

Prognostic factors for normal postnatal growth rate in low birth weight infants

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ABSTRACT

Postnatal growth restriction in low birth weight infants is associated with long term adverse neuro-developmental sequel. Meanwhile, infants with excessive weight gain in early weeks of life have a greater likelihood of later obesity, cardiovascular disease, and diabetes. Identifying factors associated with acceptable growth rate in low birth weight infants is important to prevent this potential long term morbidity. The aim of this study was to identify factors associated with acceptable growth rate in low birth weight infants. Prospective cohort study was conducted among 73 low birth weight infants. Growth rate of these infants was determined by serial weight measurement during perinatal care and after being discharged until 46 – 50 weeks post menstrual age. Growth rate was considered normal if average daily weight gain is 10 – 20 g/kg/day. Factors associated with this acceptable growth rate were analyzed by univariate and multivariate statistical analysis. Normal growth rate was found in 62.7% subjects (42/67). Significant rate difference of average daily growth was found between small for gestational age (SGA) infants and appropriate for gestational age (AGA) infants (mean difference -2.90 g/kg/day; 95%CI: -5.68 - -0.12). The SGA infants had a greater risk for gaining weight below acceptable growth rate (adjusted RR = 2.9; 95%CI: 1.1 – 8.5). In conclusion, SGA is the only factor which can be associated with normal growth rate in low birth weight infants. Moreover, SGA infants are in a greater risk for having slower growth rate compared to AGA.

ABSTRAK

Hambatan pertumbuhan postnatal bayi berat lahir rendah berhubungan dengan luaran neurologis jangka panjang yang jelek. Sementara itu, penambahan berat badan yang berlebihan pada awal kehidupan meningkatkan risiko obesitas, penyakit kardiovaskular, dan diabetes di kemudian hari. Identifikasi faktor-faktor yang berkaitan dengan laju pertumbuhan normal pada bayi berat lahir rendah penting untuk mencegah potensi timbulnya morbiditas jangka panjang tersebut. Penelitian ini bertujuan untuk mengidentifikasi faktor-faktor yang berhubungan dengan laju pertumbuhan normal pada bayi berat lahir rendah. Penelitian kohort prospektif dilakukan terhadap 73 bayi berat lahir rendah. Laju pertumbuhan bayi diukur dengan penimbangan berat badan bayi secara serial selama perawatan perinatal dan setelah keluar dari rumah sakit sampai umur 46-50 minggu post menstruasi. Laju pertumbuhan dinilai normal bila rerata penambahan berat badan berkisar 10-20 g/kg/hari. Faktor-faktor yang berhubungan dengan laju pertumbuhan dianalisis secara univariat dan multivariat. Laju pertumbuhan normal ditemukan pada 62,7% subyek (42/67). Ditemukan perbedaan yang bermakna laju pertumbuhan harian antara bayi kecil masa kehamilan (KMK) dan bayi sesuai masa kehamilan (SMK) (beda rerata -2,90 g/kg/hari; 95%CI: -5,68 - -0,12). Bayi KMK memiliki risiko lebih tinggi untuk mengalami penambahan berat badan di bawah normal (*adjusted* RR 2,9; 95%CI: 1,1–8,5). Dapat disimpulkan KMK merupakan satu-satunya faktor yang berhubungan dengan laju pertumbuhan normal pada bayi berat lahir rendah. Bayi KMK memiliki risiko lebih tinggi untuk mengalami laju pertumbuhan lebih lambat dibandingkan dengan bayi SMK.

Keywords: growth rate - post natal - low birth weight – prognostic - gestational rate

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INTRODUCTION

Growth is an essential component in health surveillance of low birth weight (LBW) infants, because almost any problem within physiologic, interpersonal and social domains can adversely affect growth. Growth monitoring is particularly important to enable early detection of growth disorders. Several studies have shown that postnatal growth restriction in low birth weight infants is associated with long term adverse neuro-developmental sequel.^{1,2}

Casey *et al.*² found that small for gestational age (SGA) infants with normal postnatal growth did not differ from the appropriate for gestational age (AGA) infants in cognitive, behavioral, or academic achievement at age 8, while SGA infants with postnatal failure to thrive had the lowest cognitive scores and academic achievement. Meanwhile, in the early weeks of life, infants with excessive weight gain have a greater likelihood of later childhood and adult obesity, cardiovascular disease, and diabetes.³⁻⁵ A prospective cohort study revealed that children who showed catch-up growth between zero and two years were fatter and had more central fat distribution at five years than other children.³

It appears that rapid gain in the first month may have long-term negative consequences.⁶ Thus, identifying factors associated with acceptable growth rate in low birth weight infant are important to prevent this potential long term morbidity. This study was aimed to identify factors associated with acceptable growth rate in low birth weight infant within 50 weeks post menstrual age.

