Paediatrica Indonesiana

VOLUME 48 March • 2008 NUMBER 2

Original Article

Effect of exclusive breast-feeding on the linear growth of children aged 24-36 months in Bandung's urban slum area

Nenden Ismawaty, Julistio Djais, Herry Garna

Abstract

Background Breast milk is an ideal nutrition source for infants because of its balanced composition, naturally adjusted to infants' need for growth and without any expenses. However, low education mothers living in slum areas are ignorant towards informations about the importance of exclusive breast-feeding.

Objective To observe the effects of exclusive breast-feeding on linear growth of children aged 24-36 months in urban slums area.

Methods A cross-sectional study was carried out on 343 children consisted of 188 exclusively breastfed infants and 155 nonexclusively breastfed infants in Puskesmas Cigondewah area on August to September 2007. Anthropometric measurements were performed to obtain linear growth status. Data were analyzed by using odd ratio (OR). The first step was performed univariately to assess the effect of data variables. Henceforth, factors which significantly influence the growth will be assesed by multivariate calculation.

Results Normal linear growth status was found in 109 (66.1%) exclusively breastfed compared with 56 (33.9%) nonexclusively breastfed children. Univariate analyzes showed that factors that influenced children normal linear growth were exclusive breast-feeding (OR: 2.44; 95%CI: 1.58;3.78), industrial product porridge as complementary food (OR: 1.65; 95%CI: 1.00;2.72), and frequency of illnesses <6x/year (OR: 1.57; 95%CI: 1.02;2.42). The result of multinomial logistic regression analyzes showed that exclusive breast-feeding became the only factor that influence children linear growth (OR: 2.254; 95%CI: 1.438;3.533).

Conclusion Exclusive breast-feeding has significant positive effect on linear growth of children. **[Paediatr Indones 2008;48:120-124]**.

Keywords: *breast milk, exclusive breast-feeding, linear growth, urban slum area*

After the second year of life, growth velocity is modulated to maintain stature at a constant position relative to the general population. The height percentile attained by about two years of age and maintained throughout childhood and correlated well with the height percentile in adulthood. In the first two years of life, catch-up growth can be a normal adaptation in children whose birth size is at variance with their genetic potential. Whereas statural growth from the age of two years to adulthood is primarily influenced by genetic factors, the determinants of body size during fetal life are largely determined by maternal and nutritional factors.[1] To avoid the retardation process of children's growth, the infant's nutritional needs should be fulfilled during this rapid growth period. Human milk differs from the milk of other mammals and is uniquely suited to meet the needs of the growing infants.[2]

From the Department of Child Health, Medical School, Padjadjaran University, Hasan Sadikin General Hospital, Bandung, Indonesia.

Reprint requests to: Nenden Ismawaty, MD, Department of Child Health, Medical School, Padjadjaran University, Hasan Sadikin General Hospital, Jl Pasteur No.38, Bandung, Indonesia. Tel.62-22-2034426. Fax. 62-22-2035957.

Nutritional problem in urban slum area has become one of the world's attentions. The US Department of Health and Human Services (DHHS) Healthy People 2010 plan to single out nutrition as essential to promote optimal health, to prevent diseases and to provide nutrition needs for children and adolescents. The health goals of this program are to increase the number of mothers who breast-feed their babies to 75% in the early postpartum period, to at least 50% until their infants are six months old and to at least 25% until their infants are one year old. Another goal is to reduce growth retardation among children aged 5 and younger to 5% or less. Low-income family 's optimal growth can be expected to achieve even by children of families living below poverty line.[3,4]

This study aimed to observe the exclusive breast-feeding effect on linear growth, in children aged 24-36 months in Bandung's slum urban areas.

Methods

This was a cross sectional study done on children aged 24-36 months old who lived in urban slum area Cigondewah, Bandung, during August to September 2007. Inclusion criteria were children with history of single birth, term, with the birth weight of ≥ 2.500 grams. Exclusion criteria were those with congenital anomaly and suffered from chronic illness. The parents of eligible children had consented to enroll their children.

Data of identities including name, age and birth date, sex, parent's education background, occupation, family income, history of breast-feeding, complementary feeding, immunization, and frequency of illness were collected by interviewing the parents. An infant was considered to be exclusively breastfed if he or she did not receive any other liquid or solid foods until four to six months. Physical examination was performed to determine health condition including congenital anomaly. Anthropometry measurement including weight and height were performed to obtain the linear growth status using table Z-score of the WHO Child Growth Standards. Stunted growth was defined as a height-for-age < -2 Z-score of the WHO Child Growth Standards.

Statistical analysis was performed into two steps by using odds ratio (OR). The first step was to perform univariate analysis followed by multivariate calculation. Data were analyzed using an SPSS version 15.0 for Windows.

