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THE DETERMINANTS OF STUNTED CHILDREN BEFORE AND DURING THE COVID-19 PANDEMIC IN YOGYAKARTA, INDONESIA: A MULTILEVEL ANALYSIS

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Abstract

Stunting is related to various determinants of individual, household and social factors. This study was aimed to identify the determinants of stunting children before and during pandemic COVID-19 in Yogyakarta, Indonesia. This was cross-sectional national study used secondary data from 2018 and 2021 resourced from nutrition national surveys, central bureau of statistics, agricultural offices, stunting.go.id, and others. As many as 731 children were sampled in 2018 and 2877 in 2021. Generalized linear mixed models (GLMM) were used in STATA 15 to examine district to individual risk factors stunting children using sample weighted. Stunting decreased from 24.4% in 2018 to 17.3% in 2021. Height for Age Z-Score (HAZ scores) increased however the increase was larger in the 0-23month age group than 24-59month age. Before and during the pandemic COVID-19, stunting is linked to individual factors: children age >2 years, birth size, and underweight. Before and after the pandemic COVID-19, poverty and rural living were household stunting risk factors. Prior to and during COVID-19, the social determinants associated with stunting were DDP scores and pregnancy health insurance coverage. As a result of long-term and early-life malnutrition, various individual factors are highly associated with stunting. While food insecurity, poverty, health insurance, and rural living might promote stunting.

Keywords: Stunting, Children, COVID-19. Determinant, Multilevel

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1. INTRODUCTION

Stunting is identified as height for age Z score (HAZ) less than -2 Standard Deviation. Stunting is related with chronic malnutrition that occurs at critical times since pregnancy and recurrent infections mainly from the first 1000 days of life [1]. This malnutrition impacts all periods of human life, increases the risk of mortality and morbidity, decreases cognitive scores, as well as low IQ and learning achievement, and developmental delay [2], [3]. In the long term, malnutrition in toddlerhood increases the risk of metabolic syndrome disorders[2], [4] and non-communicable diseases such as coroner heart disease [5,6], insulin resistance [6,7], decreases work productivity [8–10], increases Day Adjusted Life Year (DALY) [10], disadvantage to country's economy and hinders country development [12–14].

Stunting is a global problem, especially in low- and middle-income countries. According to WHO as many as 149.2 million or 22% of toddlers in the world suffer from stunting [14]. In Indonesia, the number of stunting children is slightly higher than that of the world's, i.e. 24.4%. Yogyakarta Province is smaller than Indonesia at 17.3%, and Yogyakarta has the third lowest prevalence after Bali (10.9%) and Jakarta (16.8%) [15]. The World Health Assembly (WHA) has set a specific sustainable development target (SDG's) of reducing stunting as much as 40% by 2024 [16]. In line with it, Indonesia's National Medium-Term Development Plan for 2020-2024, states that stunting prevalence is targeted at 14% in 2024 [17].

Stunting is caused by multifactor including social, household and individual factors related to the characteristics of children. The social factors comprise of government policies, Human Development Index (HDI), Dietary Diversity Pattern (DPP) scores, economic growth, national health insurance coverage, complete immunization coverage, household coverage with good sanitation and district/city characteristic [18]. Meanwhile, household factors are economic status, parental education, parental occupation, living environment, hygiene sanitation and clean water access, food availability, access of health facilities and services, and urban and rural living settings. Individual factors related to stunting are children age, gender, weight and length of birth, history of illness, breast milk, weaning food, and maternal factors such as maternal height, ANC (ante natal care), health insurance ownership, and others [20–23]. Since 2020, Indonesia and all countries in the world have experienced the COVID-19 pandemic which impacted all aspects of human life including toddlers and children health. Based on a 2020 UNICEF survey, as much as 42% of households and children are experiencing access reduction to health and nutrient intake [23]. This condition is exacerbated if the parents also have income reduction, job loss, domestic violence, stigma, parenting and child protection problem and other social problems [24–26]. According to surveys in the stunting locus areas in Yogyakarta, most of areas are severely affected, and the most related indicators are growth monitoring, vitamin A supplementation, infant and child feeding, and supplementary food distribution [26]. In addition, the pandemic COVID-19 has an effect on increasing wasting from 1.08% in 2018 to 2% in 2021 [28], thereby heightening the risk of stunting severity and possibly impeding efforts to accelerate stunting reduction[29,30]. This study was aimed to identify

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the determinants of stunting in children before and during the COVID-19 pandemic in Yogyakarta Province, Indonesia.

