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STUNTING AND DEVELOPMENTAL DELAYS AMONG CHILDREN AGED 6–59 MO

HARDYA GUSTADA HIKMAHRACHIM[1], SUDARTO RONOATMODJO[1*]

[1]Department of Epidemiology, Faculty of Public Health, Universitas Indonesia, Depok, Indonesia
Email: sudartorono@yahoo.com

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ABSTRACT

Objective: This study aimed to investigate the association between stunting and suspected developmental delay status in Kabupaten Bogor.

Methods: An observational cross-sectional study was conducted in Puskesmas Kecamatan Ciampea, Kabupaten Bogor, Indonesia, from February to April 2019. We included children aged 6–59 mo who visited outpatient clinics. All eligible children underwent standardized anthropometric examinations and developmental milestone assessments using the Denver II tool. Both bivariate and multivariate analyses were conducted to investigate any associations.

Results: From 184 children, 76 (41.3%) were stunted and 82 (44.57%) had suspected developmental delays, both relatively higher than the national prevalence. Overall, developmental delays were associated with stunting (64.5% vs. 30.6%; adjusted odds ratio (AOR): 3.45; 95% CI: 1.76–6.76; *p* = 0.000). In subgroup analyses, stunting was independently associated with suspected delays in fine motor skills (26.3% vs. 12.9%; AOR: 2.49; 95% CI: 1.00–6.18; *p* = 0.049), personal-social development (35.5% vs. 12.0%; AOR: 2.75; 95% CI: 1.24–6.12; *p* = 0.013) and language skills (27.6% vs. 12.9%; AOR: 2.95; 95% CI: 1.28–6.77; *p* = 0.011) after multivariate analyses with sex, age and undernutrition as confounding factors in the final model.

Conclusion: Stunting had a strong association with developmental delays among children visiting primary healthcare clinics. Stakeholders should focus on both the detection and prevention of stunting and developmental delays in primary healthcare facilities.

Keywords: Developmental delay, Primary healthcare facilities, Stunting

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INTRODUCTION

Stunting is a chronic malnutrition problem and is defined as a body length or height below-2 standard deviations (SDs) on the World Health Organization (WHO) growth chart standard [1]. Stunting has caught global attention and has been set by United Nations as one of the targets of the Sustainable Developmental Goals (SDGs) [2].

South Asia, including Indonesia, are among the regions with a high stunting prevalence, with approximately 35% [3]. Indonesia ranks fourth globally, with a 30.8% stunting prevalence in 2018 [3, 4]. Almost all provinces in Indonesia had a high stunting prevalence, with Kabupaten Bogor being no exception. Although slightly lower (28%) than the national prevalence, stunting in Kabupaten Bogor accounts for 140,000 children, which has raised attention in the public health arena.

Stunting is mainly found among preschoolers, but it mostly develops before two years of age and as a part of the first 1,000 d of life [2]. This period is a golden age for child growth and development, especially for brain development (e. g. synaptogenesis) [5]. Previous studies have reported an association between stunting and developmental status, although this is still debatable [6-8]. Furthermore, stunting strongly affects school performance and quality of life [5, 9]. This study aimed to investigate the association between stunting and developmental delays in Kabupaten Bogor. This study is expected to give insights into the developmental impact of stunting and provide further support for future public health prevention and intervention policies, mainly in primary care facilities.

MATERIALS AND METHODS

This was an observational study using a cross-sectional design to investigate the proportion of stunting and its association with developmental delays. This study was conducted in Puskesmas Kecamatan Ciampea, one of the district's primary healthcare facilities in Kabupaten Bogor, West Java, Indonesia from February to April 2019.

We included children aged 6–59 mo who visited the pediatric outpatient clinic in Puskesmas Kecamatan Ciampea. Children with severe illness, a history of mental retardation, congenital developmental disorder or whose parent (s) refused to participate were excluded from the study. All participants were recruited by using a convenience sampling method. Both oral and written informed consents were obtained from all participant's parents. This study followed the ethical principles for medical research from the Declaration of Helsinki.

Anthropometric measurements were done by trained physicians. Weight was measured using a calibrated baby weight scale. Length was measured using a baby length board for children under 1 y of age or a microtoise (height) for children above one year of age. Every measurement was done two to three times and an average value was calculated and documented. Developmental milestones were assessed using the Denver II Developmental Test tools in accordance with standard examination procedures. Participants who did not pass the developmental milestones according to their age were defined as having a suspected developmental delay. Developmental status assessments were conducted before anthropometric interpretations to reduce the risk of measurement bias. Other information related to the developmental status were also recorded.

