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Risk Factors for Stunting and Severe Stunting among under Five Years Children in Rural Areas in Indonesia

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Abstract: ***This research aimed to investigate the distal and proximate risk factors of stunting and severe stunting children in rural areas in Indonesia. This cross-sectional study used pooled data Riskesdas 2007, 2010 and 2013. A total of 18.225 children aged 0-59 months were observed. The multivariate analysis used STATA-13. The proximate risk factors stunting linked to stunting and severe stunting were older age of children (OR: 1.75, CI95% 1.59-1.87 and 1.22 CI95% 1.13-1.32); Low Birth Weight (LBW) (OR1.46 CI95% 1.24-1.72 and 1.31 CI95% 1.11-1.55); short mother (OR 1.64 CI95% 1.51-1.77 and OR 1.44 CI95% 1.33-1.55), short father (OR 1.35 CI 95% 1.24-1.46 and OR 1.33, CI95% 1.23-1.44). The distal risk factors stunting linked to low and middle economic (OR 1.33 CI95% 1.21-1.46) and 1.25 CI95% 1.11-1.39), and bad WASH (OR 1.45 CI95% 1.12-1.87), while the severe stunting linked to number of household member >9 (OR 1.67 CI95% 1.07-2.56), low middle economic (OR 1.13 CI95% 1.01-1.22 and OR 1.35 CI95% 1.23-1.48), mother occupation (non formal OR: 1.26, CI95% 1.11-1.58). The proximate risk factors of stunting and severe stunting children in rural areas were older age children, LBW and short paternale. Whereas the distal risk factors of stunting children were low and middle economic incomes, water and sanitation hygiene (WASH).***

Keywords: stunting, severe stunting, children, rural, Indonesia

1. Introduction

Children with stunting are an indicator of chronic malnutrition(WHO n.d.; WHO 2012), defined by height for age Z-score (HAZ) <-2 standard deviation (SD) , while severe stunting is <-3 SD , and normal is ≥-2 SD(WHO 2010). Children who suffer from stunting and severe stunting are shorter than normal, causing cumulative linear growth retardation and its consequences.

There are many risk factors which influence stunting, including distal risk factors such as education, occupation, economic level, number of household members, parity, housing, clean water and sanitation (WASH), and residence(Aryastami et al. 2017),(Akombi et al. 2017). While the proximate risk factors were food intake and late breast feeding initiation, size of birth, imunizatiton, young mother and genetics(Torlesse et al. 2016),(Tumilowicz et al. 2018). However, rural children are more disadvantaged with less access to nutritious food, transportation, communication, lack of sanitation, limited access to clean water, health facilities, health providers, and other public health facilities6. Prevalence of stunting in Indonesia remains high, due to chronic malnutrition was relatively hard to eradicate. Despite many specific and sensitive interventions to overcome this public health problem. Indonesian Basic Health Research showed that stunting prevalence for children in 2007, 2010, 2013 were 36.8%, 35.6%, and 37.2%, respectively (MoH of Indonesia 2007, 2010, 2013, 2018). The prevalence of stunting children in rural areas was relatively higher than urban (39.82% vs 30.98%)(MoH of Indonesia, 2013).

Knowing the determinants for stunting and severe stunting in rural areas was very important to formulate appropriate intervention strategies and public health policies to reduce the nutritional issues and morbidity. This research aimed to determine the distal and proximate risk factors for stunting and severe stunting children in rural areas in Indonesia using a pooled data from Indonesian Basic Health Research in 2007, 2010, and 2013.

2. Method

The study was a cross sectional design using pooled secondary data of the Indonesian Basic Health Research in 2007, 2010 and 2013, which provides community-based surveys, designed to monitor multiple health indicators for achieving the Millennium Development Goal's (MDG's). These surveys are conducted periodically by the National Institute of Health Research and Development of the Indonesian Ministry of Health. The sample size of 18,225 was selected from 108,252 under five children, with citerian data observed complete and 5.99 until 5.99SD HAZ-score, as because -6SD below or 6SD HAZ above was outlier.(WHO 2010)

