

## **Bio-Physiological Development During Adulthood**

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Defining adulthood, and what the criteria truly is to be able to consider oneself an adult, varies from culture to culture. Biologically, adulthood can also be defined as the period in which full physical and intellectual maturity has been attained. It is a period that is defined slightly differently depending on the source, but it is agreed that it tends to be considered the life period between ages 18 and 60. However, the definition of adulthood can have varying legal and sociocultural factors as well. For example, the legal definition of an adult is a person who has reached the age at which they are considered responsible for their own actions, and therefore legally accountable for them. This is referred to as the age of majority, which is 18 for most cultures, although they can vary from the age of 16 to 21. Sociocultural definitions are based on what a culture normatively views as the criteria for adulthood, which may or may not coincide with the legal definition.

Although this chapter will mainly focus on the biological and physiological development of adults, it is recognized that development occurs in a biopsychosocial environment. This chapter will cover how one's biological systems develop and change over time, and how sociological and psychological factors affect adults, particularly in relation to their changing health status.

### **Biological Markers and System Changes in Adulthood**

Physical development throughout life, including adulthood, first occurs at the biological level. During this life period, a process known as senescence begins. Senescence can be defined as a biologically expected process of deterioration with age, which occurs as a result of the loss

of a cell's power of division and growth. As a result of this process, various organs and their respective systems can begin to experience increased impaired functioning. This degeneration can eventually lead to the breakdown of muscle, bone and joints, and other systems, as well as lead to the development of physical ailments and illnesses.

One of the most notable biological markers of adulthood are the changes that occur to one's sensory modalities. During adulthood, changes to the senses of vision, hearing, touch, and smell, and taste become noticeable. Two of the most common changes that begin in mid-adulthood, for example, include our ability to see close objects and our ability to hear high pitches. During one's 30s and 40s, visual acuity (sharpness of vision) decreases, and many adults will report noticing that they might need to start using glasses soon for tasks such as reading. During this period, adults may also begin to suffer some hearing loss because of damage to the cilia, or hair cells, found in the inner ear.

Another change that an individual might notice as they are getting older is changes in their cognitive abilities and their intelligence. In adulthood, cognitive abilities show some, but not a dramatic, decline overall. Contrary to popular belief, new neurons are able to be formed during adulthood, and they are constantly formed from stem cells in the brain. This process is known as adult neurogenesis. One of the areas that is most active in neurogenesis is the hippocampus, an area involved in memory. Additionally, the adult brain is currently changing and forming new connections throughout adulthood through the process of neuroplasticity. These changes tend to occur in response to one's diet, level of physical activity, social environment, stress, and even toxins. One of the markers influenced by neuroplasticity, as well as by many other factors, is intelligence. Throughout adulthood, it is expected that one's fluid intelligence (or ability to think abstractly and understand novel material), will decline slowly but steadily

throughout adulthood. In other words, the ability to learn new material in younger adults is superior to those of older adults, as is their ability to organize new information based on their content or meaning. However, crystallized intelligence, or the knowledge acquired throughout experience, will actually increase and improve until late in life. Therefore, older adults are equal or superior to younger adults in their ability to retain general information and other accumulated knowledge.

Another component of adult physical development is the concept of growth. Growth is defined as the normal process of an increase in size as a result of accretion of tissues in an organism. In the first two decades of life, growth is considered to be the dominant biological activity. During adulthood, maturation (or the process of attaining a complete state of growth) is thought to successfully occur. Although growth and maturation rates vary on the individual level, individuals tend to follow the same general course overall.

Perhaps one of the most noticeable changes to one's physiological development during adulthood in the context of one's overall lifetime is the maturation of our skeletal system. Across developmental stages, body part proportions advance in a "head to toe" (cephalocaudal) and "midline to periphery" (proximodistal) manner. For example, an infant's head accounts for 25% of recumbent length and the legs will account for 38%, but in an adult, the head accounts for only 15% of adult height and the legs will account for 50% of total height. As body proportions change, so does the capacity to perform different motor tasks. For example, as one's legs increase in length, running speed increases as well. Ultimately, full skeletal length growth is expected to be reached by age 18.

The skeletal mass increases until approximately age 30 or so, and then begins to decrease. This decrease in mass is first noticed in the central skeleton, such as the pelvis and spine,

followed by the peripheral skeleton (such as the fingers and toes). Physical activity can have a positive effect on bone mineral content and density. However, bone tissue, like other tissues, will accommodate to usual daily activities, such as walking. Therefore, resistance-based or impact-based activities with greater than ordinary ground reaction forces (such as skipping or jumping) will have the best results in regard to increasing and maintaining bone mineral content and density.

Muscle represents about 25% of body weight at birth and averages about 40% in adults, although this percentage ranges among different individuals. Muscle mass increases through the mid-twenties, and then gradually decreases. During adulthood, muscle strength and endurance are particularly important to keep track of, as decline in these factors can lead to impaired functional capacity and even physical disability. Muscle strength is defined as the highest force generated during a single maximum voluntary contraction, whereas muscle endurance is the ability to perform repeated muscular contractions and force development over a period of time. Both strength and endurance are correlated especially at higher levels of force production.

As with other body systems, increases in muscle strength are highest between childhood and adolescence, mainly as a result of sex-related hormones. The addition of resistance training can significantly increase their strength above what is expected as a result of normal growth and maturation. In adulthood, maintenance or gains in strength are transient and can go away if one does not consistently engage in resistance training.

