HEALTHY AGING

Presented by

CONTINUING PSYCHOLOGY EDUCATION INC.

3 CONTINUING EDUCATION HOURS

"The ability to prolong life is indeed within our grasp."
Marie-Francoise Schulz-Aellen (1997)

Course Objective
The purpose of this course is to provide an understanding of the concept of healthy aging. Major topics include current biological theories of aging, physical factors, prevalent diseases and health strategies, Baltimore Longitudinal Study of Aging, psychological factors, social factors, long-term care, and the nature of healthy aging.

Accreditation
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Mission Statement
Continuing Psychology Education provides the highest quality continuing education designed to fulfill the professional needs and interests of mental health professionals. Resources are offered to improve professional competency, maintain knowledge of the latest advancements, and meet continuing education requirements mandated by the profession.

Learning Objectives
Upon completion, the participant will be able to:
1. Discuss current biological theories regarding the causes of aging.
2. Explain physical factors associated with aging.
3. Acknowledge common older adult diseases and their recommended preventative measures.
4. Articulate findings from the Baltimore Longitudinal Study of Aging.
5. Expound upon psychological effects of aging.
6. Understand social theories of aging, and the value of social support systems.
7. Describe prevalent concerns in long-term care.
8. Discuss key characteristics which promote healthy aging.

Faculty
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INTRODUCTION

Aging is a universal human experience interwoven with biological, psychological and social complexities. In our younger years, we observe illness and death of older family members, with time, we see similar changes in our own generation and ultimately within ourselves. This process is viewed as inevitable and natural, yet, it is also interesting because these changes unfold differently in each of us. Nelson and Dannefer (1992) observed increasing diversity over the adult years on various performance measures suggesting that with age, we become more unlike each other. The principle of *multi-directionality of development* (Baltes & Graf, 1996) suggests that systems within the person develop at different rates - some functions may reveal positive changes and others negative changes over time. Even within the same function, such as intelligence, a person may exhibit gains in one area and losses in another with aging. These individual differences shed optimism and refute the myth that all functioning "goes downhill" as we grow older. In fact, an older adult who exercises and remains active may be stronger, quicker and more mentally agile than a sedentary younger person.

Though aging is a basic aspect of life, scientific research, including genetic and biochemical bases of disease processes, experimental studies of aging in animals, and evolutionary biology is allowing for greater intervention into the aging process. Such progress is timely as caring for the growing number of elderly is becoming vital. *Life expectancy* - the average number of years of life remaining to a person at a particular age - from birth, has risen overall from 62.9 years in 1940 to 76.5 years in 1997; from age 65, life expectancy is estimated to be 18 years (Hoyert & Murphy, 1999). The number of Americans over age 65 has grown from 3.1 million in the year 1900 (roughly 4% of the population) to over 34 million in 1997 (almost 13% of the population). By 2030, the number is estimated at 69.4 million (about 20% of the population). Further, the oldest-old group, age 85 and older, is expected to rise at the highest rate from currently 1.5% of the population to 2.4% by 2030 to 3.7% by 2040. Not long ago, these advanced ages were not thought possible, yet, interest currently mounts to further increase the human life span and biomedical advances are attempting to delay or eliminate the afflictions of aging.

Factors contributing to longer life span include lower infant mortality, improved prenatal and postnatal medical care, drugs against infectious diseases, and improved nutrition and personal/public hygiene. Research has led to illnesses such as tuberculosis, poliomyelitis, smallpox, measles and many other infectious diseases becoming curable. Despite the convincing increase in longevity, many scientists and medical doctors believe that we die too soon. They are convinced that the potential life span is about 120 years. Agreed upon is the need to understand the mechanisms of current incurable diseases and of the biological process of aging itself.

Arking (1991) describes aging as cumulative, universal, progressive, intrinsic, and deleterious. Gerontologists, those who study the aging process, agree that aging involves changes in the chemical composition and macroscopic structures of the body; these changes affect the organism's ability to respond adaptively to the environment - at all levels, from the synthesis of molecules to cognitive abilities (Adelman, 1980); and there is greater vulnerability to diseases and to environmental changes and demands leading to a heightened risk of dying (Shock, 1985).

Aging is measured at different levels: the population level examines the life span of individuals; the individual organism level assesses changes in physiological-biochemical functions; the cellular level involves structural and biochemical factors; and the subcellular level focuses on changes in molecules, for example, the activity of enzymatic and repair systems functioning in cells.

Aging is attracting the attention of business and industry, politicians, the media, and the general public due to a rapidly aging society. Data collected by the World Health Organization (WHO) indicates that industrialized countries of the world will be forced to address a phenomenon which humanity has never encountered - demographic changes creating a society dominated in many respects by the needs of an aging or aged population. This shift in the dependency ratio will affect America's resources and various social structures such as the family, health care, pension and retirement practices, political processes, community and recreational services and housing. As a group, the elderly will have a greater influence on many aspects of society as they spend more money, use more services and possess more political power. An improved understanding of the aging process is recommended to adapt to the changes that will likely occur. To offer greater medical and social opportunities to older people designed to improve aging, in the near future, more physicians, nurses, social workers, counselors, nursing home managers, and many other positions will be needed than are available presently.

BIOLOGICAL THEORIES OF AGING

Two categories comprise the biological theories of aging: *programmed aging* and *random error*. Programmed aging theories are based on the belief that aging and death are built into the hard-wiring of all organisms. Random error theories believe that aging is due to random damage to an organism over time.

PROGRAMMED AGING THEORIES

Genetic life-span theory - It is assumed that "aging genes" exist that count off the years past maturity just as there are "development genes" which lead to the point of maturity in youth. Supportive of this assumption is the fact that life span varies according to species, therefore, life span may be part of an organism's genetic makeup. For instance, a

butterfly's life span is 3 months, a human is 120 years, and a giant tortoise 180 years.

Large human population studies in Sweden revealed that longevity has a heritability index (indicates the degree to which a characteristic is inherited) of .26 in men and .23 in women (Herskind et al., 1996a, 1996b). To identify and control the "aging" gene (if it truly exists) could potentially change the nature of aging.

The assumption that length of life is genetically programmed by one or multiple genes controlling the aging process from birth to death, however, is not regarded as viable.

Genetic postreproduction theory - This variant of the genetic life-span theory suggests that evolution has selected for species that are vigorous until the time that sexual maturity has passed. Selective survival relates to survival of the fittest when the species can still reproduce, but beyond this time, "good genes gone bad" (Hayflick, 1994) take over, in turn, cells are programmed to die.

Telomere theory - Proposes that defects develop in gene expression within cells which cause the cells to lose their ability to divide. The loss of ability to reproduce is termed *replicative senescence*. It is known that there are a finite number of times - approximately 50 - that normal human cells proliferate in culture before entering a state in which they cannot further divide (Hayflick & Moorhead, 1961).

The *telomere* is the terminal region or tail of a chromosome composed of DNA but containing no genetic information; it protects the ends of chromosomes from being degraded and fusing with other chromosome ends. The basis of the telomere theory is that every time a cell replicates, it loses part of its telomere. In other words, older cells (cells that have divided more) have shorter telomeres. This theory believes that cells stop dividing given the short telomere length being sensed as damage to the DNA.

Some cells do not display this shortened telomere length and these cells, in particular, contain the enzyme telomerase, which maintains the ends of the chromosomes. Telomerase, it could be argued, can make a cell "immortal," however, some senescent cells continue to manufacture telomerase, hence, this enzyme is not sufficient to prevent cellular senescence (Smith & Pereira-Smith, 1996).

Neuroendocrine theory - Suggests that changes in the hypothalamus, which mediates between the nervous and endocrine systems, are responsible for age changes in the hormones that ultimately lead to aging.

The endocrine glands release hormones into the blood which act on target cells. Hormones regulate many vital activities, including metabolism, reproduction, immune function and growth. In large amounts, hormones are known to be capable of slowing or accelerating some aging processes.

A common precursor to the onset of aging is decline in reproductive capability; the decline in reproductive capacity is governed by the neuroendocrine system, hence, examination of the neuroendocrine system related to aging seems logical.

Research has shown that the longevity of some animals may double when they are raised with a diet which contains all essential nutrients but is low in calories. It is hypothesized that caloric restriction slows aging by retarding the hypothalamic chronometer in the brain. There is evidence to support this hypothesis, however, an explanation of how it works (if it does) is lacking (Weindruch & Walford, 1988).

Another potential neuroendocrine factor affecting aging is a hormone secreted by the adrenal glands called dehydroepiandrosterone (DHEA). This hormone is found in larger amounts in young adults then decreases with age. When administered to mice, DHEA delays immune system dysfunction, increases longevity, and makes the animals "look younger."

Additionally, menopause, which marks the end of the woman's reproductive capacity, exemplifies hormonal events associated with many aging changes throughout the body.

Though the neuroendocrine system affects our bodies in profound ways, there is no direct evidence that it is the cause of all age changes.

Neuron theory - Theorizes that loss of neurons regulates the rate of the body's aging. The brain, similar to many other body parts, does shrink in weight and size during normal aging. In fact, brain weight decreases roughly 10%, the convolutions narrow, and the spaces between them widen. The shrinkage may result from loss of neurons, loss of water, or both, however, the cause and relevance of such shrinkage is still debated. In humans, sentiment leans toward the loss of neurons in the brain as the result, not the cause, of aging.

A theory arose suggesting that the brain was the origin of all age changes. The brain was thought to produce a "death hormone." The hormone is suggested to be made by the pituitary gland and is called the decreasing oxygen consumption hormone (DECO). Donner Denckla, an advocate of the theory, proposed that DECO circulates in the body and disrupts protein synthesis and cell division. These studies as yet are unconfirmed.

Nonetheless, the brain is not being ruled out as the cause of aging. The nervous system does control almost every other system in the body. Further, brain weight is positively correlated with life spans across species. Additional support comes from experiments showing that removal of the pituitary gland, located at the base of the brain, may cause some rejuvenation in animals.

RANDOM ERROR THEORIES

Wear and tear theory - This is one of the earliest aging theories, dating back to 1882, as articulated by the German biologist, August Weismann. He stated, "Death occurs

because a worn out tissue cannot forever renew itself." The theory submits that vital systems accumulate damage from normal use and abuse of daily living culminating in age changes; contributing factors include accidents, disease, radiation, toxins, other detrimental factors, and normal usage. Wear and tear affect the normal biochemical activities of cells, tissues, and organs to the point that our organs and joints simply wear out - such abuse causes aging.

A concern with this theory is that wear and tear is difficult to describe or quantify in most biological systems. We do not know what normal wear and tear is relative to most living cells or the molecules of which they are composed.

Another concern is that most organ systems do not abide by this theory. If organs wear out with continued usage, then athletes should have shorter life spans than sedentary people, but this does not appear to be true (Paffenbarger et al., 1993). In fact, many systems such as the cardiovascular system need regular, moderate exercise to maintain function, and intellectual stimulation may be needed to maintain cognitive functioning (Diamond, 1993). Gerontologists promote the phrase "use it or lose it."

An exception to this rule is that wear and tear on the joints is a cause of osteoarthritis, and it is very common in late life. Contrarily, total bed rest for the elderly can produce stiffened, immobile joints and problems with many other systems, including cardiovascular, respiratory and neuropsychological systems (Fishburn & de Lateur, 1996). Generally, moderate usage is recommended for organ functioning.

Abuse to a system will shorten its life span as evidenced by skeletomuscular system concerns in professional football players and neurological problems in professional boxers who have sustained many concussions.

Miquel, a biogerontologist, suggests that molecular wear and tear may affect the mitochondria - the "power plants" which provide energy for all the cell's activities. The mitochondria in old cells of many animal species reveal a decrease in numbers, and an increase in size and various structural abnormalities. Cultured normal cells reflect these mitochondrial changes at the end of their lifetime as well, prompting Miquel to believe that damage over time to the mitochondria may be a cause of aging.

The major concern with the wear and tear theory as with the mitochondrial version of the theory is the uncertainty whether such damage is the cause or the result of aging.

Rate of living theory - Believes that we are born with a finite amount of some substance, potential energy, or physiological capacity that can be consumed at various rates. Aging begins early in those who spend the energy rapidly and aging is slowed if the energy is exhausted slowly. This theory equates with "live fast, die young." The theory is traced back to 1908, when Max Rubner, a German physiologist, discovered that various species of animals of different sizes and life spans spent roughly 200 kilocalories per gram of tissue during their lifetime. Larger, long-lived animals spent fewer calories per gram of tissue per year compared to smaller, short-lived species. Raymond Pearl and Ruth DeWitt Pearl, American gerontologists, wrote, "in general, the duration of life varies inversely as the rate of energy expenditure." Rubner and the Pearls proposed that the finite element was metabolic capacity and when it declines age changes occur.

Variants of the rate of living theory suggest that other limiting factors create aging such as the amount of oxygen consumed, number of breaths taken, and number of heartbeats spent. A mouse's heart, during its three-and-a-half year life and an elephant's heart, during its seventy-year life, each beat about one billion times; a human heart beats approximately three billion times during its seventy-five year span. Few gerontologists believe, however, that number of heartbeats affects aging.

The rate of living theory lacks empirical backing - the finite substance is unknown and its existence is not certain. Moreover, a centenarian's heart has beaten about four billion times and humans metabolize roughly 800 kilocalories per gram of tissue in a lifetime - each value about four times that of the oldest elephant - yet, life spans are comparable between the two species. Generally, birds have high metabolic rates and long life spans; human athletes and busy people do not age faster than sedentary people; and among centenarians, some have led active lives, while others inactive. Finally, the literature- supported "use it or lose it" principle defies the notion of not "wasting" yourself by engaging in too much activity.

Waste product accumulation theory - Speculates that metabolic waste accumulates in the cells and interferes with normal cell functioning; in time, the toxins and refuse slowly kill the cell. Most waste products are expelled from cells and carried away by the circulatory system and then excreted. In contrast, aging cells accumulate waste matter called *lipofuscin* - a dark mixture of lipoproteins and various waste products which are common in muscle, nerve, and other cells that are not replaced but may remain through the life span. Lipofuscin is so common in old cells that they are called age pigments and are markers for old cells. Lipofuscin production artificially induced in human cells in vitro blocks cell proliferation and induces cell death (von Zglinicki, Nilsson, Docke, & Brunk, 1995). Some speculate that as lipofuscin granules amass in the cytoplasm, they may disturb transport of materials through the cytoplasm or across membranes. They ultimately occupy so much space that there is not enough room for other cellular components.

