also be age differences in the types of illnesses that stress affects. Preliminary research from our laboratory suggests that chronic stress in young adulthood results in acute illnesses such as headaches, backaches and colds, while chronic stress in midlife results in chronic illnesses (and their risk factors) such as hypertension or high cholesterol (Aldwin et al. 2002).

In 2003, we received funding from the UC Davis College of Agriculture and Environmental Sciences, as well as the American Psychological Association, to hold a conference where researchers from a variety of disciplines were asked to specifically examine this question. The immediate answer resulting from the conference was, "We don't really know," because studies either had not yet been done or yielded contradictory results. Nonetheless, the resulting publication pulled together enough information to support an intriguing hypothesis (Aldwin et al. 2007a). We think that older adults actually may be physiologically more vulnerable to both physical and psychosocial stressors.



Even in healthy older adults, the neuroendocrine and immune systems often show slower returns to normal after stress activation, but some studies found that older adults have lower stress responses.

We hypothesize that this is because, knowing their greater vulnerability, older adults consciously avoid becoming upset by minor problems to prevent increases in health problems (Aldwin et al. 2007b). For example, one older man in one of our NAS studies remarked that he used to get upset about little things, but now that he has high blood pressure, he can't afford to anymore (Aldwin, Sutton, Chiara, et al. 1996). Older adults may be less likely to appraise situations as problematic (Boeninger et al. 2009), which might account for both their lower levels of reported stress and sometimes better physical profiles under stress.

### Positive aspects of stress

The second paradox concerns the positive aspect of stress, sometimes called "post-traumatic growth" (Tedeschi and Calhoun 2004) or "stress-related growth" (Park and Fenster 2004). Although we know that stress has adverse effects on health, even individuals undergoing extreme stress can point to the "silver lining" in their experiences. Negative experiences like divorce, war or job loss can often become "turning points" for positive change.

These individuals often point to increases in mastery and coping skills, more positive values, closer relationships with loved ones, and sometimes, increased spirituality. A study using data from the DLS found that only about 10% of individuals reported exclusively negative long-term outcomes of low points in their lives, while 20% reported exclusively positive long-term outcomes. Only about 10% said there were no long-term effects, while most (60%) reported mixed outcomes, that is, there were both positive and negative long-term consequences (Aldwin, Sutton, Lachman 1996).

In this study, we also examined factors that were associated with the long-term outcomes of low points. The

type of problem did not seem to matter, for example, whether it was related to family or work; rather, how individuals coped was of greatest importance. The use of positive coping strategies such as problem-focused coping — defined as cognitive and behavioral attempts to solve or manage the problem, taking perspective and self-regulation — allowed individuals to benefit from stressful experiences, while negative coping strategies such as blaming others, escapism and the use of drugs or alcohol to regulate emotions were associated with poorer outcomes (Aldwin, Sutton, Lachman 1996).

A critical issue in the field of stress-related growth is whether older individuals are more or less likely to find benefits in problems. The literature is mixed, with many studies showing no age effects, some showing that younger adults are more likely to report stress-related growth, and a few studies showing that older adults are more likely to do so (Stanton et al. 2006).

In a DLS follow-up study, we examined the effects of age on stress-related growth, and found two contradictory paths (Aldwin et al. 2009). First, age was negatively correlated with stress-related growth, suggesting that younger adults were more likely to perceive the positive aspects of stress. In many ways, this makes sense, because we encourage our young people to "learn from their mistakes," and not let (presumably

temporary) setbacks discourage them. However, the middle-aged adults were more likely to use positive coping strategies, which in turn was positively associated with stress-related growth. There may be individual differences in perceiving benefits. If individuals learn to derive positive benefits even from low points in their lives. This ability may become enhanced with age.

However, why was there still a negative correlation between age and stress-related growth? Recently, we examined two other stressor characteristics — the severity of the problem and its duration (Bi et al. 2008). The more stressful the problem, the more likely people were to report stress-related growth. Yet, there was no relationship between stress severity and age. The duration of the low point was positively associated with stress-related growth, but middle-aged individuals were more likely experience chronic stressors such as caregiving for loved ones or chronic illnesses. It is therefore unclear why there is a negative correlation with age.

### Optimal aging

California and most of the rest of the world will experience a massive



Conor Colwell



Janet Byron



Will Suckow

Experiencing stressful events can have a "silver lining" for older persons, who report the development of positive coping skills, increased spirituality and closer relationships with family and friends as a result. Above, 85-year-old Ets Igarashi; top right, 98-year-old Blanche Reiman; right, Fred Suckow and daughter Ann McGarry.

increase in the number of older adults in the next three decades. It is imperative that we understand what promotes optimal aging in order to maintain seniors in good health as long as possible, protect their quality of life and decrease the economic burdens on society. Understanding how to protect individuals from the negative effects of stress is one way of doing this.

Stress is ubiquitous — we all will experience problems at various points in our lives. The process of finding benefits in even the worst of problems may be protective of psychological health and perhaps physical health. Further, it is likely that the two paradoxes discussed here are linked. Positively coping with stress as a young or middle-aged adult may well provide a

better perspective on one's problems, and life in general. This enhanced perspective may become protective in later life. Older adults who are successfully aging may have learned how to avoid becoming upset over relatively minor problems — or even chronic ones — thereby decreasing their negative responses to stress, protecting their health and promoting optimal aging.

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**While stress is ubiquitous in life, older adults who have learned how to manage it may age the most gracefully and healthfully.**

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# Cognitive and motivational factors support health literacy and acquisition of new health information in later life

by Lisa M. Soederberg Miller

*Health literacy refers to the ability to read, understand and use health information to maintain or improve one's health. Health literacy skills have been linked to outcomes such as medication adherence, improved health and decreased health-care costs. Health literacy is particularly low among older adults. Given demographic projections that 20% of the U.S. population will be over age 65 by 2030, there is a pressing need to understand health literacy in later life. We present such a framework, as well as data from two studies that show how cognitive and motivational factors support one aspect of health literacy, namely, the acquisition of new health information. A clearer understanding of these issues will provide insight for targeting educational interventions designed to increase health literacy among aging adults.*

**H**ealth literacy refers to the ability to obtain, process and understand the basic information and services needed to make appropriate decisions regarding one's health (Institute of Medicine 2004). The American Medical Association defines health literacy similarly, as "the constellation of skills, including the ability to perform basic reading and numeracy tasks, required to function in the health-care environment."

In general, "health literacy" includes a broad range of skills including the ability to understand language well enough to accurately complete medical forms, comprehend spoken and written medical instructions, and communicate symptoms and concerns to medical professionals, as well as the ability to seek



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Health literacy is needed to understand medical information and instructions, communicate effectively with health professionals and manage one's own medical treatment.

and understand information regarding illness and treatment options outside of the medical establishment. Individuals with low health-literacy levels may be less likely to receive adequate health care because they avoid or delay seeking care. In cases where they do seek help, they are less able to benefit due to comprehension problems during and after the care visit. Furthermore, they are less able to regulate the treatment of their chronic diseases, less likely to adhere to medication regimes and more likely to visit emergency rooms (Murray et al. 2004; Schillinger et al. 2002). Not surprisingly, low health literacy has been associated with increased health costs (Marwick 1997).

Low health literacy may be more prevalent than many realize. Among

English-speaking patients, researchers found that more than 30% could not comprehend basic health materials, 25% could not accurately read appointment slips and 40% could not understand their prescription labels (Williams et al. 1995). The White House Office of Management and Budget estimated that language barriers affect some 66 million patients annually (Newman 2003). Moreover, older adults are more

**Individuals with low literacy levels may be less likely to receive adequate health care because they often avoid or delay seeking care.**

likely to have problems related to health literacy than younger adults (Rudd et al. 2004). One estimate suggests that 30% to 40% of English-speaking older adults are unable to comprehend written health-care information (Benson

and Forman 2002; Gazmararian et al. 1999). In fact, one study found that 2,512 community-dwelling older adults with limited health literacy were nearly twice as likely to die in a 5-year period than those with adequate health literacy (Sudore et al. 2006). This relationship was evident even after controlling for age, race, socioeconomic status, current health, health-care access and health-related behaviors.

Awareness about the importance of health literacy is growing. Proposed approaches to deal with the problem include evaluating public need, identifying obstacles to effective communication, increasing access and usability, and identifying communication and educational strategies appropriate to a targeted audience (Institute of Medicine 2004). To help specify educational strategies and interventions to improve the health literacy skills of older adults, research is presented on cognitive and motivational factors that support the acquisition of health information in later life. Knowledge acquisition is an important component of programs designed to increase health literacy.

### Cognition and motivation

A wide array of basic cognitive abilities such as working memory, knowledge and language comprehension, as well as motivational factors, support health literacy and in particular the acquisition of new health information. Knowledge and motivation may be particularly important in later life due to developmental changes that occur in

adulthood. Because of these changes, older adults may be more likely to conserve cognitive (Park et al. 1999) and emotional resources (Carstensen et al. 1999).

**Cognitive ability.** Cognitive changes in later life can be characterized in terms of the mechanics (the brain's hardware) and pragmatics (the brain's software) of intellectual functioning (Baltes 1987; Salthouse 2000). Aging is associated with declines in the mechanics of functioning, including areas such as executive function and working memory capacity. Working memory is used when individuals hold information in short-term memory while simultaneously performing a computation; for example, trying to understand a message left by your doctor's office on your answering machine, while at the same time writing down the telephone number that was spoken quickly during the first part of the message. Although working memory declines in later life, cognition models also acknowledge that aging is associated with gains in pragmatic intelligence, such as word meanings (vocabulary), general world knowledge, and domain-specific knowledge such as nutrition or one's chronic disease (Salthouse 2000; Schaie 1990).

