Paediatrica Indonesiana

p-ISSN 0030-9311; e-ISSN 2338-476X; Vol.58, No.5(2018). p. 205-12; doi: http://dx.doi.org/10.14238/pi58.5.2018.205-12

Original Article

Risk factors of stunting in children aged 24-59 months

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Abstract

Background Childhood stunting (low height-for-age) still remains a global health problem because it increases the risk of disturbances in growth and development as well as mortality. The prevalence of stunting in Bali is 32.5%, with the highest in Gianyar District at 41%. However, little is known about the risk factors of stunting children in Gianyar.

Objective To investigate the risk factors of stunting in children aged 24-59 months in Gianyar.

Methods This cross-sectional study involved 166 children, collected consecutively, aged 24-59 months, who visited the integrated health posts in 13 community health centers in Gianyar District, Bali, from September to November 2016. Stunting is defined as -2SD below the WHO height-for-age *z*-score (HAZ), according to sex. Statistical analyses were done with Chi-square and multivariate logistic regression tests.

Results Of 166 subjects, 37 (22.3%) children were stunted. Multivariate analysis revealed that low paternal education (AOR 2.88; 95%CI 1.10 to 7.55; P=0.031), maternal height less than 150 cm (AOR 7.64; 95%CI 2.03 to 28.74; P=0.003), high risk maternal age (AOR 4.24; 95%CI 1.56 to 11.49; P= 0.005), low birth weight (AOR 5.09; 95%CI 1.03 to 25.31; P=0.047), and low birth length (AOR 9.92; 95%CI 1.84 to 53.51; P=0.008) were strongly associated with stunting.

Conclusion Risk factors for stunting in children are low paternal education, maternal height less than 150 cm, high risk maternal age, low birth weight, and low birth length. **[Paediatr Indones. 2018;58:205-12; doi: http://dx.doi.org/10.14238/pi58.5.2018.205-12]**.

Keywords: *stunting; children; risk factor*

Childhood stunting (low height-for-age) is one of the most significant health problems that should not be ignored in the public health realm. This kind of chronic malnutrition restricts a child's potential growth due to inadequate nutritional intake. Stunting, or being too short for one's age, is defined as below 2 standard deviations (SD) from the median height-for-age z-score (HAZ), as determined by the *World Health Organization* (WHO) Child Growth Standards.[1,2]

Globally, between 171 to 314 million children are stunted, located predominantly in African and Asian regions.[3,4] In 2010, 26.7% of children in Asia and also 26.7% in South East Asia were stunted.[5] According to the *Indonesian Basic National Health Survey* (*Riset Kesehatan Dasar*), the prevalence of stunting in Indonesia was 36.8% in 2007, decreased to 35.6% in 2010, and increased to 37.2% in 2013.[6-8]

Infants are a special population with a critical growth and development period.[9] Inadequate nutrition in infancy leads to problems later in life.

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Nutritional problems such as stunting can also be harmful to infants because it can lead to emotional, social and cognitive development problems in adulthood. In addition, childhood stunting increases the risk of mortality, deficits in cognitive function, poor motor development, and loss of physical growth potential.[10,11] The long-term consequences of stunting in children can lead to disproportions of body stucture, unfulfilled academic potential, poor reproductive health, and increased risk of infection.[12]

Studies on stunting risk factors in developing countries have yielded diverse results and site differences. Thus, the risk factors for stunting remain inconclusive.[13] A previous study reported that severe household food insecurity and lower socio-economic status were significant contributors to stunting incidence in Southeastern Kenya.[14] In addition, another study in Nepal showed that low family income and prolonged breastfeeding for more than 12 months were significant risk factors for stunting.[15] A study in India showed that maternal education, age, and body mass index (BMI) were associated with stunting.[4] To our knowledge, there is lack of national data concerning stunting determinants in Indonesia.

The prevalence of stunting in Bali is 32.5%, with the highest prevalence in the Gianyar District (41%).[16] This figure was higher compared to both national and global reports, thus, stunting remains an important issue to be tackled.[1,8] There is a lack of data regarding the risk factors for stunting in Balinese children, particularly in the Gianyar District. Therefore, to better understand stunting and the risk factors associated with stunting, we conducted this study among children aged 24-59 months in the Gianyar District of Bali.