Despite its presence in some old cells, evidence that age pigments interfere with normal cell function is lacking. The cells do not seem to show signs of distress, even with large amounts of age pigment. Further, some nerve cells and cardiac muscle cells do not contain age pigments, and some old animal cells contain little or no age pigment. Most biogerontologists believe that age pigment is an effect, not a cause of aging.

Cross-linking theory - Postulates that with age, some proteins, including *collagen*, become linked together and may interfere with cellular metabolism by obstructing passage of nutrients and wastes into and out of cells resulting in malfunctioning and aging. Collagen is an important protein found in tendons, ligaments, bone, cartilage, and skin; it makes up nearly 30% of the body's protein.

The process which affects the collagen molecule with age is called "cross-linking." Cross-links are the horizontal strands (similar to rungs of a ladder) that connect the two parallel molecules that form the collagen protein. Over time, rungs of one ladder connect to the rungs of another ladder by forming more cross-links producing larger scaffolds within the tissue. An unknown mechanism prevents this harmful cross-linking in young people but allows its occurrence with age. A manifestation of this process is that our skin becomes more rigid and shrinks in size rather than appearing soft and pliable as in our youth.

This model proposes that cross-links occur within the DNA, creating molecules whose structure is determined by faulty genes. Given accumulation of errors in various molecules over time, age changes result.

Though it is accepted that cross-linking occurs in collagen and some other proteins, it is uncertain whether it exists within the DNA. Further, experimental evidence showing that it affects metabolic processes or causes faulty molecules is lacking. Cross-linking is thought to be one of many biochemical changes contributing to aging but it is not accepted as the main cause.

Free radical theory (also called oxidative stress theory) - Believes that a chemical reaction with oxygen forms unstable *free radicals* that unite with susceptible molecules in cells producing age pigments, cross-links in some molecules, and potential damage to DNA. A free radical is an atom or molecule containing at least one odd or unpaired electron and is chemically reactive because it seeks to bind with other atoms and molecules until obtaining a complete electron pair. The molecule to which the free radical has become attached loses its functioning. Once a free radical is created, it can generate a chain reaction of atoms and molecules stealing electrons from one another. The process of transferring electrons from one molecule to another is termed *oxidation*; generally, the free radical combines with oxygen. The free radical theory suggests that aging is caused by accumulation of irreversible damage due to these oxidizing compounds.

Experimental support revealing the involvement of free radicals in aging comes from *antioxidants* - chemical inhibitors that prevent oxygen from combining with susceptible molecules to create free radicals. Vitamins E and C are considered important antioxidants. Laboratory animals have been fed large amounts of antioxidants and monitored to determine longevity as compared to control animals receiving no antioxidants. Though the results are uneven, research has shown that the antioxidant-fed animals live longer than the controls - increases in longevity up to 30% have been observed in mice. The possibility exists, however, that the antioxidants may have impeded the animals' digestion, resulting in the same effect of calorie-restriction on life expectation. A connection exists between the free radical and caloric restriction theories as suggested by the possibility that the effects of caloric restriction may result from a reduction in the process of free radical formation.

Enzymes called *superoxide dismutase (SOD)* can also destroy some free radicals. Evidence shows longer-living species have higher levels of SOD to detoxify the free radical called superoxide. Humans possess the highest SOD levels of all species studied.

The free radical theory is popular and many gerontologists continue to explore this phenomenon. Additional support is provided by the finding that the rate of production of free radicals is greater in shorter-lived species; perhaps longer-lived species have evolved to produce more antioxidants or free radical destroying enzymes, therefore, reducing the number of damaging free radicals. There is also some evidence that older animals produce more free radicals suggesting a direct link with age. The free radical theory may also be connected to the rate of living and wear and tear theories because all three may be affected by the rate and production of free radicals.

Free radical studies show administering antioxidants to animals seems to postpone cancer, cardiovascular disease, degenerative diseases of the central nervous system, and depression of the immune system. Perhaps antioxidant-fed animals live longer due to postponement of diseases that would have killed them at an earlier age. These same diseases are also postponed by caloric restriction, in turn, skeptics believe that feeding antioxidants mimics calorie restriction. Nonetheless, Sohal and Weindruch (1996) profess that current evidence in support of the free radical theory and future research will support the view that aging results from oxidative stress.

Autoimmune theory - Suggests that the aging immune system loses ability to produce antibodies in adequate number and of the proper type; secondly, it mistakenly produces antibodies against the body's own proteins.

The immune system, one of the body's major defense systems, identifies and destroys foreign substances such as bacteria, viruses, and fungi while leaving normal body cells and molecules undisturbed. Other white cells in the blood produce antibodies which circulate in the blood, deactivate foreign substances (antigens), and prepare them for digestion by other cells.

The *autoimmune theory* states that, with age, the immune system loses ability to distinguish normal from foreign materials leading to the attack and destruction of important body components causing age changes. An example of autoimmune disease in older people is inflammation of the joints (arthritis).

The *immune deficiency theory* believes that the immune

system weakens with usage and ultimately cannot defend the body against foreign molecules and microbes. These toxic agents injure and disrupt cell functioning leading to damaging age changes. For example, the immune system of a younger rather than older person may more effectively keep cancer cells in check. A possible cause for immune function decline with age is the thymus gland, located in the upper chest. This gland produces T-cells which are white blood cells that are vital in the body's ongoing effort to fight disease. The thymus begins to wither beyond adolescence and it is theorized that this spurs the ultimate demise of the entire immune system.

The immune system theory has not received strong support for several reasons. First, it is not universal as some animals that age do not manifest a well-developed immune system. Second, the immune system is subject to control by various hormones and the nervous system, therefore, a more basic source could be causing immune function changes with age. Despite the immune system revealing some functional decline with age, it lacks evidence as being the cause of aging.

Theories of errors and repairs - Proposes that mutations occur in somatic cells (those not involved in reproduction) causing age changes. A variant of the theory, called the error catastrophe theory (Orgel, 1963), believes that errors in protein manufacturing accumulate exponentially causing many cells to malfunction and die.

The production of proteins and reproduction of DNA are vital to life but these molecules are not always produced with complete constancy. Error theorists submit that an organism's manufacturing machinery sustains errors, and natural repair processes cannot make perfect repairs every time, and may be flawed from the onset. Errors then affect the molecules that compose or are produced by our cells, metabolic failures arise, and age changes and death result. Evidence shows that errors do occur and repair processes are not perfect and do not function forever.

Preserving the fidelity of DNA is so important that cells have developed methods to repair it given damage. DNA may be damaged by normal background radiation, ultraviolet radiation, cancer-causing chemicals, some normal metabolic processes, cross-linking, and free radicals; fortunately, there are at least six different kinds of DNA repair systems. It is believed that one year's worth of accumulated damage to cells would render cells to be non-functional.

Some research found that DNA repair systems were more efficient in longer-lived species which would support the error hypothesis of aging; perhaps longer-lived species have evolved more efficient ways to correct errors in vital DNA molecules. Confirmation of this finding, however, has not been constant across trials.

Additional research has found evidence that accumulated errors in enzyme proteins may contribute to aging. Speculation is high that some future version of the error theory will explain a number of age changes. It is known that errors do occur in some of the molecules that compose all cells.

Heat shock proteins theory - Similar to DNA repair mechanisms which protect genes, *heat shock proteins (Hsps)* represent a type of cellular repair mechanism considered to be an aging decelerator. The name derives from research on effects of heat-related stress upon plants. Hsps are found in every living organism, from bacteria to humans, and in almost all types of cells; they are important in protecting cells from nearly all kinds of stressors, including radiation, infection and oxidation. Additionally, they are important in promoting healthy cell growth and proliferation (Punyiczki & Fesus, 1998).

Jurivich, Qiu, and Welk (1997) suggest that cell aging is defined by poorer responses to physiological stress, possibly mediated by transcription errors in heat shock genes. This reduction in efficiency may interfere with organ functioning and may affect the body's ability to communicate and regulate functioning at the systems level causing failures in homeostasis. Continued research is needed.

Homeostasis theory - Organisms must sustain a level of homeostasis, in other words, stability in intracellular and extracellular environmental conditions, such as blood pressure, heart rate, temperature, pH balance, and electrolyte and fluid balance. Conditions change as a function of environmental demands but then must return to baseline levels. Homeostasis demands communication between organ systems and is primarily regulated by the autonomic nervous system via the neuroendocrine system.

Evidence suggests that it becomes harder to maintain homeostasis as we age (Taffett, 1996). Many systems within the elderly reveal slower responses to environmental challenges and more elevated responses requiring much longer to lessen and return to baseline. Both disease and age-related processes are inferred as the cause.

Homeostatic problems may develop from a decline in hormone production or other type of regulatory peptide, target organs may become less responsive, and/or the target organ may synthesize decreased amounts of its product. A number of illnesses associated with aging demonstrate these concerns with homeostasis, such as orthostatic hypotension and diabetes. Research is ongoing.

Order to disorder theory - States that an organism loses efficiency after passing the reproductive age due to a lack of energy needed to maintain the system; increasing disorder causes errors to develop that lead to death.

This model borrows from the field of physics, specifically, thermodynamics. Physicists report that in a *closed system*, matter tends to a state of equilibrium, which equates to increasing disorder. The measure of this state is called entropy and is illustrated in the second law of thermodynamics.

Peak efficiency drops after sexual maturation due to the

notion that "perfect order requires infinite work" and a biological system cannot supply infinite work. Further, deterioration and disorder continues to accumulate. Some biogerontologists believe that increased molecular disorder develops from mistakes in molecules (similar to error theories) leading to changes in cells, tissues, and organs called aging.

Humans and animals are examples of an *open system* through which matter and energy flow. We are affected by many environmental factors such as the food we eat and the air we breathe, consequently, it may be argued that the laws of thermodynamics may not generalize well from a closed system to a living organism. Contrarily, our bodies experience the same kind of disorder or entropy in our earlier well-ordered molecules as any machine, complex system, or even the universe itself.

Some biogerontologists argue that aging has many causes requiring a synthesis of many theories while others promote only one theory. Gerontology is still a young science searching for knowledge offering explanation for why we age. Science now knows that age changes occur within individual cells but knowledge has been essentially descriptive - answering "what" happens as we age rather than "why" it happens. Researchers have explained changes that occur as we age from the molecular level to the whole animal but these descriptive observations do not clarify the basic process. Optimism grows, as many scientists, for the first time in the history of biology, are working in the aging field, and they are encouraged by the potential of modern technological tools, the human genome and stem cell research. Understanding causes of aging may enable scientists to influence the processes of biological aging and to minimize common harmful age changes.

PHYSICAL FACTORS

Age-related physical changes may have psychological and social implications. Biological changes can affect the individual's attitudes, behaviors, and identity as self-perception is affected by one's appearance and competence. This section examines age changes within body, brain, and sensory functions beyond the well-known factors of gray hair and wrinkles.

Skin - With age, cells of the epidermis become less regularly arranged (Kligman, Grove, & Balin, 1985), explaining part of visual appearance changes in skin. Most skin change is due to loss of skin's flexibility and ability to conform to the changing shape of the skin as the limbs move. Skin sags because it cannot return to its original state of tension after being stretched out through movement.

Skin age-changes also occur due to the following: sweat glands become less active; sebaceous glands, which provide oils that lubricate skin, become less active; the layer of subcutaneous fat, which gives skin its opacity and smoothness, lessens in thickness causing skin to sag and become translucent; pigmented outgrowths (moles), elevations of small blood vessels (angiomas), and large irregularities in blood vessels (varicose veins) develop. Facial appearance changes due to teeth discoloration from enamel loss, and baggy eyes due to accumulation of fat, fluid, and dark pigmentation.

Photoaging, age changes resulting from exposure to the sun's harmful radiation, causes many negative skin effects. Body parts exposed to sun, such as face and arms, show more negative effects than non-exposed areas (Takema et al., 1997). Sunscreen, minimal level 15 SPF, is the most effective prevention (Farmer & Naylor, 1996). Some evidence shows that facial massages (Iida & Noro, 1995), skin emollients, and applying vitamin E (Nachbar & Korting, 1995) offer beneficial skin effects.

Hair - Turns gray then white, and thins. Hair changes color due to increasing loss of pigmentation as melanin production stops. People vary greatly regarding rate of hair changing color. Hair thinning occurs in both sexes but is more obvious in males. Hair loss generally results from destruction of germination centers that produce hair under the surface of the skin. Male pattern baldness occurs when hair follicles continue to produce hair but this hair is not visible; though hair stops growing or is less evident, it may surface in larger amounts in other places, such as the chin in women, ears, and eyebrows.

Present knowledge indicates that age changes in hair are unpreventable, however, pharmaceutical companies are actively searching for the answer to baldness, and improvements in hair stimulation products are considered possible.

Body build - We experience a loss of height through adulthood and it is more pronounced in women (de Groot, Perdigao, & Deurenberg, 1996; Suominen, 1997). Women's spines collapse and shorten in length due to loss of bone material in the vertebrae.

Whereas body weight increases during middle adulthood from an accumulation of body fat, mainly around the waist and hips, older adults lose weight because they lose lean body mass, which is muscle and bone (Baumgartner, Heymsfield, & Roche, 1995).

Aerobic exercise can help maintain muscle tone and lower fat deposits associated with middle-age. Resistance training exercise (weight lifting or Nautilus) can lessen age losses in bone content that add to loss of height. Benefits of exercise are well-documented. Horber, Kohler, Lippuner, & Jaeger (1996) found that highly trained men in their late 60's (ran at least ten miles each week for ten years) displayed no difference in lean body mass or body fat mass compared to young sedentary men (early 30s); older untrained men revealed lower lean body mass and higher fat.

Muscles - Aging yields a progressive loss of muscle mass called *sarcopenia* in which the number and size of muscle

fibers are lowered, particularly fibers responsible for muscle strength (Hakkinen et al., 1996). Lost muscle mass is replaced by connective tissue and ultimately by fat. There is a loss of strength beginning in the 40s to 50s with a decline of 12 to 15% thereafter per decade (Hurley, 1995).

Strength training is the main preventative measure against sarcopenia, potentially doubling muscle strength (McCartney, Hicks, Martin, & Webber, 1995, 1996). People as old as 100 years can benefit from this type of exercise.