Given the declines in one and preservation of the other, researchers have asked whether increases in knowledge and experience (pragmatics) can offset or compensate for losses in mechanics (Charness 2000). In support of this position, Miller et al. (2004) showed that older adults with high levels of knowledge were just as able as younger adults to learn about the heart in a 2-hour tutorial, and they were equally able to apply this new knowledge to understanding new passages about the heart as younger adults. However, other research has shown that age declines still remain within the high-knowledge group. Relationships

among performance, knowledge and age are complex, and there are several models that attempt to capture these relationships. According to the migration hypothesis, older adults sometimes migrate into higher knowledge groups, which in turn protects them from the declines experienced by older adults without this knowledge (Salthouse 2003).

This approach is promising because past work clearly shows that the amount of knowledge individuals possess regarding their health is closely tied to measures of health literacy as well as health outcomes (Dolan et al. 2004; Gazmararian et al. 2003; Kalichman et al. 2000; Williams et al. 1998; Wolf et al. 2005). Greater stores of health knowledge among older adults may protect against age declines in health literacy.

**Language comprehension.** Language comprehension is an important component of health literacy. For example, individuals listen to and read information provided by health-care providers. They read label instructions to understand how to take medications properly and handouts regarding post-operative care. Individuals also listen to health-care providers at clinics, reporters on the radio, pharmacists and others they encounter on a regular basis in order to make decisions regarding their health.

Language skills are also used to acquire new health information about a particular area. This can occur during brief communication exchanges with health-care providers as well as during more extensive searches on the Internet or at a library for information regarding chronic conditions or treatment options.

However, some aspects of language comprehension are compromised in later life due to age-related declines in working memory and related abilities (Norman et al. 1992; van der Linden et al. 1999). Language that is grammatically complex or packed with concepts is particularly difficult for older adults to comprehend (Wingfield and Stine-Morrow 2000). Indeed, some research shows that older adults have more difficulty understanding health information than younger adults (Brown and Park 2002).



The acquisition of new health information is a function of basic cognitive skills such as working memory and language comprehension, as well as motivational factors.



Researchers have examined ways to facilitate communication between providers and patients. Morrow et al. (2006) suggested that health materials should be presented in a way that reduces comprehension demands on general cognitive abilities as well as health literacy skills. Their work on medication adherence suggests that one way to achieve this goal is through patient-centered instructions, those written and organized in a way that is useful to the patient. In one study, for example, older adults preferred adherence information in the form of a schedule, and this preference was more pronounced among those with low health-literacy levels (Morrow et al. 2007).

**Motivational factors.** One's ability to comprehend health information is critical for health literacy skills; one's willingness to do so is another matter. The extent to which individuals choose to engage in any particular health literacy endeavor, including comprehension, new knowledge acquisition and decision making, will depend on the cognitive resources available (ability) as well as the willingness or motivation to expend those resources. This notion is captured by prominent models of health behaviors (Bandura 2005; Leventhal and Mora 2005), which argue that motivational factors are necessary for compliance with what individuals may already know to be important behaviors.

Indeed, past research indicates that interventions focusing only on comprehension and knowledge acquisition do not always lead to changes. In nutrition, knowledge of healthy diets is not sufficient to encourage individuals to make healthy food choices (Nebeling et al. 2007). Motivation is also required.

Motivational factors underlying health literacy are not well understood, most likely due to problems surrounding their definition, operation and measurement. Nevertheless, measures have been developed to tap self-efficacy and control beliefs (those surrounding one's ability to attain desired goals) related to health outcomes (Wrosch et al. 2002) and eating behaviors (Moseley 1999). These beliefs may provide motivation for individuals to persevere when faced with health behaviors that



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Some aspects of language comprehension may be compromised in late life, making it more difficult to understand language that is grammatically complex or densely packed with ideas.

are challenging, unpleasant or time consuming.

Such motivational forces have been widely researched in the area of cognition. For example, control beliefs and self-efficacy related to memory performance have been shown to be important for cognitive performance, particularly when the cognitive tasks are challenging (Bandura 1997). Within the aging literature, researchers have suggested that self-efficacy and control beliefs are particularly important for older adults because they lead to the more effective use of strategies, which in turn leads to higher levels of performance (Lachman and Andreoletti 2006; Miller and Lachman 1999). Older adults with a strong sense of control over their cognitive abilities allocated more attention to difficult reading passages than those with a weak sense of control (Miller and Gagne 2005). These data suggest that control beliefs may provide older adults with the motivation to persist in the face of a challenging comprehension task.

Although theoretical work suggests that self-beliefs are important for health (Bandura 2005), empirical evidence linking these beliefs to health comprehension and health outcomes is lacking. More research is needed to understand factors supporting the likelihood of adopting healthy behaviors as well as engaging the cognitive processes

necessary to understand what those behaviors should be.

#### Prior knowledge and motivation

Health literacy represents a broad set of skills, one of which is the ability to comprehend health information so that new knowledge is acquired. The literature suggests that comprehension and learning in later life are dependent on cognitive and motivational factors. More specifically, prior knowledge and motivation may support learning by mitigating declines in processing mechanics (e.g., working memory) that are likely underlying comprehension difficulties. Therefore, prior knowledge and motivational factors are likely to be important for health comprehension and learning later in life.

We conducted two studies that examine the roles of knowledge and motivation on the acquisition of new health information. The specific question was whether knowledge and motivation mitigate age-related declines in learning about nutrition. In the first study, motivation specific to nutrition was assessed, whereas in the second study, motivation was assessed more broadly in terms of health. In both studies, the participants were high functioning, as reflected by years of education and scores on working memory measures.

**Study 1.** In study 1, the sample included 30 younger (ages 18 to 35), 31

middle-aged (ages 36 to 59) and 32 older (ages 62 to 80) adults (data were from a larger study; Miller et al. 2010). Participants read two passages (1,400 words total) at their own pace and answered multiple-choice comprehension questions. The texts described the health benefits of consuming one of two types of foods (whole grains or fruits and vegetables) and provided information on how to identify these foods when selecting groceries.

Prior to reading the passages, participants completed a nutrition knowledge test and a battery of motivational measures. The knowledge test contained multiple-choice items (e.g., “A child who is raised on a vegan diet is most likely to become deficient in \_\_\_\_”; options: fiber, carbohydrates, vitamin C, etc.). The nutrition motivation measure was a composite of three measures: the Food Pyramid Self-Efficacy Scale (Moseley 1999), a nutrition interest scale and a stage-of-change measure. The Food Pyramid Self-Efficacy Scale contained 22 items designed to assess individual perceptions of one’s ability to follow a healthy diet when placed in a wide variety of circumstances, such as watching television or feeling restless or bored. The Nutrition Interest Scale consisted of six items (e.g., “How interested are you in knowing the difference between food facts and fallacies?”). The stage-of-change measure, modeled after Prochaska and DiClemente (1983), asked individuals to rate their readiness to follow a healthy diet within the areas

of fruits and vegetables, fat and junk food. We created a composite measure of nutrition motivation by averaging the standardized scores across the three measures. Comprehension was assessed with a multiple-choice test.

Consistent with past work on age differences in comprehension and recall (Johnson 2003), the results showed that comprehension performance significantly declined with age ( $r = -0.36$ ,  $P < 0.001$ ). However, there was a positive association between knowledge and age ( $r = 0.24$ ,  $P < 0.05$ ). Importantly, when knowledge was controlled, age differences in performance were magnified ( $r = -0.46$ ,  $P < 0.001$ ), indicating that without knowledge, older adults’ performance would have been even lower. A similar pattern was found for motivation. There was a positive age-trajectory in nutrition motivation ( $r = 0.34$ ,  $P < 0.001$ ), and larger age deficits in comprehension after controlling for motivation ( $r = -0.42$ ,  $P < 0.001$ ).

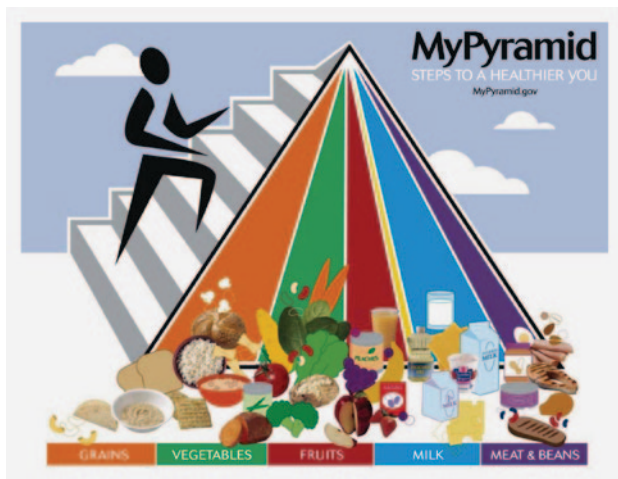
These findings are consistent with the migration hypothesis (Salthouse 2003), which suggests that adults migrate into higher levels of nutrition knowledge with increasing age, thereby mitigating further age-related declines in cognitive performance. These findings also extend the notion of migration to motivation by showing a similar age-related increase in self-efficacy and larger age differences in comprehension when self-efficacy is controlled. The implication of these findings is that knowledge and motivation related to nutrition

play a larger role in later life by compensating for age-related declines in the mechanics of processing that underlie comprehension deficits.

**Study 2.** The first study included a motivation assessment specific to nutrition, but motivation pertaining to more general health issues was not assessed. In study 2, the possibility that a more general measure of motivation mitigates comprehension declines was investigated. Data from this study, taken from a larger project (Miller and Gibson 2009), consisted of 102 adults between the ages of 18 and 81. Participants read a set of nutrition texts and completed several comprehension tasks. We focus on responses to a short-answer exercise completed after individuals read the texts (because it is most similar to the measure used in study 1) as well as the health motivation measure, Health-Engagement Control Strategies (HECS).