Methods

This cross-sectional, analytic study was conducted from September to November 2016. We consecutively included 166 children aged 24-59 months who had attended the growth monitoring program in integrated health posts (Posyandu) at thirteen community health centers (Puskesmas) in the Gianyar District, Bali, during the study period. Children who resided in the district, lived with their parents, and had maternal and child health books (*Buku Kesehatan Ibu dan Anak*/KIA), as well as health record cards (*Kartu Menuju Sehat*/KMS) published by the Ministry of Health, Republic of Indonesia were included in the study. However, those with mental disorders, disabilities, or whose mothers refused consent were excluded.

Subjects' data were obtained from anthropometry measurements and interviews using questionnaires. Primary data were obtained to determine socio-demographic items consisting of age, sex, highest level of education, monthly family income, and parity. The secondary data were obtained from the KIA book and KMS record to elicit maternal health, birth information, and the development of infant growth from birth to 5 years of age. Also included were maternal height, mid-upper arm circumference, gestational age, birth weight and length, exclusive breastfeeding status, and immunization records. Children's heights were measured with head facing forward and standing in an upright position without footwear, using a *One Med®* microtoise with 1 mm accuracy.

The dependent variable was the classification of stunting and non-stunting. Stunting was defined as WHO HAZ below -2 SD, according to sex.[1,8] Independent variables for parents were education level, family income, maternal height, mid-upper arm circumference, maternal age, parity, and gestational age; variables for children were sex, age, birth order, birth weight, birth length, exclusive breastfeeding, and immunization status. Parental education level was defined as low if the highest education completed was below high school. Family income category was based on the monthly minimum wage of Gianyar (*Upah Minimum Kabupaten*/UMK), which was IDR 1,904,141 in 2016.17 Maternal height was categorized as short if <150 cm.[8] Mid-upper arm circumference was small if ≤ 23.5 cm.[8] High risk maternal age at pregnancy was defined as less than 20 or more than 35 years.[8] Gestational age was categorized as preterm for 37 weeks, and parity was categorized as less than or equal to 2.[8] Birth order of children was categorized as first or not first. Low birth weight was defined as birth weight $<2,500$ grams, and low birth length as <48 cm.[8] The children were considered to not have received exclusive breastfeeding if stopped before 6 months of age. Immunization status was incomplete if the children had missed one or more of the following: BCG, DPT, polio, measles, and hepatits B vaccine.[8]

The questionnaires, secondary data from samples, and anthropometric data were then analyzed using *SPSS version 20* software. Descriptive analysis was used to show the frequency of variables and mean differences. Chi-square bivariate test and odds ratio (OR) were performed to assess the relationship between possible risk factors and stunting, whereas multivariate analysis by logistic regression was used to calculate the adjusted odds ratio (AOR) for defined variables that were significant by Chi-square analysis. The results were considered statistically significant for P<0.05 with 95% confidence interval (95%CI). The study was approved by the Ethics Committee of Universitas Udayana Medical School/Sanglah Hospital, Denpasar, Bali.

Results

This study involved a total of 166 children aged 24-59 months who had visited one of thirteen community health centers in Gianyar District, Bali. The majority of subjects were male (54.2%) and in the age range of 24-35 months (41.6%). Thirty-seven (22.3%) children were stunted, based on their HAZ. There was no significant difference in ages of stunted vs. non-stunted subjects (P=0.64). The baseline characteristics of subjects and parents are shown in **Table 1**.

