Drivers of Stunting Among 0-23 Months Old Filipino Children Included in the 2003 and 2011 National Nutrition Survey

Imelda Angeles-Agdeppa*, Patricia Isabel Gayya-Amita and Mario V. Capanzana

Department of Science and Technology - Food and Nutrition Research Institute, General Santos Avenue, Bicutan, Taguig City 1631, Philippines

Abstract: This study aims to evaluate household and individual level drivers of stunting among Filipino children aged 0-23 months in the 2003 National Nutrition Survey (NNS) and identified which factors pushed these same children to or out of stunting in middle childhood (8-9 years old) in 2011 Updating National Nutrition Survey (UNNS). All children aged 0-23 months in 2003 NNS were tracked if they're still in 2011 UNNS by matching identifiers: region, province, municipality/city, name, and birthdate. There are 290 children included in both surveys. Children were categorized as: stunted in 2003 but not in 2011 (catch-up); stunted in 2003 & 2011 (persistently stunted); stunted in 2011 but not in 2003 (stunted later). The prevalence of stunting increased from 17.2% in 2003 to 35.2% in 2011. About 22.1% became stunted later; persistently stunted (13.1%); catch-up (4.1%). The individual-level factors that contributed towards persistent stunting are older age onset of stunting, underweight, and a <2 years birth interval; while the household level factors are those with ≥ 5 dependents, and a higher number of under-fives in the family. Households usage of water-sealed toilets and availability of electricity decrease the odds of persistent stunting and stunting later. No significant factors were found on what moves a child out of stunting. Living in shanties (Huts) pushed a normal child to be stunted in 2011. This study reflects the strong influence of both individual and household factors on stunting. These results could be useful in crafting area and problem-specific interventions.

Keywords: Stunting, persistent stunting, children, infants, middle childhood, Philippines.

BACKGROUND

Worldwide, the Philippines ranks ninth among countries that have the highest rate of stunting in children under-fives [1]. In 2014, it was reported that the average adult Filipino male stood at 5 feet and 3.7 inches, and the average adult Filipino female was at 4 feet and 11 inches; making the Filipinos the second shortest race in the region [2]. While Filipinos' shorter stature has typically been assumed to be attributed to genetics, a recent study has found that shortness could be a manifestation of generations of chronic undernutrition [3]. Throughout the last 20 years, stunting in the Philippines has only decreased by 9 percentage points; from 39% in 1993 to 30% in 2013 [4]. However, in 2015, stunting prevalence increased again to 33% [5]; thereby failing the Philippines Millenium Development Goal of reducing stunting from 36% to 22% [6]. Stunting is the result of cumulative effects of frequent attacks of illnesses, low growth and development from poor nutrition and inadequate psychosocial stimulation [7].

It has long been known that child stunting holds back economic growth and affects efforts to reduce poverty. A World Bank study found that a 1% loss in adult height as a result of childhood stunting is linked with a 1.4% loss in economic productivity, resulting in 20% fewer earnings as adults [8]. Studies also show that stunting is associated with future negative health consequences such as impeded cognitive development, unfavourable maternal reproductive outcomes and a risk of development of non-communicable diseases [9].

Growth faltering is most pronounced during the first 24 months of life [10]. However, a study [11] found out that 30% of growth faltering also occurred beyond the early 1000 days. Many cross-sectional studies [12-14] have already presented the determinants and occurrence of stunting in the first 24 months of life. However, these studies typically do not go on to explain why some stunted children will enter early or middle childhood following the same impaired linear growth trajectory, or why some children who were not stunted initially may eventually end up stunted later as they grow older; limiting the conclusions that can be drawn regarding child growth and its associations with the environment. Thus, understanding the age-specific, country-based drivers of stunting is critical to developing appropriate interventions to reduce its short- and long-term consequences for individuals and society.