Bones - Bone consists of living tissue that reconstructs itself whereby old cells are destroyed and replaced by new cells. Aging involves an increase in the rate of bone destruction contrasted to renewal and more porosity of the calcium matrix, yielding loss of bone mineral content. The decrease of bone mineral content is estimated at 5 to 12% per decade from the 20s through the 90s (McCalden, McGeough, Barker, & Court-Brown, 1993) with a decrease in strength of 8.5% per decade (McCalden, McGeough, & Court-Brown, 1997). Microcracks develop due to stress being placed on the bones increasing the chance of fracture (Courtney, Hayes, & Gibson, 1996). A contributing factor to an older bone's susceptibility to fracture is due to loss of elasticity, thus, it breaks rather than bends given pressure (Zioupos & Currey, 1998).

The process of bone loss is usually not an issue until at least the 50s or 60s. The rate of bone loss is greater in women, especially those past reproductive age and not producing estrogen in monthly cycles (Garnero, Sornay Rendu, Chapuy, & Delmas, 1996). Smoking, alcohol use, and poor diet worsen bone loss in later adulthood, while aerobic activity, resistance training with weights, increased calcium intake before menopause, and vitamin D can slow bone loss (Dawson-Huges et al., 1995; Murphy, Khaw, May, & Compston, 1994; Sinaki, 1996; Welten, Kemper, Post, & van Staveren, 1995).

Joints - Harmful structural changes to joint functioning occur before the age of skeletal maturity and continue through adult years (Tuite, Renstrom, & O'Brien, 1997). Degeneration of the arterial cartilage, which protects the joints, begins by the 20s and 30s and contributes to the bone underneath beginning to wear away. Outgrowths of cartilage develop that interfere with smooth movement of the bones against each other. The fibers in the joint capsule become less limber which lowers flexibility (Ralphs & Benjamin, 1994). These harmful processes are directly related to the amount of stress placed on the joints.

The following early adulthood precautions are recommended to lower probability of joint issues: wearing proper footwear, particularly during exercise; wearing ergonomically designed accessories for those who engage in repetitive wrist motion; performing flexibility exercises which expand a stiff joint's range of motion for those already experiencing joint damage; and exercise that strengthens the muscles supporting the joint (Blanpied & Smidt, 1993).

Cardiovascular system - Aging of this system begins in middle age and involves both the heart and arteries that circulate blood throughout the body. The left ventricle is most significant to the aging process; it loses muscle mass and strength and increases in fat and connective tissue. The wall of the left ventricle becomes thicker and less compliant with each contraction resulting in the left ventricle's loss of efficiency as a pumping mechanism due to less blood ejected into the aorta with each heart contraction. The arteries lose ability to accommodate the blood flow that spurts from the left ventricle; this loss of flexibility in the arteries is termed *vasculopathology of aging* (Bilato & Crow, 1996). Another harmful heart effect is the deposit of plaque along the arterial walls of fatty substances, consisting of cholesterol, cellular waste products, calcium and fibrin (a clotting material in blood).

Important indicators of cardiovascular health include *aerobic capacity* - maximum amount of oxygen that can be delivered through the blood, and *cardiac output* - amount of blood the heart pumps per minute. Each indicator declines at a rate of roughly 10% per decade from age 25 such that the average 65 year-old displays 40% lower cardiovascular efficiency than a young adult. *Maximum heart rate* - heart rate attained during maximum oxygen consumption, reveals a linear decrease across adulthood as well (Whitbourne, 1996).

Research shows that trained athletes experience age declines in aerobic capacity but their loss of cardiovascular functioning is only abut 50% as compared to sedentary individuals (Pollock et al., 1997; Trappe, Costill, Vukovich, Jones, & Melham, 1996). Short-term training research demonstrates the positive effect of exercise for middle-aged and older adults (Whitbourne, 1996). Maximum exercise effects are attained when heart rate rises to 60-75% of maximum capacity, three to four times a week. The formula to determine target heart rate during exercise is: maximum heart rate = 220 minus your age; target zone = 50-80% of this number. Moderate or low-intensity exercise can be beneficial for older people who previously were not active. Recommended aerobic activities include walking, hiking, jogging, bicycling, swimming, jumping rope, and roller skating.

In males, exercise strengthens the myocardial muscle leading to the positive effect of more blood reaching the body's cells, however, in females, exercise does not yield the same effect on ventricular process (Spina, Miller, Bogenhagen, Schechtman, & Ehsani, 1996). More research is needed to understand gender differences regarding exercise and cardiovascular functioning.

Exercise also contributes to improved metabolism of dietary fat which assists in reduction of plaque deposits in the arteries; the exercise must be combined with a diet low in saturated fats. Middle-aged adults and over are recommended to monitor their cholesterol levels. Though total cholesterol level decreases during this time frame,

high-density lipoprotein (HDL), which lowers risk of heart disease (Stampfer et al., 1996), also declines (Ferrara, Barrett-Connor, & Shan, 1997; Wilson, Anderson, Harris, Kannel, & Castelli, 1994).

The metabolism of fats (called lipids) in the blood is quickened by presence in the blood of *high-density lipoproteins* (HDLs) which assist in transporting lipids out of the body. HDLs are found in certain types of unsaturated fat, such as olive oil. Health experts recommend increasing HDLs in the blood through exercise and diet. *Low-density lipoproteins* (LDLs) have the opposite effect such that lipids in the blood are retained, leading to formation of atheromas (Krauss, 1994). Improved diet can reduce harmful types of LDLs in the blood. Genetic factors also affect cholesterol metabolism by moderating effects of diet and exercise (Krauss & Dreon, 1995).

Respiratory system - Aging affects respiration through reduced strength of the respiratory muscles and increased rigidity of the chest wall connective tissue to be expanded during inspiration and contracted during expiration. This reduces the amount of air which can be pumped in and out of the lungs (Teramoto, Fukuchi, Nagase, Matsuse, & Orimo, 1995). Aging also associates with a *failing lung* (Rossi, Ganassini, Tantucci, & Grassi, 1996) which causes lung tissue itself to lose expandability. All measures of lung functioning show age-related losses from approximately age 40 and above (Rossi et al., 1996).

The chest wall may be strengthened by exercise which can offset for some loss of pumping capacity of the respiratory muscles. Nothing is known at present to compensate for changes in lung tissue itself. A study of 1400 adults from ages 51 to 95 indicated the importance of not smoking. Lung functioning was significantly lower in smokers versus non-smokers across all age groups. People who quit smoking before age 40 were not different in respiratory functioning than people who never smoked, but those who quit smoking after age 60 were not different on this measure than current smokers of the same age (Frette, Barrett-Connor, & Clausen, 1996).

Urinary system - This system is composed of the kidneys, bladder, ureters and urethra. The *nephron cells* in the kidneys filter out harmful waste products of metabolism that move through the ureters and into the bladder. Within the bladder, waste products combine with excess water from the blood and are eliminated as urine through the urethra. Studies in the 1940s indicated that nephron loss occurs at a rate of 6% per decade and that renal efficiency diminishes over time (Davies & Shock, 1950). Current research shows that aging is not correlated with impaired kidney functioning (Epstein, 1996; Fliser et al., 1997), however, declines in kidney functioning do occur given stressful conditions of illness, extreme exertion, or during a heat wave.

Age-related changes may develop in the elastic tissue of the bladder causing it to lose efficiency at retaining or expelling urine. Additionally, many men encounter hypertrophy (overgrowth) of the prostate which puts pressure on the bladder leading them to experience frequent urges to urinate. Only 2% of men and 5% of women indicate chronic bladder concerns (National Center for Health Statistics, 1997). Urinary incontinence in the over-65 age group ranges from 6-8% of those living in the community to 20-30% or more of those living in institutions (Iqbal & Castleden, 1997).

Incontinence may be treated by the "Kegel" exercise whereby the person contracts and relaxes the urinary sphincters for roughly one minute at a time. Older people can avoid worsening renal dysfunction by not becoming dehydrated during exercise or hot weather.

Endocrine system - Involves the set of glands which regulate actions of the body's other organ systems (called "target" organs) by producing and releasing hormones into the bloodstream. Age-related changes in body composition, such as loss of bone mineral content (Boonen et al., 1996), fat increase, and muscle mass decrease (Bjornstorp, 1996) are considered endocrine system related.

The *glucocorticoid cascade hypothesis* suggests that aging causes dangerous increases in cortisol levels - a hormone which provides energy to muscles during times of stress - altering immune response, fat deposits, and cognition (O'Brien, Schweitzer, Ames, Tuckwell, & Mastwyk, 1994; Wilkinson, Peskind, & Raskind, 1997). Cortisol, also known as the stress hormone, may promote the body's wear and tear due to accumulation of life stress (Van Cauter et al., 1996). Not all data, however, support cortisol increases over time (Lupien et al., 1996) necessitating additional study.

A hormone possibly related to aging that is receiving attention is *dehydroepiandrosterone (DHEA)*. This hormone decreases by 80 to 90% from ages 20 to 80 and this phenomenon is termed *adrenopause* (Lamberts, van den Beld, & van der Lely, 1997). Some evidence shows that DHEA loss correlates with various forms of physical and mental health declines, especially for women (Berr, Lafont, Debuire, Dartigues, & Baulieu, 1996). Low levels of DHEA have been associated with cancer, trauma, stress, and cardiovascular disease in men. In contrast, DHEA replacement in older animals has shown increased strength and vigor.

Estrogen, the primary female sex hormone, begins to decline about ten to fifteen years before menopause, the time when the woman's menstruation stops permanently. Hormonal changes during menstruation vary across women, but certain characteristic symptoms exist. "Hot flashes," sudden feelings of intense heat and sweating which can last from several moments to half an hour, are experienced by more than 50% of women over a two-year period. This process results from decreases in estrogen levels causing the endocrine system to release greater quantities of other hormones which affect temperature control centers in the brain. Fatigue, headaches, night sweats, and insomnia may

also occur due to changing estrogen levels. Psychological symptoms, such as irritability, mood swings, depression, memory loss, and difficulty in concentrating may occur but the connection between these symptoms and menopause is not conclusive. Decreasing estrogen levels are also associated with loss of bone strength, atherosclerosis, high blood pressure, and cardiovascular disease.

Estrogen-replacement therapy (ERT) was introduced in the 1940s to counter estrogen loss effects but this led to increased risk of cancer and blood clots. Currently, lower doses of estrogen are given along with progestin (called Hormone Replacement Therapy, or HRT) to lower cancer risk. HRT taken over a long course can increase the risk of breast cancer, asthma, gallstones, and changes in blood sugar levels. Selective Estrogen Replacement Modulaters (SERM) is another alternative which targets bone loss. Other recommendations in addition to HRT to combat effects of hormonal changes include exercise, eliminating smoking, lowering cholesterol intake, and having one alcoholic drink a day.

Age-related declines in *testosterone*, the male sex hormone, is termed *andropause*. Loss of sexual potency was considered associated with andropause, however, current research shows that erectile functioning changes relate more to the circulatory than endocrine system and to social factors and stress (Laumann et al., 1999). Contrary to the distinct estrogen decline in women, men experience only a slight testosterone decrease between ages 41 to 61 (Zmuda et al., 1997).

Immune system - The immune system function most researched by aging scientists is *acquired immunity* - an immune response that develops due to prior contact with an antigen (foreign agent in the body). Involved in acquired immunity are lymphocytes, specialized white blood cells that destroy or neutralize specific antigens. Acquired immunity increases by acquiring memory for each antigen.

Though the literature is inconsistent due to the complexity of the immune system, researchers suspect immune system declines given aging and they refer to the features of the aging immune system as *immune senescence*. Essential aging process effects of immune senescence include declines in T cell, B cell, and natural killer cell functioning; each is involved in a component of neutralizing or destroying antigens. The cause of immune senescence is theorized to be the involution of the thymus which loses much functional ability by adulthood.

Diet and exercise can help or hinder immune response. Zinc and vitamin E have been shown to improve immune responsiveness (Lesourd, 1997; Sone, 1995), while older individuals who eat low-protein diets have displayed deficient immune functioning (Castaneda, Charnley, Evans, & Crim, 1995). Exercise can improve immune responsiveness in elder adults (Shinkai, Konishi, & Shephard, 1997; Venjatraman & Fernandes, 1997). Healthy levels of diet and exercise are recommended because a malfunctioning immune system is a common contributor to mortality in middle and later adulthood.

Nervous system - This system exercises control over all body systems and behavior. The central nervous system regulates functions such as monitoring and responding to the environment, formulating and enacting thoughts, and maintaining connections with other body systems. The autonomic nervous system controls involuntary behaviors, response to stress, and the actions of other life sustaining organ systems.

Whereas early nervous system research proposed that we sustain progressive loss of brain tissue through adulthood that is noticeable by age 30, current studies show that the aging brain maintains much of its function and structure. A group of neuroanatomists in the late 1970s found that mental stimulation can compensate for loss of neurons, furthermore, the plasticity model indicates that though some neurons die, the remaining ones increase their synapses (Coleman & Flood, 1987). Technological innovations, such as brain scans and experimental research involving synaptic proliferation and neuron regeneration are providing more optimistic views of the aging nervous system.

Coffey et al. (1992) conducted a magnetic resonance imaging (MRI) study of adults and found brain atrophy percentages ranged between 6 to 8% per year, however, wide individual differences existed in patterns of cortical atrophy and ventricular enlargement; healthy adults avoided some aging effects such as temporal lobe volume reductions (DeCarli et al., 1994). Gender differences in brain aging effects are demonstrated as follows: men show larger increases in the ventricular spaces in the brain (Matsumae et al., 1996); greater reductions in the frontal and temporal lobes (Cowell et al., 1994), and in the parieto-occipital area (Coffey et al., 1998), but less reduction than women in the hippocampus and parietal lobes (Murphy et al., 1996).

Studies of the frontal lobes using MRI and positron-emission tomography (PET) show age reductions from a low of 1% per decade (De Santi et al., 1995) to a high of 10% (Eisen, Entezari-Taher, & Stewart, 1996). The volume of the hippocampus also reduces with age (de Leon et al., 1997; Raz, Gunning-Dixon, Head, Dupuis, & Acker, 1998). These findings provide a neurological basis for memory changes in later adulthood (Golomb et al., 1996; Nielsen Bohlman, & Knight, 1995).

Older adults have shown ability to compensate for brain deficits by increasing activation of other brain regions. Cabeza et al. (1997) conducted a PET scan study in which regional cerebral blood flow was compared between men in their 70s and men in their 20s and 30s while performing memory tests. The younger men utilized brain regions better designed for the cognitive task while the older men were more diffused but had higher levels of brain activation in other areas. The young group used the left half of their frontal lobes while learning new material and the right half during recall of the material while the older group showed little frontal lobe activity while learning the material but then used both right and left frontal lobes during recall.