2. METHOD

2.1 Research Design

This study was a cross-sectional study conducted with secondary data to identify the multi-level determinants of stunting, before and during the COVID-19 pandemic.

2.2 Study Outcome and Variables

Study outcome was stunting children, divide into two: normal and stunting. Individual level including all of individual characteristics, household level including parental characteristics and environment, and social level determinant such as HDI, DDP, and health program coverage.

2.3 Population and Sample

The survey population was all children who sampled in 2018 Basic Health Research as the representative the condition before the COVID-19 pandemic, meanwhile the 2021 Indonesia Nutrition Status Survey represents the condition during the COVID-19 pandemic. The number of toddler sample in the 2018 survey was 731 and in the 2021 survey was 2877 and we adjusted using weighted sample.

2.4 Data Collection Technique

We use multiple resources data social determinant of stunting including provincial and regency health offices, statistic office, agricultural office, local development planning office from official government website. While households and individual determinant of stunting were obtained from the 2018 Basic Health Research and the 2021 Indonesia Nutrition Status Survey.

2.5 Data Management

The survey data was analyzed in univariate, bivariate, multivariate, and multilevel using STATA software version 15. Univariate analysis was carried out to describe the descriptive stunting trend of the variables studied. The bivariate analysis was performed to determine the relationship between social, household and individual factors and stunting children. The variables in the results of bivariate analysis that have $p < 0.25$ subsequently were included in the multivariate analysis. The multivariate analysis employed backward process method then the confounder selection was carried out by calculating (OR Crude–OR)/AORx100%. Multilevel analysis was conducted to reveal the relationship between social, household as well as individual-level risk factors and stunting hierarchically with multilevel generalized linear mixed models (GLMM). A collinearity test was applied to detect the presence of bias with Cramer's V test.

2.6 Ethics Approval

This study approved by the Health Research Ethics Committee of Polytechnic of Health of Yogyakarta No: e-KEPK/POLKESYO/0223/II/2022, dated February 23th, 2022.

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3. RESULT AND DISCUSSION

3.1 Trends of Stunting Children in Yogyakarta before and During the COVID-19 Pandemic

In general, there was a decrease of stunting prevalence in Yogyakarta from 24.4% in 2018 to 17.3% in 2021. Three districts experienced a decreased number of stunting children when others had a little bit more. In Yogyakarta, the average rate of stunting reduction over the past three years has been 2.4%. As detailed depicted in Figure1.

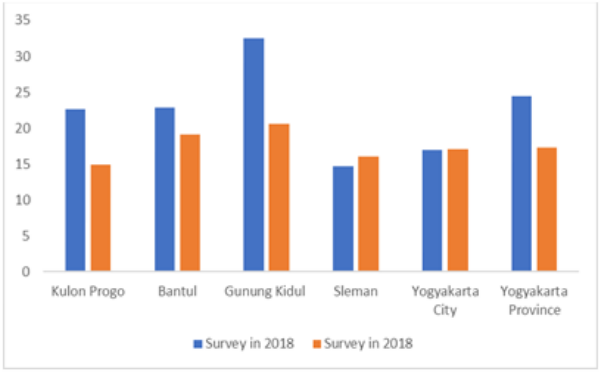

Figure 1: Prevalence of stunting children before and during the COVID-19 pandemic in Yogyakarta

Despite of the COVID-19 pandemic disaster, the prevalence of stunting in Yogyakarta has continued to decrease, in accordance with the government-mandated acceleration of stunting reduction [29]. The average speed of stunting reduction is higher than other countries such as Peru [30], Nigeria [31], Ethiopia [32], Kyrgyz Republic [33], Vietnam [34] dan Nepal [30].

Futhermore, factors that drive the acceleration of stunting reduction in Yogyakarta were governance aspects, the achievement of sensitive and specific nutritional intervention indicators which continued to increase since 2018 [35]. The government has committed to encourage the efforts of accelerating the reduction of stunting prevalence through Presidential Regulation no. 72 of 2021 and establishing Stunting Reduction Acceleration Team, constituted from provincial to village levels as an implementation of the decree of the National Family Planning Board No 12 of 2021 on national action plan for stunting reduction acceleration. In the region, the commitment and leadership of Yogyakarta government is contained in the Governor Regulation No. 92 of 2020 concerning the acceleration of stunting reduction. A local stunting prevention innovations such as GeTAR Thala (Movement to Overcome Anemia and Adolescent Thalassemia), PANdu TEMan (Integrated Antenatal Care Service towards Triple Elimination Involving All Services), Pecah Ranting Hiburane Rakyat (Prevention of Stunting Prone to Eliminate Malnutrition Improve the People's Economy)- an effort to improve the nutrition and economy of the people in an integrated program, and Gambang Stunting (Movement to Consider Preventing and Overcoming Stunting) also contribute stunting reduction [36]. The government by synergizing academics on penta-helix aspects also continues to carry out behavior change campaigns through various strategies such as education [37], home visit

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[44,45] and integrated interventions [40], as well as advocacy to local leaders to encourage the rational use of village funds [41].

