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Risk factors of stunting during the complementary feeding period 6-23 months in the Philippines

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ABSTRACT

Introduction: Stunting persists as a public health problem in the Philippines, affecting 30% of under-five children. This study aimed to identify the drivers of stunting in young Filipino children aged 6-23 months. **Methods:** Data were extracted from the cross-sectional Updating Survey conducted in 2015 by the Food and Nutrition Research Institute of the Department of Science and Technology (FNRI-DOST). Potential predictors of stunting, which were categorised into child-related characteristics, feeding practices, maternal socio-demographic status and health practices, and household economic and food security status, were examined using descriptive and regression analyses. **Results:** Of the 2,275 children aged 6-23 months, 18.7% were stunted and 8.3% were severely stunted**.** The risk of stunting increased significantly among older children aged 12-23 months (relative risk ratio, RRR 3.04), males within 6-23 months of age (RRR 1.99), and low-birth-weight infants (RRR 2.19). Children born from teenage mothers (RRR 1.90), mothers with short stature (RRR 2.33), and mothers with low education (RRR 1.59) posed higher risks of becoming stunted relative to their counterparts. Mothers with >4 children (RRR 2.44), coming from the poorest households (RRR 4.27), having untimely introduction of complementary foods (RRR 4.44), and not meeting the minimum meal frequency (RRR 2.30) increased the risks of severe stunting. **Conclusion:** The study illustrated the multi-factorial nature of stunting among Filipino children aged 6-23 months old. Therefore, a multi-sectoral approach is needed to address the underlying factors of stunting among young Filipino children to help achieve the country's nutrition targets by 2025.

Keywords: Stunting, complementary feeding, 1000 days, Philippines

INTRODUCTION

Stunting during the first two years of life has gained global attention due to its immediate and long-term irreversible consequences on individual development, including poor physical growth, poor cognitive and psychomotor developments, poor school performance, reduced work capacity, and adverse pregnancy outcomes (Agedew, 2015). The key implication is grounded on a very narrow window of time during which stunting can be reversed or prevented by nutrition interventions, with little or no catch-up growth beyond the first 1,000 days period (UNICEF, 2013).

Children are considered stunted if their height-for-age is >2 standard deviations (*SD*) below the median distribution provided in the World Health Organization (WHO) Child Growth Standards (WHO, 2006).

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Stunting, based on a lifecycle approach, starts *in utero* and continues during the first two years of life due to inappropriate breastfeeding and complementary feeding practices, micronutrient deficiency, and repeated infections, which can trap a child in a vicious cycle of malnutrition (UNICEF, 2019). Evidence from large-scale studies showed that mothers who suffered from stunting in childhood are at greater risks of having stunted children (Black *et al.*, 2013). Similarly, children being small for their gestational age (both pre-term and term) are strongly associated with maternal height and low body mass index (BMI), which are in turn associated with adolescent health and pregnancy (Christian *et al.*, 2013). In addition, a longitudinal study conducted in Cebu, Philippines showed that the likelihood of stunting is increased by diarrhoea, febrile respiratory infections, and early supplemental feeding (Adair & Guilkey, 1997).

The WHO considers childhood stunting as one of the most significant barriers to human development. Moreover, one of the six global nutrition targets for 2025 aims to reduce the global number of children under five who are stunted by 40% (WHO, 2014). In order to help attain the country's sustainable development goal targets by 2030, the Philippine government, through its development plan and nutrition strategy laid out in the Philippine Plan of Action for Nutrition, set the target of reducing stunting by 20% by 2022. The Philippines' nationally representative survey data in 2015 showed that nearly one in every five children <5 years of age was stunted, and that figure remained unchanged over the years (FNRI-DOST, 2016). A similar picture is depicted among children <2 years of age, where only a 5.0% reduction in stunting prevalence was observed between 2003 and 2015 (FNRI-DOST, 2016). Significant linear growth faltering and micronutrient deficiencies start in the second six months of infancy, when complementary foods are essential to provide sufficient diet for growth and development. Based on the recent nutrition survey in 2018, less than half (48.5%) of the children aged 0-23 months were appropriately breastfed while receiving timely complementary foods.

Given this evidence, the WHO (2014) recommended that context-specific factors should be considered in designing nutritional approaches to accelerate the rate of reduction. Since reduction in stunting prevalence among children under two is low in the Philippines, this study aimed to identify the determinants of stunting in young children 6-23 months old who are in the critical stage of complementary feeding period. Results could provide evidence for the government and other developmental agencies to design context-specific interventions and strategies to help accelerate the reduction rate of stunting during the first 1,000 days of life in the Philippines and other similar countries.

