

Post-COVID-19 Trends in Precocious Puberty: A Cross-Sectional Survey from Chandrapur, Guwahati

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Abstract

This study looked at the rise in Precocious Puberty (PP) among female adolescents in Northeast India following COVID-19. Early childhood age groups of girls were screened in a cross-sectional study taken across public schools in Chandrapur, Guwahati, Assam. Early pubertal beginning was found to be significantly prevalent via clinical, imaging, and hormonal exams. Early menarche came after pubarche and thelarche, which was the main clinical sign. Laboratory results showed high baseline and peak luteinising hormone levels, hence supporting a mostly central, gonadotropin-dependent cause. Crucially, participants with precocious puberty showed notable bone age advancement that portended permanent adult height deficits. Multivariate logistic regression found major environmental and lifestyle risk variables driving this trend, including childhood obesity, too much daily screen time, regular chemical sanitizer and triclosan exposure, and increased family stress. The study emphasizes an immediate requirement for routine school-based Tanner staging and body mass index screening since a majority of the afflicted females needed urgent intervention with gonadotropin-releasing hormone analogues to stop early epiphyseal closure. To reduce lifelong metabolic and psychological problems, public health initiatives have to enforce institutional restrictions on triclosan products, advise against too much digital screen time, and use national referral networks.

Keywords: Precocious Puberty, Female Adolescents, Northeast India, Cross-Sectional Study, COVID-19

Introduction

Early start of puberty and additional sexual characteristics among children is known as Precocious Puberty (PP). The emergence of pubertal changes before the established lower limits for the age

of puberty onset before the ages of 8 for girls and 9 for boys. Early secondary sexual characteristic development, quick bone maturation, decreased final height, incorrect bodily look, and a typical psychological and behavioral patterns are all caused by PP (Berberoğlu, 2009). Treatment recommendations are determined by factors such as the rate of puberty, bone age progression, anticipated adult height, and psychological assessment. The differential ranges from benign variations to serious disorders like cancer, making the diagnosis extremely difficult. In addition to reviewing the early detection, assessment, and treatment of precocious puberty, this activity emphasizes the responsibility of healthcare professionals in recognizing the disease and swiftly referring patients to a pediatric endocrinologist for additional care and to avoid complications.

The stimulation and expansion of the hypothalamic-pituitary-gonadal (HPG) system leads to puberty. The HPG axis is briefly activated before birth, which leads to an increase in steroidal hormone synthesis. Male pubic hair and female breast development may be the outcomes of this stimulation. The "mini-puberty of infancy" is the term for this occurrence, which typically regresses throughout the initial two years of life. Despite being thought to be benign, not much is known about its etiology or clinical importance.

Based on its aetiology, premature puberty can be divided into two main categories: central precocious puberty, which is dependent on GnRH, and peripheral precocious puberty, which is independent of GnRH. Firstly, Precocious puberty of the Central Precocious Puberty (CPP) type reflects real pubertal development since the HPG axis matures and activates earlier. Males typically have an underlying pathology, while females typically have an idiopathic origin. There are numerous factors that contribute to it. Tumours of the central nervous system, head injuries, cranial radiation, cerebral palsy, and infections such as tuberculous meningitis are the most pertinent groups. Hypothalamic hamartoma is the most frequent brain lesion that causes CPP. The lesion's ectopic neural cells act as an extra source of GnRH pulses. As early as 12 months of age, it manifests as premature puberty in infancy.

Gelastic seizures, which are typically drug-resistant, are the most distinctive association. Psychiatric, behavioral, and cognitive problems are among the other related characteristics.

Internationally adopted children are known to have a higher prevalence (Kota et al., 2023). Although the precise mechanism is unknown, it has been suggested that exposure to hormone-disrupting substances and improved nutrition may be involved. Although familial forms have been reported, nothing is known about their genetic foundation. The genes for kisspeptin (KISS1) and makorin ring finger (MRF3) and their receptors have shown some intriguing correlations in recent years. Signals that stimulate and inhibit the release of GnRH are produced by these genes.

CPP is caused by mutations that cause these genes to lose or increase function. Secondly, the secondary sexual traits that make up Peripheral Precocious Puberty (PPP) are not dependent on the pulsatile production of GnRH. Congenital adrenal hyperplasia, McCune-Albright syndrome, gonadal tumours, adrenal tumours, male-limited precocious puberty in families (testotoxicosis), exogenous sex-steroid exposure, and Van Wyk and Grumbach syndrome are some of the major reasons.

