

Implications of the Aging Process: Opportunities for Prevention

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The quality, not the longevity, of one's life is what is important. — Martin Luther King Jr. (1929-1968)

Throughout time, men and women have dreaded being labeled as ‘old’ and have yearned for both immortality and perpetual youth. Aging is as inevitable as death, though, and is in a sense a gradual loss of life functions as a prelude to death. Aging can be defined as a progressive, generalized impairment of function resulting in a loss of adaptive response to a stress (Carey, 2002), or as the ‘latter part of animate life.’ Gerontologists use the term senescence to describe aging as a progressive deterioration of many bodily functions over time, marked by a decrease in fertility and an increased risk for diseases, culminating in multi-organ failure and death (Ingram, 2006).

Trends in Population Aging

The 20th century saw a social phenomenon without historical precedent; life expectancy at birth increased by twenty years in the second half of the century alone. In total, life expectancy rose from about 47 years in 1900 to about 73 years for males and 79 years for females in 1999 (Bongaarts, 2000). An increase of an additional 10 years is expected by 2010 (Kinsella, 2001). Population aging is the result of a decreasing number of children and young people and an increase in the number of people age 60 and over (US Census, International Programs Center; Wachter, 2003). As populations age, the triangular population pyramid of 2002 will be replaced with a more cylindrical structure in 2025 (UN medium variant prediction). Control over infectious diseases and advances in medical treatment are largely responsible for the growing older adult population. Chronic diseases such as heart disease, cancer, and diabetes are now the leading cause of death (Wilmouth, 2003). People age 65 and older represented 12.4% of the population in 2005, and, because of the size of the baby boomer generation, it is expected that they will make up 20% of the population by 2030 (US Census Bureau, 2007). The fastest growing segment of the group is the oldest old (i.e. people older than 80). This trend is likely to deeply impact family solidarity and relationships within families, equity across generations and lifestyles in general (Teitelbaum 2000; OECD, 1997).

Senescence (Process of Aging)

Biology defines senescence as the process of aging, and is characterized by the steady deterioration of cell function following the period of development in youth. Cellular senescence is the loss of ability to divide in response to DNA damage; cells either senesce or self-destruct if the damage is irreparable (NIGMS, Campisi, 2003). Organismal

senescence is the aging of an organism as a whole. Species have different "rates of aging:" a mouse is elderly at 3 years, humans at 85 years. Apart from species specific genetics, chance events determine the probability of death (Tong, 2007). Senescence should not be viewed as a "disease", nor can we put a 'Time Clock' on aging (National Institute of Aging).

Biological age is not synonymous with chronological age. The aging process uniquely affects each individual and follows no set pattern. For example, some people need glasses at a young age, while many older adults maintain perfect vision (National Institute of Aging). Aging is modified by a number of factors including: genetic, racial, lifestyle factors, accidents and disease. The World Health Organization identifies age 60 as 'old' in developing nations, while in developed nations, like the United States, it is 65 years due to greater population longevity (Tuljapurkar 2000; US Census Bureau, 2000a).

Physiology of Aging

The various stages of human life are divided into infancy (birth - 2 years), childhood (3–12 years), adolescence (13-19 years), early adulthood (20-39 years), middle adulthood (40-64 years), late adulthood (65+ years), and death, or the cessation of vital bodily functions (Timiras, 2003).

Many theories have been proposed to explain why aging occurs, but none fully explain the aging phenomenon. The evolutionary senescence theory of aging is currently the most accepted (Weinert, 2003), as it is believed to offer the best explanation for varying aging in different species (Austad, 2006). It states that species prone to die to predation (e.g. mice) invest more energy in reproduction than in health maintenance, while predatory species (e.g. humans) are much better at repairing our bodies than short lived animals. Furthermore, we live in safer environments and have a longer reproductive life (Austad, 1990). This argument was made in support of the disposable soma theory (Arantes-Oliveira, 2002), which states that organisms have to balance the demands of maintaining their body, or soma, cells and reproduction

The oxidative-damage/free radical hypothesis of aging is the primary area of interest for this paper. This theory states that mitochondrial ability to repair DNA damage decreases with age, leading to decreased cell efficiency. Oxidative cell damage causes release of oxygen free radicals which cause DNA damage, cross linking of proteins, formation of age pigments and irreversible mitochondrial damage, leading to a self-perpetuating cycle of impaired function and, ultimately, death (Mehlhorn, 2003).