Table 1. Sociodemographic characteristics of parents and children

Characteristics	Total (N=166)	P value
Parents		
Paternal education, n (%)		
Low	45 (27.1)	
High	121 (72.9)	
Maternal education, n (%)		
Low	61 (36.7)	
High	105 (63.3)	
Family income, n (%)		
< *UMK*	41 (24.7)	
≥ *UMK*	125 (75.3)	
Maternal height, n (%)		
Short (<150 cm)	13 (7.8)	
Normal (≥150 cm)	153 (92.2)	
Mid-upper arm circumference, n (%)		
Small (≤ 23.5 cm)	8 (4.8)	
Normal (> 23 cm)	158 (95.2)	
Maternal age, n (%)		
High risk (< 20 or > 35 years)	30 (18.1)	
Ideal (20 – 35 years)	136 (81.9)	
Parity, n (%)		
≤ 2	139 (83.7)	
> 2	27 (16.3)	
Gestational age, n (%)		
Preterm (< 37 weeks)	16 (9.6)	
Full term (≥ 37 weeks)	150 (90.4)	
Children		
Sex, n (%)		
Male	90 (54.2)	
Female	76 (44.8)	
Age, n (%)		
24-35 months	69 (41.6)	
36-47 months	53 (31.9)	
48-59 months	44 (26.5)	
Birth order, n (%)		
First	76 (45.8)	
Not first	90 (54.2)	
Birth weight, n (%)		
Low (< 2,500 grams)	11 (6.6)	
Normal (≥ 2,500 grams)	155 (93.4)	
Birth length, n (%)		
Low (< 48 cm)	7 (4.2)	
Normal (≥ 48 cm)	159 (95.8)	
Exclusive breastfeeding, n (%)		
No	8 (4.8)	
Yes	158 (95.2)	
Immunization status, n (%)		
Incomplete	9 (5.4)	
Complete	157 (94.6)	
Height-for-age, n (%)		
Stunted (< -2 SD)	37 (22.3)	
Non-stunted (≥ -2 SD)	129 (77.7)	
Mean age (SD), months		
Stunted	39.84 (10.20)	0.64
Non-stunted	38.91 (10.51)	
Mean height (SD), cm		
Stunted	87.71 (8.78)	<0.001*
Non-stunted	95.80 (7.57)	

UMK (*Upah Minimum Kabupaten*)=district minimum wages ; *statistically significant

Bivariate analysis was used to compare nutritional status (stunted and non-stunted) and the independent variables (possible risk factors). It revealed that low paternal education (OR 2.63; 95%CI 1.22 to 5.68; P=0.012), low maternal education (OR 2.53; 95%CI 2.12 to 5.32; P=0.013), short maternal height (OR 4.78; 95%CI 1.5 to 15.28; P=0.04), high risk maternal age (OR 4.3; 95%CI 1.85 to 10; P < 0.001), low birth weight (OR 7.29; 95%CI 2 to 26.53; P= 0.001), low birth length (OR 9.92; 95%CI 1.84 to 53.5; P=0.01), and didn't receive exclusive breastfeeding (OR 6.56; 95%CI 1.49 to 28.9; P=0.05) were statistically significant. However, variables such as small mid-upper arm crcumference, parity ≤ 2, preterm birth, child sex, birth order, and incomplete immunization status were not associated with stunting (**Table 2**). The following variables were significant or had P values < 0.25, and were further analyzed using the logistic regression model: low paternal education (P=0.012), low maternal education (P=0.013), short

