THE AGE PATTERN AND SOCIO-ECONOMIC DETERMINANTS OF GROWTH RETARDATION IN PRESCHOOL CHILDREN

Hamam Hadi

Center for Health and Human Nutrition, Department of Public Health, Faculty of Medicine, Gadjah Mada University, Yogyakarta, Indonesia.

ABSTRACT

Background: The prevalence of growth stunting and growth wasting in Indonesian preschool children is still high. The age pattern and socio-economic determinants of growth stunting and wasting have not been well understood.
Objective: To describe the age pattern of linear and ponderal growth, and to identify socioeconomic and nutritional factors associated with stunting and wasting in preschool children.
Method: We analyzed the baseline data from a randomized trial. This cross sectional analysis was done using data collected at the first cycle of the Morvita study prior to treatment assignment. These data consisted of 747 preschool children aged 6-48 months from 25 rural villages of Purwodadi sub district who had completed anthropometric data.
Results: The major growth deficit in length occurred during period of 6-24 months of age. After 24 months of age the linear growth tended to be plateau. The age pattern of ponderal growth was quite similar to the age pattern of linear growth except that the growth deficit was regained after 24 months of age. In the multiple logistic regression models, age and sib ship were significantly ($p<0.05$) associated with stunting and wasting. Vitamin A status, mother's education, and time to elementary school were inversely associated with of stunting ($p<0.05$) while kitchen partition was significantly ($p<0.05$) associated with wasting.
Conclusions: The period of 6-24 months was the period of active failure in which the major deficit in linear and ponderal growth occurred. Socioeconomic factors had a significant contribution to the growth stunting and wasting of Indonesian preschool children.

Keywords: growth retardation, preschool children, socio-economic status

INTRODUCTION

Growth retardation is one of the major health-nutritional problems among children in developing countries.[1] It has long been recognized as a public health significance because of it's relationship with high child mortality rates,[1,2] short stature and reduced lean body mass in the adult which constrain reproductive performance in women and work capacity and productivity in adults.[4] Most studies on growth retardation indicate that the growth of children from developing countries begins to deviate from the growth chart of children from developed countries very early in life and ends by two or three years of age.[5] In reviewing anthropometric data of children aged 0-5 years from many different settings and ethnic backgrounds, Habicht[6] have concluded that ethnic differences in growth potential are minor prior to puberty. There is a general agreement that socioeconomic factors influence growth by affecting dietary intakes and/ or the incidence and severity of infections as immediate causes.[7]

It has been commonly perceived that the purpose of complementary feeding programs in communities that are judged to be in need of such assistance is to promote physical growth. If physical growth is protected (maintained at close to genetic potential) through feeding or other interventions, there will be commensurate benefits in terms of other dimensions of human development. Failure to grow was found to be an active process during the period 6-18 months. After the first two years, the relative magnitude of failure was greatly diminished.[8] If the period of 6-18 months is the period of active failure, then, it is also the period in which one would expect the greatest absolute impact of dietary or other interventions aimed specifically at growth faltering. The age pattern and socioeconomic determinants of growth retardation in Indonesian preschool children have not been well understood. Understanding the pattern and factors associated with growth stunting (linear growth retardation and wasting ponderal growth retardation) may be useful in the development and implementation of public health nutrition programs.

In part of nutrient intakes, there has been an increasingly wider recognition that vitamin A deficiency is associated with growth retardation. Numbers of observational studies have linked vitamin A deficiency to a greater odds of being stunted,[9,10] and wasted.[9] Previous studies also showed that indicators of socioeconomic status were strong indicators of the body sizes of the children. Food production assets such as land,[11] actual food production by the family,[7] and income[12] were among the factors identified as predicting body size. This data analysis was done to describe the age pattern of growth stunting and wasting in Indonesian preschool children, and to identify socioeconomic factors associated with stunting and wasting.

