



Early puberty paradox: an investigation of anxiety levels of mothers and children, children's quality of life, and psychiatric diagnoses

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Abstract

Early puberty signs lead to an increase in anxiety levels of parents and children. The aim of this study was to investigate the quality of life and anxiety levels of girls and their mothers who were admitted to a pediatric endocrinology clinic with concerns about early puberty. Girls and their mothers who were admitted to endocrinology outpatient clinic with concerns about early puberty were compared to healthy control group. Screen for Child Anxiety Related Emotional Disorders (SCARED) parent form, Quality of Life for Children Scale (PedsQL) parent form, and Beck Anxiety Inventory (BAI) were administered to the mothers. Children were evaluated with the Schedule for Affective Disorders and Schizophrenia for School-Age Children (Kiddie-SADS Lifetime Version) (K-SADS-PL). The study sample consisted of 92 girls and 62 of them were administered to clinic with concerns about early puberty. There were 30 girls in early puberty group (group 1), 32 girls were in the normal development group (group 2), and 30 were in the healthy control group (group 3). The anxiety level of group 1 and group 2 was significantly higher, and their quality of life was significantly lower when compared to group 3 ($p < 0.001$). Mother's anxiety level was found significantly higher in group 2 ($p < 0.001$). It has shown that anxiety level and quality of life of children were associated with anxiety level of mothers and the current Tanner stage ($r = 0.302$, $p < 0.005$).

Conclusion: Mothers and children who have concerns about early puberty are negatively affected when early puberty is a possibility. For this reason, educating parents will prevent negative impacts of this situation on children. At the same time, it will decrease health burden.

What is Known?

- Early adolescence is one of the most common reasons for admission to pediatric endocrinology outpatient clinics. It is known that increasing early adolescence anxiety in the society causes cost and time losses in the field of health. However, studies investigating the reasons for this result are limited in the literature.

What's New?

- The level of anxiety increased significantly in girls with suspected precocious puberty and their mothers, and their quality of life was affected.
- For this reason, we would like to emphasize the importance of multidisciplinary approaches before psychiatric disorders occur in children with suspected precocious puberty and their parents.

Keywords Early puberty · Anxiety · Quality of life · Psychopathology

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Abbreviations

BAI	Beck Anxiety Inventory
K-SADS-PL	Schedule for Affective Disorders and Schizophrenia for School-Age Children (Kiddie-SADS Lifetime Version)
PHTS	Physical health total score
PSTS	Psychosocial health total score
PedsQL	Pediatric Quality of Life Inventory
SCARED	Screen for Child Anxiety and Related Disorders

Introduction

Puberty usually begins between the age of 8 and 13 years in girls and 9 and 14 years in boys. Pubertal timing depends on several variables, including familial features, genetic, nutrition, and ethnic origin. Early puberty (precocious puberty) is the beginning of pubertal changes at a younger age than the lower limit of the accepted age of onset [1]. In girls aged younger than 8 years old, Tanner stage P2 level breast development (thelarche) and any pubic hair (pubarch) is considered as early puberty. Moreover, the onset of menarch before 10 years old in girls should be also be accepted as early puberty [2]. Premature pubarche/adrenarche and premature thelarche are incomplete forms of precocious pubertal development. It is important to distinguish these forms from the precocious puberty in order to avoid unnecessary treatments with analogous LHRH [3]. Several studies have showed that the start of puberty has moved up to younger ages associated with nutritional status and obesity and the influence of extrinsic factors such as exposure to endocrine-disrupting chemicals. Studies in different countries have demonstrated that the incidence and prevalence of early puberty has increased in recent years [4]. Early puberty occurs most frequently in girls (15–20 girls for every boy), with an estimated incidence of 1 case per 5000–10,000 girls in the USA [5, 6]. In a recent study in Korea, the overall prevalence of central precocious puberty during the study period was 193.2 per 100 000 persons (girls; 410.6; boys; 10.9) [4]. There is no national study on the incidence of early puberty in the literature. In our country, in a study evaluating pediatric endocrinology outpatient clinic appointments, it was reported that concern about early puberty formed a substantial proportion of new appointments (second most common), but despite this, in nearly one-third of admissions, no hormonal problem was found. It was reported that these appointments use healthcare resources (time and cost) and decrease productivity of outpatient clinic services [7].