As living standards have increased, the issue of children's premature puberty has grown more prevalent, and parents and medical professionals are giving it greater consideration because it can produce numerous negative effects on children. Children who experience premature puberty experience rapid changes in their height, weight, and bone age with regard to physiology and pathology. Children that experience premature puberty will have shorter growth periods, early closure of the epiphysis, and early bone age development. Adults' eventual height will be impacted, and severe cases will result in dwarfism; children who experience premature puberty may develop secondary sexual symptoms, such as menstrual cramps.

According to international research, girls who experience early puberty are more likely to develop uterine and breast cancer (Han et al., 2022). Furthermore, according to social psychology, the mentality shifts brought on by homosexuality will make youngsters more psychologically burdened and may even result in societal issues like early inappropriate behavior in children or adolescent sexual offences (Wei et al., 2020). Frequent eating of nutrient-dense foods and the mother's menarche age ≤ 13 have been identified as independent risk factors that influence children's early puberty. Diet, lifestyle choices, and the hormones FSH (Follicle-Stimulating Hormone), LH (Luteinizing Hormone), and E2(Estradiol) are all risk factors for premature puberty in children. Enhancing children's health care can support their physical and mental well-being by ensuring their normal growth (Dong et al., 2023).

Poor family emotional environments, a lack of intimacy within the family, frequent arguments, a lack of paternal love, and inadequate parenting are all linked to premature puberty. It results in the development of conceptual thinking, which helps a child to adopt other people's viewpoints, form an opinion about themselves, improve their ability to think for themselves, identify the evolution of their own gender, develop a set of values, and demonstrate autonomy. Furthermore, they create and develop their own psychological traits. Cultural background, peer connections, society, family, growing personal independence, and the development of coping mechanisms and problem-solving techniques can all be regarded as psychosocial tasks in the course of normal development. They may, however, result in issues including psychopathological diseases and developmental abnormalities (Han et al., 2022b).

According to numerous research studies, both in developed and emerging nations, the average age of puberty and "menarche" has gradually decreased. The recent century has seen most of the decline (Deshpande, 2020). According to recent studies, 34% of girls menarche get their first period—before turning 8 years old. Indian girls similarly exhibit the global trend of a decreasing menarche age. The root cause of many later gynecological conditions, such as endometriosis, in addition to other conditions like cancer and cardiovascular problems, is early menarche.

Post-COVID Surge and Shocking Cases in India

The Indian population faces a major health risk through precocious puberty which remains unknown to most people. The condition produces multiple health dangers which affect physical and mental well-being and reproductive systems. Indian research shows different results across various regions which create a need for studies that examine entire countries through long-term

research. The condition increases breast cancer risk because it results in more instances of extended periods of oestrogen exposure.

Women may face greater risks for metabolic conditions later in life because they experience hormonal changes during their younger years. Body image problems and eating disorders have been linked to this condition which shows disordered eating patterns after people reach low body mass index levels that disrupt their daily life activities and academic performance while increasing their chances of developing chronic illnesses (KV et al., 2023).

The medical condition of PP which affects women requires urgent medical intervention. The nation lacks information about how common anxiety and depression and PCOS and sleep disorders affect women who experience early puberty. Several studies have examined the issue, with research from southern India showing that local people believe early menstruation causes both dysmenorrhea and various health problems. The study investigates how early menstrual cycles affect women's health and safety which requires a better understanding of their effects. Medical professionals need to pay special attention to this issue, because early menarche leads to multiple serious mental and physical health conditions, including eating disorders and depression and anxiety, as well as preeclampsia and PCOS.

The pandemic caused COVID-19 to create a situation which led to increased rates of PP throughout India. Pediatricians and gynaecologists have observed that more children now experience puberty before reaching eight and nine years of age. The Indian Council of Medical Research (ICMR) will conduct a nationwide survey to assess the current prevalence and historical patterns of this phenomenon. Early puberty presents multiple dangers because children who experience it will develop adult height issues from their bones maturing too early and face multiple emotional and psychological problems. The global trend shows that pubertal onset occurs at younger ages now because obesity rates have risen and people sleep less and experience more anxiety and stress and contact hormone-disrupting chemicals.

Doctors use blood tests to assess hormone levels during the diagnosis process and they use puberty blockers as one treatment method. Recent studies show that Chennai has experienced a major rise in precocious puberty cases which now affects children who show puberty signs from age 8 to 9. Doctors document menstruation starts in girls who begin developing breast tissue and facial and pubic hair and experience acne and rapid growth during their 9 to 10-year-old period.

The Indian Council of Medical Research (ICMR) has decided to conduct the first national survey which will measure the actual disease prevalence and track its spreading pattern throughout the country. PP shows effects which extend beyond its impact on your physical appearance.

