Risk Factors of Stunting in Children Aged 6-59 Months: A Case-Control Study in Horticulture Area

Prayudhy Yushananta[1], Mei Ahyanti[1], Yetti Anggraini[1]

[1]Assistant Professor, Tanjungkarang Health Polytechnic

Abstract

Background. Stunting is a critical public health problem in Indonesia because it affects cognitive and physical development and contributes to child mortality. This study aims to identify risk factors for stunting in children aged 6-59 in the horticultural area. **Methods.** A case-control study was conducted to compare previous exposure between stunted children and non-stunted children. Measurements and interviews were conducted with 160 participants (120 controls and 40 cases), including mothers or caregivers. SPSS was used for X2 statistical analysis, multiple logistic regression, and odds ratios. **Results.** The study identified four risk factors for stunting: children who were born short (AOR = 17.57; 95% CI: 5.02-61.51), LBW (AOR = 4.35; 95% CI: 1.38-13, 78), and got a low protein intake (AOR = 4.96; 95% CI: 1.22-20.26). Significantly, a relationship between stunting and access to sanitation was also found (AOR = 6.06; 95% CI: 1.25-29.35). **Conclusion.** The risk factors for stunting in children aged 6-59 are related to nutrition during pregnancy and the child's quality of food. Nutrition interventions should emphasize improving the nutritional status of pregnant women and children and women empowering to affect access to resources and allocations for children's nutrition.

Keyword: *Stunting, birth lenght, LBW, horticulture, under-five*

Introduction

Malnutrition is a critical public health problem for children under five in developing countries, including Indonesia. Malnutrition is due to many interrelated factors and has detrimental health effects in the short and long term [1,2]. Malnutrition will affect children's cognitive and physical development, increase the risk of infection, and significantly contribute to child morbidity and mortality [3–6]. The high indicators of malnutrition in a country reflect children's low nutritional status and health under five [2,7]. Three extensively recognized indicators of children's nutritional status are stunting, wasting, and underweight, and stunting indicates chronic malnutrition form [1,2,6,8–11]. A stunted child if their height for age is more than two standard deviations below the median of the World Health Organization (WHO) 2005 [2,12].

Stunting is the best measure of malnutrition in childhood, a predictor for long-term morbidity and mortality, and long-term societal costs [13]. Children who suffer from stunting will grow into adults at risk of obesity, glucose tolerance, coronary heart disease, hypertension, osteoporosis, decreased performance, and productivity [2,5,6,10,11,13,14].

Globally, in 2025, malnutrition contributes to at least half of all deaths each year in children under five [7,13,15]. In 2025, estimating 127 million will be stunted [16]. Prevalence was greater in developing countries, especially in South Asia and Africa [15–17]. In Indonesia, the stunting prevalence was 30.8%, consisting of 11.5% very short and 19.3% short.

Corresponding author:
Prayudhy Yushananta
Soekarno Hatta Street Number 6, Bandar Lampung, Lampung. Indonesia
E-mail:prayudhyyushananta@gmail.com

Many factors are associated with stunting. Several studies reported socioeconomic inequality, geographic differences, practices of feeding, food insecurity, education, and childhood morbidity, infection, and environmental [3–6,11]. Stunting is also associated with micronutrient deficiencies, such as protein, iron, zinc, calcium, and vitamins D, A, and C [15]. There are limited research reports on risk factors for stunting, especially in horticultural farming areas. In the study area (Liwa City), the risk factors for stunting in children aged 24-59 months have not been studied. It is crucial to identify risk factors for stunting to overcome the problem of stunting and its consequences. The study aimed to identified risk factors for stunting among children under five in horticultural farming areas.

Methods

A case-control study was conducted in Liwa City, West Lampung Regency, to compare previous exposures between stunted children (cases) and non-stunting (controls). This research was conducted after obtaining approval from the Health Research Ethics Committee, Tanjungkarang Health Polytechnic(No.261/KEPK-TJK/V/2020). Guided by the Helsinki protocol, informed consent was taken, and data handling was confidential. No risk of harm would be to the participants, and participants have the right to withdraw during the study. All study procedures were described before the interview.