The aging process overall eventually leads to a decrease in muscle mass and strength. This developmentally expected process is known as sarcopenia. Sarcopenia is defined as a normal, age-associated, developmental change that is categorized by the degeneration of muscle mass, including both strength and quality. The criteria comprise of low muscle mass, low muscle

strength, and low physical performance. The diagnosis can be made if there is low muscle mass and at least one of the other two criteria are present. Factors that are considered when evaluating for sarcopenia include: a noted decline in function, strength and health status; self-reported mobility-related difficulties; a history of recurrent falls; recent unintentional weight loss of more than five percent of their previous body weight; having been recently hospitalized, and other chronic conditions, such as diabetes, chronic heart failure, COPD, arthritis, and cancer.

The causes of sarcopenia are multifactorial and include genetic heritability, disuse (due to not being physically active), altered hormone function, chronic diseases, inflammation, insulin resistance, and nutritional deficiencies (inadequate protein intake, low caloric intake, insufficient vitamin D). This change occurs even in those considered to be athletes, as physical fitness can decelerate but not stop this developmentally normal change.

This loss of muscle mass is directly connected to loss of strength. One's maximum physical capacity is found to be between years 20 to 30. Pronounced changes occur after age 50 with more than 15% strength loss every 10 years. Some studies have found significant decrease in strength reduced numbers of muscle fibers. If muscle fibers reach a specific minimal size, apoptosis (loss of fibers) begins. Other causes of apoptosis related to the aging process are denervation less neurons, the decrease of muscle protein synthesis, and the decline of anabolic hormones. Reduced hormone levels play a major role in this process. Comorbidity diseases like malignancy, obstructive pulmonary disease, congestive heart failure, inflammatory bowel disease, arthritis also contribute to muscle mass and strength loss. Overall, sarcopenia results in decreased strength, metabolic rate, and aerobic capacity, which, all together, affect one's overall functional capacity. It is also a powerful prediction of late-life disability.

Related to the function of the muscular system is the physical property of flexibility. Flexibility is defined as the intrinsic property of body tissues, such as the muscles and other connective tissues, that determine for the range of motion achievable without injury at a joint or group of joints. Increases in flexibility occur until late adolescence, and tends to decline after age 17. This decline is believed to be a result of both normal aging and a decline in physical activity. For adults in particular, one's flexibility tends to be associated with prevention and relief from lower back pain, prevention of musculoskeletal injury, and improved posture.

Aside from a reduction in lean body mass, another one of the most consistent changes associated with advancing age is an increase in fat mass. Throughout development, fat cells, known as adipocytes, will increase in size (hypertrophy) and number (hyperplasia) to accommodate the storage needs of a growing body. These cells provide storage for fatty acids that are then released when metabolic fuel is needed. They are also involved in endocrine, autocrine, and paracrine actions, and play a key role in regulating functions such blood pressure, energy balance, glucose and lipid metabolism. It is estimated that a newborn infant has approximately 5 billion adipocytes, whereas the average non-obese adult has 50 billion. Additionally, the size of the adipocytes nearly doubles when one reaches adulthood. It is expected for the number of adipocytes to increase throughout childhood and adolescence, plateauing in late adolescence and adulthood. Regardless of this expectation, the number of adipocytes can potentially increase at any age if fat storage mechanisms are stimulated by a chronic energy surfeit. In adults, any decreases in fatness with exercise are due to a reduction in fat cell size, not number. Despite the fact that it is this surfeit that causes the accumulation of fat, it has been shown that physical activity is a better predictor of weight gain or loss than overall

calorie or fat intake. Therefore, it is crucial that regular physical activity is included in order to prevent an energy surfeit and the accumulation of excess adiposity.

Fat distribution refers to the location of fat deposits on the body. Visceral adipose tissue in the abdominal cavity is particularly concerning for adults, as this type of tissue is more metabolically active than adipose tissue in other areas. Adults with higher amounts of visceral adipose tissue have a greater risk of metabolic complications, such as type 2 diabetes and cardiovascular disease. As with other types of adipose tissue, visceral adipose tissue can be reduced with weight loss brought on by exercise.

Lastly, one's cardiorespiratory system is yet another crucial system that undergoes significant changes during adulthood. This system consists of the cardiovascular system (heart and blood vessels), which work with the respiratory system (the lungs and airways). These body systems carry oxygen to the muscles and organs of the body, and remove waste products, including carbon dioxide. Although this system is fully functional by age two, one's full cardiorespiratory capacity is not reached until adolescence, when a peak in growth in all body parts occur.

While an increase in heart size leads to increases in the blood pumped per beat (stroke volume) and liters per minute (cardiac output), an increase in lung size results in greater voluntary ventilation. It is expected that from age 6 to adulthood, maximum voluntary ventilation approximately doubles. As adulthood continues and one ages, however, cardiorespiratory functions do decrease gradually. However, improvements in cardiorespiratory functions can occur with regular vigorous- and moderate- intensity physical activity, as the ability to perform sustained activity under predominantly aerobic conditions depend on the capacity of the cardiovascular and pulmonary systems to deliver oxygenated blood to other tissues. Therefore,

making one's body practice these cardiorespiratory functions under physical stress allows one to maintain the most optimal functioning for that person's age.