MATERIALS AND METHODS

Study design and population

Data used in this analysis were obtained from the Morvita study which was designed to investigate the impact of vitamin A supplementation on growth and morbidity in preschool children. Details of this study design have been described elsewhere.[13,14] Important aspects of the study and relevant information for this analysis are summarized below. The study was conducted by the Johns Hopkins University in collaboration with the Faculty of Medicine, University of Gadjah Mada from 1989 to 1992. Initially the study was concentrated in 25 rural villages of Purwodadi sub district, but one year later the study was expanded to the neighboring 9 rural villages of Ngombol sub district, located on the Southern coast of Central Java, Indonesia. The study was a randomized, double-masked, placebo-controlled trial, and consisted of 6 treatment cycles, where the treatment was given once every 4 months. Treatments were randomly assigned at the individual level to children aged 6-47 months at the start of the study. The same assignment was followed for each cycle thereafter. Children less than twelve months of age received the lower dose (103,000 IU) vitamin A or placebo capsules, while children twelve months or older received the higher dose (206,000 IU) vitamin A or placebo capsules.

This cross sectional analysis was done using data collected at the first cycle of the study prior to treatment assignment. These data consisted of 747 preschool children from 25 rural villages of Purwodadi sub district who had completed anthropometric data. These children had more complete socioeconomic data than children who entered the study in other cycles, of these children, 689 had data on serum retinol concentration measured, 638 had daily vitamin A intake data, and 636 had complete socioeconomic data.

Data Collection Procedures

Anthropometric data. The child's weight and recumbent length were measured by a team of trained anthropometrists. Weight and recumbent length were measured at the first cycle of the study prior to treatment assignment in the

Morvita Clinic Post or at home for children who did not come to Morvita Clinic Post. Weight of naked or lightly clad children was measured on a suspended Salter spring scale (CMS Model 235 PBW) and read to the nearest 0.1 kg after the pointer was completely still for at least 2-3 s. All remaining measurements were taken independently at least three times and their mean was recorded as the observed value. Recumbent length and standing height were measured to the nearest 1 mm for children aged < 24 and 24-47 months, respectively with portable wooden board structurally reinforced for increased instrument precision. Breastfeeding information was collected at the same time of anthropometry data collection. Mothers were asked whether or not their children were breastfed and whether or not they received supplementary food.

Assessment of vitamin A status. Vitamin A status was assessed at the start of the study prior to treatment assignment using serum retinol as the measurement. High-Performance Liquid Chromatography (HPLC) was used for laboratory analysis. Blood samples were collected from the children by ante-cubital venipuncture into a capped colored glass tube and transported on ice to the field office where they were centrifuged and aliquoted. On the same day sera were transported on ice to the laboratory where HPLC procedures were carried out. The samples were handled and processed using the International vitamin A Consultative Group (IVACG) guidelines.[15]

Dietary Vitamin A intake. A food frequency questionnaire was used to characterize the habitual vitamin A intake of individual children. A one-month recall was used because the diets of young children change rapidly and because of the seasonal availability of many foods in the study area. Most of interviews were conducted on the same day (70%) or within one month after the first treatment assignment.

Socioeconomic data. Before the start of the study, census data were collected on the total population in the study area. Within one month, along with enrollment and informed consent administration, data on socioeconomic status were collected using precoded questionnaires of Javanese local idiom. The socioeconomic information included number and age of siblings in the household, mother's and father's education, mother's and father's occupation, monthly earning, monthly expense, land ownership, possession of ducks, radio or tape, etc.

Data analysis

Data were edited by field supervisors before data entry and then entered into the computers by trained computer operators using Dsurvey software.[16] Statistical analysis was done using STATA (STATA corporation, V 5.0, TX software,[17] while anthropometric indicators were calculated using Epi Info software.[18]