Table 2. Possible risk factors of stunting based on bivariate analysis

Variables	Nutritional status		OR	95%CI	P value
	Stunted (n=37)	Non-stunted (n=129)			
Paternal education, n (%)					
Low	16 (35.6)	29 (64.4)	2.63	1.22 to 5.68	0.012*†
High	21 (17.4)	100 (82.6)			
Maternal education, n (%)					
Low	20 (32.8)	41 (67.2)	2.53	2.12 to 5.32	0.013*†
High	17 (16.2)	88 (83.8)			
Family income, n (%)					
< UMK	12 (29.3)	29 (70.7)	1.66	0.74 to 3.70	0.216†
≥ UMK	25 (20)	100 (80)			
Maternal height, n (%)					
Short (<150 cm)	7 (53.8)	6 (46.2)	4.78	1.50 to 15.28	0.004*†
Normal (≥150 cm)	30 (19.6)	123 (80.4)			
Mid-upper arm circumference, n (%)					
Small (≤ 23.5 cm)	1 (12.5)	7 (87.5)	0.48	0.06 to 4	0.495
Normal (> 23 cm)	36 (22.8)	122 (77.7)			
Maternal age, n (%)					
High Risk (< 20 and > 35 years old)	14 (46.7)	16 (53.3)	4.3	1.85 to 10	< 0.001*†
Ideal (20-35 years old)	23 (16.9)	113 (83.1)			
Parity, n (%)					
≤ 2	33 (23.7)	106 (76.3)	1.79	0.58 to 5.55	0.308
> 2	4 (14.8)	23 (85.2)			
Gestational age, n (%)					
Preterm (< 37 weeks)	5 (31.2)	11 (68.8)	1.67	0.54 to 5.17	0.365
Full term (≥ 37 weeks)	32 (21.3)	118 (78.7)			
Child sex, n (%)					
Male	16 (21.1)	60 (78.9)	0.88	0.42 to 1.83	0.725
Female	21 (23.3)	69 (76.7)			
Birth order, n (%)					
First	17 (22.4)	59 (77.6)	1	0.48 to 2,10	0.982
Not first	20 (22.2)	70 (77.8)			
Birth weight, n (%)					
Low (< 2,500 grams)	7 (63.6)	4 (36.4)	7.29	2 to 26.53	0.001*†
Normal (≥ 2,500 grams)	30 (19.4)	125 (80.6)			
Birth length, n (%)					
Low (< 48 cm)	5 (71.4)	2 (28.6)	9.92	1.84 to 53.5	0.001*†
Normal (≥ 48 cm)	32 (20.1)	127 (79.9)			
Exclusive breastfeeding, n (%)					
No	5 (62.5)	3 (37.5)	6.56	1.49 to 28.92	0.005*†
Yes	32 (20.3)	126 (79.7)			
Immunization status, n (%)					
Incomplete	3 (33.3)	6 (66.7)	1.8	0.43 to 7.60	0.413
Complete	34 (21.7)	123 (78.3)			

*Statistically significant; P value is based on bivariate analysis using Chi-square test
†Possible risk factors with P<0.25 were included in multivariate analysis model using logistic regression

maternal height (P=0.04), high risk maternal age (P < 0.001), low birth weight (P=0.001), low birth length (P=0.01), not exclusively breastfed (P=0.05), and family income < UMK (P=0.216).

Multivariate analysis revealed that low paternal education (AOR 2.88; 95%CI 1.10 to 7.55; P=0.031), short maternal height < 150 cm (AOR 7.64; 95%CI 2.03 to 28.74; P=0.003), high risk maternal age at pregnancy (AOR 4.24; 95%CI 1.56 to 11.49; P=0.005), low birth weight (AOR 5.09; 95%CI 1.03 to 25.31; P=0.047), and low birth length (AOR 9.92; 95%CI 1.84 to 53.51; P=0.008) were strongly associated with stunting (**Table 3**).

Table 3. Multivariate analysis of risk factors of stunting

Variables	Adjusted OR	95% CI	P value
Paternal education	2.884	1.10 to 7.55	0.031**
Maternal education	1.241	0.47 to 3.25	0.660
Maternal height	7.640	2.03 to 28.74	0.003**
Maternal age	4.239	1.56 to 11.49	0.005**
Birth weight	5.092	1.03 to 25.31	0.047**
Birth length	9.92	1.84 to 53.51	0.008**
Ecxlusive breastfeeding	2.795	0.40 to 19.66	0.302

** Statistically significant; P value is based on multivariate analysis model using logistic regression

Discussion

Childhood stunting is a type of malnutrition with potentially irreversible outcomes due to poor nutritional intake. It often goes unrecognized in communities. Stunting has long-term effects beyond the individuals, as societies are affected by by populations of people with lack of cognitive skill, delayed physical development, and risk of chronic diseases.[1] We found stunting in 37 out of 166 subjects (22.3%). This finding was quite different compared to the data based on Riskesdas in 2013 (41%). The factor that might contributted in declining the proportion of stunting was the intervention performed by either local government or Puskesmas, and Posyandu after the high prevalence finding, such as Local Action Planning (*Recana Aksi Daerah*), education and training for health workers in puskesmas and posyandu towards the community. Gianyar District is also included in 100 priority areas in Indonesia to combat stunting.[18]

Our results on the correlation of low paternal education to stunting in children are supported by other studies. Two studies in West and Central Java reported that paternal education was a risk factor of poor nutritional status in children, leading to stunting.[19,20] A Bogor study found that parents with higher education may have better understanding of children's nutritional requirements, growth, and development, which may lead to provide better care of their children.[21] This finding was also supported by the *World Health Organization (WHO) Conceptual Framework on Childhood Stunting* that noted poor care practices and low caregiver education as causes of stunting in children.[22]