The study was conducted from July to August 2020. Children aged 6-59 months with a mother or caregiver who lived for at least six months in the study area were included. Children without mothers or caregivers, children who appeared to have physical disabilities, children whose exact age was unknown were excluded from the study. Controls selected from the case's nearby neighbor who was of the same age. If multiple controls are found, they are randomly selected. The exposure considered was parenting (32,9%). Assuming 95% CI, 90% power, control to case ratio 3: 1, the total sample size is 160 (120 controls dan 40 cases).

Data were collected from measurements and interviews using a questionnaire. Data were entered into SPSS (24.0) after checked for completeness, edited, coded. The analysis used the Chi-square, Crude OR, andMultiple Logistic Regression analysis.

Results

A total of 160 (120 controls and 40 cases) children aged 6-59 months and their mothers or caregivers participated in the study. Nobody dropped out during the study period, so the participation rate was 100%. The number of samples was boys and girls almost equal (Table 1), and most were in the 6-23 month age group (73.13%). The majority of mothers or caregivers have completed junior high school (71.25%), they do not work (60.0%), and the family income is low (81.25%).

Table 1. Sociodemographic characteristic

Variables	Case (%)	Control (%)	p-value
	(n=40)	(n=120)	
Sex of childs			
Female	22 (55,0)	54 (45,0)	0,361
Male	18 (45,0)	66 (55,0)	
Age of childs (months)			
6-23	29 (73,5)	88 (73,3)	1,000
24-59	11 (27,5)	32 (26,7)	

Cont... **Table 1. Sociodemographic characteristic**

Family's income			
Low	35 (87,5)	95 (79,2)	0,350
Medium to hight	5 (12,5)	25 (20,8)	
Mother's level education			
Low	18 (45,0)	28 (23,3)	0,02
Hight	22 (55,0)	92 (76,7)	
Mother's labour status			
Work	17 (42,5)	47 (39,2)	0,85
Not work	23 (57,5)	73 (60,8)	

Although the majority was normal (Table 2), we found about 19 (47.5%) of children in the case group and 4 (3.3%) in the control group were born stunted. There were also 13 (32.5%) children in the case group and 9 (7.5%) in the control group born with low birth weight. Complete immunization was obtained by about 36 (90.0%) children in the case group and 92 (76.7%) in the control group. Almost all (90.63%) children in the case and control groups received adequate protein intake. However, around 24 (60%) in the case group and 59 (49.2%) lacked parenting.

Table 2. Health and child feeding characteristic

Variables	**Case (n=40)**	**Control (n=120)**	**p-value**
	Number (%)	Number (%)	
Birth length			
Low	19 (47,5)	4 (3,3)	<0,01
Normal	21 (52,5)	116 (96,7)	
Birth wight			
Low	13 (32,5)	9 (7,5)	<0,01
Normal	27 (67,5)	111 (92,5)	
Immunization			
Incomplete	4 (10,0)	28 (23,3)	0,110
Complete	36 (90,0)	92 (76,7)	
Protein intake			
Low	10 (25,0)	5 (4,2)	<0,01
Adequate	30 (75,0)	115 (95,8)	
Parenting			
Lack	24 (60,0)	59 (49,2)	0,315
Normal	16 (40,0)	61 (50,8)	

Almost all children in the case group (95.0%) and the control group (97.5%) were found in homes with access to safe drinking water. However, about 7 (17.5%) children in the case group and 4 (3.3%) in the control group were found in homes without access to healthy sanitation, as Table 3 shows.

Table 3. Environmental characteristic

Variables	Case (n=40)	Control (n=120)	p-value
	Number (%)	Number (%)	
Acces to safe drinking water			
No-acces	2 (5,0)	3 (2,5)	0,793
Acces	38 (95,0)	117 (97,5)	
Acces to health sanitation			
No-acces	7 (17,5)	4 (3,3)	0,007
Acces	33 (82,5)	116 (96,7)	

Only 4 of the 12 variables associated with stunting ($p < 0.05$) were shown from multiple logistic regression analysis (Table 4). Interaction tests were also carried out, but none of them showed interactions between variables. The fit model is shown by the Homers and Lemeshow test obtained (p-value = 0.253).

