

THE PENNSYLVANIA STATE UNIVERSITY  
SCHREYER HONORS COLLEGE

ROSS AND CAROL NESE SCHOOL OF NURSING

The Impact of Delayed Puberty on Anxiety and Depression in Adolescents

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SPRING 2024

A thesis  
submitted in partial fulfillment  
of the requirements  
for a baccalaureate degree  
in Nursing  
with honors in Nursing

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## ABSTRACT

**ABSTRACT BACKGROUND:** Research on the timing of adolescent developmental changes, such as pubertal timing, has become more common as associated issues such as prevalence of childhood obesity have grown. **PURPOSE:** To determine if delayed pubertal timing increases risk for developing anxiety and depression in adolescents. **DESIGN AND METHODS:** Three databases (PubMed, CINAHL, and PsycInfo) were accessed to identify a comprehensive list of sources for this systematic review. The search terms were created in the spring of 2023. The search terms used to compile the sources were (Late onset puberty OR delayed Puberty OR Pubertal timing) AND (Psychology OR psychosocial factors OR PHQ9 OR anxiety OR Depression). Related MESH terms that PubMed, CINAHL, and PsycInfo compiled utilizing the search terms were also added to the search terms. 1,375 articles were retrieved, 42 articles were full-text reviewed, 6 articles were selected, 4 articles were selected from a secondary search, 2 articles were selected from a prior systematic review, and 2 articles were selected from a “cited by” list, all to compile a final total of 14 articles to be included in this review. The search criteria limited article searches to articles published in 2008. **RESULTS:** Current evidence shows mixed findings linking delayed puberty to anxiety and depression in adolescents. Eight out of the 14 articles found some association between late onset puberty and symptoms of depression and/or anxiety (Beltz, 2018; Carter et al., 2013; Conley & Rudolph, 2009; Crockett et al., 2013; Gaysina et al., 2015; Joinson et al., 2018; Rudolph et al., 2014; Weingarden & Renshaw, 2012). Because puberty is a known link to mental health issues, more research needs to be done. **DISCUSSION:** Since puberty is already a known link for mental health issues it is important that screening for mental health issues during this time be utilized in

both healthcare and school settings. Based on the current research, the question of whether there is a link between delayed-puberty and anxiety and depression is still unknown due to lack of research and consistency within research on the topic. Early intervention through the use of nonpharmacological intervention like cognitive behavioral therapy may be more beneficial as pharmacological interventions have high risk side effects associated with them. If future research does find a link between those with delayed puberty and increasing risk of anxiety and depression, it would be even more important to increase screenings within this adolescent population.

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## ACKNOWLEDGEMENTS

I would like to thank my thesis supervisor, Dr. Diane Berish, for helping me through the process of writing my thesis and continuous edits to present the best research. Even when I decided to change topics of research, she stuck by me and continued to guide me through the process of conducting and writing this systematic review. I thank you for encouraging me through this journey and providing substantial amounts of advice throughout the past year and a half. I also want to thank both my honors advisors throughout this process, Dr. Jao Ying-Ling and Dr. Cara Exten for your endless advice and words of wisdom over my years here at Penn State.

I would also like to thank Penn State University, Schreyer Honors College, and The Nese College of Nursing for providing the best environment to flourish over these past four years. I would also like to thank my family and friends who sat by my side through the long nights of research and writing. Their support will never go unnoticed as they are the reason I am where I am today.



## Chapter 1

Worldwide, one in seven adolescents between the ages of 10 and 19 experience a mental health disorder: anxiety and depression being the leading disorders under the mental health umbrella (World Health Organization, 2021). Anxiety is a broad term that describes different anxiety disorders, defined by “the excessive, ongoing anxiety and worry that are difficult to control and interfere with day-to-day activities” (Mayo Clinic, 2022). The Mayo Clinic defines depression as “a mood disorder that causes a persistent feeling of sadness and loss of interest” (Mayo Clinic, 2022). According to the Center for Disease Control and Prevention, in the United States alone, 42% of students ages 10-19 reported feeling persistently sad and 29% said they experienced poor mental health (CDC, 2023). Additionally, there is substantial co-morbidity between anxiety and depressive disorders within the adolescent population. In nursing, the adolescents age group is defined as ages 10-19. Prior research reports that between 10-15% of children with an anxiety disorder also concurrently have a depressive disorder, while 25-50% of children diagnosed with a depressive disorder also meet the criteria to be diagnosed with an anxiety disorder (Garber, 2011).

### **Significance of the Problem**

Feelings of anxiety and depression can greatly impact adolescents’ school performance, decision making, and their overall health as well as lead to social isolation from their peers (CDC, 2023). For example, mental health problems have been linked to risky behaviors in adolescents; including, increased risk of drug use, violence, and sexual behaviors that can lead to serious health issues like HIV and STDs (CDC, 2023).

There are many factors that may contribute to the development of adolescent mental health issues, including personal, environmental and biological factors. One of the potential biological contributors to anxiety and depression in adolescence is puberty. Puberty is associated with behavioral issues in males, while it has more of a psychological impact among females. Although a full understanding of the link between puberty and mental health issues is unclear, current theory involves a combination of both biological and sociological pathways within the body (Viner, 2014). Some believe that the sudden increase in hormones that synthesize pubertal maturation may impact several phases of brain development, as well as social cognition and peer relations, all of which have been linked with increased risk for mood and anxiety disorders. These biological changes in combination with nonpubertal events may affect mental health in adolescents (Pfeifer, 2021). Sociological theories include societal factors that influence perception of puberty. For example, the sexualization of the female body has greatly increased this effect of puberty and mental health issues within the female population. (Pfeifer, 2021).

Current research suggests that pubertal timing may have a different effect on anxiety and depression than puberty itself. Early pubertal timing or precocious puberty has extensive research literature as the link between obesity rates and precocious puberty have started to increase, especially within the United States (Li, 2017). On the other end of the spectrum is delayed puberty. The national Library of Medicine defines delayed puberty in females as, “the lack of breast development by 12 years and/or lack of menarche by 15 years and in males it is evident lack of testicular enlargement by 14 or more than 5 years between testicular enlargement and the end of puberty” (Tang, 2022). There are many potential causes for delayed puberty, the most common one being genetics related. Three percent of children are affected by delayed puberty, which represents a greater proportion of the adolescent population than those diagnosed

with type 1 diabetes at 0.35% of the population ((CDC, 2023). With the increase in the number of adolescents with precocious puberty, there may be change in the definition of “normal pubertal timing,” thus widening the gap and increasing the number of adolescents facing delayed puberty. Given that puberty is a known indicator for mental health struggles, research needs to address if variation from normal pubertal timing indicates a stronger association between puberty and anxiety and depression in adolescence. Addressing the possible negative outcomes associated with anxiety and depression starts with symptom screenings and accurately diagnosing at the onset of symptoms. (World Health Organization, 2021). Depression and anxiety are diagnosed through physical exams and lab tests to rule out any underlying causes and psychiatric evaluation. Because there are no labs indicating imbalances in bloodwork or diagnostic imaging of the brain that can determine a reason for the disorder, psychological evaluations gather information about the adolescents’ thoughts, feelings, and behaviors.

According to the DSM-IV, the gold standard for diagnosing mental health disorders, specific indicators for adolescent diagnosis of depression are that they may be irritable, fail to gain appropriate weight for growth, and they may have failed grades or failed to maximize their educational potential (DSM-IV, 2023). When diagnosed with anxiety, adolescents will often show more behavioral signs than cognitive signs, such as physical aches like a headache or stomachache, avoidance of specific situations or items, school difficulties, decline in school performance, and school noncompletion (Seigel, 2012). What makes diagnosing adolescents with depression and anxiety challenging is that they may have difficulty processing and expressing their emotions fully. Additionally, due to lack of early screenings and detection, many times the only cases of adolescent depression and anxiety diagnosed are those that are the most severe (Neavin, 2018).

Treatment for anxiety and depression are similar and have proved effective, especially when used at the earliest signs of mental health struggles (Neavin, 2018). For depression, the first line of treatment is psychotherapy in the forms of Cognitive Behavioral Therapy (CBT) and Interpersonal Therapy. The second line of treatment is pharmacological interventions in selective serotonin reuptake inhibitors (SSRIs). Unfortunately, pharmacological interventions may have very serious side effects like suicidal thoughts and inducing mania in patient with undiagnosed bipolar disorder (Neavin, 2018). Seigel and colleagues (2012) found that for anxiety, the first intervention is psychoeducation in which a provider teaches the patient and their support system about anxiety, its causes and symptoms and can help them identify triggering situations for the patient's anxiety. Psychotherapy in the form of CBT has been shown to be effective in the mental health setting with long term. SSRIs have also been shown to be effective in treating anxiety as well as depression, but may result in negative side effects (Seigel, 2012). The World Health Organization states that lack of adequate treatment for adolescent mental health can ultimately affect them during adulthood, leading to impacts on both physical and mental health and limiting their potential during adulthood (World Health Organization, 2021).

### **Aims and Purpose**

**Aim:** Does delayed pubertal timing increase risk for developing anxiety and depression in adolescents?

**Purpose:** If delayed puberty has a positive association with anxiety and depression in adolescents, delayed puberty may be a modifiable risk factor for reducing anxiety and depression. If more screening is done to detect delayed puberty, this may allow for earlier detection, diagnosis, and treatment of anxiety and depression in this population. Education for

healthcare providers, families, and students on delayed puberty and treatment may help decrease the prevalence of anxiety and depression in adolescents if the delayed puberty is caught and treated early. Non-pharmacological interventions like education about delayed puberty or psychotherapy may be preferred to using pharmacological methods of treatment for anxiety and depression in adolescents because of the possible side effects associated with them. SSRI medications do not cure anxiety and depression and can have adverse behavioral side effects, therefore identifying and treating delayed puberty may be more useful than treating anxiety and depression through pharmacological means (Garland, 2016). Providing patients with the treatment they need may lessen the negative impacts and ultimately improve quality of life.

## Chapter 2

### **Anxiety**

#### *Types of Anxiety*

There are five types of anxiety under the large umbrella term that affect adolescents most frequently: Generalized Anxiety, Social Anxiety Disorder, Separation Anxiety Disorder, Panic Disorder, and Specific Phobia Disorder. Although all five are very different, they share the common symptoms of fear, avoidance of the feared situation or thing, and anticipation or worry when they may have to face feared situation or experience. In a sample of 10,123 adolescents, 2.2% were diagnosed with generalized anxiety disorder, 9.1% diagnosed with social phobia, 19.3% had a specific phobia, 2.3% has panic disorder, and 7.3% of the adolescents were diagnosed with separation anxiety. Almost 40% of the sample had one or more types of anxiety (Seigel, 2012).

Generalized anxiety is the broadest type of anxiety commonly diagnosed in adolescents. The DSM-IV-TR defines generalized anxiety disorder as, “nonspecific, uncontrollable worry occurring with one (only for children) or more of the following symptoms: restlessness, fatigue, difficulty concentrating, irritability, muscle tension, sleep difficulties” (Seigel, p. 3, 2012). Another type of anxiety is social phobia, also known as social anxiety disorder. Social anxiety disorder is defined as the “fear of humiliation or embarrassment in a social or performance situation that involves possible scrutiny by others” (Seigel, p. 3, 2012). In this disorder the child will have an immediate reaction to the exposure inducing symptoms of a panic attack like crying, tantrums, freezing, or clinging to a parental figure. A challenge with diagnosing social anxiety disorder is that psychiatrists or psychologists need to make sure that the child can have appropriate conversations and relationships to rule out any developmental delays. The anxiety also must be present with both peers their own age as well as adults.

Separation anxiety is most prevalent in adolescents, and it is anxiety surround the separation from home or from a person of comfort. It is diagnosed if the adolescent exhibits three or more symptoms: excessive distress when separation occurs or is anticipated, worry about attachment figures getting hurt, refusal to go to school or other places because of fear of separation, nightmares about separation, experiencing physical symptoms during separation or when anticipated (Seigel, 2012). Panic disorder, which often accompanies one of the other four disorders, is another common anxiety disorder. This is classified as the criteria for a recurrent unexpected panic attack, which is the “sudden onset of four or more of the following symptoms: racing/pounding heartbeat, sweating, trembling/shaking, choking feeling, chest pain, nausea/stomach, feeling lightheaded, derealization/depersonalization, fear of losing control, fear of dying, numbness or tingling sensations, chills or hot flushes” (Seigel p. 4, 2012).

Finally, specific phobia is a type of anxiety disorder where a child exhibits anxiety due to fear of a specific object or experience. This can lead to the signs and symptoms associated with generalized anxiety. Often, it will also lead to avoidance of the specific object or experience. For this specific type of anxiety, exposure therapy seems to be most effective. Exposure therapy includes exposing the adolescent to the feared object or situation in hopes that they will become desensitized and anxiety around it will lessen (Seigel, 2012).

### *Causes of Anxiety*

The biology behind anxiety is not well understood and therefore still a highly researched topic. Researchers believe that it is connected to the regulation of the amygdala (McClure, 2006 & Thomas, 2001). The amygdala is part of the brain that regulates emotions. Two studies done by Thomas and McClure (2001& 2006) found that children with generalized anxiety disorder had greater amygdala activation when presented with a fearful face as compared to a neutral or happy face. Thomas and McClure (2001 & 2006) also showed over activation of the prefrontal

cortex as well. It is yet unknown whether there is an anatomical difference in the shape of the amygdala in children with anxiety disorders (Seigel, 2012). Researchers believe that many environmental and genetic factors may also play a part in how well a child reacts to treatment. For example, in one study increased caregiver strain and familial history was significantly associated with the outcomes of increased diagnosis of anxiety disorder (Wehry, 2015).