It has been reported that parents experience some anxieties at the appearance of signs of puberty in their children.

Parents have concerns such as cessation of height increase and final short stature of their children, and they also think that their child cannot cope with the onset of menstruation [7]. Furthermore, there are reports that children and parents especially perceive short stature in a more exaggerated way [8]. It is known that anxious behavior of parents affects children psychologically. Genetic transmission and anxious parent's behavior which increase anxiety of children can be an example of environmental mechanisms [9]. Anxiety disorder symptoms of the mother have been shown to especially increase anxiety levels of children [10].

Early puberty, early development of secondary sex characteristics, and rapid bone growth-final short stature may lead to age-inappropriate body appearance and psychiatric symptoms [1]. Cases with early puberty diagnosis are riskier in terms of psychiatric and behavioral problems compared to same age- and sex-matched peers [11]. These children will show low self-esteem, negative body image, behavioral problems, depression, and anxiety [12, 13]. In follow-up studies, it was observed that in adulthood, these children are at higher risk of depression and anxiety disorders [14]. Mental illness negatively affects peoples' quality of life. It has been reported that, particularly in diseases that require follow-ups and frequent hospital admissions, impairment of quality of life is higher [15]. In a previous study, it was shown that cases diagnosed with early puberty have lower quality of life scores than healthy control group [16].

As summarized above, it has been shown in many studies that early puberty is associated with psychiatric diseases and affects the quality of life of patients. However, no study has been found in the literature comparing and evaluating children with a diagnosis of early puberty and children with suspected early puberty and found to have normal development in terms of anxiety level, quality of life, psychiatric diseases, and anxiety levels of their mothers. The aim of our study is to evaluate the two groups mentioned above and to compare them with a healthy sample. It is thought that our study outputs will contribute to the holistic evaluation of applications made to pediatric endocrinology outpatient clinics with suspicion of early puberty.

Methods

Procedures

The study took 1 year, between March 2018 and February 2019. The patient group consisted of girls who were admitted to the University of Health Sciences Diyarbakır Gazi Yaşargil Training and Research Hospital Endocrinology Outpatient Clinic for the first time and included girls who reached early puberty and their mothers. Girls who have

presented with breast tissue growth, pubic hair, rapid height increase, rapid weight gain and beginning of menstruation, and their mothers who thought these findings were due to early puberty were included in the study. The group that was admitted to the clinic with the suspicion of early puberty consisted of girls with no additional disease and their mothers who were literate and who had no previous psychiatric diagnosis or chronic illness. The healthy control group consisted of girls admitted to the pediatric outpatient clinic for follow-up and scanning, who had no additional disease and no psychiatric admission, and their mothers without a history of psychiatric illness or chronic illness. Patients diagnosed with psychotic disorder, mental retardation, and bipolar disorder were not included in the study. Verbal and written informed consent was obtained from girls and their mothers who accepted to participate in the study. After psychiatric examination was completed and K-SADS were administered, mothers were asked to fill the scales.

Participants

The sample size was calculated using G*Power version 3, based on the ability to detect a mean difference of anxiety state between groups (control group, early puberty group, and normal detected early puberty suspicion group). The standard deviation used in the calculation was reported in previous trials [17, 18]. A confidence level of 95% ($p < 0.05$) and a power of 80% were used. The calculation yielded a minimum sample size of 40. A further increase of 15% was added to allow for attrition, giving an overall sample size of participants 62.

The study sample consisted of 92 female children between the ages 6 and 11 years. Seventy cases who were admitted to the pediatric endocrinology outpatient clinic with suspicion of early puberty are accepted to participate in the study. Two cases were excluded from study due to mental retardation, and six were excluded because of missing data on scales. Finally, 62 girls with the suspicion of early puberty and their mothers formed the case group. It was observed that 30 patients from this group are diagnosed with idiopathic central precocious puberty after examination (group 1) and 32 of them showed normal development and did not get this diagnosis (group 2). The presence of breast development before the age of 8 years, menarche before the age of 10 years, advanced bone age [a standard deviation score of +2 relative to the chronological age], basal luteinizing hormone (LH) ≥ 1 mIU/mL or peak LH ≥ 5 mIU/mL in the GnRH stimulation test, uterine length ≥ 35 mm, ovarian volume ≥ 2 mL on obstetric ultrasonography, accelerated pubertal tempo, and normal cranial magnetic resonance imaging were used to diagnose central precocious puberty [19]. The healthy control group (group 3) consisted of 30

girls and their mothers who were admitted to the general pediatric outpatient clinic for developmental follow-up.