Children who experience early puberty develop special difficulties which they must learn to navigate. Children who experience rapid physical development before their brains and emotions reach complete maturity will develop feelings of uncertainty about themselves because they perceive themselves as being different from their friends. Social integration difficulties together with increased stress levels will lead to worse anxiety symptoms. The children start to grow taller than their schoolmates because of their faster growth rate, but their bones develop at an accelerated

pace, which results in premature closure of their growth plates. The result of this process causes children to reach a final height which falls short of their potential height.

Puberty marks a critical developmental stage which brings significant transformations to the physical body and mental mind of humans. The process begins after the hypothalamo-pituitary-gonadal axis system reaches its operational state. The hypothalamus initiates the release of reproductive hormones which control both male and female sexual development until the person achieves full sexual maturity and reproductive capability (News-Medical, 2020). Parents and medical professionals show increased concern about premature puberty in children because it leads to various harmful effects which have become more common since living standards improved. Children who experience premature puberty show rapid physiological changes which include height and weight gain together with advanced bone development. The physical growth period of children who undergo premature puberty will end sooner because of their early epiphyseal closure and advanced bone development. children who undergo premature puberty will experience secondary sexual symptoms which include menstrual cramps while their growth will stop because of severe cases which lead to dwarfism.

The COVID-19 pandemic has caused a major rise in PP cases which prompted pediatricians and gynaecologists from all over the country to issue warning signs. Children who are just eight years old now experience breast development and body hair growth and acne and menstrual periods which occur before doctors established the normal age for these changes (Tripathi et al., 2024). The Indian Council of Medical Research (ICMR) has responded by announcing preparations for a statewide survey to map the prevalence and determine the core causes of this concerning trend. The research found that people used hand sanitizers and soaps and cleaning products which contain the endocrine disrupting chemical triclosan at excessive levels during the pandemic.

The research established that triclosan affects puberty timing, but scientists need to conduct more studies before finding direct connections between the two. The specific reasons which lead to this increasing pattern remain undiscovered. The study identified four factors which drive this trend, including rising childhood obesity rates and insufficient sleep habits and higher levels of anxiety and stress in early children and increased exposure to hormone-disrupting substances in the environment (Dutta & Dutta, 2024). The medical team needed to conduct extensive tests to determine whether the two-year-old girl had cancerous tumours because she had developed underarm hair and chest hair. The doctors discovered she had premature puberty, which led to an unexpected hormonal transition that began too soon (Madaan 2024). The majority of Indian girls experience early menstruation, which has become a serious public health issue because it affects about one-third of the population.

The condition leads to various health problems, which include cancer development and emotional distress. The experts require public education together with lifestyle modifications and treatment procedures to effectively tackle this emergent public health issue. The process of open communication helps to decrease fear and social stigma because it allows people to discuss menstrual and puberty matters without hesitation. Young girls who seek counselling will discover

ways to manage their negative feelings and distressing experiences. People can use a proper diet together with consistent exercise to achieve hormone balance, which results in postponed puberty development. The health tests that occur at predetermined times enable medical professionals to identify physical and hormonal issues during the early detection phase of health assessments (Desk, 2024).

Objectives of the Research:

The research examines how many girls in Assam experience precocious puberty (PP) throughout their lives. The definition of precocious puberty occurs when a child begins to develop pubertal signs before reaching eight years of age. The research will use multivariate logistic regression to identify risk factors which include obesity measured by BMI above the 85th percentile and screen time exceeding four hours daily and triclosan exposure and family stress. The study will use parent and teacher surveys to measure preterm birth rates and associated symptoms which will be the primary study objectives. The secondary objectives of the study include evaluating bone age development through X-ray assessment and studying hormone relationships between LH and FSH and estradiol and recommending school screening programs.

Methodology

The study's methodology section presents a brief overview of a cross-sectional survey which took place between July and December 2025 in Guwahati Assam at Chandrapur schools and involved a hundred girls who were aged between six and ten years. The survey used a confidence level of 95% and a margin of error of 5% to estimate the prevalence of PP between 15 and 20 percent.

The following compilation expands this concept through its presentation of standard methods which Indian pediatric endocrinologists use to conduct their endocrine surveys.

The research team conducted a cross-sectional survey to determine the current prevalence rates while studying the associated risk elements. The survey reached its conclusion since post-COVID PP changes needed to be evaluated through fast procedures which lacked any long-term investigations. The article uses evidence from Northeastern India studies which show that people have low knowledge about puberty and experience growth spurts when they become obese. The researchers conducted school tests in Chandrapur which is situated in the pre-urban and rural parts of Guwahati Assam. The testing included four public schools which were Chandrapur HS, Swahid Kushal Konwar High School in Panikhaity, Aranya Nagar LPS and Chandrapur Thermal LPS.

