

Adolescence: Bio-Physiological Development

Theresa C. Allen, PhD, LPC, NCC

Liberty University

“When I was ten, I read fairy tales in secret and would have been ashamed if I had been found doing so. Now that I am fifty I read them openly. When I became a man I put away childish things, including the fear of childishness and the desire to be very grown up.” ~ C.S. Lewis

The Wonder Years was a television comedy-drama that aired for six seasons from 1988 to 1993. It was a series on the *coming of age*...life through the eyes of an adolescent boy, Kevin Arnold, living in the late 1960's - early 70's. From surviving the indignities of the junior high gym locker room, to discovering the joys of the opposite sex, to struggling to cut parental apron strings, a nation watched Kevin Arnold try to navigate the ever-changing waters of puberty, friendships, love and lust, and the uncertainty of tumultuous social times while trying to forge a sense of self and wellbeing. The television program offered its audience an up close and personal view on the changes that occur in the mental, physical, and social constructs of a maturing adolescent.

Adolescence is, indeed, a developmental period of *wonderment*, consisting of growth and maturation that moves an individual from “a caregiver-dependent child to a fully autonomous adult” (Paus, 2005, p. 60). Developing one’s personal identity, ideals, and relationships are the top priorities in the adolescent stage of growth (Erikson, 1950; Evans, 2006; Waldinger et al., 2002). Erikson (1968) described the adolescent years of 12 to 18-years old as “Identity vs. Role Confusion.” In this stage, an individual explores new experiences and social interactions in order to answer the question, “*Who am I?*” (Erikson, 1980). Erikson postulated that it is during

this stage that an individual must struggle and negotiate with social interactions to develop his/her own identity, including a personal sense of morality and knowing right from wrong, and increased autonomy from parents or caregivers. Failure to successfully navigate this stage leads to role confusion or a lack of personal cohesiveness and uncertainty about self (Erikson, 1980).

In this stage, peer relationships gain importance. While parents are not discarded as attachment figures, teens do begin to transfer attachment from mom and dad to peers and later to romantic partners (Myrick, Green, & Crenshaw, 2014). The adolescent will often have one self for peers and another self for parents in an attempt to manage his/her expanding social roles. Secure parent-child attachments encourage adolescents to move beyond the parental relationship and seek intimacy with others (Myrick, Green, & Crenshaw, 2014). Subsequently, the adolescent seeks to find a coherent sense of self as an individual, a sense of self in relationship to others outside of the family unit, and a sense of self in relationship to parents (Fulgini & Eccles, 1993; Waldinger et al., 2002). A successful end to this developmental stage will result in the emergence of a unified, harmonious person. In fact, Allen, Hauser, Bell, and O'Connor (1994) identify a state of "autonomous-relatedness" that is achieved upon the successful integration of developing a stable sense of self and developing intimate and satisfying relationships with others (Waldinger et al., 2002). Important to note is the fact that teens with insecure attachment styles are likely to experience difficulty in forming intimate relationships with others. Relatedly, research has demonstrated a link between insecure attachment styles and partner abuse in teen and young adult romantic relationships (Myrick, Green, & Crenshaw, 2014).

Adolescence is also a time when relationship schemas – *or a template for wishes and expectations in relationships* – are being forged (Waldinger et al, 2002: Baldwin, 1992). These schemas typically consist of a representation of self, a representation of the other person, and a

script of expected dialogue and behavior patterns within the relationship (Waldinger et al, 2002). Schemas form when a person repeatedly experiences specific patterns of relating to others early in life (Thorne and Klohnen, 1993; Baldwin, 1992). Subsequently, empirical research demonstrates that once these schemas are formed, they are slow to change and can have lifelong consequences (Waldinger et al, 2002; Thorne and Klohnen, 1993; Baldwin, 1992).

There are many facets to adolescent maturation as briefly identified in this introduction. This chapter, however, will focus specifically on the biological and physiological development of the adolescent. It is changes occurring in the body, both internally and externally, during adolescence that instigate the changes in the cognitions, emotions, and social constructs of an individual. Therefore, it is critical to have a foundational understanding of the mechanisms of maturation.

This chapter will discuss physical maturation. This includes defining growth, maturation, and development and describing the three phases of linear growth: infantile, childhood, and pubertal. It will examine puberty and the sexual development of adolescent girls and boys. Next, the chapter will expound upon the implications of early or late maturation and what affects it has on young adults. Then, it will examine the role of nutrition and physical fitness for the overall health and wellbeing of the adolescent, including the impact of obesity and malnutrition on the pubertal process. Lastly, the chapter will conclude with suggestions for further reading on adolescent maturation.

Physical Maturation

Adolescence is a time when a child's body is undergoing physical changes that transition into a mature body that is capable of sexual reproduction. Many cultures recognize this rite of passage with celebrations and traditional events, such as cotillions or bar mitzvahs or acts of

strength and endurance, to symbolize the ending of childhood and the beginning of adulthood (Feldman, 2008). No matter the culture, however, the adolescent stage typically begins in the preteens, around ages 11-12 years old, and ends in the late teens, around ages 17 to 18 years old (Feldman, 2008; Jaffe, 1998). It is a time when individuals are no longer children, yet they have not fully transitioned into adulthood. Subsequently, individuals in this “tween” period often experience increased moodiness, a desire to challenge parental boundaries, and internal distress over no longer wanting to be seen as a child but lacking the necessary capacity to think or behave as an adult (Feldman, 2008; Jaffe, 1998).

The terms growth, maturation, and development are often used interchangeably when discussing this period of transformation. However, each refers to its own specific process (Malina, 2014). These three processes coexist throughout the adolescent stage, albeit the timing of reaching milestones, the rate of changes, and the acquisition of skills may vary considerably from person to person (Malina, 2014; Rosen, 2004).

Growth

Growth “refers to the increase in the size of the body as a whole and of its parts (Malina, 2014, p. 157). It manifests in three categories: “incremental (height), hypertrophic (body composition), and reparative (from physical work or training or recovery from injury)” (Fuqua & Rogol, 2013, p. 245). Weight gain and linear growth – *or incremental growth that increases with age* -- serve as indicators that the general health of the individual is good (Fuqua & Rogol, 2013; Rosen, 2004). Linear growth occurs in three phases: infantile, childhood, and pubertal (Fuqua & Rogol, 2013; Rosen, 2004).

Infantile phase. The infantile phase consists of a period of rapid growth during the first two years of life whereby children grow toward their genetic potential (Fuqua & Rogol, 2013). In the

United States, children grow to around three feet tall by the age of two years old, which is approximately half the height of the average adult (Feldman, 2008). Additionally, they typically weigh between 25-30 pounds.

There are four principles of growth at work during this phase (Feldman, 2008). The first is the *cephalocaudal principle* or the “*head to tail*” direction of growth. Cephalocaudal states that growth begins at the head and upper body and then proceeds to the remainder of the body. This explains the disproportionate size of the infant’s head at birth to the rest of his body as well as his development of visual abilities before developing the ability to walk (Feldman, 2008).

The second principle is the *proximodistal principle*. It states that growth starts at the center of the body and moves outward. Therefore, the trunk of the body grows before the arms and legs, and the arms and legs grow before the fingers and toes (Feldman, 2008; Loria, 1980). This principle also applies to the development of motor skills. For instance, the infant learns to use his arms before he learns to use his hands (Feldman, 2008; Loria, 1980).