The outcome variables was stunting or wasting treated as dichotomous variables. Stunting was defined as having length for age z-scores (LAZ) < -2 and not stunting otherwise. When wasting was defined as having WLZ <-2 the proportion of wasted children was very low (3.6%), such that many cells were empty when a more complex analysis was done. Therefore, wasting was defined as having WLZ <-1.53 (represents the 25th % ile below median of the distribution). This allowed us to have the prevalence of wasting of 25%, and to model a multiple logistic regression to adjust for potential confounding factors. Age was treated as a 4-dummy variable; < 12 months, 12-23 months, 24-3 5 months, and ≥ 36 months. Vitamin A status was treated as a 3-dummy variable; < 10 mcg/dL, 10-20 mcg/dL, and ≥ 21 mcg/dL. Vitamin A intake was treated as a 3-dummy variable; <200 RE/ day; 200-400 RE/ day, and >400 RE/day. Breastfeeding was treated as a dichotomous variable; yes or no. Parental education was categorized as none (<primary school), primary school, secondary school, and high school/ higher. Number of children <5 years within household was treated as a two-dummy variable; 1 or more children. Monthly income in rupiah (Rp. 2000= US$1) was categorized as

<30,000; 30-50,000; 50-75,000; 75-100,000, and >100-125,000. Number of bedroom was treated as a 3-dummy variable; 1, 2 or ≥ 3 bedrooms. Kitchen partition was treated as a 4-dummy variable; brick wall/partly, wood, bamboos/palm leaves, or others. Time to elementary school was treated as a 4 dummy variable; <5, 5-9, 10-14, or ≥ 15 minutes represent <25th, 25-50th, 51-75th, and ≥ 75th % ile of the time-to-school distribution.

The risk of stunting or wasting was estimated by the odds of being stunted or wasted for a given covariate. Simple logistic regression models were used to obtain crude odds ratios of stunting or wasting from a given covariate, while multiple logistic regression models were used to estimate the risk of stunting or wasting from a given covariate adjusting for the remaining covariates.

RESULTS

The age pattern of stunting and wasting

Thirty seven percent of 747 children entering the study at the first cycle were stunted. The prevalence of stunting was different by age groups (χ^2= 41.3, df=3 and p-value<0.001), and the highest prevalence of stunting was found at 3 years of age. One hundred eighty seven of 747 children (25%) were wasted, i.e. WLZ <-1.53. The prevalence of wasting was also significantly different by age group (χ^2=49, df=3 and p-value <0.001). However, the highest prevalence of wasting was found at two years of age. The degree from which the nutritional status of Indonesian children deviates the NCHS charts can be evaluated by the mean Z-scores at every age group. The mean Z-scores of length for age (LAZ) for children <1 year was -0.9 ± 1.2 SD. The mean declined very dramatically during the 2nd half of the first year and continued until the first half of the 2nd year at which the mean was -1.94 ± 1.03. The mean was below -2 at 3 years of age, and it slightly increased thereafter. The age pattern of stunting was not significantly different by sex (Figure 1). Unlike length values, weight values began to fall almost concurrently with the fall of length but they reached the lowest values in the second year of age. The values returned almost to the original values after 3 years of age. Boys tended to be more wasted than girls after two years of age (Figure2).