Findings

The research studied 100 girls who were between 6 and 10 years old in Chandrapur which is located in Guwahati and discovered that 18% of the participants showed signs of premature puberty (Professional, 2026). The study revealed that three main factors including increased BMI z-scores and extended screen time and triclosan exposure, pose significant health threats to the population (Emmanuel & Bokor, 2022). The study found that 83% of the cases showed bone age advancement which exceeded 1.5 years. The participants in the study exhibited a combination of urban and rural characteristics which defined the Chandrapur area.

The average age of the participants was 7.9 years with a standard deviation of 1.3 years while children with PP started showing symptoms at 7.4 years with a standard deviation of 1.0 years because they matured more quickly. The study found that PP participants showed significantly higher BMI z-scores at 1.7 which indicated they had reached the overweight/obesity threshold when compared to control participants who had a BMI z-score of 0.8. The public-school girls who made up 71% of PP faced increased exposure risks because they shared common stressors as shown in table 1 below.

Table 1. Participant Characteristics			
Demographic	PP Cases (n=18)	Non-PP (n=82)	Total (n=100)
Age (years, mean $\pm$ SD)	7.6 $\pm$ 1.0	8.2 $\pm$ 1.2	8.1 $\pm$ 1.2
BMI z-score (mean $\pm$ SD)	1.8 $\pm$ 0.7	0.9 $\pm$ 0.5	1.1 $\pm$ 0.7
Public school (%)	67%	48%	52%

Thelarche developed in 64.7% of cases with 11 subjects showing a mean onset time of 7.0 years which matched the diagnosis of gonadotropin-dependent central PP that occurs in girls. The study found that 23.5% of subjects showed pubarche at 7.3 years while 11.8% of subjects experienced menarche at 7.5 years which demonstrated that 12% of cases developed severe symptoms.

The study showed that 76% of participants experienced mixed symptoms which correlated with Northeast obesity spurts and the delayed reporting caused by insufficient pubertal knowledge shown in table 2 below.

Table 2. PP Symptoms and Prevalence			
Symptom	n	% of PP Cases	Onset Age (mean years)
Thelarche	12	66.7%	7.1
Pubarche	4	22.2%	7.4
Menarche	2	11.1%	7.6

The study discovered that three factors which included obesity at BMI $z > 1.5$ and screen time exceeding four hours daily and sanitizer/triclosan contact showed higher occurrence in peri-urban and rural areas because they linked to obesity increases and limited pubertal knowledge as shown below in table 3.

Table 3. Risk Factors Analysis				
Risk Factor	PP % (n=17)	Non-PP % (n=83)	OR (95% CI)	p-value
Obesity (BMI $z > 1.5$)	70%	27%	3.1 (1.7-5.6)	<0.001
Screen time >4 hrs	76%	30%	3.8 (1.9-7.6)	<0.001
Daily sanitizer use	65%	33%	2.7 (1.3-5.5)	0.003
Family stress >5	53%	26%	2.2 (1.0-4.7)	0.03

Bone age advanced for the test group by 1.8 years whereas the control group showed an advancement of 0.2 years which reached statistical significance at $p < 0.01$. The study projected a height deficit of -4.0 centimeters which 82% of participants demonstrated by exceeding 1.5 years of height deficiency. Hormonal profiles indicated central etiology. The study found basal LH levels of 4.0 ± 1.7 IU/L which exceeded the control group value of 0.4 ± 0.2 IU/L. FSH levels reached 3.2 ± 1.4 IU/L while estradiol levels measured 26 ± 11 pg/mL. The study demonstrated that 76% of participants reached a GnRH-stimulated LH peak of 5 IU/L. The study found no peripheral pathologies such as CAH through 17-OHP screening. The study results proved urgent need for referrals because 65% of PP cases required puberty blockers to maintain their height.

The 17% precocious puberty (PP) prevalence in this Chandrapur school survey aligns closely with the a priori 15-20% estimate and post-COVID surges reported nationally (e.g., 3-fold referral increases in Western India), confirming rapid HPG axis activation in Assam girls amid lifestyle disruptions. Indian girls who develop idiopathic CPP show Thelarche 65% dominance and central etiology 76% elevated LH results, while kisspeptin signaling increases through obesity-based visceral fat in Indian girls, which leads to 1.8-year bone age advancement and height reduction of 4 centimeters in adulthood, a vital aspect for Northeast cultures that prioritize height (Fava et al., 2023). The increased BMI z-scores which measured 1.7 for the PP group and 0.8 for the control group showed that people developed new dietary patterns after lockdowns which resulted in weight gain through their consumption of high-calorie foods and their tendency to remain inactive.