METHODS AND MATERIALS

Study design and participants

The study utilised secondary data from the cross-sectional Updating Survey (UPS) conducted in 2015 by the FNRI-DOST (FNRI-DOST, 2016). The 2015 UPS adopted the household listings from the 2003 Master Sample (MS) of the Philippine Statistics Authority. The MS was derived from a multi-stage stratified sampling design where the first stratification was based on the country's 17 administrative regions as the primary sampling domain or primary strata. Sub-stratum was created from each of the provinces, highly urbanised cities, and component cities. The province is the largest unit in the political structure of the Philippines and consists of varying numbers of municipalities and component cities, depending on geographic size. From each of the sub-stratum, primary sampling units (defined as a barangay or contiguous barangays with at least 500 households,

from both urban and rural areas) were generated. From these, enumeration areas (EAs) consisting of 150 to 200 households were drawn. The third and final stage of sampling involved the selection of households from the EAs as ultimate sampling units where the subjects were drawn. All children aged 6-23 months from sample households, along with their demographic and economic information, infant and young child feeding practices, and maternal characteristics, were included in the study.

Data collection

Face-to-face interviews were conducted by trained field workers among mothers/ caregivers of children 6-23 months old using a pre-tested questionnaire uploaded in the electronic Data Collection System (e-DCS) to collect all relevant information on the child, including feeding practices, maternal, and household information. To identify the child's feeding practices, the child's actual food intake from the previous day was obtained from the mother or primary caregiver through a 24-hour food recall using a paper-based questionnaire and measuring tools. The mother or caregiver was asked about the child's complete food intake starting from the time the child woke up and ending when the child fell asleep at night. For breastfeeding babies, the number of times the baby breastfed throughout the day and night was also asked. Recumbent length was measured by trained field workers using an infantometer following standard protocols. Length referred to the measurement in recumbent position, the recommended way to measure children <2 years of age or <85 cm tall. At least two measurements were obtained, and averages were computed and recorded to the nearest 0.1 cm. Age in months was computed to determine the nutritional status of the children.

Study variables

Dependent variables

a. Stunting was determined based on the WHO Child Growth Standards (WHO, 2006) length-for-age *z*-score of children <-2SD of the reference mean.
b. Severe stunting was determined based on the WHO Child Growth Standards (WHO, 2006) length-for-age *z*-score of children <-3SD of the reference mean.

Independent variables

a. Child characteristics included age in months (6-11 months and 12-23 months), sex, and birth weight (<2,500g and ≥2,500g).
b. Maternal characteristics included maternal age (<20, 20-29, and ≥30 years), height (<151cm and ≥151cm), using 151cm as the average height of Filipino women based on the 2015 UPS of the FNRI-DOST; BMI (<18.5, 18.5-24.5, >24.5 kg/m2); parity (1, 2-3, ≥4); educational attainment (primary level or lower, secondary level, tertiary level); employment status (working, not working); number of antenatal check-ups (1-3 and 4 or more); received nutrition advice during antenatal care (yes, no); intake of iron-folic acid (IFA) (with, without); method of delivery (normal delivery, caesarean section delivery); place of delivery (at home and others, health facility); and assistance during delivery (health professionals, traditional birth attendant and others).
c. Household characteristics included household food security status (food insecure, food secure), based on the Household Food Insecurity Access Scale (HFIAS); wealth status (poorest, poor, middle, rich, richest), computed

based on household wealth index; area of residence (rural, urban); toilet facility, classified as improved (water sealed toilet) or not improved (no toilet/not water-sealed/open pit); and household size (≤5, >5).

d. Infant and young child feeding practices included the WHO-UNICEF core indicators of appropriate complementary feeding, such as: a) prelacteal feeding, referring to the practice of temporarily giving any liquid food within the first three days of life while waiting for breastfeeding to be established; b) timely introduction of solid, semisolid, or soft foods, which refers to the giving of solid, semisolid, or soft foods to children aged 6-8 months; c) minimum dietary diversity, which refers to the giving of foods to children 6-23 months old from at least four of the seven food groups, namely grains, roots and tubers, legumes and nuts, dairy products (milk, yoghurt, cheese), flesh foods (meat, fish, poultry, and liver/organ meats), eggs, vitamin A-rich fruits and vegetables, and other fruits and vegetables; d) minimum meal frequency, which refers to the feeding frequency during the previous day, i.e., two times for breastfed infants aged 6-8 months, three times for breastfed children aged 9-23 months, three times for non-breastfed children aged 6-23 months. 'Meals' included meals as well as snacks (other than trivial amounts), and frequency was based on caregiver's report; e) minimum acceptable diet (MAD), which was determined using both minimum dietary diversity and minimum meal frequency as criteria for meeting MAD. All other indicators were based on the 24-hour recall of infant's dietary intake as reported by the mother.

Ethical consideration

The 2015 UPS of the Nutritional Status of Filipino Children and Other Population Groups was approved by the FNRI Institutional Ethics Review Committee. Information regarding the survey's purpose, objectives, and procedures were discussed with the respondents before obtaining their verbal and written informed consent to participate in the survey.