HECS was designed to assess the degree to which individuals engage in various strategies to control their health outcomes (Wrosch et al. 2002) and has been shown to be related to health outcomes (Wrosch and Schultz 2008). Participants responded to items such as, “I invest as much time and energy as possible to improve my health.” Knowledge was assessed using an expanded version of the nutrition test in study 1 (38 items). As with study 1, the goal was to determine whether knowledge and motivation mitigate age-related declines in comprehension performance.

The results were consistent with the first study, showing an age-related decline in comprehension performance ( $r = -0.30$ ,  $P < 0.01$ ), as well as a significant age-related increase in nutrition knowledge ( $r = 0.25$ ,  $P < 0.01$ ). Also consistent with the first study was the finding that age-related declines were more pronounced when nutrition knowledge was controlled ( $r = -0.46$ ,  $P < 0.001$ ). In addition, there was a positive correlation between age and health motivation ( $r = 0.44$ ,  $P < 0.001$ ), indicating that motivation to engage in strategies to control one’s health increases with age. However, the correlation between health motivation and comprehension was nonsignificant ( $r = -0.11$ ,  $P > 0.10$ ). When motivation was controlled, age declines in comprehension performance



A study of how age affects learning about nutrition included an assessment of individuals’ understanding of information in the USDA Food Pyramid, above, and on nutrition facts panels such as the one for asparagus, right.

Nutrition Facts			
Serving Size 5 spears (93g)			
Amount per serving			
Calories 25	Calories from fat 0		
% Daily Value*			
<b>Total Fat 0g</b>	<b>0%</b>		
<b>Saturated Fat 0g</b>	<b>0%</b>		
<b>Cholesterol 0mg</b>	<b>0%</b>		
<b>Sodium 0mg</b>	<b>0%</b>		
<b>Total Carbohydrate 4g</b>	<b>1%</b>		
<b>Dietary Fiber 2g</b>	<b>8%</b>		
<b>Sugars 2g</b>			
<b>Protein 2g</b>			
Vitamin A 10%	Vitamin C 15%		
Calcium 2%	Iron 2%		
*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:			
Calories: 2,000 2,500			
Total Fat	Less than 65g	50g	
Sat Fat	Less than 20g	25g	
Cholesterol	Less than 300mg	300mg	
Sodium	Less than 2,400mg	2,400mg	
Total Carbohydrate	300g	375g	
Dietary Fiber	25g	30g	
Calories per gram:			
Fat	9	Carbohydrate 4	Protein 4





Research is needed to identify the motivational factors that promote engagement among seniors in education related to healthy behaviors, such as eating nutritious foods.

were not magnified as in the first study; in fact, the correlation was slightly attenuated after controlling for motivation ( $r = -0.27, P < 0.01$ ). These data fail to support the notion that health engagement strategies mitigate age-related declines in nutrition comprehension.

### Nutrition comprehension and literacy

Together, data from the two studies show that nutrition knowledge mitigated age-related declines in nutrition comprehension, and that nutrition motivation also mitigated age-related declines. However, no mitigation was evident for the health motivation as assessed by HECS. Firm conclusions regarding which motivators do or do not provide additional support to older adults' understanding of nutrition information are not possible without a wider range of measures within a single study to make direct comparisons.

Nonetheless, some speculations can be made. One possibility is that older adults who use more engagement strategies also have more health problems, which in turn offsets any potential benefits of increased motivation. Another possibility is that strategies used to control health behaviors are somewhat removed from one's motivation to learn about and follow a nutritious diet. Health motivation that is more specific may be more highly connected to behaviors than more general measures of

health. This is the case when examining the relative effects of cognitive control beliefs and general control beliefs on cognitive performance; cognitive control beliefs are more highly connected to cognitive performance (Lachman 1986). Similarly, the benefits of nutrition motivation could be due to their overlap with nutrition knowledge. In examining the data, there was a significant positive correlation between nutrition knowledge and motivation in the first study ( $r = 0.23, P < 0.05$ ). In contrast, the association between nutrition knowledge and health motivation in the second study was nonsignificant ( $r = 0.13, P > 0.10$ ), indicating that individuals who reported using frequent strategies to control health outcomes were not necessarily those with greater stores of nutrition knowledge.

Although speculative, these findings could indicate that motivating factors within a health domain have greater effects on older adults when they are highly specific to that domain. The knowledge domain addressed here was nutrition; however, other specific health domains (e.g., glucose regulation, exercise) may show similar advantages.

### Further questions

Although these findings shed some light on factors that support health literacy in later life, they also raise questions. One is, how does motivation

support information acquisition and health literacy skills? Recent evidence suggests that nutrition motivation helps individuals sustain attention during a comprehension task (Miller et al. 2010). It could be that motivation within a domain provides individuals with the perseverance to engage in health literacy tasks that are cognitively demanding.

The samples in the two studies reported here were representative of high-functioning adults. Thus, the age effects reported here most likely represent a best-case scenario. It remains unclear how having fewer educational advantages would affect the opportunity for older adults to use knowledge and motivation to compensate for age-related declines in the mechanics of processing. Future research on health knowledge acquisition would benefit from a more diverse sample, which would help to determine if (1) motivational factors are constant across various educational or socioeconomic groups, and (2) patterns would be altered if age-related declines in comprehension were increased and knowledge levels were decreased, as may be expected within a less-educated group. Past research suggests that education would provide a substantial benefit for older adults (Wilson et al. 2009), but the mechanisms responsible for this are not well understood.

Increasing health literacy skills among older members of society is a goal that is growing in importance. A clearer understanding of factors that support health literacy in later life is essential if we are to meet the forthcoming demands on our health-care system and ultimately promote older adults' quality of life. Research presented here suggests that prior knowledge plays a critical role in supporting the acquisition of new health knowledge, which in turn will support health literacy skills in later life. More effort should be directed toward educational programs to promote health behaviors among older adults.

The data also suggest that motivational factors support new knowledge acquisition and health literacy skills in later life. However, associations among knowledge, motivation and health literacy are complex. Greater effort should be directed toward research that identifies a wide range of motivational factors

that encourage engagement in educational activities that promote healthy behaviors, such as eating healthy foods to prevent or control disease. To be sure, knowledge and motivation alone will not solve the problem of low health literacy or poor dietary habits. However, attention to these factors in addition

to social marketing (e.g., encouraging manufacturers to reduce the number of foods processed with partially hydrogenated oils (trans fats), and identifying ways to provide affordable fresh fruits and vegetables to consumers in low-income urban areas) may provide an initial step toward increasing health

literacy and improving health outcomes throughout adulthood.

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## Limited-income seniors report multiple chronic diseases in quality-of-life study

Mary L. Blackburn

*The silver century is now! Seniors 65 and older are the fastest growing segment of the world's population, and in the United States the 85 and over age group is increasing at the highest rate. This study documents the chronic diseases reported by a diverse group (n = 377) of urban, limited-income seniors who attended UC Cooperative Extension Quality of Life education forums. The data suggests that their greatest educational need is learning how to integrate multiple concepts and complex research and technology into their personal lives. The data correlated disease conditions, diet and physical activity with age and ethnicity to show the magnitude of multiple diseases among them, identify perceived educational needs, and describe seniors' expectations and preferred education and training delivery methods.*

Americans are living longer. The life expectancy at birth in California is currently 75.9 years for men and 80.7 for women (Lee and McConville 2007). The number of people 65 and older is expected to double in several decades, making up 20% of the U.S. population by 2030 (AOA 2003). Seniors over age 65 currently comprise almost 11% of California's population, and they are expected to double or triple in some counties by 2030. Seniors age 85 and older will increase at the fastest rate, over 150% in 38 counties (mostly northern and central California). The impact of this older group will become more evident as the first wave of baby boomers reaches age 85 in 2030 (CDA 2003).

At the same time, the Centers for Disease Control and Prevention (CDC) reports that chronic diseases such as



Good nutrition and a healthy lifestyle are often disconnected from concepts of wellness and "quality of life," especially among the elderly.

heart disease, stroke, cancer and diabetes are among the most prevalent, costly and preventable of all health problems. Yet seven out of 10 Americans die each year from chronic "lifestyle" diseases that are extensions of what they do, or do not do, as they go about their daily living. Health-damaging behaviors such as tobacco use, lack of physical activity and poor nutrition are major contributors to the nation's leading killers, heart disease and cancer (US DHHS 2003). In California, these two diseases represent 54% of annual deaths, 29% and 25% respectively. Among adults 65 and over in California, the top-six chronic diseases diagnosed are hypertension (53.5%), arthritis (50%), heart disease (23.7%), cancer (17.3%), diabetes (14.8%) and asthma (10.3%) (Wallace et al. 2003).

One of the goals of the U.S. Department of Health and Human Services guidelines for health promotion and disease prevention is to extend the years of "healthy life" — physically, mentally and socially (US DHHS 2000). In this context, proactive consumer education on health and wellness should promote positive conditions under which people can be healthy (IOM 2002). Client-friendly information and

education are necessary to help elders address their quality-of-life issues more effectively. However, the complexity of disease processes, as well as health-related information, is often confusing for seniors and educators.

With the gradual rise in availability of ready-to-eat, high-calorie foods, food security issues, and families eating away from home more frequently, the benefits of good nutrition and healthy lifestyle seem to be disconnected from concepts of wellness, or "quality of life" issues. Likewise, obesity rates have risen rapidly in all age groups, as have other nutrition- and lifestyle-related diseases.

Wallace et al. (2003) notes that public health as a social good is concerned with equitable access to health care, with conditions conducive to high-quality care for all ages. Certainly, a well-informed aging populace can help respond to these concerns, and advance the notion that growing older and living longer does not necessarily mean that one must be in ill health.

