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LONG TERM CONSEQUENCES OF PRECOCIOUS PUBERTY - EXPLORING HEALTH, METABOLIC, AND PSYCHIATRIC CHALLENGES

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ABSTRACT

Introduction and objective:
Precocious puberty (PP) is a condition marked by the premature onset of puberty in children, which can lead to a range of physical, metabolic, and psychological challenges. This review seeks to assess the health implications of precocious puberty and evaluate the treatment options available, with particular emphasis on GnRH analog therapy and the psychological support required for both affected children and their families.
Review methods:
A comprehensive review of studies related to precocious puberty was conducted, focusing on its physical, metabolic, and psychological effects. Research was analyzed on how PP impacts growth, obesity risk, insulin resistance, cardiovascular diseases, and emotional and social challenges in affected children.
Results:
The findings suggest that precocious puberty leads to reduced final height, an increased risk of obesity, insulin resistance, and cardiovascular diseases. Additionally, girls with precocious puberty are at higher risk for developing polycystic ovary syndrome (PCOS), mood disorders, body image issues, and social challenges. GnRH analog therapy has been shown to improve growth outcomes, though the effectiveness of treatment varies depending on the age of initiation and the progression of puberty.
Conclusion:
Precocious puberty is associated with a range of serious health consequences that require a comprehensive treatment approach. Successful management should not only address the medical aspects but also incorporate psychological support and emotional monitoring to improve the overall well-being and quality of life. Early intervention and parental education are essential for improving outcomes, and further research is needed to refine treatment strategies and better understand the long-term effects of this condition.

KEYWORDS

Precocious Puberty, Growth, PCOS, Insulin Resistance, Anxiety, Depression, Body Image, ADHD

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Introduction.

Precocious puberty – epidemiology, pathogenesis and treatment.

Precocious puberty is defined as the onset of secondary or tertiary sexual characteristics before the age of 8 in girls and 9 in boys. There are two main types of premature puberty: progressive and non-progressive. In the case of progressive premature puberty, the appearance of one sexual characteristic leads to further pubertal progression. It can be central, associated with activation of the hypothalamic-pituitary-gonadal (HPG) axis, or peripheral, where sex hormones are produced by the gonads or adrenal glands without activation of the HPG axis. In both cases, excessive sex hormones are a common factor, though their sources differ. In central premature puberty, activation of the HPG axis leads to pulsatile secretion of gonadotropins, which can result from spontaneous causes or be due to structural abnormalities, such as brain tumors (e.g., craniopharyngiomas, ependymomas) or central nervous system damage (e.g., hemorrhage, meningitis, trauma, or radiation therapy). Functional causes of central puberty include idiopathic cases, but also adoption from developing countries, where improved nutrition leads to elevated IGF-1 levels and subsequent activation of GnRH. Other functional causes include secondary true premature puberty, which develops after the treatment of peripheral puberty, and genetic mutations, such as those in the KISS1-R gene, which lead to early activation of the kisspeptin mechanism.(Banerjee & Bajpai, 2023) Peripheral premature puberty occurs when the HPG axis remains inactive, and sex hormones are produced autonomously by the gonads or adrenal glands. The causes of hormonal excess in this form of puberty can be gonadal tumors, such as granulosa cell tumors or thecomas in the ovaries and Leydig cell tumors or estrogen-producing tumors in the testes. Testotoxicosis, an