The dependent variable was nutritional status divided into three categories; severe stunting, stunting, and normal. Severe stunting was defined by HAZ-score <-3 SD, stunting if 2<HAZ<2 SD and normal if HAZ>2 SD(WHO 2010). Independent variables were children's characteristics: gender (girl vs. boy), age (<24 months vs. ≥ 24 months), birth weight (LBW:<2500 gr and normal:≥ 2500 gr(World Health Organization (WHO) 2014)) and household characteristics: parents education (low: junior high school and below, middle: senior high school, and high: college); occupation (no, yes non formal, yes formal); economic status (low: quintile 1 and 2, middle: quintile 3, high: quintile 4 and 5), setting (rural, urban); Isles (Java-Bali, Sumatra, East Indonesia), parent's height (short and normal, short mother < 150 cm and short father < 160 cm), mother's age (<19 y, 20-35 y, >35y); number of household members (<5, 5-9, >9); and number of children (1, 2, ≥3). The

characteristics data were collected by interview, while the anthropometry for adult and children ≥ 24 months height used microtoa, and length board for children < 24 months from ministry of health. Body weight was measured by digital weight scales with 0.01 precision. The risk factors of stunting and severe stunting children will compare to normal ones. Data were analyzed by univariate, bivariate and multivariate using backward method with STATA version 13. The final model was considerate by the fittest BIC values.

3. Results

A total of 18,225 data of children form pooled data Riskesdas 2007, 2010, and 2013 were selected . Description of stunting and severe stunting children in rural areas (Table 1).

Table 1: The children and household characteristics of stunting and severe stunting children in rural areas in Indonesia

Variables	*Severe stunting*		*Stunting*		*Normal*	
	n (3,513)	*%*	*n(3,364)*	*%*	*n(11,348)*	*%*
Proximate factors						
Age children (months)						
0-23	1,592	45.32	1,247	37.07	5,630	49.61
24-59	1,921	54.68	2,117	62.93	5,718	50.39
Sex						
Girls	1,728	48.76	1,780	50.54	5,720	50.36
Boys	1,785	51.24	1,584	49.46	2,260	49.64
Birth weight						
LBW	213	6.06	228	6.78	512	4.51
Normal	3,300	93.94	3,136	93.22	10,836	95.49
Vit A supplementation						
No	891	25.36	810	24.08	3,049	26.87
Yes	2,622	74.64	2,554	75.92	8,299	73.13
Mother's height						
Short	1,607	45.74	1,620	48.16	4,056	35.74
Normal	1,906	54.26	1,744	51.84	7,292	64.24
Father's height						
Short	1,394	39.68	1,345	39.98	3,586	31.60
Normal	2,119	60.32	2.019	60.02	7.762	68.40
Mother's age						
< 19 y	64	1.82	48	1.43	189	1.67
20-35 y	2,606	74.18	2,448	72.77	8,428	74.22
> 36 y	843	24.00	868	25.80	2,736	24.11
Distal factors						
Number of households						
> 9	32	0.91	20	0.59	63	0.56
5-9	1,593	45.35	1,511	44.92	4,783	42.15
< 5	1,888	53.74	1,833	54.49	6,502	57.30
Number children						
>3	70	1.99	54	1.61	209	1.84
2-3	725	20.64	686	20.89	2.146	18.91
1	2,718	77.37	2,624	78.00	8,993	79.25
Mother's education						
Low	1,737	49.44	1,629	48.42	5,111	45.04
Middle	860	24.48	848	25.21	2,864	25.24
High	916	26.07	887	26.37	3,373	29.72
Father's education						
Low	1,720	48.96	1,630	48.45	4,975	43.84
Middle	784	22.32	738	21.94	2,560	22.56
High	1,009	28.72	996	29.61	3,813	33.60
Economic level						
Low	1,888	53.74	1.729	51.40	5,164	45.51
Middle	701	19.95	738	21.94	2,397	21.12
High	924	26.30	897	26.66	3,787	33.37
Mother's occupation						
No	1,904	54.20	1,872	55.65	6,562	57.83
Yes, non-formal	1,423	40.51	1,295	38.50	3,942	34.74
Yes, formal	186	5.29	197	5.86	844	7.44
Father's occupation						
No	64	1.82	63	1.87	237	2.09
Yes, non-formal	3,074	87.50	2,955	87.84	9,531	83.99
Yes, formal	375	10.67	346	10.26	1,580	13.92
WASH						
Bad	3,424	97.47	3,289	0.59	63	96.14
Good	89	2.53	75	44.92	4,783	3.86
Isles						
Java-Bali	883	25.14	940	54.49	6,502	27.97
Sumatra	1,396	39.74	1,130	1.61	209	37.28
East Indonesia	1,234	35.13	1,294	20.89	2.146	34.75

