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Original Article

Influence of socioeconomic status on the association between low weight at birth and stunted growth or overweight in rural and urban Indonesian prepubertal children

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Abstract

Background Low birth weight (LBW) has been associated with increased risk for both stunted growth andand overweight later in life.

Objective To assess relative contribution of LBW on the prevalence of stunted growth or overweight in rural and urban Indonesian children in Indonesia.

Methods This is a cross-sectional survey of 2 833 (1125 rural and 1708 urban) school-aged prepubertal children. Each child had data on age, sex, stature, BMI (body mass index) and birth weight.

Results Compared to the urban population, the prevalence of stunted growth was significantly higher in the rural, i.e. 16.3 vs. 32.7%, P<0.001. However, there was no significant difference iin n the prevalence of LBW in the two communities. While overall, stunted children were more likely to be born with LBW, OR 1.80 (95%CI 1.31; 2.47), P<0.001. After stratifying data into rural and urban residences, the contribution of LBW on the risk of stunted growth appeared to be only significant in the urban population, OR 2.42 (95%CI 1.59; 3.68), P<0.001. In the rural, similar proportions of LBW were found in stunted and not stunted children. Test of interaction showed that this difference in OR was significant, the ratio of OR 1.88 (95%CI 1.11; 3.17), P=0.02. We observed no association between LBW and overweight.

Conclusions In rural area, LBW is not an important contributor for stunted growth, while in urbanarea LBW is an important risk factor for stunted growth. As there is no significant difference in the prevalence of LBW between the two communities, the difference in the prevalence of stunted growth is more likely to be associated with different pattern of post-natal growth **[Paediatr Indones 2008;48:214-9]**.

Keywords: *low birth weight, stunted growth, overweight, prepubertal children*

Around one third of children in the developing world are growth retarded before the age of 5 years.[1] Stunted linear growth is an important public health problem because of its association with increased risk for morbidity and mortality,[2,3] as well as its association with poor functional outcomes such as impaired cognitive development later in life.[4]

Low birth weight (LBW) infants, especially those who were born small for gestational age (SGA), have been reported to have a tendency to remain shorter than infants born with a normal weight.[5-7]Although there might be some biological potency for catch-up growth after birth,[8] the opportunity might be low in children who lived in the poor environments which does not support catch-up growth.

In addition to its association with prenatal growth deficits, stunted growth in the developing

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world might be also related to post-natal failure of growth. It had been widely recognized that children in the developing countries experienced retarded growth during the first years of life.[9] A previous longitudinal study in a rural area in Indonesia observed a significant deficit in growth starting from the age of six to seven months. This deficit increased the prevalence of stunted growth from only 7% in the neonatal period to 24% at the age of 12 months.[10]

In some developing countries, especially in those experiencing nutrition transition, problems of overnutrition is gradually replacing or adding to the existing problem of undernutrition.[11] Furthermore, several countries have documented the association between stunted growth and higher risk of obesity. [12-4] Studies in affluent populations observed that rapid weight gain during infancy, particularly in those born with lower weight, was associated with an increased risk for obesity.[15,16]

The contributions of pre- and postnatal growth deficits for subsequent stunted growth or overweight might be manipulated by the socioeconomic status of that population. Therefore, it is questioned in which way a poor or a relatively rich environment influences the association between a low weight at birth and stunted growth or overweight during childhood. The aim of this study was to assess the relative contribution of low weight at birth on the prevalence of stunted growth or overweight in school-aged prepubertal children from rural and urban communities in Indonesia.