The third principle of growth is the *principle of hierarchical integration*. It states that simple skills develop independently and then integrate into more complex skills. For instance, the infant learns to move his fingers before he can master grasping an object (Feldman, 2008).

The fourth principle is the *principle of the independence of systems*. It states that different body systems grow at different rates and at different times (Feldman, 2008). In other words, growth in the skeletal system does not require or imply growth in other body systems and so forth.

Childhood phase. The childhood phase consists of a steady growth rate of approximately 5-7cm each year (Fuqua & Rogol, 2013). The average height of a six-year-old is 46 inches, and the average height of an 11-year-old is 4’10 for girls and 4’9½ for boys (Feldman, 2008). That

is a growth rate of 2 to 3 inches per year. Although these are general statistics, children do vary individually in weight and height. There are many variables that may impact growth in childhood, including genetics (Paternoster et al., 2011; Smith et al., 1976), hormones and proteins (Human Growth Foundation, 2015; Fuqua & Rogol, 2013), disease (Gasparetto & Guariso, 2014; Human Growth Foundation, 2015), and environment (Fuqua & Rogol, 2013). Research suggests that even economic factors may play a role in growth rate and that children from lower poverty level homes are smaller overall than children from more affluent homes (Feldman, 2008).

Pubertal phase. The pubertal phase is another period of rapid growth. The typical growth rate during this time spurts to 8-14cm each year (Fuqua & Rogol, 2013; Feldman, 2008; Jaffe, 1998). Again, this rate is impacted by internal and external variables in each individual's life. Young people in this phase may be susceptible to an imbalance in their nutritional intake and their energy expenditure. Therefore, maintaining a healthy diet during this phase of growth is imperative to healthy functioning and overall wellbeing (Fuqua & Rogol, 2013).

The pubertal phase also transforms the anatomy of the individual into a reproductive body. Cells in the anterior pituitary, called gonadotrophs, increase secretion of gonadotropins and gonadal steroid hormones in both male and female adolescents (Blakemore, Burnett, & Dahl, 2010; Lavery & Sanfilippo, 1985). The awakening of this significant gonadal function -- also known as *gonadarche* -- results in reducing the gonadal steroid feedback inhibition on the entire system that regulated gonadotropin-releasing hormone (GnRH) from the hypothalamus prior to adolescence (Fuqua & Rogol, 2013). Subsequently, luteinizing hormone (LH) and follicle-stimulating hormone (FSH), produced by the pituitary, activate maturing changes in the gonads (Blakemore, Burnett, & Dahl, 2010). Ovaries in females and testes in males begin to grow and

increase the production of sex steroids (Fuqua & Rogol, 2013; Lavery & Sanfilippo, 1985). External changes -- often referred to as *secondary sex characteristics* -- also begin to occur, including breasts and pubic hair in girls and testes and pubic hair in boys (Malina, 2014).

Maturation

The movement toward biological maturity is referred to as maturation (Malina, 2014). It is important to distinguish the difference in maturation and maturity. Maturation is a *process* that culminates in a *state* of maturity. Maturation takes place in all of the body's organs and systems and is the pathway to somatic growth and fully functioning adult systems (Malina, 2014). For example, maturation of the nervous and endocrine systems promotes sexual maturity and reproductive capability (Malina, 2014).

Development

Growth and maturation are the biological processes that occur on the journey from childhood to adulthood. Development, on the other hand, is the behavioral and socialization process. It is the acquisition of skills and competencies and the refinement of socially acceptable behaviors as determined by one's culture or environment (Malina, 2014). One's home life, school, sports, church, or other communal activities assist in the development of social competence, relational competence, cognitive competence, and moral competence. The youth learns what is accepted and expected in his/her "world." Skill acquisition, such as motor development, involves neuromuscular maturation and competency in gross and fine motor patterns interacting with environment (Malina, 2014; Loria, 1980).

Puberty

For parents, it may seem like their son or daughter's adolescent body changed overnight. Their once little boy or little girl has suddenly become a man or a woman. The sequence of

maturation, however, is a methodical biological and physiological process that takes several years to complete.

For the youth, puberty can be simultaneously exciting and awkward. The process involves a series of undeniable changes in the human body, both seen and unseen. While outwardly facial hair is growing, shoulders are broadening, and breasts are developing, inwardly sex drive hormones are raging and cognitions are expanding. Such changes can often feel embarrassing to the adolescent.

According to Harry Stack Sullivan's Developmental Epochs, the onset of puberty introduces a shift in the mind concerning relationships that moves beyond companionship and emotional connection onto sexual interest, expression, and exploration (Evans, 2006). The pubescent is undergoing physical changes that can cause him/her to feel awkward and uncertain. The adolescent seeks validation for his/her new emerging adult form. Subsequently, self-worth, during this time, often becomes synonymous with sexual attractiveness to one's peer (Evans, 2006). Acceptance by the opposite sex ultimately influences the adolescent's sense of identity and personality development (Evans, 2006).

The hallmark of the pubertal stage is the body's production of sex steroids, testosterone in males and estrogen in females, which usher the adolescent into reproductive adulthood (Natsuaki, 2013). While the end goal is the same...adulthood...girls and boys transition through the physical maturation of puberty at different rates. Additionally, sexual maturation is unique to gender and to the individual.

Girls

Puberty begins around the age of 11 or 12 for girls. It is a time of rapid growth and redistribution of weight and body mass. Females grow an average of 3.5 inches a year during

puberty, but they can have a growth spurt of up to 5 inches in a single year (Feldman, 2008).

The female body continues to grow until epiphyseal closure occurs – or *the ends of the bones fuse with the bone shafts* – eliminating any future growth (Sugar, 1993). Since females begin puberty earlier than males, it is not uncommon for an 11-year-old girl to be greater in stature than an 11-year-old boy. However, by the age of 13 when boys have begun their pubertal growth spurts, boys generally become taller than girls (Feldman, 2008).

Interestingly, there is no relationship between growth in stature to other somatic development (Sugar, 1993). Peak weight occurs in girls after the height growth spurt. Girls develop broader hips and gain fatty deposits in their breasts, hips, thighs, and buttocks (Sugar, 1993). Thelarche – *the onset of developing breast tissue*, pubarche – *the onset of pubic hair*, and adrenarche – *the onset of axillary hair, body odor, and acne*, mark additional changes in the female body during puberty (Blakemore, Burnett, & Dahl, 2010).

Sexual maturation in females. The first signs of sexual maturation in girls are the development of breasts and sexual hair. In many cultures, however, the first acknowledgment of a girl “becoming a woman” is when she starts her period because she is now able to reproduce (Chandra & Chaturvedi, 1992). Menarche – *the onset of menstruation* – can occur at different ages among adolescent girls. Research suggests, however, that moderate to vigorous physical activity or severe caloric restrictions can delay or interrupt menarche in girls (Fuqua & Rogol, 2013; Baker, Birch, Trost, & Davison, 2007; Rogal, Clark, & Roemmich, 2000). This is believed to be due to the loss of energy availability from decreases in body mass index (Fuqua & Rogol, 2013). Conversely, obesity, as reflected by body mass index, and low physical activity can result in earlier onset of menarche (Hillard, 2008).