The bivariate analysis showed that proximate risk factors for stunting and severe stunting children were age, sex, birth weight, vitamin A supplementation, mother age and parents height. While the distal risk factors for stunting and severe stunting were number of household, parent's education, economic level, parent's occupation, clean water and sanitation (WASH). All of risk factors compares to normal children (Table 2).

Table 2: Bivariate analysis of distal and proximate stunting and severe stunting children in rural areas in Indonesia

Variables	Severe stunting			Stunting		
	n	%	OR (95%CI)	n	%	OR (95%CI)
Proximate risk factors						
Age children (months)						
0-23	1,592	45.32	1	1,247	37.07	1
24-59	1,921	54.68	1.18(1.10-1.28)	2,117	62.93	1.67(1.55-1.81)*
	3,513	100.00		3,364	100.00	
Sex						
Girls	1,728	48.76	1	1,780	50.54	1
Boys	1,785	51.24	1.12(1.04-1.21)	1,584	49.46	1.03(0.96-1.12)
	3,513	100.00		3,364	100.00	
Birth weight						
LBW	213	6.06	1.37(1.16-1.61)*	228	6.78	1.54(1.31-1.81)*
Normal	3,300	93.94	1	3,136	93.22	1
	3,513	100.00		3,364	100.00	
Vit A supplementation						

No	891	25.36	0.92(0.84-1.01)	810	24.08	0.86(0.79-0.94)
Yes	2,622	74.64	1	2,554	75.92	1
	3,513	100.00		3,364	100.00	
Mother's height						
Short	1,607	45.74	1.52(1.41-1.63)*	1,620	48.16	1.67(1.55-1.81)*
Normal	1,906	54.26	1	1,744	51.84	1
	3,513	100.00		3,364	100.00	
Father's height						
Short	1,394	39.68	1.42(1.32-1.54)*	1,345	39.98	1.44(1.33-1.56)*
Normal	2,119	60.32	1	2,019	60.02	1
	3,513	100.00		3,364	100.00	
Distal risk factors						
Mother's age						
< 19 y	64	1.82	1.09(0.82-1.45)	48	1.43	0.87(0.63-1.21)
20-35 y	2,606	74.18	1	2,448	72.77	1
> 36 y	843	24.00	1(0.91-1.09)	868	25.80	1.01(1-1.19)
	3,513	100.00		3,364	100.00	
Distal factors						
Number of household						
> 9	32	0.91	1.75(1.06-1.23)*	20	0.59	1.13(0.68-1.87)
5-9	1,593	45.35	1.15(1.06-1.24)	1,511	44.92	1.75(1.14-2.68)*
< 5	1,888	53.74	1	1,833	54.49	1
	3,513	100.00		3,364	100.00	
Number of children						
>3	70	1.99	1.11(0.84-1.46)	54	1.61	0.88(0.65-1.19)
2-3	725	20.64	1.12(1.01-1.23)	686	20.89	1.09(1-1.21)
1	2,718	77.37	1	2,624	78.00	1
	3,513	100.00		3,364	100.00	
Mother's education						
Low	1,737	49.44	1.11(1-1.23)	1,629	48.42	1.21(1.11-1.33)*
Middle	860	24.48	1.25(1.14-1.37)*	848	25.21	1.13(1.01-1.25)
High	916	26.07	1	887	26.37	1
	3,513	100.00		3,364	100.00	
Father's education						
Low	1,720	48.96	1.31(1.20-1.43)*	1,630	48.45	1.25(1.15-1.37)*
Middle	784	22.32	1.16(1.04-1.29)	738	21.94	1.10(1.123)
High	1,009	28.72	1	996	29.61	1
	3,513	100.00		3,364	100.00	
Economic level						
Low	1,888	53.74	1.50(1.37-1.64)*	1.729	51.40	1.30(1.16-1.45)*
Middle	701	19.95	1.20(1.07-1.34)*	738	21.94	1.41(1.29-1.55)*
High	924	26.30	1	897	26.66	1
	3,513	100.00		3,364	100.00	
Mother's occupation						
No	1,904	54.20	1.32(1.15-1.56)*	1,872	55.65	1.41(1.19-1.66)*
Yes, non-formal	1,423	40.51	1.64(1.38-1.94)*	1,295	38.50	1.22(1.04-1.44)*
Yes, formal	186	5.29	1	197	5.86	1
	3,513	100.00		3,364	100.00	
Father's occupation						
No	64	1.82	1.36(1.21-1.53)*	63	1.87	1.41(1.25-1.60)*
Yes, non-formal	3,074	87.50	1.14(0.84-1.53)	2,955	87.84	1.21(0.89-1.64)*
Yes, formal	375	10.67	1	346	10.26	1
	3,513	100.00		3,364	100.00	
WASH						
Bad	3,424	97.47	1.55(1.26-1.95)*	3,289	0.59	1.76(1.38-2.26)*
Good	89	2.53	1	75	44.92	1
	3,513	100.00		3,364	100.00	
Isles						
Java-Bali	883	25.14	1	940	54.49	1
Sumatra	1,396	39.74	1.19(1.08-1.31)	1,130	1.61	0.91(0.82-0.99)
East Indonesia	1,234	35.13	1.12(1.02-1.24)	1,294	20.89	1.11(1.01-1.21)
	3,513	100.00		3,364	100.00	