activating mutation of the LH receptor gene in the testes, leads to excessive testosterone production, which affects only boys. In the case of tumors producing hCG, such as those located in the CNS, mediastinum, gonads, or liver, hCG acts agonistically on the LH receptor, stimulating testosterone production by Leydig cells. Additionally, primary hypothyroidism can lead to elevated TSH levels, which agonistically stimulate FSH receptors, causing isosexual premature puberty in girls or testicular enlargement in boys. Congenital adrenal hyperplasia (CAH) is the most common cause of peripheral premature puberty in boys, but in girls, it is rarer since virilization of the external genitalia is usually detected in the newborn period and treated accordingly. Rare adrenal tumors (e.g., adenomas or hormonally active carcinomas) can also cause premature puberty. Genetic causes of peripheral premature puberty include mutations in the aromatase gene, which can lead to either a deficiency or excess of aromatase, affecting androgen and estrogen levels and influencing the timing of pubertal features. Non-progressive premature puberty, or mild variants of puberty, may present with isolated features such as thelarche (early breast development in girls), adrenarche (early pubic hair), or isolated premature menstruation. These cases generally do not progress to full puberty, and the cause is usually premature activation of adrenal androgens. These forms of puberty typically do not require treatment but may be associated with future risks such as metabolic syndrome and hyperandrogenism.

Precocious puberty (PP) is becoming increasingly common, especially in girls, with studies reporting a higher prevalence than previously thought. A study conducted in Qufu City, China, found that the prevalence of PP in girls was 14.23%, significantly higher than in boys (1.54%) (Fuqua, 2013). Similar findings have been noted in other regions as well, with studies showing varying rates of PP across different populations (Zhang et al., 2022). One of the contributing factors to the rise in PP may be related to obesity. Research has found that children with higher body mass indices (BMI) are more likely to experience early onset puberty. For instance, overweight and obese children have a higher prevalence of PP, with studies showing that obesity in particular is linked to the early activation of puberty. (Zhang et al., 2022) Overall, the epidemiology of PP varies based on geography, ethnicity, and body composition, but there is clear evidence of its increasing prevalence. Studies highlight the importance of monitoring children with high BMI, as obesity appears to be a significant risk factor for early puberty.

In the treatment of premature puberty, a long-acting GnRH analogue is used, which is approximately 150 times more potent than the native hormone. Initially, GnRH analogues strongly stimulate the release of gonadotropins, leading to the so-called "flare effect," which results in an initial increase in these hormones. However, after about 10 days, due to "downregulation" of the number of GnRH receptors, a strong hypogonadotropic effect occurs. In the early stages of treatment, symptoms of progressing puberty may appear, such as breast enlargement, increased hair growth, or the appearance of vaginal discharge.

After the brief stimulation of gonadotropin secretion, their production is inhibited due to the negative autoregulation of GnRH receptor content by the analogue. The loss of receptors leads to decreased sensitivity of gonadotrope cells in the pituitary to both the analogue and the endogenous hormone. As a result, the gonadotropin function of the pituitary is inhibited, which leads to secondary suppression of gonadal function and a decrease in sex steroid production. This effect is fully reversible after discontinuing therapy. Pharmacological treatment to suppress premature puberty is continued until the patient reaches the appropriate age for physiological sexual maturation. The exception is in cases of hypothyroidism and congenital adrenal hyperplasia (CAH), where hormonal treatment is given for life.

Premature puberty, regardless of its form, has significant health implications, including effects on growth and development, metabolic health, and psychological well-being. Long-term consequences may involve issues with physical development, increased risk of obesity, insulin resistance, and emotional problems related to early puberty. Early diagnosis and appropriate treatment are crucial for minimizing the negative effects of this condition.

Materials and Methods.

The authors extensively explored the PubMed electronic database, employing pertinent keywords and combinations like "Precocious puberty," "Precocious puberty consequences" "Diabates," "Precocious puberty psychiatric outcomes". Studies focusing on the psychiatric, metabolic and health consequences of precocious puberty were incorporated. These selected studies underwent thorough critical analysis. The foundational research for this article was conducted between July and November 2024. We assessed the relationship between CPP and final adult height (FHt), bone health, reproductive function, body mass index, metabolic and cardiovascular abnormalities, and increased cancer risk.

Results.

Growth and Final Adult Height.