Statistical analysis

Descriptive statistics, such as means and percentages, were used to describe the children aged 6-23 months who were sampled in the study. Sampling weights were calculated as the product of base-weights, (unit) non-response adjustment, and post-stratification adjustment. Post-stratification adjustments were made to ensure that the survey estimates conformed to well-known population by age-sex distribution. Thus, all estimates, such as proportions and regression analysis, were computed based on weighted data. Bivariate analysis was done to test the association of stunting with child-related characteristics and feeding practices, as well as maternal and household characteristics. Pearson's Chi-square test was performed to determine the association of each predictor with stunting. All independent variables with significant associations with child stunting were entered into the multinomial logistic regression analysis. The coefficients of the multinomial logistic regression model were interpreted in terms of relative risk ratio (RRR). In the final model, potential risk factors associated with stunting and severe stunting among children 6-23 months old were determined. All statistical analyses were done using

Table 1. Characteristics of study children 6-23 months old and their mothers, and the socio-demographic and economic status of households: Philippines, 2015 (*n*=2,275)

Characteristics	*n*	*Proportion*	*95% Confidence Interval*	
			LL	*UL*
Child characteristics				
Age in months				
6-11	797	35.1	33.0	37.3
12-23	1478	64.9	62.7	67.0
Sex				
Male	1155	49.9	47.7	52.1
Female	1120	50.1	47.9	52.3
Birth weight				
<2,500g	314	13.2	11.6	14.9
≥2,500g	1961	86.8	85.1	88.4
Maternal characteristics				
Age in years				
<20	149	6.7	5.6	7.8
20-29	1130	50.6	48.4	52.8
≥30	996	42.8	40.7	44.9
Height				
<151 cm	1060	45.5	43.3	47.8
≥151 cm	1215	54.5	52.2	56.7
BMI (kg/m^2)				
<18.5	309	13.4	12.0	14.9
18.5-24.5	1326	58.3	56.1	60.6
>24.5	640	28.3	26.2	30.4
Parity				
1	712	31.9	29.8	34.0
2-3	966	42.9	40.7	45.1
≥4	597	25.3	23.5	27.1
Educational attainment				
Primary level or less	328	13.3	11.8	14.9
Secondary level	1207	54.1	51.9	56.4
Tertiary level	740	32.6	30.5	34.7
Employment status				
Working	487	21.7	19.9	23.6
Not working	1788	78.3	76.4	80.1
Number of prenatal check-ups				
1-3	283	12.0	10.6	13.6
4 or more	1992	88.0	86.4	89.4
Received nutrition advice during ANC				
No	991	42.5	40.2	44.9
Yes	1284	57.5	55.1	59.8
Intake of IFA				
Without	1994	87.8	86.1	89.4
With	281	12.2	10.6	13.9

Table 1. Characteristics of study children 6-23 months old and their mothers, and the socio-demographic and economic status of households: Philippines, 2015 (*n*=2,275) [Cont'd]

Characteristics	*n*	*Proportion*	*95% Confidence Interval*	
			LL	*UL*
Method of delivery				
Normal	2021	88.4	86.7	89.9
Caesarean	254	11.6	10.1	13.3
Place of delivery				
At home	262	10.9	9.5	12.5
Health facility	2013	89.1	87.5	90.5
Assistance during Delivery				
Doctor/Nurse/Midwife	2113	93.4	92.2	94.4
Traditional birth attendant and others	162	6.6	5.6	7.8
Household characteristics				
Household size				
≤5	835	36.5	34.4	38.6
>5	1440	63.5	61.4	65.6
Food security status				
Food insecure	1712	74.6	72.5	76.6
Food secure	563	25.4	23.4	27.5
Wealth quintile				
Poorest	516	19.5	17.9	21.1
Poor	545	21.8	20.0	23.6
Middle	476	21.6	19.8	23.5
Rich	406	20.1	18.3	22.0
Richest	332	17.1	15.3	19.0
Area of residence				
Rural	1322	50.6	47.9	53.3
Urban	953	49.4	46.7	52.1
Toilet facility				
No toilet/not water-sealed/open pit	283	11.3	10.0	12.8
Water-sealed	1992	88.7	87.2	90.0

the statistical software package STATA version 15 (Corp LLC, Texas, USA). The level of significance was set at $p<0.05$ for all statistical tests performed.

RESULTS

General profile of study children

Table 1 shows the characteristics of study children and their mothers, as well as the socio-demographic and economic status of the households. The study covered 2,275 young children aged 6-23 months, which was composed of children aged 6-11 months (35.1%) and 12-23 months (64.9%), with almost equal representation of boys (49.9%) and girls (50.1%). Less than one-fifth of the study children (13.2%) were low-birth-weight (<2,500g). Most mothers of the study children were ≥20 years old (93.4%). More than half (58.3%) of mothers of the study children had normal BMI, while 13.4% were undernourished and 28.3% had BMI above normal. Almost half of

the mothers (45.5%) were under 151 cm in height. About one-third (31.9%) were first time mothers, while 42.9% had 2-3 children and 25.3% had ≥4 children. More than half (54.1%) of the mothers reached secondary level, while 32.6% were at tertiary level in terms of educational attainment. Majority of the mothers (78.3%) were not working at the time of the survey. Most of them (88.0%) received at least 4 times of prenatal check-ups throughout the course of their pregnancy. More than half (57.5%) received nutrition advice during prenatal check-up, while only 12.2% reported having consumed iron-folic acid supplements during their pregnancy. Meanwhile, most mothers (88.4%) delivered their child through normal delivery, in a health facility (89.1%), and with the assistance of health professionals (93.4%). More than two-thirds (63.5%) of the children belonged to households with >5 members. Majority of the study children (74.6%) belonged to food insecure households and many were from poor households (41.3%). An almost equal proportion of children were from rural (50.6%) and urban (49.4%) areas. Most households had improved toilet facility.