Data are presented in both a descriptive and analytic manner. All associated variables with *p* values<0.20 in bivariate analyses were included in multivariate analyses. Final models were determined using multiple logistic regression for developmental delays as the primary outcome and each developmental aspect as a subgroup analysis. Variables with a *p* value above 0.05 were excluded from the model, consecutively from the highest *p* value. If excluding a variable changed the odds ratio (OR) by ±10%, it was then interpreted as a confounding variable, thus it was not excluded from the model. The final model was robust and parsimonious. All statistical analyses were performed using STATA software for windows.

RESULTS

From the 184 children who participated in this study, 53.80% were girls who were relatively equal in age distribution. The primary working diagnosis during most outpatient clinic visits was an acute upper respiratory infection (83.15%). Most of the children (80.43%) came from families with a low socioeconomic status.

Stunting was found in 76 children (41.30%), while undernutrition was found in 65 children (38.01%). There were 44.57% of the children with suspected developmental delays, specifically in gross motor (8.15%), fine motor (18.48%), personal-social (21.74%) and language (19.02%) areas. The demographic characteristics of the children are presented in table 1.

Table 2 shows the results from bivariate analyses of potential associated factors to suspected developmental delays. We found that sex (OR: 2.26; 95% CI: 1.23–4.15; p = 0.007), age group (OR range: 1.80–3.67 for each subgroup), stunting (OR: 4.12; 95% CI: 2.12–8.01; p = 0.001) and undernutrition (OR: 2.14; 95% CI: 1.14–4.02; p = 0.017) were associated with suspected developmental delays. We also conducted subgroup analyses that analyzed the associations between stunting and each developmental aspect (table 3). In general, stunting and developmental delays a had strong association. All aspects of development, except gross motor skills (OR: 1.27; 95% CI: 0.44–3.62; p = 0.661), were associated with stunting. Based on this result, gross motor delays were not included in further analyses.

In the multivariate analysis, developmental delays were independently associated with stunting (table 4). The strongest associations were found between overall developmental delays (AOR: 3.45; 95% CI: 1.76–6.76; p<0.001) and language aspects (AOR: 2.95; 95% CI: 1.28–6.77; p = 0.011). Sex, age group and undernutrition acted as confounders in these analyses, so these variables were included in the final models.

Table 1: Demographic characteristics of study participants (*n* = 184)

Characteristics	Total	
	N	**%**
Sex		
Boys	85	46.20
Girls	99	53.80
Age group		
6–11 mo	15	8.15
12–23 mo	43	23.38
24–35 mo	38	20.65
36–47 mo	35	19.02
48–59 mo	53	28.80
Working diagnosis at visit		
Acute respiratory tract infection	153	83.15
Gastroenteritis	8	4.35
Unspecific skin infection	8	4.35
Fever	5	2.72
Other diagnosis	10	5.43
Height for age		
Stunting	76	41.30
Normal	108	58.70
Nutritional status		
Undernutrition	70	38.04
Normal	114	61.96
Developmental status		
Suspected developmental delay	82	44.57
Gross motor	15	8.15
Fine motor	34	18.48
Personal-social	40	21.74
Language	35	19.02
Normal	102	55.43
Number of children (including subject)		
<2	140	76.09
>2	44	23.91
Birth order		
First	79	42.94
Second	64	34.78
Third or more	41	22.28
Exclusive breastfeeding		
No	54	29.35
Yes	130	70.65
Birthweight status		
<2500 g	22	11.96
≥ 2500 g	162	88.04
Gestation at birth		
<37 w	3	1.63
≥ 37 w	181	98.37
Immunization status		
Incomplete	46	25.00
Complete	138	75.00
Maternal age at pregnancy		
<20 y old	25	13.59
20–40 y old	151	82.06
>40 y old	8	4.35
Maternal education		
<6 y	59	32.07
6–9 y	72	39.13
>9 y	53	28.80
Socioeconomic level		
Low (below regional salary standard)	148	80.43
Middle to High	36	19.57
Caregiver		
Parents	176	95.65
Relatives	6	3.26
Babysitter	2	1.09

Table 2: Associated factors of developmental delay (*n* = 184)