Results

During the study period, 343 children were recruited, consisted of 175 (51.0%) boys and 168 (49.0%) girls. The median age was 30 months, the average heights was 84.0 (SEM 0.4) cm whereas average weight was 11.3 (SEM 0.1) kg. About 318 (92.7%) subjects were breast-fed (data not shown); only 188 (55.8%) children were exclusively breast-fed. Normal linear growth status was found in 109 (66.1%) of exclusively breast-fed children compared with 56 (33.9%) of nonexclusively breast-fed children, despite the prevalence of children with stunted growth were 79 (44.4%) breastfed children with history of exclussive breastfeeding compared with 99 (55.6%) of nonexclusive breastfed children (data not shown). Other characteristics are shown in **Tables 1** and **2**.

The results of univariable analysis shown in **Table 3**.

As shown in **Table 3**, the influencing factors for normal linear growth prevalence in subjects were exclusive breastfeeding, industrial product porridge as complementary feeding, and frequency of illness of less than six times per year. Those factors were ana-

Table 1. Characteristics of subjects

Characteristics	
Sex	
Male	175 (51.0%)
Female	168 (49.0%)
Age (median) (months)	30
Mean weight (kg)	11.3 (SEM 0.1)
Mean height (cm)	84.0 (SEM 0.4)
History of breast-feding	
Exclusive breastfeeding	188 (55.8%)
Nonexclusive breastfeeding	154 (44.2%)
Type of solid foods	
Industrial product	258 (75.2%)
Traditional porridge	85 (24.8%)
Frequent illness (per year)	
< 6 times	201 (58.6%)
≥ 6 times	142 (41.4%)
Basic immunization	
Complete	286 (83.4%)
Incomplete	57 (16.6%)

lyzed by using multinomial logistic regression to find out the most influencing factors of the prevalence of children's linear growth. The results are shown in **Table 4**.

As shown in **Table 4**, exclusive breastfeeding became the only factor that influence the prevalence of children normal linear growth.

Table 2. Characteristics of parent subjects

Characteristics	N	%
Maternal schooling		
≤Junior high school	299	87.2
>Junior high school	44	12.8
Maternal job		
No	276	80.5
Yes	67	19.5
Father's education		
≤ Junior high school	260	75.8
> Junior high school	83	24.2
Father job		
No	10	2.9
Yes	333	97.1
Family income		
< Rp 850.000,00	235	68.5
≥ Rp 850.000,00	108	31.5

Table 3. Univariate analysis factors that influence children linear growth

Factors[1]	OR	CI 95%
Maternal schooling: > Junior high school	1.345	0.712; 2.538
Maternal job: yes	1.228	0.720; 2.096
Father schooling: > Junior high school	1.141	0.696; 1.871
Father job: yes	0.925	0.263; 3.254
Family income: ≥ Rp 850.000,00	1.179	0.747; 1.861
Exclusive breastfeeding	2.4392	1.575; 3.777
Type of solid food: industrial product	1.651[2]	1.001; 2.721
Basic immunization: complete	1.127	0.637; 1.995
Frequent illness < 6 x/year	1.570[2]	1.017; 2.422

[1] Adjusted by the prevalence of normal linear growth
[2] OR > 1; CI 95% does not include mark 1

Table 4. Multivariate analysis factors that influence children linear growth

Factors[1]	OR	CI 95%	P value
Exclusive breastfeeding	2.254[2]	1.438;3.533	0.000
Type of solid food: industrial product	1.671	0.997;2.801	0.051
Frequent illness < 6 x/year	1.384	0.876;2.185	0.163

[1] Adjusted by the prevalence of normal linear growth
[2] OR > 1; CI 95% does not include mark 1

Discussion

Until recently, the only scientific evidence contributing to other studies was based on observational studies, with well-recognized sources of potential bias. Some of the biases tend to favor exclusively breastfed infants, while others favor those who received earlie r complementary feeding. Confounding by indication factor is another important bias, and could operate in either direction. Poor-growing infants (especially those in developing countries) are likely to receive complementary feedings earlier because of their slower growth.[5]

Data taken from this study showed that the rate of exclusive breastfeeding was 55.8% with the prevalence of stunted growth was 51.9% (data not shown) in children aged 24 to 36 months. This prevalence of stunted growth was similar to health surveillance on children under five in Indonesia in 2001 which found the prevalence of stunted growth of more than 40%.[6] This showed that in that area nutrition is still a problem that has to be taken seriously.

Univariate statistical analysis on risk factors predicted in influencing children's linear growth showed that there are three factors that affected growth significantly: exclusive breastfeeding, industrial product porridges, complementary feeding, and frequency of illness less than six times per year. However, after being adjusted with multinomial logistic regression analysis, only exclusive breastfeeding influenced children's normal growth significantly.