Prevalence of stunting in relation to child, maternal and household characteristics

Stunting and severe stunting prevalence by child characteristics are presented in Table 2. Stunting and severe stunting were significantly higher among older children aged 12-23 months (23.1% and 11.0%, respectively), boys (22.7% and 10.4%, respectively), and low-birth-weight children (28.3% and 13.1%, respectively) than their subgroup counterparts. Moreover, stunting and severe stunting were significantly higher among children born from mothers with height <151 cm (24.7% and 12.2%, respectively), and with BMI <18.5 kg/m^2 relative to their counterpart children. Similarly, stunting and severe stunting were higher among children 6-23 months old whose mothers had lower educational attainment (28.1% and 10.8%, respectively) and were not working (20.0% and 7.9%, respectively), compared to children whose mothers reached at least secondary level of education (14.9% and 6.5%, respectively) and were working (14.4% and 9.8%, respectively). More severely stunted children were noted among those born via normal as opposed to caesarian delivery (9.0% vs. 3.0%), born at home than at a health facility (15.2% vs. 7.5%), and born through the assistance of traditional birth attendants than of health professionals (17.3% vs. 7.7%). In terms of household characteristics, higher proportions of severely stunted children were recorded from food insecure (9.3%) than from food secure households (5.4%). Stunting was also higher among children from the poorest (21.6%) and poor households (24.3%) than those from the richer households (12.4%). Likewise, cases of stunting and severe stunting were higher among households with unimproved toilet facilities (24.3% and 14.6%, respectively) compared to households with water-sealed toilet facilities (18.0% and 7.5%, respectively).

Prevalence of stunting in relation to feeding practices

Table 3 shows the prevalence of stunting by feeding practices of children 6-23 months old. Provision of prelacteals, timing of introduction to complementary foods, minimum meal frequency (MMF), and MAD were found to be significantly associated with stunting and severe stunting. Children who did not receive prelacteals (20.0%) had a higher prevalence of stunting than those who were given prelacteals (14.6%). A greater percentage of children who were introduced to complementary foods either too early or too late were stunted (20.4%) and severely stunted (9.6%) compared to those who received timely

Table 2. Prevalence of stunting and severe stunting in children 6-23 months old by child, maternal, and household characteristics: Philippines, 2015 (*n*=2,275)

Characteristics	*Stunted*		*Severely stunted*	
	HAZ <-2SD (%)	*p-value*	*HAZ <-3SD (%)*	*p-value*
Child characteristics				
All	18.7		8.3	
Age in months		<0.01*		<0.01*
6-11	10.8		3.4	
12-23	23.1		11.0	
Sex		<0.01*		<0.01*
Boys	22.7		10.4	
Girls	14.8		6.2	
Birth weight		<0.01*		<0.01*
<2,500g	28.3		13.1	
≥2,500g	17.3		7.6	
Maternal characteristics				
Age in years		0.08		0.57
<20	25.5		6.0	
20-29	18.0		8.6	
≥30	18.6		8.4	
Height		<0.01*		<0.01
<151 cm	24.7		12.2	
≥151 cm	13.7		5.1	
BMI (kg/m^2)		0.22		0.02*
<18.5	22.3		10.5	
18.5-24.5	17.9		9.0	
>24.5	18.8		5.9	
Parity		0.41		<0.01*
1	17.7		6.1	
2-3	18.4		7.8	
≥4	20.6		12.2	
Educational attainment		<0.01*		0.05*
Primary level or less	28.1		10.8	
Secondary level	18.8		8.9	
Tertiary level	14.9		6.5	
Employment status		<0.01*		0.18
Working	14.4		9.8	
Not working	20.0		7.9	
Number of prenatal check-ups		0.94		0.04*
1-3	18.9		11.9	
≥4	18.7		7.9	
Received nutrition advice		0.58		0.09
No	19.3		9.5	
Yes	18.3		7.5	
Intake of IFA		0.82		0.83
Without	18.8		8.4	
With	18.2		8.0	

Table 2. Prevalence of stunting and severe stunting in children 6-23 months old by child, maternal, and household characteristics: Philippines, 2015 (*n*=2,275) [Cont'd]