### Nutrition and wellness concerns

This study was designed to document the nutrition and wellness

concerns among a diverse group of limited-income seniors, many with multiple chronic diseases, who participated in UC Cooperative Extension (UCCE) Quality of Life forums, which informed UCCE education and outreach programming for elderly Californians.

**Data collection.** The Quality of Life interactive educational forums were initiated in 1993 and conducted by a UCCE nutrition, family and consumer sciences advisor in Alameda County. The goal was to increase the ability of seniors with limited incomes and/or low literacy to integrate science-based nutrition and wellness information into their lifestyles and ultimately improve the quality of their lives.

Self-assessment data was collected from 2003 to 2005 on a convenience sample of self-selected, multicultural seniors ( $n = 377$ ) and 16 agency staff and volunteers. Seniors from 22 facilities serving limited-income seniors volunteered to complete the written, baseline self-assessments prior to the forums. The sites were senior meal programs, centers, clubs and low-income housing complexes in eight Alameda County cities.

Directors and coordinators of the programs distributed the assessments, assisted seniors who needed help completing the forms, set dates for the forums, and transmitted the assessments to the UCCE advisor-educator about 2 weeks prior to the 2.5-hour educational

forums and focus group evaluations. The seniors listed their chronic conditions, lifestyle practices, physical activities and special diets. They reported whether they understood the physical effects of the chronic conditions they listed, their special diets, prescribed medications and perceived needs for nutrition and wellness education.

**Data analysis.** The assessments were identified by numerical codes, which allowed the data to be treated confidentially. The responses were entered into an Excel database, and totaled; averages and standard deviations were computed and normalized. Computations from the raw data were compiled into two worksheets to show the distribution and prevalence of the responses. A third worksheet compiled the normalized data by dividing total responses for the questions and items by the population total ( $n = 377$ ).

The normalized data expressed as percentages were used to describe and demonstrate relationships in selected areas, such as the intersections of age and ethnicity with diet, physical activity and chronic diseases. We calculated sample means, standard deviations,  $t$ -values,  $P$  values and  $\alpha$  values to determine levels of significance.

### Forums and focus groups

The goal of the forums, usually conducted just before the noon meal, was to (1) process the concerns listed in

the seniors' assessments; (2) prioritize their nutrition and wellness education needs; and (3) learn more about how UCCE educators can meet their needs for information and education. We used several interactive, facilitative, learner-centered (LCE) techniques and principles, as described by the American Psychological Association (APA 2006). These included cognitive factors that influence knowledge construction and strategic thinking; and motivational, emotional, developmental and social factors that influence learning. We used these principles to help participants express their particular concerns, verbalize their needs in more detail, and identify their levels of knowledge and understanding for several diseases, including diabetes and hypertension. We used questions posed by the seniors themselves to demonstrate how to integrate, apply and expand their personal knowledge.

At the end of the forums, we conducted a 30- to 40-minute focus group evaluation to assess the clients' satisfaction with the interactive teaching approach; clarify needs, and enhance knowledge and understanding; and allow seniors to express what they expected from UCCE educators. This client-centered process helped to highlight and prioritize mutual concerns and needs among the seniors, build confidence and personal motivation, promote positive wellness attitudes and encourage participation in more personal wellness activities.

### Demographics and disease

The participants were 75% female and 25% male. They were multicultural: 54.9% white, 24.2% Asian/Pacific Islander, 15.4% black, 4.9% Latino and 0.5% American Indian.

The age groupings were 60 to 69 years (26.3%), 70 to 80 years (38.5%), over 80 years (19.4%) and age not reported (15.8%). All seniors in this sample reported at least one chronic condition; 22% reported two, 15.4% three, 8.2% four, 4.8% five and 5.0% six to seven.

The diseases reported were arthritis (40%), high blood pressure (38%), overweight (32%), high blood cholesterol (21%), stress (21%), heart disease/hardening of arteries (19%), gout (15%), diabetes (13%) and food allergies (12%).



UC Cooperative Extension educators have offered quality-of-life workshops to seniors in order to help them integrate science-based information on nutrition and wellness into their lives. In focus groups, the seniors said they preferred client-centered education with a personal touch.



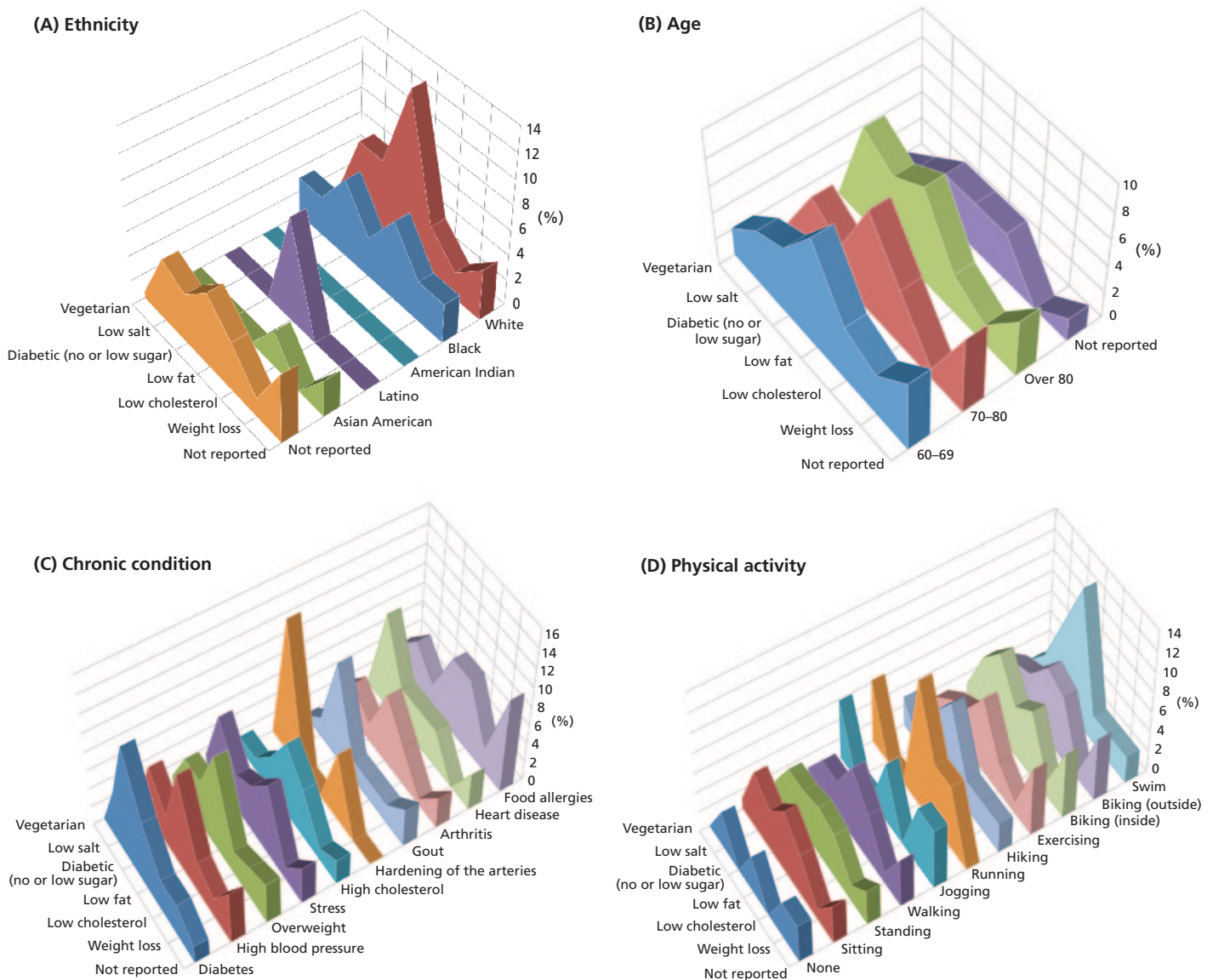


Fig. 1. Senior diets distributed by (A) ethnicity, (B) age, (C) specific chronic condition and (D) physical activity ( $n = 377$ ).

We collected data on center staff (40 to 59 years,  $n = 16$ ), but the number was too small to examine independently and was used for comparative purposes only.

### Diet and exercise

About 26.5% ( $n = 100$ ) of the group ( $n = 377$ ) reported being on various diets, including low fat (34.2%), low/no salt (21.5%), diabetic and low sugar (20.3%), low cholesterol (19%), weight loss (7.6%), vegetarian (2.5%) and non-specific, such as renal, gout or no red meat (10%).

**Ethnicity.** Whites were significantly more likely to report low-fat and low-salt diets; blacks reported low-salt,

low-cholesterol and weight-loss diets; Asian/Pacific Islanders reported only low-cholesterol diets; Latinos reported only low-fat diets; and American Indians reported no special diets ( $P > 0.05$ ) (fig. 1A). Whites and blacks reported more low-sugar/diabetic and vegetarian diets.

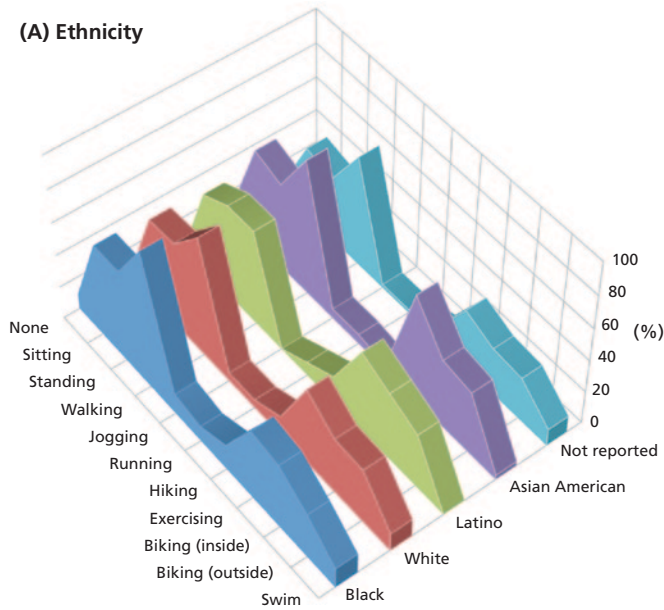
**Age.** Relatively few differences were found by age except for a significant increase in low-salt diets in later years ( $P > 0.05$ ) (fig. 1B).

