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.

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.
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.\textsuperscript{10,11} The long-term consequences of stunting in children can lead to disproportions of body structure, unfulfilled academic potential, poor reproductive health, and increased risk of infection.\textsuperscript{12}

Studies on stunting risk factors in developing countries have yielded diverse results and site differences. Thus, the risk factors for stunting remain inconclusive.\textsuperscript{13} A previous study reported that severe household food insecurity and lower socio-economic status were significant contributors to stunting incidence in Southeastern Kenya.\textsuperscript{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.\textsuperscript{15} A study in India showed that maternal education, age, and body mass index (BMI) were associated with stunting.\textsuperscript{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\%).\textsuperscript{16} This figure was higher compared to both national and global reports, thus, stunting remains an important issue to be tackled.\textsuperscript{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.\textsuperscript{1,8} Independent variables for parents were education level, family income, maternal height, mid-upper arm circumference, gestational 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.\textsuperscript{17} Maternal height was categorized as short if <150 cm. Mid-upper arm circumference was small if ≤ 23.5 cm. High risk maternal age at pregnancy was defined as less than 20 or more than 35 years. Gestational age was categorized as preterm for 37 weeks, and parity was categorized as less than or equal to 2.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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)     |         |
| $\geq$ UMK                                    | 125 (75.3)    |         |
| Maternal height, n (%)                       |               |         |
| Short (<150 cm)                              | 13 (7.8)      |         |
| Normal ($\geq$150 cm)                        | 153 (92.2)    |         |
| Mid-upper arm circumference, n (%)           |               |         |
| Small ($\leq$ 23.5 cm)                       | 8 (4.8)       |         |
| Normal ($>$ 23 cm)                           | 158 (95.2)    |         |
| 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)     |         |
| Parity, n (%)                                |               |         |
| First                                        | 76 (45.8)     |         |
| Not first                                     | 90 (54.2)     |         |
| Birth weight, n (%)                          |               |         |
| Low ($<$ 2,500 grams)                        | 11 (6.6)      |         |
| Normal ($\geq$ 2,500 grams)                  | 155 (93.4)    |         |
| Birth length, n (%)                          |               |         |
| Low ($<$ 48 cm)                              | 7 (4.2)       |         |
| Normal ($\geq$ 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 ($\geq$ -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 circumference, 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** |
| Exclusive 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 contributed 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 childbirth 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, Oktarina & Sudiarti, and Rahayu 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. 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. 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. 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.

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. 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. Indonesian studies also showed that non-exclusive breastfeeding increased the risk of stunting. 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.