Measures

Sociodemographic information form

This was a form prepared by the researchers, containing information about sociodemographic data, such as age, gender, educational status, socioeconomic status, age of parents, and clinical characteristics including admission complaint, puberty stage, and findings of psychiatric examination.

Screen for Child Anxiety and Related Disorders (SCARED) parent form

Screen for Child Anxiety and Related Disorders (SCARED) scale was developed by Birmaher et al. for screening of childhood anxiety disorders and its reliability and validity in the Turkish language version were reported and confirmed by Çakmakçı [20, 21]. The SCARED scale consists of 41 items, with a total score of 25 and above being considered as a warning sign for anxiety disorder. The scale contains somatic-panic anxiety, separation anxiety, general anxiety, social anxiety, and school phobia subscales.

Pediatric Quality of Life Inventory parent form (PedsQL)

In order to evaluate quality of life of children and adolescents, the Pediatric Quality of Life Inventory (PedsQL) was administered to the parents. This quality of life scale was developed by Varni et al. in 1999 for measuring health-related quality of life in children and adolescents between the ages of 2 and 18 [22]. The total score of the first eight items divided by 8 gives the physical health total score (PHTS), the total score of next 15 items divided by 15 gives the psychosocial health total score (PSTS), and the total point of all 23 items of scale divided by 23 gives the total score (PedsQLTS). Higher PedsQL total scores indicate a better health-related quality of life.

Beck Anxiety Inventory (BAI)

BAI is a self-rating scale developed by Beck and colleagues (1988) that is used to measure frequency of anxiety symptoms [23]. It consists of 21 items and uses a four-point (0–3) Likert scale. The reliability and validity study in Türkiye was performed by Ulusoy et al. (1998). In this study, this inventory was used to measure anxiety levels of the mothers [24].

Schedule for Affective Disorders and Schizophrenia for School-Age Children (Kiddie-SADS Lifetime Version) (K-SADS-PL)

This is a semi-structured diagnosis interview to measure current and past psychopathologies of children and adolescents according to the DSM-4 criteria [25]. K-SADS-PL was administered to parents and children, and all the information gathered from all sources was evaluated. The final decision about diagnosis was based on the clinician's view. This scale (interview) was administered to people between the ages of 6 and 18. Turkish version of scale was adapted to DSM-4 and DSM-5 [26].

Statistical analysis

The data was evaluated with SPSS, version 20.0 (IBM Corp., Armonk, NY, USA). Normality assumption was evaluated by the Shapiro Wilk test. Normally distributed variables are presented as mean \pm standard deviation, while non-normally distributed variables are shown as median and interquartile range (25–75%). Categorical variables are presented as frequency (percentage). Differences between groups were evaluated by using one-way analysis of variance in normally distributed variables and by using Kruskal–Wallis test in not-normally distributed variables. Dunn's test was used for multiple comparisons. Relationship between categorical variables was evaluated with Chi-square analysis, and

relationships between numeric variables were evaluated with Spearman's correlation analysis. A $p < 0.05$ was accepted as statistically significant in hypothesis tests.

Results

The study sample consisted of girls who were diagnosed with early puberty (group 1, $n = 30$), girls who were admitted because of the suspicion of early puberty suspicion but showed physiological development (group 2, $n = 32$), and the healthy controls (group 3, $n = 30$). Sociodemographic characteristics of the three groups are given in Table 1. In the section of mental illnesses in the family, data of first-degree relatives (father and siblings) who received psychiatric treatment other than the mother are included.

The most frequent admission reason in group 1 and group 2 was reported as breast growth 38% ($n = 35$). Admission causes were pubic hairing (20,7%); rapid weight gain (4,3%); rapid height increase (2,2%); and menstruation (2,2%). There was no significant difference between these two groups in terms of admission reasons ($p < 0.05$). When Tanner staging of these two groups was investigated, the most frequently observed stage was Tanner stage 2 (66.1%; $n = 41$). The two groups were compared in terms of staging, and no significant difference was found ($p > 0.05$). The evaluation of group 1 vs group 2 in terms of reasons for presentation and Tanner staging is presented in Table 2.