**Diseases.** In general, vegetarians reported a significantly lower incidence of chronic conditions such as arthritis, allergies, stress and heart disease ( $P > 0.05$ ) (fig. 1C). Those on low-salt diets reported significantly more heart disease,

stress, high blood pressure, diabetes and allergies. The seniors on low-sugar/diabetic diets reported higher incidences of arthritis, diabetes and overweight. Those on low-fat diets reported higher incidences of overweight, high blood pressure and arthritis. And subjects on low-cholesterol diets reported higher incidences of overweight, stress, high cholesterol and allergies. Those on weight-loss diets reported higher incidences of overweight, diabetes, hardening of the arteries and allergies.

**Physical activity.** Seniors on different diets and those who reported no diets were equally as likely to report particular exercise activities. Vegetarians mostly swam, ran and jogged; low-salt

(A) Ethnicity



(B) Age

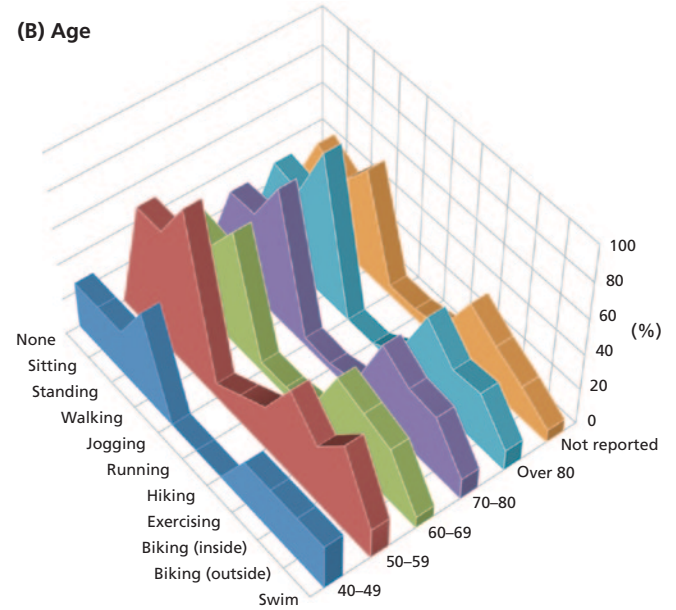


Fig. 2. Senior physical activity distributed by (A) ethnicity and (B) age ( $n = 377$ ). Physical activities of the small staff group aged 40–59 ( $n = 16$ ) are shown for contrast only.

dieters swam, rode stationary bikes inside and walked; diabetic dieters swam, walked, rode stationary bikes and did stand/sit exercises; low-fat dieters swam, hiked, ran and jogged; low-cholesterol dieters rode bikes inside and outdoors, jogged and stood/sat; and

weight-loss dieters just walked. Seniors not reporting any diets tended to report more high-energy activities ( $P > 0.05$ ) (fig. 1D).

**Types of exercise.** Self-reported activities included walking (73%), exercising (including classes and videos) (42%), biking outside (30%), biking inside (32%), working around the house and yard (16%), swimming (10%), running/jogging (5%), going to the gym (4%) and yoga (2%). Physical activity distributed by ethnic group and age showed that all groups performed at about the same level irrespective of age or ethnicity (fig. 2).

**Health education needs**

Over 51% of the survey participants said they were on medications but only 14.8% ( $n = 56$ ) reported the names of the medications. Of the participants on medication, 48% were on one medication, 30% on two, 14% on three or four, and 8% on five or six. When asked if they understood why they were taking the medications, about 49.1% said “yes” and 50.9% said “no.” While 59.7% said they did not know how the medication worked in their body, only about 15% listed a need for training, a workshop or further explanation (table 1).

Some 71.6% said they understood the diets they were on, 74.8% said they

understood their chronic conditions, 68.2% said their conditions had been explained to them, and 68.7% reported they understood what they needed to do to manage or control their condition.

Specific education and information needs concerned arthritis and gout (17%), low-fat/low-cholesterol diets and high blood pressure (about 16% each), diabetes (11%) and weight control (9%). Other areas (about 3% to 4% each) included health education, up-to-date food and nutrition, allergies, asthma, swollen ankles or legs, numbness in the legs, restless legs, dizziness and trouble walking, thyroid disorders, rapid weight loss, hypoglycemia, how to diet, medication and aging issues.

**Processing complex information**

Over 55% of the seniors reported multiple disease conditions. In the forums, some said the large volume of information encountered in their everyday lives often confused them. They expressed concerns about how difficult it is to make good use of information and to process confusing or conflicting recommendations. Participants were asked if they had difficulties reading or understanding information related to their disease conditions, medication or diets. Some with low literacy expressed low self-esteem and were offered extra



Of the seniors surveyed who exercised, 5% said they ran or jogged regularly. Other exercises reported included walking (73%), biking indoors and outdoors (62%) and exercise classes and videos (42%).



peer-group support to participate in the interactive process. In general, these seniors were at higher risk of poor management of their chronic conditions because they were more likely not to make the best use of available information. Some had to contend not only with their personal concerns and conditions but also had responsibility for one or more family members with health concerns. Others struggled with adjusting lifestyles, making dietary changes and taking multiple medications prescribed to manage their conditions.

**Literacy.** While many seniors from the baby-boomer era have high literacy levels and are computer savvy, millions of low-literacy and low-income seniors of the pre-baby boom era, similar to the ones in our forums and focus groups, remain at risk of poor health outcomes due to lack of information, misinformation, lack of understanding and/or misinterpretation. We found some seniors with literacy, vision, strength or memory concerns who also had multiple disease conditions with complicated ramifications, such as arthritis, diabetes and hypertension. This information challenge left some seniors timid and afraid to ask their health providers questions. Lacking sufficient understanding of their personal conditions, they said they needed an advocate to help them comprehend prescribed treatment and prevention plans. Without appreciation for the importance of their plans, they were less likely to make a firm commitment to follow through, whether the changes were lifestyle, dietary or medicinal.

**Commitment.** We learned that when faced with the need to take multiple actions — such as improving their diets, adding activity to their lives and taking medications — some seniors complied with the easiest mandates and ignored the difficult ones; for example, they would “take the medicine, and eat what you want.” Some were less diligent with dietary and activity adjustments than needed. Some were also hoping for a quick result and became discouraged if they had to maintain changes over a period of time. If changes needed to become a way of life, or if they felt the adjustments were too limiting or difficult to fit into their daily lives, their commitment to the management plan waned.

**Attitude.** Attitudinal responses suggested that some seniors tuned out and gave up. Their comments included, “What will be, will be,” “It runs in the family” and “I know someone with the same thing, and there is nothing they could do.” Some of these statements were expressions of frustration or feelings and attitudes resembling defeat, or they believed that they had no real control over the quality of their life experiences. Other seniors demonstrated good negotiation skills and assertiveness and were open to the possibilities of a healthier existence and better quality of life.

#### Seniors prefer the personal touch

Information presented to the low-income seniors that we studied needs to be not only science-based, but also client-friendly, useful and presented in



**Health-damaging behaviors such as smoking, lack of exercise and poor nutrition are major factors contributing to heart disease and cancer, the nation's top two killers.**

an appealing format. The seniors' stated preferences included: “We want people to talk to us, spend time with us”; “We have had enough of canned speeches”; “Speakers bring us what they want us to hear”; and “People often bring videos because they don't want to spend time to find out what we really want or need.” Their comments suggested the tenor of their concerns with tradi-

**“Lady, whatever you do, don't bring me another video!”**

tional education and training delivery methods.

The baseline self-assessments and forum discussions showed that many seniors want more than a lecture to “pile on” more information and statistics. They want to have a meaningful dialogue, including: (1) participating in personal interaction, (2) feeling a personal touch, (3) having an exchange about questions and issues that matter to them and (4) spending personal time talking with the educator. One very elderly senior said, “Lady, whatever you do, don't bring me another video!” Their comments bear out the notion that in client-centered education people want educators to “tell me a story and put me in it” (Norris 2005).

#### Serving aging baby boomers

More than half of the state's seniors are at risk for chronic diseases related to nutrition and lifestyle, and the needs of aging baby boomers are expected

TABLE 1. Level of understanding reported by seniors (n = 377) for diet, disease and medication

Question	Yes	No
	..... % .....	
Do you understand the condition(s) you have?	74.8	25.2
Have your condition(s) been explained to you?	68.2	31.8
Do you understand what you need to do to manage or control your condition?	68.7	31.3
Are you on a special diet of any kind?	21.0	79.0
Do you understand this diet?	28.4	71.6
Are you on medications?	51.7	48.3
Do you understand why you are using these medications?	49.1	50.9
Do you understand how these medications work in your body?	40.3	59.7
Would you want training and workshops to help you understand your medications?	14.6	85.4

to challenge health-care providers and UCCE nutrition and wellness educators for decades. Yet UCCE does not have a continuing framework for community education of California's aging baby boomers. The information that we collected from limited-income seniors in the self-assessments and focus groups suggests that their greatest educational need is learning to integrate multiple concepts and complex research, education, and information and technology into their personal lives.

