

# Puberty development among children and adolescents with chronic disease in Saudi Arabia

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**BACKGROUND AND OBJECTIVES:** Increasing numbers of children with chronic health conditions are now surviving into adolescence and adulthood because of advancing health care. These chronic health conditions are generally known to impact a child's growth and development, including pubertal development. In Saudi Arabia, chronic diseases are prevalent, yet no reports of pubertal onset and its relation to chronic illness are available. The aim of this study was to explore pubertal development among Saudi children and adolescents with a chronic illness.

**DESIGN AND SETTING:** Cross-sectional study conducted at schools in Riyadh, Saudi Arabia in 2006.

**SUBJECTS AND METHODS:** Those students whose parents reported that their son/daughter had a chronic illness and/or was taking a long-term medication underwent a physical examination to determine sexual maturity rating and growth parameters.

**RESULTS:** Of 1371 students who participated in the study, 155 (11.3%) had a chronic illness. Of those, 79 (51%) were male, and the mean SD age of all the students was 11.4 (2.4) years. Ninety (58%) students were taking medication for their health condition. Bronchial asthma was reported to be the most common chronic condition (n=66; 42.6%), followed by blood disorders (n=41; 26.5%). Fifty-three (34%) students were overweight or obese. For male gonadal (G) development, the mean age of boys with G stage 2 was 11.7 years; stage 3: 13.5 years; stage 4: 14.1 years; and stage 5: 14.6 years. For female breast (B) development, the mean age of girls with B stage 2 was 10.7 years; stage 3: 11.3 years; stage 4: 12.4 years; and stage 5: 14.1 years. The pubic hair development for both boys and girls was similar to the corresponding gonadal or breast development, respectively.

**CONCLUSIONS:** The age of onset of pubertal development for both boys and girls with a chronic illness are within normal limits. The high prevalence of overweight and obesity may contribute to this phenomenon, yet further studies should consider the effects of disease severity and chronicity and medication use as possible confounders.

With advancing health care, increasing numbers of children with congenital or perinatal health conditions as well as acquired chronic health conditions survive into adolescence and adulthood.<sup>1,2</sup> It has also become common for individuals to suffer from multiple or comorbid chronic conditions.<sup>3</sup> The definition of chronic illness and chronic health conditions has been an area of discussion for many years and includes elements, such as duration

of condition, limitations of function, and health care needs.<sup>4,5</sup> An internationally agreed upon definition is essential for research implications and hence different prevalence rates have been reported for children with chronic health conditions or a chronic illness.<sup>2,4,5</sup>

Chronic health conditions come with their own challenges and complications. In addition to the symptoms that present as a result of the condition itself, a child may also experience a negative impact on his/

her physical growth, pubertal development, and overall health-related quality of life.<sup>6-8</sup> Although pubertal delay is a recognized consequence of chronic illness, its incidence is unknown.<sup>7</sup> The hypothalamic-pituitary axis may be affected to varying degrees based on the severity and chronicity of the illness, malnutrition, and long-term use of medications.<sup>6,7,9</sup>

In Saudi Arabia, chronic diseases are prevalent and accounted for 69% of all deaths in 2002.<sup>10</sup> The age of puberty onset among Saudi children has previously been reported to be similar to that in other countries.<sup>11</sup> However, no report is available exploring pubertal onset and development among Saudi children with a chronic illness. The aim of this study was to explore pubertal development among Saudi children and adolescents with a chronic illness.

## SUBJECTS AND METHODS

Data for this study was extracted from the Riyadh Puberty Study<sup>11</sup> that was conducted in 2006. This was a cross-sectional study carried out among school children and adolescents in Riyadh, Saudi Arabia. Riyadh is the capital city with over 5 million inhabitants, almost 40% of whom are children and adolescents younger than 15 years of age.<sup>12</sup> Through the cluster sampling strategy, private and public school students were randomly selected to participate in the study. The methods of sampling allowed for representation of different geographical and socioeconomic backgrounds of individuals within the city. The details of sampling technique are described elsewhere.<sup>11</sup> The Institutional Review Board approval was obtained for the study.