This decrease in stunting is not only shown by the decrease in prevalence but also accompanied by the quality of children's health, which can be seen from the increase in HAZ. Where stunting is <-3 HAZ, stunting is -3 to -2 HAZ, and normal is <-2 HAZ. As detailed in Figure 2.

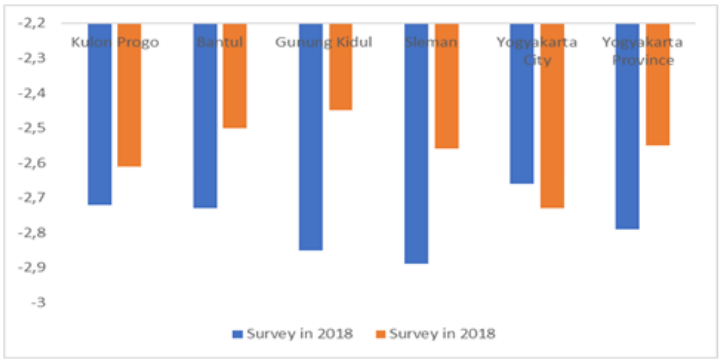

Figure 2: HAZ score of children 0-59 months before and during the COVID-19 in Yogyakarta

When compared to older ages, the 0-23month age group saw greater increases in their HAZ scores than the other age groups. It is possible to explain why the objective of the first one thousand days of a person's existence is emphasized in the focus of efforts to enhance nutrition [38,39]. The first one thousand days of a person's existence are a golden era that provide possibilities for improving nutrition with optimal results [44], improving human resources and public health degrees [42] and improving welfare throughout their lifetimes[45].

3.2 Characteristics of Children before and During the COVID-19 Pandemic

Most of the children were female, living in urban areas, have no illness history, immunized, fully exclusive breast-milk, and experienced early breast-milk initiation. As detail in Table 1.

Table 1: Individual Chidren's Characteristics

Characteristics	Before pandemic (n = 731)		During pandemic (n = 2877)		Total	
	n	%	n	%	n	%
Origin						
Kulon Progo Regency	142	11.5	450	11.2	592	11.3
Bantul Regency	164	24.5	737	28.4	901	27.5
Gunung Kidul Regency	149	18.1	578	17.5	727	17.8
Sleman Regency	189	33.6	692	32.9	881	33.3
Yogyakarta City	87	10.2	420	9.9	507	10.1
Gender						
Male	385	51.8	1463	50.6	1848	51.2
Female	346	48.17	1414	49.4	1760	48.8

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Characteristics	Before pandemic (n = 731)		During pandemic (n = 2877)		Total	
	n	%	n	%	n	%
Residential setting						
Urban	497	74.8	1997	75.7	2494	75.21
Rural	234	25.3	880	24.4	1114	24.8
Illness history						
No	644	87.1	2759	96.0	3403	91.6
Yes	87	12.9	118	0.4	205	8.4
Immunization						
No	162	20.9	18	0.1	180	10.7
Yes	569	79.1	2859	99.4	34228	89.3
Exclusive breast-milk						
Yes	508	68.3	752	84.8	1260	72.2
No	223	31.7	131	15.2	354	27.8
Early breast-milk initiation						
Yes	194	68.5	574	57.0	768	62.6
No	76	31.5	470	43.0	546	37.4

3.3 Characteristics of Households before and During the COVID-19 Pandemic

Most of the children were from legal married families, mothers are high school educated, do not work, have proper drinking water and sanitation facilities. Unfortunately, the subset data of stunting risk factors before and during the COVID-19 pandemic are not the same, so that some variables are not available. Characteristics of households depicted in Table 2.