The proportion of children born shortly was significantly higher in the case group than in the control group. Low birth length (boy less than 46.1 cm, and girl less than 45.6 cm) was found to be a risk factor for stunting (adjusted odds ratio (AOR) = 17.57; 95% confident interval (CI): 5.02-61.51). Birth weight less than 2500 grams was also a risk factor for stunting (AOR = 4.35; 95% CI: 1.38-13.78). The proportion of children with low protein intake was higher in the case group than in the control group (AOR = 4.96; 95% CI: 1.22-20.26). We also found a statistically significant relationship between house access to sanitation and stunting (AOR = 6.06; 95% CI: 1.25-29.35). This study found that the dominant variable related to stunting was the low birth length.

Table 4. Risk factor for stunting

Variables	Case (n=40)	Control (n=120)	Cruide OR (95%CI)	Adjusted OR (95%CI)
	Number (%)	Number (%)		
Birth length				
Low	19 (47,5)	4 (3,3)	26,24 (8,11-84,89)	17,57 (5,02-61,51)
Normal	21 (52,5)	116 (96,7)	1	1
Birth wight				
Low	13 (32,5)	9 (7,5)	5,94 (2,30-15,33)	4,35 (1,38-13,78)
Normal	27 (67,5)	111 (92,5)	1	1
Protein intake				
Low	10 (25,0)	5 (4,2)	7,67 (2,43-24,12)	4,96 (1,22-20,26)
Aquate	30 (75,0)	115 (95,8)	1	1
Acces to health sanitation				
No-acces	7 (17,5)	4 (3,3)	6,15 (1,69-22,3)	6,06 (1,25-29,35)
Acces	33 (82,5)	116 (96,7)	1	1

Discussion

Of all the factors studied, the length of birth showed the dominant risk factor for stunting in horticulture farming areas. The results confirm Islam, that low birth length and LBW are relationships with stunting [17]. Birth length is associated with low maternal nutritional intake during pregnancy, which is influenced by low family economic status [2,15], and food insecurity in the family [18].

Food insecurity in the family results in a decrease in the variety and the nutritional value of food consumed. It will sustainably affect the family's nutritional status, including child development. In pregnant women, which impacts stunted babies' birth [19,20]. Access and availability of food for the poor combine poverty problems, lack of permanent jobs, low and irregular cash income, and limited purchasing power[18,20], and closely related to low education levels[21].

In addition to impaired motor and verbal development, an increase in degenerative diseases, morbidity, and mortality, a further concern of stunting is the disruption of cognitive development [2,5,6]. Most child early malnutrition did not finish high school and work as manual laborers [19]. Impaired cognitive development and learning achievement will reduce work productivity to hinder economic growth, increase poverty, and widen inequality in a country [19,22].

Multivariate analysis showed that four variables were significantly associated with the incidence of stunting. If related to the child's life span, it has caused the mother's nutritional status during pregnancy. These

results explain the concept of stunting in the first 1000 days of life [15–17,23]. The role of mothers is critical in facilitating interventions through strengthening their nutritional status during pregnancy and breastfeeding [23].

Malnutrition in pregnancy results from a low average intake of protein, fat, total energy, and often insufficient micronutrients such as folate, Fe, Ca, and Zn. Malnutrition in pregnant women affects disruption of intra-uterine growth [23] due to LBW, stuntedness, perinatal mortality [4,7,21,24]. Linear growth failure is mostly caused in the intra-uterine period due to an inadequate diet [13].

Malnutrition in pregnancy is detected from anemia [15]. Anemia is a condition characterized by an abnormal decrease in the total mass of red blood cells caused by blood loss due to acute or chronic bleeding, destruction of red blood cells, and insufficient red blood cell production. Anemia is a risk for pregnant women in agricultural areas due to the chronic impact of pesticide exposure [25]. Sanitation access is associated with increased exposure to microbes and infectious diseases, especially diarrhea [1,9]. Fecal-oral pathways are water, food, vectors, and vectors [26]

Control with a nutrition approach for the first 1,000 days by promoting healthy behaviors, breastfeeding, nutrition during pregnancy includes micronutrient supplementation, breastfeeding, and disease prevention will reducing child malnutrition, especially chronic malnutrition in the form of stunting [15,23]. Nutrition sensitive interventions must also highlight a fundamentally important factor that indirectly impacts mothers' and children's nutrition, namely women's empowerment. Empowerment of women is a process of improving women's institutions and status, affecting household access to resources, including allocations for children's health and nutrition.