UCCE educators have the opportunity to promote positive nutrition and wellness attitudes and behavioral changes to ensure a better quality of life for Californians in their later years. The challenge is to appreciate the needs and expectations of seniors and use educational approaches that they find most helpful to understand complex or conflicting information. In addition to a better quality of life, more-effective educational interventions can help reduce the costs of treating preventable diseases.

In light of the trend toward increased health awareness (Gorman 2007) such as eating healthier foods, seniors (like other age groups) can benefit

from an enhanced understanding of how to make positive behavior changes. Educational obstacles can affect people of all ages, but chronic disease conditions among seniors, especially those with literacy and limited income or poverty, can exacerbate the problem (Weimer 1997, 1998). If the concept of healthy aging is to add life to years, not years to life, then nutrition and wellness can play a major role in enhancing the quality of life of California's elders.

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**Californians are living longer, but growing older does not necessarily mean that one must be in ill health.**

**Their greatest educational need is learning to integrate multiple concepts and complex research, education, and information and technology into their personal lives.**

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# The need for caregiver training is increasing as California ages

by Gloria J. Barrett and Mary L. Blackburn

***As the first baby boomers reach age 65 in 2011, California will face unprecedented growth in its aging population. At the same time, budget cuts threaten California's In-home Supportive Services (IHSS), which now assists seniors aging at home and the disabled. We conducted a cost analysis and compared caseload changes using IHSS raw data from 2005 and 2009. Results showed an across-the-board increase in caseload and cost for indigent in-home care in California, with significant variation from county to county. Large numbers of minimally trained IHSS caregivers, and family caregivers with little or no training, raise concerns about the quality of care that elders and the disabled receive, while highlighting the need to protect the health and well-being of caregivers themselves. UC Cooperative Extension can play a vital role in training undertrained and unskilled caregivers through applied research, curriculum design, education and evaluation, and proposing public policy options to help raise the competencies of caregivers.***

Advances in medical technology and improved health care have contributed to an increase in life expectancy from 47 years in 1900 to 72 years in 2001. In California, life expectancy at birth is currently 75.9 years for men and 80.7 for women (Lee and McConville 2007). The projected rate of increase in Californians over age 60 (fig. 1A) and age 85 (fig. 1B) is expected to rise across the state but at varying rates in different counties, and urban and rural areas. As California ages it will become more racially and ethnically diverse, with



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**As the baby boomers become senior citizens, the number of people needing assistance with the basic activities of daily living will rise.**

over 40% of baby boomers being ethnic minorities (black, Latino or Asian-American) and one-third born outside of the United States (Lee et al. 2003).

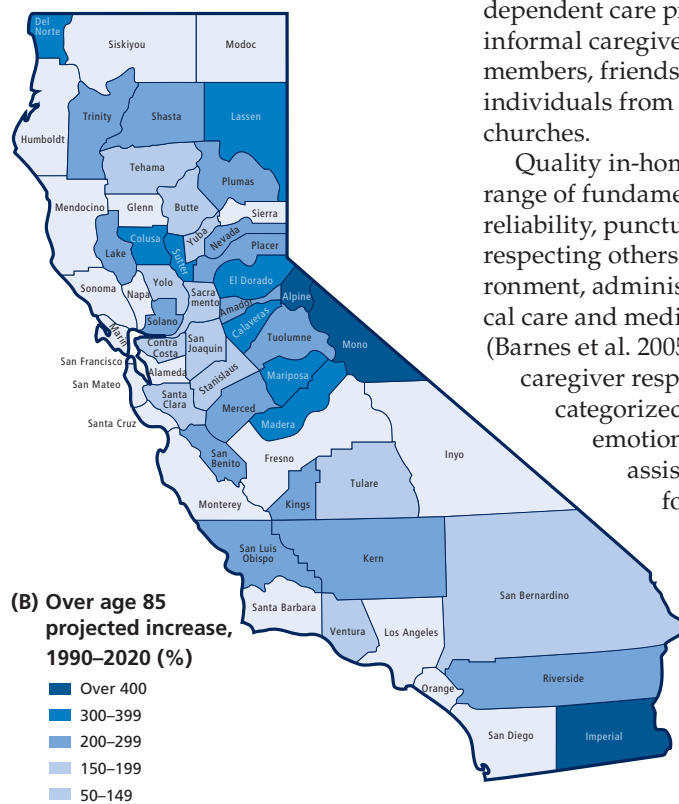
The aging baby boomers are changing the characteristics of the typical family unit. Their sheer numbers are expected to affect a myriad of social, family, financial and health issues. In a state report, former Assemblywoman Patty Berg, then chair of the California Assembly Committee on Aging and Long-Term Care, expressed concerns that the state is at a crossroads: "Whether aging Californians live in their own homes, receive in-home support, live with a relative [or in an] assisted-living, residential facility or a nursing home, one of the keys to their well-being is quality family caregiver support" (Berg 2006).

The risk of disease and disability increases with advancing age. Nationally and in California, 80% of elders over age 65 have one chronic condition and about 50% have at least two. In some California counties, chronic disease accounts for as much as 80% of the total disease burden (Prentice and Flores 2007). One study using a convenience sample of fixed-income seniors from 22 urban program sites in Alameda

County ( $n = 377$ ) reported that 55.4% experienced two or more chronic conditions, and about 10% had five to seven conditions (see page 195). The Centers for Disease Control and Prevention expects chronic diseases to exact heavy health and economic burdens on older adults from long-term illness, diminished quality of life and major increases in health-care demands (CDC 2008).

More than 3 million older adults cannot perform the basic activities of daily living, such as bathing, shopping, dressing or eating (Prentice and Flores 2007). By one estimate, more than 1.5 million adults in California have physical or mental disabilities requiring ongoing assistance with day-to-day activities (Scharlach et al. 2001). Public health professionals are gravely concerned that the health-care workforce, including family caregivers, is not adequately prepared for the demands and emerging needs of America's aging population (Krisberg 2005).

A recent report by the California Legislative Analyst's Office found that about 83% of California In-Home Supportive Services (IHSS) cases are age 45 and over; 25% are 45 to 64 years old; 58% are over 65; and 25% are over age 90 (LAO 2010). California faces a



**Fig. 1. Projected rate of increase in California's elderly population (A) 60 and over and (B) 85 and over, 1990–2020. Source: CDA 2008.**

shortage of trained professionals with the knowledge and skills to provide and operate quality caregiving programs and services for older adults (Berg 2004). The demands for unpaid family caregiver services, particularly among the “near-elderly” population aged 40 to 64, are expected to increase substantially (Lee et al. 2003).

**The caregiver's role**

The term “caregiver” refers to an individual who provides assistance to someone incapacitated to some degree, who needs help with the activities of daily living such as dressing, eating, shopping and toileting. Caregivers are formal and paid, or informal and unpaid. Formal caregivers can be associated with a

service system or may be hired as independent care providers. Most often, informal caregivers are unpaid family members, friends, neighbors and other individuals from organizations such as churches.

Quality in-home care involves a range of fundamental skills such as reliability, punctuality, confidentiality, respecting others in the work environment, administrative tasks, physical care and medically related skills (Barnes et al. 2005). The most common caregiver responsibilities can be categorized as personal care, emotional support, financial assistance and linking to formal care providers, with an array of

time-consuming tasks in each category.

Public and private institutions and agencies provide skilled, certified in-home caregivers and skilled independent workers.

IHSS, a California Public Authorities

agency, was mandated by AB1682 in 1999. IHSS screens and registers caregivers, provides orientation and serves as their employer of record. It is the largest publicly funded caregiver service in California for the blind, aged or disabled requiring nonmedical personal care. It pays for in-home care while impoverished, low-income seniors and disabled or incapacitated persons remain safely in their homes. The program is intended as an alternative to nursing homes and board-and-care facilities, or to limit the time that clients need to be institutionalized. However, the majority of about 400,000 IHSS registry caregivers are either not certificated or are undertrained. The California Public Authorities mandates some training — the minimum requirement is a 30-minute video focused on how the IHSS program works, elder abuse and fraud.

A large body of research has investigated the impact of caregiver responsibilities on family members, particularly families who care for members with mental illness. An estimated 4 million or more families nationally care for members with dementia, and most have no formal training. In general, informal family caregivers are more likely to care for someone with emotional problems, dementia/memory problems, behavioral problems, stroke or paralysis.

Many caregivers spend 4 to 7 years, or up to 15 to 20 years, doing a job that is stress-filled, overwhelming and isolating (Zarit 2010). Caregivers often face a variety of physical, emotional and financial stressors alone, which increases the probability that they themselves will suffer from breakdown, neglect and abuse. Over time caregivers suffer mental and emotional drain, feelings of defeat, anxiety, resentment, anger and stress (Noh and Turner 1987; Miller et al. 1990). The burden of caring for a schizophrenic has been associated with infectious disease episodes (Dyck et al. 1999). Caregivers reported twice as many gingival (gum-related) symptoms as noncaregivers (Vitaliano et al. 2005) and other metabolic changes (Vitaliano et al. 1996).

The stresses associated with caring for an elderly patient at home can also prematurely age the immune system,





About 400,000 caregivers are registered with California In-Home Supportive Services (IHSS), an agency that screens caregivers, provides orientation and serves as their employer of record. However, training requirements are minimal.

placing caregivers at greater risk for developing or aggravating a number of age-related diseases. Researchers tested blood samples over a 6-year period from a group of caregivers working with Alzheimer's patients. They measured the levels of a naturally produced immune chemical, interleukin-6 (IL-6), which increases with age; high levels are a known risk factor for illnesses such as diabetes, depression, atherosclerosis, rheumatoid arthritis and some cancers. Test results showed that the blood levels of IL-6 increased fourfold among caregivers compared to a control group (Kiecolt-Glaser et al. 1987).