Table 1 Comparison the sociodemographic characteristics of the groups

		Group 1 ($n = 30$)	Group 2 ($n = 32$)	Group 3 ($n = 30$)	<i>p</i>
Child's age (age at the time of diagnosed)		8,14 \pm 0,9	9,11 \pm 1,1	8,57 \pm 1,1	0,007**
School success	Above average	25 (83,3%)	24 (75%)	23 (76,7%)	0,598*
	Average	4 (13,3%)	6 (18,8%)	6 (20%)	
	Low	1 (3,3%)	2 (6,3%)	1 (3,3%)	
Mother's age		36,8 \pm 5,4	35,7 \pm 5,7	37,4 \pm 4,7	0,407**
Education time of mother (year)		8,8 \pm 4,7	10,1 \pm 4,1	10,4 \pm 4,4	0,368**
Mother's education level	Literate	3 (10%)	1 (3,1%)	2 (6,9%)	0,836*
	Primary school	9 (30%)	7 (21,9%)	4 (13,8%)	
	Secondary school	4 (13,3%)	5 (15,6%)	6 (20,7%)	
	High school	6 (20%)	9 (29,1%)	7 (24,1%)	
	University	8 (26,7%)	10 (31,3%)	10 (34,5%)	
EP presence in family	Present	10 (33,3%)	7 (21,9%)	0 (0%)	0,468*
	Absent	20 (66,6%)	25 (78,1%)	29 (100%)	
Mental illness in family***	Present	5 (16,7%)	11 (34,4%)	2 (5,8%)	0,193*
	Absent	25 (83,3%)	21 (65,6%)	27 (94,2%)	

\pm standard deviation

EP early puberty

*Chi-Square

**one-way analysis of variance

***1st degree relative other than mother

Table 2 Evaluation of group 1 and group 2 in terms of admission reasons and Tanner staging

		Group 1	Group 2	<i>p</i> *
Admission reason	Breast growth	20 (66,7%)	15 (49,9%)	0,520
	Pubic hair	6 (20,0%)	13 (40,6%)	
	Rapid weight gain	2 (6,7%)	2 (6,3%)	
	Rapid height change	1 (3,3%)	1 (3,1%)	
	Menstruation	1 (3,3%)	1 (3,1%)	
Tanner stages	Stage 1	0(0)	7 (21,9%)	0,479
	Stage 2	4 (13,3%)	19 (59,4%)	
	Stage 3	22 (73,3%)	5 (15,6%)	
	Stage 4	4 (13,3%)	1 (3,1%)	
	Stage 5	0(0)	0(0)	

*Chi-square test

When all three groups were evaluated in terms of scale scores, a significant difference was found. The evaluation of scale scores of three groups is given in Table 3.

Pairwise comparisons of the groups were performed to identify the difference between groups. This showed that there was no significant difference between group 1 and group 2 in terms of SCARED, PHTS, PSTS, and PedsQLTS scores, but group 3 was different from both group 1 and group 2 from all of these scores (Table 3). All three groups were different in terms of BAI scores. When SCARED, PHTS, PSTS, and PedsQL-TS scale scores were examined, the following pattern emerged: Group 1 ≈ Group 2 > Group 3. However, when BAI scores were examined, the pattern was Group 2 > Group 1 > Group 3. In terms of SCARED

Table 4 Distribution of diagnosis of group 1 and group 2

		Group 1	Group 2	<i>p</i> *
Psychiatric diagnosis	Present	16	15	0,796
	Absent	14	17	
ADHD	Present	6	11	0,326
	Absent	24	21	
AD	Present	10	7	0,468
	Absent	20	25	
SAD	Present	7	6	0,564
	Absent	23	26	
SAD (separation)	Present	7	4	0,507
	Absent	23	28	
MDD	Present	0	2	0,501
	Absent	30	32	

*Chi-square test

ADHD attention deficit and hyperactivity disorder, AD anxiety disorder, SAD social anxiety disorder, SAD separation anxiety disorder, MDD major depressive disorder

subscales, separation anxiety and social phobia subscales of group 2 were significantly higher than group 1 and group 3.

