

## Puberty onset in rural and urban children

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### Abstract

**Background** Accelerated pubertal onset has been reported in recent years. Environmental factors are assumed to influence this condition.

**Objective** To assess differences in pubertal onset between children in rural and urban areas, as well as to evaluate body mass index (BMI) and socioeconomic status that affect pubertal onset.

**Methods** This cross-sectional study was conducted in July 2010 at junior high schools in Mandailing Natal and Medan, North Sumatera. Data were collected with purposive sampling of children aged 8 to 13 years. Sexual maturity was assessed by Tanner stage and risk factors was determined by questionnaires. The comparison between pubertal onset in rural and urban areas was assessed by Mann-Whitney U test. The relationships between nutritional status, socioeconomic status, sexual maturity, and pubertal onset were assessed by Spearman's correlation.

**Results** Eighty-four subjects (38 boys and 46 girls) from a rural area and 87 subjects (40 boys and 47 girls) from an urban area participated in this study. There were significant differences in mean pubertal age of onset between subjects living in rural vs. urban areas, for both girls and boys [girls: 10.2 vs. 9.5 years, respectively ( $P=0.008$ ); boys: 11.7 vs. 10.1 years, respectively, ( $P=0.001$ )]. We found weak negative correlations between BMI and pubertal onset in boys ( $r=-0.246$ ;  $P=0.03$ ) and in girls ( $r=-0.548$ ;  $P=0.001$ ). We also found weak negative correlations between socioeconomic status and pubertal onset in boys ( $r=-0.406$ ;  $P=0.0001$ ) and in girls ( $r=-0.575$ ;  $P=0.001$ ).

**Conclusion** Pubertal onset is faster in girls and boys who lived in an urban area. There are negative correlations between BMI and socioeconomic status with pubertal onset. [Paediatr Indones. 2017;57:52-6. doi: 10.14238/pi 57.1.2017.52-6].

**Keywords:** pubertal onset; children; urban; rural

In some countries, there has been an acceleration of puberty in boys and girls in recent decades.<sup>1,2</sup> This situation occurs due to the possibility of increasing socioeconomic conditions, nutrition, psychologic stimulation, health, urban and rural areas.<sup>2-4</sup> Changes in attitude and behavior towards a more advanced and healthy lifestyle, as well as diet and nutrition, have impacted the health of certain groups. Obesity has impact on child develop, including onset of puberty.<sup>4</sup>

Incidence of pubertal disorders differs between sexes. The incidence of precocious puberty was ten times greater in girls than in boys.<sup>5</sup> Pubertal age is also influenced by ethnicity, and this may be caused by differences in BMI between races. Onset of puberty was associated with greater BMI. Onset of puberty in girls starts with the development Tanner stage breast 2. Normal puberty in girls begins at the age of 8 to 13 years. Onset puberty in boys, if testicular volume more than 3 mL and age of onset puberty in boys is 10 to 14 years.<sup>1</sup> Pubertal acceleration will cause

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This study was presented at the Kongres Nasional Ilmu Kesehatan Anak/ KONIKA XV (The 15<sup>th</sup> Child Health National Congress), Manado, July 11–14, 2011.

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pubertal hormonal changes, both qualitatively and quantitatively, resulting in rapid weight and height gain.<sup>5</sup> The aim of this study was to assess differences in pubertal onset between children who lived in rural and urban areas. We also evaluated BMI and socioeconomic status that affected pubertal onset.

## Methods

We conducted a cross-sectional study from May to June 2010, in elementary schools at Gunung Baringin (rural area) and Medan (urban area), North Sumatera Province. Inclusion criteria were girls and boys 8 to 13 years with Tanner sexual scale of stage 2 or more. Exclusion criteria were the long term use of steroids, precocious or delayed puberty, use of chemotherapy or radiotherapy, use of hormonal drugs, chronic diseases, dismorphic diseases, orchitis, kryptorchismus and phymosis.