The primary concern in cases of precocious puberty is identifying and addressing any underlying medical conditions, particularly central nervous system abnormalities or gonadal tumors, which must be ruled out as part of the initial diagnostic process. A secondary concern is its impact on growth, as precocious puberty accelerates growth and bone maturation, ultimately leading to a shorter adult height(Carel et al., 2004). In terms of growth, children with precocious puberty may experience faster growth compared to their peers initially, but ultimately, they may achieve a shorter final height due to the earlier onset of bone maturation. Notably, long-term results of treatment with gonadotropin-releasing hormone (GnRH) analogs have demonstrated an increase in final height, particularly in younger patients, with no significant adverse effects on bone health or reproductive function. GnRH analog therapy is generally well-accepted by patients and effectively suppresses the pulsatile release of luteinizing hormone and ovarian activity.(Neely & Crossen, 2014)

The issue, however, is more complex. A study investigating the effect of untreated central precocious puberty (CPP) on the final adult height (FAH) of girls diagnosed between the ages of 8 and 9 included two groups: 36 untreated girls and 206 girls of the same age who received gonadotropin-releasing hormone (GnRH) agonist treatment. The collected data included midparental height (MPH), predicted adult height (PAH) based on bone age (BA) at the time of diagnosis, and PAH estimated using the Bayley-Pinneau method. These predictions were then compared to the actual FAH measurements. The findings showed that untreated girls achieved an average FAH of 160.71 cm, surpassing the predictions based on bone age and the Bayley-Pinneau method. The difference between their actual FAH and MPH was minimal, around 1 cm. On the other hand, the treated group reached an average FAH of 159.31 cm, suggesting that the lack of treatment did not necessarily result in significantly poorer height outcomes. Factors such as the timing of puberty onset, height at diagnosis, bone age, luteinizing hormone levels, predicted height, and the rate of pubertal progression should guide treatment decisions. Notably, the study indicated that the height outcomes for untreated girls in this age group may be more favorable than previously believed.(Jang et al., 2023)

Another interesting article explores the effects of both central and gonadotropin-independent precocious puberty on final adult height, alongside the treatment outcomes of current therapeutic approaches. In cases of progressive precocious puberty in girls, the available evidence consistently indicates an increase in adult height compared to initial predictions or untreated historical controls. However, the extent of this height gain varies significantly, largely due to the inherent limitations in height prediction methods. For girls whose puberty begins at the younger end of the typical age range (8-10 years), studies utilizing GnRH agonists have shown minimal or no improvement in height outcomes. Although less commonly observed in boys, precocious puberty also appears to follow a similar pattern, with fewer studies available but supporting the general trend. The optimal timing for discontinuing treatment remains a topic of ongoing debate. In conclusion, while GnRH agonists can be effective in restoring height in children affected by precocious puberty, the outcomes are variable, and further research is needed to determine the best treatment duration.(Carel et al., 2004).

Metabolic and Cardiovascular Risks.

Precocious puberty, particularly when accompanied by early adiposity rebound, is associated with a higher risk of developing obesity and metabolic syndrome. Additionally, it is linked to increased insulin resistance and a greater likelihood of developing type 2 diabetes. Furthermore, girls who experience early menarche may face a slightly elevated risk of hypertension and ischemic heart disease later in life.

A systematic review of studies published between January 2000 and March 2023, sourced from databases such as Medline, PubMed, Google Scholar, and Web of Science, explored the relationship between central precocious puberty (CPP) and various health outcomes, including final adult height (FHt), bone health, reproductive function, body mass index (BMI), metabolic and cardiovascular disorders, and cancer risk. The review revealed several key findings: treatment of CPP in girls before the age of 6-7 and in boys before 9 years old leads to improved FHt; bone mineral density (BMD) decreases during GnRHa treatment but normalizes after cessation, with no lasting effects on peak bone mass during puberty; GnRH therapy does not negatively impact menstrual cycles; however, untreated CPP increases the risk of premature or early-onset menopause; women with a history of CPP may have a slightly higher incidence of polycystic ovary syndrome (PCOS) or hyperandrogenemia, although overall reproductive health remains largely unaffected; early thelarche and menarche could raise the risk of breast cancer development; CPP increases the likelihood of obesity and type 2 diabetes in both sexes; early menarche may slightly raise the risk of coronary artery disease and ischemic

strokes; and an earlier onset of puberty is associated with a heightened risk of depression and anxiety disorders.(Soliman et al., 2023)