Characteristics	*Stunted*		*Severely stunted*	
	HAZ <-2SD (%)	*p-value*	*HAZ <-3SD (%)*	*p-value*
Method of delivery		0.07		<0.01*
Normal	19.3		9.0	
Caesarean	14.3		3.0	
Place of Delivery		0.18		<0.01*
At home and others	21.7		15.2	
Health facility	18.4		7.5	
Assistance during Delivery		0.09		<0.01*
Doctor/Nurse/Midwife	18.4		7.7	
Traditional birth attendant and others	23.7		17.3	
Household characteristics				
Food security status		0.06		<0.01*
Food insecure	19.8		9.3	
Food secure	15.8		5.4	
Wealth quintile		<0.01*		<0.01*
Poorest	21.6		13.9	
Poor	24.3		8.0	
Middle	17.9		9.3	
Rich	16.3		7.0	
Richest	12.4		2.8	
Area of residence		0.04*		0.03*
Rural	20.4		9.6	
Urban	17.0		7.0	
Toilet facility		0.02*		<0.01*
No toilet/ not water-sealed/open pit	24.3		14.6	
Water-sealed	18.0		7.5	
Household size		0.20		0.99
≤5	17.3		8.3	
>5	19.6		8.3	

*Significantly different across categorical variables at $p<0.05$ using Pearson's Chi-square test (test of proportion).

introduction of complementary foods (9.9% and 1.3%, respectively). Similarly, children who failed to meet the MMF had a higher proportion of severe stunting (13.0%) than those who met the MMF (8.1%). Children who met the minimum acceptable diet, however, had a higher proportion of severe stunting (10.8%) than those who did not meet the MAD (7.7%).

Risk factors of stunting

Results of the multinomial logistic regression analysis conducted to determine the predictors of stunting after controlling for potential confounding variables are shown in Table 4. In terms of child-related characteristics, belonging to an older age group increased the relative risk of being stunted. Children aged 12-23 months had about three-

Table 3. Prevalence of stunting and severe stunting in children 6-23 months old by feeding practices: Philippines, 2015 (*n*=2,275)

Feeding practices	*Stunted*		*Severely Stunted*	
	HAZ <-2SD (%)	*p-value*	*HAZ <-3SD (%)*	*p-value*
Breastfeeding initiation				
Never	26.1	0.58	0.0	0.26
Within one hour	19.3			
Beyond one hour	17.3			
Do not know	19.8			
Ever had exclusive breastfeeding				
No	14.4	0.06	6.9	0.39
Yes	19.4		8.6	
Prelacteal feeding				
Not given	20.0	0.01*	8.5	0.67
Given	14.6		7.8	
Introduction to complementary foods				
Untimely	20.4	<0.01*	9.6	<0.01*
Timely	9.9		1.3	
MDD				
Not met	18.5	0.62	7.9	0.26
Met	19.3		9.4	
MMF				
Not met	23.6	0.17	13.0	0.03*
Met	18.5		8.1	
MAD				
Not met	18.7	0.97	7.7	0.05*
Met	18.8		10.8	

*Significantly different across categorical variables at $p<0.05$ using Pearson's Chi-square test (test of proportion).

fold higher risk of being stunted (RRR 3.04; 95% CI 2.14-4.32) and three times more risk of being severely stunted (RRR 3.31; 95% CI 1.87-5.84) than children aged 6-11 months old. Likewise, male children had two times higher risk of stunting (RRR 1.99; 95% CI 1.56-2.54) and severe stunting (RRR 2.24; 95% CI 1.58-3.18) than their female counterparts. Low birth weight (LBW) can also lead to a more than two-fold increase in the risk of being stunted (RRR 2.19; 95% CI 1.63-2.94) and severely stunted (RRR 2.34; 95% CI 1.48-3.69). Teenage mothers had 90% higher risk of having a stunted child (RRR 1.90; 95% CI 1.11-3.25), while mothers 20-29 years old had 66% greater risk of having a severely stunted child (RRR 1.66; 95% CI 1.10-2.50). Shorter mothers also had more than two-fold higher probability of having a stunted child (RRR 2.33; 95% CI 1.83-2.97) and a three-fold risk of having a severely stunted child (RRR 3.01; 95% CI 2.12-4.30). Mothers with more than four children, meanwhile, had double the risk of having a severely stunted child (RRR 2.44; 95% CI 1.135-4.41). Mothers who did not finish any grade levels or reached at most primary level of education had 59% greater risk of having a stunted child (RRR 1.59; 95% CI 1.09-2.32). Children from the poorest households had more than four-fold greater risk of being severely stunted (RRR 4.27; 95% CI 1.96-9.28)

Table 4. Multivariate analysis of child, maternal, household characteristics, and feeding practices associated with stunting and severe stunting in children 6-23 months old: Philippines, 2015 (*n*=2,275)