Height was measured by 2M microtoise (sensitivity 0.5 cm) and weight was measured by a pair of Camry® scales (sensitivity 0.1 kg). Body mass index (BMI) was calculated and plotted on the CDC 2000 BMI growth charts.<sup>6</sup> Sexual maturity in both girls and boys was determined by Tanner scale assessment.<sup>7</sup> We also assessed testicular volume with Prader orchidometry and measured penile length with a wooden spatula. This study was approved by the

Health Research Ethics Committee at the University of Sumatera Utara Medical School.

We used Mann-Whitney U test to assess the difference between onset of puberty in urban and rural areas. Spearman's correlation test was used to assess relationships between BMI, socioeconomic status, and onset of puberty. The limit of significance was  $P < 0.05$ .

## Results

Of 85 subjects in rural children, 1 boy was excluded because of orchitis and 87 subjects in urban children, 2 boys were excluded because of kryptorchismus (Figure 1). In this study, the approximate minimal sample were 36 boys and 43 girls in overall area that fulfill the criteria. The general characteristics of subject study between rural and urban children are shown in Table 1.

Tanner stages in rural and urban areas children are shown in Table 2. There was a difference in physical and sexual characteristics between boys ( $P = 0.001$ ) and no difference in girls ( $P = 0.112$ ) (Table 2).

Relationship between BMI, socioeconomic status and puberty in children are shown in Table 3. We found in girls a significantly negative correlation ( $P < 0.001$  and  $r = -0.548$ ) between age at onset of