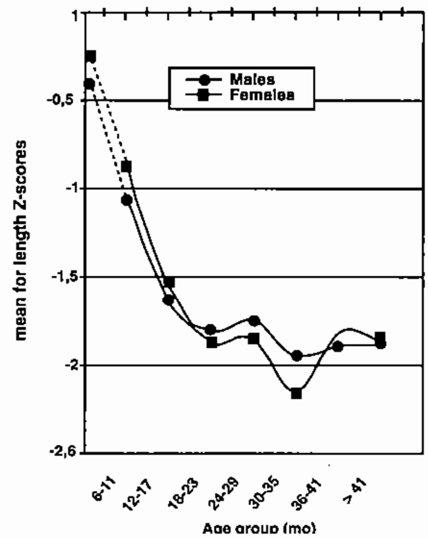

Figure 1. The mean length for age z-scores by age group

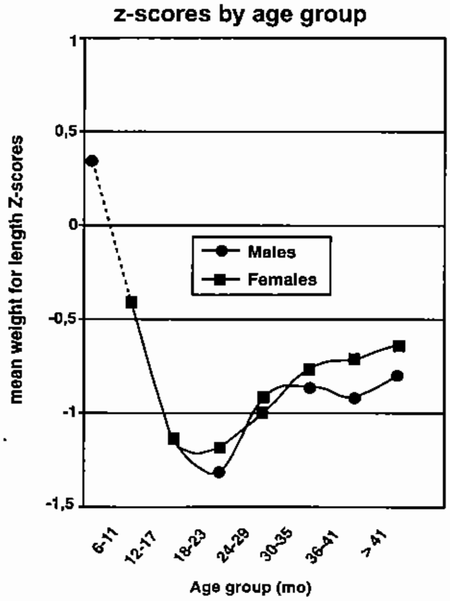

Figure 2. The mean weight for length z-scores by age group

Risk factors for stunting

Results from simple logistic regression models indicated that the following factors were found to be associated with stunting; age, level of serum retinol, vitamin A intake, breastfeeding, mother's education, monthly income, number of bed rooms, and time to elementary school (Table 1). Stunting was not associated with sex, number of children <5 years, kitchen partition, and time to elementary school. When multiple logistic regression models were performed to adjust for confounding factors, the following factors remained or became significant at a significant level of 0.10; age, vitamin A status, number of children < 5 years, number of bedrooms, mother education, and time to elementary school (Table 2, $Model_1$).

Results from the multiple logistic regression models indicated that the older children, the lower serum retinol concentration, the higher number of children <5 years within household, the smaller number of bedrooms, the lower mother's education level, and the closer to elementary school the higher the odds of being stunted. The odds of being stunted was ~5 times (OR=4.7, 95% CI: 4.7; 9.9) higher among children aged 2 years compared to children aged < 1 year. The odds of being stunted was ~9 times (OR=8.6, 95% CI: 4.2; 17.7) higher among children aged >3 years as compared to children aged < 1 year.

Stunting was inversely associated with the level of serum retinol concentration. Children whose serum retinol concentration was low (10-20 mcg/ dL) had odds of being stunted 1.2 (OR=1.2, 95% CI: 0.8; 1.7) higher than children whose serum retinol >20 mcg/ dL. However, children with serum retinol concentration <10 mcg/ dL had odds of being stunted ~2.4 times (OR=2.4, 95% CI= 1.2; 5.1) higher than children with serum retinol >20 mcg/ dL.

Children whose mother had education level less than 12 years had odds of being stunted 3 to 4 times higher than children whose mother had education level >12 years. However, there seemed to be little different between children whose mother's education level below 12 years and those children whose mother's education level below 9 or 6 years.

Number of children <5 years within households, and number of bedrooms were also inversely associated with stunting. Children living in households with more than one child had odds of being stunted ~1.5 times (OR=1.5, 95%CI= 1.04; 2.28) higher than children who had no other preschool children Children living in houses with one bedroom had odds of being stunted 1.5 times (OR=1.5, 95% CI=0.96; 2.31) higher than those who lived in houses with more than 1 bed room.

The closer children from elementary school the higher their odds of being stunted. For example, children with <5 minutes walk to elementary school had odds of being stunted 2.2 times (95% CI: 1.2; 4.0) higher than children with >15 minutes walk. When breastfeeding variable was added into the model, the association between stunting and these socioeconomic indicators was stronger (Table 2, $Model_2$)

Risk factors for wasting

Of 12 independent variables, 5 variables were found to be significantly associated with wasting at significant level of 0.10 in simple logistic regression models including age, breastfeeding, monthly income, number of children< 5 years, number of bedrooms, and kitchen partition (Table 1). When multiple logistic regression models were performed to adjust for confounding factors, the following variables remained significant at a significant level of 0.10; age, number of children <5 years, number of bedrooms, and kitchen partition (Table 3, $Model_1$).

Results from the multiple logistic regression models revealed that the odds of being wasted was 3.7 fold (OR=3.7, 95% CI: 2.0; 6.8) higher among children aged <12-23 months than among children <12 months. Among children aged 24-36 months, the odds of being wasted was 2.0 (OR=1.98, 95% CI=1.08; 3.66) times higher than among children <12 months. However, among children above 36 months of age, the odds of being wasted was 1.5 (OR=0.68; 95% CI= 0.35; 1.3) lower than among of children < 12 months.

