

# Potential Association of Sanitation Factors on Stunting Incidences Among Children Under Age 5 in Bali Province, Indonesia

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## ABSTRACT

Some sub-districts in Bali province have stunting prevalence more than national average which might be associated with the environmental health condition in those areas. This study aimed to examine the association between environmental health factors with stunting prevalence among children age 2 – 5 years. Case-control study was conducted at Karangasem district with 101 case and 101 control. Cases were obtained from the list of stunted children from the result of PSG 2017 in 4 sub-districts. The controls were children at the same age and sex which were randomly selected from the available list of children in the health center. Bivariate and multivariate (logistic regression) were used for analysis. The study shows that cases and controls were comparable for age, sex, health access, nutrition sensitive intervention, infection history, water access, solid waste management. Cases and controls differed for variables: education level of parents, toilet access and ownerships, disposal of child's feces, hand washing practice and facilities, and distance to livestock shelter. Logistic regression showed that only father's education (AOR=2.429; 95%CI: 1.304-4.525) associated with stunting among children age 2 – 5 years. The optimum prediction model was obtained with variables of father's education, disposal of child's feces and distance to animal shelter. In conclusion, only father's education was found associated with stunting and only weak associations were found between environmental health factors and stunting.

**Keywords:** *urban–rural, disparities, facility-based childbirth, health-care evaluation*

## 1. INTRODUCTION

Stunting is malnutrition issue which becomes one of the health priorities to be addressed in the Sustainable Development Goals. Stunting, which is defined as children with a height less than 2 times the height standard deviation expected for normal children of the same age, is a chronic malnutrition problem caused by undernourished nutrition for a long time [1]. This is generally associated with socioeconomic conditions, poor health and nutritional conditions during pregnancy, frequent infections and / or inadequate food intake and care for newborns [1, 2]. Stunting can lead to adverse cognitive development in children and adults, short school days, decreased productivity, and incapable to achieve optimal height in adulthood [1].

In 2016, it was estimated around 155 million children under five with stunting throughout the world [2]. There were 27% stunted children lived in Asia and 36% in Africa [1]. Stunting prevalence rate in Indonesia ranks

fifth in the world (Kementrian Kesehatan RI, 2013) and this rate was higher than other East Asian countries such as Myanmar (35%), Vietnam (23%), and Thailand (16%) [3]. The National Health Survey result in 2007, 2010 and 2013 shows that malnutrition is still a major health problems in Indonesia and stunting prevalence among children under five was predicted at 36,8%, 35,6%, 37,2% [4]. The results of Nutrition Status Monitoring (PSG) conducted by the Ministry of Health in 2016 shows that the proportion of children under five experiencing stunting is 27.5% [5].

Currently, the living environment condition is also highlighted as a risk factor for stunting among children. Around 2.4 billion of the world's population do not have access to basic sanitation facilities and 946 million of them are defecating in the open, particularly in rural areas [6].

Several studies have shown that access to clean water, sanitation and hygiene can influence the incidence of diarrhea, trachoma and soil-transmitted helminth

infections [7-11]. These diseases can contribute to children's nutritional problems including stunting [9, 12]. It is estimated that about 50% of children's malnutrition can be caused by poor sanitation practices [13]. Therefore, nutrition specific interventions alone are not satisfactory to promote optimal growth among children in developing countries [14].

This can be explained that frequent exposure to germs due to unhygienic behavior and unsanitary environment can lead to intestinal infections among infants, and consequently can interfere the nutrient absorption process [12, 15]. Recently, an ecological analysis of data from 112 rural areas in India showed a strong relationship between the open defecation practice and stunting [16]. Water supply facilities, latrines and hand washing facilities have also been found to influence the growth of children under five in Ethiopia and Bangladesh [17, 18]. Previous study has focused on the association between stunting and nutrition specific intervention such as breast feeding, supplementary feeding, infant growth monitoring. Some studies also focus on hygiene behavior and clean water access. However, little research has attempted to look at the relationship of the indicators of environmental health interventions implemented by government with stunting in Indonesia.