Note: * sig p<0.05
AOR : adjusted odd ratio

The multivariate analysis show that the proximate factors influencing severe stunting were low birth, and parents height, while the distal risk factors associated with stunting were number of household, economic status (Table 3).

Table 3: Multivariate analysis of distal and proximate stunting and severe stunting children in rural areas in Indonesia

Variables	B coefficient	SE	p-value	AOR (95% CI)
Proximate risk factors				
Age children (month's)	0.136	0.0801	0.091	1.22(1.13-1.32)
Sex	0.116	0.077	0132	1.14(1.06-1.23)
Birth weight	0.187	0.174	0.028	1.31(1.11-1.55)
Mother's height	0.322	0.081	0.000	1.44(1.33-1.55)
Father's height	0.188	0.482	0.022	1.33(1.23-1.44)
Distal risk factors				
Number of household 1.047		0.115	0.030	1.66(1.07-2.56)
Father's education	0.081	0.097	0.404	1.01(1.01-1.22)
Economic level	0.261	0.049	0.000	1.35(1.23-1.48)
Mother's occupation	0.207	0.115	0.054	1.26(1.11-1.58)
Constanta	-2.429891			

. SE: standard error, AOR : adjusted odd ratio

The proximate factors influencing stunting were age children, low birth, and parents height, while the distal risk factors associated with stunting were number of household, economic status and water and sanitation hygiene (WASH) (Table 4).

Table 4: Multivariate analysis of distal and proximate stunting children in rural areas in Indonesia

Variables	B coefficient	SE	p-Value	AOR (95% CI)
Proximate risk factors				
Age children (months)	0.528	0.041	0.000	1.73(1.59-1.87)
Sex	0.053	0.040	0.211	1.03(0.96-1.12)
Birth weight	0.377	0.084	0.000	1.46(1.24-1.72)
Mother's height	0.494	0.040	0.000	1.64(1.51-1.77)
Father's height	0.297	0.0417	0.000	1.35(1.24-1.46)
Distal risk factors				
Number of household	0.163	0.264	0.538	1.13(0.68-1.89)
Economic level	0.285	0.048	0.000	1.33(1.21-1.46)
WASH	0.432	0.125	0.001	1.45(1.12-1.87)
constanta	-3.053702			