It should be noted that reducing worldwide stunting by 40% by 2025 is one of the intermediate targets under the Sustainable Development Goal 2 [15]; and to contribute to this, the Philippine Plan of Action for

*Address correspondence to this author at the Food and Nutrition Research Institute, Department of Science and Technology, DOST Compound, Gen. Santos Ave., Bicutan, Taguig City, Philippines; Tel/Fax: 632-8372934;
E-mail: iangelesagdeppa@yahoo.com.ph

E-ISSN: 1929-4247/19

Nutrition, the country's framework for improving the nutritional status of the Filipinos aimed to bring down the stunting rate of our country to 21% [16].

This study aims to evaluate the household and individual level drivers of stunting among Filipino children aged 0-23 months in the 2003 National Nutrition Survey and identified drivers that pushed these same children to or out of stunting in middle childhood (8 - 9 years old) in 2011 Updating NNS. The results of this study will give a basis for what interventions could be installed to address stunting.

METHODOLOGY

The Department of Science and Technology – Food and Nutrition Research Institute regularly conducts National Nutrition Surveys (NNS) every 5 years. However, within the 5 years (about 2.5 years), an Updating NNS is done wherein anthropometry is one of the components. A stratified multi-stage sampling design covering all regions and provinces of the country is employed in every survey periods.

The 2003 NNS was conducted in all 17 regions and 79 provinces with a total sample size of 5,522 households and 25,897 individuals of different age groups. The response rate was 95.7% of the targeted families. This study has only selected children aged 0-23 months during this survey period, and there were about 1390 children. The variables that were considered and matched in order to track how many children were still included in the 2011 Updating NNS were: region, province, municipality/city, name, and birth date. The dataset of the 2003 and 2011 were thoroughly screened and validated to obtain the final number of children for analysis in this study. Only 290 children with complete information have been found in both 2003 and 2011 datasets. The children were aged 0-23 months in 2003 and about 8-9 years old in 2011 (Figure **1**).

This study categorized these children into three groups: first, those who were stunted in 2003 and continued to be stunted in 2011 or referred to as the "persistently stunted" group. Second, are those who