Other theories under investigation are the reliability theory of aging and the neuron-endocrine hypothesis of aging. The reliability theory of aging states that natural selection programs animals to live long enough to reproduce, and after

reproductive failure, it takes variable lengths of time for an animal's subsystems to fail, making them vulnerable to death (Miller, 2001). It does not explain why certain species live longer than others, but supports many aspects of evolutionary senescence theory of aging. The neuron-endocrine hypothesis of aging states that the neuron-endocrine system becomes less functional with age, leading to conditions like menopause, hypertension, diabetes and sleep disorders (McEwen, 2002). However, recent evidence suggests the opposite: reduction in some hormones can prolong life. Areas of interest to delay aging are reduced dietary intake (Mobbs, 2001; Nikolich-Zugich, 2005), insulin-like growth factor (Tatar, 2003), and pharmaceuticals which target reactive oxygen species, underscoring the substantial role of oxidants in the aging process (Huang, 2000).

Most manifestations of aging are attributed to a gradual reduction in efficiency of cardiovascular and lung functions, resulting in reduced oxygen perfusion and cell damage (Gerstenblith, 2005). Overall, progressive reduction in blood flow occurs as we age. The heart of a 20-year old can pump 10 times the amount actually needed to maintain life, but after age 30, about 1% of reserve is lost per year (Burke, 2001).

Processes of aging can be both visible and invisible. Visible changes are evident as baldness, gray hair, sagging of the skin, loss of agility, decreased stamina, the need for glasses and reduced acuity of hearing, to name a few. Invisible changes affect internal systems like the cardiovascular system, causing high blood pressure and heart attack/stroke, a decrease in lung capacity (Janssen, 2005) and a decline in digestive and mental faculties. The skeletal system changes are characterized by bone resorption, leading to a reduction in height by 1 cm every 10 years after age 40, and an increased risk of fractures (Raisz, 2007) and arthritis, which can be crippling if left unattended. Progressive loss of muscle mass occurs as we age, accelerating after age 65. This causes weight loss and changes in body shape, which affect balance and contributes to falls. The reproductive system of females is more profoundly affected than that of males, with a loss of reproductive function and deprivation of the sex hormones estrogen and progesterone (Timira, 2003). Though men do not suffer from such a dramatic change, decrease in libido and sexual frequency is common. Most cases (90%) of erectile dysfunction, if seen, have medical rather than physiological origins, and can be treated (Medline Plus, 2006). Aging itself deprives neither men nor women of the power to enjoy sex. With age, the immune system's overall effectiveness decreases, leading to an increased infection risk, decreased ability to fight diseases, slower wound healing, and the development of autoimmune disorders and various cancers (National Institute of Aging). Multiorgan deterioration occurs gradually as we age, though normal aging can be a remarkably benign process if we can control or modify environmental and lifestyle insults to health.

The five senses are affected to varying degrees in different individuals. Acuity of hearing declines slightly after age 50 and about 30% of people over age 65 have impaired hearing and equilibrium. Decline in visual acuity is gradual and is not universal, but most people after age 55 need glasses. Driving ability is impaired in 15% to 20% due to bad vision; 5%

become unable to read and peripheral vision is reduced (Subramaniun, 2006). Red and yellow colors are better recognized as we age. Taste and smell are minimally affected after age 70, but aging can reduce sensations of pain, vibration, cold, heat, pressure and touch.

Mental Health and Aging

Good mental health is essential elements for active aging (WHO). Unfortunately, brain tissue does not have the power to regenerate or repair cells, which makes changes in function irreversible. As we age, the speed of communication between and within nervous tissues is decreased (NLM, 2006). The normal manifestations of mental aging may occur in the areas of visual and verbal memory, visuospatial abilities, immediate memory, the ability to name objects, reduced reflexes with problems in movement and safety and a slight slowing of thinking (Christensen, 2003). The ability to learn continues throughout life, though more time may be necessary to absorb new information, and avoidance of learning new concepts is common (NLM). Older adults tend to make fewer mistakes than younger people in decisions taken, and their answers are more accurate, though response may be slower in intelligence tests. Furthermore, with age, most people manage their daily affairs and perform life skills better due to experience, but may fail in times of stress or loss. Whether a decline in intelligence occurs is controversial. It is inaccurate to equate 'senility,' an obsolete term, with all old people.