Table 1. Odds ratios (OR) derived from simple logistic regression models of stunting and wasting in relation to socioeconomic and nutritional factors

Explanatory variables	Outcome Variables			
	Stunting		Wasting	
	(OR)	p-value	(OR)	p-value
Sex				
Male	0,89	0,4742	0,98	0,9623
Female	1		1	
Age (months)				
< 13	1		1	
13 – 24	3,63	0,0001	3,87	0,0001
25 – 36	5,78	0,0001	2,10	0,0156
37 – 48	5,98	0,0001	0,77	0,4141
Vitamin A status (ug/dL)				
< 10	1,92	0,0487	1,65	0,2283
10 – 20	1,02	0,9266	1,2	0,4291
21+	1		1	
Dietary vitamin A intake (RE/day)				
< 200	0,66	0,0325	1,21	0,3789
201 – 400	0,74	0,1108	1,10	0,6705
> 400	1		1	
Breastfeeding				
Yes	0,53	0,0001	1,60	0,0060
No	1		1	
Breastfeeding				
Exclusive	0,38	0,0001	3,00	0,0624
Non Exclusive	0,54	0,0002	3,67	0,0001
No	1			
Mother's education (highest completed)				
< primary School	2,63	0,0173	1,20	0,6263
primary School	3,16	0,0052	1,00	0,9563
secondary school	2,80	0,0325	1,80	0,2025
high school/ higher	1		1	
Monthly income (Rp.)				
< 30.000	1,56	0,0180	0,54	0,0263
30.001 – 50.000	1,82	0,0112	0,42	0,0311
50.001 – 75.000	1,42	0,3001	0,21	0,0568
> 75.000	1		1	
# children < 5 yrs				
1	1		1	
≥ 2	1,31	0,1300	2,02	0,0014
Number of bedrooms				
1	1,61	0,0132	1,48	0,0805
2	1,35	0,1446	1,26	0,2854
≥ 3	1		1	
Kitchen partition				
Brickwall/partly	1		1	
Others	0,84	0,4457	0,51	0,0101
Wood	0,75	0,2427	0,47	0,0053
Bamboos/palm leaves	0,81	0,3418	0,73	0,1705
Time to school (minutes)				
< 5	1,7	0,0725	1,30	0,3010
5 – 10	1,6	0,0402	1,03	0,8998
10 – 15	1,5	0,0828	1,34	0,1961
> 15	1		1	

Stunting: LAZ <-2 and WLZ ≥-2; Wasting: WLZ <-1,53 (25% ile below median of the distribution)

Tabel 2. Multiple logistic regression models of stunting in relation to socioeconomic and nutritional factors

Explanatory variables	Outcome Variables = stunting			
	$Model_1$		$Model_2$	
	OR	p-value	OR	p-value
Age (months)				
< 12	1		1	
12 – 23	4,7	0,0001	5,0	0,0001
24 – 35	8,4	0,0001	10,2	0,0001
> 36	8,6	0,0001	11,0	0,0001
Vitamin A status (mcg/dL)				
< 10	2,4	0,0182	2,5	0,0151
10 – 20	1,2	0,3783	1,2	0,4092
≥ 21	1		1	
# children < 5 yrs				
≥ 2	1,5	0,0323	1,6	0,0291
1	1		1	
Number of bedrooms				
1	1,5	0,0774	1,5	0,0765
2	1,3	0,3325	1,3	0,3524
≥ 3	1		1	
Mother's education (highest completed)				
< primary School	3,2	0,0159	3,2	0,0157
primary School	4,2	0,0032	4,2	0,0029
secondary school	4,2	0,0116	4,4	0,0093
high school/ higher	1		1	
Time to school (minutes)				
< 5	2,2	0,0150	2,2	0,0148
5 – 10	1,7	0,0188	1,8	0,0173
10 – 15	1,5	0,0904	1,5	0,0825
> 15	1		1	
Breastfeeding				
Yes			1,3	0,2574
No			1	

Stunting: LAZ <-2 and WLZ ≥-2; $Model_1$: H&L goodnes of fit=5,7, p=0,6825; $Model_2$: H&L goodness of fit=7,7, p=0,4643.