The researchers concluded that older adults can gather and use their resources in a demanding situation even if those resources are less efficiently organized. Additional research using PET scans has shown similar findings. Older people may be less capable of increasing blood flow to specific areas of the brain in response to tasks requiring usage of these specific areas (Ross et al., 1997), but they utilize other brain circuits to compensate for decreases in frontal lobes (Chao & Knight, 1997).

Demonstrated age-changes in the frontal lobes and circuits between the limbic system and cortex are consistent with cognitive changes in adulthood. Fortunately, we experience plasticity of the brain throughout adulthood, and older people compensate for their neural circuitry concerns. Older persons may experience reduction in efficiency, but they still may put their brain to work.

Vision - Visual acuity consistently declines through adulthood. The level of acuity of an 85 year-old is approximately 80% less than a 40 year-old. Improved illumination can compensate somewhat for this loss. *Presbyopia*, another normal age-related eye change, is caused by thickening and hardening of the lens which creates difficulty in focusing on near objects. This condition is corrected by wearing glasses or bifocals.

Aging also increases probability of acquiring eye disease, in fact, about 50% of those over age 65 report having experienced some type of visual impairment. One common eye disease is the *cataract* - clouding which occurs in the normally clear crystalline lens causes blurred or distorted vision because the image cannot be focused clearly onto the retina. Cataracts represent the main visual impairment in older adults. Klein, Klein, & Linton (1992) found significant cataracts present in 14% of males and 24% of females aged 65 to 74, and in 39% of males and 46% of females of 75 years and older. Most people over age 60 have some amount of cataract formation as the condition seems to develop as part of normal aging. Contributing factors include heredity, prior injury, disease such as diabetes, sunlight exposure, and cigarette smoking. Cataract surgery, due to advances in surgical procedures over the past 20 years, offers effective treatment.

Another type of blindness more common in later adulthood is *age-related macular degeneration* - a destruction of the photoreceptors in the central area of the retina, termed the macula, resulting in the appearance of a dark or empty area in the center of one's vision. This condition is one of the leading causes of blindness in those over 65, with 16,000 new cases annually. There is no treatment at this time. Avoidance of cigarette smoking is a preventative measure (Seddon, Willett, Speizer, & Hankinson, 1996).

Glaucoma is an eye disease found in middle-aged and older adults; it is a group of conditions in which the optic nerve is damaged producing loss of visual function such that peripheral vision is lost, and with time, forward vision may decrease until there is no vision. The most common form affects 3 million Americans, with 95,000 new cases annually; over 80,000 Americans have glaucoma-caused blindness. Some types of glaucoma can be controlled but not cured and other types can be treated successfully with surgery.

Hearing - Two types of hearing loss are so common in later life that they are considered normal to the aging process. In *presbycusis*, degeneration occurs in the cochlea or auditory nerve leading from the cochlea to the brain, most commonly resulting in loss of high-pitched sounds. In *conducive hearing loss*, damage takes place in one of the structures in the ear that transmits sounds, usually the tympanic membrane. Contributing factors include heredity, health problems (diabetes, heart disease, and high blood pressure), medications such as aspirin and antibiotics, but exposure to loud noise is the most common cause. *Tinnitus* is another commonly occurring hearing disturbance in older individuals whereby the person perceives sounds in the head or ear (ringing noise) in the absence of an external source. Much of age-related hearing loss is corrected by hearing aids.

Balance - Age-related changes in the vestibular system that controls balance creates greater probability of dizziness, vertigo, difficulty detecting body position, and falling in older persons. Falling is the second leading cause of injury-related death among those aged 65-84, and falls account for 33% of all injury-related deaths for those aged 85 and older (Centers for Disease Control and Prevention, 1996). Compensation for vestibular system deficits include having proper eyeglass prescription since vision facilitates navigation of the environment, using a prosthetic aid in walking, utilizing balance aids in the home such as handrails, and increasing alertness while walking. Balance training and aqua aerobics can lower likelihood of falling (Wolf et al., 1996; Simmons & Hansen, 1996).

In conclusion, age-related alterations in physical functioning interact with psychological and social factors which can affect one's identity through adulthood. Healthy aging suggests utilizing preventative and compensating measures to slow the qualitative and quantitative effects of physical aging.

PREVALENT DISEASES AND HEALTH STRATEGIES

Several major types of physical disease which attack the body's primary organ systems affect adults. These illnesses are examples of *secondary aging* (also called impaired aging) which constitute later life changes due to disease, as compared to *primary aging* (also called normal aging) which involves age-related changes that are universal, intrinsic, and progressive. People are advised to utilize preventative measures beginning in early adult years to potentially avoid disabling and lethal effects of these conditions.

CARDIOVASCULAR SYSTEM DISEASES

Diseases affecting the cardiovascular system are the leading causes of death in those over age 65. Heart and cerebrovasuclar disease, together, totaled 43% of all deaths in those over 65 in 1997 (Hoyert & Murphy, 1999), with over 15 million deaths worldwide (World Health Organization, 1997). Men have a higher chance of dying from heart disease than women; African-American men have the highest death rate from heart disease (more than double the rate of other age and sex groups); African-American women have an elevated death rate for this disease; and Asian/Pacific Islanders have the lowest death rate for heart disease.

Diseases of the heart and arteries are also among the most prevalent chronic condition affecting older adults, specifically, in 1994, over 22 million people in the U.S. reported suffering heart conditions, totaling 30 to 40% of men and women in the over 65 age group.

Presently, four major heart disease risk factors are identified. The first risk factor is leading a sedentary lifestyle, a theme supported by many studies. A large-sample study examined nearly 1400 men from Finland, ages 35 to 63, over an eleven-year interval from 1980 to 1991 (Haapanen, Miilunpalo, Vuori, Oja, & Pasanen, 1996). The 27% of the sample who engaged in vigorous activity at least twice a week revealed a 60% lower death rate from all causes, including cardiovascular disease, compared to those not involved regularly in vigorous activity. Those who burned less than 800 calories per week in some type of physical activity displayed almost five times the risk of dying from cardiovascular disease contrasted to those who burned 2100 calories or more.

The second risk factor is smoking, and the Finland study typifies common findings. Smoking more than doubled the risk of dying from any disease over the eleven year study and tripled the risk of dying from cardiovascular disease. Researchers do not know the exact cause for smoking increasing heart disease risk but they suspect it damages the arteries and makes them more vulnerable to passing fat cells that contribute to plaque formation.

The third risk factor for cardiovascular disease is body weight (Kannel., D'Agostino, & Cobb, 1996), especially for those between ages 30 and 70 (Stevens et al., 1998). Obesity is defined by the relationship between body weight to body height. The BMI (Body Mass Index) calculates risk based on the weight to height ratio and it equals weight in kilograms divided by height in meters, squared. An ideal BMI is 23 in men and 21 in women while "overweight" is a range of 25 to 29.9 and obesity is 30 and above.

Alcohol intake is the fourth risk factor but findings are inconsistent as to how much is "good" versus "bad." A certain amount (one drink per day) may have some favorable effects on cholesterol levels.

Additional preventative strategies involve taking dietary supplements, including vitamin C (ascorbic acid), which is found in fruits (Gatto, Hallaen, Brown, & Samman, 1996). Various foods lower LDLs such as high-fiber cereals (Rimm, Ascherio, Giovannucci, Spiegelman, & Stampfer, 1996), and folic acid (Verhoef, Stampfer, Buring, Gaziano, & Allen, 1996), which is found in yeast, liver, green vegetables and certain fruits. Due to heart disease rising significantly in women after menopause, estrogen-replacement therapy is an option. Estrogen seems to lower harmful aspects of LDLs and increase HDLs (Haines, Chung, Chang, Masarei, & Tomlinson, 1996).

CANCER

Cancer is a generic term for a group of over 100 different diseases. Each cancer type has its own unique symptoms, treatment, and effect on the individual. Skin cancer is the most common type of cancer in America. Odds are 40 to 50% of having skin cancer at least once by age 65. Breast cancer is the most prevalent cancer occurring in women and the second leading cause of cancer death (National Center for Health Statistics, 1997). The most common type of breast cancer is called ductal carcinoma; the cancer starts in the lining of the ducts that lead from the milk-producing glands (lobules) to the nipple. The cancer cells develop in a duct and spread through the wall of the duct and invade the breast fatty tissue. The cancer cells then have the potential to metastasize through the blood and lymphatic system.

Cancer of the reproductive organs most often develops in the uterus, cervix, and ovary in women and in the prostate gland in men.

Many types of cancer become lethal when they spread to the lymph nodes and enter the lymphatic system. Upon reaching these nodes, cancer cells may have spread to other body parts, including other lymph nodes and organs such as the bones, liver, or lungs. Unfortunately, many cancer types have already metastasized by the time the individual becomes aware of his or her condition because many cancers do not cause symptoms when they are growing within the affected organ.

All cancer is genetically caused in that genes that control orderly replication of cells are damaged, frequently due to random mutations that develop in body cells. The mutations arise either as a cell division mistake, in response to injury from environmental agents as radiation or chemicals, or as an inherited tendency for developing certain cancers such as breast and colon cancer. The evolution of a cell from normal to malignant to metastatic appears to follow distinct steps, each controlled by a different gene or set of genes.

Most cancers become more common with increasing age due to age being associated with more cumulative exposure to environmental harmful toxins (carcinogens). The three main cancer risk factors during adulthood are sun-exposure, cigarette smoking, and lack of dietary control. The following cancer statistics were reported in 1998: one million diagnosed skin cancers - many were preventable given use of sun protection; 175,000 deaths caused by tobacco use; 19,000 deaths from excessive alcohol use -

often used with tobacco; and 33% of the 564,800 total cancer deaths in 1998 were due to unhealthy nutritional patterns.

Skin cancer is directly linked to exposure to the sun's ultraviolet (UV) radiation. Melanoma is more common in Texas than in Minnesota, where levels of the sun's UV radiation are weaker. South Africa and Australia have the highest skin cancer rates due to high UV radiation amounts.

Most lung cancer is caused by cigarette smoking and exposure to cigarette smoke is a risk factor for developing cancers of the mouth, throat, esophagus, larynx, bladder, kidney, cervix, pancreas and stomach. Lung cancer risk begins to lessen as soon as one quits smoking. "Second-hand smoke" (exposure to cigarette smoke) is potentially as great or greater a risk for lung cancer.

The link between diet and breast cancer has not been established, but some evidence shows that exercise and a low-fat diet combined with well-balanced meals may be beneficial. Though not clearly established, in men, a diet high in fruits and vegetables may decrease prostate cancer risk while a high-fat diet may increase such risk. Stomach cancer is more common in places where people eat foods preserved by drying, smoking, salting, or pickling, such as Japan, Korea, parts of Eastern Europe and Latin America. Conversely, fresh foods, particularly fruits and vegetables may help to protect against stomach cancer. Colon cancer risk is also considered to be higher in those with a high-fat diet, low fruits and vegetables, and low high-fiber foods such as whole-grain breads and cereals.

Additionally, environmental toxins including pesticides, electromagnetic fields, engine exhausts, and contaminants in water and food are under investigation as possible breast cancer risks. Workplace carcinogens, for example, asbestos and radon (a radioactive gas) increase lung cancer risk; fumes and dust may increase stomach and colorectal cancer. Furthermore, one's lifestyle, history of disease, variations due to race and ethnicity, and hormonal factors may increase cancer risk.

The American Cancer Society recommends frequent cancer detection screenings such as breast self-examination and mammograms for women, prostate examinations for men, and colon cancer screenings for men and women.

Cancer treatment options include surgery, radiation therapy (high-energy X-rays which damage cancer cells and stop their growth), chemotherapy (use of drugs to kill cancer cells), and biological therapy (involves substances called biological response modifiers that assist the body's immune system in fighting disease). New treatment methods are anticipated over the next few decades as cancer research evolves, and cancer deaths may decrease given educational programs targeting high-risk groups on preventable cancers such as lung cancer.

MUSCULOSKELETAL SYSTEM DISORDERS

The two main musculoskeletal system disorders affecting middle-aged and older adults are arthritis and osteoporosis. The effects of these common ailments range from minor but annoying limitations to severe disability.

Arthritis is a general term applying to conditions which affect the joints and surrounding tissues. The most common form of arthritis is termed *osteoarthritis*, and it is one of the most frequent chronic conditions in older adults, affecting about 50% of those over age 65 and more women than men. This condition develops in joints that are injured due to overuse or from being overweight. Ultimately, this injury or repeated impact thins or wears away cartilage designed to cushion the ends of the bones in the joint leading to the bones rubbing together. The synovial fluid which fills the joint loses its shock-absorbing properties and joint flexibility is lowered, bony spurs develop, and the joint swells. These alterations in joint structures and tissues cause pain and loss of movement.

Pain medications are often prescribed, including aspirin, acetaminophen, ibuprofen, and aspirin-like drugs termed nonsteroidal anti-inflammatory drugs (NSAIDs). The injection of corticosteroids are sparingly used to reduce swelling and inflammation. While these pain medications only lessen symptoms, new treatment techniques are becoming available such as injection of a synthetic material into the arthritic joint designed to replace the loss of synovial fluid. Another technique involves injection of sodium hyaluronate into the joint which is an injectable form of a chemical usually present in high amounts in joints and fluids. Total replacement of an afflicted joint such as a hip or knee is also possible.

Rheumatoid arthritis, an inflammatory disease causing pain, swelling, stiffness, and loss of function in joints, is an *autoimmune disease* whereby the immune system destroys the person's own cells inside the joint capsule. The wrist joints and finger joints closest to the hand are often affected. Activity that induces stress on the joints does not appear to affect this condition as is the case with osteoarthritis. Whereas osteoarthritis is a progressive degenerative disease, rheumatoid arthritis varies in course and may last from several months to one or two years but can persist for many years in some people. Life expectancy of those with rheumatoid arthritis is reduced by seven years in men and three years in women.

Roughly two million people in America and 165 million people worldwide have rheumatoid arthritis (World Health Organization, 1997). It is two to three times more likely in women. The cause is a combination of genetic and environmental factors and it can be triggered by exposure to an infectious agent.

Treatment focuses upon relieving pain, lessening inflammation, and slowing or stopping further joint damage. Drugs may include disease-modifying antirheumatic drugs (DMARDs), additionally, corticosteroids, aspirin or NSAIDs may be recommended, and joint replacement or tendon reconstruction may be an option.

Normal aging associates with loss of bone mineral content due to imbalance between bone resorption and bone

growth. *Osteoporosis* (means "porous bone") is loss of bone mineral content greater than 2.5 standard deviations below the mean of young white, non-Hispanic women.