Delirium, dementia, and severe memory loss are not normal processes of aging, but are due to degenerative brain disorders such as Alzheimer's disease and need medical attention (Kantor, 2006). Previously known as senility, dementia is a 'condition where one has a progressive decline in memory and other cognitive functions that results in a change in the ability to conduct one's usual activities' (Medline Plus, 2006). Dementia is characterized by multiple cognitive deficits with memory impairment as an early symptom, with additional symptoms such as asking the same questions repeatedly, becoming lost in familiar places, being unable to follow directions, becoming disoriented with regards to time, people and places and neglecting personal safety, hygiene and nutrition (Callahan, 2002).. Illnesses not directly related to the brain can also cause changes in thinking or behavior, such as uncontrolled diabetes or severe infections (Amella, 2006).

Delirium, or acute confusion, is a sudden change in mental function, which can be mistaken for dementia or schizophrenia (Kantor, 2006). One-third of older adults arrive at hospital emergency departments in a delirious state for one reason or another.

Most people experience some deterioration of mental function with age, but not to the extent of compromising daily activities (Amella, 2006). Dizziness and lightheadedness are common complaints in people over age 65, impacting 13-38% of older Americans, and is frequently a side effect of medications taken for other illnesses. Dizziness increases the risk of falling and decreases quality of life. Anxiety disorders are seen in one of five older adults (Lauderdale, 2003) and are often associated with over-arousal. General anxiety disorder, panic attacks, phobias, obsessive compulsive disorders and post-traumatic stress disorders are all types of anxiety disorders. Exposure to high levels of manganese, carbon

disulfide or certain pesticides increases the risk of mental disorders (NASD). Major depression is found among 1-2% of older women and in less than 1% of older men. It is the continuation of previous problems in 30-50% of cases and is often compounded by grief due to illness or loss, which is more common in older people (Mojtabai, 2004). An individual with compromised functions should be evaluated for mental disorders and treated as necessary.

Farmers and Aging

In the United States more than 3.1 million workers were employed in the agriculture, forestry, and fishing industry in 2001 (Bureau of Labor Statistics, 2001). Agriculture ranks among the most hazardous industries, with one of the highest mortality rates due to occupational injuries (NIOSH, 2004). The fatal occupational injury rates in the agricultural sector were more than four times that of the private sector in the decade spanning 1992–2002 (Bureau of Labor Statistics, 2003).

Agriculture employs more workers age 55 and older than any other industry (22.9% in agriculture versus 13.6% for all industries). Because of the absence of a mandatory retirement age and as a result of their proximity to their workplace or family farm, farmers tend to work to an age beyond their safety limits. Injury rates are disproportionately higher for older workers, with an increase in work-related injuries as farmers move into their 60's (Fullerton, 2001; Murphy, 1999).

According to the 2002 Census of Agriculture, of an estimated 500,000 farm workers, 25% of farm operators are age 65 or older, and the only age category showing a substantial increase since 1992 included farmers age 70 or older (Census of Agriculture, 2002). The census also reveals that the proportion of farmers age 55 and older has risen from 37% in 1954 to 61% in 1997, while the share of farmers less than 35 years declined from 15 percent in 1954 to 8 percent in 1997.

Farmers are often unwilling to recognize or accept their physical limitations (Reed, 1998) and the subsequent dangers to life and limb. They are at high risk for fatal and nonfatal injuries, work-related lung diseases, noise-induced hearing loss, skin diseases due to exposure to sun and pesticides and certain cancers associated with chemical use. Because they often share work, entire families, including children, area at a similar risk (Rein, 2002). Fatal occupational injury rates are higher in the agriculture, forestry and fishing sector than the private sector for every age group. The rates ranged from 13.7/100,000 for workers aged 16–24 to 62.0 for workers older than 64; the greatest differences were noted for workers aged 55 or older (Bureau of Labor Statistics, 2003).

Adverse health effects in farmers are often due to cumulative, multiple and/or acute exposures to chemicals and can be exhibited by either delayed or immediate toxic effects. It is well documented that chronic exposure to pesticides (organophosphates) produces neurotoxicity, cancers, birth defects, immune suppression and developmental and reproductive compromise (NASD). Nausea and convulsions can occur due to acute exposure to pesticides. Fungicides used for crops can cause eye damage (macular degeneration), potentially resulting in permanent blindness. Age-related sensory and physical impairments occur among senior farm operators at various rates (Browning, 2001). Older farmers routinely work in situations with inadequate lighting, making them more prone to injury as visual acuity declines with age

(NASD). Farm workers of all ages have higher levels of noise-induced hearing loss than the general population due to working in close quarters with noisy machinery without adequate ear protection. Senior farmers who have difficulty hearing words or sounds may not be able to detect warning signals. A loss of sense of balance and bouts of dizziness increase the risk of injury for senior farmers (Safety for Aging Farmers). Falls around tractors and farm machinery are particularly hazardous, though walking across an uneven surface such as hay can also cause falls. One's physical ability to avoid dangerous situations may be compromised due to a loss of strength and flexibility in limbs and joints, impaired muscular capability or arthritis.