Children who lived in households with one or more other preschool children had odds of being wasted 2.2 times (OR=2.2, 95% CI: 1.4; 3.4) higher than the only preschool children in households. Children living in houses with only one bedroom had odds of being wasted 1.6 times (OR=1.5, 95% CI=0.97; 2.56) higher than children living in houses with more than 3 bedrooms. Children living in houses with kitchen partition of wood had odds of being wasted 2.3 times (OR=0.43, 95% CI=0.24; 0.76) lower than children living in houses with kitchen partition of brick wall/ partly brick wall. When breastfeeding and vitamin A status variables were added into the model, the association between wasting and these socioeconomic factors did not change (Table 3, $Model_2$).

Tabel 3. Multiple logistic regression models of wasting in relation to socioeconomic and nutritional factors

Explanatory variables	Outcome Variables = wasting			
	$Model_1$		$Model_2$	
	OR	p-value	OR	p-value
Age (months)				
< 12	1		1	
12 – 23	3,7	0,0001	3,6	0,0001
24 – 35	2,0	0,0279	2,0	0,0554
> 36	0,67	0,2333	0,67	0,3072
# children < 5 yrs				
≥ 2	2,2	0,0008	2,2	0,0009
1	1		1	
Number of bedrooms				
1	1,6	0,0685	1,6	0,0611
2	1,5	0,1026	1,5	0,0965
≥ 3	1		1	
Kitchen partition				
Brickwall/partly	1		1	
Others	0,53	0,0212	0,51	0,0153
Wood	0,43	0,0037	0,41	0,0026
Bamboos/palm leaves	0,69	0,1410	0,67	0,1136
Vitamin A status (mcg/dL)				
< 10			0,57	0,2017
10 – 20			0,82	0,2929
≥ 21			1	
Breastfeeding				
Yes			1,04	0,8560
No			1	

Wasting: WLZ <-1,53 (<25^{th}% ile below median of the distribution);
$Model_1$: H&L goodnes of fit=3,4, p=0,9074; $Model_2$: H&L goodness of fit=4,4, p=0,81

DISCUSSION

One of the methods to evaluate how well children from different places grow is to use a single growth standard and compare the growth of the children under the study to the growth standard charts. It was recommended that the US National Center for Health Statistics (NCHS) standard should be used to evaluate growth of children under 10 years of age.[19] Compared to the NCHS standard, the linear growth of Indonesian preschool children was typically similar to the growth of children from other developing countries[7] characterized by 3 major aspects. ***First,*** during the first few months of life the length of children in this study population was projected (doted line in figure 1) to be near the fiftieth percentile of the NCHS growth charts. The achieved growth in this period was more likely to reflect the result of continuing growth rate at birth.

Second, major growth stunting occurred during period of 6- 24 months of age. Interestingly, the longitudinal data from this study population showed that the burden of diarrhea and acute respiratory infection was the highest during this period.[20] Similar results have also been reported in previous studies.[7] The evidence is quite clear that recurring diarrhea has a major inhibitory effect on young child growth.[21] Both reduced food intake and intestinal malabsorption seem to play a part in the impact of diarrhea. It is likely that recurrent infections also have direct impact on the growth process, unrelated to decrease in food intake or nutrient absorption.[8] Since a complete catch up growth inherent to the growth deficit occurred in this period is difficult to regain thereafter, the achieved length in this period is thought to reflect a process of failing to grow, and accordingly, the expected impact of dietary or other interventions aimed specifically at growth faltering is thought to be the greatest in this period.[5] ***Third***, after 24 months of age, the growth rate tended to be plateau with exception during the second half of the third year where the linear growth was most affected. Since these data were cross sectional, the achieved size in length might be more likely to reflect a cumulative history of events occurring in earlier years. The apparent decline in the length z-scores at age 30-35 months might be due to a more severe growth failure during earlier period of this cohort of children.