### Lifestyle Factors

Unhealthy behavior or lifestyle factors account for approximately 50% of the annual number of deaths in the United States, whereas the other deaths are believed to be due to environmental factors (20%), genetics (20%), and inadequate medical care (10%). Lifestyle behaviors also tend to be partially linked to socioeconomic status, as well as by age, social support, marital status, and the presence of children. While lifestyle factors or behaviors tend to be seen by others as solely attributable to one's personal choices and for failing to accept personal responsibility, it should be understood that these choices are also greatly shaped by our environment. For example, unhealthy lifestyles and behaviors are often used because they are effective at managing stress. Other factors like social norms, availability, price, and legality also play an important role.

Unhealthy lifestyles and behaviors are also commonly associated with mental illness, as mental health problems and adverse experiences in childhood can predict and lead to the adoption of unhealthy lifestyles in adolescence and adulthood. Despite these obstacles, adults should attempt to engage in as many healthy lifestyle behaviors in order to improve their overall health, increase longevity, and improve their functionality even when at a more advanced age.

*Diet:* Diets low in saturated fats and cholesterol are associated with low risks and rates of coronary heart disease. Eating foods higher in healthier fats, such as polyunsaturated and monounsaturated fats decrease the risk of coronary heart disease. One of the diets that is suggested frequently that follows these guidelines is the Mediterranean Diet.

The average American family spends about 40% of their food budget at restaurants and carryout. Food purchased from restaurants, fast food outlets, and vending machines are generally higher in saturated fats, cholesterol, and sodium. They also tend to be lower in fiber and calcium than food that would be prepared at home. Furthermore, people tend to eat larger portions of higher calorie food when they eat out. Following such a dietary pattern can lead to an increased risk of becoming overweight or obese, as well as developing many chronic conditions.

*Physical Activity:* Physical activity has both immediate and long-term physical and psychological health benefits. Physical activity is associated with maintaining greater fat-free mass and lower body fat in one's body. Physical activity may reduce osteoporosis-related fractures by increasing bone mineral, enhancing bone strength, and reducing the risk of falls by improving muscle strength, flexibility, coordination, and balance.

Furthermore, it has beneficial effects for one's cardiovascular functioning, and maintaining active has shown to decrease risk factors for cardiometabolic disease. How significant these benefits are can be influenced by the initial level of body fat, and the duration and regimen of exercise. Walking alone can reduce the risk of coronary heart disease by 30-40%, and further increases in exercise time and intensity can yield even greater reduction in risk

Ongoing participation in physical activity throughout life to maintain the adaptations that your body makes and underlie these benefits. However, due to biological processes that make it harder for us to maintain peak physical fitness, as well as social factors that lead to a decline in participating in physical fitness as one ages, one's corresponding physical fitness begins to decline over time. Currently, only 11 percent of US adults report engaging in physical activity for 20 min or longer more than twice a week. Aside from losing the physical benefits that were listed previously, withdrawal of physical activity can also result in psychological distress, such

as experiencing irritability, restlessness, nervousness, and frustration. This is believed to be partially due to a drop in endorphin levels.

Although more studies are needed to understand exactly how exercise impacts neurological pathways related to one's psychological well-being, studies done using animals such as rats indicate that exercise leads to immunological, neural, and cellular changes that can mitigate consequences that one could experience when presented with acute stress. A recent study with children demonstrated that those who were physically more active produced less cortisol in response to stress, suggesting that physical activity can promote mental health by regulating hormones related to stress. These findings are believed to also apply to adults. Aside from the biological effects of exercise, physical exercise can provide one with benefits through purely psychological mechanisms, such as providing distraction from negative stimuli, increasing one's self efficacy, and increasing positive interactions with other individuals engaged in a group exercise is also more

The *combination of inactivity and an unhealthy diet* has been marked as the second leading factor contributing to mortality in the United States. A sedentary lifestyle has been linked to 23% of deaths from chronic diseases, as it has been linked with four of the ten leading causes of death: coronary heart disease, stroke, some forms of cancer, and non-insulin dependent diabetes mellitus. Additionally, this combination has led to an increase in overweight and obese individuals. Overweight is defined as having a body mass index (BMI) of 25 to 30, while Obesity is defined as having a BMI greater than 30. Because full skeletal and muscular growth is reached by adulthood, any additional weight gain tends to be through the addition of fat. Lack of weight gain also does not necessarily mean an absence of gaining fat. At adulthood, it can also mean that one's muscle mass is redistributed to fat, generally in one's abdomen.

*Alcohol Use:* Light to moderate alcohol consumption (one drink a day for women and two drinks a day for men) has been shown to have positive effects on overall health, especially among people at greater risk for heart attacks, including men over age 45 and women after menopause. Ethanol has been shown in short-term experimental studies to increase the serum concentrations of high density lipoprotein cholesterol, and it also appears to affect platelet function and other components of clotting. The difference in these recommendations for men and women are because women metabolize alcohol less efficiently than men do and because women have less body water than men making them prone to intoxication.