Osteoporosis occurs in 4% of women aged 50 to 59, in 19% in their 60s, 31% in the 70s, and in 50% of women over 80 (National Center for Health Statistics, 1997). Women experience greater risk than men because they have lower bone mass and menopause accelerates the process due to its estrogen production decrease.

The risk of developing osteoporosis is increased by alcohol and cigarette smoking and is decreased by adequate intake of calcium through dairy products, dark green leafy vegetables, tofu, salmon, and calcium-fortified foods such as orange juice, bread, and cereal. Vitamin D, as a dietary supplement or by exposure to sunlight is a preventative source because it is involved in calcium absorption and bone health. Exercise and physical activity also reduce osteoporosis risk.

Osteoporosis treatment attempts to restore bone strength through nutritional supplements and a weight-bearing exercise program. Medication can be used to slow or stop bone loss, increase bone density, and lower fracture risk. Hormone replacement therapy has been a successful drug in osteoporosis treatment.

DIABETES

This disease is caused by a defect in the metabolizing of *glucose,* a simple sugar which is a vital source of energy for the body's cells. In the most common type of diabetes, Type 2, or noninsulin dependent diabetes (NIDDM), the pancreas produces some insulin, however, the body's tissues do not respond to the insulin signal, a condition termed insulin resistance. Insulin does not bind to the cell's insulin receptor, and glucose is not transported into the body's cells for use. The excess glucose overflows into the urine and leaves the body causing loss of a main energy source.

Symptoms include fatigue, frequent urination, thirst, weight loss, blurred vision, frequent infections, and slow healing of sores. Hypoglycemia occurs when blood sugar levels become too low causing one to potentially feel nervous, jittery, faint, and confused. Given this condition, the individual must eat or drink something with sugar in it as soon as possible. Hyperglycemia occurs when blood sugar levels rise too high and can also cause serious illness.

There are approximately ten million Americans diagnosed with diabetes and possibly five million more who have the disease but have not been diagnosed. In 1997, over 62,000 people in America died from diabetes and 76% of these deaths were in the over 65 age group (Hoyert & Murphy, 1999). The incidence is 60% higher in African Americans and about 115% higher in Mexican Americans and Puerto Ricans as compared to whites.

Management of Type 2 diabetes includes diet control, exercise, and frequent blood testing to monitor glucose levels; the goal is to keep blood sugar within acceptable levels. Taking oral drugs or insulin to lower blood glucose levels may be needed. An exercise program designed to manage weight and lower blood pressure and blood fats can produce reductions in blood sugar levels.

ALZHEIMER'S DISEASE

Alois Alzheimer, a German neurologist, was the first person to correlate brain tissue changes with observable dementia symptoms. Alzheimer treated a patient, Auguste D., who experienced progressive mental deterioration, increasing confusion and memory loss. Through a staining technique, he observed an odd disorganization of the nerve cells in the patient's cerebral cortex and, in 1907, he published in a medical journal that these microscopic changes caused the dementia. Recent analysis of this patient's brain slides confirm the correlation (Enserink, 1998). Currently, a definite diagnosis of Alzheimer's disease requires an autopsy revealing these characteristic neurofibrillary tangles (tangled nerve fibers) and beta-amyloid plaques (looks like accumulated waste products of collections of dead neurons).

The early prevalence estimate of four million people is considered to be an over-estimation (Zarit & Zarit, 1998) due to primitive diagnostic methods, instead, 2.3 million (with a potential range of 1 to 5 million) suffer from Alzheimer's disease. This equals 6.9% of those over age 65 and 29% of those 85 and older (Brookmeyer & Kawas, 1998).

Psychological symptoms evolve gradually over time beginning with early signs of occasional memory loss for recent events and familiar tasks. Cognitive functioning changes represent the essence of the disease but personality and behavior changes ultimately arise. The final stage involves inability to perform simple and basic everyday functions.

Alzheimer's disease is known to be associated with the formation of plaques and tangles, especially in brain areas controlling memory and other important cognitive functions. The cause is unknown, but a common theory is that genetic abnormalities are responsible for neuron death (Wisniewski, Wegiel, & Kotula, 1996). New genetic engineering technology is discovering genes that may cause the brain changes associated with this disease. For example, the *apolipoprotein E (ApoE) gene*, located on chromosome 19, may be involved in plaque formation.

Genetic contributions to Alzheimer's disease are thought to explain about 40 to 50% of the disease, in turn, environmental factors are studied. Serious injuries involving loss of consciousness increase the risk of acquiring the disease in late life. Such injury may initiate production of cytokines and other proteins, a process which ultimately destroys neurons (Griffin et al., 1998).

Higher education and continued mental activity throughout life may protect against Alzheimer's disease. A study of 678 nuns within a religious order known for low

rates of Alzheimer's disease revealed that they lived an intellectually challenging life into their 80s and 90s. One nun maintained high scores on cognitive tests until her death at age 101. Amazingly, this person's autopsy showed characteristic plaques and tangles found in the brains of those with profound behavioral deficits (Snowdon, 1997). The study also highlights that some people can function through life without any observable signs of the disease.

At present, there is no cure for Alzheimer's disease. The drugs currently being tested have not offered significant improvements in Alzheimer's patients, but they may lead to more productive treatments.

BALTIMORE LONGITUDINAL STUDY of AGING

The Baltimore Longitudinal Study of Aging (BLSA) began in 1958, and is a longitudinal study conducted by roughly 150 gerontologists examining physical, mental, and emotional aging effects in healthy people. Nathan Shock, often regarded as the father of gerontology in the United States, is accredited with initiating the study. Participants include over 1500 men and 700 women, ranging from ages 17 to 96, who undergo extensive testing over two and a half days every two years. Subjects are mostly healthy, well-educated and working in or retired from high-level positions and have been followed for an average of 13 years. The following is a review of BLSA findings regarding aging changes.

Appearance - Both sexes lose about one-sixteenth of an inch per year in height starting at about age 30.

With age, the extremities become thinner and the trunk thicker.

Dental - The chance and severity of periodontal disease increases with age.

Weight and metabolic changes - Life expectation is not greatest for the leanest, rather, for those ranging from the middle of the "desirable" weight range to 20% over that midpoint.

Weight lowers between age 55 and 75 due mainly to loss of lean tissue, muscle mass, water, and bone.

Blood cholesterol rises from early adulthood to age 60 or 65 and then falls.

Coronary artery disease risk factors are cigarette smoking, hypertension, elevated serum cholesterol and low density lipoproteins, low vital capacity, diabetes, and obesity. The incidence of this disease increases with age.

If disease-free, an older person's heart pumps about as well as that of a young adult. Evidence does not show that heart function declines with age.

Pulse rate diminishes with age and is not a health problem.

Reaction time - Those over age 70 show a declined ability to detect and report small environmental changes.

With age, responses to stimuli become slower and have a greater chance of being inaccurate, particularly complex tasks. There is a 20% slowing in reaction time from age 20 to 60.

Cognitive - Short-term memory declines as we age.

Beyond age 70, performance on logic tests decreased for most BLSA participants, but no change occurred for some.

Ability to learn oral material decreases only in those over 70.

Those who experience no decline on mental tasks exist in every age group, including the oldest.

Visual memory, measured by reproducing geometric designs from memory, slightly declines between ages 50 and 60, and diminishes greatly after 70.

Vocabulary scores show no change with age.

Personality - Barring disease, personality traits remain basically the same throughout life. The notion of becoming crankier or more mellow with age is a myth.

Preference for fast-paced activities decreases around age 50.

Evidence suggests that older people do not become hypochondriacs.

Sexuality - Sexual activity decreases with age despite maintenance of normal amounts of sex hormones. A slightly higher testosterone level is present in more sexually active men.

Sperm counts per unit volume or per ejaculate remain the same, but the proportion of immature sperm present rises with age.

Prostate gland enlargement is common in men over age 60.

Sexual daydreams lower in frequency and intensity with age and they virtually disappear after age 65.

Relative frequency of sexual activity does not change with age; the most sexually active men in their 70s were also highly sexually active in their 20s.

Senses - Visual acuity decreases with age, but wearing glasses allows for 20/20 vision or better into the 80s.

There is a progressive loss in ability to hear sound at all frequencies.

With age, ability to taste sweet or sour does not change, but it becomes a little more difficult to detect salty or bitter.

Ability to identify odors declines with age.

Physiological - Kidney function, measured by ability to clear nitrogenous wastes from the blood, decreases with age.

Lymphocytes, a white blood cell, show a lowered ability to kill cancer cells starting at age 40. Other white blood cells which fight infectious disease, termed neutrophils, also decline in ability with advancing age.

Pulmonary function declines with age.

Physical activity and maximum exercise performance decline with age. Physical performance can improve over time given lifestyle changes such as daily exercise.

Physical performance can delay, eliminate, or slow some diseases, but evidence does not reveal that increased exercise can affect basic aging causes.

Gender aging differences - Pre-menopausal women reveal no bone density loss with age, but post-menopausal women have a faster rate of bone loss than men of similar age.

Aging men and women have different proportions of the several types of white cells found in the bloodstream.

Older men have 20% higher maximum oxygen

consumption capacity than women.
The longitudinal decrease in hearing sensitivity is more than twice as fast in men than women.

The BLSA offers the following conclusions:
a) Chronological age alone is a poor predictor of performance because age changes are individualized - an 80 year-old may perform equally well as a 50 year-old;
b) Some decrements are inevitable effects of aging, such as reduced reaction speed and short-term memory losses;
c) Many disabilities associated with old age may be caused more by effects of disease than aging; d) Aging results from interaction of genetic, environmental, and lifestyle factors;
e) Lifestyle decisions, such as maintaining a low-cholesterol diet or stopping cigarette smoking, can affect occurrence or progression of some age-related diseases.

PSYCHOLOGICAL FACTORS

The effects of aging upon mental abilities may influence ability to adapt to everyday life. Further, cognitive abilities can affect self-esteem and how we view our own aging process. Despite some losses in speed and memory in later adult years, normal age-related changes are not completely negative. Fortunately, individuals can compensate for memory changes by implementing a balanced approach to their self-concept.

Information Processing - Age-related changes in information processing are determined by measuring *psychomotor speed* - time needed to process a signal, prepare a response, and execute the response. Research shows that reaction time increases with age in adulthood. The *general slowing hypothesis* states that the increase in reaction time is due to a general decline of information processing speed within the aging nervous system. The *age-complexity hypothesis* suggests that due to slowing of central processes in the nervous system, age differences increase given increasing task complexity (Cerella, Poon, & Williams, 1980). Older adults perform at comparable speeds on tasks which can be completed quickly by a young adult (500 milliseconds), but on tasks requiring 1000 milliseconds for young adults, older adults take proportionally longer (1500-2000 milliseconds). The general slowing hypothesis indicates that older adults do not become deficient during information processing tasks, rather, they are just slower.

Attention - The slowing of reaction time with age may have many causal factors, including the possibility that older adults have difficulty during information processing when the stimulus to be focused upon is placed into the system. *Attention* involves ability to focus or concentrate on a portion of experience while ignoring other features of experience, shifting that focus as required by the situation, and coordinating information from multiple sources. Additional cognitive operations, such as memory or problem-solving, may then be performed on this information.

The theory of *attentional resources* and aging suggests that older adults have limited available energy for cognitive operations due to reductions in central nervous system capacity (Salthouse, 1985). The *inhibitory deficit hypothesis* proposes that inhibition (ability to restrict attention to irrelevant or distractor information) is negatively affected by aging, while activation (ability to engage the search process) is spared aging effects. Studies reveal that younger adults inhibit response to distractor information better than older adults indicating that older people are less likely to inhibit processing of irrelevant information. These theories imply that older adults focus more effectively given distractions kept to a minimum.

Memory - This construct is simplistically defined as the acquisition, storage, and retrieval of information. It involves a sequence of stages allowing information to be initially processed, maintained in a holding pattern, then either discarded or moved into more or less permanent storage. Most researchers agree that memories are based on patterns of neuronal activity in the brain.

Previously called short-term or immediate memory, *working memory* is a system which keeps information temporarily available and active while the information is being used in other cognitive tasks (Baddeley, 1986). Three components are theorized to be associated with working memory. The *phonological loop* is composed of a memory store for speech-based information called the phonological store, and an articulatory control process for processing this information. For example, one may hear a name (phonological store) and repeat it several times subvocally (articulatory control process) to avoid forgetting the name. The *visuospatial scratch pad* facilitates manipulation and maintenance of visual and spatial images, for instance, it may be used to determine the shortest route between home and a grocery store. The third component, the *central executive*, determines how to allocate cognitive resources such as whether to rehearse that name or to create a mental street map in deciding the shortest route.

Most studies on working memory span reveal clear age-related deficits, both in verbal (Verhaeghen, Marcoen, & Goossens, 1993) and computational span (Salthouse & Babcock, 1991). It appears that the articulation rate slows in adulthood which may affect processing of information in the phonological loop (Multhaup, Balota, & Cowan, 1996). The visuospatial scratch pad diminishes with age as apparent from spatial memory deficits in older adults (Smith, 1996; Wilkniss, Jones, Korol, Gold, & Manning, 1997).

Information does not always remain within working memory, eventually, it is either forgotten or consolidated in *long-term memory* - the repository of information held for a time-frame ranging from several minutes to a lifetime. The effect of working memory deficits on long-term memory is illustrated in the *environmental support hypothesis* which proposes that age-related differences exist on tasks that

provide little context or support and require high levels of self-initiated processing in which the person must work hard to remember the material (Craik, 1994). When such high demands are placed on working memory, older adults do not process the material as efficiently or effectively.

Memory for information which is highly familiar and frequently retrieved, and memory that occurs without conscious processing are immune to negative aging effects. The following types of memory, therefore, show little or no age effects: semantic memory - the equivalent of "knowledge," and includes the words and definitions of words in one's vocabulary or storehouse of historical facts; procedural memory - non-verbal memories in the form of knowledge of how to perform certain activities such as riding a bicycle; implicit memory - recall of information acquired unintentionally; autobiographical memory - recall of information from one's own past (no aging effect if the information is of great importance); and prospective memory - recall of events to be performed in the future (no aging effect for event-based prospective memory such as remembering to meet someone after dinner, but there are significant age effects in time-based prospective memory such as remembering to meet someone at the specified time of 6:00 p.m.).