Karangasem Regency, Bali has a relatively high stunting rate (26.1%) compared to the provincial average (19.7%) [5]. Karangasem Regency also has a low proportion of population who have access to improved sanitation (62.87%) in 2015 compared to the average in Bali Province [19]. It is possible that environmental conditions are an important factor influencing the nutritional status of children under five in Karangasem. Policies related to efforts to eradicate stunting prevalence in Karangasem Regency are urgent. This study aims to understand the potential association of the indicators of national environmental health intervention with stunting incidence, which may assist in the decision making related to nutrition and environmental health interventions.

## 2. METHOD

Case-control study was conducted in Karangasem Regency, with matching by frequency design for age and sex variables, from August to September 2018. Calculation of the minimum sample size using the method suggested by (20) with the probability that the control population did not have access to basic sanitation is 30% (exposure), the minimum number of samples obtained was 77 respondents for each case group and control group, with a confidence level of 95% and relative precision of 50%. There were a total of 101 cases and 101 controls involved in this survey. Cases were obtained from a list of children aged 2-5 years who were stunted in the results of the 2017 PSG survey for the sub-districts of Manggis, Abang, Karangasem and Kubu. The controls were children with the same age and gender which were randomly selected from the available list in the same puskesmas with the cases. Respondents in this

study are biological mothers of children under five or caregivers who have signed an informed consent form. Interviews were conducted by trained enumerators to collect data covering the characteristics of families and children, factors related to specific nutrition intervention (exclusive breastfeeding, PMT, and a history of infectious diseases), and sensitive nutritional factors (clean water, defecation practices, disposal of baby feces, hand washing facilities and other waste management aspects in the household).

The analysis was carried out using statistical software for chi square analysis and logistic regression. This study was approved by the Ethics Commission of the Faculty of Medicine, Udayana University and Sanglah General Hospital in Denpasar with reference number 1674 / UNU14.2.2 / PD / KEP / 2018.

## 3. RESULTS AND DISCUSSION

Based on the demographic information, cases and control are differ in regards to education level of father and mother, family income, occupation of father and mother (Table 1). Table 2 shows the relationship of variables related to specific nutrition interventions with stunting incidence. However, variables related to infection records over the past year may vulnerable to recall bias. Chi-square test shows a positive but not significant association between these factors and stunting incidence ( $p > 0.05$ ).

Table 1. Demographic Characteristic of Respondent (Infants)

Characteristics	Case n (%)	Control n (%)	Total	p-value
<b>Age (months) (mean ± SD)</b>	42.96 ± 9.37	42.99 ± 9.67	42.97 ± 9.51	0.914
<b>Sex</b>				
boy	48 (47.5)	49 (48.5)	97 (48)	0.888
girl	53 (52.5)	52 (51.5)	105 (52)	
<b>Father's education</b>				
< junior high school	54 (53.5)	27 (26.7)	81 (40.1)	0.000
≥ junior high school	47 (46.5)	74 (73.3)	121 (59.9)	
<b>Mother's education</b>				
< junior high school	53 (52.5)	37 (36.6)	90 (44.6)	0.024
≥ junior high school	48 (47.5)	64 (63.4)	112 (55.4)	
<b>Family income per month</b>				
< Rp 2.000.000	87 (86.1)	75 (74.3)	162 (80.2)	0.034
≥ Rp 2.000.000	14 (13.9)	26 (25.7)	40 (19.8)	
<b>Father's occupation</b>				
Lower level labour or farmer	34 (33.7)	52 (51.5)	86 (42.6)	0.010
Employee or	67 (66.3)	49 (48.5)	116 (57.4)	

Characteristics	Case	Control	Total	p-
entrepreneur				
<b>Mother's occupation</b>				
Lower level labour or farmer	13 (12.9)	25 (24.8)	38 (18.8)	0.031
Employee or entrepreneur	88 (87.10)	76 (75.2)	164 (81.2)	
<b>Settlement type</b>				
rural	93 (92.1)	90 (89.1)	183 (90.6)	0.470
urban	8 (7.9)	11 (10.9)	19 (9.4)	
<b>4 wheel vehicle access</b>				
No	50 (49.5)	53 (52.5)	103 (51)	0.673
yes	51 (50.5)	48 (47.5)	99 (49)	
<b>Distance to health centre</b>				
≥15 minutes	56 (55.4)	57 (56.4)	113 (55.9)	0.887
<15 minutes	45 (44.6)	44 (43.6)	89 (44.1)	