Research shows that there is a U-shaped relationship between the amount of alcohol consumption recommended and health impact. Long-term excessive drinking increases risk for high blood pressure, irregularities of heart rhythm, disorders of the heart muscle, and stroke, as well as increase the risk of developing cancers of the esophagus, mouth, throat, and voice box and of the colon and rectum. Sustained heavy drinking worsens the outcome for patients with hepatitis C and increases the risk of cirrhosis and other liver disorders. Cirrhosis is one of the 10 leading causes of death in the United States. However, not drinking any alcohol also appears to have negative health effects, as mortality rates are higher for nondrinkers in comparison to those who moderately drink. Heavy drinkers have an increased mortality risk in comparison to both moderate and non-drinkers.

*Smoking:* Smoking causes cancers of the lung, larynx, esophagus, pharynx, mouth, and bladder. Tobacco use is the leading contributor to lung cancer incidences. Additionally, it has been found to contribute to cancers of the pancreas, kidney, and cervix. Smoking also causes other lung diseases, such as chronic bronchitis and chronic obstructive pulmonary disease.

According to the U.S. Department of Health and Human Services, cigarette-smoking is the major cause of preventable mortality in the United States, as it accounts for more than 400,000 deaths among adults. Smoking is linked to the two leading causes of death in the United States: heart disease and cancer. The burden of disease and death contributed to tobacco in many developed countries was substantially higher than what is attributable to any other risk factor, including alcohol use, unsafe sex, hypertension, and physical inactivity.

Smoking can also lead to medical complications for pregnant women. Complications associated with maternal smoking include premature detachment of the placenta, bleeding during pregnancy, premature membrane rupture, and development of the placenta in the lower uterine segment, which can lead to hemorrhaging in the last trimester. Smoking can additionally lead to spontaneous abortions. However, if a woman is able to stop smoking within the first 3-4 months of pregnancy, most of the negative effects will not accumulate and their infants will have equivalent birthweights to those infants whose mothers did not smoke during their pregnancy.

Smoking is a particularly dangerous lifestyle factor because nonsmoking people can still experience adverse consequences even if they do not smoke themselves. Among adults, second-hand smoke has been linked to increased risk of heart disease. Studies have also shown that approximately 88 percent of nonsmokers still had detectable serum cotinine, which is a biological marker indicative of exposure to second-hand smoke.

Given how addictive nicotine is and the fact that damage caused by smoking is cumulative, the ideal strategy to deal with this risk factor would be emphasizing prevention rather than cessation. However, smoking cessation should be emphasized and encouraged even to those that have been smoking for a long time. It has been found that, on average, people who quit smoking before age 50 reduce their risk of dying before the age of 65 than those who do not

quit before this time. Additionally, if adults were to stop and refraining from smoking, it could lead to the prevention of most lung cancer cases. Lung cancer cases account for 28% of all cancer cases.

*Sexual Behaviors:* Approximately 16.9% of US adults aged 18 to 59 have had a sexually transmitted infection. This number increases dramatically with the number of sex partners that one has. Because most sexually transmitted infections are asymptomatic, or produce very mild symptoms they often are disregarded so infected persons do not seek immediate medical care.

For example, about 85% of women about 50% of men with chlamydia had no visible symptoms. Several sexually transmitted viral infections are known or strongly suspected to cause cancer. The most important of these are the sexually transmitted types of human papilloma virus. At least 90% of the approximately 16,000 cases of cervical cancer diagnosed each year estimated to be attributable to infection with human papilloma virus.

Overall, the more of these negative health factors one engages in, the likelihood that one will die younger increases. Studies have shown that those who had an unhealthy diet, smoked, drank more or less than recommended, and did not engage in physical activity had approximately one quarter the mortality risk of those who engaged in practically none of these factors. In other words, such a difference is the equivalent of a 14 year difference in chronological age due to these lifestyle factors. The presence of these factors was found to most strongly affect the possibility of death from cardiovascular diseases, but effects are also apparent for deaths related to cancer and other causes, such as diabetes-related complications.

#### Health Status and Disorders in Adulthood

Health is a multi-dimensional concept encompassing the physical and psychological health outcomes, such as the diagnosis of various diseases, presence of symptoms, activity

limitations (functional health), distress, and the subjective appraisal of one's health. As one ages, immune system functioning decreases, leading to greater occurrences of infection the older one becomes. Aging also changes how the immune system reacts to infections, making new infections harder to detect and attack, and making it easier for it to become compromised. It is important to note that many chronic health conditions experienced by adults have their origins in childhood and adolescence, as both biological (e.g. adiposity) and behavioral (e.g. engaging in physical activity) risk factors tend to follow one from childhood into adulthood. It has been shown, for example, that childhood BMI is related to adult BMI, and that approximately 80 percent of obese adolescents become obese adults. In this section, some of the most common diseases and syndromes will be discussed.

*Metabolic Syndrome.* According to the National Cholesterol Education Program, metabolic syndrome is defined as exceeding thresholds on three of the five following components: waist circumference, blood pressure (system or diastolic), blood lipids (high-density lipoprotein and triglycerides), and blood glucose levels. These guidelines provide a useful index of risk for conditions related to overall body-fat percentage.

In adults, it has been shown that even a loss of five to ten percent of body weight through calorie restriction and exercise has been shown to reduce the risk of cardiometabolic diseases, such as diabetes. Even without reaching a significant amount of weight loss, the inclusion of exercise alone can have significant effects in adults by improving one's glucose metabolism, improving lipids and lipoprotein profiles, and lowering blood pressure. For adults that are considered to be health and not having reached levels that meet criteria for metabolic syndrome, higher levels of physical activity lead to a slower progression towards metabolic activity. While both diet and exercise have effects on fat loss, only exercise has a direct effect on metabolic

health through its ability to increase muscle mass. Physical activity has also been shown to reduce inflammation, which is a significant feature of both metabolic syndrome and cardiometabolic diseases in general.