Along with working memory span, the following types of memory have significant age effects: episodic memory - memory for events (episodes) and can include recall of information administered during a memory experiment such as a word list; flashbulb memory - remembering details of a distinctive historical event; source memory - recall of where information was heard or seen; tip-of-the-tongue phenomenon - difficulty in retrieving a well-known piece of information such as a name or word; and remote memory - recall of information from the distant past. It appears that memory tasks that require the type of processing involved in working memory, which put high demands on cognitive resources, are negatively affected by aging. Evidence from brain imaging and other neurophysiological data suggest possible areas of age-related effects are the frontal lobes, which may affect working memory and source memory (Trott, Friedman, Ritter, & Fabiani, 1997), and the hippocampus-medial temporal lobe areas (Henkel et al., 1998; Raz, Gunning-Dixon, Head, Dupuis, & Acker, 1998; Smith, 1996).

Older people participating in high levels of aerobic fitness reveal a small (5%) but significant improvement on complex speed-based cognitive measures (van Boxtel et al., 1997). An older adult Swiss sample study found that high levels of antioxidants in the blood (ascorbic acid and beta-carotene) correlated with enhanced memory functioning over a 22-year period (Perrig, Perrig, & Stahelin, 1997), but this finding requires additional confirmation.

Simple practice has been shown to improve memory task performance and negate negative effects of mental inactivity (Lachman, Weaver, Bandura, Elliott, & Lewkowicz, 1992). Training older adults in traditional memory improvement techniques such as mnemonics has offered limited success, instead, helping them to devise their own memory enhancement strategies has yielded better results (Park, Smith, & Cavanaugh, 1990). Self-guided practice offers a more positive training effect (Kotler-Cope & Camp, 1990; Willis, 1990), and improves the older person's feelings of efficacy and mastery (Cavanaugh & Green, 1990).

Language - The average healthy older adult does not experience significant losses in language usage (Burke, 1997). Age-related changes in cognition, however, may affect language usage (MacKay & Abrams, 1996). Working memory declines create difficulty in gaining meaning from written material or conversation because information must be retained in memory while new information is being processed. Cognitive processing declines are viewed as a significant factor in reducing the quality of interpretations which older adults derive from written and spoken language. It may be more difficult to retrieve needed words to complete thoughts or sentences while speaking (Kemper, 1992), and an older adult's speech may become more ambiguous (Shadden, 1997).

Older individuals can compensate for aging effects on speech production and understanding through their backlog of experiences. They can utilize the context of a situation to understand the correct meaning, and they can anticipate and organize information, at times, better than a novice in that situation.

Problem-solving - The process of problem-solving involves assessing the present state of a situation, determining the desired end-state, and finding ways of changing the current into the desired state. Through years of problem-solving experience, an older adult may routinely search for relevant factors in a problem, and this increased selectivity to information can reduce the risk of becoming burdened with excess information. Secondly, an experienced problem-solver often has well-organized storehouses of knowledge that can be easily accessed and implemented.

Research on speed of decision-making shows that older adults can arrive at an answer more quickly than younger persons who do not have their knowledge bases as well-stored or categorized. It also appears that older adults make quicker decisions in areas that they are not especially expert; they are also less likely to seek additional information upon making the decision compared to young adults (Meyer, Russo, & Talbot, 1995). Quicker problem-solving in older adults may result from their greater experience base creating a feeling of lower dependency on incoming information compared to younger adults.

Two problem-solving styles are the *top-down approach* - the person uses "heuristics" or rules-of-thumb to approach a problem (this method is commonly used by an expert problem-solver as illustrated by a chef who does not need to measure the sugar needed in pie crust), and the *bottom-up approach* - the individual collects as much data as possible before making a decision (the novice baker would precisely

measure the needed sugar for pie crust). The top-down approach is quicker but it can lead to mistakes given incorrect assumptions during the beginning stage of problem-solving. This type of mistake occurs given too much, not too little familiarity. Young adults use more bottom-up processing, older adults use more top-down, and middle-aged adults use the better approach of combining both (Sinnott, 1989).

Willis (1996) theorizes that older adults rely on top-down processing and make quicker decisions with less information as an attempt to conserve cognitive resources. Further, this style may lessen the elder's discomfort of ambiguity and the quicker decision may give the individual more time to prepare for necessary action given their decision.

Due to greater experience and expertise, older persons have an advantage given familiar choices, but they are disadvantaged when a familiar concern arises with a change, or when a premature decision results in ignoring important information. Young problem-solvers may make mistakes due to unfamiliarity with many situations, however, their ability to process larger amounts of information in a shorter time can lead to avoiding some mistakes that older adults may make.

Intelligence - The construct of *intelligence* has been difficult to define beyond the idea that it represents the overall quality of the individual's mental abilities. Results from the Wechsler Adult Intelligence Scale, developed by David Wechsler in the 1930s, indicated that age-related differences in intelligence followed the "classic aging pattern" (Botwinick, 1977) of an inverted U-shaped pattern; specifically, a peak in early adulthood followed by steady decline over succeeding decades of adulthood. This conclusion has been challenged by the *Seattle Longitudinal Study (SLS)* in association with K. Warner Schaie which found, for most abilities, there was an increase or no change between the first and second testing, even within the oldest age group. The archives of the SLS are considered the major repository of data on adulthood intelligence.

Multi-dimensional intelligence theories suggest that intelligence involves multiple abilities or dimensions of abilities rather than the idea of intelligence as a unitary construct. The multi-dimensional approach proven to be effective in understanding intelligence is the primary mental abilities framework presented by Thurstone (1938). This model proposes seven *primary mental abilities*, including verbal meaning, word fluency (generating words following a particular lexical rule), number (arithmetic), spatial relations, memory, perceptual speed, and general reasoning. Five of these seven abilities form the basis of most studies on adult intelligence: Verbal Meaning, Space, Reasoning, Number, and Word Fluency.

Stemming from the primary mental ability theory, Raymond Cattell (1963) proposed that intelligence involves two basic sets of abilities called *secondary mental abilities*: one set is based on unlearned thought processes and the other set on educational training. The first ability, *fluid intelligence*, represents the individual's innate abilities to perform higher-level cognitive operations involving integration, analysis, and synthesis of new information, "the sheer perception of complex relations" (Cattell, 1971, p. 98). Fluid intelligence also involves the quality of biopsychosocial factors such as nervous system functioning and sensory structures and it cannot be trained or taught, rather, it is a "pure" measure of ability not influenced by educational experiences. The second ability, *crystallized intelligence*, comprises acquisition of specific skills and information acquired by familiarity with the language, knowledge, and conventions of one's culture; it involves the learned ability to infer relationships, make judgments, analyze problems, and utilize problem-solving strategies. Together, fluid and crystallized intelligence include biological factors related to the nervous system, psychological factors encompassed in cognitive processing, and social factors obtained from education and experience in one's culture.

The peak of fluid intelligence is theorized to occur during the years of adolescence, when theoretically, the nervous system and sensory structures are at optimum levels. Beyond adolescence, age-changes which diminish these systems create a downward trajectory in fluid intelligence. Crystallized intelligence continues to grow throughout adulthood while the person gains experience and culture-specific knowledge.

Verbal meaning scores peak by the 50s on cross-sectional studies and somewhat later on longitudinal studies, then scores start to drop about 10 years later followed by performance being about half the peak-level by age 80. Numerical ability peaks in middle age and undergoes a detectable drop by the 60s. The three primary mental abilities representing fluid intelligence, spatial orientation, inductive reasoning, and word fluency remain stable until the late 60s and drop steadily afterward.

The SLS reveals that health status affects intelligence test performance. Arthritis, cancer, and osteoporosis are associated with lower intelligence test scores (Schaie, 1996), as is cardiovascular disease, and hypertension in middle adulthood is a risk factor for poorer cognitive performance in the 70s and beyond (Launer, Masaki, Petrovitch, Foley & Havlik, 1995).

Gender differences reveal that men outperform women on numerical skill, the crystallized ability of knowledge of general information, and the fluid ability scale of spatial orientation. Women score higher on a fluid measure called Digit Symbol - substituting symbols for digits in a speeded coding task (Kaufman, Kaufman, McLean, & Reynolds, 1991; Portin, Saarijaervi, Joukamaa, & Salokangas, 1995). Changes through adulthood indicate that men show earlier losses on crystallized abilities and women decline earlier on fluid abilities (Dixon & Hultsch, 1999).

SLS data reveal that those with higher levels of education are protected somewhat from aging effects on intelligence, and this buffering effect also includes being involved in a

complex and stimulating work environment, being married to a spouse with higher levels of education and intelligence, and exposure to intellectually stimulating environments in general. Retirement positively affects maintenance of intellectual functioning if one is leaving a boring and routine job, but those leaving a complex and stimulating occupation sustain a more pronounced decrement after retirement (Schaie, 1996). Cumulatively, these qualities produce higher amounts of "Life Complexity" (Schaie, 1983).

Older adults who demonstrate more flexible attitudes and personality style are less likely to experience a decline in intellectual functioning (Schaie et al., 1991). It is theorized that flexible people are more willing to play with ideas resulting in greater interest in receiving new information throughout the life-span. SLS findings suggest that older people are not becoming more rigid, rather, younger people are becoming more flexible.

Personality - Studies have found age-differences in usage of defense mechanisms and coping strategies (Labouvie-Vief, Hakim-Larson, & Hobart, 1987; Diehl, Coyle, & Labouvie-Vief, 1996). Older adults managed their emotions through more mature defense mechanisms, while younger people reacted to psychologically demanding situations by acting-out against others, projecting their anger on others, or regressing to more primitive behavior. Older individuals were more likely to use defense mechanisms which controlled their negative emotions or that attempted to put the situation into perspective. Regarding coping, older adults were less likely to react in self-destructive or emotional ways, instead, they tried to understand the situation and find a way around it, through problem-focused coping and other strategies such as suppressing their negative feelings or channeling those feelings into productive behavior. Additionally, older persons with higher verbal intelligence and more mature levels of ego functioning were more likely to use defense mechanisms and coping strategies utilizing thoughtful analysis, regulation of feelings, and realistic assessments and reactions to difficult situations.

Gender differences revealed that women tended to avoid unpleasant or stressful situations, blamed themselves upon things going wrong, and sought the support of others. The "feminine" coping style included showing empathy toward others and tolerating complex and ambiguous feelings in difficult situations. Men tended to externalize their feelings and use reaction formation.

Findings from trait theories of personality indicate that, as a group, older adults become less emotionally volatile, get along better with others, and accept responsibility for their actions (McCrae & Costa, 1990).

Theories of personal control, emerging from cognitive theory, suggest that personality is driven by desire to achieve control over interchanges with the environment. Two types of control processes underlie this theory (Rothbaum, Weisz, & Snyder, 1982). In *primary control*, the person's desires and goals prevail over any environmental constraints, for example, one might climb the lower shelves in a grocery store to reach the top shelf which secures a desired box of cookies. *Secondary control* involves changing the perceptions of one's goals or desires instead of the environment itself, hence, one might accept a different box of cookies within closer reach. Studies show that age-related changes in physical, cognitive, and social processes lead older adults to increasingly choose secondary control (Heckhausen, 1997). Aging individuals can avoid the frustration of inability to choose primary control by channeling their energy into attainable goals redefined through the process of secondary control.

Further, both primary and secondary control can interact with selectivity - focusing energy on a more narrow objective or changing one's approach to personal goals, or compensation - making environmental changes that will offer help in goal-attainment or downgrading the desirability of a failed goal.

Heckhausen (1997) proposes that healthy development in later life involves finding balance among these control strategies contingent upon opportunities and constraints resulting from the aging process. The potential for primary control still prevails even as capabilities decline in later years.

Based on the MacArthur Study of Adult Development, a large national survey of roughly 3500 adults, Lachman & Weaver (1998) observed that, despite awareness of increasing life constraints, older adults (over 60) compared to people of younger ages, experienced high levels of control. They perceived their resources and potential in a positive manner instead of focusing on losses.

Erik Erikson, an optimist at heart, shared some positive qualities of older adults in the book *Vital Involvement in Old Age* (Erikson et al., 1986). The book analyzes interviews of 29 people in the Berkeley Growth Study who were studied from birth and were in their 80s during the interviews. People who rose above the infirmities and limitations of aging were identified which led to the statement, "although impairment and a certain degree of disability may be inevitable in old age, handicap and its deleterious effects on psychosocial well-being need not necessarily follow" (Erikson et al., 1986, p. 194). Everyone in the sample was not determined to overcome adversity, however, defining oneself independently of age- or illness-based limitations differentiated the two groups.

SOCIAL FACTORS

The following social theories explain changes in social relationships occurring in late adulthood, and factors leading to successful aging.

Role Theory - People play different social roles throughout life, such as student, daughter, or parent, and these roles form the basis of self-concept. Each role is associated with a particular age or stage of life. Successful aging depends

on the ability to accept the role changes common to the elder years.

Age-norms - beliefs about age-related capabilities and limitations - regulate the roles that people of different ages can play. Norms can be formally expressed (i.e., required retirement policies) or as is more common, informal. Individuals also have norms regarding the appropriateness of their own behavior at specific ages, such that "social clocks become internalized and age norms operate to keep people on the time track" (Hagestad and Neugarten, 1985).

Older adults encounter various role dilemmas: they are more likely to lose previously-held roles than to gain new ones, and many role losses are irreversible; roles become more ambiguous; and the transition from the worker to retiree role yields role discontinuity - knowledge gained at one age level may be useless or conflicting at the next age level. Role loss can produce a decrease in social identity and self-esteem because roles are the basis of one's self-concept (Rosow, 1985). Though old age encompasses role loss, role gains can occur, such as volunteer, part-time worker, mentor, grandparent, and so on.

Activity Theory - Assumes that active older adults will be more satisfied and better adjusted than less active elderly. The theory suggests that one's self-concept is validated through involvement with roles characteristic of middle age, hence, older people are recommended to maintain as many middle-age activities as possible, and to substitute new roles for roles lost by widowhood or retirement (Lemon, Bengston, and Peterson, 1972). To lessen society's withdrawal from the elderly, older adults must deny the existence of old age through maintaining middle-age lifestyles as long as possible, which includes remaining active, keeping busy and staying young. Behavior inappropriate to middle age is deemed to be maladaptive.

This perspective supports our society's value system which emphasizes work and productivity, and it reflects gerontological practitioners' attempts to devise new roles for older people that offer responsibilities and obligations. Despite the logic, empirical support for activity theory is mixed.

Disengagement Theory - This controversial theory proposes that older people, undergoing losses of roles and energy, want to be freed from society's expectations of competitiveness and productivity. Disengagement is seen as adaptive behavior, facilitating self-worth and tranquility while engaging in more peripheral social roles. In support, Cumming and Henry (1961) suggest that disengaged older people, who are released from employment roles, participate better in family relationships than employed people. The process of disengagement for men is often abrupt as they discontinue their occupational roles, while for women it is more gradual as they transition from what is frequently their central role as parent. More employed women may experience this process differently.