Table 2. Association of Nutrition Specific Intervention Indicators with Stunting Incidence

Variables	Case	Control	Total	Crude OR	95%CI		p-value
	n (%)	n (%)	n (%)		lower	upper	
<b>Normal birth weight</b>							
No	13 (13.1)	8 (8.2)	21 (10.7)	1.628	0.664	4.259	0.269
Yes	86 (86.9)	89 (91.8)	175 (89.3)				
<b>Early initiation of breast feeding</b>							
> 24 hours	8 (7.9)	7 (6.9)	15 (7.4)	1.155	0.403	3.315	0.788
≤ 24 hours	93 (92.1)	94 (93.1)	187 (92.6)				
<b>Exclusive breast feeding</b>							
No	38 (37.6)	33 (32.7)	71 (35.1)	1.243	0.697	2.217	0.461
Yes	63 (62.4)	68 (67.3)	131 (64.9)				
<b>Growth monitoring book</b>							
No	14 (13.9)	9 (8.9)	23 (11.4)	1.645	0.677	3.994	0.268
Yes	87 (86.1)	92 (91.1)	179 (88.6)				
<b>Received supplement food</b>							
No	7 (6.9)	2 (2)	9 (4.5)	3.686	0.747	18.196	0.170
Yes	94 (93.1)	99 (98.0)	193 (95.5)				
<b>SF was all consumed</b>							
No	22 (23.4)	19 (19.2)	41 (21.2)	1.287	0.644	2.569	0.475
Yes	72 (76.6)	80 (80.8)	152 (78.8)				
<b>Infection in the last year</b>							
Yes	88 (87.1)	82 (81.2)	170 (84.2)	1.568	0.728	3.377	0.248
No	13 (12.9)	19 (18.8)	32 (15.8)				
<b>Diarrhoea in the last year</b>							
Yes	39 (38.6)	31 (30.7)	70 (34.7)	1.420	0.793	2.543	0.237
No	62 (61.4)	70 (69.3)	132 (65.3)				

Table 3 shows the relationship between variables related to environmental health condition (nutrition sensitive intervention) which are indicators in the five pillars of STBM (A National Program of Community-Based Total Sanitation). The five pillars include access to latrines, hand washing with soap, safe drinking water management, solid waste management and wastewater

management at household level. Another waste management indicator related to livestock was also added as a variable in this study.

Table 3. Association of Environment Health Factors (STBM) With Stunting Incidence