Characteristics	*Stunting*				*Severe Stunting*			
	RRR†	*p-value**	*(95% C.I.)*‡ *LL*	*UL*	*RRR*†	*p-value**	*(95% C.I.)*‡ *LL*	*UL*
Child characteristics								
Age in months								
6-11	ref. category							
12-23	3.04	<0.01	2.14	4.32	3.31	<0.01	1.87	5.84
Sex								
Male	1.99	<0.01	1.56	2.54	2.24	<0.01	1.58	3.18
Female	ref. category							
Birth weight								
< 2,500 g	2.19	<0.01	1.63	2.94	2.34	0.000	1.48	3.69
≥ 2,500 g	ref. category							
Maternal characteristics								
Age in years								
<20	1.90	0.02	1.11	3.25	1.64	0.30	0.65	4.13
20-29	1.16	0.30	0.88	1.52	1.66	0.02	1.10	2.50
≥30	ref. category							
Height								
<151 cm	2.33	<0.01	1.83	2.97	3.01	<0.01	2.12	4.30
≥151 cm	ref. category							
Parity								
1	ref. category							
2-3	1.19	0.30	0.86	1.64	1.46	0.12	0.91	2.32
≥4	1.20	0.35	0.82	1.76	2.44	<0.01	1.35	4.41
Education								
Primary level and less	1.59	0.02	1.09	2.32	0.85	0.59	0.48	1.53
Secondary level	1.07	0.68	0.79	1.44	0.97	0.90	0.62	1.52
Tertiary level and above	ref. category							
Wealth status								
Poorest	1.43	0.14	0.89	2.31	4.27	<0.01	1.96	9.28
Poor	1.69	0.03	1.05	2.73	2.42	0.03	1.07	5.44
Middle	1.29	0.28	0.81	2.04	2.87	0.01	1.29	6.38
Rich	1.23	0.41	0.75	2.01	2.32	0.03	1.07	5.03
Richest	ref. category							
Feeding practices								
Prelacteal feeding								
Not given	0.67	0.01	0.49	0.92	0.88	0.59	0.56	1.39
Given	ref. category							

Table 4. Multivariate analysis of child, maternal, household characteristics, and feeding practices associated with stunting and severe stunting in children 6-23 months old: Philippines, 2015 (*n*=2,275) [Cont'd]

Characteristics	*Stunting*				*Severe Stunting*			
	RRR†	*p-value**	*(95% C.I.)*‡		*RRR*†	*p-value**	*(95% C.I.)*‡	
			LL	*UL*			*LL*	*UL*
Complementary feeding introduction								
Untimely	1.28	0.33	0.78	2.09	4.44	<0.01	1.59	12.34
Timely	ref. category							
MMF								
Not met	1.82	0.02	1.12	2.95	2.30	<0.01	1.34	3.97
Met	ref. category							
Constant	0.02	<0.01	0.01	0.04	0.00	<0.01	0.00	0.00

†Relative Risk Ratio
‡95% Confidence Interval; Lower Limit (LL); Upper Limit (UL)
*Significant at $p<0.05$

compared to children from the richest households. Similarly, children from the poor, middle and rich quintiles had more than two times higher risk of becoming severely stunted as compared to their counterparts in the richest quintile. In terms of feeding practices, a history of not giving any prelacteal feed during the first three days of life reduced the risk of stunting by 67% (RRR 0.67; 95% CI 0.49-0.92). Untimely introduction to complementary foods, either too early or too late, increased a child's risk of being severely stunted by more than four-folds (RRR 4.44; 95% CI 1.59-12.34). Children who failed to meet the MMF had almost two-fold higher risk of being stunted (RRR 1.82; 95% CI 1.12-2.95) and more than double the risk of being severely stunted (RRR 2.30; 95% CI 1.34-3.97) than children meeting the MFF. The indicators of minimum dietary diversity (MDD) and MAD were found to be not associated with child stunting after controlling for confounding factors. No significant association was noted between stunting and other breastfeeding indicators.

DISCUSSION

Study findings reiterated the multi-factorial nature of stunting among children 6-23 months of age in the Philippines. Stunting and severe stunting were determined by the following proximal and distal factors: a) child-related characteristics (older age at 12-23 months, being male, and having low birth weight); b) maternal socio-demographic factors (younger age of <20 years and 20-39 years old, short stature of <151cm, high parity of >4, and lower educational attainment, and non-working status); c) prenatal care practices (<4 prenatal check-ups, vaginal method of delivery, childbirth at home, and assisted by traditional birth attendants); d) postnatal factors that affect the feeding practices of children 6-23 months old; and e) household socio-economic and demographic factors (poverty, food insecurity, residence in rural areas, and lack of improved toilet facility).

Associations of child, maternal, and household characteristics with stunting

Older age in children (12-23 months) and being male were found to increase the likelihood of stunting and severe stunting in the Philippines, as indicated by the results of the multinomial regression analysis. This is supported by the findings of Capanzana *et al.* (2020) and Adair and Guilkey (1997), which indicated that stunting in the Philippines follows an age and sex pattern. Based on this study, stunting prevalence is the same for both girls and boys at 12% during the first six months. However, between six and 18 months of age, linear growth in boys falters faster than in girls, resulting in a higher stunting prevalence among boys (29%) than girls (20%). Similarly, low birth weight (LBW<2,500g) increases the likelihood of stunting among children aged 0-23 months. This finding provides evidence that LBW can be used as a proxy for undernutrition *in utero,* which is strongly linked to the nutritional status of women at the time of conception and during pregnancy (Black *et al.*, 2013). By and large, foetal growth restrictions and LBW are identified as important contributors to stunting and wasting among children. To quantify the burden of LBW in the Philippines, a recent study examined the global prevalence and burden of small-for-gestational-age (SGA) and estimated that in 2012, 25.6% of Filipino newborns were SGA and 22.7% of neonatal deaths were attributable to SGA (either term or preterm), placing the Philippines among the top 10 countries with the highest SGA burden globally based on the INTERGROWTH-21st project (PSA & ICF, 2018).