### *Diagnosing Anxiety*

When utilizing diagnostic tools to diagnose a child with anxiety, the provider will first start with a self-report or a parent-report questionnaire. Second, the provider will conduct an interview with the patient and parents. Many times, primary care providers will only perform these evaluations if there is a concern about anxiety made through parent reports, symptom reports, or behavioral concerns. Self-report measures used include Multidimensional anxiety Scale for Children (MASC), the Screen for Childhood Anxiety Related Emotional Disorders (SCARED), or the Revised Children's Manifest Anxiety Scale (RCMAS) which are used in ages 8-19 years of age and then 6-19. Most doctors will use the Anxiety Disorders Interview Schedule for DSM-IV: Child and Parent Version (ADIS-C/P) or the Schedule for Affective Disorders and Schizophrenia for School-age Children (KSADS) when interviewing a patient for anxiety (Seigel, 2012).

One of the largest differences in diagnostic criteria when evaluating children for anxiety compared to adults is that they must only exhibit one associated symptom while adults must experience three. This is due to the lack of understanding in a child that the fears they may have been arbitrary or irrational. It can also be difficult for both the parents and the providers to determine if the fears are rational for appropriate development of the child. One way to determine this is that a child exhibiting signs and symptoms of anxiety will have persistent functional impairment that may interfere with how they perform at school, home, or with peers.



Another difference is that children may have more physical symptoms rather than psychological symptoms of anxiety (Seigel, 2012).

### *Treatment for Anxiety*

Treatment for anxiety can be highly effective in the adolescent population if caught at the earliest signs. Treatment for anxiety includes both pharmacological and nonpharmacological interventions. The first line intervention is psychoeducation in which a provider teaches the patient and parents/ support system about anxiety, causes for anxiety, the physical signs, and can help them identify triggering situations for the patient's anxiety (Wehry, 2015).

### *Non-Pharmacological Treatments for Anxiety*

Psychotherapy in the form of cognitive behavioral therapy (CBT) has been shown to be effective in the mental health setting primarily with long-term use. CBT works to cognitively restructure the brain by naming the anxiety provoking thoughts and then challenging them. The psychologists or psychiatrists will work with the patients to practice coping skills when facing fear or anxiety-provoking situations and provide exposure to those situations. Exposure can be in the form of imagining, simulating, or purposefully putting oneself into the anxiety situation to desensitize to fear. For Social phobia specifically, Social Effectiveness Therapy (SET-C) was seen to be more effective with faster rates of succession than no treatment or treatment with fluoxetine (Wehry, 2015).

### *Pharmacological Treatments for Anxiety*

Pharmacological interventions for anxiety include the use of serotonergic antidepressants, which effect serotonin levels in the brain to decrease fear responses. Multiple clinical trials have demonstrated some SSRIs, which include fluoxetine, fluvoxamine, sertraline, and escitalopram, have benefits that outweigh the risks in treatment, but there are many other SSRI's and SNRI's that do not (Garland, 2016). Fluoxetine was seen to reduce symptoms of social phobia in

children with multiple anxiety disorders when started with prescriptions of 10mg/day and then increased slowly up until 40 mg/day were given over a 12-week period. Along with the black box warning, many of the patients experienced side effects like nausea, abdominal pain, drowsiness, and headaches. Sertraline is another highly prescribed SSRI and, in some research, it is seen to have less side-effects but still has the black box warning for suicidal ideation. What researchers have found is that SSRI use in treatment for anxiety has shown less suicidal thoughts and behaviors, when compared to its use in treatment for depression (Garland, 2016). When considering the use of serotonergic antidepressants, the risks associated with them should be greatly considered, since the effects of long-term use are lacking research as well as long-term use on a developing brain. If early intervention includes utilizing non-pharmacological intervention, the patients may experience more beneficial outcomes in the long run as they were not exposed to the side effects of pharmacological interventions.

### **Depression in Adolescents**

Depression is a cluster of symptoms that often cause impairment in daily living for an adolescent. In adolescents, depression is a major risk factor for suicide which is the second leading cause of death in the adolescent age category (Thapar, 2012). Depression has also been found to be linked with risky behaviors like increased rate of smoking, substance misuse, and obesity rates. It is often under diagnosed, which is why the DSM-IV makes the exception that irritability may be a diagnostic factor rather than depressed mood for adolescents compared to adults. Similar to anxiety, depression in adolescents often presents itself in physical forms like eating disorders, refusal to attend school, decline in school performance, behavioral problems, and physical symptoms. Epidemiologists have found that there is a large increase in the prevalence of cases of depression in post-pubertal adolescents. Depression in adolescence also

has a very strong link to recurrent diagnoses in adulthood, most likely because of lack of appropriate treatment in adolescence (Thapar, 2012).

### *Types Of Depression*

The national Institute of Mental Health names five different types of Depression: Major Depression, Persistent depressive disorder, Perinatal Depression, Seasonal affective disorder, and Depression with Symptoms of Psychosis (National Institute of Mental Health, 2023).

Adolescents can experience four out of the five disorders pre-puberty but can only experience perinatal depression if they become pregnant after sexual maturity.

Major depression is described as “depressive mood or loss of interest for most of the time for at least 2 weeks that interfere with daily activities” (National Institute of Mental Health, p. 1). Persistent depressive disorder is similar to major depression, but it has less severe symptoms of depression that persist for more than 2 years. Seasonal affective disorder is depressive symptoms associated with the season, timing of the year, or weather. It usually persists during late fall through winter until spring. Depression with symptoms of psychosis is the most intense form of depression and the most highly associated with suicidal thoughts. The patient can experience many symptoms of psychosis in which they may have disturbing or false thoughts and hallucinations (National Institute of Mental Health, 2022).

### *Causes of Depression*

As with anxiety, here are many factors that play a part in developing depression. For example, familial and genetic risks, gene-environment relations, brain and neuroendocrine mechanisms, and psychosocial risk factors, etc. (Caplan, 2014). In adolescents, one frequently used theoretical framework is the vulnerability-stress framework. Under this framework, stressors may activate depressive symptoms, with certain factors influencing the way a child reacts biologically to the stressor. Stressors can be defined as both environmental events or

chronic conditions that may influence both physical and psychological health. Researchers have found that those suffering from depression have experienced at least one significant negative life event within the month of depression symptom onset. What they also have found is that stressful events not only predispose the child to depression, but personality characteristics like depressive or negative moods seem to be connected to creating more stressful events for oneself, thus increasing depressive symptoms even more (Caplan, 2014).

Researchers have also found a genetic link to depression. One of the strongest predictors is having a parent diagnosed with major depressive disorder. A study conducted with twins indicated that the heritable gene for depression may be prevalent by age 11 (Caplan, 2014). In a twin study done in 1999, by Silberg, they found that risk for depression increased after puberty for females, but not before. Personality and temperament also seem to be a risk factor for developing depression in adolescents. Neuroticism is the biggest vulnerability in developing depression and facing stressful life events (Hankin, 2006). Biological research looking at depression has found reduced bilateral amygdala activity, as well as abnormal pituitary hippocampal and amygdala volumes in patients with depression (Caplan, 2014).

### *Diagnosing Depression*

Diagnosis for depression usually starts with screening those in high-risk groups based on predisposing factors. One common screening tool is the patient health questionnaire (PHQ-2), a two-question screening for depression in adults and adolescents in primary care. The strength and difficulties questionnaire (SDQ) may also be used to screen for attention deficit hyperactivity disorder (ADHD) in addition to Depression. There are also the short mood and feeling questionnaire and the children's depression inventory that may also be used. If the adolescent scores above the evaluated cut-off and shows initial signs and symptoms of depression, the provider must complete a full clinical assessment. They will evaluate the severity

and duration of the symptoms and how they affect outside situations or participation in daily activities. Most of the time the provider will not only ask the child questions but will also ask the parent while they are in the room or separately. The provider will need to rule out any other disorders: bipolar disorder, adjustment disorder, dysthymic disorder, and schizophrenia (Thapar, 2012).

### *Treatment for Depression*

Treatment for depression is very similar to anxiety; it is broken down into nonpharmacological and pharmacological interventions.

### *Non-Pharmacological Treatments for Depression*

The first line of treatment is psychotherapy in the forms of Cognitive Behavioral Therapy (CBT) and Interpersonal Therapy (IPT). These are recommended for patients 13 years and above because of the emotional and psychological development needed to discuss their concerns with a trained psychologist or psychiatrist. Interpersonal therapy is less studied than CBT and is therefore not used as often but focuses on communication skills and how to build relationships. Unfortunately, there is limited supply of pediatric trained professionals that can provide these services and lacks in meeting the demands for them (Neavin, 2018).

### *Pharmacological Treatments for Depression*

Selective Serotonin Reuptake Inhibitors (SSRI) are the second line of treatment for depression and are known as pharmacological methods of treatment. Fluoxetine and Escitalopram are both SSRIs used within the pediatric population. Fluoxetine is indicated for ages 8-18 years of age and Escitalopram is indicated for ages 12 to 17. Unfortunately, pharmacological interventions may have negative side effects as indicated by a Black Box warning for an increased risk for suicide, especially during the first few weeks of administration and then again with consequent dose changes. They also can induce mania in patients with

undiagnosed bipolar disorder with has been seen to be comorbid with depression. Through research they have found that concurrent use of fluoxetine and CBT have been most useful in treating Depression (Neavin, 2018).

### **Stigma Surrounding Mental Health in Adolescents**

Stigma is a negative association with a particular event or situation (Rossler, 2016).

Mental health stigma is a more relevant topic in society as it is becoming more widely accepted to acknowledge mental health issues. Historically, mental illness was seen as a plague which led to the killing and imprisonment of innocent people suffering from an illness they could not control. Because of these circumstances, for many years mental health went not talked about for fear of the repercussions (Rössler, 2016).

During the period of adolescence, children grow more independent from their parents and support systems and are trying to understand and cope with an ever-changing environment around them (Bulanda, 2014). Mental health issues may make navigating these difficult times even more stressful for an adolescent. Stigma surrounding mental health may be due to cues, stereotypes, prejudice, and discrimination, all of which are social-cognitive processes (Bulanda, 2014). Much of these stigmatizing attitudes are due to public opinions and are perceptions of what they believe mental illness includes (Fretian, 2021). Stigma around mental health has been researched for years, but just recently they have started to research interventions to decrease stigma regarding this important topic (Bulanda, 2014). The most significant issue with negative stigma around mental health is that it causes adolescents to not seek help and ultimately leads to more negative effects on top of the mental health issues they already have present (Fretian, 2021). It can impact self-esteem and social interaction between self and peers. Adolescents with mental health issues avoid treatment to avoid their mental illness and the stigma around it, even

though treatment interventions work best when used early (Bulanda, 2014). Interventions to provide education of mental health literacy in schools have provided the most evidence in improving stigma around mental health in adolescents (Fretian, 2021). This may also increase the importance of screenings within the healthcare industry so that providers may identify who is at elevated risk, for example those with pubertal off-timing, so that the healthcare providers may reach out to them.

### **Covid-19's Effect on Mental Health in Diagnoses**

The prevalence of mental health diagnoses in adolescents has been on the rise and this rate increased during the pandemic (Temple, 2022). Additionally, adolescents were not seeking help during this time, either formally or informally, due to mandated lockdowns. Increased instability for many family units may also negatively impact adolescents both physically and mentally. Increased family conflict and parental stress may be associated with decreased academic achievement, increased mental health symptoms, and increased suicide rates. The Centers for Disease Control and Prevention (CDC) found that 37.1% of US high school students reported poor mental health during the Covid-19 pandemic (CDC, 2021). Although there was an increasing rate in mental health diagnoses at this time, the number of resources for treatment was decreasing as the healthcare system struggled with worker retention. Negative coping strategies like substance use and peer avoidance may be a reason for these increasing mental health shifts due to Covid-19 (Temple, 2022).

### **Biology of Puberty**

Puberty, a time when mental health issues often arise, is a shared experience among almost everyone, even though it may be different for each person (Wood, 2019). Puberty is the transition from childhood to adulthood, through many factors influencing the physical and

mental body. Biologically, it is the time when an individual becomes sexually mature and can reproduction. Researchers have yet to find one attributing factor the can kickstart puberty, yet they believe it is a cascading effect of multiple factors that initiate puberty. Puberty is stimulated by the central nervous system and the hypothalamus-pituitary axis (HPA) through the release of luteinizing hormone (LH) and follicle stimulating hormone (FSH). Sex steroids increase in response to LH and FSH release, thus causing physical changes in genitalia, skin, breast, brain, muscle, and bone. This period is also marked by linear growth in bones (growth spurt). Researchers believe that the timing of puberty is affected both genetically and environmentally. About 50% to 80% of it is genetically influenced while environmental factors will play a role in the other part of initiation. Factors such as socioeconomic status and obesity for example have been linked to earlier pubertal timing (Wood, 2019).

### *Measuring puberty*

When identifying the stages of puberty, most health care providers will use the Tanner Staging System (Wood, 2019). This system uses pictures of genitalia and pubic hair development in males, and breast and pubic hair development in females in a series of stages. The provider will ask the child what stage they are in based on what pictures resemble them, to promote independence within the child so that they feel most comfortable. Some providers will complete examinations to ascertain the staging that the child is reporting. Biologically, when males develop a volume of 4 milliliters of testicular volume and females start to develop breast tissue, they are in the onset of puberty. Males tend to growth later within the staging, while females grow on the earlier side of pubertal development, most likely on the downhill slope of height growth by the time they develop menarche (Wood, 2019).



## **Delayed Puberty and its Causes**

Delayed puberty in females is, “the lack of breast development by 12 years and/or lack of menarche by 15 years and in males it is evident lack of testicular enlargement by 14 or more than 5 years between testicular enlargement and the end of puberty” (Tang, p. 24, 2022). Delayed puberty is usually genetically linked, meaning that a child who is experiencing delayed puberty most likely had a parent or first degree relative that followed a similar pubertal timeline as themselves. This is known as constitutional delay in puberty and growth and is more prevalent in males than in females. For normal pubertal timing, the growth spurt will usually occur between stages 3 and 4 when utilizing the Tanner staging, but for males with constitutional delay in growth and development, it occurs much later in stages and usually the individual will not reach peak height until 17 or 18 years of age. Another cause for delayed puberty is functional hypogonadotropic hypogonadism. This state is brought on by multiple stressors on the body. It can include chronic illnesses like sickle cell anemia and cystic fibrosis or nutritional deficiencies like eating disorders or child maltreatment within the home setting. Panhypopituitarism is another cause for functional hypogonadotropic hypogonadism but is usually identified early because it also affects growth hormone deficiencies (Tang, 2022).