Methods

A study was conducted in two adjacent areas in Central Java. Yogyakarta, an urban area, with approximately 487,000 inhabitants, and Gunung Kidul, a rural area located about 20 to 40 km from Yogyakarta, with approximately 710,000 inhabitants at the time of the study. Definition of rural and urban population was based on agricultural activities and population densities. Yogyakarta had a population density of 14,988/km^2, while Gunung Kidul had 498/km^2.[17] These two study areas were chosen because of the relatively homogenous ethnicity of their populations. Most of the people in both areas are of Javanese descent. The altitude of both study areas is less than 500 meter above sea level.[17]

A cross sectional study was conducted in school-aged prepubertal children in both areas. Thirty-three out of 509 public primary schools in the rural area and 37 out of 172 in the urban area were randomly selected. Prepubertal children (aged 8 years old or less for girls and aged 9 years or less for boys) from the first- and second year classes of each school were included. As it is obligatory for children to enter primary school at the age of 6 to 7 years, the ages of the children finally studied ranged from 6 to 7.9 years for girls and from 6 to 8.9 years for boys. In this study only prepubertal children were selected since puberty, which normally occurred after the age of 8 years in girls and 9 years in boys, may interfere with the interpretation of the measurements due to the changes in body composition and to the differences between children in the timing of the adolescent growth spurt.

Children with prominent chronic diseases, i.e. congenital heart diseases or major thalassemia, and children who had physical handicaps that might interfere with the determination of anthropometric measurements, were excluded. The study was conducted from February to May 1999 and was approved by the ethical committee of Gadjah Mada University, Yogyakarta, Indonesia.

Anthropometric data were collected by health professionals. Heights and weights were measured using the standard techniques described by the World Health Organization (WHO).[18] Training for standardization of the measurements, followed by field practice and testing, was performed prior to data collection. All measurements were performed at around 8 to 10 a.m. The children, wearing light clothing, were weighed to the nearest 0.1 kg using a Seca digital scale (Germany). Height was measured to the nearest 0.1 cm using a portable stadiometer with the child standing facing the fieldworker, without shoes. Information on birth weight was collected using a questionnaire sent to the parents with the help of the teachers. Birth dates were verified by the copy of the child's birth certificate filed at the school.

The body mass index (BMI) was calculated by dividing weight in kilograms by the square of height in meters (kg/m^2). Data on BMI were converted to percentiles based on the year 2000 sex-specific Center for Disease Controls and Prevention (CDC) growth charts using the nutritional anthropometry module (NutStat) of the CDC's Epi Info 2000 (Centers for

Disease Control and Prevention, Atlanta, Georgia, USA). Children were classified as at risk for overweight if they had a BMI equal to or above the 85th percentile.[19]

Data on height were converted to standard deviation scores (height SDS) using the same references above and statistical software. Biologically implausible values, such as height SDS below -6.00 or above +6.00, were excluded from the analysis. Values that were most likely to represent errors, i.e., those with 4 SDS units outside the observed mean for every age in one full year, were also excluded (flexible exclusion range). Children were classified as stunted if they had height SDS below -2.00, and as not stunted if they had height SDS of –2.00 or more.[20] Children were considered to have low birth weights (LBW) when their birth weights were less than 2500 g, and considered to have normal birth weights when they were 2500 g or above.[1] Overweight, stunted growth and LBW were all defined using an international reference standard to allow for international comparison.

The prevalence of stunted growth, overweight and LBW in rural children was compared to urban children as the reference by using $\chi 2$-test. Similar analyses were used to compare the prevalence of LBW in stunted vs. not stunted children and in overweight vs. not overweight children. Odds ratios were presented with 95% confidence intervals (95% CI). Test of interaction was performed to assess significance of the difference in odds ratios observed in subgroup analyses (rural vs. urban).[21] All statistical analyses were performed using the CDC's Epi Info 2000 (Centers for Disease Control and Prevention, Atlanta, Georgia, USA).

Results

Seventy schools were visited to examine a total of 3689 prepubertal children listed as first- and second-year students. Six hundred and seventy-four children were excluded because they were not in the required age range. Of the remaining 3015 children, four missed the measurement session and one had a height SDS in the flexible exclusion range.

From the 3010 children for whom measurements were available and considered valid, 2833 (94%) children reported their birth weight, i.e. 1125 rural children (92.4% of the eligible rural children) and 1708 (95.3%) urban children. After stratifying the data into urban and rural residence, there was no significant difference in the prevalence of stunted growth and overweight between those who reported their birth weight and those who did not (data not shown).