Characteristics	Suspect developmental delay (*n* = 82)		Normal (*n* = 102)		OR (95% CI)	*p* value
	n	%	*n*	%		
Sex						
Boys	47	55.29	38	44.71	2.26 (1.23–4.15)	**0.007**
Girls	35	35.35	64	64.65		
Age group						
6–11 mo	4	26.67	11	73.33	1.00	
12–23 mo	20	46.51	23	53.49	2.39 (0.66–8.70)	**0.186**
24–35 mo	17	44.74	21	55.26	2.27 (0.60–8.26)	0.231
36–47 mo	20	57.14	15	42.86	3.67 (0.97–13.81)	**0.055**
48–59 mo	21	39.62	32	60.38	1.80 (0.51–6.43)	0.362
Height for age						
Stunting	49	64.47	27	35.53	4.12 (2.12–8.01)	**0.001**
Normal	33	30.56	75	69.44		
Nutritional status						
Normal	46	40.35	68	59.65		
Undernutrition	40	57.14	30.00	42.86	2.14 (1.14–4.02)	**0.017**
Number of child (incl. subject)						
<2	62	44.29	78.00	55.71		
>2	20	45.45	24.00	54.55	1.05 (0.53–2.07)	0.892
Birth order						
First	34	43.04	45.00	56.96	1.00	
Second	30	46.88	34.00	53.13	1.17 (0.60–2.27)	0.646
Third or more	18	43.90	23.00	56.10	1.04 (0.48–2.22)	0.928
Exclusive breastfeeding						
Yes	55	42.31	75.00	57.69		
No	27	50.00	27.00	50.00	1.36 (0.72–2.58)	0.340
Low birth weight						
Yes	7	31.82	15.00	68.18	0.54 (0.21–1.40)	0.205
No	75	46.30	87.00	53.70		
Gestational age						
Normal	81	44.75	100.00	55.25		
Preterm	1	33.33	2.00	66.67	0.62 (0.55–6.93)	0.696
Immunization						
Complete	61	44.20	77.00	55.80		
Incomplete	21	45.65	25.00	54.35	1.06 (0.54–2.07)	0.864
Maternal age at pregnancy						
<20 y old	12	48.00	13.00	52.00	2.77 (0.46–16.46)	0.263
20–40 y old	68	45.03	83.00	54.97	2.46 (0.48–12.57)	0.263
>40 y old	2	25.00	6.00	75.00	1.00	
Maternal education						
<6 y	30	50.85	29.00	49.15	1.00	
7–9 y	30	41.67	42.00	58.33	0.69 (0.35–1.38)	0.295
>9 y	22	41.51	31.00	58.49	0.69 (0.32–1.45)	0.323
Socioeconomic status						
Low	15	41.67	21.00	58.33		
Middle to high	67	45.27	81.00	54.73	1.16 (0.55–2.42)	0.697
Caregiver						
Parents	79	44.89	97.00	55.11	1.00	
Relatives	3	50.00	3.00	50.00	0.62 (0.19–2.04)	0.434
Babysitter	0	0.00	2.00	100.00	-	

Table 3: Bivariate analysis between stunting and suspected developmental delays (overall and subgroup)

Stunting status	Suspected developmental delay		Normal		OR	95% CI	*p* value
	n	%	*n*	%			
Stunting	49	64.47	27	35.53	4.12	2.12–8.01	0.000
Normal	33	30.56	75	69.44			
Total	82	44.57	102	55.43			
	Suspected gross motor delay		Normal		OR	95% CI	*p* value
	n	%	*n*	%			
Stunting	7	9.21	69	90.79	1.27	0.44–3.62	0.661
Normal	8	7.41	100	92.59			
Total	15	8.15	169	91.85			
	Suspected fine motor delay		Normal		OR	95% CI	*p* value
	n	%	*n*	%			
Stunting	20	26.32	56	73.68	2.4	1.11–5.19	0.020
Normal	14	12.96	94	87.04			
Total	34	18.48	150	81.52			
	Suspected personal-social delay		Normal		OR	95% CI	*p* value
	n	%	*n*	%			
Stunting	27	35.53	49	64.47	4.03	1.85–8.78	0.000
Normal	13	12.04	95	87.96			
Total	40	21.74	144	78.26			
	Suspected language delay		Normal		OR	95% CI	*p* value
	n	%	*n*	%			
Stunting	21	27.63	55	72.37	2.56	1.19–5.54	0.010
Normal	14	12.96	94	87.04			
Total	35	19.02	149	80.98			