Disengagement is considered functional for society as well. Cumming and Henry (1961) suggest that all societies must transfer power from older to younger generations. Retirement policies, for example, allow younger people with new energy and skills to move into occupational roles.

Critics of this theoretical perspective argue that not everyone disengages, in fact, many people in their 80s are employed, healthy, and socially active. Disengagement and activity theory do not consider variability in individual preferences (Hochschild, 1975). Disengagement theory has generally lacked empirical support.

Continuity Theory - The weaknesses of disengagement and activity theories created a third social-psychological theory of adaptation in the elder years. Continuity theory postulates that older adults substitute similar types of roles for lost ones, and they continue to exercise typical ways of adapting to the environment to maintain psychological continuity, and continuity of social behavior and circumstances (Neugarten, Havighurst, and Tobin, 1968). Personality plays a vital role in adjusting to aging, hence, a previously active and social person is unlikely to sit quietly at home during elder years. Essentially, this theory promotes that, with age, we become more of what we were when younger. Significant personality traits and core values become even more important to the aging individual. Continuity theory believes that successful aging is a function of maintaining a mature, integrated personality while growing old, and this underscores life satisfaction (Neugarten, Havighurst, and Tobin, 1968). In this model, people rely on their own standards for successful aging instead of adjusting to a common norm.

Though continuity theory has some intuitive appeal, it also has limitations. It stresses earlier stages of development as criteria for successful aging, and assumes that people attempt to maintain a certain pattern of behavior through the life span. In fact, maintaining previous patterns can be maladaptive when change is indicated (Fox, 1981-82), and releasing oneself from former roles can have positive effects (Guttmann, 1974). For example, it is considered healthy for females to adopt "masculine" personality traits with age and for men to act on tendencies that are "feminine." It is difficult to empirically test continuity theory due to its complexity.

The Elderly as a Subculture - This theory believes that older adults maintain their self-concept and social identity through membership in a subculture of older persons. An aging subculture has two effects upon older persons: identification as being old, hence, being socially and culturally distant from the rest of the youth-oriented society; and a growing group consciousness that offers potential for political power and social action. Similar to viewing older adults as constituting a subculture is identifying the aged as a minority group (Blau, 1981), being discriminated against because of age.

This theory helps in understanding the role and status of older people, but the concept of a disadvantaged aging

subculture does not apply to all older persons. Some elders have high status and financial security, therefore, this theory is limited in predicting behavior.

Age Stratification Theory - Proposes that just as societies are stratified by socioeconomic class, every society places people into categories or strata based on age, specifically, young, middle-aged, and old. Age stratification of roles frees and limits older persons, for example, older people are free from many mandatory adult roles but norms for age-appropriate behavior discourage them from working part-time or returning to school.

Two factors that explain many differences in how people think, act, and contribute to society are termed the life course dimension and the historical dimension. *Life course dimension* suggests that individuals of the same chronological age or stage in the lifecycle (i.e., infancy, childhood, adolescence, early adulthood, etc.) share much in common, such as biological development, roles they have experienced, and potential years ahead, whereas people at different life stages differ in these areas. *Historical dimension* submits that people born at the same time period (cohort) share a similar historical and environmental past, present and future. Major events, such as the two World Wars, the Civil Rights Movement, space exploration, and technological advances differentially affect cohorts' values and behaviors. Often, we choose friends with similar values perhaps stemming from common experiences.

The process of *cohort flow* is illustrated by individuals stepping onto an escalator at birth (Riley, Johnson, and Foner, 1972), resulting in those who began at the bottom at the same time moving up collectively. The age group does not remain stable during the upward movement, however, as people develop unique social attributes that affect the probability of remaining on the escalator for the entire ride. Similarly, the dynamic process of age stratification confirms that different cohorts age in different ways as they "move up the escalator" (move through the age strata) due to socioeconomic factors.

Age stratification theory has been criticized for evaluating age by the too narrow concepts of chronology and life stage and not considering personal characteristics. Moreover, individual differences increase with age suggesting that cohorts become less cohesive with age rather than more unified. Age stratification can illuminate how society uses age to fit people into structural niches in the social world.

Interactionist Perspectives - Emphasize the importance of dynamic interaction between older people and their social world. Given change, older individuals are advised to try to master the changing situation while utilizing resources within their environment to preserve a positive self-concept.

The *symbolic interactionist* view of aging indicates that the interaction of the environment, individuals, and their encounters in the environment affect the type of aging process people experience (Gubrium, 1973). For example, an older person who becomes confused after moving to a new dwelling may be labeled as senile, when simply lowering the stress of moving could reduce the confusion. Creating new alternatives is recommended, for example, withdrawal from social involvement is not inevitable with aging, rather, it is one possible outcome of a person's interaction which can be changed.

Labeling theory states that people gain self-concept from interacting with others in their social milieu. The labeling process begins, for example, when someone ready to retire acts non-productively because others have defined retirement in this manner.

The *social breakdown theory* argues that older people who accept negative labeling begin to act in dependent ways and their independence diminishes.

The social reconstruction model believes that even small changes in restructuring the environment can improve the quality of life for elders. Unfortunately, an assumption within this model is that socioeconomic class creates inequality which limits one's potential mastery over life (Tindale and Marshall, 1980).

Social Exchange Theory - States that a vital factor in defining the elderly's status is the balance between their societal contributions, which are determined by their control of power resources, and the costs involved in supporting them. Given possession of material goods, abilities, achievements, and other qualities deemed desirable by the culture, individuals can exert power in their social relationships. Those elderly in possession of fewer power resources than younger people may experience diminished status.

This theory proposes that older people disengage because they have little of value to exchange, in turn, they are often forced to accept the retirement role. Inability to work limits their access to two valuable power resources - material possessions and authority positions.

Dowd (1975) asserts that the only major power source unscathed by aging is the category of generalized reinforcers, such as respect, approval, recognition and support; this category is less valued than other resources, which limits elderly in influencing exchange rates. Despite limited resources, most older adults attempt to exercise a degree of reciprocity and active control in the management of their lives.

Additional empirical research is needed to assess the value of exchange theory as explanation for the aging process.

Political Economy of Aging - This perspective believes that social class is a barrier to older people's access to important resources, and that powerful societal groups maintain their own interests by perpetuating class inequalities (Minkler and Estes, 1984; Walker, 1981). Estes asserts that social, political, and economic conditions affect how the elderly's concerns are defined and treated. The elderly's problems are thought to be socially constructed due to societal

conceptions of aging and the aged. The aging process itself is not the problem, instead, the issue is the societal conditions encountered by older people lacking sufficient income, health care, or housing, which are needs created by a capitalist society. Estes argues that major policy changes are needed which would not separate the elderly because of their age, and would improve social perceptions and objective conditions of the aged.

Essentially, the political economy of aging model analyzes sociopolitical factors that separate social policies for groups, such as the elderly. The main limitation of this critique is lack of empirical research.

SOCIAL SUPPORT SYSTEMS

The *socioemotional selectivity theory* indicates that throughout adulthood, people decrease the range of their relationships in order to maximize social and emotional gains and minimize risks (Carstensen, 1987). Further, as individuals grow older, they are more focused upon maximizing emotional rewards and less interested in seeking information or knowledge through their relationships. This shift occurs as people become increasingly aware that they are "running out of time." Young adults feeling real or artificial time constraints show similar desire toward emotional gains from their social interactions as older adults (Carstensen, Isaacowitz, & Charles, 1999). In other words, at this stage, we want to spend time with those who have been closest to us rather than establishing new friends or acquaintances.

Older adults are often better able to control expression of their emotions (Lawton, Kleban, Rajagopal, & Dean, 1992), and they have fewer negative emotions, possibly because of greater ability to regulate their affective experiences (Gross et al., 1997). These age differences in emotions support the importance of emotional experience in older adults and imply that they would prefer to spend time with their long-term relationship partner.

Over 50% of those over age 65 are married and living with a spouse in an independent household (U.S. Senate Special Committee on Aging, 1992). Due to women's longer life expectancy and fewer options for re-marriage, 40% of women age 65 and over are married, as compared to 74% of men. Women represent 80% of the elderly who live alone.

Marital tensions due to changing roles and expectations may be heightened for older couples as partners change roles through retirement, post-parenthood, or illness. Inability to negotiate role expectations and consequent disagreements can lead to feelings of inequity and depression in older spouses (Holahan, 1984). Despite such potential tension, most older partners seem satisfied, with men being more satisfied with marriage and their emotional need fulfillment than women (Chappell, 1990; Gilford, 1984).

Research indicates that there is no physiological reason for a lessening of older women's ability to enjoy sexuality. In fact, the main obstacle to a woman's ability to experience a rewarding sex life after age 60 is the unavailability of a partner (Marsiglio & Donnelly, 1991; Masters & Johnson, 1966; Pfeiffer, Verwoerdt, & Davis, 1974). Regarding men, the ability to have an erection may be affected by various physiological and psychological factors from middle age onward. Men over age 60 experience normal age-related changes in sexual functioning involving a slowing down and decrease of intensity in their movement through the sexual response cycle. Arousal is slower, orgasm is shorter, and less seminal fluid is ejected (Masters & Johnson, 1970). Roughly 15-25% of men 65 and over have erectile dysfunction (National Institute of Diabetes and Digestive and Kidney Diseases, 1999; National Institutes of Health, 1992). Health can significantly affect erectile functioning, especially disorders of the cardiovascular and endocrine systems. Stress, depression and anxiety can also interfere with sexual functioning.

The majority of older adults have positive and accepting attitudes toward sexuality and believe that it has importance in their lives (Starr & Weiner, 1981). Findings from this survey of 800 participants over age 60 obtained through community centers indicated: 76% expressed that sex has a positive effect on their health; 75% felt that sex feels the same or better compared to their younger days, with 41% of women and 27% of men stating that sex is better now; 99% would like to have sex if it were available; and 91% approved of sex and living together without marriage for older adults.

Estimation of sexual activity in single, divorced, and widowed people ranges from 32% (Starr, 1985) to over 50% of women and 75% of men in their 60s and 70s (Brecher, 1984).

Older people who live alone without social support systems have higher probability of institutionalization, lower personally reported well-being, and greater difficulty adjusting to widowhood compared to those with strong social supports (Lopata, 1979; Kasper, 1988; Wallston et al., 1983).

About 80% of people over age 75 with functional disabilities and living in the community are assisted by their families (U.S. Senate Special Committee on Aging, 1988). Wives and daughters perform most of the personal care (Cantor, 1991; Stoller, 1990), in fact, women represent over 80% of the family caregivers to chronically ill elderly. Without such family support, many of these elders would be institutionalized and the number of nursing home residents would triple (Brody, 1985). Those without family ties, mainly widowed women and the very old who have outlived family members, have the greatest likelihood of institutionalization.

With age, siblings frequently renew past ties, forgive conflict and rivalry, and become closer, often through shared reminiscence (Cicirelli, 1991; Brubaker, 1990).

After one's spouse, adult children represent the most relevant source of support and social contact for older

adults. The majority of those over age 65 live near their children but do not share the same home; most older persons report not wanting to live with their children for reasons of privacy and autonomy. Less than 20% of elderly live in their children's households, but this number increases to 33% of all men, and 50% of all women age 65 and over who are widowed, separated, or divorced that live with their children or other family members. Roughly 80% of older adults with children live less than one hour away from at least one child, and over 75% have phone discussion at least weekly (AARP, 1991; Crimmins and Ingegneri, 1990; Shanas, 1979, 1980).

Approximately 30% of people over 65 and 45% of those 85 and over live alone, and they are most likely to be women, ethnic minorities, the oldest-old, and of low socioeconomic status. These individuals often rely more on community services than on friends and neighbors for support to continue independent living; and they report lower life-satisfaction than married people (Kasper, 1988).

Several intervention models are designed to increase peer group interaction for the elderly's well-being. *Personal network building* consists of caring and concerned neighbors, for example, who act as "natural helpers" by offering support or services to elderly in need. Further, "gatekeepers," such as newspaper or postal carriers (by observing whether the newspaper or mail is brought in) can connect isolated elderly with sources of assistance as Senior Information and Assistance lines. Churches may also serve as personal networks by providing a surrogate family for elders or facilitating church members to offer various types of assistance.

Volunteer linking utilizes volunteers to perform chores, offer peer counseling and serve as Friendly Visitors.

Mutual help networks offer problem-solving and reciprocal exchange of resources, for example, groups focusing upon shared problems such as widow-to-widow programs or stroke clubs can offer new skills, expanded social networks, and greater solution capabilities.

Another intervention model is *neighborhood and community development* which strives to maximize a community's self-help and problem-solving capacities. Older adults in a low-income neighborhood, for example, can unite as a "family" to solve personal and community concerns.

Social relationships maintain importance throughout life. A biopsychosocial model of adult relationships is termed the *social convoy* which suggests that people possess a network of close relationships that "carries" them or offers social support throughout their lives (Kahn & Antonucci, 1980). Though the convoy may change, it maintains its size of 5 to 10 close social ties and the exchange of support within the social network. The model resembles a set of concentric circles in which the closest family members reside within the innermost circles and more distant relationships extend outward (Antonucci &Akiyama, 1987; Chatters, Taylor, & Jackson, 1986). Support is exchanged in both directions from and to others within the convoy, and despite older adults tending to feel they are receiving more than providing support, exchange relationships remain reciprocal through adulthood (Antonucci & Akiyama, 1987).

The degree of feeling satisfied with the number of people in the closest circle is a predictive factor in one's well-being (Antonucci, Fuher, & Dartigues, 1997). Satisfaction with the social network may contribute to improved physical functioning and health in the cardiovascular, endocrine, and immune systems (Uchino, Cacioppo, & Kiecolt-Glaser, 1996).

LONG-TERM CARE

The concept of *long-term care* refers to a wide range of services for impaired older adults in institutional and community settings designed to preserve the individual's independence. Services are intended to fulfill physical, social, and emotional needs of older persons with chronic illnesses or disabilities that hinder independent daily functioning. Nursing homes are but one form of long-term care, in fact, home-maker services, nutrition programs, congregate housing, and visiting nurse services are also components along the continuum of long-term care. For every person 65 and over residing in a nursing home, there are almost four times as many living in the community needing some type of long-term care (U.S. Senate Special Committee, 1992).