Early menarche in girls may elevate the risk of developing polycystic ovary syndrome (PCOS) later in life, a condition characterized by menstrual irregularities and hyperandrogenism. One study aimed to assess the likelihood of developing PCOS in adolescent girls with a history of idiopathic central precocious puberty (ICPP) compared to healthy peers. The study also compared the prevalence of PCOS in ICPP girls who were treated with gonadotropin-releasing hormone agonists (GnRHa) and those who were not.

The participants included post-menarcheal girls with a gynecological age of at least 2.5 years. Data collected included age at menarche, menstrual cycle characteristics, body mass index (BMI), clinical signs of hyperandrogenism (HA), and levels of total and free testosterone. PCOS was diagnosed based on adolescent-specific criteria. A total of 94 participants were analyzed, 63 of whom had received GnRHa treatment. Menstrual irregularities were observed in 29% of participants, clinical HA in 36%, and biochemical HA in 23%. PCOS criteria were met by 12% of the girls. No significant differences were found in BMI, menstrual irregularities, or hyperandrogenism between the treated and untreated groups. However, untreated girls had a higher prevalence of clinical HA compared to those treated with GnRHa. The relative risk (RR) of PCOS in girls with ICPP was 2.5 compared to healthy adolescents, with GnRHa treatment showing no impact on this increased risk.

The results suggest that adolescent girls with a history of ICPP are at a heightened risk of developing PCOS, regardless of GnRHa treatment. This underscores the importance of monitoring this group for early signs of PCOS.(Arcari et al., 2024)

When dealing with cardiovascular concerns, it's important to consider the possibility of monogenic arterial hypertension (AH) in patients who exhibit either early or delayed puberty, along with those experiencing growth impairments.(Ostrowska & Skrzypczyk, 2022)

A meta-analysis was performed to determine whether lipid levels—triglycerides (TG), total cholesterol (TC), high-density lipoprotein (HDL), and low-density lipoprotein (LDL)—differ in girls with precocious puberty compared to healthy controls. This analysis included data from 14 studies involving 1,023 girls with precocious puberty and 806 healthy controls. The results revealed that girls with precocious puberty had significantly higher levels of TG (SMD: 0.28; 95% CI: 0.01 to 0.55; P = 0.04), TC (SMD: 0.30; 95% CI: 0.01 to 0.59; P = 0.04), and LDL (SMD: 0.45; 95% CI: 0.07 to 0.84; P = 0.02) compared to the control group. However, there were no significant differences in HDL levels (SMD: -0.06; 95% CI: -0.12 to 0.61; P = 0.62). Subgroup analysis suggested that factors like the type of precocious puberty, geographical location, sample size, age, body mass index, and medication use might account for the variations observed in lipid profiles. These findings indicate that girls with precocious puberty may have an altered lipid profile, which could elevate their risk for cardiovascular diseases. As a result, early intervention strategies, particularly to prevent obesity in children with precocious puberty, are critical to reducing the long-term cardiovascular risks they face.(Jiang et al., 2023)

Emotional and Psychological Impact of Early Puberty.