Research points to the need for more caregiver training and physical, emotional and financial support, for both formal and informal workers. Caregivers often suffer under enormous demands, with greater burdens placed on those caring for people with complex chronic illnesses (Family Caregiver Alliance 2008). California caregivers experiencing the highest levels of financial hardship, physical strain and emotional stress are more likely to be female, Latino, low income and in poor health themselves (Scharlach, Giunta, et al. 2003). The physical and emotional stress and strain over time, without relief, can take a toll on the caregiver and in some cases elders may suffer negative consequences. One of the main

topics in the 30-minute IHSS orientation video is elder abuse. Thousands of cases of elder abuse and fraud are reported for both formal and informal caregiver services (Bailey and Paul 2008).

#### Pay and training needs

We conducted a cost analysis using raw data from the California IHSS database for January 2005 and January 2009. We calculated rates of increase in caseload, cost per case and unit cost of services, and compared county-by-county caseloads and costs. Demographics and needs data were derived from U.S. Census annual population estimates, the Centers for Disease Control and Prevention, Administration on Aging, UC Center for the Advanced Study of Economics and Demography, UCLA School of Public Policy, California Legislative Analyst's Office (LAO), Sacramento County's UC Cooperative

Extension (UCCE) caregiver research and training program, and Alameda County's assessment of the quality-of-life education needs of limited-income seniors (see page 195).

**Caseload, hours and unit costs.** IHSS has been one of the fastest-growing California programs in recent years. Prior to budget cuts, annual funding was estimated at \$5.42 billion dollars in 2009 (Halper 2009), and in January 2010 the LAO estimated a yearly cost of \$5.5 billion. In August 2010, the number of Californians receiving care was reported at 416,000; the number of caregivers employed, as estimated by disability advocates, was 800,000; and the cost of the program was reported as \$5.7 billion. Our calculations showed that the caseload for IHSS caregivers grew about 29.3% over 4 years from 334,778 to 432,869 cases (table 1).

The increase in monthly caseloads ranged from 62% to 74% in two small counties (El Dorado and Placer) and one large county (Santa Clara), to a decline in three very small counties (Amador, Colusa, Trinity), one medium (Stanislaus) and one large (San Bernardino). We calculated that IHSS spent an estimated \$387,988,594 for registry caregivers in January 2009, up 16.6% from the cost for January 2005. The rise in cost was due in part to increased caseloads, hours per caseload and unit cost of services (table 1). Our calculations of cost per hour of service delivered in January 2009 ranged from a high of \$13.64 in San Francisco to a low of \$7.87 in Ventura County. The hourly rate of pay in rural areas was generally lower than in urban centers (for detailed county cost analysis, see <http://groups.ucanr.org/elderly/index.cfm>).

Halper (2009) estimated that the IHSS cost of services per county ranged

TABLE 1. California statewide caregiver caseload and cost comparisons, January 2005 and January 2009

	2005	2009	Change	Rate of change ..... % .....
Monthly caseload	334,778	432,869	98,091	23
Monthly hours of service	27,869,618	37,501,477	9,631,859	26
Cost of services (\$)	257,350,901	387,988,594	130,637,693	34
Hours of service/case	83.25	86.63	3.39	4
Cost of services/case (\$)	768.72	896.32	127.60	17

Source: CDSS 2009.

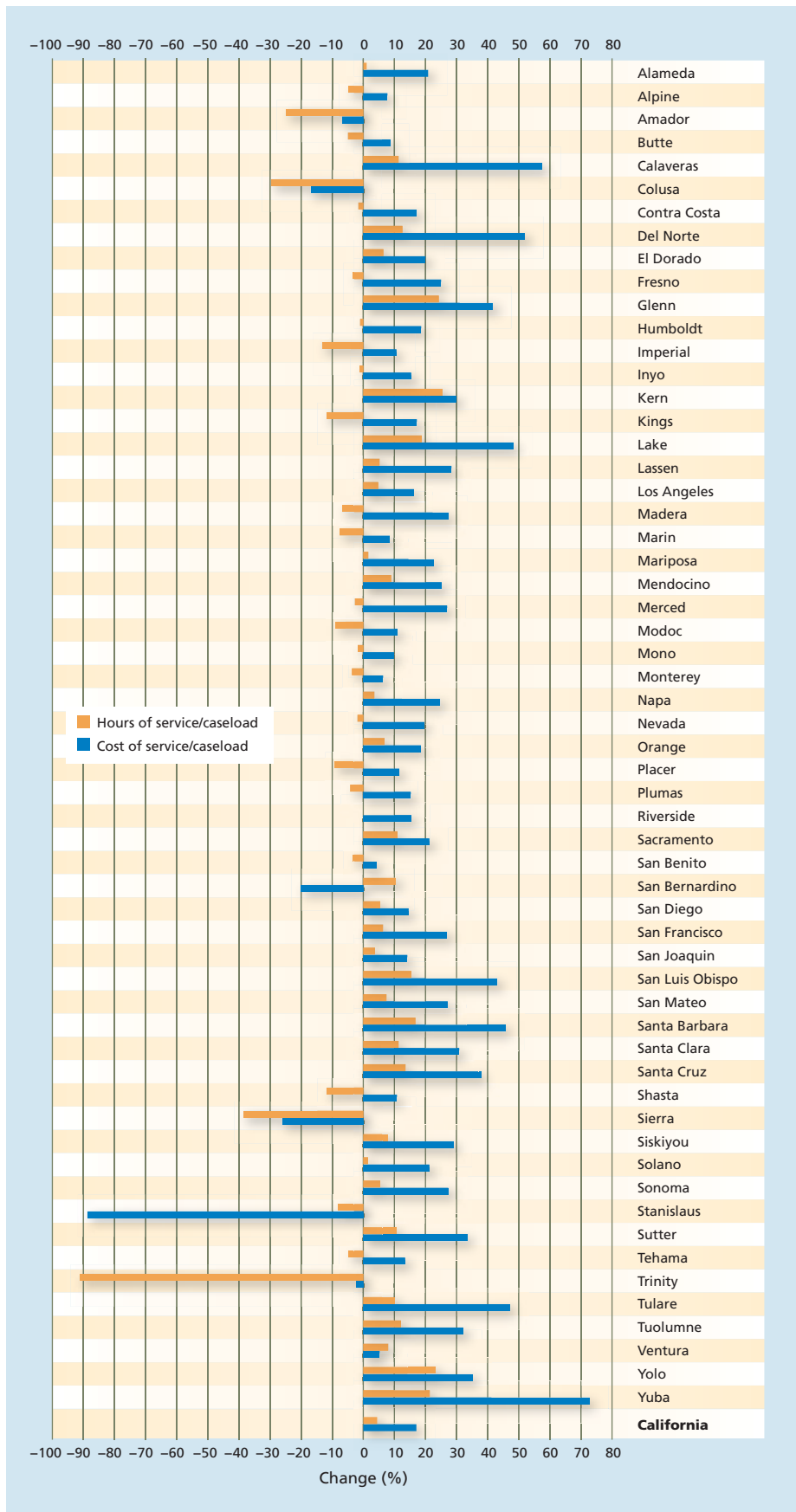


Fig. 2. Comparison of changes in monthly hours of service per case and cost of services per hour for California counties between January 2005 and January 2009. Source: CDSS 2009.

from \$8.00 to \$14.68 per hour. A survey by California Public Authorities in February 2010 reported that hourly caregiver wages in counties ranged from \$8.00 to \$11.55, and the cost per hour in August 2010 was between \$9.00 and \$11.00 (Oakley 2010).

When we calculated the changes in unit cost of services by county for January 2005 and January 2009, we found that the IHSS registry caregiver data did not show any particular regional growth trends over the 4 years, either by size of monthly caseload or geographical location. Three counties grew over 60%; eight from 40% to 50%; nine from 30% to 39%; 11 from 20% to 29%; eight from 10% to 19%; and nine from 1% to 9%. Four counties showed essentially no growth, and six small counties with 40 to 1,700 cases showed declines from -0.81% to -12% (fig. 2).

The county highs for the average change in cost of services delivered per case were 72.66% (Yuba), 55.75% (Calaveras) and 52.08% (Del Norte). Changes in other counties ranged from 40% to 48% in four, 30% to 39% in six, 20% to 29% in 15, 10% to 19% in 17 and 1% to 9% in six counties. A decline was noted in six counties, Stanislaus (-89.12%), Sierra (-26.33%), San Bernardino (-20.35%), Colusa (-16.93%), Amador (-6.73%) and Trinity (-2.28%).

When California's IHSS program is examined as a potential cost saver, it has strengths and weaknesses. The LAO report suggests that the program may not be cost-effective when state and county costs are combined, but it is successful if one evaluates its potential to increase the quality of life of individuals (LAO 2010).

#### Education and training needs.

Research clearly points to the need for increasing the knowledge and skills of large numbers of undertrained caregivers in California (Scharlach, Sirotnik, et al. 2003; Barrett et al. 2005; Scharlach et al. 2006; Bailey and Paul 2008). Some public and private agencies and institutions provide skilled nursing and related care, but given their minimal training and orientation requirements most IHSS registry caregivers are undertrained. We collaborated in 2008 and 2009 with the training and outreach coordinator for IHSS in Alameda County



to conduct food safety training for caregivers. The coordinator reported that budget cuts had forced many counties to stop providing any training beyond the minimum 30-minute video.

### Formal/paid caregivers

A survey conducted in 2000-2001 of formal/paid caregivers (certified nurse assistant [CNA] and IHSS registry caregivers) provide insight into the training levels, working conditions, benefits and makeup of in-home caregivers in California (Ong et al. 2002).

**Noncredentialed.** IHSS providers surveyed were mostly female (88.3%). Over half were relatives of the people that they cared for, and one-third had been an IHSS provider for five or more years.