A normal, healthy menstrual cycle for adolescent girls ranges between 20 to 45 days. The young female must learn her cycle, pay attention to any irregularities, and trust when her body is telling her something. If the adolescent's cycle is consistently outside of the 20 to 45 day range, she should be checked by a gynecologist for pathologic conditions, such as polycystic ovary syndrome, eating disorders, thyroid disease, hyperprolactinemia, or other abnormalities (Hillard, 2008).

Boys

Puberty begins around age 13 or 14 in the life cycle of a boy, which is about two years later than a girl (Rosen, 2004). Thus, it is not uncommon for girls to initially increase in size before boys their same age. However, males tend to add 10 to 11 inches to their height over a grow spurt period of two – three years. During this time, a boy's body mass becomes leaner and fat decreases from 14.3% to 11.2% according to Tanner stages -- *The Sexual Maturity Rating (SMR)*, a commonly used scale created by British pediatrician James Tanner designed to measure the development of secondary sexual characteristics of individuals, such as breasts, genitalia, and pubic hair, on an ordinal puberty scale of 1 to 5 (Blakemore, Burnett, & Dahl, 2010; Goldstein, 2003; Tanner & Whitehouse, 1976).

Boys often compare their growth and size to that of their same sex peers. So, although a female may be taller, it is more concerning to boys if their male counterparts are taller or more fully developed (Goldstein, 2003). Adolescent boys who are short in stature may appear younger than their biological age. This can result in feelings of low self-esteem or being the object of ridicule or teasing by peers (Goldstein, 2003). Common causes of short stature in young males are constitutional delay of growth and puberty (CDGP), growth hormone deficiency, or parental genetics (Fuqua & Rogol, 2013; Goldstein, 2003).

In addition to an increase in height and a leaner body mass in puberty, boys also experience the growth of pubic hair around age 12, followed by facial and underarm hair (Natsuaki, 2013; Feldman, 2008). Their youthful voices become deeper as vocal chords lengthen and the larynx enlarges. Hormone levels and sex drive increase and contribute to mood swings demonstrated by anger outbursts or low frustration tolerance.

Additionally, pubescent boys experience physical changes in their genitalia. The penis and scrotum of the male begin to increase their growth rate around age 12 years old and reach adult size by age 15-16 years old (Feldman, 2008). The flaccid length of the male penis can range from 2.0 to 6.1 inches, with an average erect length of 5.5 to 6.5 inches (Biro & Dorn, 2005; Goldstein, 2003). It is common for adolescent boys to be concerned with having a shorter flaccid penis than other males. However, research has shown there is no relationship between the flaccid size and the erect size (Goldstein, 2003).

Sexual maturation in males. As the penis and scrotum enlarge, the prostate gland and the seminal vesicles that produce semen are also developing. *Spermarche* –a boy's first ejaculation-- is equivalent to menarche for a girl and typically occurs around the age of 13 years old (Feldman, 2008; Goldstein, 2003). The sperm content in the semen of first ejaculations is relatively low. However, the amount of sperm the male body produces greatly increases as the adolescent continues to mature.

Ejaculation can occur without manual stimulation during nocturnal emissions or by manual stimulation during masturbation. Nocturnal emissions – or *wet dreams* – are a common experience in adolescent boys. They are typically provoked by erotic dreams. However, some males never experience this type of ejaculation (Goldstein, 2003). While ejaculation can occur spontaneously, other times it occurs through erotic stimulation.

Masturbation – *manual stimulation of the genitals for sexual pleasure* -- is a common ejaculation experience among males that generally begins in adolescence. Despite its prevalence and its pleasure, ejaculation, especially through masturbation, is an extremely sensitive topic for most young males (Best & Fortenberry, 2013). This may be due to a sense of guilt or shame associated with the behavior. Research indicates that discussions on masturbation are typically omitted from sex education, including abstinence-only content, and few parents are comfortable broaching the subject in their sex talks with children, which may explain the source of shame adolescents experience over the behavior (Best & Fortenberry, 2013). If no one is talking about it, *it* must be wrong.

Adolescent sexual behaviors

Sexual maturation produces a flood of sex driving hormones, which awakens sexual desire and exploration in the minds and bodies of pubescent boys and girls. The thoughts they think about self and the opposite sex radically change due to the insurgence of testosterone and estrogen produced by the gonads in their transforming biological systems. Adolescents must learn to integrate with their new sexual selves. Many factors influence how an adolescent manages his/her sexual self-concept and sexual behaviors. These include family, peers, and cultural influences (Best & Fortenberry, 2013).

Sexual self-concept. Freud was often criticized for his beliefs that children could be sexual beings. In his theory on psychosexual development, adolescents experience the genital stage, in which the drive for sexual stimulation is initially confusing but is ultimately integrated into the life of the adolescent by directing the desire toward peers. While Freud's focus seemed to be more on the biological or hormonal drive for sex, there are other determinants involved in sexual maturation. As the adolescent becomes more aware of self as a sexual being, he/she

begins to develop a sexual self-concept or a collection of beliefs regarding sex. The adolescent's decisions about sexual behaviors are greatly influenced by this sexual self-concept (Best & Fortenberry, 2013). There are four domains that help to shape sexual self-concept: sexual self-esteem, sexual openness, sexual ambivalence, and sexual anxiety (O'Sullivan, Cheng, Harris, & Brooks-Gunn, 2007).

The first domain is sexual self-esteem. This refers to an individual's appraisal of their sexual thoughts, feelings, and behaviors. Research suggests that adolescents who consider him/herself to be sexually attractive and satisfied with his/her body, have a higher sexual self-esteem, place a higher value on sexual encounters, and tend to have a later onset of sexual activity and fewer sexual partners than those with lower sexual self-esteem (Hensel, Fortenberry, O'Sullivan, & Orr, 2011; O'Sullivan, Cheng, Harris, & Brooks-Gunn, 2007).

The second domain is sexual openness. It refers one's ability to experience sexual behavior with a sense of wellbeing and believes he/she is entitled to sexual pleasure and exploration. It is generally associated with increased sexual pleasure and exploration, greater use of condoms, lower pregnancy rates, and later onset of sexual intercourse (O'Sullivan, Meyer-Bahlburg, & McKeague, 2006).

The third domain is sexual ambivalence. This is associated with lower use of condoms and increased unplanned sexual encounters. This is either because the individual wants to engage in sex but does not, or the individual does not want to engage in sex but does. This type of ambivalence is common in normal sexual development and is frequently seen in younger adolescents, individuals with low body image, an individuals experiencing peer pressure in regards to sexual behaviors (Pinquart, 2010; O'Sullivan, Cheng, Harris, & Brooks-Gunn, 2007).

The fourth domain is sexual anxiety. This refers to negative feelings or feelings of fear regarding sexual behaviors. This mindset about sex often serves as a deterrent to engaging in sexual behaviors and lends itself to stronger abstinence beliefs. Sexual anxiety can also lead to sexual dysfunctions (O'Sullivan, Meyer-Bahlburg, & McKeague, 2006).