MATERIALS AND METHODS

Study population

This was a prospective cohort study involving LBW infants admitted to perinatal ward, Dr. Sardjito General Hospital in

Yogyakarta between September and December 2011. Any infants, whose birth weight were between 1500 and 2499 gram, with no major congenital anomaly, had undergone prenatal care and were discharged according to medical considerations, were eligible for this study. We excluded any infants who had potential growth impairment due to several clinical conditions such as congenital heart disease, broncho-pulmonary dysplasia, maternal HIV infection, malignancy and feeding problem. Subject was also excluded if written consent from parents failed to obtain or was unreachable by phone for periodic monitoring. The protocol of the study has been approved by the Medical and Health Research Ethics Committee, Faculty of Medicine, Universitas Gadjah Mada.

Data collection

To monitor weight gain, we weighed the infants everyday during hospitalization. After being discharged, monthly weight gain data were obtained from parental reporting by phone call. Subjects were followed until 46 to 50 weeks post menstrual age, in which the growth reference chart remains linear during this period.⁷ Growth rate was calculated by comparing the amount of weight gain (gram) and time unit to obtain that weight increment (days). Growth rate was considered as normal if average daily weight gain was 10 – 20 g/kg/day.⁸ Factors associated with growth rate were recorded i.e. small for gestational age (SGA), gestational age, breastfed, maternal education, maternal occupation and socioeconomic level. Infants were considered as SGA if their birth weight was below the 10th percentile of mean weight for gestational age; infants with birth weight between 10th – 90th percentile was categorized as appropriate for gestational age (AGA). Infants were categorized as preterm if the gestational age was less than 37 weeks gestation. Socioeconomic level was determined

based on family income; when the family income was lower than minimal standard province salary, it would be categorized as low socioeconomic level. Infants were categorized as fully breastfed if they only got breastfed with no other nutritional substances beside pre-lacteal feeding that been given during perinatal care.

Statistical analysis

Pearson chi square test was used to compare distributions of each prognostic factors, two tailed p values of less than 0.05 were set to indicate statistical significance. All variables with significance level less than 0.15 in univariate analysis were subjected to multivariable logistic regression model. Relative risk with 95% CI was calculated for each factor.

RESULTS

There were 77 LBW infants who met the inclusion criteria, four infants were excluded; three of them unreachable by phone and one infant born from mother with HIV infection. Six subjects were lost to follow up, leaving 67 subjects for final analysis. TABLE 1 presents the baseline characteristic of the subjects. During perinatal care, most infants (85%) showed suboptimal growth rate. Normal growth rate was found in only 15% (11/73) infants. At post discharged period, 70% (47/67) infants could attain normal growth rate. Overall,

TABLE 1. Baseline characteristics of the infants enrolled in the study

Characteristics	n (%)
Sex, n = 67	
• Male	36 (54)
• Female	31 (46)
Birth weight, mean (SD) gram	2086.4 (282.3)
Maternal age, mean (SD) years	30.4 (6.5)
Gestational age, mean (SD) years	35.4 (2.7)
Duration of perinatal care, mean (SD) days	13.9 (9.7)
Post menstrual age at the end of follow up, mean (SD) weeks	47.5 (3.8)

average daily weight gain was normal in 63% (42/67) infants.

The distribution of variables by post natal growth rate achievement within 46 – 50 weeks post menstrual age is presented in TABLE 2, whereas the prognostic factors for normal growth rate based on multivariate analysis are presented in TABLE 3. This study found that SGA and socioeconomic level were factors which influence normal growth rate among LBW infants. However, further multivariate analysis using logistic regression showed that just SGA that influence normal post natal growth rate (TABLE 3). The SGA infants had growth rate less than 10 g/kg/day within 46-50 weeks post menstrual age 3.3 time higher than AGA infants.

TABLE 2. Distribution of variables by post natal growth rate achievement within 46 – 50 weeks post menstrual age

Variables	Sub-optimal growth rate	Normal growth rate	RR	95% CI	p
SGA/AGA					
• SGA	13	11	3.1	1.1 – 8.7	0.03
• AGA	12	31			
Gestational age					
• Preterm	13	29	0.5	0.2 – 1.4	0.16
• Term	12	13			
Maternal education					
• High school	14	33	0.4	0.1 – 1.0	0.06
• College	11	9			
Maternal occupation					
• Housewife	13	25	0.7	0.3 – 2.0	0.55
• Working	12	17			
Socioeconomic level					
• Low	18	26	1.6	0.5 – 4.6	0.40
• Middle-High	7	16			
Breastfed					
• Fully breastfed	14	32	0.4	0.1 – 1.2	0.09
• Not fully breastfed	11	10			