Short maternal stature was also a risk factor for stunting prevalence noted by the WHO,[22] similar to our study. Several studies in Indonesia also reported that maternal height contributed to stunting prevalence.[20,23,24] Studies revealed that short maternal stature was associated with growth failure in children, and short mothers tended to have stunted children at 2 years.[25] The interaction between maternal stature and linear growth of children is likely due to genetics and environmental aspects overseen by mothers, such as hygiene, adequate nutritional intake, and reproductive health.[25,26] Mothers with short stature might have inadequate anatomical and metabolic systems which may affect maternal and fetal health, such as lower glucose level, or decreased protein and energy. These conditions may lead to intrauterine growth restriction, which also plays a role in short stature in children.[25,27,28]

Child nutritional status also can be influenced by maternal age. Young maternal age at childbearing was associated with increased risk of preterm birth, intrauterine growth restriction, mortality of both infant and mother, and undernutrition.[29] Young mothers also generally had lower nutritional status than older mothers, thus manifesting as low pre-pregnancy weight (under 50 kg) and/or weight gain during pregnancy of less than 10 kg.[30] Less than ideal maternal nutritional status can increase the risk in having a low birth weight child, which makes them prone to stunting.[31] On the other hand, older mothers also have higher pregnancy risk, increased risk of stillbirth, preterm birth, intrauterine growth restriction, and chromosomal abnormality.[29] We found a significant association between stunting and high risk maternal age (<20 years or >35 years old).

Our study found that low birth weight and length had significant associations with stunting. Indonesian studies by Kuntari,[32] Oktarina & Sudiarti,[24] and Rahayu[33] also showed a significant association between low birth weight and stunting. Birth weight is an important predictor of child body size in the next phase of their growth and development.[34] Children with low birth weight (under 2,500 grams) have higher risk of malnutrition, infection, and degenerative diseases. Malnutrition and infection may negatively affect growth and development and increase child morbidity later in life.[35] Rahayu *et al.* found that low birth length was significantly associated with stunting prevalence in children aged 6-12 months. However in children aged 36-48 months, low birth length was not significantly associated with stunting prevalence. This condition may be because low birth length may have a greater effect at early ages, but be overcome to result in normal growth later on.[33] Another study by Utami *et al.* in Bogor showed that low birth length had a significant association with children aged 0-23 months. This circumstance may be due to genetic factors or poor maternal nutritional status during pregnancy.[36]

Breast milk is recognized as essential feeding for infants for the first six months of life. The *WHO* and the *Indonesian Ministry of Health* recommend exclusive breastfeeding, because it provides adequate nutrition and has advantages over formula, such as in developing brain function, increased immune system function, and enhancing infant growth and development.[37] Our study showed that lack of exclusive breastfeeding had an association with stunting, based on bivariate analysis. The WHO framework of child stunting stated that inadequate breastfeeding, such as non-exclusive breastfeeding, delayed initiation, or early cessation of breastfeeding are significantly associated with stunting cases.[38] Indonesian studies also showed that non-exclusive breastfeeding increased the risk of stunting.[33,39] However, in our study, lack of exclusive breastfeeding was not a significant risk factor for stunting by multivariate analysis.

The limitations of this study were the cross-sectional design which does not reveal causal relationships between the variables. In addition, several variables that might be significant risk factors for stunting in children were not investigated in this study, such as infectious disease (diarrhea, helminth infection, or upper respiratory tract infection), sanitation of the house and environment, supplemental feeding, and parental knowledge on child nutrition. Thus, we suggest future studies with better methodologies, larger sample size, and more variables. Further studies are needed to combat and eradicate stunting by intervening to reduce the risk factors.

In conclusion, the proportion of stunted children aged 24-59 months in Gianyar District is 22.3%. Low paternal education, short maternal height, high risk maternal age, low birth weight, and low birth length are significantly associated with stunting.

Conflict of interest

None declared.

Funding acknowledgment

This work was supported by the Research and Development Unit (Unit Penelitian dan Pengembangan), Udayana University Medical School, Bali, Denpasar.

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