Conclusion

This study found four factors associated with stunting among children aged 6 to 59 months in horticulture farming areas, length at birth, LBW, protein intake, and access sanitation. Of the four variables, it indicates malnutritional during pregnancy. Therefore, it needs intervention and nutrition programs for pregnant women, including micronutrient supplementation and fortification. It also empowers women in the family to affect household access to resources, including allocations for children's health and nutrition.

Conflict of Interest: Authors declare no conflict of Interest in this study

References

1. Bomela NJ. Social, economic, health and environmental determinants of child nutritional status in three Central Asian Republics. Public Health Nutrition [Internet]. 2009 Oct 1;12(10):1871–7. Available from: https://www.cambridge.org/core/product/identifier/S1368980009004790/type/journal_article
2. WHO. Guideline: Updates on the management of severe acute malnutrition [Internet]. Vol. 5, WHO. 2017. 1–8 p. Available from: https://ejournal.poltektegal.ac.id/index.php/siklus/article/view/298%0Ahttp://repositorio.unan.edu.ni/2986/1/5624.pdf%0Ahttp://dx.doi.org/10.1016/j.jana.2015.10.005%0Ahttp://www.biomedcentral.com/1471-2458/12/58%0Ahttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&P
3. Imelda I, Rahman N, Nur R. Risk Factors for Stunting in Children aged 2-5 Years at Biromaru Health Center. Journal of Nutrition and Health [Internet]. 2020 Jun 16;2(1):39–43. Available from: http://jurnal.untad.ac.id/jurnal/index.php/ghidza
4. Rahman FD. The Effect of Feeding Patterns on the Incidence of Stunting in Toddlers. The Indonesian Journal of Health Science [Internet]. 2018 Jun 15;10(1):15–24. Available from: http://jurnal.unmuhjember.ac.id/index.php/TIJHS/article/view/1451
5. Adedeji I, John C, Okolo S, Ebonyi A, Abdu H, Bashir M. Malnutrition and the Intelligence Quotient of Primary School Pupils in Jos, Nigeria. British Journal of Medicine and Medical Research [Internet]. 2017 Jan 10;21(2):1–13. Available from: http://www.sciencedomain.org/abstract/18847
6. He P, Liu L, Salas JMI, Guo C, Cheng Y, Chen G, et al. Prenatal malnutrition and adult cognitive impairment: a natural experiment from the 1959–

1961 Chinese famine. British Journal of Nutrition [Internet]. 2018 Jul 28;120(2):198–203. Available from: https://www.cambridge.org/core/product/identifier/S0007114518000958/type/journal_article