From all children studied, 1625 were boys (57.4%) and 1208 were girls. There was no significance difference in the ratio of males to females ($P \geq 0.05$), i.e. 58.8% and 56.4% boys in the rural and urban population, respectively. None of the children had either a prominent chronic disease or a physical handicap that might interfere with the measurements.

The overall prevalence of LBW was 7.0% (199 children). There was no significant difference in the odds to have been born small between the rural and the urban children. The overall prevalence of stunted growth, i.e. having a height SDS of less than –2.0, was 22.8%. Rural children, as compared to urban children, had significantly higher odds to be stunted. On the other hand, the prevalence of overweight was almost three times higher in the urban compared to rural children (**Table 1**).

The prevalence of LBW in stunted children (10.4%) was higher than those in not-stunted children (6.0%). Compared to not-stunted children, the odds ratio for being born small in stunted children was 1.80 (95%CI 1.32; 2.45), $P<0.001$. In rural children, with higher prevalence of stunted growth (32.7%), there was no significant difference in the odds to be born small between the stunted and the not-stunted children. In urban children, with a lower prevalence of stunted growth (16.3%), the odds to be born small in stunted children was more than twice those of not-stunted children. Test of interaction showed a significant difference in the observed odds ratios from urban vs. rural population, the ratio of the odds ratios was 1.88 (95%CI 1.11; 3.17), $P= 0.02$ (**Table 2A**). This study did not reveal any association between LBW and the tendency to be overweight, i.e. OR of 0.84 (95%CI 0.38; 1.82), $P=0.79$.

Discussion

This study addressed the question whether low weight at birth was associated with the prevalence of stunted growth or overweight in prepubertal children from rural and urban communities in Indonesia. We observed that, although only approximately 10% of stunted children had low weight at birth, the proportion of LBW in stunted children was significantly higher than in not-stunted children. However, when the data were stratified into rural and urban residences, a significantly higher proportion of LBW in stunted children was only observed in urban population.

In the rural population, where the prevalence of stunted growth was highest, there was no significant association between LBW and stunted growth. As there was no significant difference in the odds for low weight at birth between the rural and the urban children, the observed higher prevalence of stunted growth in rural children might be associated with an inceased incidence of impaired growth post-natally occurring in this population.

Table 1. Prevalence and odds ratio of stunted growth[a], overweight[b] and low weight at birth (LBW)[c] in rural children compared to urban children as the reference

Characteristics	Population	Prevalence (%)		Odds Ratio	P[d]
		Rural	Urban	(95% CI)	
Stunted Growth[a]	All	32.7	16.3	2.49 (2.08; 2.98)	<0.001
	Boys	31.7	16.2	2.40 (1.90; 3.05)	<0.001
	Girls	34.1	16.5	2.62 (2.00; 3.44)	<0.001
Overweight[b]	All	2.0	5.5	0.36 (0.23; 0.57)	<0.001
	Boys	2.1	5.9	0.34 (0.19; 0.62)	<0.001
	Girls	1.9	5.0	0.38 (0.18; 0.79)	0.008
Low weight at birth (LBW)[c]	All	7.5	6.7	1.12 (0.84; 1.50)	0.45
	Boys	6.3	5.4	1.19 (0.78; 1.81)	0.42
	Girls	9.1	8.5	1.08 (0.72; 1.63)	0.71

[a] having a height standard deviation scores (height SDS) below –2.00
[b] having a BMI equal to or above the 85th percentile of the CDC 2000 reference population
[c] LBW= low birth weight, having a birth weight less than 2500 g
[d] $\chi 2$

Table 2. Odds ratio for low weight at birth (LBW)[a] among stunted[b] or overweight[c] children relative to those not-stunted nor overweight respectively, stratified by rural and urban residence