Table 2: Household Characteristics Before and During the COVID-19 Pandemic

Characteristics	Before pandemic (n = 731)		During pandemic (n = 2877)	
	n	%	n	%
Parental marriage status				
Married	700	99.1	2810	98.7
Divorced	8	0.1	27	0.1
Death divorced	3	0.1	10	0.1
Maternal education level				
Elementary school	55	8.2	199	7.8
Junior high school	54	19.8	175	18.9
Senior high school	352	49.6	1472	51.7
College	149	22.0	607	22.2
Maternal occupation				
Not working	380	52.2	1342	46.6
Student	4	0.1	11	0.1
Civil servant/military/police	22	0.3	67	0.3
Clerk	103	2.0	624	0.2
Entrepreneur	101	2.0	370	1.0
Farmer	19	0.3	111	0.4
Labor	49	0.7	159	0.6
Others	33	0.5	163	0.5
Paternal education level				
Elementary school	65	10.0	-	-

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Characteristics	Before pandemic (n = 731)		During pandemic (n = 2877)	
	n	%	n	%
Junior high school	97	16.3		
Senior high school	319	54.6	-	-
College	108	18.6	-	-
Paternal occupation			-	-
Not working	4	0.6	-	-
Civil servant/military/police	34	5.1	-	-
Clerk	156	27.8	-	-
Entrepreneur	177	32.8	-	-
Farmer	64	08.1	-	-
Fisherman	1	0.3	-	-
Labor	135	22.4	-	-
Others	18	3.0	-	-
Water source				
Adequate	645	89.9	2604	92.0
Inadequate	86	10.1	273	8.0
Water supply				
Clean	631	88.5	2641	92.4
Not clean	100	11.5	236	7.6
Maternal smoking behavior				
Yes, every day	5	0.1	-	-
Yes, not every day	19	25.9	-	-
Never	687	96.4	-	-
Paternal smoking behavior			-	-
Yes, every day	352	58.9	-	-
Yes, not every day	144	22.9	-	-
Never	93	18.2	-	-
National health insurance				
Yes	-	-	2346	82.3
No	-	-	485	17.2
Does not know	-	-	16	0.5
Property index	-	-		
Quintile 1	-	-	238	78.9
Quintile 2	-	-	682	23.6
Quintile 3	-	-	565	19.0
Quintile 4	-	-	598	20.9
Quintile 5	-	-	794	28.7
Latrine ownership	-	-		
Yes, private owned and used	-	-	2671	93.3
Yes, private owned communal used	-	-	123	0.1
Yes, private owned but not used	-	-	4	0.1
No	-	-	79	0.2
Mother get iron supplementation	-	-		
Have ever get	-	-	2658	93.1
Never	-	-	140	5.1
Does not know	-	-	39	1.9

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3.4 Fixed Model Analysis of Stunting Determinants before and During the COVID-19 Pandemic

The analysis show that before and during the COVID-19 pandemic, factors related to stunting based on individual factors were age >24 months, underweight, low birthweight, and short birth length. Meanwhile, the household factors related to stunting before COVID-19 pandemic was living in rural areas and during pandemic was economic factors. The social factors related to stunting before and during COVID-19 were DDP scores and Pregnancy health insurance coverage. As detail in Table 3.

Table 3: Multilevel Analysis of Stunting Risk Factors before & During the COVID-19 Pandemic

Variable	Before pandemic RRR CI 95%	During pandemic RRR CI 95%
Individual Level		
Age		
0-23 month		1
24-59 month	1.20 (1.19-2.11)*	1.29 (1.11-1.71)*
Underweight		
No	1	1
Yes	15.66 (7.57-32.39)*	28.2 (13.33-59.65)*
Wasted		
No	1	1
Yes	0.06 (0.04-1.43)	0.3 (0.11-0.78)
Birth weight		
Normal	1	1
LBW	1.51 (1.02-4.22)*	1.86 (1.35-2.10)*
Short birth length	0.88 (0.76-0.98)*	0.86 (0.81-0.91)*
Immunization coverage		
Complete	-	1
Not complete	-	0.77 (0.10-57.69)
Household Level		
Residential	-	
Urban	1	1
Rural	1.49 (1.055-2.61)*	0.95 (0.68-1.32)
Maternal education		
Never schooling	1	-
Graduated elementary school-Senior high school	0.41 (0.006-2.87)	-
College	0.43 (0.05-3.50)	
Paternal education		
Never schooling	1	-
Graduated elementary school-Senior high school	0.56 (0.14-2.23)	-
College	0.52 (0.11-2.47)	-
Maternal occupation	-	
Not working	-	1
Working	-	0.96 (0.73-1.26)
Water facility	-	
Clean/protected	-	1