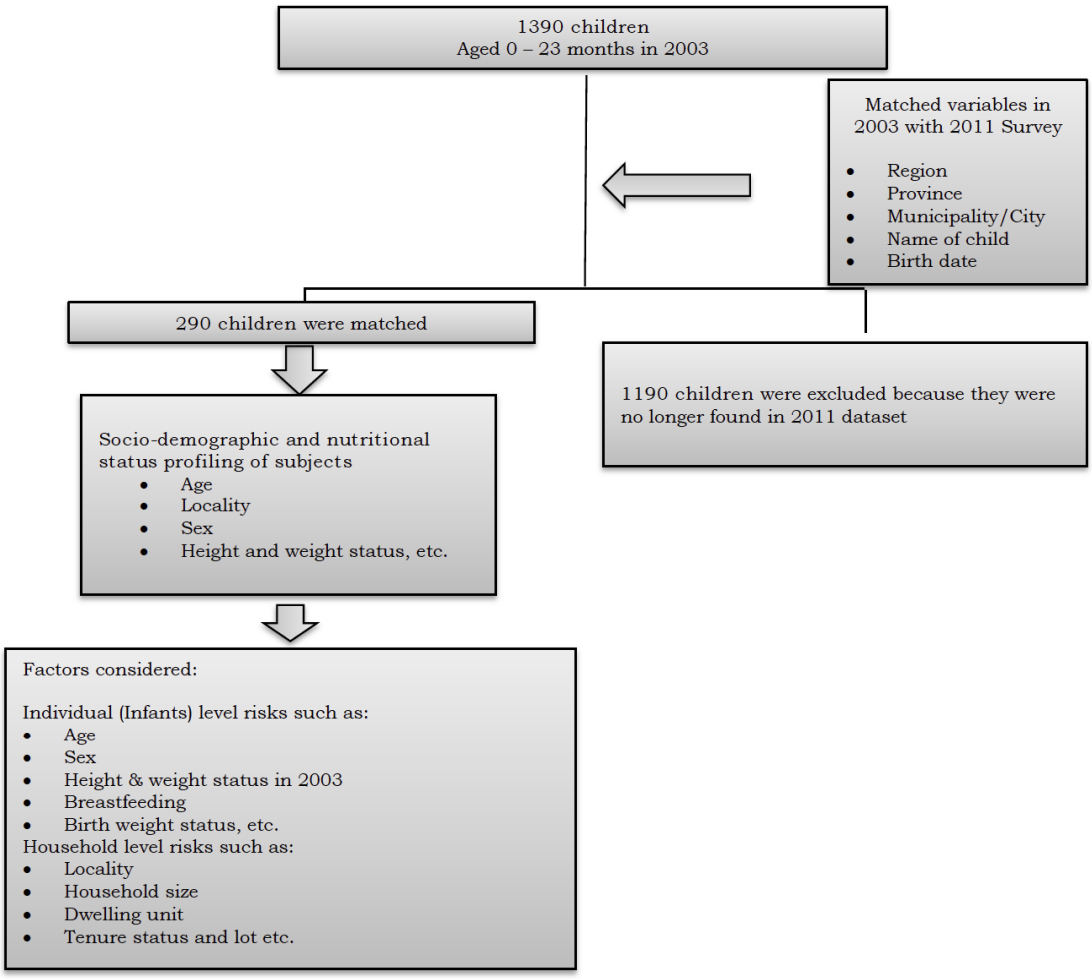

Figure 1: Process Flow in the Inclusion of Subjects.

were stunted in 2003 but not stunted anymore in 2011 or referred to as the “catch-up” group. Third, are those who were not stunted in 2003 but stunted in 2011 is referred to as the "stunted later" group.

The two survey periods were selected because of the same master sample used for the selection of samples and sample areas. The said master sample was developed for the 2003 Family Income, and Expenditure Survey (FIES) by the National Statistics Office now called the Philippine Statistics Authority.

Trained researchers conducted face-to-face interview among the parents or caregivers of children to collect socio-demographic variables using pre-tested questionnaires usually used during surveys.

Anthropometric measurements such as weight and height were measured using standard techniques described by Gibson [17]. Weight of children aged 0-23 months in 2003 and 8-9 years old in 2011 was measured using calibrated beam balance (Detecto weighing scale, Webb City, Mo. U.S.A). Infants were measured together with their mother, and then the mother was weighed alone using standard procedure. The infant's weight was calculated by subtracting the mother's weight from the combined weight of the mother and child. Weight measurement was recorded to the nearest 0.1 kilograms. Weight status was expressed as underweight if weight-for-age was less than -2SD (WAZ), overweight if weight-for-age is higher than 2SD [18].

Recumbent height in 2003 was measured using an infantometer or a wooden length board, and it was recorded to the nearest 0.1 centimetres. In 2011, height was measured using calibrated microtoise [19]. Two measurements were taken from each subject. The average of the two readings was considered in the analysis. Height status was expressed as “stunted” if length/height-for-age *Z*-score was less than -2SD (HAZ) and “normal” if between -2SD and 2SD [18].

The potential drivers for stunting were classified into two main categories, which are at household and individual levels. The variables selected from 2003 for analysis at the household level were: socio-demographics such as sex, education level and working status of the household head; locality (urban vs. rural); tenure of dwelling and lot; household size; source of drinking water; availability of toilet and electricity, number of children below 5 years; and number of dependents. Several dependents are the count of children aged below 15 years and older adults age 65 years and above in the household [20]. At the individual level: sex, age, weight and height measurements, birth weight, birth interval, and type of gestation, immunization, deworming and feeding practices were included. Birth weight status was categorized as “below” if child’s birth weight was less than 2500 grams, “normal” if equal to 2500 grams and “above” if more than 2500 grams [21]. Age interval was derived as the absolute difference of the age of the subject and next older or younger sibling aged 5 years and below in the household. The birth interval was assessed using the age interval. Type of gestation was categorized as premature or full-term, pre-mature if the child was born within 7 or 8 months.