Influencers of sexual behaviors. It is normal for adolescents to engage in a variety of sexual behaviors. The context of such behaviors, however, may range from low risk to higher risk activities. From kissing and non-coital touching, to masturbation alone or with a partner, to oral sex or vagina intercourse, adolescents experiment with their budding curiosities and sexually maturing bodies (Best & Fortenberry, 2013). Many influencers impact an adolescent's sexual behaviors, including the media and internet, family, friends, and environment.

The media and cyberspace. With advanced technology and the online world at their fingertips, more young people are experimenting with *virtual* forms of sexual behaviors, such as sexting – *texting sexually explicit messages or pictures* -- and pornography viewing (Feldman, 2008). Approximately 90% of adolescents 14 years or older have viewed sexually explicit images, whether intentionally or unintentionally, through electronic sources (Ybarra & Mitchell, 2005). Additionally, 37% of adolescent girls and 40% of adolescent males have sent sexually explicit text messages, and 22% of adolescent girls and 18% adolescent boys have texted nude or seminude pictures of themselves (Best & Fortenberry, 2013). Initially, this may seem to be a “safe” way to experience sexual pleasure, however, just the opposite seems to be true. Exposure to such explicit material has been shown to increase sensationalized sexual behaviors, such as seeking multiple partners or incorporating substance use with sex (Luder et al., 2011). Additionally, such provocative images misrepresent sexual engagement as more of a physical behavior than a relational activity (Peter & Valkenburg, 2010).

Sexual experimentation, whether real or virtual, coital or non-coital, can place stress on the adolescent. It can even put the adolescent at risk for emotional dysregulation, sexually transmitted diseases, and pregnancy (Feldman, 2008; Feldmann & Middleman, 2002).

Therefore, it is important that adolescents have access to reliable information about healthy sex, such as through school and community resources, and safe relationships to discuss questions, fears, or concerns, such as with parents, teachers, or counselors (Jaffe, 1998).

Parents, peers, and environment. Adolescent youth are attempting to define their personal sexual identity. Yet, they are greatly influenced by role models in their lives and the desire to imitate or fit in with others. Although the desire is to move towards personal autonomy, parents, peers, and culture still heavily influence the adolescent worldview about sexual behaviors (Best & Fortenberry, 2013).

Parents. According to Bowlby, parents become a child's first attachment relationship (Myrick, Green, & Crenshaw, 2014). Adolescents who view their parents positively are more likely to engage in successful exploration with a felt sense of security and support (Myrick, Green, & Crenshaw, 2014). Parents who have open communication with their sons and daughters about sex, abstinence, and contraceptives tend to have adolescents who delay onset of sexual activity for one year (Fasula & Miller, 2006). Additionally, this intentional communication style leads to less risk-taking behavior in adolescents, fewer sexual partners for adolescents, and increased parental status as reliable sources for sexual information (Best & Fortenberry, 2013).

Peers. Peer pressure has probably been around as long as two or more people have gathered together on the earth. This is especially true for vulnerable adolescents trying to figure out how to *do this adult life right*. Young people look around to see what others in their peer

group are doing in regards to sexual activity. Friends are often the ones who set the standard for what type of sexual activity is acceptable and expected. This pressure may be overt, as in challenging or mocking, or subtle in its influence. Literature shows that sexual activity increases in adolescents who associate with more sexually experienced peers or who perceive their peers may be more experienced than them (Sieving, Eisenberg, Pettingell, & Skay, 2006). Even the media has been identified as a *super peer* that subtly influences adolescent thinking and behaviors through the promotion of sexually enticing programs, advertisements, and messaging (Brown, Halper, & L'Engle, 2005)

Environment. An adolescent's social environment places a large role in influencing sexual attitudes and behaviors. Youth who lack supervision, who spend time at home alone, or who live in disadvantaged neighborhoods are more likely to engage in sexual activity and are more likely to have multiple sexual partners (DiClemente et al., 2008). However, adolescents who have a higher levels of parental attachment (Best & Fortenberry, 2013) and those who are affiliated with a religious organization since childhood (Armour & Haynie, 2007) are less likely to engage in risky sexual behaviors, such as unprotected sex or multiple partners, and are more likely to delay onset of sexual behaviors. In fact, both males and females who report active participation in a religious organization beginning in childhood are more likely to remain virgins and not engage in oral sex during adolescence (Brewster & Tillman, 2008).

Impact of Early and Late Maturation

It remains a mystery as to exactly when the body clock strikes puberty in each individual. It is hypothesized that pubertal onset is controlled by master regulatory genes and originates in the hypothalamus (Rosen, 2004). And, it is known that the endocrine system plays a major role in the pubertal growth spurt, with increased growth hormone (GH) and insulin-like growth factor

(IGF) production rates (Reiter & Lee, 2002). Onset of puberty in girls begins with breast development and increased growth velocity, and onset of puberty in boys begins with the increase of testicular volume (Reiter & Lee, 2002). However, for some adolescents maturation begins earlier or is delayed from the average age of onset, which is between 8-13 years old in females and 9-14 years old in males (Reiter & Lee, 2002; Goldstein, 2003).

Early maturation

Adolescence is often identified by its physical growth and development of puberty. However, it is a complex process that also involves psychological and social maturation.

Girls. Precocious puberty is more common in females than males (Malina, 2014). Girls who experience premature physical maturation often struggle because they are not mentally and emotionally prepared for their changing bodies (Rosen, 2004; Baker, Birch, Trost, & Davidson, 2007). They are at greater risk for adjustment difficulties and experience more negative events at home and at school due to their body image (Sugar, 1993). A study by Baker, Birch, Trost, and Davidson (2007) suggested that early maturation in girls resulted in several negative outcomes. These include depression, poor body image, eating disorders, greater risk of early sexual activity, and increased risk of breast cancer.

Early maturation in girls can be linked to obesity and lack of physical activity (Malina, 2014; Drenowatz et al., 2013; Baker, Birch, Trost, & Davidson, 2007). Research identified a significant decrease in the physical activity of these “early bloomers” due to changes in their interactions with parents and peers (Baker, Birch, Trost, & Davidson, 2007). For example, parents, especially the father, may become uncomfortable with their daughter’s changing body and encourage her to behave more maturely and less “childlike”. Likewise, developing girls may be feel awkward or conspicuous running or playing with friends whose bodies are less

developed. Subsequently, early maturing girls tend to gravitate to older peer groups and become less active than other girls their age cohort (Baker, Birch, Trost, & Davidson, 2007).

Boys. Early maturation is more common in girls, but boys experience this anomaly as well. The early onset of sexual maturation in boys is not linked to obesity as it is in girls (Drenowatz et al., 2013; Goldstein, 2003). Instead, these adolescent boys tend to be thinner in comparison to their cohorts (Drenowatz et al., 2013). However, it still has challenging consequences for boys (Biro & Dorn, 2005). Early maturing boys have been found to be at greater risk for sexual activity, smoking, drinking, and other delinquent behaviors (Ge, Conger, & Elder, 2001).