Variable	Case	Control	Total	Crude OR	95% CI		p-value
	n (%)	n (%)	n (%)		lower	upper	
<b>Access to improved sanitation (Pillar 1)</b>							
<b>Toilet access at home</b>							
No	23 (22.8)	11 (10.9)	34 (16.8)	2.413	1.106	5.262	0.024
Yes	78 (77.2)	90 (89.1)	168 (83.2)				
<b>Toilet ownership</b>							
No	28 (27.7)	13 (12.9)	41 (20.3)	2.596	1.255	5.373	0.009
Yes	73 (72.3)	88 (87.1)	161 (79.7)				
<b>Number of household share toilet</b>							
sharing > 3 hh and no access	44 (43.6)	32 (31.7)	76 (37.6)	1.664	0.937	2.957	0.081
sharing ≤ 3 hh	47 (56.4)	69 (68.3)	126 (62.4)				
<b>Infant use toilet</b>							
No	35 (34.7)	16 (15.8)	51 (25.2)	2.817	1.437	5.523	0.002
Yes	66 (65.3)	85 (84.2)	151 (74.8)				
<b>Disposing child's faeces in toilet</b>							
No	34 (33.7)	15 (14.9)	49 (24.3)	2.909	1.456	5.78	0.002
Yes	67 (66.3)	86 (85.1)	153 (75.7)				
<b>Hand hygiene (Pillar 2)</b>							
<b>Good handwashing practice</b>							
No	32 (31.7)	18 (17.8)	50 (24.8)	2.138	1.105	4.137	0.022
yes	69 (68.3)	83 (82.2)	152 (75.2)				
<b>Hand washing facility</b>							
Not available	25 (24.8)	13 (12.9)	38 (18.8)	2.227	1.065	4.654	0.031
Available	76 (75.2)	88 (87.1)	164 (81.2)				
<b>Safe drinking water (Pillar 3)</b>							
<b>Water sources</b>							
Rain water	8 (7.9)	4 (4)	12 (5.9)				
Piped water	63 (62.4)	65 (64.4)	128 (63.4)				
Private dig well	24 (23.8)	30 (29.7)	54 (26.7)				
Public water storage	0 (0)	3 (3)	3 (1.5)				
Water vendor	10 (9.9)	6 (5.9)	16 (7.9)				
Others	5 (5)	0 (0)	5 (5)				
<b>Access to continuous water supply at home</b>							
No	17 (16.8)	9 (8.9)	26 (12.9)	2.069	0.875	4.891	0.093
yes	84 (83.2)	92 (91.1)	176 (87.1)				
<b>Adequate water quantity throughout the year</b>							
No	18 (17.8)	22 (21.8)	40 (19.8)	0.779	0.389	1.560	0.480
Yes	83 (82.2)	79 (78.2)	162 (80.2)				
<b>Hygienic drinking water container</b>							
No	45 (44.6)	34	79 (39.1)	1.584	0.896	2.799	0.113

Variable	Case n (%)	Control n (%)	Total n (%)	Crude OR	95% CI		p- value
					lower	upper	
		(33.7)					
Yes	56 (55.4)	67 (66.3)	123 (60.9)				
<b>Solid waste management (Pillar 4)</b>							
Presence of open waste dumping around house							
Yes	50 (49.5)	45 (44.6)	95 (47)	1.22	0.702	2.122	0.481
No	51 (50.5)	56 (55.4)	107 (53)				
<b>Wastewater management (Pillar 5)</b>							
Presence of stagnant wastewater							
Yes	11 (10.9)	10 (9)	21 (10.4)	1.112	0.450	2.748	0.818
No	90 (89.1)	91 (90.1)	181 (89.6)				
<b>Other waste</b>							
House distance to livestock shelter							
Near	54 (53.5)	35 (34.7)	89 (44.1)	2.167	1.230	3.817	0.007
Far	47 (46.5)	66 (65.3)	113 (55.9)				

From the table above, it can be seen that there are several variables that show a significant positive association with stunting incidence, namely: pillar 1 of STBM includes access to toilet at home, toilet ownership, use of toilets by infants, disposal method of infant feces, pillar 2 of STBM includes handwashing practice at least at 3 critical time, the availability of hand washing facilities at home, and other waste management aspect, that is distance of livestock shelter to the house. But there is no significant association with the variables in pillars 3, 4 and 5 of STBM.

Table 4. Nutrition Specific and Sensitive Factors Associated With Stunting Incidence

Variabel (n =196)	RL: enter method			p-value
	Adjusted OR	95% CI		
		lower	upper	
Father's education < high school	2.257	1.058	4.815	0.035 *
Mother's education < high school	1.189	0.596	2.373	0.623
Family income < Rp 2 mio	1.358	0.584	3.16	0.477
Father's occupation as labour	0.881	0.393	1.974	0.758
Mother's occupation as labour	1.305	0.539	3.157	0.555
Not receive supplementary food from health centre	3.285	0.607	17.774	0.167
Infection in the last year	1.539	0.661	3.582	0.317
No toilet access at home	0.395	0.044	3.55	0.407
Not own toilet	1.526	0.244	9.529	0.651
Share with more than three families	1.54	0.691	3.432	0.291
Toilet not use by infant	1.16	0.065	20.765	0.920
Not dispose infant faeces in toilet	1.546	0.072	33.24	0.781
Lack of handwashing practice	1.232	0.544	2.792	0.617
Unavailability of	1.593	0.641	3.957	0.316

handwashing facility				
Inadequate water supply	1.139	0.405	3.204	0.805
Non-hygienic water container	0.908	0.461	1.786	0.780
House close to livestock shelter	1.79	0.921	3.479	0.086
Constant	0.047			0.003