Statistical Analysis

Data were processed and analyzed using STATA v.12. The socio-demographic characteristics were analyzed by cross-tabulation to compare the frequencies. A one-way ANOVA was conducted to determine if the mean age when complementary foods were introduced to infants was different across the categories of children. Mc-nemar Change test was used to determine the changes in the proportion of stunting between 2003 and 2011. Pearson's Chi-Square test was used to determine the association between the children's growth trajectories and risk factors (i.e. birth weight status, gestation, etc.). Logistic regression was carried out to investigate the risk factors that contribute to the different growth trajectories of stunted children. The risk was estimated using the odds ratio.

RESULTS

About 1390 infants and young children aged 0-23 months had participated in the 2003 NNS. However, only 290 infants with complete information of interest were found in the 2011 Updating NNS. Hence this is the sample size for analysis in this study.

The prevalence of stunting among our samples has significantly increased from 50 (17.2%) in 2003 to 102 (35.2%) in 2011 (Figure **2**). About 64 (22.1%) children who had an average height in 2003 became stunted in 2011 (stunted later group). Thirty-eight (13.1%) children who were stunted in 2003 remained stunted in 2011 (persistently stunted group). On the other hand, 12 (4.1%) children who were stunted initially in 2003 were no longer stunted in 2011 (catch up group) (Table **1**).

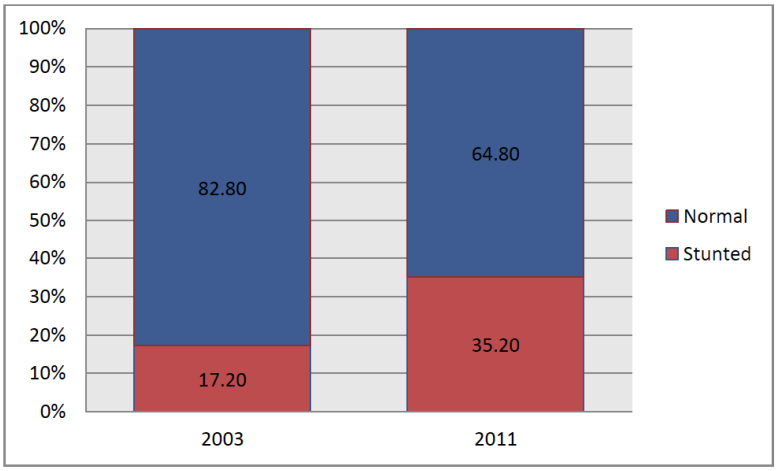

Figure 2: Height status of children in 2003 & 2011.

Table 1: Characteristics of Children in 2003 and 2011

	Not stunted in 2003 & 2011 (normal)	Stunted in 2003 but not in 2011 (catch-up)	Stunted in 2003 & 2011 (persistently stunted)	Stunted in 2011 but not in 2003 (stunted later)
Individual Level				
Number & percentage of children	176 (60.7%)	12 (4.1%)	38 (13.1%)	64 (22.1%)
Mean Age in 2003 (months)	11.3	18.4	17.3	9.7
Mean Age in 2011 (years)	8.9	9.5	9.4	8.8
Boys (%)	51.14	66.67	65.79	50
Girls (%)	48.86	33.33	34.21	50
Mean HAZ in 2003	-0.12	-2.35	-2.88	-0.91
Mean HAZ in 2011	-0.96	-1.52	-2.64	-2.52
Mean WAZ in 2003	-0.27	-2.05	-2.16	-0.74
Mean WAZ in 2011	-0.91	-1.33	-2.68	-2.27

Table **1** shows the child characteristics of the three groups of children compared to the children who were never stunted in both years. The baseline mean age of children who were persistently stunted (17.3 months) and those who were able to catch up (18.4 months) is higher than those who were normal (11.3 months) and those who were stunted later on (9.67). The prevalence among boys is higher among those who were persistently stunted and those who were able to catch up compared to the two other groups. The HAZ and WAZ of persistently stunted children are consistently lower compared to the other groups of children in both years.