Data were collected by means of a household questionnaire as well as a physical examination of the participating student at his/her school. The questionnaire included items pertaining to demographic information, and parents were also asked to identify if their son or daughter was living with a chronic disease and/or taking a medication for a long period. The physical examination included identification of sexual maturity rating (SMR) as well as measurement of growth parameters. SMR for males was determined by assessing gonadal stage and pubic hair development, whereas for females by assessing breast and pubic hair development. Weight and height was measured for all students, with the details of clinical assessment and measurement described elsewhere,<sup>11</sup> and the body mass index (BMI) was calculated. Only students who were not reported to have a chronic illness were included in the analysis of this study. A small number of students were not reported to have a chronic illness, but were taking a long-term medication; hence, they were considered to have a chronic illness.

Descriptive analyses were conducted. Stratified analyses by age for the height, weight, and BMI were also carried out. Moreover, the mean, standard deviation, and 95% confidence intervals of age by stage for pubic hair and gonadal/breast development was calculated. Data management and analyses were carried out using SPSS program (IBM Corp, Armonk, NY, United States, version 15).

## RESULTS

Of 1371 students who participated in the study, 155 (11.3%) had a chronic illness. Seventy-nine (51%) of those students were male, and the mean age was 11.4 (2.4) years. The majority of students (92.9%) lived with both of their parents. Ninety (58%) students were taking medication for their health condition.

Chronic diseases were classified into nine disease/system categories: bronchial asthma, allergic disorders (other than bronchial asthma), blood disorders, skin disorders, endocrinopathies, central nervous system and behavioral disorders, musculoskeletal disorders, and genitourinary disorders. All students were reported to have only one single chronic illness, with the most common condition being bronchial asthma (n=66; 42.6%). This was followed by hematological disorders (n=41; 26.5%) and others (Table 1).

Table 2 summarizes the mean ages of the stages of pubertal development for both genders.

Seventy-two (46.4%) students had unhealthy weights (BMI was either <5th percentile or more than the 85th percentile for age and gender). Fifty-three (73.6%) of these students with unhealthy weights were either overweight or obese. Out of those students who were found to be underweight (n=19), defined as hav-

**Table 1.** Distribution of chronic illnesses.

Chronic illness/system involvement	Frequency	%
Allergic disorders (other than asthma)	14	9.0
Asthma	66	42.6
Blood disorders	41	26.5
Central nervous system and behavioral disorders	3	1.9
Endocrinopathies	9	5.8
Genitourinary disorders	5	3.2
Musculoskeletal disorders	5	3.2
Skin disorders	12	7.7
<b>Total</b>	<b>155</b>	<b>100.0</b>

**Table 2.** The mean ages of students at the different stages of pubertal development.

Stages	N	Mean	Standard deviation
<b>Males<sup>a</sup></b>			
<b>Gonadal development</b>			
I	30	9.3	2.0
II	17	11.7	1.3
III	13	13.5	1.5
IV	7	14.1	1.4
V	8	14.6	0.9
<b>Pubic hair</b>			
I	34	9.4	2.0
II	13	11.9	1.2
III	13	13.5	1.5
IV	8	14.1	1.3
V	7	14.7	1.0
<b>Females</b>			
<b>Breast development</b>			
I	23	8.0	0.9
II	9	10.7	1.0
III	9	11.3	0.9
IV	8	12.4	1.9
V	27	14.1	1.9
<b>Pubic hair</b>			
I	32	8.8	1.5
II	5	10.8	0.8
III	7	12.0	0.8
IV	16	12.8	1.8
V	16	15.1	1.5

<sup>a</sup>Four students refused physical examination.

ing a BMI <fifth percentile, thirteen (68.4%) had a blood disorder. The majority of students who were overweight or obese, defined as having BMI between 85th and 95th and >95th percentile, respectively, had bronchial asthma (Table 3).