Children with precocious puberty often face heightened levels of anxiety, depression, and lower self-esteem compared to their peers, largely due to early physical changes and associated social difficulties. Research has also indicated a higher incidence of attention-deficit/hyperactivity disorder (ADHD), aggressive behavior, and struggles with social interactions in these children. A study explored the relationship between self-esteem and depression in children with precocious puberty (PP) and evaluated the effects across both genders. The research included 60 children diagnosed with PP and 60 age- and sex-matched controls without PP. The children were assessed using the Birleson Depression Self-Rating Scale for Children and the Piers-Harris Children's Self-Concept Scale. The findings revealed notable differences between the two groups, particularly in areas such as body image, anxiety, happiness, and overall life satisfaction. Children with PP exhibited significantly higher levels of depression compared to the control group. Among the PP group, girls showed higher levels of anxiety and unhappiness than boys. The study highlighted gender differences in how PP affected self-esteem, with girls being more susceptible to anxiety and dissatisfaction. These results underscore the importance of addressing both the physical and emotional well-being of children affected by precocious puberty.(Huang et al., 2021) A separate study aimed to evaluate the influence of a nursing support program (NSP), based on the Roy Adaptation Model, on the psychosocial adaptation of girls with precocious puberty. The study involved 26 girls diagnosed with precocious puberty, alongside their mothers, using a pre-post design. To assess the impact, data were collected through a Demographic Information Form, the Child

Behavior Checklist for Ages 6-18, and the Depression, Anxiety, and Stress Scale. After participating in the NSP, the same evaluations were repeated.

Initial results indicated that many of the girls displayed significant psychosocial challenges, including high levels of anxiety and depression. Following the NSP, improvements were noted, with a considerable reduction in both anxiety and depressive symptoms in the girls, along with a decrease in overall behavioral concerns. These findings suggest that the nursing support program positively impacted the psychosocial well-being of the girls with precocious puberty, promoting better mental health and emotional adaptation.(Turan Miral & Hotun Sahin, 2022) There was also a study conducted to investigate the prevalence of psychiatric issues and evaluate depression, anxiety, and self-concept in girls with precocious puberty (PP). The study involved 41 girls diagnosed with PP and 45 age-matched controls, ranging from 7 to 11 years old. Psychiatric evaluations were carried out using semi-structured interviews, while behavioral and emotional difficulties were assessed through the Child Behavior Checklist and Teacher Report Form. Additionally, the Children's Depression Inventory, State-Trait Anxiety Inventory for Children, and Piers-Harris Children's Self-Concept Scale were administered.

The results indicated that girls with PP had a significantly higher rate of psychiatric diagnoses compared to the control group (68.3% vs. 20%, $p < 0.001$). These girls exhibited more pronounced symptoms of anxiety and depression, along with somatic complaints, social difficulties, aggressive behavior, and, notably, autistic traits. Furthermore, the girls with PP showed greater levels of depression and anxiety, accompanied by lower self-esteem. The study concluded that precocious puberty is a distinct risk factor for psychiatric disorders, leading to poorer mental health outcomes, including diminished self-worth and the emergence of autistic-like traits. The findings suggest that an integrated, multidisciplinary approach that combines both endocrinological and psychiatric care is crucial in supporting the well-being of girls with PP.(Temelturk et al., 2021)

Research was undertaken to explore the relationship between body image perception and depression in girls with precocious puberty (PP) undergoing gonadotropin-releasing hormone (GnRH) analogue therapy. The study included 82 girls diagnosed with PP, with assessments focusing on key factors such as height, weight, body mass index, and stages of pubertal development. Participants completed self-report questionnaires regarding their body image and pubertal self-assessment, while depression levels were evaluated using the Korean version of the Kovacs' Children's Depression Inventory.

The results revealed that girls with PP tended to view themselves as more overweight compared to their healthy counterparts, although depression scores were similar across both groups. However, a noticeable increase in depression scores was observed as pubertal stages advanced. Girls who expressed dissatisfaction with their body image showed significantly higher levels of depression. Regression analysis further indicated that negative body image perceptions and progression to later pubertal stages were key factors influencing depression. These findings suggest that girls with PP are more likely to experience body image distortion, which can contribute to heightened depression. Their subjective views of pubertal development often do not align with objective physical changes, underscoring the need for targeted psychological interventions. (Choi & Kim, 2016)