Both girls and boys whose bodies are becoming adult-like prematurely often experience greater expectations from actual adults, such as parents or teachers, than their non-maturing peers. They “look” like adults, so they should “act” like adults. The problem, however, is they are not adults *yet*. This can lead to stress and emotional distress for the adolescent. Depression, parental conflict, and school problems are common experiences this group (Graber, Lewinsohn, Seeley, & Brooks-Gunn, 1997). They are also at a higher risk for pseudosexuality – a need for acceptance and closeness which can lead to unwanted sexual encounters (Hajcak & Garwood, 1988). Adolescents in general, and specifically those maturing prematurely, engage in sexual behavior to satisfy nonsexual needs, such as feelings of loneliness, low self-esteem, and even anger or boredom (Hajcak & Garwood, 1988). Using sex as a coping mechanism can create negative associations with sex and impair the individual from a healthy sex life. It can even make adolescents prime targets for sexual predators. When feelings of acceptance and esteem are met nonsexually, however, the person is more likely to be able to develop healthy sexual relationships (Hajcak & Garwood, 1988).

Late maturation

Physical appearance becomes increasingly important in the life of the adolescent. Both boys and girls have a desire to fit in with peer groups and spend time assessing their appearance. When it seems like others are growing and changing while their bodies are not, it can feel disheartening and concerning. Delayed puberty is the absence of physical changes by a chronologic age of 2.5 standard deviations (SD) about the mean age of normal puberty onset (Reiter & Lee, 2002). Therefore, if a female is not experiencing breast budding by age 13 or menarche by age 15, she is considered to be delayed; and if a male's testicular volume is not 4ml by age 15, he is considered to be delayed (Reiter & Lee, 2002).

Girls. Late maturing girls have been found to experience less distress than their early maturing cohorts (Sugar, 1993). These "late bloomers" continue to function well in school and in their home lives. Their delayed blossoming is more readily acceptable to family and peers who are uncomfortable with the idea of little girls becoming too womanly too soon (Sugar, 1993). While some girls are eager for breasts and curves, this social acceptance can make the waiting more tolerable for girls. Some reasons for delayed maturation in girls includes strenuous physical activity, such as in athletes, and poor diets, such as in low poverty environments or in eating disorders (Malina, 2014).

Boys. Whereas females seem to struggle more with early maturation, males seem to struggle more with late maturation. These males are smaller in stature than their peers. This can result in being rejected, bullied, or teased (Goldstein, 2003). Subsequently, late maturing males have lower self-esteem and are at greater risk to smoke and engage in substance use in order to bolster their need to not be seen as a *kid* (Biro & Dorn, 2005). They are also at an

elevated risk for bulimic-type eating as a coping skill for negative feelings, such as stress or depression (Goldstein, 2003).

The most common reason for delayed puberty in males is constitutional delay of growth and puberty (CDGP). CDGP describes youths that have a normal growth pattern throughout childhood but experience a temporary delay in skeletal growth resulting in small stature. In CDGP, “belated sex steroid production secondarily leads to seeming deficiency of GH production...” (Reiter & Lee, 2002, p. 105). Other potential reasons for delayed puberty in males are issues related to genetics or hypogonadotropic hypogonadism, which refers to lowered production of gonadal steroids (Reiter & Lee, 2002).

Nutrition and Physical Fitness

Adolescence is a critical stage in the life cycle. The body is undergoing strenuous changes and requires adequate nutrition in order to fuel proper growth and development (Lassi et al., 2017). Healthy and unhealthy diet and physical fitness patterns are being established during this time that can have lifelong affects on the individual (Ortega, Ruiz, Catillo, & Sjostrom, 2008). A longitudinal study by Williams and Mummery (2012) revealed an overall decline in nutritional quality and energy intake during adolescence. The study suggests that while some parents may have encouraged healthy diets during childhood, lifestyle changes and independent choices in adolescents reflect a decline in nutritional values (Williams & Mummery, 2012). This illustrates the need for ongoing parental involvement in encouraging their teens to maintain healthy dietary habits that may require them to eat differently from their peers (Salvy, de la Haye, Bowker, & Hermans, 2012).

There are many factors that can be explored when considering the nutritional and physical fitness needs of an adolescent and how these needs affect the bio-psycho-social

developmental processes of the individual. For this chapter, however, the discussion will be limited to a more generalized overview of obesity, malnutrition, and eating disorders. It will also discuss the role of a balanced diet and physical exercise for healthy development. It is recommended, however, that further reading be done on each of these factors, especially for future counselors and therapists who plan to specialize in an adolescent clientele.

Obesity

Obesity is an abnormality of excessive fat that affects boys and girls alike (Salvy, de la Haye, Bowker, & Hermans, 2012; Goldstein, 2003). It is a classification beyond *overweight*, which is defined as having excess body weight from fat, muscle, bone, or water for a particular height range and being > 85th - < 95th percentile (CDC, 2017). A person with a body mass index (BMI) of 25 or higher, > 95th percentile or higher, is considered to be obese (CDC, 2017; Bratber, Nilsen, Homan, & Vatten, 2007).

Larson and Neumark-Sztainer (2009) conducted a research project called Project EAT (Eating Among Teens). Through national surveys and population-based studies on eating and weight-related issues among teenagers, they identified five common nutritional concerns among adolescents. The concerns were 1) low intake of fruits and vegetables; 2) low intake of whole grains; 3) low consumption of calcium and low-fat dairy foods; 4) high consumption of sweetened beverages; and 5) frequent intake of fast foods (Larson & Neumark-Sztainer, 2009). Some may read this list and think, “*That’s part of the American teenage experience – eating fast food and drinking soda!*” While the teenage years are often romanticized as being the last chance age to be footloose and fancy free before responsible adulthood sets in, the aforementioned study is eye opening in that it demonstrates the lack of basic dietary nutrition

necessary for proper growth, weight management, and disease prevention among this population (Larson & Neumark-Sztainer, 2009).

The high consumption of sugar is a dangerous trend among adolescents that is especially concerning because sugar is a major contributor to obesity. Subsequently, obesity is the most serious long-term health risk to the adolescent population in the United States (Salvy, de la Haye, Bowker, & Hermans, 2012; Jasik & Lustig, 2008; Drenowatz et al., 2013). This is because it instigates many serious comorbid physical health conditions, such as type two diabetes mellitus, high blood pressure, high triglycerides and low HDL cholesterol, cardiovascular disease, to name a few (Delamate, Pulgaron, & Daigre, 2013; Anderson et al., 2004; Goldstein, 2003).

Overweight teens also struggle with being different from their peer group. This can lead to mental and emotionally distresses such as low self-esteem, isolation, and depression (Delamate, Pulgaron, & Daigre, 2013; Anderson et al., 2004; Goldstein, 2003). Additionally, obesity in adolescence leads to obesity in adulthood, which can result in a lifelong cycle of negative physical, mental, and social issues (Delamate, Pulgaron, & Daigre, 2013; Jasik & Lustig, 2008).

Malnutrition

Malnutrition on the BMI scale is <18.5 (Center for Disease Control, 2015). It is the result of not having enough to eat or not eating enough of the right kinds of food with the necessary nutrients to maintain good health (Dasgupta et al., 2010). Malnutrition in adolescence can be due to poverty, zealous dieting, eating disorders, excessive exercising, or metabolic disorders (Jaffe, 1998). This nutritional disorder can delay the onset and successful progression of puberty (Soliman, De Sanctis, & Elalaily, 2014). Additionally, as the greatest cause of growth retardation in children and adolescents worldwide, the effects of malnutrition can be permanent

resulting in impaired growth, osteopenia, anemia, or vitamin deficient related syndromes (Soliman, De Sanctis, & Elalaily, 2014).