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Variable	Before pandemic RRR CI 95%	During pandemic RRR CI 95%
Not clean	-	0.2 (0.11-1.36)
Property quintile	-	
Quintile 5	-	1
Quintile 4	-	1.18 (0.77-1.80)
Quintile 3	-	1.36 (0.89-2.07)
Quintile 2	-	1.70 (1.13-2.55)*
Quintile 1	-	2.53 (1.49-4.27)*
Latrine ownership	-	
Yes	-	1
No	-	1.20 (0.58-2.47)
Social Level	-	
HDI	1.18 (0.64-3.06)	1.29 (0.92-2.01)
DDP	1.45 (1.29-3.06)*	1.25 (1.20-2.97)*
Pregnancy health insurance coverage	1.67 (1.01-2.56)*	1.34 (1.21-2.88)*
Complete immunization coverage	-	0.84 (0.10-6.88)
Household with adequate sanitation coverage	-	1.05 (0.67-98.73)

*p<0.0

In this study, both before and during the COVID-19 pandemic, consistently the older age, LBW, short of birth, and underweight were related to the risk of stunting. This finding was consistent with previous studies with the data of 2013 Basic Health Research in urban areas in Indonesia [46], children in the Philippines [47], Tanzania [48], in Ethiopia [49], and in some LMIC [50]. Some of the causal factors related to older stunting children are: 1) beginning in utero and continuing for around three years after delivery, stunting is a cumulative process so that not surprisingly, that the risk of stunting increased with age [49], 2) some interventions such as nutritional intervention packages are prioritized at first 1000 days of life, so that toddlers at the age above >24 months is not covered as the main focus of stunting prevention [39], 3) the protective effect of breast milk decreases as the toddlers get older, toddlers enter the weaning age [51] or simply the opposite to become prolong breastfeeding [52] as well as inadequate intake, IYCF and weaning food [68–70]. The size of the birth relates to micro- and macro-malnutrition, as well as maternal health status during pregnancy[55]. If malnutrition occurs in pregnancy, it will increase the risk of impaired performance of important organs, including the heart, blood vessels[56,57], and insulin resistance [57]. The performance of babies born to malnourished mothers depends largely on the period of malnutrition. If the mother is malnourished in the first trimester, the baby born tends to be small (short and underweight), whereas if the malnutrition occurs in the second trimester, the baby tends to be thin, and if the malnutrition occurs in the third trimester, the babies will have normal weight but be short[58]. The early period of life is a critical time. In the womb, there is developmental plasticity, i.e., when a system is plastic and sensitive to the environment. Then the next period is the loss of plasticity and sedentary functional capacity.

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In addition to malnutrition during pregnancy, which affects the size of the infant at birth, malnutrition in adolescents during the postnatal period can increase the risk of morbidity and mortality. As a result, children will fail to grow, fail to develop, and shorten because they do not reach their height milestones. This has a negative impact on their performance, increases the risk of infectious diseases, and reduces the likelihood of child survival[59]. In countries with high neonatal mortality, malnutrition accounts for 15% of the total number of life years lost due to disability[60]. Children who are malnourished are 8.4 times more likely to perish before the age of five than those who are well-nourished[61]. Aside from this, underweight children decrease human productivity and increase the risk of economic losses between Rp 3,054 billion (2%) and Rp 13,740 billion (9%)[62].

In this study, several social factors were also found related to stunting in the before and during pandemic period, including DDP scores and health insurance for pregnant women. Meanwhile, during the COVID-19 pandemic, poverty is a structural factor related to stunting. The underline assumption is that many attributes related to limitations in rural areas and poor communities include food access, maternal education, maternal knowledge, parenting and attention to their children [63]. The DDP score represents food diversity that is very close to stunting, as shown previous studies in Yogyakarta [64], East Java [65], and overall Indonesia [66]. Health insurance is also related to stunting as has been proven in West Sulawesi [67], and Uganda [68]. However, this study has limitations in explaining causality relationships because the study design used is cross-sectional, the subset of data analyzed is not comprehensive so that direct variables related to the nutritional status of toddlers such as consumption and infection are not available.

4. CONCLUSION

Stunting prevalence was fell and HAZ scores was increased during COVID-19 pandemic. But, the reduction in stunting prevalence and severity needs to be accompanied by an impact evaluation because stunting affects all periods of human life. Before and during the COVID-19 pandemic, stunting was connected to age >2, birth size, and underweight. Poverty and rural living risked household stunting before and after COVID-19. DDP scores and pregnancy health insurance covered stunting before and during COVID-19. Long-term and early-life malnutrition causes stunting as well as food insecurity, poverty, health insurance, and rural life may cause stunting. This finding implies that mitigating measures are necessary to prevent new stunting caused by other social catastrophes related to economic and food crises.

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