Isolated hypogonadotropic hypogonadism physiologically occurs when there is a permanent delay in the maturation of the Hypothalamic-pituitary-gonadal (HPG) axis. An MRI can rule out any tumors or lesions on the HPG axis that may be causing delay in maturation and therefore a decrease in sex hormones. In males it can also be because of gonadal failure, which is either acquired or congenital, and in females it is a result of primary ovarian failure which is also acquired or congenital. Acquired forms for both males and females include radiation or surgeries that alter the anatomy of the gonads or ovaries. For congenital types, males can be diagnosed with Klinefelter’s syndrome and women may be diagnosed with Turner’s Syndrome. Both

syndromes occur due to abnormalities in the sex chromosomes within a cell. Males can also have gonad failure due to testicular regression syndrome (TRS), although researchers are not sure what causes TRS because in utero the testes look normal (Tang, 2022).

Isolated hypogonadotropic hypogonadism with anosmia (loss of smell) may be due to Kallmann syndrome. GnRH, the hormone released to start the cascade of pubertal hormones originates in olfactory tissue. In Kallmann syndrome there is an interruption in the olfactory neurons, causing anosmia and reduction in? GnRH development and transfer to the hypothalamus (Gohil, 2020).

### **Diagnosing Delayed Puberty**

When diagnosing an adolescent with delayed puberty, the healthcare provider will do a full medical history of both the patient and their family. They will also do a medication reconciliation to make sure no medications could be the cause. The provider will also evaluate development and assess milestones that the patient may have missed. The patient's predicted height as well as growth chart should be plotted so that growth curves may be evaluated before ordering labs or diagnostic imaging (Tang, 2022).

If diagnostic imaging is needed, an x-ray of the left wrist to evaluate bone age will be taken. Other imaging may include an ultrasound to look at the ovaries, uterus, and testes to make sure there are no abnormal findings like tumors. The provider may also order blood work to evaluate levels of hormones involved in puberty including LH, FSH, testosterone for males, and estradiol in females. They will also test the blood for thyroid hormones as well. If a pediatric endocrinologist is involved, they may order a GnRH stimulation test, but it is not usually part of an original work up (Tang, 2022).

### **Treatment of Delayed Puberty**

Treatment is not always an option, but when it is, treatment for delayed puberty includes administering sex steroids, like testosterone or estrogen and progesterone, to induce puberty in these adolescents and replicate it as closely to natural puberty as possible. Currently, there is not a universal treatment plan utilizing sex steroid, as puberty is so different between individuals. Pediatric endocrinologists use specialized formulas to determine the amount that should be administered of estrogen and progesterone in females and testosterone in males (Gohil, 2020). Sex steroid therapy utilized for constitutional delay of puberty and growth is usually started due to psychosocial issues, as parents seek medical help for the delay in growth. This may be due to negative interactions with peers (bullying), decreased self-esteem, and anxiety about growth rate or body appearance. Treatment with sex steroids in males has been shown to be effective in psychosocial outcomes with limited side effects. (Palmert, 2012). Although oral contraceptives do contain estrogen and progesterone, they are contraindicated for the use in treating delayed puberty (Gohil, 2020).

### **Puberty and Mental Health Link**

Mental health problems are increasing within the adolescence population over the past four years and has prompted researchers to evaluate life experiences that occur during this time period (Viner, 2015). One possible link between this time and mental health changes is puberty, as shared experience among most adolescents (Viner, 2015). Although the link is still unclear, scientists believe it is due to many different factors including biological and psychosocial. In a study done by Angold (1998), they found that puberty may decrease depressive symptoms in males, while increasing them among the female population. In a study done, they found that for

each increasing stage on the Tanner scale the more at risk both males and females were for developing a panic attack (Hayward et al.,1992).

Researchers have classified potential causes into two categories: psychosocial mechanisms and biological mechanisms. Psychosocial mechanisms that may connect puberty to mental health disorders are the differentiation from peers during puberty, adopting an adult lifestyle at an earlier onset, and limiting educational progression because of puberty (risk of pregnancy at a young age). Biological mechanisms discuss the impact of pubertal hormones on the central nervous system and genetic mechanisms that may be activated during puberty. Although puberty has been linked to mental health outcomes, it is still unknown whether pubertal timing has an association through the same psychosocial and biological links as puberty (Viner, 2015).

### **Nursing Role in Adolescent Mental Health Care**

The adolescent time period is marked by a varied amount of change over a rather short time period. To provide the utmost care for adolescents suffering from mental health disorders, nurses will work within an interdisciplinary healthcare team including psychologist, primary providers and other healthcare staff. One of the greatest aspects of this role of nursing is that the nurses will take the time to gain a deep knowledge about their patient. The nurses are advocates for their patients and usually take a more holistic approach when treating the patients. Research has shown that nursing practice within acute care psychiatric facility is lacking congruency. This is due to the idea that each patient's care is individualized and that through advanced practice within this field, the nurses adapt many different types of therapeutic models of care. Each nurse cares for their patients slightly different, but all with the same goal of promoting health and well-being for their patients (Baldwin, 2002).

## Summary

Mental health is a highly discussed topic within society currently and there is a multitude of research on many different aspects because of its prevalence. The types, causes, diagnosis, and treatment of anxiety and depression ultimately vary from child to child, but overall encompasses many of the same problems. Stressful environments, genetic predispositions, and many other factors can trigger anxiety and/or depression, and both are treated by forms of nonpharmacological and pharmacological interventions including cognitive behavioral therapy and selective serotonin reuptake inhibitors. Puberty, a potential indicator for the start of mental health disorders, is a commonality that can be accounted for in almost all adolescents. Marked as a short time period of great change, physically and mentally, puberty is staged through primary care providers using the Tanner scale. Late or delayed-onset puberty may or may not increase that risk for anxiety and depression during puberty. This study aims to conclude if delayed pubertal timing increase risk of developing anxiety and depression in adolescents, and if so an increase method of screenings needs to conduct in both health care settings, but in school as well.

## Chapter 3

### Methods

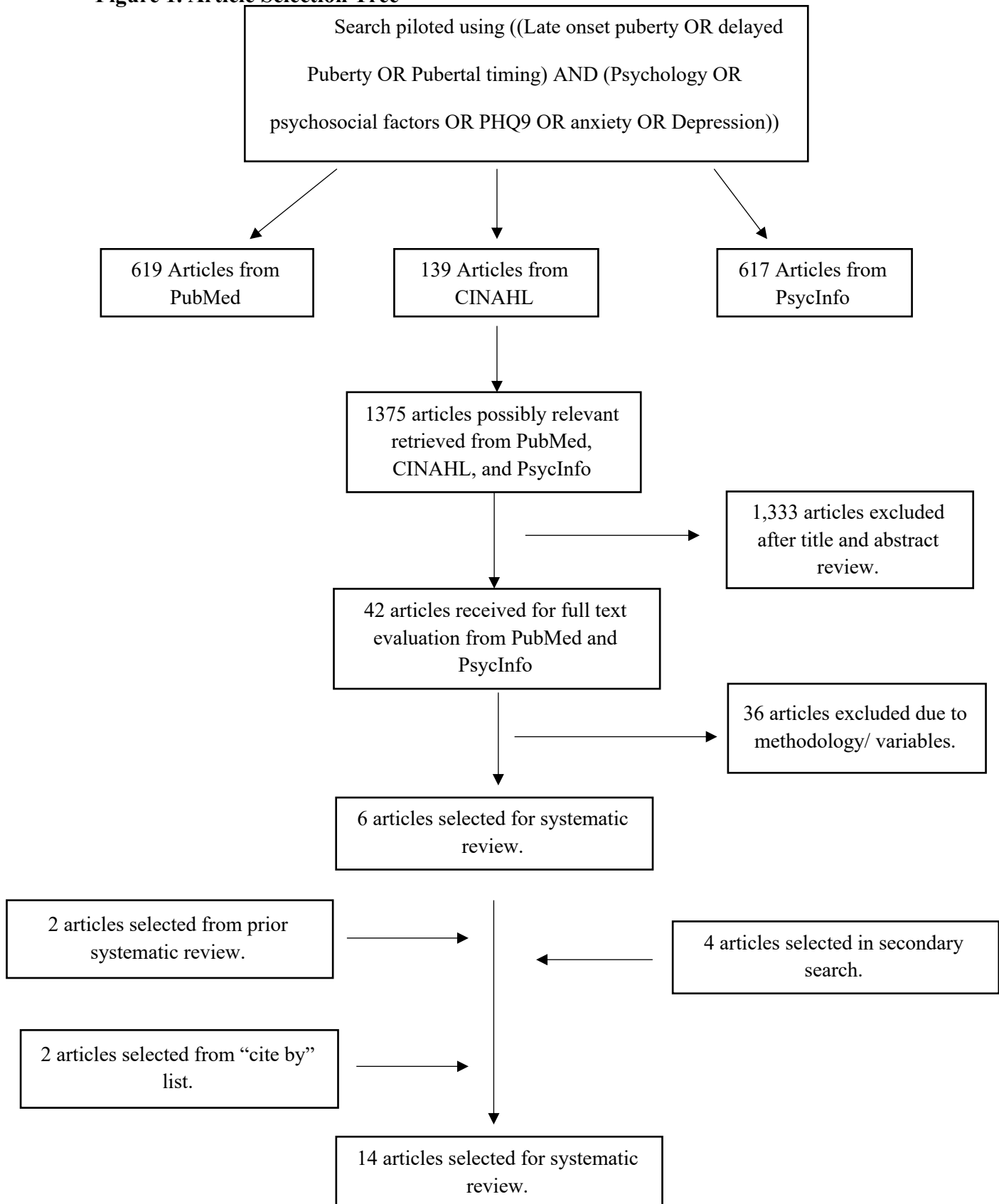
This Chapter will explain the search methods that were utilized to configure the list of sources that would be reviewed to analyze the link between delayed puberty and anxiety and depression in adolescents. The methods of this search were overseen by both a thesis advisor as well as an expert librarian to conduct the most complete search possible.

Three databases (PubMed, CINAHL, and PsycInfo) were accessed to identify a comprehensive list of sources for this review. The search terms were created in the spring of 2023. The search terms used to compile the sources were (Late onset puberty OR delayed Puberty OR Pubertal timing) AND (Psychology OR psychosocial factors OR PHQ9 OR anxiety OR Depression). Related MESH terms that PubMed, CINAHL, and PsycInfo compiled utilizing the search terms were also added to the search terms. The same search terms were used in each of the three databases. The search criteria limited article searches to articles published in 2008. As seen in Figure 1, the Article Selection Tree, PubMed retrieved 619 articles, CINAHL retrieved 139 articles, and PsycInfo retrieved 617 articles, resulting in 820 possibly relevant articles. After initial title, abstract review, and duplication extraction, 778 articles were excluded from the search. 36 articles from PubMed and 6 articles from PsycInfo went under a full review of methodology and results. A full review was conducted of the 42 remaining articles, after which 36 were excluded. The 36 articles were extracted due to lack of enough information on the late puberty variable, leaving 6 articles for the systematic review. 2 articles were added from the source list of a prior systematic review, 2 articles were added from a “cited by” section in PubMed from another source, and 4 were added from prior systematic reviews. These processes resulted in a final count of 14 articles for inclusion in this review. Two other reviewers looked at

the articles selected, and all sources were discussed and finalized between self, an expert librarian, and thesis advisor.

The inclusion criteria for the search were (1) published within the past 15 years, 2008-2023, (2) used human subjects, (3) original research, and (4) used delayed puberty as one of the variables. The first search conducted only included research from the past ten years, but there was a lack of research conducted within the last ten years, so the search was expanded to include research conducted within the last 15 years. This may be due to the increase in research on obesity rates increasing and its link to precocious puberty. The research must include human subjects because of the diagnostic criteria for depression and anxiety in adolescents. One of the mesh terms used in the search was “pubertal timing,” which opened the research to both early puberties, “on-time” puberty, and late puberty, so it was important to make sure that late puberty was one of the variables evaluated when looking at anxiety and depression scores. All the studies chosen were ranked using the Johns Hopkins Nursing Evidence-Based Practice Evidence Level and Quality Guide (Dang et al., 2022). Based on the research variables, and the lack of ability to complete random control trials or experimental trials, all the studies utilized were Level II evidence.