One study of particular interest explored the prevalence of attention deficit hyperactivity disorder (ADHD) in girls diagnosed with central precocious puberty (CPP). The participants were prospectively recruited from a pediatric clinic, with screening for ADHD conducted using the ADHD Rating Scale (ADHD-RS) and the Child Behavior Checklist (CBCL). Girls who showed positive results on the ADHD-RS were then referred for further evaluation, which included a Computerized Performance Test (CPT) and a clinical interview with a child and adolescent psychiatrist. A total of 81 girls with a mean age of 8.97 ± 0.91 years participated in the study. The findings revealed that 11 girls (13.58%) were diagnosed with ADHD—5 with the inattentive type and 6 with the combined type. Notably, the study indicated that the prevalence of ADHD among girls with CPP was higher than the global prevalence of ADHD in the general pediatric population. This highlights a potential association between early pubertal onset and an increased risk of developing ADHD, suggesting the need for careful monitoring and early intervention for neurodevelopmental concerns in girls with CPP.(Lee et al., 2023) The psychological effects of early physical and hormonal changes in girls with central precocious puberty (CPP) and premature thelarche (PT) have been a subject of growing concern, as these developmental shifts can have significant emotional and mental health impacts. Many young girls may not possess the emotional maturity necessary to fully comprehend the implications of these early changes, potentially leading to stress and psychological difficulties. This study sought to investigate the prevalence of psychiatric disorders, as well as the levels of depression, anxiety, coping difficulties, and quality of life in girls diagnosed with PT in comparison to those diagnosed with idiopathic CPP (ICPP). Fifty girls, aged 6 to 9 years,

participated in the study, with 33 diagnosed with PT and 17 with ICPP. Four months after their initial diagnoses, the participants were evaluated by pediatric psychiatrists. The findings revealed that the PT group had an average age of 7.81 years, while the ICPP group averaged 8.15 years. Girls with ICPP showed greater growth, body mass, and hormonal levels (LH, FSH, E2) than those with PT. The PT group also had significantly higher scores on the Revised Child Anxiety and Depression Scale (RCADS), indicating more pronounced anxiety and depression symptoms. Furthermore, quality of life, as assessed by the Pediatric Quality of Life Inventory (PedsQL), was lower in the PT group, reflecting reduced physical and psychosocial well-being. Both groups displayed similar results on the Strengths and Difficulties Questionnaire (SDQ), which measures coping difficulties. The study's results indicated a clear link between higher anxiety and depression scores and a decreased quality of life, underscoring the importance of addressing the psychological aspects of PT. Despite the absence of activation in the hypothalamic-pituitary-gonadal axis in PT, the physical changes associated with early puberty can still adversely affect psychological well-being. The authors emphasize the need for psychological support for girls with PT, even in the absence of endocrinological intervention, suggesting that such care could improve their overall mental and physical health. The study advocates for further investigation with larger sample sizes and control groups to better understand the relationship between early physical changes and psychological outcomes.(Donbaloglu & Bostan, 2024). This study sought to explore and compare anxiety, self-esteem, and body image between girls with precocious puberty and those without. It included 15 girls diagnosed with precocious puberty and 16 age-matched controls. The researchers employed tools such as the State-Trait Anxiety Inventory for Children (STAIC) and the Self-Description Questionnaire (SDQ) to assess these psychological factors. The results revealed significant differences between the two groups, with girls with precocious puberty reporting higher levels of anxiety and a more negative body image. However, self-esteem levels did not differ significantly between the groups. These findings suggest that girls with precocious puberty are more prone to experiencing heightened anxiety and negative body image, emphasizing the psychological challenges they face compared to their peers who experience puberty at a typical age..(Mercader-Yus et al., 2018).