Maternal factors that determined the likelihood of stunting included being <20 years old, having a height of <151cm, parity of >4, lower educational attainment, and non-working status. Poor nutritional status in pregnant teenage Filipino women is considered a major factor that can lead to poor child nutrition even as economic conditions improve. These findings are consistent with several studies conducted in Bangladesh (Donowits *et al.*, 2018; Alam *et al.*, 2017; Hasan *et al.*, 2019). Moreover, maternal weight at birth was reported as the strongest predictor of linear growth at two years of age (Donowitz *et al.*, 2018). The children of underweight mothers (BMI <18.5 kg/m^2) in the study of Donowitz *et al.* (2018) had 1.11 times the risk of being stunted (95% confidence interval, CI: 1.02–1.20) than Bangladeshi children of normal weight mothers. Mothers with BMI <18.5 kg/m^2 had 3.55 times higher odds (adjusted Odds Ratio, *aOR* 3.55, 95% CI: 2.34–5.38) of having stunted children than mothers with BMI ≥18.5 kg/m^2 in urban slum areas in Bangladesh (Alam *et al.*, 2017). Another important predictor of stunting among children <2 years is maternal short stature (<145cm), as reported by several studies (Ahmed *et al.*, 2012; Hasan *et al.*, 2019). Mothers with short stature (<145cm) have 4.7 times (95% CI: 2.28–9.56) higher chance of having a stunted child compared to mothers with greater height (Hasan *et al.*, 2019). Short mothers are also more likely to have a stunted child at two years of age (Addo *et al.*, 2013). A study done by Espo *et al.* (2002) in Malawi on the determinants of linear growth also found an association between short maternal stature and stunting at 12 months of age. This is because mothers and their offspring are likely to share the risk of having short stature both through genetic susceptibility and environmental exposure (Espo *et al.*, 2002). Goyal and Canning (2017) reported that the children whose mothers were <18 years old had 1.15 times (95% CI: 1.08–1.122) higher risk of being stunted. Furthermore, maternal education and working status have emerged as important factors that can predict stunting among children 6-23 months old. Infants born from mothers with at

least secondary education have a lower risk of stunting than children born from mothers without or with only elementary education. This probably reflects the role of formal education in the acquisition of knowledge for more effective meal selection and feeding practices for children. This finding corroborates with a study in Bangladeshi children whose mothers had ≥10 years of education had a 22% reduction in the risk of being stunted relative to those whose mothers had no education, while those whose mothers had 5–9 years of education had a 12% decrease in risk (Mistry *et al.*, 2019). Infants aged 6-23 months whose mothers were working had higher odds of being severely stunted as opposed to children with non-working mothers, possibly indicating the greater burden of caregiving and housework among non-working mothers who spend more time taking care of their children.

Other risk factors associated with stunting among children aged 6-23 months based on the bivariate analysis included inadequate health care during pregnancy (<4 prenatal check-ups) and childbirth (home birthing and births assisted by traditional birth attendants). These findings highlighted that the health care services availed by mothers during pregnancy and birth delivery affected their child's health and nutrition outcomes, reiterating the importance of addressing the first 1,000 days of a child's life. In the Philippines, the utilisation of prenatal care and care during delivery is high. Majority (80%) of mothers of children under 2 attended at least four antenatal visits and received assistance during delivery by a skilled practitioner (85%). However, the analysis of the 2015 national nutrition data showed that the disparity in maternal prenatal care including birth services was very high and associated with income and education (Capanzana *et al.*, 2020), of which 95% of mothers with college education had skilled assistance during delivery, while only 62% of mothers with elementary education or less had skilled assistance. This can probably explain the significant associations between stunting and inadequate prenatal check-ups and birth assisted by unskilled birth attendants. Furthermore, the ability of mothers to access adequate nutrition and health care for herself and her baby prior to and during pregnancy, as well as for postnatal care services highlights the importance of maternal health seeking behaviours, as mothers who underwent more prenatal check-ups and gave birth in hospitals may be more likely to avail of immunisation for their children or seek health care professionals for consultation when their children are ill.

The negative impacts of poor environmental conditions during the first 1,000 days of life provide the general picture of the factors associated with stunting in the Philippines. The risk of stunting linked to food insecurity, residence in rural areas, and poor sanitation (indicated by the absence of latrine or improved types of toilet) in the bivariate analysis points to the importance of household income as an underlying determinant of nutritional status in children <2 years of age. The negative impact of household food insecurity on childhood stunting was reported in Bangladesh (Alam *et al.*, 2017; Mistry *et al.*, 2019), where significant negative association between food insecurity and stunting among children under 2 years was documented. Other studies reported, however, that only severe food insecurity was significantly responsible for short stature in children (Choudhury *et al.*, 2017; Raihan *et al.*, 2018). Empirically, higher income enables households to secure adequate, diverse, frequent, and safe foods, and to ensure proper hygiene and sanitation that may result in a more enabling environment that leads to better nutrition among household members, specifically young children under 2 years of age. In the study of Capanzana *et al.* (2020), children in food

secure households and with access to animal source foods (ASFs) were around 10% less likely to be stunted compared to children from food insecure households and with poor access to animal source foods, though the inclusion of socio-economic factors in the adjusted model attenuated these associations, likely reflecting the role of income in mediating access to foods. Improved hygiene and toilets were also identified as protective factors that prevented stunting in children (Ahmed *et al.*, 2012; Alam *et al.*, 2017; Mistry *et al.*, 2019).