**Credentialed.** About 32% of those surveyed were CNAs; 35% were home health, home care and personal aides; and about 30% of CNAs also had a home health aide (HHA) certificate.

CNAs must complete 50 hours of theory training and 100 hours of supervised clinical training; pass a state test; know emergency procedures; be CPR-certified; and complete 48 hours of continuing education every 24 months. For HHAs, some states require CNA credentials, additional training and passage of a state exam. HHA tasks include giving medications, feeding patients, checking vital signs and assisting with errands and chores.

**Employment.** Over 60% of HHAs and personal home-care aides, and over 30% of nurse aides, were part-time or temporary workers.

**Working conditions.** About 25% of CNAs received welfare at some time from 1995 to 2000; 10% received welfare in 2000; and the proportion of welfare-eligible IHSS providers was 24%.

**Benefits.** Job benefits were available only to full-time caregivers.

**Job mobility.** About 5% to 12% of CNAs/HHAs trained to become licensed vocational nurses.

### Unpaid family caregivers

Informal/family caregivers are unpaid individuals such as family members, friends and neighbors who provide care without compensation. A random telephone survey in 1996 of

California households estimated that one in six (16.7%) with a telephone had at least one family caregiver — about the same rate found in a 1997 national telephone survey (17%) (Scharlach, Sirotnik, et al. 2003). Over 4 million unpaid family caregivers in California provide services worth about \$45 billion annually, if estimated at \$10.37 per hour. The number of family caregivers nationwide is over 65 million, and one-third are male (Sheehy 2010). More than 10 years ago, it was estimated that family caregivers provided the equivalent of \$196 billion in free care annually (Arno et al. 1999).

The majority (61%) of family caregivers in the 1996 California survey were white, and the rest were Latino (25%), black (6%) and Asian/Pacific Islander (5%). The average age was 51 years; 75% were women; and 60% were married. Most (86%) were U.S. born, and 69% graduated from high school and 35% had college or some post-graduate education. Of those who provided incomes, 60% made over \$30,000 and 36% more than \$50,000 (Scharlach, Sirotnik, et al. 2003).

### Training considerations

A large body of research shows that stress associated with caregiver duties may have negative impacts on their physical and emotional well-being, creating new risk factors for disease among caregivers themselves. The use of untrained workers in roles that potentially affect the quality of life of frail elders and disabled persons poses concerns for the caregivers as well as California's public policymakers, planners and service administrators.



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**More than 4 million unpaid caregivers provide an estimated \$45 billion in services annually. Many take care of family members at home with little support or training.**

In 2003, when considerably more training funds were available, IHSS in Sacramento County contracted with UCCE to provide 150 hours of training annually for its registry caregivers. In the absence of a training curriculum, UCCE Sacramento developed lesson plans based on assessment data from about 1,000 caregivers. Over a 6-year period, at least 600 IHSS caregivers were trained in basic care skills, including bowel and bladder care, skin care, diabetes care, infection control, dementia/memory loss, fall prevention,

**Stress associated with caregiver duties may have negative impacts on their physical and emotional well-being, creating new risk factors for disease among caregivers themselves.**

self-neglect, food safety, cancer, hypertension, heart attacks and job skills. New subject areas were added based on needs expressed by the caregivers.

Evaluations conducted on knowledge gained, ability and willingness to use information, program effectiveness and caregiver satisfaction with the training were uniformly positive. The results were presented at local, state and national professional meetings, posted on UC Delivers (a Web site of stories demonstrating how UC delivers to the citizens of California) and published in peer-reviewed journals (Barrett and Song 2003; Barrett et al. 2005). Funding for the project was discontinued in 2009,

# Long-term care is an important consideration in financial planning for later life

by Patti C. Wooten Swanson and Karen P. Varcoe

“Long-term care” refers to a variety of services and supportive measures to meet health or personal care needs over an extended period of time. Most long-term care is nonskilled personal care assistance, such as help with the everyday activities of living.

Long-term care can be very expensive. A private room in a California nursing home (the most expensive type) averages \$239.30 per day or \$87,345 per year, and the care recipient must pay for doctor bills, hospitalizations and prescription drugs (Kaiser Commission 2006; Genworth Financial 2010).

While not all Californians will need expensive long-term care, 70% of those over age 65 will need some during their lifetimes. Without advance planning, paying for long-term care could result in sacrificing a lifetime of savings or even losing one’s financial independence (California Healthcare Foundation 2010).

Age, gender, marital status and lifestyle choices influence whether or not a person will need long-term care. The older a person gets, the more likely that it will be needed. Regardless of health status, the very old (over age 85) may need assistance with activities of daily living, such as household chores or transportation (Family Caregiver Alliance 2005). Women are more likely than men to need long-term care, and typically for a longer period of time (average 3.7 years) than men (average 2.2 years) (US DHHS 2002).

Women 65 or older today have a 44% chance of entering a nursing home at some point, compared with 27% of men

(Genworth Financial 2006). A single or widowed elder is more likely to need long-term care than one who has a spouse or partner at home. Lifestyle choices such as smoking, sedentary living and poor nutrition increase the risk of needing long-term care and may result in the need for more extensive services at the end of life.

Several factors affect what an individual actually pays for care. Often, the intensity and duration of care increase over time and may coincide with a progression of care settings from home and community, to assisted living, and in some cases to a nursing home. For example, an elder might need occasional assistance (once or twice per year for certain activities such as traveling), then periodic assistance (monthly or weekly, for activities such as cleaning and shopping), then daily assistance (with tasks such as preparing meals, bathing and dressing), and finally assistance and supervision 24 hours per day. Increasing levels of care are usually more expensive. Homemaker services (shopping, meal preparation, cleaning, etc.) are generally less expensive than home health care, which usually costs less than assisted living. Skilled nursing care is the most expensive.

A person’s age when care begins influences how long care will be needed, and thus the lifetime costs. Someone who receives long-term care at age 65 will probably require care for more years than one who begins at age 85. Those who are cognitively impaired, as with Alzheimer’s disease, may need care for longer because the disease affects the ability to live independently but doesn’t necessarily shorten life.

Costs also depend on where a care recipient lives. California has some of the highest costs in the country, and averages about 15% higher in urban than in rural areas (Genworth Financial 2007).

The Web site [www.medicare.gov](http://www.medicare.gov) has a calculator for estimating one’s potential lifetime care costs. The Long-term Care Planning Tool uses a confidential survey and national usage data to create a customized estimate, suggest types of long-term care services that might be needed and identify possible financing options, including insurance.

Another approach is to project the types of care a person may need over a lifetime and how many years for each, then calculate estimated lifetime costs using local cost data. The default planning scenario used by the Federal Long-Term Care Insurance Program (for federal employees) is 5 years: 2 for home health, 1 of assisted living and 2 of nursing home care (table 1). Since most Californians will likely need some type of long-term care as they age, although the type and duration of care will vary, it is important for families to address the issue of long-term care as part of a comprehensive personal financial plan.

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TABLE 1. Estimate of lifetime total for long-term care received over 5 years in California, 2010

Years	Type of care	Annual cost	Total cost
2	Home health care: Medicare-certified & licensed home health aide (50 hours per week)	46,904	93,808
1	Assisted living (private one-bedroom unit)	42,000	42,000
2	Nursing home (private room)	87,345	174,690
<b>Total</b>			<b>310,498</b>

Source: Genworth Financial 2010; California – State Median: Annual Care Costs in 2010.



but long-range goals to develop, refine and standardize basic nutrition and wellness curricula for in-home caregivers statewide remain a priority among UCCE's human resources professionals. UCCE can play an integral role in framing educational solutions to increase the competencies of undertrained IHSS and family caregivers.

More research is needed to pilot and refine specific tools and methodologies for instruction, appropriate educational materials, and evaluation tools and methods. UCCE Sacramento County began important work on a basic caregiver-training curriculum, and at least five counties have trained caregivers on safe food-handling practices (Barrett and Song 2003; Barrett et al. 2005; Barrett and Blackburn 2009; Blackburn et al. 2009).

## Human resources priorities

UC can make further contributions to the body of research on appropriate curricula, evaluate outcomes and impacts, and determine effective educational approaches and practices to train a diverse group of undertrained caregivers. The education and training needs of in-home caregivers were identified as a priority area during the 2008 ANR Human Resources Nutrition Update. Members of several ANR workgroups (Aging, Food Safety and Health Promotion) have conducted trainings with IHSS caregivers, developed and are pilot-testing curricula appropriate for caregivers, and are exploring possible funding sources for this work.

The University can work with policymakers, public administrators, service

providers and caregivers to promote the need for a statewide strategy to upgrade the basic skills of undertrained caregivers. The expected impact is to increase the competencies of diverse groups of undertrained caregivers, enhance the quality and safety of care delivered to elderly and other disabled persons in California, and protect the well-being of caregivers themselves.

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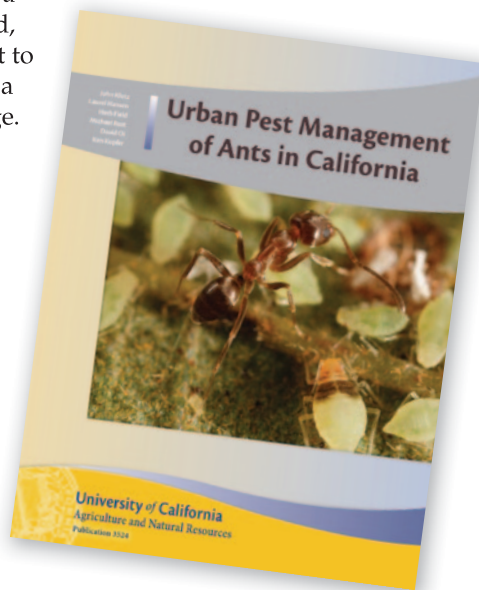
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