*Cardiovascular Diseases:* These are conditions that involve narrowed or blocked blood vessels that can lead to a heart attack, chest pain (angina) or stroke. Other heart conditions, such as those that affect your heart's muscle, valves or rhythm, also are considered forms of heart disease. In overweight adults, cardiac failure develops as a consequence of the increased demand on the heart to supply blood to the increased body fat. Overweight women, for example, experience a two-fold increase in coronary heart disease, whereas obese women experience a 3.6 increase. Additionally, an 11- to 22-pound increase from their weight at age 18 will lead to a 1.5 to 2-fold increase in developing coronary heart disease.

The US preventative services task force recommend screening for hypertension for all children and adults. The prevalence of hypertension increases with age, and it is more common in African-Americans than whites, it is estimated that 40 to 50 million Americans have hypertension. A simple blood pressure cuff is the most appropriate way to screen for hypertension in general population, including adults. When hypertension is properly treated survival can increase one's survival from near 0 to 75% improved detection and treatment of high blood pressure in adults is responsible for a substantial portion of greater than 50% reduction age-adjusted stroke mortality.

It is recommended that blood pressure be measured at least once every two years for adults with a diastolic blood pressure below 85 in a systolic pressure below 130. More frequent testing is recommended for persons with higher measures or those that are older. Additionally,

elevated blood cholesterol is another major modifiable risk factor for cardiovascular disease. Therefore, it is recommended that screening for high blood cholesterol is done every five years.

*Osteoporosis:* Medical condition in which the bones become brittle and fragile from loss of tissue. This typically occurs as a result of hormonal changes, or deficiency of calcium or vitamin D. Although most young children meet the dietary requirements for calcium, the intake of calcium tends to decline with age. In part as a consequence of inadequate calcium in the diet, osteoporosis is affecting more than 25 million people in the United States alone. It is the principal cause bone fractures in postmenopausal women and the elderly. Physical activity, such as strength training, has been shown to help postmenopausal women preserve bone density.

*Osteoarthritis:* The most common form of arthritis. It is the leading cause of activity limitation among adults. Although some competitive athletic activities are associated with increased risk of osteoarthritis in specific joints, regular noncompetitive physical activity tends to not be harmful to join these might actually relieve symptoms from functioning among persons with already had osteoarthritis and rheumatoid arthritis.

*Cancer,* or diseases caused by an uncontrolled division of abnormal cells in a part of the body, have been shown to begin or increase in rate of occurrence in adults over the age of 50. This is believed to be due to a declining immune system. Although there are many types of cancers that affect adults, some of the most common ones are breast, prostate, and colorectal cancers.

*Breast Cancer:* It is expected that 268,670 new cases of breast cancer will occur in the United States in 2018. This makes up the second leading cause of cancer deaths among American women, after lung cancer. Incidence rates continue to increase as one ages. Although annual screenings happen recommended by some, data reveals little evidence that screening

every year provides a greater benefit than screening every two years. One of the most preventable or controllable risk factors associated with breast cancer is obesity. Women found to be in the top 75 percent of BMI tend to show a four-fold greater risk for post-menopausal cancer. Increased physical activity has also been hypothesized to prevent breast cancer by reducing lifetime exposure to circulating ovarian hormones.

*Prostate Cancer:* Each year about 245,000 men are diagnosed with prostate cancer and 40,000 die. Prostate cancer is the most common non-skin cancer among American men. The prostate-specific-antigen, or PSA, test is the principal screening test for prostate cancer. After lung cancer, prostate cancer accounts for more cancer deaths in men than any other. American Cancer Society does recommend yearly PSA testing beginning at age 50 for white men age 40 for African-American men in whom risk of this disease is higher.

*Colorectal Cancer:* The second most common form of cancer in the United States after lung cancer. Screening for colorectal cancer is recommended by a variety of groups for all persons aged 50 years and older. For persons with a family history of colorectal cancer, screening is recommended to begin at an earlier age, particularly if a family member was diagnosed with colorectal cancer at a young age. Screening for early stages of this cancer as well as its precursor nations adjust polyps can significantly reduce morbidity and mortality associated with colorectal cancer. Incidences related to colon cancer in adults have been also linked to physical inactivity. It is hypothesized that this is due to physical activity increasing intestinal motility and decreasing transit time and the duration of contact between colon mucosa and potential carcinogens. Diet can also be a risk factor in the development of colon cancer, as diets low in folate increase the possibility of developing such a cancer.

Gender and Ethnic Health Differences

Although all the health factors and diseases described can occur in any adult individual, it has been shown that each one can affect those of different genders or races/ethnicities in an unequal manner. Since gender and ethnicity are both influenced by biological and social differences, it is likely that health inequalities between individuals belonging in different groups are reflective of an interaction between these two factors.

It has been found that women tend to experience poorer health than men. Overall, women have higher rates of mortality, yet they also report higher levels of chronic disorders, distress, and psychiatric disorders. However, the pattern of gender differences in health is varied and will also change based on symptoms and the specific phase of life cycle being looked at. There are two main hypotheses that attempt to explain why these differences are observed. These are known as the differential exposure hypothesis and the differential vulnerability hypothesis.