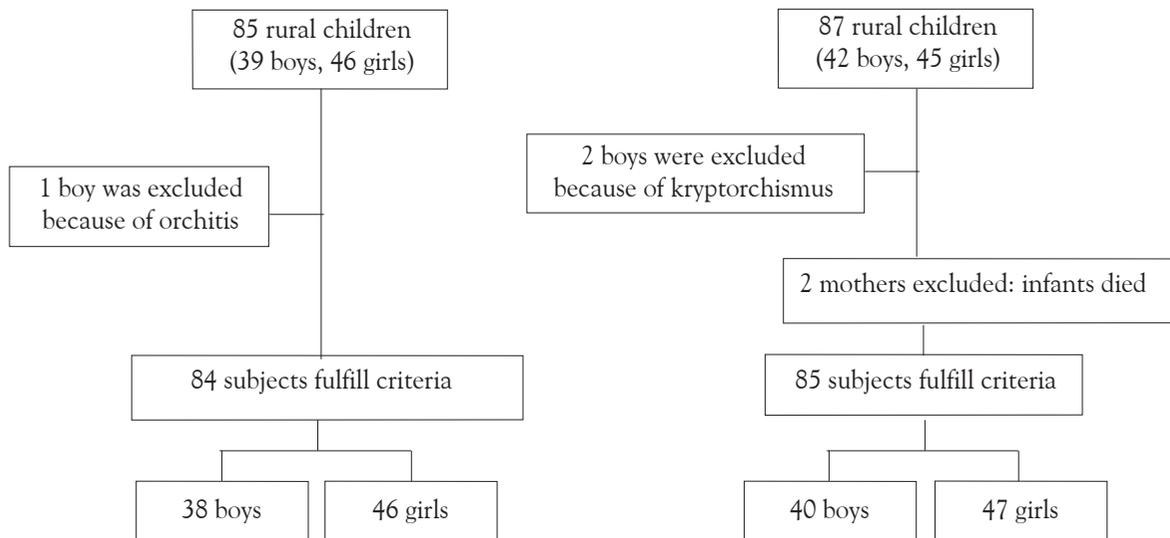


Figure 1. Study profile

**Table 1.** Characteristics of subjects

Characteristics	Boys		Girls	
	Rural (n=38)	Urban (n=40)	Rural (n=46)	Urban (n=47)
Mean age (SD), years	11.3 (1.45)	9.9 (0.61)	10.2 (1.22)	8.4 (3.24)
Mean body weight (SD), kg	24.1 (4.98)	27.5 (9.45)	25.3 (6.26)	24.7 (5.52)
Mean height (SD), m	1.2 (0.12)	1.2 (0.180)	1.3 (0.11)	1.3 (0.15)
Mean body mass index (SD), kg/m <sup>2</sup>	14.2 (2.21)	15.8 (3.42)	14.6 (2.44)	15.1 (2.92)
Nutritional status, n				
Underweight	20 (25.6)	10 (12.8)	18 (19.8)	15 (16.3)
Normoweight	18 (23.1)	27 (34.6)	27 (30.2)	27 (29.1)
Overweight	0	3 (3.8)	1	5 (4.7)
Mean monthly income (SD), IDR	144,177 (139.42)	276,608 (177.43)	195,940 (157.94)	211,110 (120.71)

**Table 2.** Physical and sexual development of subjects

Tanner stage, n(%)	Boys		P value	Tanner stage, n(%)	Girls		P value
	Rural (n=38)	Urban (n=40)			Rural (n=46)	Urban (n=47)	
G2P1	34 (43.6)	21 (26.9)	0.001	M2P1	33 (35.4)	36 (38.7)	0.112
G2P2	3 (3.8)	17 (21.8)		M2P2	10 (10.8)	5 (5.4)	
G3P2	1 (1.3)	1 (2.6)		M3P1	0	4 (4.3)	
				M3P2	3 (3.2)	2 (2.2)	

**Table 3.** The relationships between pubertal onset and nutritional and socioeconomic status

Variables	Boys		P value	Girls		P value
	Coefficient correlation (r)			Coefficient correlation (r)		
Body mass index	-0.246		0.03	-0.548		0.001
Economic status	-0.406		0.001	-0.575		0.001

**Table 4.** Differences in pubertal onset between boys and girls who lived in rural and urban areas

Variables	Boys		P value	Girls		P value
	Rural (n=38)	Urban (n=40)		Rural (n=46)	Urban (n=47)	
Median pubertal onset (range), years	11.7 (9.0-13.6)	10.1 (9.0-11.2)	0.001	10.2 (8/0-12/6)	9/5 (8/0-12)	0.008

puberty with BMI, the higher BMI associated with earlier puberty. We also found in boys and girls a significantly negative correlation between age onset of puberty with economic status, the higher income associated with earlier puberty.

Differences in pubertal onset between boys and girls who lived in rural and urban areas are shown in **Table 4**. There were significant differences in the mean age of pubertal onset. Pubertal onset in boys and girls from urban area were faster than those from rural area.

## Discussion

We determined rural and urban areas based on a scoring system which was developed by the National Statistical Agency in 2000.<sup>8</sup> Scores were based on population density and the percentage of households that have telephones, electricity, and the supporting urban facilities.<sup>8</sup> Gunung Baringin Village, Panyabungan East District, Mandailing Natal Regency, classified as rural because it had a score of less than 10, while the Maimoon District, Medan

municipality had a score over 10. The poor are people who have an average income below the poverty line (Rp. 262,262 per capita per month in 2008 - 2009).<sup>9</sup> In this study, we observed low incomes below the poverty line in both rural and urban areas, [boys in rural areas: Rp. 144,177 (SD 139.4); girls in rural areas: Rp. 195,940 (SD 157.9); girls in urban areas: Rp. 211,110 (SD 120.7)].

One of the impact of obesity was earlier pubertal onset.<sup>10</sup> BMI represents body fat, which is shown in two studies of 100 boys and 92 girls between the ages of 7 to 17 years. The correlation between BMI and fat mass (measured using dual-energy radiograph absorptiometry) in girls was 0.94 in White girls and 0.96 in Black girls. The Correlation of BMI and fat mass was 0.83. The correlation between BMI and body mass in boys was 0.85, while the correlation of BMI to body fat is 0.54.<sup>11,12</sup> Our study showed mean BMI values were significantly different between the boys in urban and rural areas, However, this difference was not observed in girls.