Eating Disorders

The rapid physical changes and sexual development of boys and girls during the pubertal stage can lead to a fear of becoming fat. This is enough to motivate some adolescents to take drastic measures in an effort to avoid gaining weight. Anorexia nervosa (AN) and bulimia nervosa (BN) are serious psychological eating disorders that can have hazardous effects on the health of adolescents (Feldman, 2008). AN is self-induced food restriction whereby its participants literally starve themselves to death (Soliman, De Sanctis, & Elalaily, 2014). Even though the anorexic's body is emaciated and wasting away, the individual sees self as disgusting and fat and continues to withhold food (Feldman, 2008). BN involves eating large amounts of food and then purging through vomiting or use of laxatives. The bulimic's body weight does not change much during this eating-purge cycle, however, the effects of this cycle can lead to dangerous chemical imbalances that can lead to heart failure (Feldman, 2008).

Eating disorders can affect males and females. However, it is more commonly associated with girls. Statistical figures among adolescents in the United States reveal that 0.5% to 1% of adolescent girls ages 12 to 18 are anorexic and 1% to 3% of this same population are bulimic (American Psychiatric Association, 2017). Anorexia and bulimia are more prevalent among Caucasian girls, yet the disorders are also found among ethnic minorities (Douchis, Hayden, & Wilfley, 2001). Hispanic females, for instance, are more prone to excessive dieting and food restriction (Douchis, Hayden, & Wilfley, 2001). Black females, on the other hand, are more prone to binge eating (Douchis, Hayden, & Wilfley, 2001).

The exact cause of eating disorders remains unknown. However, there are several factors that seem to be linked to these types of maladies. Some experts believe that dieters become overzealous with a feeling of control or success, which can trigger them to want to lose more and more weight (Feldman, 2008). Depression has been associated with eating more or less during depressive episodes (McCarthy, 1990). Physical or sexual abuse, poor coping skills, and perfectionism are factors that increase the risk of eating disorders in youth (Dounchis, Hayden, & Wilfley, 2001). Additionally, early maturing adolescents may utilize eating disorders to try and bring their body weight back in line with their peer group (Salvy, de la Haye, Bowker, & Hermans, 2012).

Balanced Diet and Physical Activity

Diet and exercise are key factors in the healthy maturation process of body systems and organs. Research suggests that there are direct links between nutrition and exercise and the development of verbal intelligence (Jackson & Beaver, 2015); the risk of early or late maturation (Malina, 2014; Drenowatz et al., 2013; Baker, Birch, Trost, & Davidson, 2007); and the maintenance of good mental health (Feldman, 2008). Research also shows that while many adolescents report understanding the importance of healthy eating, the majority of them do not meet nutritional guidelines (Williams & Mummery, 2012). Instead, many engage in maladaptive behavioral patterns of consuming sugar and high fats or of skipping meals and risky weight loss practices (Williams & Mummery, 2012). Couple this with the fact that physical activity in childhood typically peaks around ages 12 to 14 then subsequently decreases during adolescence (Malina, 2014) and a perfect storm for unwanted weight gain in pubertal youth is created.

The Center for Disease Control and Prevention (2015) provides an estimate of the calories needed per day by age, sex, and physical activity level. The CDC suggests that males

who are between the ages 13-18 years old and who lead a more sedentary lifestyle should have a caloric intake of 2000- 2400 daily. On the other hand, males in this same population who lead a moderately active lifestyle should eat 2200-2800 calories per day. For females who are between the ages of 13-18 and who lead a sedentary lifestyle, the recommended daily caloric intake is 1600-1800. However, females in this same population who lead a moderately active lifestyle, the recommendation is 2000 calories per day. This caloric intake should consist of fruits, vegetables, nuts, legumes, whole grains, lean meats, and unsaturated fats (World Health Organization, 2015).

As discussed earlier in this chapter, unhealthy dietary choices can become hazardous. The same is true for physical activity. If an adolescent engages in low levels of physical activity, he/she becomes vulnerable to weight gain, low self-esteem, depression, comorbid disease, and early maturation (Jasik & Lustig, 2008). Conversely, if an adolescent engages in extremely high levels of physical activity, he/she becomes vulnerable to obsessive weight control, unhealthy BMI, amenorrhea, or delayed maturation (Jasik & Lustig, 2008). In some instances, as in athletic or dance programs, youth may experience amenorrhea or delayed maturation due to the strenuous nature of the activity (Shearer & Moore, 2013).

Exercise can be used for muscle or coordination development, for maintaining healthy weight, for psychological wellbeing, and for developing social skills and making friends (Shearer & Moore, 2013). However, it can also be used as a way to satisfy a need for power or control, as a means of asceticism, or as extreme weight management (Shearer & Moore, 2013). *So, what is a healthy approach to exercise during adolescence?* The CDC (2015) suggests a healthy approach to exercise is 60 minutes or more of physical activity each day consisting of a combination of aerobic, muscle strengthening, and bone strengthening exercises.

Conclusion and Further Reading

Adolescence is a complex time of growth and change physically, cognitively, emotionally, and socially for boys and girls. The passage from childhood to adulthood can be an exciting adventure or a frightening journey. A sense of self and finding one's place in the world is being established. Therefore, adolescents require a strong support network of consisting of family, friends, and community.

This chapter provided a brief examination of physical maturation, puberty, early and late maturation, and the role of nutrition and physical fitness for this developmental stage of life. The depths of the adolescent experience, however, are yet to be fully explored in these few pages. Future counselors, therapists, and social workers that wish to work with this population should pursue further research and readings on this important subject matter. Issues such as attachment styles, ethnicity, cultural differences, dating, sex, sexual identity, sexual orientation, teen pregnancy, sexual abuse, romantic partner abuse, eating disorders, and social media influences are just a few of the many contextual variables in the *coming of age* process that should be examined.

A particularly concerning issue in relation to physical maturation, however, is the issue of nutrition and physical activity. The United States is a nation whose overweight adolescent population has steadily increased year-over-year for the last 40+ years. The CDC growth charts for children and teens in the BMI 95th percentile – *the classification for obesity* – reveals that youth ages 6-11 years has increased from 4.0% in 1971-74 to 18.0% in 2009-2010, and ages 12-19 years has increased from 6.1% to 18.4% in 2009-2010 (CDC, 2015). Obesity in youth is associated with obesity in adulthood, chronic health conditions, social isolation, low self-esteem, and depression (CDC, 2017). Understanding the genetics, metabolism, eating and physical

activity behaviors, environmental factors, and social and individual psychology can help in creating a more comprehensive approach in the prevention of obesity among teens (CDC, 2017).