**Figure 1. Article Selection Tree**





**Table 1: Evidence Table**

Source	Objective of Study/ Relationship to Thesis	Design Type	Study Design and Measurements r/t relevant variables	Study Sample/Setting	Study Intervention/ limitations	Key Findings
<p>Boden, J. M., Fergusson, D. M., &amp; Horwood, L. J. (2011). Age of Menarche and Psychosocial Outcomes in a New Zealand Birth Cohort. <i>Journal of the American Academy of Child &amp; Adolescent Psychiatry</i>, 50(2), 132-140.e5.  <a href="https://doi.org/10.1016/j.jaac.2010.11.007">https://doi.org/10.1016/j.jaac.2010.11.007</a></p>	<p>-Looked at age of menarche and its associations to many variables one including mental health</p>	<p>-Longitudinal birth cohort</p> <p>-Data gathered during the Christchurch Health and Development study</p>	<p>-Studied at ages of birth, 4 months, 1 year, annually till age 16, and then again at 18, 21, 25, and 30 years of age</p> <p>-Parents asked at what age their child had their first menstrual cycle</p> <p>-Took into account covariate factors: family socioeconomic status, family stability, functioning, and parental maladjustment, Child abuse exposure, Individual characteristics and behaviors</p> <p>-Depression and Anxiety evaluated using the CIDI to assess DSM-IV symptoms' criteria for diagnoses of major Depression and a spectrum of anxiety disorders</p> <p>- Took into covariates: maternal education level, family living standards, family socioeconomic status, Measures of Family</p>	<p>-New Zealand</p> <p>-497 Female subjects (78.9% of the starting sample)</p>	<p>- can be subject to recall bias due to results coming from self-reporting</p>	<p>-No statistically significant data suggesting an associated between age of menarche and major depression and anxiety disorders</p> <p>-Early onset of puberty showed 38.4% of the population reporting signs of depression, which then decreases to 30.9% to the middle timing, and then back up to 32.5% of subjects who developed delayed puberty all by the age of 18. This showed a p value of greater than .50 which means that it is not statistically evident.</p> <p>-The p-value for anxiety disorders was &lt;.10 which shows slightly more statistically evident data, but it actually decreases 54.1% to 39.3% between early and late onset</p>

			Stability, Family Functioning, and Parental Maladjustment, Individual Characteristics and Behavior			
Rudolph, K. D., Troop-Gordon, W., Lambert, S. F., & Natsuaki, M. N. (2014). Long-term consequences of pubertal timing for youth depression: Identifying personal and contextual pathways of risk. <i>Development and Psychopathology</i> , 26(4pt2), 1423–1444. <a href="https://doi.org/10.1017/S0954579414001126">https://doi.org/10.1017/S0954579414001126</a>	-differences in females and males in pubertal timing and the link to depression	- longitudinal over a 4-year period	<p>-Used the Pubertal Development Scale that included measurements of growth spurt, body hair, skin changes, voice changes, facial hair, breast development and age of menarche to assess puberty; given score of 1 to 4; higher score meant earlier puberty</p> <p>-Also utilized the Tanner Staging Scale</p> <p>-Depression was measured using the Schedule for Affective Disorders and Schizophrenia for School-Age children to both the youth and caregivers, then researchers compared it to the DSM-IV criteria (22% met diagnostic criteria and another 25% experienced depression symptoms</p> <p>-Used a varied population and took into account SES and age of participants for covariate.</p> <p>-Latent growth curve analyses were conducted using Mplus software to determine if pubertal</p>	<p>-167 youth, 86 girls and 81 boys</p> <p>-77.8% Caucasian, 22.2% Non-Caucasian</p> <p>-Mean age was 12.41 at Wave 1</p> <p>-Recruited based on Children’s Depression Inventory Score</p> <p>-United States</p>	-talks about the limiting research and overreliance on longitudinal and cross-sectional studies done within this field of research	<p>-No difference in depression scores among females to males at any timing</p> <p>-Late maturing boys had the second highest rate of initial depression, while late maturing girls had the lowest initial depression scores. There was a significantly higher rate of depression in late maturing boys than late maturing girls with a p-value of 0.02.</p>

			<p>timing had an association with depression (initial levels), changes of depression, and then enduring effects of depression</p> <p>-Chi-square difference tests were used to compare models</p>			
<p>Barendse, M. E. A., Byrne, M. L., Flournoy, J. C., McNeilly, E. A., Guazzelli Williamson, V., Barrett, A.-M. Y., Chavez, S. J., Shirtcliff, E. A., Allen, N. B., &amp; Pfeifer, J. H. (2022). Multimethod assessment of pubertal timing and associations with internalizing psychopathology in early adolescent girls. <i>Journal of Psychopathology and Clinical Science</i>, 131(1), 14–25. <a href="https://doi.org/10.1037/abn0000721">https://doi.org/10.1037/abn0000721</a></p>	<p>-associations between pubertal timing and mental health outcomes</p>	<p>- longitudinal study- 18 months</p>	<p>- Used the Pubertal development Scale and then asked if the parent thought her puberty was earlier or later than most girls her age; along with tanner state LD, physical maturation scores, and hormone levels (saliva samples)</p> <p>-Participants were screened for Depression using the Center for Epidemiologic Studies Depression Scale for Children and for anxiety using the Screen for Child Anxiety Related Disorders</p> <p>-Participants were then evaluated at ages 10-13 at wave one and then again at wave 2 18 months later using the Schedule for Affective Disorders and Schizophrenia</p> <p>- Took Covariant into account: Internalizing psychopathology, early life stress (ELS), and BMI at time 1</p>	<p>-174 females, recruited from schools. -Ages 10-13  -66% white, 34% non-white  -United States</p>	<p>-limited recall bias by using a continuous variable method instead of 3 categories</p>	<p>- Did not find any significant associations with age of menarche and depression and anxiety</p> <p>-When utilizing Tanner Staging as form of pubertal measurement, results were the most statistically significant</p> <p>-This means that psychosocial mechanisms may be affected by visible physical changes of puberty rather than hormonal changes</p>

			-performed bootstrapping to determine if the associations were statistically significant			
Gaysina, D., Richards, M., Kuh, D., & Hardy, R. (2015). Pubertal maturation and affective symptoms in adolescence and adulthood: Evidence from a prospective birth cohort. <i>Development and Psychopathology</i> , 27(4 Pt 1), 1331–1340. <a href="https://doi.org/10.1017/S0954579414001448">https://doi.org/10.1017/S0954579414001448</a>	Pubertal timing's effect on affective timing, in adolescents and evaluate in adulthood	Longitudinal prospective birth cohort- 53 years	-Focused on group two and four: which are symptoms in adolescents only, and symptoms in adolescents and adulthood  -Age of menarche was used to describe pubertal timing in females: females were broken into categories based on age of menarche  -pubertal timing for males was measure by visible pubic hair, axillary hair, development of genitalia, and voice breaking, which broke them up into four categories from fully mature, to advances puberty, early puberty, and infantile  -Affective Symptoms were screened using the Rutter teacher questionnaire in adolescences. Then they were reevaluated again at age 36 using the psychiatric Symptoms frequency scale - Affective symptoms were broken down into absence of symptoms occasional symptoms,	-England  -1972 men (69% of original study) and 1809 women (71% of original study)	-because pubertal timing was determined by age of menarche for grouping of female subjects, it can cause some limitations because a lot of factors influencing affective symptoms are the visible changes of puberty in adolescents	-saw a large difference in males vs females in levels of affective symptoms. Those females having late onset maturation had less of a likelihood to develop adult onset, but no difference in adolescent onset when compared linearly to early/on-time maturation. In males, late pubertal timing was associated with increased risk of affective symptoms in adolescent and then continuing into adulthood.

			<p>moderate symptoms, and severe symptoms.</p> <p>-Took covariates into account: Birth weight, SES activity, birth order, and occupation at ages 4 and 15</p> <p>-multinomial logistic regression models were fitted to determine associations</p>			
<p>Pu, Y., Tang, Y., Shi, Q., &amp; Wang, H. (2022). The association between pubertal timing and quality of life among children and adolescents: A cross-sectional study in Chongqing, China. <i>Environmental Health and Preventive Medicine</i>, 27, 49. <a href="https://doi.org/10.1265/ehpm.22-00159">https://doi.org/10.1265/ehpm.22-00159</a></p>	<p>-Relationship between pubertal timing and quality of life in children and adolescents</p>	<p>Cross-sectional Study: stratified cluster sampling method</p>	<p>-Pubertal developmental scale was used to assess pubertal timing</p> <p>-Males: growth spurt, body hair growth, facial hair growth, deepening of the voice, and skin</p> <p>-Females: body hair growth, growth spurt, skin changes, and breast growth.</p> <p>-Graded on a 4-point scale: 1= “not yet started” to 4= “seems completed”; then split into three groupings based on pubertal timing: early, on time, and late</p> <p>-39 item QoL scale for children was used to assess QoL, 11 of which were about mental health.</p>	<p>- Qi Jiang district, Chongqing, China from 11 schools.</p> <p>-7223 valid participants</p> <p>-556 males were in the late onset category, and 393 females were in that category as well.</p> <p>-2538 males and 2575 females were in the normal pubertal timing category.</p>	<p>- did state limitations</p> <p>- used questionnaires instead of professional examiners</p>	<p>-When compared to the normal pubertal timing, the late onset group had almost the exact same mean of QoL score at 142.02 compared to 142.76. The standard deviation for late-onset was slightly larger than the normal pubertal timing group, with a difference being 18.35 (late-onset) and 17.98 (normal timing)</p> <p>-Cronbach’s alpha was 0.877</p>

			<p>- Took covariates into account: age, gender, family life, self-reported physique, academic performance, financial situation, physical condition</p> <p>-Statistical analysis was completed using SPSS</p>			
<p>Goering, M., Mrug, S. (2022). The distinct roles of biological and perceived pubertal timing in delinquency and depressive symptoms from adolescence to adulthood. <i>Journal of Youth and Adolescence</i>, 51(11), 2092–2113. <a href="https://doi.org/10.1007/s10964-022-01657-7">https://doi.org/10.1007/s10964-022-01657-7</a></p>	<p>-examines whether both early and late pubertal timing is associated with negative development and whether it is affected by perception of pubertal timing or actual biomarkers of pubertal timing</p>	<p>-longitudinal study- 19 years</p>	<p>-evaluated both perceived pubertal timing by peers and reported biomarkers of pubertal timing relative to age</p> <p>-used the Tanner scale to have the subject rate themselves on biomarkers of pubertal timing (measured as a continuous variable, higher score=more developed)</p> <p>-perceived pubertal timing was measured by the Pubertal developmental scale (same score rating a biological indications)</p> <p>-In wave 2: depressive symptoms were assessed using the Major Depressive Disorder scale of the Diagnostic Interview Schedule for Children Predictive Scales, then at Wave 3 and 4 depressive symptoms were measured using the 20-item Center for Epidemiologic Studies Depression scale.</p>	<p>-704 youth who were assessed at 4 points.</p> <p>-recruited in the 5<sup>th</sup> grade from 17 Birmingham, AL, USA area schools</p> <p>- looked at associated for depressive symptoms in adolescents between 2003 and 2022</p>	<p>- stated limitations</p>	<p>-Perceived off-set did not predict depressive symptoms at Waves 2,3, or 4</p> <p>-biological pubertal timing also did not show any association in depressive symptoms</p>

			<p>Depression symptoms were ranked on a scale of 1 to 4 based on frequency.</p> <p>-Income and household composition were taken into account</p>			
<p>Conley, C. S., &amp; Rudolph, K. D. (2009). The emerging sex difference in adolescent depression: Interacting contributions of puberty and peer stress. <i>Development and Psychopathology</i>, 21(2), 593–620. <a href="https://doi.org/10.1017/S0954579409000327">https://doi.org/10.1017/S0954579409000327</a></p>	<p>-evaluated pubertal status, early or late timing compared to peers, and sex differences and in which they affect the many aspects of depression</p>	<p>-longitudinal study- 1 year</p>	<p>- completed in person sessions with two interviewers and lasted between 3-4 hours</p> <p>-Participants self-surveyed using the Tanner staging and Pubertal Developmental Scale.</p> <p>-perceived pubertal timing was assessed by asking if pubertal development was much earlier too much later compared to others and then given a score of 1 to 5.</p> <p>-used the Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children-Epidemiologic Version 5 in semi structured interviews, in which from the interviewers gave ratings (0=no symptoms, 4=severe impairment)</p> <p>-assessed secondary sex characteristics and other physical</p>	<p>-152 youths interviewed in two waves, each a year apart.</p> <p>-pulled from midwestern cities and several rural towns in the United States</p> <p>-51.9% were females</p>	<p>- stated limitations</p>	<p>-Depression was associated with biological late onset and perceived late onset in males.</p>

			changes of puberty, tanner scale and Pubertal development Scale -utilized a varied population to address covariates			
Crockett, L. J., Carlo, G., Wolff, J. M., & Hope, M. O. (2013). The role of pubertal timing and temperamental vulnerability in adolescents' internalizing symptoms. <i>Development and Psychopathology</i> , 25(2), 377–389. <a href="https://doi.org/10.1017/S0954579412001125">https://doi.org/10.1017/S0954579412001125</a>	- looks at the role of pubertal timing and temperament as variables influencing internalizing symptoms (depression and anxiety)	-longitudinal study- 4 years	- tanner staging by physical exam was completed by a nurse of physician  -for internalizing behaviors mothers and fathers filled out the child behavioral checklist and then the participants reported symptoms using the Children's Depression Inventory  -Children were assessed at ages 12, 13, 14, and 15 after initial assessment in 6 <sup>th</sup> grade  - To covariates into account: Gender, race, and SES, and family size	-1,025 youths -taken from waves 3 and 4 of the National Institute of Child Health and Human Development Study of Early Childcare and Youth Development, United states  -80.4% white, 12.9% Blacks, 1.6% Asians, 0.4% American Indians, 4.7% labeled "other"	- does state limitations	-Curvilinear effect of puberty showed that those who were early and later were more likely to demonstrate internalizing behaviors. There was no effect in males.
Joinson, C., Heron, J., Lewis, G., Croudace, T., & Araya, R. (2011). Timing of menarche and depressive symptoms in adolescent girls from a UK cohort. <i>The</i>	Compare girls who develop early menarche to late and normal onset menarche to see is examine the association with higher levels of depression	Longitudinal study-a little over 3 years	-Puberty was assessed based off age of menarche, and the late category was evaluated as any female having their period after 13 years and 6 months.  -They used the Short Mood and Feelings Questionnaire to measure depression symptoms at 10.5, 13, and 14 years of age	-2184 girls from the Avon longitudinal study  -608 girl in the late onset category compared to normative being 2246 girls.	-does state limitations	-late onset of menarche showed an increase in depressive symptoms at the age of 10.5, but showed a decrease in depressive symptoms when compared to the early and late groups at ages 13 and 14