*Differential Exposure Hypothesis:* Men and women are differentially and unequally exposed to different determinants of health. Women tend to report higher levels of health problems because of their reduced access to the material and social conditions of life that foster health. One of the ways in which men and women are *unequally exposed* to health-related factors is through employment inequality. Women are more likely to be unemployed or receive lower incomes for comparable employment, leading to less access to proper preventative and treatment-focused medical care. Also, women are more likely to carry a “double day”, meaning that they will work full- or part-time outside of the home and then have to work in the home doing domestic labor and caring for their family members. These and other factors can additionally lead to women becoming exposed to greater chronic stress associated to gender and marital roles, lower levels of perceived control, and lower levels of self-esteem, which can further impact one’s physical and mental health.

Men and women also tend to differ in the lifestyle behaviors that they are exposed to. Men are more likely than women to engage in risk behaviors such as smoking, consuming alcohol, and having an unbalanced diet. On average, 27% of men in the United States smoke in comparison from 22% of women. Women are more likely to be physically inactive, as they are not as encouraged to engage in physical activities during their leisure time. Findings have shown that the effects of being overweight and physically inactive are more significant for women and lead to poorer health outcomes. It is important to note that even when the opposite gender is exposed to factors that tend to disproportionately affect the other gender more, differential vulnerabilities to social forces remain. Therefore, it is important to additionally understand and explore a second hypothesis.

*Differential Vulnerability Hypothesis:* Men and women are different in how vulnerable and more easily impacted they are by a specific factor. Women report higher level of health problems because they react differently than men to the material, behavioral, and psychosocial conditions that foster health. Stress, for example, is one factor that has adverse effects to one's physical and psychological health. However, stress is experienced differently by men and women. Women seem to be more affected by social life stress, child-related stress, family health stress and environmental stress. For example, single women who live alone are more likely to have health problems, whereas men are less likely to experience chronic health problems when living alone. Adult women that still live with their family of birth tend to have poorer scores on measures of health. Women who care for a family, but also have a job outside the home, are actually less likely to have a chronic illness than those who solely take care of their families at home.

This effect is believed to be due to the social support they receive from others in their jobs outside of the home. Also, women are more likely to have experienced more stressful events and childhood trauma, and the impact suffered from these events and the accumulation of these chronic stressors are generally more severe for women. Men, on the other hand, are more likely to react to economic stressors. For example, retired men tend to have higher incidences of chronic illness than those of the same age that are still working. Of course, there are stressors which impact both genders fairly equally. Going to school and attempting to get a degree is equally associated with greater odds of chronic illness for both men and women.

As far as ethnic group differences are concerned, research has found that racial and ethnic groups in the United States are unequally impacted by factors that affect their overall health and that make them differentially susceptible to different diseases. The United States is relatively unusual in comparison to other industrialized countries in that it reports the health status of its population based on race, whereas other countries tend to focus on social class differences. Findings reveal that race and ethnicity are, in fact, potent predictors of variations in health status.

Historically, differences in racial health factors have been focused on biological and genetic differences among races. However, scientific evidence that this type of classification system is flawed, as races tend to be more alike than different in terms of their genetics, and no specific scientific criteria has been found that objectively distinguish different racial groups. Even diseases that have a clear genetic component account for only a tiny part of racial disparities in health. For example, sickle cell anemia is a disease that tends to be more prominent in African American individuals, yet deaths related to this disease account for only three-tenths of one percent of the total number of excess deaths in the black population.

Many studies have focused on the contrast between African-Americans and Caucasian individuals. However, since the 1970s, research has focused on exploring differences among this country's increasingly diverse racial populations. Currently, the US government requires all federal statistical reporting agencies to recognize the following racial and ethnic groups: American Indian or Alaskan Native, Asian or Pacific Islander, black, white, and Hispanic, or by the alternate names, such as Native American, Latino, and African American.

When looking at health patterns in the Asian Pacific American or Islander racial group, it has been found that Native Hawaiians have the highest cancer rates and highest heart-disease related deaths out of any racial group in the United States. Native Hawaiians and Samoans also tend to have higher rates of obesity and diabetes.

Death rates for Native Americans tend to be high particularly for adults under the age of 45, and young American Indian adults are two to four times more likely to complete suicide. Native American adults also show higher levels of alcohol and other drug use in comparison to other racial groups. American Indians and Alaska natives are the most likely to smoke (34%), whereas Hispanics, Asians, and Pacific Islanders are less likely to smoke in comparison to other ethnic groups (16%). African American and Caucasians tend to find themselves in the middle, at 26% and 25% respectively. Japanese Americans tend to have high rates of stomach cancer, and Chinese American's have an incidence of liver cancer that is four times higher than those of the white population.

Hispanics, or Latinos, are yet another group that has been more frequently included in health-related research. While Latinos have lower death rates for heart disease and cancer (the two leading causes of death) than non-Latinos, they also have higher rates of tuberculosis, septicemia, chronic liver disease (such as cirrhosis), diabetes, and homicide. Hispanics also tend

to have elevated rates of infectious diseases such as measles, rubella, tetanus, tuberculosis, syphilis, and AIDS. Obesity and glucose intolerance are also higher in Hispanics, especially among Mexican Americans. Within the Hispanic group itself, it has been found that mortality rates for adult Puerto Ricans are higher than any other Hispanic groups.