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References
1. World Health Organization. WHA global nutrition targets 2025: stunting policy brief. Geneva: WHO; 2014. p.1-6.
2. World Health Organization. Nutrition Landscape Information System (NLIS) country profile indicators: interpretation guide. Geneva: WHO; 2010. p. 1.
3. Prendergast AJ, Humphrey JH. The stunting syndrome in developing countries. Paediatr Int Child Health. 2014;34:250-65.
4. Fenske N, Burns J, Hothorn T, Rehfuess EA. Understanding child stunting in India: a comprehensive analysis of socio-economic, nutritional, and environmental determinants using additive quantile regression. PLoS One. 2013;8:e78692.
5. de Onis M, Blössner M, Borghi E. Prevalence and trends of stunting among pre-school children, 1990–2020. Public Health Nutr. 2012;15:142-8.
6. Badan Penelitian dan Pengembangan Kesehatan, Kementrian Kesehatan RI. Riset Kesehatan Dasar (Riskesdas) 2007. Jakarta: Kemenkes RI; 2008. p. 34-7.
7. Badan Penelitian dan Pengembangan Kesehatan, Kementrian Kesehatan, Kementrian
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Kesehatan RI. Riset Kesehatan Dasar (Risksdas) 2010. Jakarta: Kemenkes RI; 2010. p. 18-22.
8. Badan Penelitian dan Pengembangan Kesehatan, Kementrian Kesehatan RI. Riset Kesehatan Dasar (Risksdas) 2013. Jakarta: Kemenkes RI; 2013. p. 212-3.
9. Nurliyana AR, Mohd Shariff Z, Mohd Taib MN, Gan WY, Tan KA. Early nutrition, growth and cognitive development of infants from birth to 2 years in Malaysia: a study protocol. BMC Pediatr. 2016;16:160.
10. Purnama D, Raksanagara A, Arisanti N. The correlation between maternal behavior in feeding and parenting towards nutritional status of children at Sukaresmi District Garut Regency [thesis]. Pustaka Unpad: Padjajaran University; 2016.
11. de Onis M, Branca F. Childhood stunting: a global perspective. Matern Child Nutr. 2016;12:12-26.
12. Dewey KG, Begum K. Long-term consequences of stunting in early life. Matern Child Nutr. 2011;7:5-18.
13. Prawirohartono EP, Nurdiati D, Hakimi M. Prognostic factors at birth for stunting at 24 months of age in rural Indonesia. Paediatr Indones. 2016;56:48–56.
14. Shinsugi C, Matsumura M, Karama M, Tanaka J, Changoma M, Kaneko S. Factors associated with stunting among children according to the level of food insecurity in the household: a cross-sectional study in a rural community of Southeastern Kenya. BMC Public Health. 2015;15:441.
15. Tiwari R, Ausman LM, Agho KE. Determinants of stunting and severe stunting among under-fives: evidence from the 2011 Nepal Demographic and Health Survey. BMC Pediatr. 2014;14:239.
16. Badan Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan Republik Indonesia. Riset Kesehatan Dasar dalam Angka Provinsi Bali. Jakarta; Kemenkes RI: 2013. p.253 - 254
17. Gubernur Bali. Peraturan Gubernur Bali Nomor 1 Tahun 2016 tentang Upah Minimum Kabupaten/Kota. Bali; 2016. p. 1-5.
18. Tim Nasional Percepatan Penangulangan Kemiskinan (TNPPK). 100 kabupaten/kota prioritas untuk intervensi anak kerdil (Stunting). Vol. 2. Jakarta; 2017. p. 441.
19. Linda O. Hubungan pendidikan dan pekerjaan orangtua serta pola asuh dengan status gizi balita di Kota dan Kabupaten Tangerang, Banten. Prosiding Penelitian Bidang Ilmu Ekstaksa 2011 [serial on the Internet]. 2011 [cited 2017 Aug 18];134–41:[about 5 p.]. Available from:http://www.stkipislambumiayu.ac.id.ac.id.
20. Nasikah R, Margawati A. Faktor risiko kejadian stunting pada balita usia 24-36 bulan di Kecamatan Semarang Timur. J Nutr Coll. 2012;1:176-84.
21. Astani LD, Nasoetion A, Dwiriana CM. Hubungan karakteristik keluarga, pola pengasuhan, dan kejadian stunting anak usia 6-12 bulan. Med Gizi Keluarga. 2005;29:40–6.
22. Stewart CP, Iannotti L, Dewey KG, Michaelsen KF, Onyango AW. Contextualising complementary feeding in a broader framework for stunting prevention. Matern Child Nutr. 2013;9:27-45.
23. Hanum F, Khomsan A, Heryatno Y. Hubungan asupan gizi dan tinggi badan ibu dengan status gizi anak balita. J Gizi Pangan. 2014;9:1-6.
24. Oktarina Z, Sudiarti T. Faktor risiko stunting pada balita (24-59 bulan) di Sumatera. J Gizi Pangan. 2014;8:175-80.
25. Sinha B, Taneja S, Chowdhury R, Mazumder S, Rongsen-Chandola T, Upadhayay RP; et al. Low-birthweight infants born to short-stature mothers are at additional risk of stunting and poor growth velocity: evidence from secondary data analyses. Matern Child Nutr. 2018;14:1-9.
26. Addo OY, Stein AD, Fall CH, Gigante DP, Gunupalli AM, Horta BL, et al. Maternal height and child growth patterns. J Pediatr. 2013;163:549-54.
27. Murphy VE, Smith R, Giles WB, Clifton VL. Endocrine regulation of human fetal growth: the role of the mother, placenta, and fetus. Endocr Rev. 2006;27:141-69.
28. Lowy C. Regulation of intrauterine growth: the role of maternal health. Horm Res. 1994;42:203-6.
29. Fall CHD, Sachdev HS, Osmond C, Restrepo-Mendez MC, Victoria C, Martorell R, et al. Association between maternal age at childbirth and child and adult outcomes in the offspring: a prospective study in five low-income and middle-income countries (COHORTS collaboration). Lancet Glob Health. 2015;3:e366-77.
30. Institute of Medicine and National Research Council. Weight gain during pregnancy: reexamining the guidelines. Rasmussen KM, Yaktine AL, editors. The National Academic Press. Washington (DC): The National Academic Press; 2009. p. 1250-3.
31. Dewey KG. Reducing stunting by improving maternal, infant and young child nutrition in regions such as South Asia: evidence, challenges and opportunities. Matern Child Nutr. 2016;12:27-38.
32. K Kuntari T, Jamil NA, Kurniati O. Faktor Risiko Malnutrisi pada Balita. Kesmas: National Public Health Journal. 2013;7:572–6. 3United Nations Children’s Fund and World Health Organization. Low birthweight: country, regional and global estimates. UNICEF. New York; 2004. p. 1-31.
33. Rahayu LS, Sofyaningsih M. Pengaruh BBLR (berat badan lahir rendah) dan pemberian ASI eksklusif terhadap
perubahan status stunting pada balita di Kota dan Kabupaten Tangerang Provinsi Banten. In: Seminar Nasional Peran Kesehatan Masyarakat dalam Pencapaian MDG’s di Indonesia. 2011 Apr 12. p. 160-9.

34. United Nations Children’s Fund and World Health Organization. Low Birthweight: Country, regional and global estimates. UNICEF New York; 2004. p. 1-31

35. Alderma H, Shekar M. Nutrition, food security, and health. In: Kliegman RM, et al. Nelson textbook of pediatrics. 19th ed. Philadelphia: Elsevier Saunders; 2011. p.170-8

36. Utami NH, Rachmalina R, Irawati A, Sari K. Short birth length, low birth weight and maternal short stature are dominant risks of stunting among children aged 0-23 months: Evidence from Bogor longitudinal study on child growth and development, Indonesia. Mal J Nutr. 2018;24:11-23.

37. Martin CR, Ling PR, Blackburn GL. Review of infant feeding: key features of breast milk and infant formula. Nutrients. 2016;8:279.

38. World Health Organization. Stunted growth and development [framework leaflet]. 2017 [cited 2017 Nov 25]. Available from: www.who.int/nutrition/childhood_stunting_framework_leaflet_en.pdf.

38. Al-rahmad AH, Miko A, Hadi A. Kajian stunting pada anak balita ditinjau dari pemberian ASI eksklusif, MP-ASI, status imunisasi dan karakteristik keluarga di Kota Banda Aceh. J Kes Ilm Nasuwakes. 2013;6:169-84.