<p><i>British Journal of Psychiatry: The Journal of Mental Science</i>, 198(1), 17–23, sup 1–2.  <a href="https://doi.org/10.1192/bjp.bp.110.080861">https://doi.org/10.1192/bjp.bp.110.080861</a></p>			<p>-does take into consideration confounding variables such as absence of biological father, socioeconomic disadvantage, and Body mass index.</p> <p>-Took into account absence of father, SE disadvantage, and BMI</p>	<p>-Southwest, England</p>		
<p>Beltz, A. M. (2018). Gendered Mechanisms Underlie the Relation Between Pubertal Timing and Adult Depressive Symptoms. <i>The Journal of Adolescent Health: Official Publication of the Society for Adolescent Medicine</i>, 62(6), 722–728.  <a href="https://doi.org/10.1016/j.jadohealth.2017.12.019">https://doi.org/10.1016/j.jadohealth.2017.12.019</a></p>	<p>-Sex differences and pubertal timing influences depressive symptoms in adolescence, this researched looked at whether these predictors continued into adulthood as well.</p>	<p>-Cross sectional: retrospective pubertal timing, with depression and puberty measured at current time</p>	<p>- Measured Perceived Puberty on a scale of 1 (much earlier than peers) to 5 (much later than peers)</p> <p>-Females: age of first period, breast development, teen growth spurt, and bra purchase</p> <p>-Males: age of first wet dream, beard growth, teen growth spurt, and voice cracking</p> <p>-utilized the Dimensional 26-item Children’s Depression Inventory during the years of 18-32</p> <p>-Took age in as a covariate</p>	<p>-318 young adults (201 women and 117 men)</p> <p>-Between 18 and 32 years of age</p> <p>-United States</p>	<p>-states limitations</p>	<p>-Found that females, when compared to males, were more symptomatic for depression and affect.</p> <p>-There was a significant quadratic effect signaling that those females with off-time puberty had an increase in depression symptoms.</p> <p>-For males there was a linear association between late onset puberty and feelings of depression.</p> <p>-there was also a link between late onset of puberty with low levels of feelings of masculinity which researchers think may be the link between late-onset and symptoms of depression.</p>

<p>Weingarden, H., &amp; Renshaw, K. D. (2012). Early and late perceived pubertal timing as risk factors for anxiety disorders in adult women. <i>Journal of Psychiatric Research, 46</i>(11), 1524–1529.  <a href="https://doi.org/10.1016/j.jpsychires.2012.07.015">https://doi.org/10.1016/j.jpsychires.2012.07.015</a></p>	<p>- Evaluated if Late or early menarche is a predictor of PTSD, Specific phobias, Social anxiety disorder, generalized anxiety disorder, and panic disorder</p>	<p>-cross sectional</p>	<p>- Measured perceived pubertal timing through question did you receive your menstrual period earlier, later, or about same time as other</p> <p>-utilized the World Mental Health Survey Initiative World Health Organization Composite International Diagnostic Interview to assess risk for anxiety diagnoses and then compared symptoms to DSM-IV criteria at one point in time.</p> <p>-age was a covariate</p>	<p>-Used probability sampling to choose participants</p> <p>-5692 only women</p> <p>-18-99 years old</p> <p>-71.9% were Non-Latino Whites, 13.7% African American, or Afro-Caribbean, 9.5% were Latino/ and or Hispanic, 1.4% were Asian, and 3.4% identified as other</p>	<p>-states limitations</p>	<p>-there was no link between late timing a lifetime anxiety diagnosis, but there was an increased risk for social anxiety</p>
<p>Mendle, J., Harden, K. P., Brooks-Gunn, J., &amp; Gruber, J. A. (2010). Development's tortoise and hare: Pubertal timing, pubertal tempo, and depressive symptoms in boys and girls. <i>Developmental</i></p>	<p>-Evaluated pubertal tempo and timing's effect on depressive symptoms</p>	<p>-Longitudinal over 4 years</p>	<p>- Tanner Staging assessed pubertal status after the mothers were asked, if the mother did not know then the child answered.</p> <p>-Depression Symptoms were assessed using the CDI which was adapted from the Beck inventory. Participants were then ranked based on their answers, scores over 19 indicated clinical levels of depressions</p>	<p>-138 women and 138 men, United states</p> <p>-Recruited from the Girls and Boys Health Development project (1995-1996 recruitment)</p>		<p>-There was no evidence of association between late timing or early timing and depression and anxiety.</p>

<p><i>Psychology</i>, 46(5), 1341–1353.  <a href="https://doi.org/10.1037/a0020205">https://doi.org/10.1037/a0020205</a></p>			<p>-Covariates included: family characteristics, child ethnicity, their own education and occupational status, and SES</p>	<p>-lost 19.5% of original wave by wave 4          -United States</p>		
<p>Carter, R., Silverman, W. K., &amp; Jaccard, J. (2013). Race and perceived pubertal transition effects on girls' depressive symptoms and delinquent behaviors. <i>Journal of Youth and Adolescence</i>, 42(8), 1155–1168.  <a href="https://doi.org/10.1007/s10964-012-9885-1">https://doi.org/10.1007/s10964-012-9885-1</a></p>	<p>-Examined different measurements of puberty effect on girls' depressive symptoms and delinquent behaviors</p>	<p>-longitudinal over 1 year</p>	<p>- Female participants answered 4 questions about pubertal development, age of menarche, and perceived pubertal timing and then was rated on a scale of 1 to 5.</p> <p>- Depression symptoms were assessed utilizing the 19 item version of the Center for epidemiologic studies depression scale which were ranked on a 3 point scale (0= never experience symptoms, 3= suffer from symptoms all the time)</p> <p>-Assessed 2 times over a 1 year span</p> <p>-Covariates include: adolescent age, primary caregivers marital status, and primary caregivers educational level</p>	<p>-1740 participants          -Girls in 7<sup>th</sup> and 8<sup>th</sup> grade at wave 1          -(481 African American) (1259 European American) located in the United States</p>		<p>-There was only association between girls who had perceived late onset of puberty and high levels of depressive symptoms at wave 1. Association leveled out in later waves.</p>
<p>Reynolds, B. M., &amp; Juvonen, J. (2012). Pubertal timing fluctuations across middle</p>	<p>- Looked at the link between pubertal timing and internalizing symptoms among an females</p>	<p>-Longitudinal over 3 years</p>	<p>- Participants filled out the Pubertal Development Scale: put into 3 categories of early, on-time, and late in wave 1.</p>	<p>-1,167 girls only United states          -Girls recruited in the fall of 6<sup>th</sup> grade</p>		<p>-Because Females were only categorized at one point, it's hard to measure changes. Only those in the early category in grade 6 had an increase in depressive</p>

<p>school: Implications for girls' psychological health. <i>Journal of Youth and Adolescence</i>, 41(6), 677–690. <a href="https://doi.org/10.1007/s10964-011-9687-x">https://doi.org/10.1007/s10964-011-9687-x</a></p>			<ul style="list-style-type: none"> <li>- Depression symptoms and Social Anxiety were measured using the Short Form of the Children's Depression Inventory</li> <li>-Social anxiety was measured using the items from the Fear of Negative Evaluation Subscale of the Social Anxiety for Adolescents</li> <li>-Participants were evaluated every 6 months for 3 years</li> <li>- Covariates included: race and socioeconomic status</li> </ul>			<p>symptoms and social anxiety. No association in the late category.</p>
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## Chapter 4

### Results

This chapter will synthesize the data presented in the evidence table (see Table 1) from the 14 studies found in the literature search (Barendse et al., 2022; Beltz, 2018; Boden et al., 2011; Carter et al., 2013; Conley & Rudolph, 2009; Crockett et al., 2013; Gaysina et al., 2015; Goering & Mrug, 2022; Joinson et al., 2011; Mendle et al., 2010; Pu et al., 2022; Reynold & Juvonen, 2012; Rudolph et al., 2014; Weingarden & Renshaw, 2012). The studies chosen depict data surrounding anxiety and depression in children with late-onset puberty, published between the years of 2009 and 2022. This chapter will provide details about the sample, setting, methods, and results found within each study to evaluate the state of the current literature.

### Quality of Studies

All fourteen studies were rated using the Johns Hopkins Nursing Evidence-Based Practice Evidence Level and Quality Guide (Dang et al., 2022). All of the fourteen studies were Level II evidence quality since they were quasi-experimental studies search (Barendse et al., 2022; Beltz, 2018; Boden et al., 2011; Carter et al., 2013; Conley & Rudolph, 2009; Crockett et al., 2013; Gaysina et al., 2015; Goering & Mrug, 2022; Joinson et al., 2011; Mendle et al., 2010; Pu et al., 2022; Reynold & Juvonen, 2012; Rudolph et al., 2014; Weingarden & Renshaw, 2012). When assessing the variables of late versus normal timing puberty, it is hard to create random-control trials since there is no intervention that can be assessed, so therefore none of the studies were Level I. The studies did all use quantitative methods to assess both puberty and anxiety and depression. 13 of the studies were Quality A of evidence because of consistent methods, with

good sample sizes, and definitive conclusions (Barendse et al., 2022; Beltz, 2018; Boden et al., 2011; Carter et al., 2013; Conley & Rudolph, 2009; Crockett et al., 2013; Gaysina et al., 2015; Goering & Mrug, 2022; Joinson et al., 2011; Mendle et al., 2010; Reynold & Juvonen, 2012; Rudolph et al., 2014; Weingarden & Renshaw, 2012). One study with Quality B evidence because of its lack of congruency in comparative methods between late, normal, and early timing puberty and its lack in definitive conclusions (Pu et al., 2022).

## **Study Design**

### *Longitudinal Studies*

As shown in Table 1, 11 of the 14 studies used a longitudinal design varying in length (Barendse et al., 2022; Boden et al., 2011; Carter et al., 2013; Conley & Rudolph, 2009; Crockett et al., 2013; Gaysina et al., 2015; Goering & Mrug, 2022; Joinson et al., 2011; Mendle et al., 2010; Reynold & Juvonen, 2012; Rudolph et al., 2014). The longitudinal studies ranged in length from 1 year to 53 years. 8 out of the 11 studies covered between 1 and 4 years (Barendse et al., 2022; Carter et al., 2013; Conley & Rudolph, 2009; Crockett et al., 2013; Joinson et al., 2011; Mendle et al., 2010; Reynold & Juvonen, 2012; Rudolph et al., 2014). Barendse et al. (2022) analyzed participants at an initial age of 10-13 at wave one, and then evaluated again 18 months later in wave 2. Carter et al., (2010), analyzed participants at an initial age of 12-15 then again 1 year later. Conley & Rudolph (2009), measured at an initial wave one and then again, a year later at year 2. Crockett et al. (2013), assessed participants at age 12, 13, 14, and 15. Joinson et al. (2011), assessed participants at ages 10 years 8 months, 12 years 10 months, and 13 years 10 months. Mendle et al., (2010), assessed participants once a year starting between 7.6-10.2 years for females and 8.1-12.0 years for males, for four years. Reynold & Juvonen (2012), measured

participants every 6 months for 3 years, creating 6 waves of measurements. Rudolph et al. (2014), started measuring participants at a mean age of 12.41 and then each year following for 3 more years. The other 3 took place over 19 (Goering & Mrug, 2022), 30 (Boden et al., 2011), and 53 years (Gaysina et al., 2015). Goering & Mrug (2022), measure puberty at wave one, then assessed depression mean starting at a mean age of 13.2, then again at waves 3 and 4, which mean ages were 18.1 and 27.7. Boden et al. (2011), assessed puberty annually until 16 and then participants were interviewed at ages 18, 21, 25, and 30 regarding symptoms of depression. Gaysina et al. (2015), puberty assessed throughout childhood and then at ages 36, 43, and 53 depression was assessed for both childhood and adulthood.

#### *Attrition Rates*

Two studies addressed attrition rates in limitations but never gave an attrition or retention rate (Barendse et al., 2022; Joinson et al., 2011). The rest of the studies gave retention rates from wave 1 to the last wave of the study. One study had a retention rate of 55% (Goering & Mrug, 2022). Four Studies had a retention rate between 65-79% (Boden et al., 2011; Crockett et al., 2013; Gaysina et al., 2015; Reynold & Juvonen, 2012). Four studies had between 80% and 97% retention rate (Carter et al., 2013; Conley & Rudolph, 2009; Mendle et al., 2010; Rudolph et al., 2014).

#### *Cross-Sectional Studies*

There were three studies that utilized a cross-sectional study design, in which they interviewed participants at one set time and utilized retrospective measurement of puberty (Beltz, 2018; Pu et al., 2022; Weingarden & Renshaw, 2012). Beltz (2018) used retrospective pubertal timing to assess participants between ages 18 and 32, and then assessed depression and affect at the time of the study. Pu et al. (2022) recruited students from third to ninth grade and assessed

them at one singular point in time. Weingarden & Renshaw (2012) did a similar process in which researchers conducted one round of interviews between 90 minutes and 6 hours with participants.

## **Setting and Sample**

### *Location*

Nine out of the fourteen studies recruited participants from the United States (Barendse et al., 2022; Beltz, 2018; Carter et al., 2013; Conley & Rudolph, 2009; Crockett et al., 2013; Goering & Mrug, 2022; Mendle et al., 2010; Reynold & Juvonen, 2012; Weingarden & Renshaw, 2012). Three of the studies were conducted in England (Gaysina et al., 2015; Joinson et al., 2011; Rudolph et al., 2014) in New Zealand (Boden et al., 2011), and one in China (Pu et al., 2022). Participants were recruited through many different methods. Seven studies recruited from schools (Barendse et al., 2022; Beltz, 2018; Carter et al., 2013; Conley & Rudolph, 2009; Pu et al., 2022; Reynold & Juvonen, 2009; Rudolph et al., 2014)), while two utilized participants from birth cohorts (Boden et al., 2011; Gaysina et al., 2015) and the final three studies recruited participants from prior studies done (Crockett et al., 2013; Joinson et al., 2011; Weingarden & Renshaw, 2012). Those participants recruited from other studies were chosen based on predisposing factors assessed in those prior studies.

### *Sample Size*

Sample sizes, found in Table 1, ranged greatly from 152 to 7,223, with a mean value of 1,793 participants and a median of 865 participants per study. Four of the studies had between 100 and 299 participants (Barendse et al., 2022; Conley & Rudolph, 2009; Mendle et al., 2010; Rudolph et al., 2014). Three studies had between 300 to 999 participants (Beltz, 2018; Boden et al., 2011; Goeing & Mrug, 2022). Five studies had between 1,000 to 4,999 participants (Carter et al., 2013; Crockett et al., 2013; Gaysina et al., 2015; Joinson et al., 2011; Reynold & Juvonen,



2012,). There were two studies with over 5,000 participants utilizing 5,692 (Weingarden & Renshaw) and 7,223 valid participants (Pu et al., 2022 & 2012).