References

- Allen, J. P., Hauser, S. T., Bell, K. L., O'Connor, T. G. (1994). Longitudinal assessment of autonomy and relatedness in adolescent-family interactions as predictors of adolescent ego development and self-esteem. *Child Development, 65(1)*, 179-194. doi: 10.1111/j.1467-8624.1994.tb00743.x
- American Psychiatric Association. (2017). *Developing adolescents: A reference for professionals*. <http://www.apa.org/pubs/info/brochures/develop.aspx>
- Anderson, L. B., Hasselstrom, H., Gronfeldt, V., Hansen, S. E., & Karsten, F. (2004). The relationship between physical fitness and clustered risk, and tracking of clustered risk from adolescence to young adulthood: Eight years follow-up in the Danish youth and sport study. *International Journal of Behavioral Nutrition and Physical Activity, 1(6)*.
- Armour, S., & Haynie, D. (2007). Adolescent sexual debut and later delinquency. *Journal of Youth and Adolescence, 36*, 141–152.
- Baker, B. L., Birch, L. L., Stewart, G., Trost, S. G., Davison, K. K. (2007). Advanced pubertal status at age 11 and lower physical activity in adolescent girls. *Journal of Pediatrics, 15(5)*, 488-493. doi:10.1016/j.jpeds.2007.04.017
- Baldwin, M. W. (1992). Relational schemas and the processing of social information. *Psychological bulletin, 112(3)*, 461-484.
- Best, C., & Fortenberry, J. D. (2013). Adolescent sexuality and sexual behavior. In O'Donohue, W. T., Benuto, L. T., & Tolle, L. W. (Eds.), *Handbook of adolescent healthy psychology* (868-935). New York, NY: Springer.

- Biro, F. M., & Dorn, L. D. (2005). Puberty and adolescent sexuality. *Pediatric Annals*, 34(10), p. 777-784.
- Blakemore, S. J., Burnett, S., & Dahl, R. E. (2010). The role of puberty in the developing adolescent brain. *Human Brain Mapping*, 31, 926-933.
- Bratber, G. H., Nilesen, T. I., Holmen, T. L. Vatten, L. J. (2007). Early sexual maturation, central adiposity and subsequent overweight in late adolescence: A four-year follow-up of 1605 adolescent Norwegian boys and girls: the Young HUNT study. *BMC Public Health*, 7(54), 1-7. doi:10.1186/1471-2458-7-54
- Brewster, K. L., & Tillman, K. H. (2008). Who's doing it? Patterns and predictors of youths' oral sexual experiences. *The Journal of Adolescent Health*, 42, 73–80.
- Brown, J. D., Halpern, C. T., & L'Engle, K. L. (2005). Mass media as a sexual super peer for early maturing girls. *The Journal of Adolescent Health*, 36, 420–427.
- Center for Disease Control (CDC). (2015). BMI.
https://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html
- Center for Disease Control (CDC). (2017). Childhood obesity facts.
<https://www.cdc.gov/healthyschools/obesity/facts.htm>
- Chandra, P. S., & Chaturvedi, S. K. (1992). Cultural variations in attitudes toward menstruation. *The Canadian Journal of Psychiatry*, 37(3). Dasgupta, A., Butt, A., Saha, T. K., Basu, G., Chappopadhvav, A., & Mukherjee, A. (2010). Assessment of Malnutrition Among Adolescents: Can BMI be Replaced by MUAC. *Indian Journal of Community Medicine*, 35(2), 276–279. doi: 10.4103/0970-0218.66892
- Delamater, A. M., Pulgaron, E. R., & Daigre, A. (2013). Obesity in Adolescence. In O'Donohue,

- W. T., Benuto, L. T., & Tolle, L. W. (Eds.), *Handbook of adolescent healthy psychology* (1897-1970). New York, NY: Springer.
- DiClemente, R. J., Crittenden, C. P., Rose, E., Sales, J. M., Wingood, G. M., Crosby, R. A., et al. (2008). Psychosocial predictors of HIV-associated sexual behaviors and the efficacy of prevention interventions in adolescents at-risk for HIV infection: What works and what doesn't work? *Psychosomatic Medicine*, *70*, 598–605.
- Dounchis, J. Z., Hayden, H. A., Wilfley, D. E. (2001). Obesity, body image, and eating disorders in ethnically diverse children and adolescents. In J. K. Thompson & L. Smolak (Eds.), *Body image, eating disorders, and obesity in youth: Assessment, prevention, and treatment* (67-102). Washington, DC: American Psychological Association.
- Drenowatz, C., Wartha, O., Klenk, J., Brandsetter, S., Wabitsch, M., Steinacker, J. (2013). Differences in health behavior, physical fitness, and cardiovascular risk in early, average, and late mature children. *Pediatric Exercise Science*, *25*, 69-83.
- Erikson, E. H. (1950). Growth and crises of the “healthy personality.” In Senn, M. J. E. (Ed.). *Symposium on the healthy personality* (91-146). Oxford, England: Josiah Macy Jr. Foundation.
- Erikson, E. H. (1980). *Identity and the life cycle*. New York, NY: W. W. Norton & Company, Inc.
- Evans, F. B. (2006). *Harry stack sullivan: Interpersonal theory and psychotherapy*. New York, NY: Routledge.
- Fasula, A. M., & Miller, K. S. (2006). African-american and hispanic adolescents' intentions to delay first intercourse: Parental communication as a buffer for sexually active peers. *The Journal of Adolescent Health*, *38*, 193–200.

Feldman, R. S., (2008). *Development across the life span (5th ed.)*. Uppper Saddle River, NJ: Pearson Prentice Hall

Feldmann, J., & Middleman, A. B. (2002). Adolescent sexuality and sexual behavior. *Current Opinion in Obstetrics and Gynecology, 14(5)*, 489-493.

Fulgini, A., & Eccles, J. S. (1993). Perceived parent-child relationships and early adolescents' toward peers. *Developmental Psychology, 29(4)*, 622-632. <http://dx.doi.org/10.1037/0012-1649.29.4.622>

Fuqua, J. S., & Rogol, A. D. (2013). Puberty: Its role in adolescent maturation. In O'Donohue, W. T., Benuto, L. T., & Tolle, L. W. (Eds.), *Handbook of adolescent healthy psychology (787-867)*. New York, NY: Springer.

Gasparetto, M., & Guariso, G. (2014). Crohn's disease and growth deficiency in children and adolescents. *World Journal of Gastroenterol, 20(37)*, 13219–13233. doi: 10.3748/wjg.v20.i37.13219

Ge, X., Conger, R. D., & Elder, G. H. (2001). Pubertal transition, stressful life events, and the emergence of gender differences in adolescent depressive symptoms. *Developmental Psychology, 37*, 404-417.

Goldstein, M. A., (2003). Male puberty: Physical, psychological, and emotional issues. *Adolescent Medicine, 14(3)*, 541-553.

Graber, J. A., Lewinsohn, P. M., Seeley, John R., & Brooks-Gunn, J. (1997). Is psychopathology associated with the timing of pubertal development? *Journal of the Academy of Child and Adolescent Psychiatry, 36*, 1768-1776.

Hajcak, F., & Garwood, P. (1988). Quick-fix sex: Pseudosexuality in Adolescents. *Adolescence, 23*, 755-760.