The three groups were compared in terms of psychiatric diagnoses. Group 1 and group 2 were significantly different from the healthy control group. Comparison between group 1 and group 2 showed that the distribution of psychiatric diagnosis was similar (*p* > 0.05). In group 1 and group 2, the most frequently reported diagnoses were ADHD (27,4%) and anxiety disorder (27,4%). The most common anxiety disorders were social anxiety disorder (SAD) (19,3%) and separation anxiety disorder (SAD) (12,9%). Distribution of diagnosis is shown in Table 4.

Table 3 Evaluation of groups in terms of scale scores

	Group 1 (1) Median (IQR)	Group 2 (2) Median (IQR)	Group 3 (3) Median (IQR)	<i>p</i> *	Pairwise comparisons**
SCARED	15 (10–22)	20,5 (12.2–30)	9,5 (7.7–11)	< 0,001	1 > 3 (<i>p</i> < 0,001) 2 > 3 (<i>p</i> < 0,001)
PHTS	71,8 (65–84)	71,8 (57–80)	93,7 (87–94)	< 0,001	1 > 3 (<i>p</i> < 0,001) 2 > 3 (<i>p</i> < 0,001)
PSTS	78,3 (65–85)	7,6 (61–86)	93,3 (90–93.3)	< 0,001	1 > 3 (<i>p</i> < 0,001) 2 > 3 (<i>p</i> < 0,001)
PedsQL-TS	75,5 (64–81)	69,7 (63–83)	92,3 (91–93)	< 0,001	1 > 3 (<i>p</i> < 0,001) 2 > 3 (<i>p</i> < 0,001)
BAI	8 (3–13)	14 (10–19)	3 (1–6)	< 0,001	2 > 1 (<i>p</i> < 0,001) 2 > 3 (<i>p</i> < 0,001)

Bold face values indicate statistically significant differences

SCARED Screen for Child Anxiety and Related Disorders, PHTS physical health total score, PSTS psychosocial total score, PedsQL-TS pediatric quality of life total score, BAI Beck Anxiety Inventory, IQR interquartile range

*Kruskal–Wallis test

**Dunn’s test

Table 5 Correlation between children's anxiety level and Tanner staging, anxiety level of mother, and quality of life

Variables		1	2	3	4	5	6
1. SCARED	<i>r</i>	1,000					
	<i>p</i> *						
3. Tanner staging	<i>r</i>	,353	1,000				
	<i>p</i> *	0,005					
5. BAI	<i>r</i>	,302	,130	1,000			
	<i>p</i> *	0,017	,312				
7. PHTS	<i>r</i>	-,313	-,658	-,343	1,000		
	<i>p</i> *	0,013	<0,001	,006			
9. PSTS	<i>r</i>	-,443	-,643	-,338	,441	1,000	
	<i>p</i> *	<0,001	<0,001	,007	<0,001		
11. PedsQL-TS	<i>r</i>	-,441	-,713	-,369	,728	,898	1,000
	<i>p</i> *	,004	<0,001	,003	<0,001	<0,001	

*Spearman's rank correlation coefficient analysis

SCARED Screen for Child Anxiety and Related Disorders, PHTS physical health total score, PSTS psychosocial total score, PedsQL-TS pediatric quality of life total score, BAI Beck Anxiety Inventory

The relationship between anxiety level of mothers and children was evaluated using Spearman's rank correlation coefficient analysis and shown in Table 5. Anxiety level of mothers and children in group 1 and group 2 was positively related ($r=0.302$, $p<0.001$). It was found that the anxiety level of children increased with the increase in Tanner staging ($r=0.353$, $p<0.001$). When the relationship between anxiety level of children with other variables was examined, the anxiety level of children negatively correlated with quality of life ($r=0.441$, $p<0.001$). Furthermore, as Tanner stage increased, the reported quality of life decreased ($r=0.713$, $p<0.001$).

Discussion

The aim of this study was to investigate the anxiety level and reported quality of life of girls who were admitted to the hospital with the suspicion of early puberty and the anxiety level of their mothers. The results showed that the mean age of girls in group 2, who were finally determined to have normal physiological development, was significantly older than that of the other two groups. The most frequent reason for admission of children who were admitted to clinic with the suspicion of early puberty (group 1 and group 2) was breast growth. The anxiety levels and quality of life of both group 1 and group 2 were significantly worse than the healthy control group. The anxiety level of mothers was significantly higher, especially in group 2 compared with the other groups. Moreover, in group 2, in the same group in anxiety subtests, separation anxiety and social phobia subscales were significantly higher. In group 1 and group 2, it was found that as Tanner stage increased, the anxiety level of the girls increased, and their reported quality of life

decreased. There was a positive correlation between anxiety level of mothers and children, and anxiety level of mothers and quality of life of children were negatively related.