Role of prevention

As the adage says, "An ounce of prevention is worth more than a pound of cure." Despite continued advancements in curative medicine, prevention is critical to good health for young and old alike. Annual medical exams are recommended for assessing vision, hearing, balance, muscular range and mobility. Furthermore, seeking treatment for medical conditions and adhering to prescription drug regimens will (what?) (National Safety Council, NSAD). Redesigning work schedules to suit physical capabilities is an excellent way to maintain productivity without endangering safety (Schramm, 2002). Several simple safety measures are recommended for senior farmers (Farm Safety Association, CDC). Measures to reduce falls include: increased lighting levels in buildings; ensuring that all steps, stairs, and handrails are of excellent quality and well lighted with switches at both ends of stairs and by all entrances; and installing non-slip surfaces on walkways and steps where possible. The use of mechanized fence gates, building doors and animal handling devices reduces chances of injury, and the use of properly fitted and easily accessible personal protection devices/clothes is further helpful (National Safety Council). Special attention should be paid to tractor operation and the ability to do so safely (Legault, 2002). Wearing rubber or leather gloves will help protect hands from injuries and contact with chemicals. Ear plugs or ear muffs can be worn to reduce hearing loss. A variety of respirators are available to protect against allergens and toxic gases (National Safety Council, NSAD). Adequate rest and frequent breaks for nutritious food increase energy levels and concentration (Schramm, 2002).

Good personal health is vital for physical safety in the farming profession. Healthy eating and physical exercise form the backbone of a lifestyle that ensures a good quality of life and relative freedom from disease (Smith, 2002). Caloric requirements decrease as we grow older, and should be adjusted to meet daily physical activity (Pickard, 2006). Consumption of a variety of foods is recommended for good health: whole grains, vegetables and fruits in a variety of colors, milk and milk products and lean meat, poultry, fish, dry beans, eggs, and nuts (Dietary Guidelines for Americans 2005). Fats should be limited to 2 teaspoons per day, and the use of unsaturated vegetable fats is recommended. Maintaining a healthy Body Mass Index (BMI), between 20-25, reduces the risk of chronic ailments typically associated with being overweight such as hypertension, heart disease and arthritis and preserves alertness and physical agility for more years (NIA). The health risks of being underweight include a poor memory, decreased immunity, osteoporosis with

a proneness to fractures, and decreased muscle strength. Daily physical activity reduces functional declines associated with aging, boosts mood and energy, reduces the risk of bone fractures, improves immunity and enhances quality of life (Barnes, 2003). Most people require about thirty minutes of moderate physical activity daily to stay fit (NIA). Exercise intensity is less important than the total amount of time spent exercising. Walking for ten minutes three times a day is well suited to the capabilities of seniors and is as effective as 30 continuous minutes of exercise.

Drinking and substance abuse are common among the rural elderly, as they suffer from more grief and stress due to loss of spouse, job or social status, and it is easier to mask the abuse as their public interactions become limited (NASD, 2002; SAMSHA, 2005). Drinking a small amount of alcohol (1-2 units per day) may protect against heart disease and stroke. Recommended weekly limits are 4 units per day and 21 units per week for men and 3 units per day and 14 units per week for women. The risk of dying from lung cancer is 22 times higher in men and 12 times higher in women who smoke cigarettes, as compared with those who have never smoked. Additionally, smokers are more likely to develop emphysema, bronchitis and cancer; have a two to four fold increased chance of developing coronary heart disease; are at twice the risk for having a stroke; and are ten times more likely to develop peripheral vascular disease, which may lead to limb amputations (CDC, 2002).

Important factors that contribute to Active Aging (WHO, 2005; Robine,1998) are to stay away from smoking and limit alcohol consumption; maintain a high level of physical activity; seek routine medical and dental care, including preventive screenings; and maintain active social contacts and links to faith based activities. Social support networks among peers provide an outlet for sharing the pains and joys of the aging process with others who face similar challenges of adjusting to the infirmities of increasing age. Such activities keep cognitive decline at bay, and help maintain a quality of life that keeps one physically independent, safe and medically fit. Now is the time to indulge in activities you always yearned to do, but never had the time for when younger!

“The secret of life is enjoying the passage of time.” James Taylor

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