Those unable to live independently due to chronic psychiatric disabilities, cognitive disorders, or physical illnesses may be treated within a variety of long-term care facilities. The main factors determining institutionalization are age (85 or older), a recent hospital admission, living in retirement housing instead of being a homeowner, having no spouse at home, the absence of a caregiver or social support network, some degree of cognitive impairment, and one or more problems with instrumental activities of daily living (Greene & Ondrich, 1990). The most common institutional setting, the *nursing home*, is a residence providing a room, meals, skilled nursing and rehabilitative care, medical services, and protective supervision. Nursing homes are certified by state and federal government agencies to provide services at varying levels of care. *Skilled nursing facilities* offer the most intensive nursing care accessible beyond a hospital, whereas an *intermediate care facility* provides health-related services to those needing institutional care beyond the level of room and board, but not requiring hospital or skilled nursing facility care. In 1997, roughly 4% of the older population lived in nursing homes, with 1% of people 65-74 years old and about 20% of those 85 and older (Kramarow, Lentzner, Rooks, Weeks, & Saydah, 1999). More women than men reside in nursing homes due to women's longer life expectancy, their greater risk of multiple chronic illnesses, and greater chance of being unmarried. The typical resident has lived in a nursing home for more than one year. In 1997, nursing home services were estimated to be $82.8

billion, or 7.6% of total health care expenditures in the United States.

Another institutional setting is the *residential care facility* which offers 24-hour supportive care services and supervision to those not requiring skilled nursing care - it includes board and care homes, foster care homes, family homes, group homes, and domiciliary care facilities.

Community-based facilities within hospitals, nursing homes, or community agencies that provide services to people living on their own or with family include the following:

geropsychiatry clinic - offers outpatient psychiatric, psychological, and social work services to elders.

geriatric partial hospital - daily outpatient therapy is provided to elders recently discharged from a psychiatric hospital.

geriatric continuing day treatment - clients participate in a day treatment program three days a week and are encouraged to live independently the remainder of the week.

day care centers - clients receive supervised meals and activities on a daily basis.

home health services - includes a variety of services, such as "Meals on Wheels" which provides a hot meal once a day; friendly visiting, which entails someone making a social visit to the home; assistance with shopping; additionally, some nursing services, physical therapy, homemaker services, personal care, and adult day care may also be offered.

Other community care options include provision of housing and specialized services. *Subsidized senior housing* offers low-rent apartment complexes with shopping and laundry assistance. *Assisted living* involves individuals living in their own apartment within an assisted living complex and paying rent plus an additional fee for services required as cooking, laundry, and reminders to take medication. The *continuing care retirement community (CCRC)* is a housing community that provides different levels of care ranging from independent living apartments to skilled nursing care in an affiliated nursing home.

LEGISLATIVE ISSUES

Current laws regulating the operation of nursing homes and community-based services originated in a report to Congress in 1986 by the Institute of Medicine called "Improving the Quality of Care in Nursing Homes." The report recommended major changes in quality and nature of services provided to nursing home residents. The report resulted in the Omnibus Reconciliation Act of 1987 which included the *Nursing Home Reform Act*. The conclusion is that every resident must be provided with services and activities designed to attain or maintain the highest practicable physical, mental, and psychosocial well-being. Required services include availability of physicians and nurses, specialized rehabilitation, social services, pharmaceutical, dietary, and dental services, and an ongoing activities program. Facilities are monitored by outside survey agencies to ensure compliance with the federal conditions of participation. In 1997, significant reductions in deficiencies were reported, however, deficiencies were observed in approximately 33% of all surveyed facilities, suggesting that issues remain in need of improvement.

LONG-TERM CARE FINANCING

The need to address economic issues in health care is becoming more pronounced. In many respects, the health care financing dilemma results from the enormous expenses of long-term care for older adults. The United States spends at least $600 billion annually on health, about 12% of the gross national product. Elderly health services amount to approximately 36% of total health expenditures (AARP, 1991). Average health expenditure for persons age 65 and older is about four times the cost for those under 65 due to older people's chronic health care needs and use of hospital and nursing home care - mainly due to at least 25% of the older population being predicted to encounter catastrophic illness at some point (Waldo et al., 1989).

Health care costs are rapidly escalating due to several factors: a) modern medical care has produced greater longevity resulting in better health for the young-old but has also created more chronically ill old-old who require a disproportionate amount of health support services, particularly in the last year of life; b) demand upon acute, high-tech medical care has produced greater need for custodial services for frail elderly which raises long-term care costs; c) separation of Medicare and Medicaid funding responsibilities creates difficulty in maintaining the concept of "clinical investment" - current treatment may be initially costly but may reduce later costs. For example, hospitals, which depend on Medicare payment, are reluctant to pay for an older person's additional day of care, despite the possibility it could prevent a lengthy nursing home stay, which is covered by Medicaid or private pay (Kane and Kane, 1990); and d) price inflation in health care has escalated faster than the general inflation rate for the last 15 years (Lee and Benjamin, 1989).

After much debate, the U.S. Congress passed legislation as part of the Social Security Amendments of 1965 which established the Medicare and Medicaid programs. Title XVIII, called *Medicare*, is entitled Health Insurance for the Aged and Disabled. The purpose is to provide older people with financial protection against hospital, nursing home, and physician care costs.

Medicare has grown from covering 19.1 million people in 1966, to 38 million people in 1997, and 87% of those covered used one of its services. In 1998, Medicare paid benefits of $217 billion.

The two main parts to Medicare are Hospital Insurance, known as "Part A," which covers intensive medical and psychiatric services, and Supplementary Medical Insurance, known as "Part B," which covers physician services

provided in hospital and non-hospital settings, and other services, such as medications, supplies, tests, and other medical costs not covered by Part A, to those 65 and over. An optional third part of Medicare is "Medicare + Choice," known as "Part C," which is for those who have both Part A and B and who choose to utilize HMOs, PPOs, private fee-for-service plans, or federal government health insurance policy. In addition, one may purchase Medicare supplemental insurance policies called Medigap or Medicare SELECT.

Various gaps and limitations in Medicare coverage can create difficulty for the elderly, for example, it covers little of outpatient care provided by non-physicians, including home health services, visiting nurses, and home health aides. Spending for home care represents only 3% of Medicare payments. These limitations combined result in Medicare covering less than 50% of total health expenditures of the elderly (U.S. Senate Special Committee on Aging, 1992), and almost 75% of all non-institutional care (i.e., home health care, homemaker services, and adult day care) is financed through private pay (Kane and Kane, 1990).

Title XIX of the Social Security Act of 1965, called *Medicaid*, pays for medical assistance for certain people (regardless of age) with low income and resources. Regarding older adults, Medicaid covers inpatient and outpatient hospital services, physician services, nursing facility services, laboratory and X-rays, medication and prosthetic devices, some eye care, rehabilitation and physical therapy, and home and community-based care for certain chronic impairments. Older adults represent 16% of total Medicaid users, but they account for 40% of total Medicaid expenditures, for similar reasons that underlie rising Medicare costs. Limitations and gaps within Medicaid coverage can create hardships for older adults. In 1996, Medicaid provided health care assistance to roughly 36 million people at a cost of $160 billion. Projections for the near-term are estimated at over $250 billion annually.

PERSONAL ADJUSTMENT FACTORS

Institutional settings must consider the physical, psychological and social parameters of the residents. Providers of institutional care attempt to satisfy the "average" resident which suggests that certain individuals will be dissatisfied. For example, room temperature may be comfortable for one at 68 degrees and another at 76 degrees. The average of the two temperatures, 72, would satisfy the "average" person but neither of the persons in this example. Residents will also differ regarding level of physical infirmity which may affect their adjustment and adaptability within the setting. Psychologically, residents may vary regarding emotionality, cognitive ability, and preferences which can be stressful to some. Socially, varying cultural backgrounds, social class, ethnicity, age, and life experience can create challenges in establishing relationships with fellow residents.

The *competence-press model* (Lawton & Nahemow, 1973) predicts levels of adjustment that institutionalized individuals may experience given their levels of competence (physical and psychological) and levels of environmental press (demands). Optimal adjustment is predicted to occur when there is an approximate match between a person's abilities and the environment's demands. A small amount of discrepancy is acceptable, but if the mismatch moves outside this range then the person may experience negative affect and maladaptive behaviors. For example, an intellectually competent older resident (high competence) may feel comfortable in an environment requiring autonomous decisions (high press), while one with a cognitive impairment will adapt more fully in a structured setting (low press).

The quality of life of residents, which is now being regulated by state and federal certification standards, can be pursued by using multi-dimensional approaches that consider both personal and environmental factors. Interventions utilizing these methods can enhance the dignity and self-respect of those people living their last chapter of life in the care of another.

Escalating health care costs concern many Americans. The increasing proportion of the older population coupled with rising hospital and physician costs continue to pressure the health care funding sources of Medicare and Medicaid. A national long-term care policy may be needed which might include improved reimbursement systems, a community-based social support element for elderly and their caregivers, and cost-containment incentives (Hooyman & Kiyak, 1993).

THE NATURE OF HEALTHY AGING

Aging researchers study factors which contribute to the survival capability of older adults, whereas theorists of healthy aging examine such concepts as "mental health" factors which allow older adults to transcend losses and physical limitations often accompanying later years.

Findings from a research project called the McArthur Foundation Study of Aging in America found the following three factors extant in successful aging (Rowe & Kahn, 1998): a) absence of disease and the disability associated with disease, and not displaying risk factors that increase likelihood of disease and disability; b) revealing high cognitive and physical functioning which enhances potential of being active and competent; and c) showing "engagement with life" which means involvement with productive activity and interacting with people.

Supportive of the possibility for healthy aging are the findings that most older people do not become depressed, personality development in later life moves toward enhanced adaptiveness, and Erikson's theory of psychosocial development suggests that elders' level of development is fuller than that of younger people whose egos are yet to be thoroughly tested by time and experience.

The *paradox of well-being* suggests that the majority of

older people experience relatively high levels of well-being (Mroczek & Kolarz, 1998). Older adults maintain a positive view of themselves and their life situations despite hardships and this favorable perspective seems to be the norm. A study of over 32,000 Americans from 1972 to 1994 revealed that the large majority of older individuals rated themselves as "very" or "pretty" happy (Mroczek & Kolarz, 1998). Research from many countries supports this concept of increased feelings of satisfaction with aging (Diener & Suh, 1998).

Older adults often utilize various methods to maintain a positive perspective, such as adaptation, coping mechanisms, including problem-focused and emotion-focused strategies, *social comparison* - assessing negative circumstances of others and realizing one's own situation could be worse (Michalos, 1985), and the process of interpreting life events in a positive manner.

Beyond maintaining a positive mental attitude, older adults can experience a renewal in productivity and creativity culminating in a secondary peak, and those with high creative potential are more likely to exhibit a high rate of productivity both early and late in their careers (Simonton, 1998). Lehman (1953) noted that "older thinkers" have produced great achievements as evidenced by an upturn in artists producing "best" paintings in their 70s. For example, Michaelangelo contributed the "Pieta Rondanini"at age 89, similarly, Benjamin Franklin invented bifocals at 78, and Galileo contributed greatly to the field of mechanics at 74. Such contributions may be motivated by closeness to death, urge to leave a legacy, or as reaction to age-related changes or health problems. Retirement, with the right frame of mind, can open new doors to enjoyment and productivity.

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TEST - HEALTHY AGING

3 Continuing Education Hours.
Record your answers on the Answer Sheet (click the "NCC Answer Sheet" link on Home Page and click your answers).
Passing is 70% or better.
For True/False questions: A = True and B = False.

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TRUE/FALSE

1. **Programmed aging and random error theories comprise the biological theories of aging.**
   A) True B) False

2. **The free radical theory is being explored as a possible cause of aging.**
   A) True B) False

3. **The majority of older people have positive and accepting attitudes toward sexuality.**
   A) True B) False

4. **Diet and exercise can affect immune system response.**
   A) True B) False

5. **Life expectancy has fallen over the past 60 years.**
   A) True B) False

6. **Current research indicates that the aging brain maintains much of its function and structure.**
   A) True B) False

7. **Secondary aging involves later life changes due to disease.**
   A) True B) False

8. **Higher education and continued mental activity throughout life may protect against Alzheimer's disease.**
   A) True B) False

9. **Most studies on working memory span indicate age-related deficits.**
   A) True B) False

10. **The Baltimore Longitudinal Study of Aging concludes that lifestyle decisions <u>cannot</u> affect the occurrence or progression of some age-related diseases.**
    A) True B) False

11. **Age-related changes in body composition, such as loss of bone mineral content, fat increase, and muscle mass decrease are related to the _____.**
    A) endocrine system
    B) respiratory system
    C) urinary system
    D) reproductive system

12. **Brain research indicates that _____.**
    A) mental stimulation can compensate for loss of neurons.
    B) remaining neurons do not increase their synapses.
    C) there is no neurological basis for memory changes in later adulthood.
    D) older adults cannot compensate for brain deficits.

13. **The leading cause of death in people over age 65 involves the _____.**
    A) reproductive system
    B) cardiovascular system
    C) vestibular system
    D) bones

14. **The formation of plaques and tangles is associated with _____.**
    A) diabetes
    B) skin cancer
    C) Alzheimer's disease
    D) hearing impairment

15. **Sedentary lifestyle, smoking, body weight, and alcohol intake represent the four major risk factors for _____.**
    A) skin disorders
    B) diabetes
    C) heart disease
    D) Alzheimer's disease

16. **Older adults demonstrating more flexibility in attitude and personality style are less likely to experience a decline in _____.**
    A) endocrine system functioning
    B) intellectual functioning
    C) visual acuity
    D) cardiovascular system functioning

17. **Decreasing the range of one's relationships to maximize social and emotional gains and minimize risks, illustrates _____.**
    A) age-related memory deficits
    B) socioemotional selectivity theory
    C) Alzheimer's disease
    D) cognitive impairment

18. **The Nursing Home Reform Act concludes that _____.**
    A) residents are always correct
    B) fees should be waived for the indigent
    C) resident services must facilitate the highest well-being
    D) a sliding fee scale is needed

19. **Older people living alone without social support systems, compared to those with strong social supports, have greater likelihood of _____.**
    A) institutionalization
    B) lower personally reported well-being
    C) more difficulty adjusting to widowhood
    D) all of the above

20. **The concepts of increased feelings of satisfaction and positive view of self, with aging, despite hardships, _____.**
    A) rarely occurs
    B) is an unrealistic expectation
    C) are overly dependent upon financial status
    D) seems to be the norm

Please transfer your answers to the Answer Sheet (click the "NCC Answer Sheet" link on Home Page and click your answers).

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