The multivariate analysis using logistic regression shows that only one factor of father's education was significantly associated with the incidence of stunting (Table 4). Whereas logistic regression analysis using the backward stepwise method shows the final model for predicting stunting incidence which includes father's education (AOR = 2.49, 95% CI: 1.3 - 4.54), disposal of infant feces (AOR = 2.09, 95% CI: 1 - 4.35) and distance of livestock shelter to the house (AOR = 1.8, 95% CI: 1 - 3.28) in the equation.

This study analyses socio demographic factors, nutrition specific factors and environmental health factors that influence stunting incidence among children 2 -5 years old. The results indicate only father's education (AOR = 2,257; 95% CI: 1.06–4.81) as a risk factor for stunting. These results are consistent with previous research which shows that father's education is one of the risk factors for stunting in children under five (AOR = 0.58; 95% CI: 0.38–0.89) [17]. Father's education can have a significant influence on the economic condition of the family which is also found to be correlated with the incidence of stunting [17]. With a better socioeconomic status of a family, parents are more likely to have ability to provide good parenting and good environmental health conditions to support growth of their children.

However, another predicting model in this study also shows that factors related to environmental health such as disposal of child faeces (pillar 1 of STBM) (AOR = 2.09; 95% CI: 1.0 - 4.3) and distance of livestock shelter to the house (AOR = 1.8; 95% CI : 1 - 3.28) are risk factors for stunting among children aged 2-5 years in Karangasem. But there is no significant association between stunting and variables in pillars 2, 3, 4 and 5 of STBM. Previous literature review article has shown that there is only a low effect of improving environmental health conditions on child development [20]. Another study also shows that the environmental health conditions of a house, consisting of drinking water quality, availability of sanitation and hand washing facilities are aspects that influence child growth and development through enteropathy environmental conditions [18]. Access to clean water (AOR = 6.49; 95% CI: 1.61 - 26.2) and personal hygiene (AOR = 3.52; 95% CI: 1.03 - 12.03) were also found to be significantly related to the incidence of stunting among infants aged 1-3 years in Bangli, Bali Province [21]. In this study, access to sanitation facilities (OR = 2.9; 95% CI: 1.25 - 5.37) hand washing facilities (OR = 2.23; 95% CI: 1.06 - 4.65) and good hand washing practices (OR = 2.13; 95% CI: 1.1 - 4.13) only have a weak relationship with stunting

incidence, where significant associations are shown only in bivariate analysis.

Disposal method of child's faeces is also an important factor that influence the infection pathway on infants [22, 23]. In this study, it can be seen that the use of toilet facilities by children (OR = 2.8; 95% CI: 1.44 - 5.52) and the practice of disposing child's faeces in a toilet (OR = 2.9; 95% CI: 1.45 - 5.78) are factors that significantly affects the incidence of stunting as shown by the result of bivariate analysis.

Another environmental health condition that can also affect infection pathway is contact with livestock waste, which has so far been rarely analysed and is rarely subjected to environmental health interventions [22].

In this study it turned out that contact with livestock manure, mainly because of the presence of a livestock pen near to the house is a risk factor that affects the incidence of stunting. Therefore, environmental health interventions should also consider a proper management of livestock waste particularly in rural setting where the majority of the population tends to live close to their fields and livestock.

There are some weaknesses in this study that should be considered in interpreting the results. Some confounding variables related to nutritional intake which may also influence the incidence of stunting in infants such as the pattern of feeding and types of supplementary food in infants were not included in the study. Sampling bias may occur due to use of sample frame from the listed children in the previous national survey and list available in community health center during the study period.

#### **4. CONCLUSION**

Rumah Sobat as an integrated selfcare group, is a modification of classic selfcare group, can be use as alternative activity to support leprosy program, especially in active case finding and raising knowledge about leprosy.

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