The age pattern of growth wasting in this study population was quite similar to the age pattern of growth stunting with exception of plateau stunting curve after 24 months which was not the case on the wasting curve. It is very obvious that the weight deficit is regained soon after inhibiting factors have disappeared. In this particular study population, the percentage of days with diarrhea among children <24 months was 0.34% (95% CI= 0.27%, 0.41%) higher compared to that among children ≥ 24 months, while the percentage of days with acute respiratory infection among children < 24 months was 4% higher (95% CI= 3.2%, 4.8%) compared to that among children ≥ 24 months.[20] The high prevalence of infectious diseases and their interacted-nutrient intake deterioration during this period might have been associated with major growth deficit of this study population.

Maternal education has been shown to be associated with a variety of health outcome.[22] In this study population, mother's education was inversely associated with stunting; the higher maternal education the less likely their children to be stunted. The major behavioral pathways through which maternal education might enhance the health of children included greater protection against infection, primarily by means of improved hygiene; reduced susceptibility to infection, primarily through nutrition and immunization; enhanced recovery from infection, brought about by more effective domestic and external health care.[23]

Number of children < 5 years was also an important factor associated with stunting and wasting. In this study population, it has been reported that sib ship was inversely associated with the mean serum retinol.[24] Thus, the greater odds of being stunted among children living with other preschool children might represent an indirect association between stunting and vitamin A deficiency. However, it might also represent deficiency of other nutrients resulting from inability of the parents to feed more children resulting in a greater odds of being wasted.

Number of bedrooms might represent the level of crowding and socioeconomic status. Thus, number of bedrooms might indicate an indirect association between poor nutrient intake & high infection load and growth. Specifically, the less bedroom available in a family the more exposure to infection and the less nutrient intakes received by children, and might, therefore, the higher the odds of being stunted and wasted.

In rural areas of Indonesia, kitchen is usually thought as a part of the house which is less important than other parts. Thus, people tend to locate the kitchen on the back of the house, and sometimes it is separated from the main house. In population where most people (85%) use wood as cooking fuel, kitchen partition may represent more the quality of ventilation than socioeconomic status. It is not the availability of kitchen, rather the type of kitchen partition which could be more predictive for wasting. In this study population, children whose kitchen was from wood or bamboos were 1.5 to 2 times more likely to be protected from wasting than those children whose kitchen partition was from brick wall. These suggest that good ventilation leads to less infections resulting in less likely of children to be wasted. In studying the relationship between anthropometric characteristics and simple measures of wealth, Martorell[7] found that the most informative indicators was "the house score" which considered the presence or absence of a separate kitchen, a separate bedroom and a floor other than a dirt floor. There was a clear pattern, such that the poorer the quality of the house, the smaller the children.

Elementary school can be viewed as an infectious disease agent and/ or a health information agent. In Indonesia where health information are mostly provided in village health posts, elementary school may not as important as the center of health information. In other words, people may receive most health information not from elementary schools but from village health posts. It is in the schools where infectious diseases are easily to spread from one individual to another. It is also around the schools where food stalls marketing unhygienic foods for children usually exist. Thus in this study population, children who lived around elementary schools might have a higher exposure to infections than children who lived far from the schools. Therefore, school based-food stalls and school environmental health control may have to be improved to reduce exposure and transmission of infections.

In summary, we have found that the growth rate of Indonesian preschool children begins to deviate from the NCHS charts very early in life. The major growth deficit in length occurs during period of 6-24 months of age, but after 24 months of age the linear growth tends to be plateau. Thus the prevalence of stunting peaks in the second year of life and continues to be similar in the years after. The age pattern of ponderal growth is quite similar to the age pattern of linear growth except that the growth deficit is regained after 24 months of age, i.e. soon after inhibiting factors disappear. The period of 6-24 months of age is the period of active failure, and therefore, it is also the period in which one would expect the greatest impact of dietary or other interventions aimed specifically at growth faltering. This indicates that nutrition education needs to be reinforced to promote appropriate supplementary feeding practices in addition to preventive action from infectious diseases especially in communities with low socio-economic status.

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