When looking at discrepant health patterns between African Americans and whites, one of the major differences noted is the rates of smoking and consequent lung cancer between these groups. Cigarette smoking is responsible for more than one in six deaths annually in the United States, over 430,000 deaths a year. Although African Americans start smoking later in their life and smoke fewer cigarettes a day, they are more adversely affected by the effects of smoking and have a higher rate of lung cancer in comparison to whites. One factor that is believed to account for this difference is that African Americans tend to smoke cigarettes that have higher tar content than those smoked by whites, and are also more likely to smoke nonfilter cigarettes.

Considering that different ethnic groups and unequally represented among different socioeconomic groups, it is important to understand the effect on how socioeconomic status (SES) affects health. Findings show that SES is a pervasive predictor of variations in health outcomes. Low SES individuals, for example, are more likely to be employed in occupational settings where there is an elevated risk of exposure to toxic substances and bad working conditions, such as having daily contact with poisons, dust, smoke, acid, explosives, and more. These findings have been observed in all countries around the world in which this phenomenon has been studied. Overall, it has been found that higher levels of income and education are associated with lower levels of mortality. There are two hypotheses which attempt to explain the direction of causality between SES and health.

*Selection (or Drift) Hypothesis.* An individual's poor health is the cause of their current SES. However, the social causation theory views the elevated rates of illness among low SES as a consequence of their low SES. Although it is extremely difficult to figure out the direction of causality between these factors, current research suggests that, although a decrease in one's SES can occur due to decreasing health, this tends to make only a minor contribution to observed SES differences in health.

*Social Causation Hypothesis.* Being in a lower social class is a contributor to the development of poorer physical and mental health. Different SES groups vary in the accessibility, utilization, and quality of care received by the individuals that make up that group, and will therefore be affected negatively.

Findings have shown that black and Hispanic individuals have been experiencing worsening health among a number of health status indicators. This widening in racial health disparities appears to be connected to the widening economic inequality among these groups. Between the periods of 1980 to 1991, the gap in life expectancy between blacks and whites has widened from 6.9 years to 8.3 years for males and from 5.6 years to 5.8 years for females. Socioeconomic differences between racial groups are largely responsible for the observed racial health patterns. For example, while approximately 11 percent of the white population are poor, approximately 33 percent of African Americans and 29 percent of Hispanics are poor. A widening difference for rates of sexually transmitted diseases between African Americans and whites has also been evident. For example, the rates for gonorrhea and syphilis has decreased by 50 percent and 11 percent respectively for whites. For African Americans, the rates for gonorrhea has declined by only 11 percent, while syphilis has actually increased by 100 percent. It is hypothesized that this increase might be associated with African Americans being

disproportionally exposed to neighborhoods in which the use of drugs and the presence of prostitution is more prevalent.

Additionally, racial and ethnic differences in the use of medical care is another major factor that impacts these differing health rates. The inadequate use of medical care, especially preventative medical care, is a prominent issue among racial and ethnic minorities. It has been found that deaths due to causes that could have been treated with proper medical treatment accounted for one-third of the excess total death rates of black individuals relative to those of white individuals. In other words, minorities will have mortality rates related from later diagnosis of a disease, comorbidities, and other gaps in the quality of care.

Evidence suggests that early life socioeconomic and health conditions have long term consequences for an adult's health status. For example, living in a crowded household can increase one's risk for infections, such as streptococcal infections and acute rheumatic fever, which can later become factors for heart disease later in life. Infection can also play a role in growth retardation, and malnutrition adversely affects one's immune system. The risk factors just mentioned tend to be most common among minority individuals that are disproportionately represented among the lowest SES categories.

Despite these prevalent differences in SES, it has been found that adjusting for SES only reduces, but does not eliminate racial health disparities. Another factor that is considered to affect racial health disparities is racism experienced in the healthcare field and in their social environment. Racism is conceptualized as incorporating ideologies of superiority, negative attitudes and beliefs, towards racial and ethnic outgroups, and differential treatment of individuals that make up those groups by other individuals and societal institutions. For example, despite having the same degree, college-educated blacks are almost four times more likely to be

unemployed than their white counterparts. Racism can also restrict access to the quantity and quality of health-related services such as public education, healthcare, housing, and recreational facilities based on the neighborhood in which minorities tend to live in.

Race was also the strongest predictor of the location of hazardous waste sites in the United States. This phenomenon, known as residential segregation, has been found to have a positive association with mortality rates. Also, experiencing chronic racial discrimination can lead to psychological distress that may adversely affect physical and mental health. For example, it has been found that obesity and high blood pressure rates tend to be absent in childhood but emerges in early adulthood. This pattern is hypothesized to reflect an accumulative effect of exposure to environmental adverse living conditions and other environmental assaults.

Furthermore, health disparities have been observed not only between different racial and ethnic groups, but also between the same group but with different levels of acculturation. The effect of acculturation has been found to be significant due to examples such as the finding that foreign-born Hispanics tend to have a better health profile than do their counterparts born in the United States. As the length of stay in the United States begins to increase, so do the rates of cancer, high blood pressure, and psychiatric disorders.