### *Sample Demographics*

There is a significantly more research linking females with mental health issues, as seen in the studies collected for this analysis as they all included female participants (Barendse et al., 2011; Boden et al., 2011; Carter et al., 2013; Joinson et al., 2011; Reynold & Juvonen, 2012; Weingarden & Renshaw, 2012), while the 8 included both males and females (Beltz, 2018; Conley & Rudolph, 2009; Crockett et al., 2013; Gaysina et al., 2015; Goering & Mrug, 2022; Mendle et al., 2010; Pu et al., 2022; Rudolph et al., 2014). Ages varied per study and included all ages up until age 53 (Gaysina et al, 2015), as one used retrospective pubertal timing (Beltz, 2018) to recall pubertal timing in past but looked at symptoms of depression and affect in that moment. Two looked at many different variables starting at birth but assessed puberty during the adolescent years as well as depression symptoms at ages 18, 21, 25, and 30. (Boden et al., 2011; Gaysina et al., 2015).

### **Measurements of Puberty**

One of the biggest difficulties within research regarding puberty is the lack of continuity in measuring the variable of puberty itself. As found in Table 1, nine out of the fourteen studies utilized a single method of measurement, while the other 5 used multiple methods of measurement to create the variable of pubertal timing. Three studies utilized age of menarche as their sole measurement of puberty (Boden et al., 2011; Gaysina et al., 2015; Joinson et al., 2011). Three studies only utilized the Tanner Staging scale to measure pubertal status, but administration of these scales was slightly different among them (Crockett et al., 2013; Goering

& Mrug, 2022; Mendle et al., 2010). Two studies only utilized the Pubertal Developmental Scale to assess pubertal timing in participants (Pu, 2022; Reynold, 2012). Beltz (2018) measured perceived and biological pubertal timing through a questionnaire assessing females and males biological changes as well as their feelings on the timing. Five of the studies used a combination of pubertal measurements to assess multiple aspects of pubertal change in adolescence (Barendse et al., 2022; Carter et al., 2013; Connelly & Rudolph, 2009; Gaysina et al., 2015; Rudolph et al., 2014). Due to lack of continuity between measurement variable of puberty, there is still argument over reliability and validity of the measurements used through all the studies reviewed.

#### *Age of Menarche*

In seven of the studies, female participants were asked when they experienced their first menstrual cycle which was identified as “age of menarche.” Three of the studies used this as their primary measurement of puberty (Boden et al., 2011; Gaysina et al., 2015; Joinson et al., 2011). In four other studies, it was used within combination with other types of measurements or a question in a survey the participant completed (Carter et al., 2013; Pu et al., 2022; Rudolph et al., 2014; Weingarden & Renshaw, 2012). In Boden et al., parents were asked the question and then participants were grouped by age (10-11, 12-13, 14-15) based on when they had their first menstrual cycle and late onset being considered anything in the 14-15 age of menarche category (2011). In Gaysina et al., female participants were asked when their age of menarche was, and then also categorized in the similar age groupings as Boden et al., those who did not receive their first menstrual cycle by the last wave of the study were put into the over 15 age category (2015, 2011). Joinson et al., conducted slightly differently in which they compared the age of menarche reported by maternal figure within participants and then created an early, on-time, and late

category (2011). Joinson et al., defined late as first menstrual cycle after 13 years and 6 months of age (2011). Assessing age of menarche was the most common form of pubertal timing measurement.

### *Tanner Staging*

There were four studies that utilized the Tanner Staging Scale to measure pubertal status in participants (Conley & Rudolph, 2009; Crockett et al., 2013; Goering & Mrug, 2022; Mendle et al., 2010). Each study conducted the use of Tanner Staging Scales differently. Crockett et al. had nurses rate the participants maturity using the diagrams of breast development and pubic hair growth for females and similar diagrams assessing development of testes and pubic hair growth in males (2013). In Mendle et al., study, the maternal caregivers rated the participants pubertal status using the same Tanner Staging diagrams, and in Goering & Mrug, participants rated self-pubertal status using the same diagrams (2010; 2022). All four studies used numerical values (1 to 5) in order to quantitatively analyze pubertal status. A score of 1 meant no to very little signs of puberty and a score of 5 meant very advanced/ completion of puberty.

### *Pubertal Developmental Scale*

There were three studies that utilized the Pubertal Developmental Scale to assess pubertal status in participants (Conley & Rudolph, 2009; Pu, 2022; Reynold, 2012). One of the studies utilized it for both males and females in the study but did not indicate whether the questionnaire was self-answered or if there was someone else filling out the responses (Pu, 2022). The pubertal developmental scale assessed females on body hair growth, growth spurt, skin changes, age of menarche, and breast growth and it assessed males on change in growth, body hair growth, facial hair growth, deepening of voice, and skin changes. Pu et al., utilized a point scale (1-4) to analyze results. The number 1 on the scale indicated “not yet started” and a score of 4 indicated

“seems completed” (2022). Participants were then categorized into three groups based on pubertal status: early ( $>\text{mean} + 1 \text{ SD}$  for peers of the same age and sex), on time (within  $\text{mean} \pm \text{SD}$ ), and late ( $<\text{mean} - 1 \text{ SD}$ ) (Pu et al., 2022). Reynold & Juvonen also utilized the Pubertal Developmental Scale, but participants self-answered the questionnaire and therefore it can be argued that it is now perceived pubertal status variable. Like Pu et al., Reynold & Juvonen participants ranked pubertal change on the above categories using a 1 to 4 scale and then placed into categories of early, on-time, and later (2012).

#### *Multiple Methods of Pubertal Measurement*

Barendse et al. (2022), utilized age of menarche, the Pubertal developmental Scale, Tanner staging, Physical Maturation Composite score, and hormone levels to assess pubertal status (2022). DHEA, testosterone, and estradiol hormones were measured in participants using a spit test (Barendse et al., 2022). Carter et al. (2013), used a question survey that assessed pubertal development, age of menarche, and perceived pubertal timing. Conley & Rudolph utilized both the Tanner Stages and The pubertal Developmental Scale. Gaysina, et al., (2015) utilized age of menarche as the primary measurement for female participants, but males were asked to fill out a survey asking about signs of genitalia changes, voice breaking, and pubic hair. The male participants were then broken into categories ranging from infantile to fully mature (Gaysina et al., 2015). Rudolph et al. (2014) also used multiple measurements: self-rated pubertal developmental scale, youth and caregiver completed Tanner staging scales, and age of menarche for females. Results were gathered and averaged, with higher scores indicating earlier puberty (Rudolph et al., 2014)

### *Perceived Pubertal Timing*

Six of the studies made alterations to the questionnaire used in the methods of measurement above to measure perceived pubertal timing as main predictor compared to objective biological timing (Beltz, 2018; Carter et al, 2013; Conley & Rudolph, 2009; Goering & Mrug, 2022; Reynold & Juvonen, 2012; Weingarden & Renshaw, 2012). Beltz (2018) asked participants questions about pubertal development. Females were asked about first period, noticeable breast development, teen growth spurt, and bra purchase, and males were asked about first wet dream, beard growth, teen growth spurt, and voice cracking. Participants answered utilizing responses that coordinated with a numerical value: 1= much earlier than peers to 5= much later than peers, making it perceived pubertal timing vs biological timing (Beltz, 2018). Reynold & Juvonen (2012) and Goering & Mrug (2022) assessed perceived pubertal status utilizing a self-answered pubertal developmental scale. Goering & Mrug (2022) utilized a numerical scale (1 to 5), while Reynold & Juvonen (2012) utilized categories of early, on-time, and later to categorize participants. Carter et al. (2013) and Conley & Rudolph (2009) both asked participants to assess their pubertal development based on the timing of development of their peers of the same age and then based on answered rated them on a scale of 1 to 5. In the study done by Carter et al., a numerical value of 1 indicated that the participant looked younger than most or less developed compared to peers of same age, and a value of 5 indicated the participant looked older than peers or more developed (2013). In the study completed by Conley & Rudolph, a numerical value of 1 indicated that the participant perceived that they developed much earlier to peers and a value of 5 indicated they developed much later than peers, with values in between ranging in a continuous fashion (2009). Weingarden & Renshaw assessed

perceived pubertal timing/ development through the question, “Did you have your first menstrual period earlier, later, or about the same time as other girls you knew” (2012).

Although many of the studies utilized similar forms of measurement, no two studies utilized the exact same measurement for pubertal timing. Three studies utilized age of menarche as their sole measurement of puberty (Boden et al., 2011; Gaysina et al., 2015; Joinson et al., 2011). Three studies only utilized the Tanner Staging scale to measure pubertal status, but administration of these scales was slightly different among them (Crockett et al., 2013; Goering & Mrug, 2022; Mendle et al., 2010). Two studies only utilized the Pubertal Developmental Scale to assess pubertal timing in participants (Pu, 2022; Reynold, 2012). Beltz (2018) measured perceived and biological pubertal timing through a questionnaire assessing females and males biological changes as well as their feelings on the timing and five of the studies used a combination of pubertal measurements to assess multiple aspects of pubertal change in adolescence (Barendse et al., 2022; Carter et al., 2013; Connelly & Rudolph, 2009; Gaysina et al., 2015; Rudolph et al., 2014).

### **Dependent Variable Measurements**

Mental Health disorders are not usually diagnosed until the age of 18 because of the negative stigma associated with them, along with labeling adolescents before the age of 18 with these diagnoses have shown to have negative outcomes. Because diagnoses of mental health issues are not as prevalent as symptoms, many of the studies utilized symptoms of depression and anxiety in measurement of association. Two studies (Boden et al., 2011; Reynold & Juvonen, 2009) assessed participants for both anxiety and depression symptoms. One study assessed for Depression and anxiety diagnoses (Barendse et al., 2022). Eight of the studies

assessed participants for depression symptoms (Barendse et al., 2022; Beltz, 2018; Carter et al., 2013; Conley & Rudolph, 2009; Goering & Mrug, 2022; Joinson et al., 2011; Mendle et al., 2010; Rudolph et al., 2014). Conley & Rudolph (2009) assessed for both depression diagnoses and symptoms, but not anxiety. Weingarden & Renshaw (2012) only assessed for risk of anxiety diagnosis. Gaysina et al. (2015), assessed for affective symptoms, and Crocket et al. (2013), assessed for internalizing behaviors which encompassed behaviors of anxiety and depression. Pu et al., assessed participant's quality of Life, which included 11 questions to assess mental health (2022). All of the surveys and questionnaires used in the reviewed studies were tested for reliability and validity and have proven to be throughout their years of use within the research industry.

## **Depression**

### *Center Epidemiologic Studies Depression Scale for Children*

Barendse et al., (2022) Carter et al., (2013) and Goering & Mrug (2022) utilized a form of the Center Epidemiologic Studies Depression Scale for Children to measure depression symptoms, but each one utilized it slightly differently. Barendse et al. also performed diagnostic interviews that were double scored by clinical interviewers using the Schedule for Affective Disorders and Schizophrenia for School Aged Children Symptoms (2022). Carter et al. utilized the 19-item version of the Center for epidemiologic studies depression scale that assesses depression symptoms (2013). Participants ranked answers to the questionnaire on a 3-point scale, 0 = never experience symptoms and 3 = experiencing symptoms all the time (Carter et al., 2013). Goering & Mrug first utilized 6 items of the Major Depressive Disorder (MDD) scale of the Diagnostic Interview Schedule for Children Predictive Scales (2022). Participants answered yes

(1) or no (0) to questions assessing for depressive symptoms at wave 2. Researchers then utilized the Center Epidemiologic Studies Depression Scale and symptoms were rated on how often they occurred (1: rarely – 4: five to seven days a week) (Goering & Mrug, 2022).

### *Children's Depression Inventory*

Beltz (2018), Crockett et al. (2013), Mendle et al. (2010) & Reynold & Juvonen (2012), utilized a form of the Children's Depression Inventory to assess for symptoms of depression. Beltz used the Dimensional 26-item Children's Depression Inventory to assess participants' depressive symptoms in the past two weeks (2018). Based on participants answers, scores were analyzed, and higher scores indicate a higher rate of depressive symptoms (Beltz, 2018). Mendle et al., (2010) practiced a similar method, using a Children's Depression Inventory that was adapted the Beck Depression Inventory. Participants answered 26 questions that had a 0-2 scale and then numerical value added together to create a total score. Any score over the value of 19 indicated significant levels of depression. Reynold & Juvonen utilized a short form of the Children's Depression Inventory to assess depression symptoms (2012). Participants would answer survey questions with answers that were then computed to numerical values ("I am sad once in a while"-0, "I am sad many times"-1, and "I am sad all the time"-2) (Reynold and Juvonen, 2012). Crockett et al. (2013), measured internalizing behaviors which include symptoms of depression and anxiety. Mothers and Father s completed the Child behavioral Checklist and the participants responded to the Children's Depression Inventory at age 12, using a 3-point scale (0- once in a while, 1- many times, 2- all the time). The participants then were assessed again using the same methods at age 13, 14, and 15 (Crockett et al., 2013).



### *Schedule for Affective Disorders and Schizophrenia for School-Age Children*

Rudolph et al. (2012) & Conley & Rudolph (2009) both utilized a form of the Schedule for Affective Disorders and Schizophrenia for School-age Children. Rudolph et al. utilized the Schedule for Affective Disorders and Schizophrenia for School-age children then compared to DSM-IV criteria (2014). Participants were interviewed by clinical psychology staff during all of the waves (Conley & Rudolph at waves 1 & 2, and Rudolph et al. (2012) at all three waves). Participants rated symptoms using a numerical scale (0= no symptoms, 4 = diagnosis with severe impairment) (Rudolph et al., 2014). Conley & Rudolph also utilized the Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children- Epidemiologic Version 5 (2009). A semi-structured interview assessed youth psychopathology during in person interviews with two trained professionals. At wave 1, participants rated symptoms since childhood out of 4 (4 being the most severe), and at Wave 2, about a year later, participants assessed symptoms of depression over that year out of 4 again (Conley & Rudolph, 2009).