TABLE 3. Prognostic factors for normal growth rate based on multivariate analysis

Prognostic factors	Adjusted RR	95%CI	p
AGA	2.9	1.1 – 8.5	0.04
Fully breastfed	0.4	0.1 – 1.3	0.12
Lower social economic level	0.6	0.1 – 2.2	0.39
Lower maternal education	0.4	0.1 – 1.9	0.28

DISCUSSION

Several studies have shown that most of LBW infants will regain their weight at early life.^{9,10} A cohort of 133 full-term, LBW infants from poor families in Brazil showed that increment of weight was clearly seen during the first 8 weeks of life. Between birth and 12 months of age, 90.2% LBW infants had improved in weight-for-age z-scores (WAZ). The estimated median age at WAZ peak was 77 days (interquartile range 65–90 days).¹¹ In this study it was found that more than 60% of LBW infants had an acceptable growth rate within 46 – 50 weeks post menstrual age.

Other studies have also demonstrated that most preterm SGA children who ultimately grow into normal range for population will demonstrate significant compensatory growth within the first year of life, and that the likelihood of such compensation diminishes after that age.¹² This tendency to catch back to normal is influenced by the size at birth and degree of prematurity, VLBW SGA infants have a greater chance of never catching back toward normal over time. In contrast, the growth pattern of the larger LBWPT infants shows that their size tends to return close to the reference size of normal birth weight term infants in the first years of life.¹³ In this study it was found that SGA infants

had significantly lower average daily weight gain compared to AGA infants (mean difference -2.90 g/kg/day; 95% CI: -5.68 - -0.12).

Prospective study which enrolled 818 preterm infants in the Infant Health and Development Program (IHDP) who were studied from birth to 36 months of corrected age showed that preterm SGA infants demonstrated decreasing weight-gain velocity compared with preterm infants with AGA until 40 weeks of corrected age. Heights and weights of infants with either symmetric or asymmetric intrauterine growth retardation remained significantly retarded compared with AGA preterm patients and the National Child Health Survey (NCHS) reference population. Preterm infants with both symmetric and asymmetric growth retardation demonstrated limited catch-up growth in weight until age 4 months and then paralleled the AGA preterm patients and the NCHS reference population.¹⁴ This finding is in line with this study which found that SGA infants tend to attain growth rate below acceptable average daily weight gain.

Nutritional supplementation during early infancy may be of particular importance for infants with on-going additional metabolic requirements. Several strategies for increasing nutrient delivery for preterm infants following hospital discharge are available. However, until nowadays there are limited data from randomized controlled trials to determine whether feeding preterm infants following hospital discharge with nutrient-enriched formula milk versus human breast milk affects growth and development.^{15,16} Review from seven trials which recruited a total of 631 infants also does not provide strong evidence that feeding preterm infants following hospital discharge with nutrient-enriched formula compared with standard term formula affects growth rates or development up to 18 months correctional ages.¹⁷ It was also found that proportion of infants with normal growth rate in LBW infants

who were fully breastfed and in LBW infants who got additional formula milk were not significantly different.

Maternal behaviors are related to the growth of term and premature infants, although the mechanism through which this occurs is unclear. Maternal behaviors which were assessed using home visits with global ratings of Warm Sensitivity and Punitiveness indicated that higher levels of maternal Punitiveness were related to slower rates of physical growth in preterm infants.¹⁸ This study failed to prove that maternal factor, which assessed based on education level and occupation, was one of prognostic factors for normal growth rate attainment in low birth weight infants.

An epidemiological study which explored the impact of socio-economic status on postnatal growth showed that poverty, as measured by house rate-able value, was associated with weight gain during the first year of life.¹⁹ Longitudinal study which intensively monitored 133 LBW infants living in poor socioeconomic conditions in northeast Brazil also found that in a multivariate model, socio-economic variables responsible for the variation in maximum gain in weight-for-age z-score achieved during the 12-month period.¹¹ In this study, socio-economic level which was determined by family income did not significantly affect normal growth rate among LBW infants. This finding needs to be reconsidered because family income did not merely reflect poverty.

The present study has several limitations. During post discharged period, body weight data were obtained using non-standardized measurement methods using many different weight scales. This may affect measurement precision. We relied on maternal reporting of first day of the last menstruation period to estimate gestational age thus recall bias may occur, but we validated this estimation by performing Dubowitz scoring methods.

CONCLUSION

In conclusion, this study shows that SGA is the only factor associated with normal growth rate in low birth weight infants. Infant being SGA had a greater risk of having slower growth rate within 50 weeks post menstrual age.

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