## DISCUSSION

The prevalence of chronic illness in Riyadh was found to be similar to that reported in the regional published studies. In Qatif, a city in the Eastern province of Saudi Arabia, the chronic illness was found among 344 respondents (11.7%).<sup>13</sup> International data, such as that

from the United States, has shown that the chronic illness is prevalent in 31% of children, and similar to our findings, bronchial asthma is ranked high among the chronic health conditions.<sup>2</sup>

Chronic illness is known to impact pubertal development of both boys and girls and results in delayed onset of pubertal maturation. This obviously depends on the severity of the illness, its degree of chronicity, as well as other factors, including nutritional status and medication use.<sup>6,7,9,14,15</sup> In our study, we found no evidence of delayed puberty. All students exhibited physical evidence of pubertal development within normal limits that was comparable to that of healthy peers.<sup>11</sup> The fact that 53 (34.2%) students were overweight or obese may have played a role in this, as the effect of increased body fatness on triggering the neuroendocrine events of pubertal onset is well documented.<sup>16</sup> Furthermore, no evidence of early onset puberty was available in any of the students, including those who were overweight or obese. This may suggest that the presence of obesity with a coexisting chronic illness may result in a “balance” or equilibrium of the neuroendocrine system and hence result in normal onset of pubertal development.

Interestingly, as mentioned earlier, 53 (34.2%) students were found to be overweight or obese, yet not a single family reported this as being a chronic health condition. Obesity is internationally recognized as being a chronic illness requiring a multidisciplinary team care approach; yet despite this fact, many may not recognize the significance that the increased body mass may have on an individual until specific organ involvement occurs. This is not unusual as it is known that health conditions that impact on a child’s functioning and activities or require regular encounters with health care facilities are more accurately reported than conditions that do not.<sup>2</sup> The social and economic consequences that obesity has on young individuals have been reported.<sup>17</sup> Children who have multiple chronic conditions have increased morbidity,<sup>3</sup> and in adults, the presence of obesity in addition to a coexisting chronic illness, as compared to the presence of obesity alone, has been found to affect not only the physical well-being but also the emotional well-being.<sup>18</sup>

Although we had a representative sample of students in Riyadh, the fact that this was a school-based study means that the children and adolescents with a chronic illness impairing their functioning and who may be unable to attend school have not been included. Therefore, we may be reporting an underestimation of the prevalence of chronic disease among school-aged children and adolescents in Riyadh. Overweight and obesity were incidentally found to be highly prevalent, yet parents never reported this as being a chronic illness. This

raises the issue of individual understanding and perceptions of chronic illness and health conditions, the possibility of under- or overestimating the existence of such conditions, and the importance of having accurate and internationally accepted definitions or criteria.

In conclusion, the prevalence of chronic disease among children and adolescents in Riyadh is similar to that reported in other parts of the country. It is less prevalent than that reported internationally; however, our report here is probably an underestimation. Bronchial asthma is one of the more prevalent chronic conditions, similar to others' findings. The mean age of pubertal development among students with chronic disease is similar to that of healthy students. The high prevalence of overweight and obesity may be contributing to this phenomenon, yet further studies should consider the effects of disease severity and chronicity and medication use as possible confounders. Because chronic illness has been shown to be prevalent, further studies should explore these individuals' access to health care as well as the impact of such chronic illness on one's well-being, quality of life, and health care costs. Public health education and awareness of the significance of

**Table 3.** Body mass index according to disease category.

Chronic illness/system involvement	Body mass index percentiles				Total
	<5th	5–85th	>85th–95th	>95th	
Allergic disorders (other than asthma)	0	8	2	4	14
Asthma	4	32	14	16	66
Blood disorders	13	23	1	4	41
Central nervous system and behavioral disorders	0	1	0	2	3
Endocrinopathies	1	6	0	2	9
Genitourinary disorders	0	2	1	2	5
Musculoskeletal disorders	1	2	1	1	5
Skin disorders	0	9	0	3	12
<b>Total</b>	<b>19</b>	<b>83</b>	<b>19</b>	<b>34</b>	<b>155</b>

abnormal body mass measures, whether increased or decreased, need to be emphasized.