Evidence found on exclusive breastfeeding was a positive predictor for children's linear growth in this study that confirmed the previous studies. Alvarado *et al*[7] in their longitudinal study found that breast-fed children had a higher growth rate (regression coefficient = 0.269 cm/mo; within-child) than that of nonbreast-fed children. After adjusting for the complementary food consumption score and morbidity, breast-feeding was still a positive predictor for linear growth rate (regression coefficient=0.26; $P<0.05$). This additional longitudinal evidence provide convincing facts of the benefits of breast-feeding after six months of age on length and weight gains, i.e., breast-feeding was associated with greater length and faster linear growth.

The same result showed by Kramer *et al*[8] based on their observational study performed in Belarus.

Nonetheless, their results offerred no support in the prevailing premise that prolonged and exclusive breast-feeding inexorably leads to deficits in weight and length during the first year of life. Instead, the results showing faster weight and length gains in infants exposed to the experimental intervention support the current WHO and UNICEF recommendations for prolonged and exclusive breastfeeding. The same result has been shown in the longitudinal study performed by Villalpando and Lopez-Alarcon. They found that breast-feeding positively affected the growth performance of the infants by averting infections and possibly by improving nutrient intake during infections.[9]

Study performed by Marquis *et al*[10]proved that in subjects with low intake of animal product foods, breast-feeding was positively associated ($P < 0.05$) with linear growth. There was a 0.5 cm/3 month difference in linear growth between weaned toddlers and those who consumed the average number of feedings of breast milk. When the family's diet is low in quality, breast milk is an especially important source of energy, protein, and accompanying micronutrients in young children.[10]

Other studies proved against the positive effect of breast-feeding such as study performed by Shrimpton and Kachondam in Democratic Peoples Republic Korea in 2002. They found that the prevalence of stunting was 98% in children under two year olds who were ever breast-fed; was higher than that in those who were never breast-fed (Chi square = 3.135, $P=0.043$).[11] However, this study has only stated "were ever breast-fed" and did not explain whether breast-feeding was given exclusively or not.

Study performed by Butte *et al*[12] also showed that body length tended to be lower in breast-fed than formula-fed infants, but the difference was not significant ($P=0.07$).[12] In other study, Heinig *et al*[13] found that there was no significant difference about body length increment between breast-fed infants and formula-fed infants. The same result has also shown in study performed by Dewey *et al*[14].

In the other study, Fomon found that on a gender-specific basis, from 8 to 42 days of age, gains weight and length of breastfed and formula-fed infants were similar, whereas from 42 to 112 days of age, formula-fed infants grow more rapidly than do breastfed infants.[15] But still, there was no significant difference compared with this study results. However, this acknowledgement had some comments from Lende that stated that Fomon avoided one of the important considerations might address activity levels among infants (e.g., being in a crib versus being carried by a hunter-gatherer) and whether the lower growth rates of breastfed infants are temporary and offset by catch-up growth after weaning.[16]

The positive effect of exclusive breastfeeding on children linear growth has provided support about how important an early and adequate nutrition intake for optimal growth achievement. Winick and Noble, as quoted by Russell and Rhoads[1], provided further evidence that the nutritional state during neonatal period influences cell proliferation and consequently determines the ultimate size of the animal and its organs. Food restriction in the first 21 days of life produces a subnormal complement of cells in most tissues. However, the size of the cells was normal. Adequate nutrition after weaning can not restore normal growth, presumably because of an irreplaceable deficit of cells. Food restriction between 21 and 42 days resulted in a comparable stunting of growth in most tissues, but the brain and lung were able to resume normal growth with the restoration of proper nourishment. In these tissues, the total adult cell number had already been attained, and malnutrition produces a reversible decrease in cell size. When malnutrition develops between 65 and 86 days, almost all organs undergo a reversible decrease in cell size only.[1]

Breast milk as the ideal nutrition source with its balanced composition and naturely adjusted to infants needs has became the most important part to achieve the goal of children optimal growth. Mature human milk contains approximately 9 g protein per liter, of which approximately 70% is whey proteins. Protein quantity and quality affect both digestibility and the ability to support growth. The chemical properties of casein in human milk promote the formation of a soft, flocculent curd, which is easier for human infants to digest than those of the casein in other animals' milk. Additional proteins in human milk, such as the important immunologic factors secretory immunoglobulin A (SIgA), lactoferrin, and lysozyme, are active in the gastrointestinal tract but do not contribute nutritionally available protein. Their concentration has been estimated to be 3 g/l. Thus, nutritionally available protein could approximate 7 g/l. This would provide the normal infant consumption 180 ml/kgbw in the

first months of life with approximately 1.3 g of protein per kilogram per day, a figure that is in accordance agrees with theoretical calculations of protein requirements during early infancy but it is inadequate to support growth during the second half of the first year of life.[2]