Table 4: Final model of multivariate analysis

Overall suspected of developmental delay				
Variable	Coefficient	AOR	95% CI	*p* value
Stunting	1.2376	3.45	1.76–6.76	0.000*
Boys	0.7197	2.05	1.07–3.95	0.031*
Undernutrition	0.5021	1.65	0.83–3.03	0.156
Null deviance =-118.17; residual deviance =-105.68; AIC = 219.37				
*statistically significant				
Suspected of fine motor delay				
Variable	Coefficient	AOR	95% CI	*p* value
Stunting	0.9124	2.49	1.00–6.18	0.049*
Age group	0.5479	1.73	1.19–2.52	0.004*
Boys	0.9755	2.65	1.12–6.27	0.026*
Undernutrition	0.7964	2.22	0.92–5.34	0.076
Null deviance =-83.88; residual deviance =-71.22; AIC = 152.45				
*statistically significant				
Suspected of personal-social delay				
Variable	Coefficient	AOR	95% CI	*p* value
Stunting	1.0117	2.75	1.24–6.12	0.013*
Boys	0.8193	2.27	1.04–4.97	0.040*
Undernutrition	0.9315	2.54	1.15–5.62	0.022*
Null deviance =-91.81; residual deviance =-81.41; AIC = 170.82				
*statistically significant				
Suspected of language delay				
Variable	Coefficient	AOR	95% CI	*p* value
Stunting	1.0801	2.95	1.28–6.77	0.011*
Age group	0.3811	1.46	1.05–2.04	0.025*
Undernutrition	-0.2759	0.76	0.33–1.76	0.519
Null deviance =-86.67; residual deviance =-81.32; AIC = 170.64				
*statistically significant				

DISCUSSION

This study found an independent association between developmental delays and stunting among children in Indonesia. However, there was no association for gross motor areas. This study also showed that sex, age groups and nutritional status affect that association. To date, studies concerning developmental delay associations with stunting are less studied in patients visiting primary care outpatient clinics in high-prevalence stunting regions.

The proportion of stunting in this study was higher than the national prevalence (30.8%) or the Kabupaten Bogor prevalence (28.0%). This finding could indicate that stunted children have a higher risk of mild illness [10], since stunting is found to be related to immunity [11-13]. On the other hand, a proportion of suspected developmental delays in this study (44.57%) reconfirmed results from previous studies (6–48%) [14-17]. This result illustrates the importance of early detection of developmental delays and stunting at the primary healthcare level.

The highest number of children exhibited suspected delays in the personal-social and language domains, followed by fine and gross motor areas. Previous studies have also reported a higher proportion of personal-social (87.5%) and language (75%) delays compared to other aspects16. Although found in an area with a lower prevalence, a study at a day care center in Jakarta also reported most delays occur in language (14.2%) and personal-social (11.3%) aspects compared to motor aspects [18].

The association between developmental delays and stunting in this study were also found in a previous study (72.7% vs. 31.6%; $p<0.05$) [16], but not in studies with a low developmental delay prevalence [8, 18]. Stunting is associated with a negative effect, a tendency to apathy and a low interest in social communications, which could contribute to developmental delays [19]. This condition also causes a detrimental impact on school performance [19, 20]. Moreover, we found that sex, age group and nutritional status were also related to those associations. Boys were at a higher risk of developmental delay [21], while children older than two years of age had a higher risk of both stunting and developmental delays [7]. Nutritional intake is the key to both lean mass and brain development, especially during the infant and preschool periods [22]. Although other contributing factors, such as low birthweight, prematurity, maternal education and low socioeconomic level, were insignificant in this study due to an unequal distribution among groups, we could not conclude those factors as being unnecessary.

In developing countries, developmental delays are not consistently associated with stunting [8, 15]. The most accepted assumption is that parental stimulation and social environment are the major factors affecting developmental milestones [8, 9, 23].

A further prospective cohort study might add a new perspective on the associations between developmental delays and stunting, mainly on causalities and the incidence of stunting and developmental delays. This study did not assess the quantity and quality of stimulation given to the participants, primarily due to knowledge and language barriers and the limited time for interviews.

CONCLUSION

Stunting had a strong independent association with developmental delays among children aged 6–59 mo who visited a primary healthcare clinic. Stakeholders should focus on both the early detection and intervention of stunting and developmental delays at the primary care level as it would effectively prevent long-term impacts on future quality of life.

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AUTHORS CONTRIBUTIONS

All the author have contributed equally.

CONFLICT OF INTERESTS

The authors declare there are no conflicts of interest.