Emotional and psychological challenges are faced by girls with central precocious puberty (CPP), especially with a focus on peer victimization, psychiatric disorders, quality of life, and overall emotional and behavioral well-being. The study that involved 71 girls diagnosed with CPP and 50 healthy, age-matched peers as a control group, investigated this topic. Through semi-structured interviews led by a child and adolescent psychiatrist, various assessment tools were employed, including the Olweus Bully/Victim Questionnaire, the Pediatric Quality of Life Inventory (PedsQL), the Child Depression Inventory (CDI), and the Strengths and Difficulties Questionnaire (SDQ). The results revealed some intriguing patterns. While the overall rate of psychiatric diagnoses was slightly higher in the CPP group (28% vs. 20%), social anxiety disorder emerged as the most prevalent condition in these girls. Although depression levels and quality of life did not differ significantly between the groups, girls with CPP exhibited notably higher scores in prosocial behavior, suggesting a possible adaptive coping mechanism. However, the study also uncovered a concerning trend: girls with CPP were significantly more likely to experience bullying, with 28% reporting victimization compared to just 12% of the control group.These findings shed light on the complex psychological landscape faced by girls with CPP, highlighting the importance of regular monitoring for bullying and other emotional challenges. The study underscores the need for more in-depth, long-term research to explore the broader psychological implications of early puberty on these young girls' lives..(Çoban Ö et al., 2021).

Discussion.

Precocious puberty (PP) presents a complex array of health challenges that impact various aspects of a child’s development, including physical, metabolic, and psychological well-being. From a physical standpoint, PP accelerates the maturation of bones, often resulting in an early closure of the growth plates, which can significantly compromise adult height. While gonadotropin-releasing hormone (GnRH) analog therapy has been shown to improve final height outcomes, particularly in younger patients, the results are not always consistent. The variability in height gain depends on a range of factors, such as the age at which treatment is initiated and the speed at which puberty progresses. These differences highlight the need for more refined research to determine the optimal timing for starting and stopping treatment, as well as how to best tailor interventions to each individual case.

Metabolically, PP is linked to a greater risk of obesity, insulin resistance, and metabolic syndrome, which can increase the likelihood of developing cardiovascular conditions like hypertension and ischemic heart disease later in life. Additionally, girls with PP are at a higher risk of developing polycystic ovary syndrome

(PCOS), regardless of whether they undergo GnRH treatment. This makes it crucial to monitor these patients closely throughout their adolescence and into adulthood to manage any emerging complications and prevent long-term health issues.

Psychologically, children with PP are more susceptible to anxiety, depression, and social difficulties. Research consistently points to negative body image, lower self-esteem, and heightened vulnerability to bullying as common struggles faced by this population. Girls with PP may also display increased aggression, experience challenges in forming healthy peer relationships, and exhibit symptoms of depression. Given the emotional and social ramifications, it is essential to provide comprehensive psychological support to both the children and their families.

Considering the multifaceted nature of PP, it is clear that a multidisciplinary approach is necessary to address the complex needs of these children. A collaborative effort involving pediatricians, endocrinologists, psychologists, and other specialists is crucial to manage the physical, emotional, and social challenges these children face, ensuring a holistic and supportive care model that promotes overall well-being. Additionally, further research is needed to explore the long-term impact of early treatment and its potential side effects, ensuring that interventions are as effective and safe as possible.

Conclusions.

Precocious puberty (PP) is associated with significant health, metabolic, and psychological consequences. These include adverse effects on final adult height, increased risks of obesity, insulin resistance, and cardiovascular diseases such as hypertension and ischemic heart disease. Additionally, girls with PP may be more susceptible to developing PCOS, mood disorders, body image disturbances, and social challenges, including bullying.

Despite the availability of effective treatments, such as GnRH analogs, research highlights the need for a holistic approach to diagnosis and therapy. This includes addressing biological, psychological, and social factors, alongside systematic monitoring of emotional and behavioral health and overall quality of life. Early psychological intervention and parental education are pivotal for improving the well-being of children with PP. Further studies are required to deepen our understanding of the long-term effects of precocious puberty and to optimize therapeutic strategies.

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