A. Stunted[b] or not-stunted

Population		Prevalence (%) of LBW[a] in		OR (95%CI)	p[d]
		Stunted[b]	Not Stunted		
Rural	All	8.7	6.9	1.29 (0.82; 2.04)	0.27[e]
	Boys	7.1	6.0	1.21 (0.63; 2.33)	0.57
	Girls	10.8	8.2	1.35 (0.71; 2.58)	0.36
Urban	All	12.5	5.6	2.42 (1.59; 3.68)	<0.001[e]
	Boys	10.3	4.5	2.45 (1.32; 4.53)	0.003
	Girls	15.4	7.1	2.40 (1.35; 4.27)	0.002

B. Overweight[c] or not-overweight

Population		Prevalence (%) of LBW[a] in		OR (95%CI)	p[d]
		Overweight[c]	Not Overweight		
Rural	All	4.3	7.5	0.56 (0.07; 4.19)	1.00[f]
	Boys	0	6.5	Not applicable	1.00[f]
	Girls	11.1	9.0	1.26 (0.15; 10.32)	0.58[f]
Urban	All	6.4	6.8	0.94 (0.3; 2.29)	0.94[g]
	Boys	7.0	5.3	1.35 (0.47; 3.88)	0.54[f]
	Girls	5.4	8.6	0.61 (0.14; 2.58)	0.76[f]

[a] LBW= low birth weight, having a birth weight less than 2500
[b] having a height standard deviation scores (height SDS) below –2.00
[c] having a BMI equal to or above the 85th percentile of the CDC 2000 reference population
[d] $\chi 2$ or Fisher's exact test
[e] Ratio for odds ratio observed in urban vs. rural population 1.88 (95%CI 1.11; 3.17), P=0.02 (test of interaction)
[f] Fisher's exact test
[g] Yates corrected

It had been widely recognized that children in the developing countries experienced growth faltering during the first years of life. A common feature of growth pattern in infants from the developing world is acceptable growth during the first four to six months, followed by a progressive decline in growth rate compared to the affluent population. This decline in growth rate usually began at the age of six months up to the age of 12 to 24 months or perhaps longer.[9]

A previous follow up study in a rural area in Indonesia documented a significant decline in growth rate starting from the age of six to seven months. This decline was responsible for the increase in the prevalence of stunted growth from only 7% in the neonatal period to 24% at the age of 12 months.[10] A study in the Philippines showed that the prevalence of stunted growth increased from around 35% at the age of 12 months to 65% at the age of 2 years, with the rural area worse off than the urban.[6]

This study and previous studies in Indonesia showed that most children in Indonesia were not born with low birth weight. The prevalence of a low birth weight is about 6 to 9%.[1,10] However, most infants did exhibit growth deficits during the first years of life.[10] Our previous study documented a worse growth in the poorer area.[22]

Since stunted growth reflects long-term cumulative inadequacies of health and nutrition, and had been strongly associated with poverty.[6,20] It may be conclude that the rural communities in this study seemed to be poorer than the urban area. The rural area had an increased prevalence of stunted growth, i.e. 32.7%, compared to 16.3% in the urban area.

Our study did not detect any association between LBW and overweight. A study in Sweden observed a positive association between rapid growth in infancy and early childhood with BMI in young adulthood. In that study, individuals with lower birth weights gained more weight in infancy.[23] Similar studies in Britain documented the role of infant and childhood growth on the association between LBW and obesity.[15,24] The association between LBW and overweight seemed to be mediated through rapid weight gain in infancy or childhood, which probably did not occur in our population. Since our study did not examine growth longitudinally, we cannot precisely assess the influence of postnatal growth.

In summary, in an area where the prevalence of stunted growth is very high (the rural area), low weight at birth is not an important contributor for stunted growth. However, in an area where the prevalence of stunted growth is less (the urban area), low weight at birth becomes an important risk factor for subsequent stunted growth. Furthermore, as we did not observe a significant difference in the prevalence of low birth weight among the rural and urban populations, we suggest that the observed difference in the prevalence of stunted growth among rural and urban prepubertal children might have its origin in the socioeconomic environment influencing the pattern of post-natal growth.

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