Associations of breastfeeding and complementary feeding with child stunting

After controlling for household socio-economic, child and maternal characteristics as potential confounding variables in the regression analysis, the history of not giving prelacteal feeds during the first three days of life reduced the risk of stunting. Untimely introduction of complementary foods (either too early or too late) increased the child's odds of being stunted by almost twice and of being severely stunted by more than four times. This is consistent with the findings of a meta-analysis conducted in Bangladesh (Islam *et al.*, 2020), where the initiation of complementary feeding at or after seven months of age increased the risk of stunting by 1.23 times (adjusted β=1.23, 95% CI: 1.05–1.44) with respect to those who were introduced to complementary foods at 5–6 months of age. Children meeting the minimum meal frequency in this study had significantly lower odds of becoming stunted than children who failed to meet the MMF. This parallels the results of other studies that showed that children who took foods at less than the required frequency had higher risks of being stunted (Hasan *et al.*, 2019). For children who received soft, semi-solid, and solid foods according to their age, the chance of chronic malnutrition was 1.34 times (p=0.005) lower (Zongrone *et al.*, 2012). The MDD indicator, intended as a proxy indicator of micronutrient adequacy intake, was not associated with stunting in this study. This result was unexpected given the considerable amount of evidence demonstrating the positive association between diverse diets and better child growth outcomes. The small proportion of children meeting the MDD indicator (19.3% among stunted; 9.4% among severely stunted) in this study may not have allowed for sufficient power to detect differences in child stunting. Similarly, the MAD indicator was not associated with stunting in this study. This might also be due to the small proportion of children meeting the MAD indicator, which is driven largely by the MDD component of the MAD, as a composite indicator of MDD and MMF. Capturing the complex dynamics of complementary feeding in a single indicator may contribute to the lack of association observed in MDD and MAD with child stunting.

Way forward

The evidence from this study suggests that the risk factors of stunting among young children 6-23 months include maternal nutrition prior to and during pregnancy, and during the first two years of life, which points out the importance of the first 1,000 days approach. The major challenges to address the multi-factorial nature of stunting in the Philippines warrant critical planning and significant investments, both in nutrition specific and nutrition sensitive interventions to improve the two major drivers: maternal and young child nutrition as well as food security and diversity. Further, greater focus should be placed on adolescent girls and pregnant women for the improvement of birth outcomes, health and nutrition through sound policy framework and nutrition action plan, both at the national and local levels, followed by scaling up effective nutrition interventions. In view of the scaling up of nutrition interventions, nutrition

services should be mainstreamed into the health system nationally and locally. At the local level, nutritionist-dedicated nutrition interventions should be in place to ensure priority, along with strong monitoring and evaluation mechanisms of the various nutrition interventions.

Strengths and limitations

This study has several strengths, one of which was that it utilised a large, national, and population-based survey with a high response rate (97.0%) among eligible respondents. Also, the survey was conducted by trained researchers and employed standard equipment and techniques of measurements. Results can therefore be generalised for the entire country and can also be compared with other countries. Moreover, this study used the WHO conceptual framework in determining a broad range of factors that influence stunting during the first 1,000 days of life. Study analysis and results could also serve as crucial inputs for action planning and future research on stunting. The primary limitation of this study is that its results only reflect associations, as relationships between the identified factors and stunting cannot be inferred. This is due to the cross-sectional nature of the study design, wherein data was collected at a single point in time. Another limitation is that other factors were not considered, such as micronutrient levels, infection, and childcare stimulation.

CONCLUSION

These findings illustrate the multi-factorial nature of the stunting problem in the Philippines during the complementary feeding period from 6 to 23 months. Identified predictors of stunting among children 6-23 months are older age; being male; having low birth weight; being born from mothers in younger age groups, with low educational attainment, shorter stature, and higher parity; history of prelacteal feeding within the first three days of life, untimely introduction of complementary foods; less frequent feeding; and poor wealth status. Findings of the study support the efforts to promote and ensure not only the timely introduction of complementary foods, but also the diversity, appropriate frequency, and acceptability of foods to ensure adequate energy and micronutrient consumption among young children. With this, a multi-sectoral approach is needed to address the different underlying factors of stunting among young children.

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Authors' contributions

MOG, conceived and carried out the study; EAG, reviewed and edited the manuscript; MLVM, analysed and interpreted the data. All authors read and approved the manuscript.

Conflict of interest

The authors declare that they have no competing interests.

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