As expected, the mean age of group 2 was older than group 1. Children in group 2 were expected to experience physical changes in accordance with age, such as breast development and the appearance of pubic hair [2]. However, mothers of the girls in this group were concerned about the timing of these changes and believed these changes were early. Group 2 (normal physiological development) and group 1 (diagnosed with true precocious puberty) were compared, but the educational level and age of mothers were statistically similar. Thus, the concern of mothers about early puberty could not be explained by educational level and age. A study performed by Ahn et al. showed that information about puberty was low even if the educational level of mother was high [27]. A study conducted in Türkiye revealed that parents have incorrect information and false beliefs about normal onset of puberty. Mother's evaluation is often based on their own puberty experience, but this has changed temporally and now conflicts with puberty timing of present-day girls [28]. This may be due to a number of reasons. In families with a history of early puberty and whose daughters were admitted with concerns about early puberty often show normal development. As a result, mothers may have some concerns and prejudices about the issue in question [28]. In the present study, a history of precocious puberty in the family and concerns of mothers about early puberty was similar in both groups 1 and 2. Such concern may be explained by the differences in pubertal timing of mothers and daughters. It has been suggested that as a result of changes in dietary habits, especially in the last 20 years, girls are showing signs of puberty earlier. Pubertal timing of mothers (mean age of mothers: 35.7 years)

and daughters differ due to these circumstances. However, mothers interpret this situation as early puberty and have concerns about it [29].

According to the psychosocial acceleration hypothesis, it is thought that negative events experienced in early childhood may cause early puberty [30, 31]. It is known that mental illnesses of family members affect the child in terms of genetically transmitted diseases, as well as in-familial communication and the psychological climate of the family. When psychosocial stress factors are evaluated, it has been stated that parental conflict, negative-hard parenting, and biological father absence may be associated with early puberty [32]. The mothers evaluated in our study did not have a previous psychiatric illness. However, other family members (first-degree relatives such as father and sibling) other than the mother had some mental illnesses. When the three groups were compared with each other in terms of family mental illnesses, no significant difference was found. These data were not compatible with the literature. This result may be due to the limited number of patients. In addition, all family members with diagnosed mental illnesses were receiving treatment. Therefore, it may have caused less psychosocial stress.

In a comprehensive study evaluating reasons for presentation because of concerns about early puberty, the most common admission reasons were premature thelarche, premature adrenarche, and the growth of breast tissue due to lipomastia [33]. In the present study, the most common admission reason was growth of breast tissue, and the second most common was onset of pubic hair (armpit and/or pubis). It has been reported that the age of occurrence of breast development and onset of pubic hair decreases, independent of heredity in recent years [34].

When published studies investigating the relationship between early puberty and anxiety were examined, there were studies presenting evidence that early puberty increases anxiety level and decreases quality of life [18, 35, 36]. In a study performed by Xiao et al., it was found that in the patient group, quality of life was lower than healthy control group. In a 1-year follow-up study, it was reported that physical quality of life decreased in girls diagnosed with early puberty, but no change was found in distribution of psychological diagnosis [37]. In a study, girls with early puberty diagnosis were compared with healthy girls, and it was found that the level of anxiety was significantly higher in the diagnosis group compared to healthy control group [38]. A retrospective study examining adults revealed that individuals who have experienced early puberty have higher anxiety levels [39]. The present study showed that the level of anxiety was higher and quality of life was lower in group 1, who had a final diagnosis of precocious puberty, compared to the healthy control group, which is in accordance with the literature. The most surprising result was that group

2, who had a final diagnosis of normal physiological development, was as equally affected as group 1. In the literature, there are studies which report that most of the girls who were admitted to the pediatric endocrinology outpatient clinics with concerns about early puberty only showed normal development [28, 33]. Studies have reported that these girls were anxious, but no studies were found that evaluated the level of anxiety and quality of life of these girls.