REFERENCES

1. Crane RJ, Berkley JA. Progress on growth faltering. Lancet Global Health 2017;5:e125-e6.
2. Bhutta ZA. Global child nutrition and the sustainable development goals. Lancet Child Adolescent Health 2017;1:256-7.
3. World Bank. Joint Child Malnutrition Estimates. UNICEF/WHO/World Bank May edition; 2018.
4. Kementerian Kesehatan Republik Indonesia. Hasil Utama Riskesdas. Jakarta: Kementerian Kesehatan Republik Indonesia; 2018.
5. Grantham McGregor S, Cheung YB, Cueto S, Glewwe P, Richter L, Strupp B, *et al.* Developmental potential in the first 5 y for children in developing countries. Lancet 2007;369:60-70.
6. Hizni A, Julia M, Gamayanti IL. Status stunted dan hubungannya dengan perkembangan anak balita di wilayah pesisir pantai utara kecamatan lemahwungkuk kota cirebon. J Gizi Klinik Indonesia 2010;6:7.
7. Sitaresmi MN, Ismail D, Wahab A. Risk factors of developmental delay: a community-based study. Paediatr Indones 2008;43:161-6.
8. Miller AC, Murray MB, Thomson DR, Arbour MC. How consistent are associations between stunting and child development? Evidence from a meta-analysis of associations between stunting and multidimensional child development in fifteen low-and middle-income countries. Public Health Nutr 2016;19:1339-47.
9. Engle PL, Black MM, Behrman JR, Cabral de Mello M, Gertler PJ, Kapiriri L, *et al.* Strategies to avoid the loss of developmental potential in more than 200 million children in the developing world. Lancet 2007;369:229-42.
10. Hall C, Bennett C, Crookston B, Dearden K, Hasan M, Linehan M, *et al.* Maternal knowledge of stunting in rural Indonesia. Int J Child Health Nutr 2018;7:139-45.
11. Budge S, Parker AH, Hutchings PT, Garbutt C. Environmental enteric dysfunction and child stunting. Nutr Rev 2019;77:240-53.
12. Bourke CD, Jones KDJ, Prendergast AJ. Current understanding of innate immune cell dysfunction in childhood undernutrition. Front Immunol 2019;10:1728.
13. Harper KM, Mutasa M, Prendergast AJ, Humphrey J, Manges AR. Environmental enteric dysfunction pathways and child stunting: a systematic review. PLoS Negl Trop Dis 2018;12:e0006205.
14. Lukman F, Sri Rattana R, Lindra A, Nimas Dwi Ayu R. editors. Empowerment of trained health volunteers to increase detection rate of children with developmental delay in urban Kendal, Indonesia. International Seminar Public Health Education; 2018.
15. Febrikaharisma MH. Hubungan antara TB/U dengan fungsi motorik anak usia 2-4 tahun. Semarang: Universitas Diponegoro; 2013.
16. Hanani R, Syauqi A. Perbedaan perkembangan motorik kasar, motorik halus, bahasa, dan personal sosial pada anak stunting dan non stunting. Semarang: Universitas Diponegoro; 2016.
17. Ozkan M, Senel S, Arslan EA, Karacan CD. The socioeconomic and biological risk factors for developmental delay in early childhood. Eur J Pediatr 2012;171:1815-21.
18. Widyastuti SB, Soedjatmiko, Firmansyah A. Growth and development profile of children at two day care centers in Jakarta. Paediatr Indones 2005;45:275-80.
19. Walker SP, Wachs TD, Gardner JM, Lozoff B, Wasserman GA, Pollitt E, *et al.* Child development: risk factors for adverse outcomes in developing countries. Lancet 2007;369:145-57.
20. Benjamin TE, Lucas Thompson RG, Little LM, Davies PL, Khetani MA. Participation in early childhood educational environments for young children with and without developmental disabilities and delays: a mixed methods study. Phys Occup Ther Pediatr 2017;37:87-107.
21. Lehr M, Wecksell B, Nahum L, Neuhaus D, Teel KS, Linares LO, *et al.* Parenting stress, child characteristics, and developmental delay from birth to age five in teen mother–child dyads. J Child Family Studies 2016;25:1035-43.
22. Gould JF. Complementary feeding, micronutrients and developmental outcomes of children. Nestle Nutr Inst Workshop Ser 2017;87:13-28.
23. Suryaputri IY, Rosha B, Anggraeni D. Determinan kemampuan motorik anak berusia 2-5 tahun: studi kasus di kelurahan kebon kalapa bogor. Penel Gizi Makan 2014;37:43-50.