- Hensel, D. J., Fortenberry, J. D., O'Sullivan, L., & Orr, D. P. (2011). The developmental association of sexual self-concept with sexual behavior among adolescent women. *Journal of Adolescence, 34*, 675–684.
- Hillard, P. J. A. (2008). Menstruation in adolescents: What's normal? *Medscape Journal of Medicine, 10(12)*, 295.
- Human Growth Foundation. (2015). Pediatric growth hormone deficiency. <http://hgfound.org/resources/pediatric-growth-hormone/>
- Jackson, D. G., & Beaver, K. M. (2015). The role of adolescent nutrition and physical activity in the prediction of verbal intelligence during early adulthood: A genetically informed analysis of twin pairs. *International Journal of Environmental Research and Public Health, 12*, 385-401. doi:10.3390/ijerph120100385
- Jaffe, M. L. (1998). *Adolescence*. New York, NY: John Wiley & Sons, Inc.
- Myrick, A. C., Green, E. J., & Crenshaw, D. (2014). The influence of divergent parental attachment styles on adolescent maturation: Implications for family counseling practitioners. *The Family Journal: Counseling and Therapy for Couples and Families, 22(1)*, 35-42. DOI: 10.1177/1066480713491217
- Jasik, C. B., & Lustig, R. H. (2008). Adolescent obesity and puberty: The “perfect storm.” *Annals of the New York Academy of Sciences, 1135*, 265-279. doi: 10.1196/annals.1429.009
- Larson, N., & Neumark-Sztainer, D. (2009). Adolescent nutrition. *Pediatrics in Review, 30(12)*, 494-496.
- Lassi, Z. S, Moin, A., Das, J. K., Salam, R. A., & Bhatta Z. A. (2017). Systematic review on evidence-based adolescent nutrition interventions. *Women's and Adolescent Nutrition*,

34-50. doi: 10.1111/nyas.13335

Lavery, J. P., & Sanfilippo, J. S. (Eds.). (1985). *Pediatric and adolescent obstetrics and gynecology*. New York, NY: Springer-Verlag.

Loria, C. (1980). Relationship of proximal and distal function in motor development. *Physical Therapy, 60*(2). 167-172.

Luder, M. T., Pittet, I., Berchtold, A., Akre, C., Michaud, P. A., & Suris, J. C. (2011).

Associations between online pornography and sexual behavior among adolescents: Myth or reality? *Archives of Sexual Behavior, 40*, 1027–1035.

Malina, R. M. (2014). Top 10 research questions related to growth and maturation of relevance to physical activity, performance, and fitness. *Research Quarterly for Exercise and Sport, 85*, 157-173. doi: 10.1080/02701367.2014.897592

McCarthy, M. (1990). The thin ideal, depression and eating disorders in women. *Behavior*

Research and Therapy, 28(3), 205-214. [https://doi.org/10.1016/0005-7967\(90\)90003-2](https://doi.org/10.1016/0005-7967(90)90003-2)

Natsuaki, . N., (2013). Puberty in context: Toward a more nuanced understanding of early maturation. *Journal of Adolescent Health, 53*.

O’Sullivan, L. F., Cheng, M. M., Harris, K. M., & Brooks-Gunn, J. (2007). I wanna hold your hand: The progression of social, romantic and sexual events in adolescent relationships. *Perspectives on Sexual and Reproductive Health, 39*, 100–107.

O’Sullivan, L. F., Meyer-Bahlburg, H. F. L., & McKeague, I. W. (2006). The development of the sexual self-concept inventory for early adolescent girls. *Psychology of Women Quarterly, 30*, 139–149.

Ortega, F. B., Ruizl, J. R., Castillo, M. J., Sjo, M. (2008). Physical fitness in childhood and adolescence: a powerful marker of health. *International Journal of Obesity, 32*, 1-11.

- Paternoster, L., Howe, L. D., Tilling, K., Weedon, M. N., Freathy, R. M., Frayling, T. M., ...Ring, S. M. (2011). Adult height variants affect birth length and growth rate in children. *Human Molecular Genetics*, 20(20), 4069-4075. doi: 10.1093/hmg/ddr309
- Paus, T. (2005). Mapping brain maturation and cognitive development during adolescence. *Trends in Cognitive Sciences*, 9(2), 60-68.
- Peter, J., & Valkenburg, P. M. (2010). Processes underlying the effects of adolescents' use of sexually explicit internet material: The role of perceived realism. *Communication Research*, 37, 375-399.
- Pinquart, M. (2010). Ambivalence in adolescents' decisions about having their first sexual intercourse. *Journal of Sex Research*, 47, 440-450.
- Reiter, E. O., & Lee, P. A. (2002). Delayed puberty. *Adolescent Medicine* 13(1), pp. 101-118.
- Rogol, A. D., Clark, P. A., & Roemmich, J. N. (2000). Growth and pubertal development in children and adolescents: Effects of diet and physical activity. *The American Journal of Clinical Nutrition*, 72, 521S-528S).
- Rosen, D. S. (2004). Physiologic growth and development during adolescence. *Pediatric in Review*, 194-200.
- Salvy, S. J., de la Haye, K., Bowker, J. C., & Hermans, R. C. J. (2012). Influence of Peers and Friends on Children's and Adolescents' Eating and Activity Behaviors. *Physiology & Behavior*, 106(3), 369-378. <http://doi.org/10.1016/j.physbeh.2012.03.022>
- Shearer, E. M., & Moore, B. A. (2013). The effects of physical activity on the physical and psychological health of adolescents. In O'Donohue, W. T., Benuto, L. T., & Tolle, L. W. (Eds.), *Handbook of adolescent healthy psychology* (534-565). New York, NY: Springer.
- Sieving, R. E., Eisenberg, M. E., Pettingell, S., & Skay, C. (2006). Friends' influence on

- adolescents' first sexual intercourse. *Perspectives on Sexual and Reproductive Health*, 38, 13–19.
- Smith, D. W., Trugg, W., Rogers, J. E., Greitzer, L. J., Skinner, A. L., McCann, J. J., Harvey, M. A. S. (1976). Shifting linear growth during infancy: Illustration of genetic factors in growth from fetal life through infancy. *The Journal of Pediatrics*, 89 (2), 225-230.
- Soliman, A., De Sanctis, V., & Elalaily, R. (2014). Nutrition and pubertal development. *Indian Journal of Endocrinology and Metabolism*, 18(Suppl 1), S39–S47.
<http://doi.org/10.4103/2230-8210.145073>
- Sugar, M. (Ed.). (1993). *Female adolescent development*. New York, NY: Brunner/Mazel, Inc.
- Tanner, J. M., & Whitehouse, R. H. (1976). Clinical longitudinal standards for height, weight, height velocity, weight velocity, and stages of puberty. *Archives of Disease in Childhood*, 51, 170-179. doi: 10.1136/adc.51.3.170
- Waldiner, R. J., Diguier, L., Guastella, F., Lefebvre, R., Allen, J. P., Luborsky, L., & Hauser, S. T. (2002). The same old song? Stability and change in relationship schemas from adolescence to young adulthood. *Journal of Youth and Adolescence*, 31(1), 17-29.
- Williams, S. L., & Mummery, W. K. (2012). Associations between adolescent nutrition behaviors and adolescent and parent characteristics. *Nutrition & Dietetics*, 69, 95-101.
doi: 10.1111/j.1747-0080.2012.01581.x
- World Health Organization. (2015). Healthy diet fact sheet.
<http://www.who.int/mediacentre/factsheets/fs394/en/>
- Ybarra, M. L., & Mitchell, K. J. (2005). Exposure to internet pornography among children and adolescents: A national survey. *CyberPsychology & Behavior*, 8(5), 473-486.