## REFERENCES

1. Van Cleave J, Gortmaker SL, Perrin JM, Perrin. Dynamics of obesity and chronic health conditions among children and youth. *JAMA* 2010;303:623-30.
2. Newacheck PW, Taylor WR. Childhood chronic illness: Prevalence, severity, and impact. *Am J Public Health* 1992;82:364-71.
3. Newacheck PW, Stoddard JJ. Prevalence and impact of multiple childhood chronic illnesses. *J Pediatr* 1994;124:40-8.
4. Perrin EC, Newacheck P, Pless IB, Drotar D, Gortmaker SL, Leventhal J, et al. Issues involved in the definition and classification of chronic health conditions. *Pediatrics* 1993;91:787-93.
5. Mokkink LB, van der Lee JH, Grootenhuys MA, Offringa M, Heymans HS. Dutch National Consensus Committee Chronic Diseases and Health Conditions in Childhood. Defining chronic diseases and health conditions in childhood (0-18 years of age): National consensus in the Netherlands. *Eur J Pediatr* 2008;167:1441-7.
6. Traggiai C, Stanhope R. Delayed puberty. *Best Pract Res Clin Endocrinol Metab* 2002;16:139-51.
7. Pozo J, Argente J. Delayed puberty in chronic illness. *Best Pract Res Clin Endocrinol Metab* 2002;16:73-90.
8. Ingerski LM, Modi AC, Hood KK, Pai AL, Zeller M, Piazza-Waggoner C, et al. Health-related quality of life across pediatric chronic conditions. *J Pediatr* 2010;156:639-44.
9. Balfour-Lynn L. Growth and childhood asthma. *Arch Dis Child* 1986;61:1049-55.
10. WHO. The Impact of Chronic Disease in Saudi Arabia. 2002; Available from: [http://www.who.int/chp/chronic\\_disease\\_report/en/](http://www.who.int/chp/chronic_disease_report/en/). [Last Accessed on 2010 Oct 30].
11. Al Alwan I, Felimban N, Altwaijri Y, Tamim H, Al Mutair A, Shoukri M, et al. Puberty Onset Among Boys in Riyadh, Saudi Arabia. *Clinical Medicine Insights: Pediatrics* 2010;4.
12. Population Reference Bureau Demographic and Health Highlights. 2007; Available from: <http://www.prb.org/Countries/SaudiArabia.aspx>. [Last Accessed on 2010 Oct 30].
13. Saleh M, Al-Suleiman S, Al-Awamy B, Kaul K. Growing up in Qatif health profile of Qatif region in Eastern Province, Saudi Arabia. *East Mediterr Health J* 1995;1:27-34.
14. Simon D. Puberty in chronically diseased patients. *Horm Res* 2002;57 Suppl 2:53-6.
15. Rosen DS. Pubertal growth and sexual maturation for adolescents with chronic illness or disability. *Pediatrician* 1991;18:105-20.
16. Kaplowitz PB, Slora EJ, Wasserman RC, Pedlow SE, Herman-Giddens ME. Earlier onset of puberty in girls: Relation to increased body mass index and race. *Pediatrics* 2001;108:347-53.
17. Gortmaker SL, Must A, Perrin JM, Sobol AM, Dietz WH. Social and economic consequences of overweight in adolescence and young adulthood. *N Engl J Med* 1993;329:1008-12.
18. Doll HA, Petersen SE, Stewart-Brown SL. Obesity and physical and emotional well-being: Associations between body mass index, chronic illness, and the physical and mental components of the SF-36 questionnaire. *Obes Res* 2000;8:160-70.