WASH: water and sanitation hygiene ,SE: standart error, AOR : adjusted odd ratio

4. Discussion

The proximate risk factor for stunting and severe stunting in rural area were relatively no different, ie. age children, birth weight, and stature parent. Low birth weight and was proven have association with stunting(Aryastami et al. 2017; Rahayu 2015; Akombi et al. 2017; Rachmi, CN; Agho KE; Li et al. 2016)

Some studies also showed that parents height was consistently a factor to determine stunting in children(Rahayu 2015; Perkins et al. 2016; Bogale et al. 2018). Maternal body size was tend related to pelvic size, so that short mother relatively have a small pelvic size and deliver to babies with a small size. LBW was a strong predictor for stunting and severe stunting children.(Aryastami et al. 2017) These stunting children will grow into short adolescents and adults, their opportunities for education and decent income were limited as a long-term consequence of stunting.(WHO n.d.)·(Tumilowicz et al. 2018)·(World Health Organization (WHO) 2005)

Supporting these findings, Rachmi et al., (2016) showed that short parents have a strong association with stunting children ≥24 months (AOR 1.91, 95% CI (1.51-2.41)(Rachmi, CN; Agho KE; Li et al. 2016). The interestingly finding was the severe stunting have more association with major social issues such as poor economic, education and occupation. Based on social determinants of health, social factors have strong association with welfare, including maternal and children health(Tumilowicz et al. 2018; Akram et al. 2018; Islam et al. 2018). Education level have strong association with occupation, social support, housing, health provider, food consumption, knowledge, parental, so that affecting children nutritional status(Casale et al. 2014; Tiwari et al. 2014; Mcgovern et al. 2017; Angdembe et al. 2019; Tumilowicz et al. 2018; Chirande et al. 2015). But there was no collinearity between social issues.

Children need a pleasant environment to support optimal growth, such as sanitation facilities, latrines, clean water, healthy housing, air free of pollutants to incrase welfare.(Akombi et al. 2017)·(Tumilowicz et al. 2018)·(WHO n.d.; WHO 2019) Many studies proven that clean water and others components environmental health related to stunting.(Tumilowicz et al. 2018)·(Torlesse et al. 2016)·(Rah et al. 2015) So that mothers have an essential role in providing enough nutrition for healthy growth and development for children as well as adequate water access, avoidance of smoke pollution, good food intake, and vaccination and prevention of recurrent infections, early breastfeeding, appropriate breast milk and complementary feeding, micronutrient supplementation and general well-being(Millward 2017; Mcgovern et al. 2017; Angdembe et al. 2019; Haddad et al. 2016). If the main factors for limiting growth can be eliminated, then under-priveldged children can still grow optimally as normal ones(Haddad et al. 2016). Unfortunately, low-income families tend to give birth within intergenerational poverty(Akram et al. 2018), with severe health consequences, including poor caring and poor nutrition[6,31]. The cognitive, motoric, social, and emotional skills of children cannot develop optimally, resulting in poor learning performance at school, and a lack of ability to compete to get higher education and obtain decent work. In addition, poor families are associated with limited access to basic needs, including food, health, education and recreation facilities(Asmare et al. 2018; Mcgovern et al. 2017; Millward 2017)while they also experience lack of social support and networking, poor housing, and bad sanitation(Torlesse et al. 2016)·(Budge et al. 2019).

According to public health expertise, economic growth is the most effective effort to eradicate malnutrition especially in developing countries. Economic growth can reduce poverty, increase household income, and open better opportunities for jobs and public services, including health facilities(Akram et al. 2018; WHO n.d.). In Indonesia, economic development has occurred rapidly. But

unfortunately, the growth was not equitable between isles, geographical disparities, and social issues.(WHO n.d.)(Hanandita & Tampubolon 2015)

5. Conclusions

There were social issues (economic, occupation and education) as a distal risk factors for severe stunting of children in rural areas in Indonesia, and the distal risk factors were low birth weight and stature height.

6. Recommendations

Stunting and severe stunting were cause by the distal and proximate risk factors, including social, environment, and low birth weight. So that the specific and sensitive integrated sinergystic interventions were important to combat stunting and severe stunting children.

7. Conflict of interest

There was no conflict of interest

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