7. Atmarita. Optimal Nutritional Intake to Prevent Stunting. Health Data and Information Bulletin. 2018;14–25.
8. Khan S, Zaheer S, Safdar NF. Determinants of stunting, underweight and wasting among children < 5 years of age: evidence from 2012-2013 Pakistan demographic and health survey. BMC Public Health [Internet]. 2019 Dec 1;19(1):358. Available from: https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-019-6688-2
9. Karpati J, Neubourg C, Laillou A, Poirot E. Improving children's nutritional status in Cambodia: Multidimensional poverty and early integrated interventions. Maternal & Child Nutrition [Internet]. 2020 Oct 4;16(S2). Available from: https://onlinelibrary.wiley.com/doi/10.1111/mcn.12731
10. Kang Y, Aguayo VM, Campbell RK, Dzed L, Joshi V, Waid JL, et al. Nutritional status and risk factors for stunting in preschool children in Bhutan. Maternal & Child Nutrition [Internet]. 2018 Nov 9;14(S4):1–16. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/mcn.12653
11. Semba RD, de Pee S, Sun K, Sari M, Akhter N, Bloem MW. Effect of parental formal education on risk of child stunting in Indonesia and Bangladesh: a cross-sectional study. The Lancet [Internet]. 2008 Jan;371(9609):322–8. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0140673608601695
12. Ministry of Health Indonesia. Decree of the Minister of Health of the Republic of Indonesia Number 1995 / Menkes / SK / XII / 2010 concerning Anthropometric Standards for Assessing the Nutritional Status of Children. Ministry of Health Indonesia, 1995/Menkes/SK/XII/2010 Indonesia; 2010.
13. Victora CG, Adair L, Fall C, Hallal PC, Martorell R, Richter L, et al. Maternal and child undernutrition: consequences for adult health and human capital. The Lancet [Internet]. 2008 Jan;371(9609):340–57. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0140673607616924
14. Berkes J, Raikes A, Bouguen A, Filmer D. Joint Roles of Parenting and Nutritional Status for Child Development: Evidence from Rural Cambodia. Developmental Science [Internet]. 2019 May 31;e12874. Available from: https://onlinelibrary.wiley.com/doi/abs/10.1111/desc.12874
15. Ministry of Health Indonesia. The Situation of Stunting in Indonesia. Health Data and Information Bulletin. 2018;1:6–18.
16. WHO. Stunting global and regional trends jme-(unicef-who-wb) [Internet]. World Health Organization (WHO); 2020. Available from: https://www.who.int/data/gho/data/themes/topics/indicator-groups/indicator-group-details/GHO/gho-jme-global-and-regional-trends-stunting-jme-unicef-who-wb
17. Islam MS, Zafar Ullah AN, Mainali S, Imam MA, Hasan MI. Determinants of stunting during the first 1,000 days of life in Bangladesh: A review. Food Science & Nutrition [Internet]. 2020 Sep 20;8(9):4685–95. Available from: https://onlinelibrary.wiley.com/doi/10.1002/fsn3.1795
18. National Development Planning Agency. National Action Plan for Food and Nutrition 2011-2015 [Internet]. 2011. 1–86 p. Available from: https://www.bappenas.go.id/files/4613/5228/2360/ran-pg-2011-2015.pdf
19. Galler JR, Bryce C, Waber DP, Zichlin ML, Fitzmaurice GM, Eaglesfield D. Socioeconomic Outcomes in Adults Malnourished in the First Year of Life: A 40-Year Study. PEDIATRICS [Internet]. 2012 Jul 1;130(1):e1–7. Available from: http://pediatrics.aappublications.org/cgi/doi/10.1542/peds.2012-0073
20. Kusumawati E, Rahardjo S, Sari HP. Model for controlling risk factors for stunting in children under three years. National Public Health Journal [Internet]. 2015 Apr 1;9(3):249. Available from: http://journal.fkm.ui.ac.id/kesmas/article/view/572
21. Azwar A. Trends in Nutrition Problems and Challenges in the Future. Ministry of Health. 2004;(September):1–16.
22. Waber DP, Bryce CP, Girard JM, Zichlin M, Fitzmaurice GM, Galler JR. Impaired IQ and academic skills in adults who experienced moderate to severe infantile malnutrition: A 40-year study. Nutritional Neuroscience [Internet]. 2014 Feb 26;17(2):58–64. Available from: http://

www.tandfonline.com/doi/full/10.1179/1476830513Y.0000000061

23. Kinshella MLW, Moore SE, Elango R. The missing focus on women's health in the First 1,000 Days approach to nutrition. Public Health Nutrition. 2020;
24. WHO. Childhood Stunting : Context , Causes and Consequences WHO Conceptual framework. 9th ed. 2013.
25. Petit C, Chevrier C, Durand G, Monfort C, Rouget F, Garlantezec R, et al. Impact on fetal growth of prenatal exposure to pesticides due to agricultural activities: A prospective cohort study in Brittany, France. Environmental Health: A Global Access Science Source [Internet]. 2010;9(1):71. Available from: http://www.ehjournal.net/content/9/1/71
26. Pickering AJ, Ercumen A, Arnold BF, Kwong LH, Parvez SM, Alam M, et al. Fecal Indicator Bacteria along Multiple Environmental Transmission Pathways (Water, Hands, Food, Soil, Flies) and Subsequent Child Diarrhea in Rural Bangladesh. Environmental Science & Technology [Internet]. 2018 Jul 17;52(14):7928–36. Available from: https://pubs.acs.org/doi/10.1021/acs.est.8b00928