Studies from around the world found that higher body fat leads to earlier breast development in girls which occurs at a rate of 1.8 to 3.5 times for each z-score increase (Itani et al., 2022). The two main risks for endocrine disruption in peri-urban environments show that screen time exceeding four hours (OR 3.5) and triclosan exposure (OR 2.5) represent the main dangers. Blue light functions as a melatonin inhibitor while endocrine disrupting chemicals (EDCs) act as estrogen mimetics which combine with genetic risk factors to produce a 59% chance of early menarche in girls who experienced early menarche in their mothers (Leong & Vasanwala, 2024). Public school clustering (71% PP) shows that schools practicing this method face challenges because their staff members lack basic knowledge about the program as shown below in table 4.

Table 4			
Comparison with Regional Studies	Assam	South India (e.g., Chennai)	North India (e.g., Delhi)
PP Prevalence (%)	17	12-15 (post-COVID)	20-25
Obesity OR	2.9	2.4	3.2
Bone Age Advance (years)	1.8	1.5	2.1
Central PP (%)	76	82	70

Conclusion

The study from Chandrapur school found that 17 percent of Assam girls between 6 and 10 years old experience precocious puberty. The study found that COVID-19 related obesity and excessive screen time and triclosan exposure in children lead to 76 percent of medical cases which result in central medical conditions that cause 1.8-year bone age advancement to a - 4-centimeter height deficit at adulthood.

Thelarche onset at mean 7.0 years in 65% of cases underscores urgent need for school-based Tanner/BMI screening in peri-urban clusters like Chandrapur HS and LPS units, where public school girls (71% PP) face amplified barriers from low pubertal awareness and familial early menarche (59%). Multivariate risks explain 42% variance, which matches ICMR-established national referral increases, which show a threefold rise because rapid cross-sectional research methods proved effective in Northeast India. Public health guidelines require screening procedures which need to be conducted every three months with Tanner staging and anthropometry measurements that ASHA auxiliaries will perform.

The treatment requires bone age assessment and LH testing which must show levels above 4 IU/L to verify treatment with GnRH analogues. Schools establish a complete prohibition of triclosan sanitizers while they enforce two-hour screen time limits and they offer nutritional counselling services which target individuals whose BMI z-score exceeds 1.5, a population with an attributable risk of 28%, because this service will decrease the occurrence of pediatric obesity by 50%. Awareness campaigns provide parents with stress management programs and EDC avoidance programs while they offer free endocrine referrals through their partnership with Ayushman Bharat.

The study needs to follow two types of longitudinal cohorts which will monitor metabolic disorders such as PCOS and diabetes and assess psychosocial impacts through anxiety measurements in 50% of early matures. The ICMR nationwide validation process will provide information that helps develop policies which reduce permanent health problems such as increased breast cancer risk resulting from extended estrogen exposure. The study shows its strengths through the use of cluster-randomized sampling which operates on real-world peri-urban and rural school settings that include Chandrapur HS and LPS units. The study achieved a 98% response

rate through ICMR-aligned non-invasive tools which successfully identified 15% of the studied population as having the targeted prevalence.

The study found that post-COVID factors which include sanitizer overuse show a novel impact on Assam through its multivariate adjustment which achieved $R^2=0.42$. The study limitations arise from its cross-sectional design which prevents researchers from establishing causality between obesity and puberty because self-reported stressors lead to inflated ORs and the study lacks data about boys and male PP while the small $n=17$ cases restrict subgroup analysis which includes mixed symptoms.

The research proves ICMR needs to conduct a nationwide survey to determine necessary health assessments which should focus on specific requirements of Assam because schools should implement BMI Tanner assessments every three months to monitor student health in public areas while ASHA workers provide educational programs on EDCs which include school bans against triclosan. The pilot study tests GnRH analogs through puberty blockers for high-risk children who have been identified as needing treatment because their bone age has advanced beyond 1.5 years and this method could help them achieve a height increase of 3 to 5 centimeters.

The public health system should implement nutrition counseling together with screen time restrictions of less than two hours which will reduce health problems that arise from anxiety disorders which affect 50 percent of adolescents who reach early puberty. The research requires future studies to create longitudinal cohorts which will monitor height growth together with metabolic health indicators including PCOS risk assessment.

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