### *Composite International Diagnostic Interview*

In Boden et al., participants were interviewed using the Composite International Diagnostic Interview to assess symptoms based on DSM-IV criteria for major depression (2011). Participants were interviewed categorized at expressing depression symptoms based on diagnostic criteria from the questionnaires (Boden et al., 2011).

### *Short Mood and Feelings Questionnaire*

Joinson et al. (2011) utilized the Short Mood and Feelings Questionnaire, where they administered questionnaires at each wave of the study, Participants answered questions assessing depression symptoms within the past two weeks on three levels (“true”, “sometimes true”, and “not at all”) (Joinson et al., 2011).

### *Psychiatric Symptoms Frequency Scale*

Gaysina et al. measured affective symptoms utilizing the Rutter teacher questionnaire in adolescence, then the Psychiatric Symptoms frequency Scale at 36 and 43 years of age, and at 53 they used the 28-item General Health Questionnaire (2015). Affective symptoms were measured in four categories: absence of symptoms, occasional symptoms, moderate symptoms, and severe symptoms. Participants were then categorized for results into absence of symptoms, symptoms only in adolescence, symptoms in only adulthood, and symptoms in adulthood and adolescence (Gaysina et al., 2015).

A multitude of different surveys and questionnaires were utilized to assess symptoms and diagnoses of depression. Ten of the studies assessed participants for depression symptoms (Barendse et al., 2022; Beltz, 2018; Boden et al., 2011; Carter et al., 2013; Conley & Rudolph, 2009; Goering & Mrug, 2022; Joinson et al., 2011; Mendle et al., 2010; Reynold & Juvonen, 2009; Rudolph et al., 2014). Beltz (2018), Crockett et al. (2013), Mendle et al. (2010) & Reynold & Juvonen (2012), utilized a form of the Children's Depression Inventory to assess for symptoms of depression. Rudolph et al. (2012) & Conley & Rudolph (2009) both utilized a form of the Schedule for Affective Disorders and Schizophrenia for School-age Children. In Boden et al., participants were interviewed using the Composite International Diagnostic Interview (2011). Joinson et al. (2011) utilized the Short Mood and Feelings Questionnaire and Gaysina et al. (2015) measured affective symptoms utilizing the Rutter teacher questionnaire in adolescence, then the Psychiatric Symptoms frequency Scale at 36 and 43 years of age, and at 53 they used the 28-item General Health Questionnaire.

### **Anxiety and Quality of Life**

### *Composite International Diagnostic Interview*

Both Boden et al. and Weingarden & Renshaw, used the Composite International Diagnostic Interview to assess DSM-IV criteria for many forms of anxiety including, generalized anxiety disorder, specific phobia, agoraphobia, and panic disorders (2011 & 2012). Boden et al assessed participants and were categorized at risk for diagnosis of anxiety based on diagnostic criteria from the questionnaires (Boden et al., 2011). Weingarden & Renshaw only assess anxiety symptoms through the lifetime at one set point, analyzing participants ranging from 18-99 (2012). Reynold & Juvonen assessed participants for only social anxiety using items from the Fear of Negative Evaluation Subscale of the Social Anxiety Scale for Adolescents. Participants answered questions based on how often they felt symptoms (1= not at all, 5 = all the time).

### *Quality of Life Scale for Children*

Pu et al. only utilized the Quality of Life Scale for Children, which included 39 questions, 11 of which assessed mental health and analyzed symptoms of both anxiety and depression (2022). Based on responses only given during one assessment, scores were analyzed, and higher scores indicated a better Quality of Life (QoL) (Pu et al., 2022)

### **Covariates**

Covariates can alter results greatly if not considered. Three studies considered age and demographics when recruiting their participants for the study (Conley & Rudolph, 2009; Reynold & Juvonen, 2012; Rudolph et al., 2014). Conley & Rudolph did consider ethnicity and varying household incomes when recruiting a population (2009). Reynold & Juvonen analyzed race and socioeconomic status in their research question and therefore was included in primary analysis (2012). Nine of the studies addressed family composition and/or family life (Barendse et al., 2022; Boden et al., 2011; Carter et al., 2013; Crockett et al., 2013; Gaysina et al., 2015;

Goering & Mrug, 2022; Joinson et al., 2011; Mendle et al., 2010; Pu et al., 2022). Seven of the studies addressed socioeconomic status as a covariate (Boden et al., 2011; Crockett et al., 2013; Gaysina et al., 2015; Goering & Mrug, 2022; Joinson et al., 2011; Mendle et al., 2010; Pu et al., 2022). Three studies addressed age as a covariate (Beltz, 2018; Pu et al., 2022; Weingarden & Renshaw, 2012). Two studies took into consideration BMI (Barandse et al., 2022; Joinson et al., 2018).

### **Statistical Analyses**

Statistical analyses are important when comparing outcomes of different studies. It is important as the researcher to understand the analyses that were used to find congruencies among studies. Four studies conducted linear regression analyses to analyze data (Barendse et al., 2022; Boden et al., 2011; Pu et al., 2022; Reynold & Juvonen, 2012). Barendese et al. (2022) used a logistic regression when analyzing diagnoses, and bootstrapping (2022). Two studies utilized logistic regression models (Gaysina et al., 2015; Weingarden & Renshaw, 2012). Three studies used structural equation models (Carter et al., 2013; Crockett et al., 2013; Joinson et al., 2011). Joinson et al. also used ANOVA in preliminary data analysis (2011). Two studies used multiple regression models (Beltz, 2018; Conley & Rudolph, 2009). Two studies utilized Logistic regression models (Gaysina et al., 2015; Weingarden & Renshaw, 2012). Two studies utilized latent growth models (Mendle et al., 2010; Rudolph et al., 2014). One study utilized mediation path models (Goering & Mrug, 2022).

## **Study Findings**

### *Significant Relationship*

Eight out of the fourteen studies showed an increase in levels of depression and/or anxiety in delayed/ late-onset puberty at one point in the study, during the length of the study (Beltz, 2018; Carter et al., 2013; Conley & Rudolph, 2009; Crockett et al., 2013; Gaysina et al., 2015; Joinson et al., 2018; Rudolph et al., 2014; Weingarden & Renshaw, 2012). Three studies found significant association for all groups, while 5 found mixed results between participants. Beltz (2018) found that there was a quadratic u-shaped function during statistical analysis of female pubertal timing and depression symptoms, indicating increased depressive symptoms in females with off-set (both early and late) puberty.

For males, there was a linear curve indicating as puberty occurred later depression symptoms increased, as well as lower levels of feelings of masculinity (Beltz, 2018). Gaysina et al. indicated that that late onset puberty in males was associated with higher rates of affective symptoms (2015). The study results show that those increased affective symptoms continued into adulthood (Gaysina et al., 2015). Gaysina et al., (2015) did not see an increase in association in female participants with late-onset puberty when comparing to the normal timed group. Conley & Rudolph found that biological peer differences in late- pubertal timing and perceived late pubertal timing in males was associated with higher levels of depression (2009). The study indicated that when comparing males and females, who experienced late-onset puberty and perceived late-onset of puberty, males were much more depressed than those of their counterpart females (Conley & Rudolph, 2009). They did not find any association between late-developing females and symptoms of depression (Conley & Rudolph, 2009).

### *Mixed Findings*

Crockett et al. reported a curvilinear effect as well, indicating females who were off-set (early and late) puberty reported more internalizing behaviors at age 11, but as pubertal development continued into later waves, effects dissipated in older aged females (2013). Crockett et al. (2013), found no association in males at any wave. Similarly, Carter et al. (2013) also found that there was a quadratic curve in female's perceived pubertal timing and depression symptoms, indicating that females who perceived late overall development reported higher levels of depression symptoms at wave 1. However, there was no association found in biological timing and increase in depressive symptoms, and initial increase in symptoms of depression associated with perceived late pubertal timing decreased as the study continued (Carter et al., 2013). Weingarden & Renshaw did see that the females with late onset puberty were at an increased risk of a lifetime diagnosis of social anxiety disorder, but there were no apparent diagnostic factors in adolescents. Joinson et al. (2018), found that late onset of menarche in females showed an increase in depressive symptoms at the age of 10.5, but showed a decrease in depressive symptoms when compared to the early and late groups at ages 13 and 14. Joinson et al. (2018), summarized that low levels of depressive symptoms in late-onset group may be linked to a protective factor for psychological distress in adolescent girls based on their results. Rudolph et al. found that there was a significant increase in initial depressive symptom associated with late timing pubertal onset in males, and it had dissipated by the end of the study when compared to on-time pubertal timing (2012; 2014). Rudolph et al., (2014) found no association in females.

### *No Relationship*

6 out of the 14 studies found no association between delayed / late-onset puberty and symptoms of depression and/or anxiety but did give insight for further research on puberty

(Barendse et al., 2022; Boden et al., 2011; Goering & Mrug, 2022; Mendle et al., 2010; Pu et al., 2022; Reynold & Juvonen, 2012). Although no significant data supporting the link between pubertal timing and internalizing psychopathology was found, Barendse et al. (2022) reported that Tanner staging, as compared to other measures of puberty such as PDS, showed the strongest associations with mental health outcomes. Researchers within the study hypothesize that utilizing the Tanner staging may signify that psychosocial mechanisms may have a stronger link to mental health disorder rather than actual hormonal changes (Barendse et al., 2022). Goering & Mrug indicated that both perceived and biological pubertal timing did not show an effect on depressive symptoms in early or late-timing puberty (2022). Boden et al. (2011), found that there were trends of mental health issues decreasing as age of menarche increase, but they were not statistically significant. Mendle et al. (2010) found that only early timing females had an increase in depressive symptoms. Pu et al. (2022), only analyzed results of the late group compared to the early group, and the early group showed an increase in depressive symptoms compared to the late timing group. The late-onset group were never compared to the on-time group and therefore no significant data supporting late-onset 's link with increase in levels of mental health issues were found. Because Reynold & Juvonen (2012) only categorized females at one point in time, it was hard to identify changes across varying ages and therefore showed no significant data supporting the hypothesis.

## **Summary**

In summary, eight out of the fourteen studies found some association between late onset puberty and symptoms of depression and/or anxiety (Beltz, 2018; Carter et al., 2013; Conley & Rudolph, 2009; Crockett et al., 2013; Gaysina et al., 2015; Joinson et al., 2018; Rudolph et al.,

2014; Weingarden & Renshaw, 2012). One study supports the hypothesis that there was a link between late-onset puberty in females and increased levels of depression (Beltz, 2018), while three supported it when studying male participants (Beltz, 2018; Conley & Rudolph, 2009; Gaysina et al., 2015). Five of the studies found mixed results, four of which pertain to females (Carter et al., 2013; Crockett et al., 2013; Joinson et al., 2018; Weingarden & Renshaw, 2012) and one of which pertains to males. Six of the studies did not find any association between late-onset puberty and increased levels of depression and/or anxiety (Barendse et al., 2022; Boden et al., 2011; Goering & Mrug, 2022; Mendle et al., 2010; Pu et al., 2022; Reynold & Juvonen, 2012).



## Chapter 5

### Discussion

This systematic review encompasses current literature surrounding the impact of delayed puberty on depression and anxiety in adolescents. Prior chapters have introduced the background literature and significance of the topic, as well as a description of the search process and results of the review. This chapter will discuss the main findings and place them in a broader context, the strengths and limitations of the research, implications for clinical practice, needs for further research, and provide overall conclusions.

### Summary of Findings

Based on the mixed pattern of results found as part of this review, there is inconclusive evidence to identify a relationship between delayed puberty and anxiety and depression among adolescents. Three of the studies found an association between delayed puberty and anxiety and depression (Beltz, 2018; Conley & Rudolph, 2009; Gaysine et al., 2015), five studies found mixed results (Carter et al., 2013; Crockett et al., 2013; Joinson et al., 2018; Rudolph et al., 2014; Weingarden & Renshaw; 2012), and six of the studies found no association (Barendse et al., 2022; Boden et al., 2011; Goering & Mrug, 2022; Mendle et al., 2010; Pu et al., 2022; Reynold & Juvonen, 2012). The results did however emphasize a prior finding of pubertal timing differences between males and females, as well as perceived puberty vs biological pubertal timing. Females overall having an early age of maturation when compared to boys and this was taken into consideration throughout all the studies. Of the 8 studies that did find an association between late puberty and an increase in depressive and/or anxiety symptoms, 3 showed a u-shaped function when looking at levels of depression and/or anxiety in adolescent females

(Beltz, 2018; Carter et al; Crockett et al. 2013), while 2 of the studies indicated a linear relationship between the pubertal timing of males and levels of depression (Carter et al, 2013; Gaysina et al., 2015). This indicates that in females, both early and late-onset puberty have a relationship with symptoms of depression and/or anxiety while males only have an association with delayed-onset puberty and symptoms of anxiety and/or depression. Weingarden & Renshaw (2012), however, found that both males and females experiencing late-onset puberty were at a risk for a lifetime diagnosis of social anxiety disorder.

Previous research has examined the effects of early onset puberty within females due to the increasing rate of precocious puberty. Precocious puberty is newly emerging issue facing adolescent females as the rates of childhood obesity steadily increase the age of puberty is beginning to decrease. What research has failed to acknowledge is that with the age of puberty decreasing it has thus widened the gap between early and late puberty and there is a lack of research focusing on the effects of late pubertal timing. More studies found an association between males with late onset puberty and symptoms of anxiety and depression, than compared to female. This could be due to many different aspects and will need to be further researched to identify psychosocial factors/ biological pubertal markers that may play a role in this finding. There are a multitude of factors that may contribute to anxiety and depression in adolescents but if late timing pubertal status is one of them, it is important to identify this risk factor to implement screening tools/ treatment plans for these adolescents so that they may have the best outcome in the future.