The content of hormones, growth factors, and hormone-like peptides in cow milk appears to be similar with that in human milk. Concentrations of bovine growth hormone in cows' milk and human growth hormone in human milk are both approximately 1 ng/mL (one part per billion). The concentration of insulin-like growth factor-I (IGF-1), a mediator of growth hormone action, is in the range of 1.5 to 8 ng/mL in pooled bovine milk and 1 to 3 ng/ml in human milk. Because these hormones are digested in the gastrointestinal tract and are not absorbed intactly into the bloodstream, they are not believed to have biological significance when ingested, at least after the newborn period.[17]

The results of this study show the advantage of exclusive breastfeeding for children linear growth. Breastfeeding, the best infant's early nutrition, should be given in every segment of society including low-income family in urban slum area. Exclusive breastfeeding could barely accomplish the optimal growth albeit infants from low-income family. Thus, the results of this study reinforce the groundwork of promoting exclusive breastfeeding campaign as the best nutrition for infants to achieve the optimal growth, primarily in high-risk-nutritional-insult area.

References

1. Russell WE, Rhoads JM. Humoral regulation of growth. In: Walker WA, Watkins JB, Duggan C, editors. Nutrition in pediatrics, basic science and clinical applications. London: BC Decker Inc; 2003. p. 277-303.
2. Hendricks KM. Weaning: Pathophysiology, practice, and policy. In: Walker WA, Watkins JB, Duggan C, editors. Nutrition in pediatrics, basic science and clinical applications. London: BC Decker Inc; 2003. p. 528-38.
3. Dwyer J, Stuart MA, Hendricks K. Community nutrition and its impact on children: developed countries. In: Walker WA, Watkins JB, Duggan C, editors. Nutrition in pediatrics, basic science and clinical applications. London: BC Decker Inc; 2003. p. 142-60.
4. Lawrence R, Lawrence RM. Approach to breast-feeding. In: Walker WA, Watkins JB, Duggan C, editors. Nutrition in pediatrics, basic science and clinical applications. London: BC Decker Inc; 2003. p. 562-79.
5. Kramer MW, Kakuma R. The optimal duration of exclusive breastfeeding: a systematic review. Pediatrics 2005;115: 496-506.
6. Atmarita. Nutrition problems in Indonesia. An Integrated International Seminar and Workshop on Lifestyle – Related Diseases; 2005 March 19-20; Yogyakarta, Indonesia.
7. Alvarado BE, Zunzunegui MV, Delisle H, Osorno J. Growth trajectories are influenced by breast-feeding and infant health in an Afro-Colombian community. J Nutr 2005;135: 2171-8.
8. Kramer MS, Tong G, Platt RW, Shapiro S, Collet JP, Chalmers B, et al. Breastfeeding and infant growth: biology or bias? Pediatrics. 2002;110:343-7.
9. Villalpando S, Lopez-Alarcon M. Growth faltering is prevented by breast-feeding in underprivileged infants from Mexico City. J Nutr 2000;130:546-52.
10. Marquis GS, Habicht JP, Lanata CF, Black RE, Rasmussen KM. Breast milk or animal-product foods improve linear growth of Peruvian toddlers consuming marginal diets. Am J Clin Nutr 1997;66:1102-9.
11. Shrimpton R, Kachondham Y. Analysing the causes of child stunting in DPRK (Cited 2007 September 27). Available from: *http://www.hawaii.edu/hivandaids/Analyzing_the_Causes_of_Child_Stunting_in _DPR_Korea.pdf.*
12. Butte NF, Wong WW, Hopkinson JM, Smith EO, Ellis KJ. Infant feeding mode affects early growth and body composition. Pediatrics 2000;106:1355-66.
13. Heinig MJ, Nommsen LA, Peerson JM, Lonnerdal B, Dewey KG. Energy and protein intakes of breast-fed and formula-fed infants during the first year of life and their association with growth velocity: the DARLING study. Am J Clin Nutr. 1993;58:152-61.
14. Dewey KG, Heinig MJ, Nommsen LA, Peerson JM, Lonnerdal B. Growth of breast-fed and formula-fed infants from 0 to 18 months: the DARLING study. Pediatrics 1992;89:1035-41.
15. Fomon SJ. Assessment of growth of formula-fed infants: evolutionary considerations. Pediatrics 2004;113:389-93.
16. Lende DH. Review of Fomon's "assessment of growth of formula-fed infants: evolutionary considerations". Pediatrics 2004;114:1365.
17. Grumbach MM, Bier DM, Blumenthal H, Clark J, Dunkley WL, Gray GM, et al. Bovine somatotropin technology assessment conference statement. 2007 (Cited 2007 Juni 28). Available from: *http://www.monsantodairy.com/index.html.*