Parents of children with chronic disease have various psychological disorders, and their level of anxiety is high [40]. The parent group in the present study consisted of mothers who were already admitted to pediatric endocrinology outpatient clinic with early puberty concern. High level of anxiety was an expected result for this group. However, it was observed that mothers of girls with normal development and no true precocious puberty have higher anxiety levels, suggesting that these mothers' knowledge about the timing of puberty was flawed. In a study assessing tertiary healthcare service admission, it was found that conditions that can be easily followed-up in primary healthcare were guided to tertiary healthcare service due to the mothers' concerns [28]. It was discovered that these admissions disrupt outpatient clinic services, cause unnecessary testing, and result in social and financial losses. It was suggested that educating parents about timing and signs of puberty will decrease healthcare costs and will save time.

Several studies have shown that anxiety levels and quality of life of children whose mothers have concerns about early puberty are associated with family and parent [27, 35, 41]. The present study revealed that anxiety levels of mothers were positively correlated with their children's level of anxiety and negatively correlated with the reported quality of life. No relationship was detected between anxiety level of mothers and actual puberty staging of children. It was found that there is a positive relationship between puberty staging of children and anxiety level and a negative relationship between puberty staging and quality of life. In the literature, no study was found which had investigated the relationship between puberty stage and anxiety level of children and mothers. In a study examining the relation between anxiety sensitivity and puberty stage, it was found that there was a positive relationship between Tanner staging and anxiety sensitivity [42]. Anxiety sensitivity increased with the increase in physical changes and self-consciousness in adolescents.

When children were evaluated in terms of psychiatric diagnosis, no significant difference was reported between group 1 and group 2. It was found that in both of these groups, a psychiatric diagnosis was significantly more likely than in the healthy control group. It was shown that, independent of other variables, risk of psychiatric disorder was greater for children with early puberty diagnosis than their healthy peers [18]. The frequency of depressive illness was

high among patients diagnosed with early puberty compared to normal development peers. However, an increase in the frequency of depression was not detected in our study. As patients were evaluated on the very first admission, this result may be related to the timing of psychiatric assessment. It is possible that likelihood of depression will increase in time after experiencing negative life events, such as peer victimization or parental pressure [43]. Anxiety disorders were significantly higher both in group 1 and group 2. It was found that scores of child anxiety-related emotional disorders scale and results of psychiatric examination correspond with high anxiety levels. There are previous studies that have reported a positive relationship between timing of puberty and anxiety [36, 44]. A study performed by Pomerantz and colleagues demonstrated that children with precocious puberty show more internalization symptoms due to relational aggression, which lead to high anxiety levels. Adolescence seems to be a risky stage where anxiety disorders begin and intensify. Typical physical and hormonal changes in puberty probably leave predisposed children vulnerable in terms of anxiety [36]. Therefore, early puberty may be accepted as a risk factor in regard to anxiety disorders.

Limitations

This is the first study that has evaluated children who were admitted to the pediatric endocrinology clinic with concerns about early puberty but are shown to have normal development from a psychiatric perspective. It is a cross-sectional study and was conducted with a clinical sample, so the results may not reflect the general population. Considering the limitations of this study, it is recommended to plan follow-up studies and population-based studies in order to explain this causality.

Conclusion

In conclusion, the findings of this study demonstrated that mothers and children who have anxiety about early puberty have higher anxiety levels and the quality of life of affected girls is reduced. Moreover, it is considered that parents' comments about the physiological signs of puberty as early increase patient load of pediatric endocrinology outpatient clinics and cause unnecessary tests. Provision of community-based information may go some way to correct the misinformation and false beliefs of parents. In addition, we would like to suggest that multidisciplinary evaluation of girls and mothers attending hospital with concerns about early puberty will prevent psychiatric deteriorations.

Author contribution BK, ÖK, and MD designed and conducted this study. ÖK and MD undertook the statistical analyses. BK wrote the first draft of the manuscript. All authors have participated to drafting the manuscript; authors BK and MNÖ revised it critically. All authors read and approved the final version of the manuscript.

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Code availability N/A.

Declarations

Ethics approval The study was conducted after approval from the University of Health Sciences Diyarbakır Gazi Yaşargil Training and Research Hospital Ethics Committee approval, dated 02.03.2018/36. The study was conducted in accordance with the Helsinki Declarations.

Consent to participate N/A.

Consent for publication N/A.

Competing interests The authors declare no competing interests.

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