Another significant aspect of the findings is looking at the differences between perceived puberty and biological pubertal timing. Many of the articles are self-surveying adolescents on biological pubertal timing, they are combining perceived pubertal timing with biological pubertal

timing thus potentially skewing the results (Beltz; 2018, Goering & Mrug, 2022). The studies that separated biological timing from perceived pubertal timing, biologic timing utilized a trained clinicians or guardian to evaluate pubertal status, while perceived timing was assessed by asking participant to rank own pubertal timing/ compared to others. Of the studies that separated biological timing from perceived timing, one study showed there was a significance in perceived late pubertal timing and increased levels of depression for both males and females (Gaysina et al., 2015). The study done by Goering & Mrug (2022) indicated no difference in both biological and perceived pubertal timing when comparing late-onset to increased symptoms of depression. Although there are mixed results when looking at perceived vs biological pubertal timing, it presents the idea of psychosocial factors that may play a part in connecting pubertal timing with mental health issues, such as perceived pubertal timing.

The studies evaluated also indicate a great difference between biological pubertal timing and perceived pubertal timing. Puberty is a large aspect of contributing to psychosocial issues within adolescents and it is also a huge reason why there is lack of congruency within measurement variables for it as well. For example, Tanner staging completed by a trained medical professional measures biological timing, but as soon as it is self-administered it may now be considered perceived pubertal timing because it is evaluated by the participants own perception of their pubertal development. Within adolescents, perceived pubertal timing may largely contribute to the association between late-timing and anxiety and depression based on the social group around them. For example, based on the medical definition of puberty a participants may not be “late-timing”, but if they are surrounding by individuals who have all experienced precocious puberty, then they are perceived late within that group because they are developing later than the majority of the group and may exhibit similar symptoms of those that a biologically

late developer. Beltz (2018) identified that males with late-pubertal timing (biologic and perceived) had a strong association with decrease in feelings of masculinity and had an association with symptoms of depression. Beltz (2018) indicates that a mixture of perceived as well as biological pubertal timing may play a large role in the association between late pubertal timing and depression and anxiety. Eight out of fourteen studies identify some association between late-pubertal timing and depression and anxiety in adolescents, which signifies more research needs to be conducted to evaluate the influences of pubertal timing on anxiety and depression, both biologic and perceived outcomes.

### **Strengths and Limitations of the Studies**

This systematic review includes all relevant and current primary research on the topic of pubertal timing (specifically delayed puberty) and symptoms of anxiety and depression. Because of the recent link between obesity rates and precocious puberty, there is lack of research within the field of delayed puberty, which is the main focus of this research. This also includes any articles that were not published in English or were not published at all yet provide evidence to support the hypothesis.

Eleven out of the fourteen studies in this systematic review were longitudinal studies, which allows researchers to collect data at the present time and limit recall bias (Barendse et al., 2022; Boden et al., 2011; Carter et al., 2013; Conley & Rudolph, 2009; Crockett et al., 2013; Gaysina et al., 2015; Goering & Mrug, 2022; Joinson et al., 2011; Mendle et al., 2010; Reynold & Juvonen, 2012; Rudolph et al., 2014). Because puberty is a slow progression that can take up to two years to complete and timing is different from person to person, a longitudinal study is the best option when evaluating both puberty and its association with depression and anxiety. The

studies utilized in this systematic review also gathered data of participants from a wide variety of geographical locations covering, the United States, England, New Zealand, and China, as well as many ethnicities within the United States to account for cultural and ethnic effects on pubertal allowing the results to be generalizable (Barendse et al., 2022; Beltz, 2018; Boden et al., 2011; Carter et al., 2013; Conley & Rudolph, 2009; Crockett et al., 2013; Gaysina et al., 2015; Goering & Mrug, 2022; Joinson et al., 2011; Mendle et al., 2010; Pu et al., 2022; Reynold & Juvonen, 2012; Rudolph et al., 2014; Weingarden & Renshaw, 2012). All the studies utilized primary quantitative data, which is the highest level of quality according to the Johns Hopkins Nursing Evidence-Based Practice Evidence Level and Quality Guide (Dang, 2022), which strengthens this systematic review.

One of the biggest limitations in research analyzing puberty is the lack of universal measures for puberty and defining puberty as a variable within research. Three main surveys were utilized to measure puberty: age of menarche, Tanner staging, and pubertal developmental scale. Additionally, 4 studies utilized multiple surveys or adjusted universal surveys for specific use in their study (Barendse et al., 2022; Beltz, 2018; Boden et al., 2011; Carter et al., 2013; Conley & Rudolph, 2009; Crockett et al., 2013; Gaysina et al., 2015; Goering & Mrug, 2022; Joinson et al., 2011; Mendle et al., 2010; Pu et al., 2022; Reynold & Juvonen, 2012; Rudolph et al., 2014; Weingarden & Renshaw, 2012). One study utilized 4 measurement methods to evaluate pubertal status including the three methods mentioned above, along with a physical maturation composite and pubertal hormone levels from a spit test (Barendse et al., 2022). There is lack in consensus on the best definition of puberty between the medical community and the public, thus allowing miscommunication between the public who are taking the surveys and healthcare professionals. Some of the public may define puberty by the rapid growth spurt

associated with the influx of sexual hormones, while others may define it by testicular development and the beginning of a menstrual period for females. Unfortunately, this also develops a limitation within the medical community as puberty encompasses all of these and therefore lacks a universal measurement. Different measurements of puberty can warrant different answers, thus limiting the generalizability of results when comparing results of many different studies. Studies that only utilized a single variable, like age of menarche, to measure puberty limits the results as pubertal assessments can include growth spurts, mood changes, as well as pubertal hair growth. The study by Barendse et al. (2022), was the only study that addressed this limitation as they included age of menarche, the Pubertal developmental Scale, Tanner staging, Physical Maturation Composite score, and hormone levels to address the lack of universal measurement of biological pubertal status (2022).

The timing of the studies also limits the results generalizability as societal changes have significantly impacted pubertal timing over the last few years. Although longitudinal studies would be the best method for assessing pubertal timing and changes in mental health associated, utilizing data from birth cohorts from the 1950's limits the results to be applied to today's data as both pubertal timing measurements and mental health diagnoses have changed greatly. The timeline of a 1-year longitudinal study, in which there are only 2 waves of the study, limits the strength associated with utilizing a longitudinal study to assess the changes related to pubertal and mental health as puberty is a multi-year process. As discussed in many of the limitations of the studies that utilized cross-sectional methods, recall bias is a significant limitation as many cannot recall both biologic and perceived puberty, as well as feelings around these times as they progress in age. Longitudinal studies are hard to complete because of attrition as well as the length of time it takes to publish the results after completion and cost, resources, and effort that

is takes to conduct the study. A 5-year longitudinal study would be ideal as it is long enough to encompass the full length of puberty, as well as establishing participants that are early, on-time, and late and evaluating their outcomes. It also allows the research to be synthesized and published within the next 5 years so that societal norms do not have as much of an effect, as well as the data still being relevant. Of the sources reviewed within this study, there were three studies that were over the length of 5 years (Boden et al., 2011; Gaysina et al., 2015; Goering & Mrug, 2022). These studies were too long as the results were harder to generalize as they were published after changes of societal views on puberty. The other longitudinal studies were under five years, and thus were not enough time as puberty can take anywhere from 2 to 5 years to complete and thus can have implications on mental health for that entire time.

## **Clinical Implications**

### *Screenings in School*

Because of the lack in congruency between the results of the present data, it is still unknown whether there is a relationship between delayed puberty and anxiety and depression within adolescents. Because of the variability in the research, the results still identify that off-set pubertal timing may be a risk factor for mental health issues and therefore should be a concern for primary care providers to be aware of when screening adolescents during puberty. Puberty has shown to be a time of potential mental instability among adolescents and more screenings for puberty should be done within the school setting (Viner, 2014). If mental health issues are assessed and identified early, interventions have shown to be more effective and there are more positive outcomes long-term.

In the United States, Certified School Nurses (CSNs) play a vital role in advocating and detecting deficiencies within growth and development of adolescents (Council on School Health, 2008). Schools in the United States, only screen for hearing, vision, height, and weight which many times will overlook issues related to puberty since it is a multifactorial process. For a girl, they may be growing normally, but lacking their menstrual period, which would invoke questioning from a provider. CSNs facilitate a working relationship between many of these kids and their primary care providers. For adolescents that lack adequate healthcare, utilizing school screenings will allow a wider population of adolescents to be treated. The CSN can also provide information to the family as well as education on medical needs for these children. For those studies that recruited through schools, CSN were involved when giving initial screenings for recruitment. A need for more in depth pubertal assessments are needed within the educational setting as lack in pubertal development often indicates both short term and long-term complications for both males and females.

CSN often play the role of counselor for many adolescents in schools as well (Council of School Health, 2008). Seven of the fourteen studies recruited from schools because of the accessibility to students going through puberty (Barendse et al., 2022; Beltz, 2018; Carter et al., 2013; Conley & Rudolph, 2009; Pu et al., 2022; Reynold & Juvonen, 2009; Rudolph et al., 2014), thus indicating the need to implement these screenings in schools. Implementing school screening for mental health disorders have shown to prove effective in adolescents presenting with early signs and symptoms. In a study done in 2010, a voluntary mental health screening resulted in identifying a larger part of the schools' adolescents in need of mental health services and an increased number of referrals that would not have taken place if not for the screening (Huskey et al., 2010). By implementing mental health screenings in schools, the school nurse



can identify individuals at risk and treatment can be recommended earlier in the course of the disease. Early intervention for adolescents suffering from mental health issues have shown to have more favorable outcomes.

The lack of mental health professionals is a serious issue facing society today (Cuddy & Currie, 2020). Many studies have indicated positive mental health outcomes throughout a lifetime when participants seek early intervention treatment. A study completed in the United States looked at the treatment plans of adolescents facing mental health disorders based on how they were evaluated at first sign of struggle (Cuddy & Currie, 2020). Those that were referred from primary providers or school nurses were treated with therapy first, and then a medication was added if needed. Those that were seen in a hospital or seen by primary provider in crisis, where more likely just treated with medication (Cuddy & Currie, 2020). According to the American Academy of Child and Adolescent Psychiatry, the FDA has only approved Prozac for kids older than the age of 8, and Lexapro for adolescents over the age of 12, which invokes questioning on the long-term effects of these medications on a developing brain. The American Academy of Child and Adolescent Psychiatry recommends therapy be the first line of treatment as a child may benefit more from Cognitive behavioral therapy since they are still developing at a rapid rate and react to change much quicker than an adult (Emslie et al., 2018). If better research shows a link between pubertal status/ timing and mental health issues, utilizing school screenings could identify early risks factors and allow school nurses to make referrals so that children can avoid mental health crisis and have the best outcome in the long run.

### *Education on Mental Health*

Education on mental health should take place in multiple levels, including the adolescents themselves, school nurse, teachers, guardians, and other healthcare providers. Education can

reduce stigma around mental health to allow open discussion within the classroom and allow children suffering to seek medical help more easily (Song et al. 2023). Negative stigma may have also skewed results as participants were not fully open or honest regarding their symptoms of mental health, especially at the adolescent age. Decreasing stigma might ultimately reduce the link between pubertal timing and mental health disorders like anxiety and depression. Education can also allow teachers, school nurses, guardians, and healthcare providers to identify those children that are at risk for developing a mental health disorder and provide screening at an earlier age.

Education on mental health has proved to be the most effective way to decrease negative stigma because of its ways to correct misinformation or notions about mental health disorders and combat negative attitudes and beliefs surrounding mental health. Stigma plays the largest role in preventing treatment or widening the treatment gap (Song et al., 2023). By decreasing the negative stigma surrounding mental health disorders, nurses as well as other healthcare providers can hope that more people will seek help and treatment and therefore have better outcomes.

The studies evaluated throughout this research have indicated that increased screenings and education are needed for both puberty and mental health within the education system since it will hit the largest majority of adolescents. Screenings and education will only benefit adolescents as they can seek treatment at an earlier time in hopes for more beneficial outcomes. School nurses play a large role in these changes as they multitask in the many roles they play while taking care of the adolescents.

### **Direction for Future Research**

As research has started to link precocious puberty to rising obesity rates within the United States, puberty is becoming a highly researched topic. This also indicates a widening range of ages for pubertal timing and thus may increase the difference between early and late-onset puberty as the median age of puberty starts to decrease. Limited research is currently available on delayed puberty, but with the widening gap more research should be conducted.

Defining puberty universally as well as more research on the reliability and validity of measurement tools for puberty are needed. In the research conducted by Barendse et al., (2022) they took this into consideration and found that the Tanner Staging Scale presented the most statistically significant data when compared to a multitude of other methods. More research needs to be done to provide results that signify what method is the most universally applicable when measuring puberty. Future research on this topic need to include a multitude of studies utilizing a universal measurement method and evaluating the best method of measurement of puberty. There also needs to be more research evaluating different psychosocial factors that may play a role in linking late-puberty with anxiety and depression within adolescents. The best method of studying this topic would be evaluating pubertal timing utilizing a universal method of measurement for puberty on a continuous scale instead of categorical groupings over a 5 year longitudinal study.

Another aspect that research needs to focus on is separating perceived pubertal timing and biological timing, as the results have shown that psychosocial factors may play a part in mental health risk factors more than late puberty itself. Researchers should assess whether there is an effect between a child who is biologically late or when compared to peers they feel they are late but biologically they are on time. Biological puberty needs to be assessed by a clinical

professional so that a child's perceived puberty cannot skew the data, and perceived puberty may be assessed by self-assessment.

### **Conclusion**

This systematic review explores the impact of delayed puberty on anxiety and depression in adolescents. Findings of the present studies indicate that there may be a relationship between delay-puberty and anxiety and depression as 8/14 the studies included found a link, while 6/14 the studies did not. From the present research, clinicians can provide more screenings and education on both topics to prevent long-term complications of mental health disorders and other complications that may relate to delayed puberty. If an association does link delayed puberty to anxiety and depression, screenings for these at-risk individuals can impact treatment plans and allow the child to seek help before crisis. To formalize a conclusion, more highly rigorous research on the topic needs to be completed and a universal measurement for puberty needs to be formulated so that findings around the topic can be aggregated.

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