This pattern has also been seen in other racial groups, as Asian individuals such as the Chinese and Japanese demonstrate increased rates of prostate and colon cancer when they migrate to the United States. While the relationship between acculturation and worsening health outcomes is not clearly defined, it is believed that the transition to a new culture can lead to adverse health consequences. Also, as individuals migrate to a new country, they might adopt the diet and behavior patterns of that culture. Overall, acculturated individuals tend to evidence a decrease in fiber consumption and an increase in alcohol, cigarette, and illegal drug use.

It should be noted that research related to race health disparities have serious flaws, and any results presented should be interpreted with caution. One issue that has been studied is discrepancies in self-reported race in different periods of time. A study that looked at a large national population found that about one-third of the US population reported a different racial or ethnic status one year after their initial interview.

Additionally, when studies included both self-reported and interviewer-observed races, there was a very significant discrepancy between the two categories given to the same individual. Given that racial status on health documentation, such as death certificates, are typically based on observer identification, race-based mortality rates might not be accurate. Furthermore, the fact that the current racial categories (such as Latino, Asian Pacific Islander, or Native American) are so heterogeneous and diverse might also affect the reporting of accurate disease presence and risk factors for individuals categorized by these labels.

#### Male and Female Reproductive Changes in Adulthood

During the stages of early and middle adulthood, both men and women experience gradual declines in fertility. Most men never completely lose their fertility, but they do experience a gradual decrease in testosterone levels, sperm count, and speed of erection and ejaculation. Several studies have shown that testosterone levels start to decline at age 30 and continue to decline each decade after at approximately 1-2% per year. Studies have shown that approximately 49% of men aged 40 to 49 and 70% of men aged 70 and older have subnormal levels of testosterone. This decline occurs in even extremely healthy men, but the rate of decline does tend to be more rapid in individuals suffering from health complications or illnesses.

Just as women tend to demonstrate physical symptoms as their available hormones decrease, men, too, appear to have their own set of symptoms known as “climacteric” symptoms. These

symptoms include impairments in potency and libido, hot flashes, headaches, vague pains, numbness, tingling, and obesity. Men also appear to experience psychological symptoms such as nervousness, irritability, fatigue, depression, and decreased memory. In order to assess for the presence of these symptoms prior to performing any physical laboratory work, the ADAM questionnaire can be used. This questionnaire is made up of 10 items that are meant to measure factors that could indicate low testosterone.

Despite changes in testosterone levels, male fertility levels tend to stay relatively preserved. Although, sperm motility does decrease, the overall concentration of sperm tends to stay unchanged. Therefore, men still have the ability to fertilize a female egg especially if they use methods that do not depend on the sperm mobilizing by itself, such as via in vitro fertilization. However, with increased age does come the risk of any resulting children inheriting autosomal dominant diseases.

Changes in the female reproductive system during adulthood, however, are quite different and much more final, as females do eventually reach a biological point in which they cease to be able to further reproduce (menopause). Prior to reaching that point, there is first a gradual decrease in the production of the female hormones estrogen and progesterone. These hormones are responsible for the production and release of eggs into the uterus. This gradual decline generally lasts for an average of 3 to 4 years and will begin during the fourth decade of life, but it may start as early as age 35 or as late as age 53. As one becomes closer to reaching menopause, symptoms such as hot flashes, insomnia, and mood swings may occur. Additionally, one's menstrual cycles will become increasingly irregular as menopause is closer. These changes prior to menopause are often referred to as perimenopause. Eventually, women experiences

menopause, which tends to occur at around age 50. Menopause is considered to be reached once a woman's menstrual cycle has stopped for 12 consecutive months.

Although most of the perimenopausal symptoms will stop once menopause is reached, hot flashes might still be experienced by women even after reaching menopause. Studies show that up to 93% of women will still experience hot flashes in the first two years of menopause. Hot flashes might still persist in 25% to 75% of women in the first five years of menopause, and a small percentage of women report that they continue to experience them even as late as 30 to 40 years after menopause started.

Aside from the primary symptoms experienced by women due to menopause, there are many secondary symptoms that affect women due to changes in their reproductive system. One condition that women are primarily susceptible to post-menopause is osteoporosis. While this condition can affect both men and women, post-menopausal women are particularly susceptible to osteoporosis due to the combination of low peak bone mass and the loss of estrogen. On average, women will lose about one-third of their bone mineral density post-menopause.

Urinary incontinence and urinary tract infections (UTIs) are other conditions that affect women due to age-related changes to their reproductive system. It is estimated that 10% to 30% of women between the ages of 50 and 64 suffer from urinary incontinence, in comparison to only 1.5% to 5% of men. Regarding the higher rates of UTIs, it is thought that changes in the vaginal pH brought on by hormonal changes make the vagina more susceptible to overgrowth of specific bacteria, such as *Escherichia coli*. Estrogen replacement in the form of estrogen vaginal creams have been shown to lower overall vaginal pH and prevent urinary tract infections.

Summary

In this chapter, we have attempted to provide the reader with an overview of how one's bio-physiological development changes throughout adulthood. Although the most dramatic and significant changes occur prior and after this period of time during childhood, adolescence, and old age, adulthood is still a significant period in our development that warrants to be understood and studied. While adults tend to follow a general pattern of development and change, this chapter highlighted the differences that adults of different genders, races, ethnicities, and socioeconomic standings face. While a decline in overall function is normal and to be expected, there are many lifestyle and health choices that one can make in order to maintain and improve a functional and fulfilling quality of life.

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