In 1997, an *American Academy of Pediatrics Pediatric Research in Office Settings* (PROS) study of 17,000 girls in the United States found that the mean age of onset of puberty was 10 years in white American girls and 8.9 years in African-American girls.<sup>13</sup> A 1970 study in boys in England observed that the mean age of onset of puberty was 11.6 years.<sup>14</sup> Similarly, the mean age of pubertal onset was 11.5 years in the US in 1985,<sup>15</sup> 11.6 years in Sweden in 1996,<sup>16</sup> and 11.5 years in the Netherlands in 2001.<sup>17</sup> A 2005 study in Indonesia found the mean age of pubertal onset to be 11-12 years.<sup>18</sup> A study in West Sumatera found a mean age of pubertal onset in boys from urban areas was lower than suburban areas [112.26 (SD 21.77 months vs. 119 (SD 19.65) months]. The mean age of pubertal onset in girls from urban areas is also lower than suburban areas [113.56 (SD 21.9) months vs. 115.6 (SD 18.78) months].<sup>4</sup> This situation occurs due to differences in socioeconomic and nutrition conditions. Previous studies have found that children in cities experienced earlier puberty than children in villages.<sup>19,20</sup> Our study also showed faster pubertal onset boys and girls who lived in urban area.

Children with good nutritional status may experience earlier puberty than children with less nutrition.<sup>21-23</sup> A hypothesis said that obesity can trigger the neuroendocrine system to start puberty.<sup>24</sup>

Age of puberty was also influenced by ethnicity, and this may be due to differences in BMI between the races. Several studies also found associations between onset of puberty and BMI.<sup>1,4,12</sup> Some studies also showed correlations between adolescent BMI and pubertal onset.<sup>25,26</sup> A 2008 study reported that a one-unit increase in age between 2 and 8 years was associated with sooner growth spurt at puberty, approximately  $\pm 0.6$  years in boys and  $\pm 0.7$  years in girls.<sup>11</sup> A 2009 study in Semarang in 502 children found a significantly negative correlation ( $r = -0.49$ ;  $P < 0.001$ ) between age at onset of puberty with BMI, The higher BMI associated with earlier puberty.<sup>26</sup> Our study also found relationship between BMI and age of pubertal onset, especially in girls with greater BMI caused early onset of puberty.

A study in Semarang found a strong correlation between socioeconomic status and the onset of puberty ( $r = -0.64$ ;  $P < 0.001$ ).<sup>26</sup> Study in Kosovo found that socioeconomic factors influenced differences in the quality and quantity of food intake. Girls with less food intake experienced menarche in 13.<sup>29</sup> years, while girls with good food intake experienced menarche in 12.91 years.<sup>27</sup> A California study found girls from high family incomes (over \$75,000) had earlier onset of puberty than girls from low income families (less than \$75,000).<sup>12</sup> Problems related to puberty were physical appearance, pregnancy, sexually transmitted diseases, sexual abuse, drug abuse, eating disorders, depression, and obesity.<sup>28</sup> Earlier onset of puberty was also associated with increased risk of psychological disorders, such as post-traumatic stress disorder (PTSD), specific phobias, and social anxiety disorder (SAD).<sup>29</sup> We found a moderate relationship between age at pubertal onset in boys and socioeconomic level. We also found negative correlations between socioeconomic status and pubertal onset in boys ( $r = -0.406$ ;  $P = 0.0001$ ) and in girls ( $r = -0.575$ ;  $P = 0.001$ ).

In conclusion, pubertal onset are faster in girls and boys who lived in an urban area compared to those in rural area. We also find negative correlations between nutritional status and socioeconomic status with pubertal onset.

## Conflict of Interest

None declared.

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