No significant difference was observed in the mean age of all groups of children with regards to the introduction of complementary foods except for the introduction of commercial milk. The mean age when commercial milk was given is 7 months for persistently stunted children and 5.6 months for healthy children (Table **2**). Looking at breastfeeding practices, no significant association was found between growth trajectories and infants who were ever breastfed, exclusively breastfed and given colostrum (Table **3**).

At the individual level, factors that are associated with the growth trajectories of children in 2011 were the ff: age, weight status in 2003, gestation and birth interval; while at the household level factors include type of dwelling unit, availability of sanitary toilet, availability of electricity, number of dependents and number of children below 5 years old in the household (Table **3**).

Table **4** column 1 looks at the factors that may explain persistent stunting in both 2003 and 2011. Looking at the child level factors, the odds of being persistently stunted is 1.2 times higher for every increase in age. Having a birth interval of fewer than two years also increases the odds of being persistently

Table 2: Mean Age of Introduction of Complementary Foods Among Breastfed Infants

	Not stunted in 2003 & 2011 (mean ± sd)	Stunted in 2003 & 2011 "persistently stunted" (mean ± sd)	Stunted in 2003 but not in 2011 "catch-up" (mean ± sd)	Stunted in 2011 but not in 2003 (mean ± sd) "stunted later"	p-value
Water	3.2 ± 1.9	3.7 ± 2.3	4.2 ± 3.1	3.6 ± 2.4	0.417
Am	4.8 ± 2.4	3.8 ± 1.3	6.2 ± 5.1	5.1 ± 2.3	0.219
Juice	6.6 ± 2.9	7.8 ± 2.8	7.2 ± 2.1	7.4 ± 3.1	0.378
Water with Sugar	7.9 ± 10.4	5.7 ± 3.7	5	5.2 ± 3.5	0.773
Soup	5.6 ± 3.5	5.3 ± 1.9	7.5 ± 3.2	5.7 ± 2.5	0.061
Commercial Milk	5.2 ± 4.5	7 ± 6.7	6.5 ± 3.9	4.5 ± 3.2	0.032*
Solids	5.6 ± 2.6	6.5 ± 2.9	6.9 ± 1.8	6 ± 2.56	0.297

*significant at 0.05.

Table 3: Relationships between Child & Household Characteristics in 2003 & Growth Trajectories in 2011

Variable	Dependent Variables										
	Not Stunted in 2003 & 2011		Stunted in 2003 & 2011 "persistently stunted"		Stunted in 2003 but not in 2011 "catch-up"		Not stunted in 2003 but stunted in 2011 "stunted later"		Total		
	n	%	n	%	n	%	n	%	n	%	p-value
Individual (Infants) level (n-290)											
Sex											0.287
Male	90	31.03	25	8.62	8	2.76	32	11.03	155	53.45	
Female	86	29.66	13	4.48	4	1.38	32	11.03	135	46.55	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Age group											0.000*
0-5 mos.	41	14.14	0	0	0	0	21	7.24	62	21.38	
6-11 mos.	51	17.59	6	2.07	2	0.69	17	5.86	76	26.21	
12-23 mos.	84	28.97	32	11.03	10	3.45	26	8.97	152	52.41	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Weight status in 2003											0.000*
Underweight	12	4.14	21	7.24	5	1.72	6	2.07	44	15.17	
Normal	160	55.17	17	5.86	7	2.41	56	19.31	240	82.76	
Overweight	4	1.38	0	0	0	0	2	0.69	6	2.07	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Birth weight status											0.843
<2500 gms	16	6.93	4	1.73	2	0.87	7	3.03	29	12.55	
>=2500 gms	133	57.58	23	9.96	6	2.6	40	17.32	202	87.45	
Total	149	64.5	27	11.69	8	3.46	47	20.35	231	100	
Gestation											0.025*
Premature	0	0	2	0.7	0	0	4	1.09	6	1.6	
Full term	176	60.69	36	12.59	12	4.14	60	20.98	284	98.4	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	

(Table 3). Continued.

Variable	Dependent Variables										
	Not Stunted in 2003 & 2011		Stunted in 2003 & 2011 "persistently stunted"		Stunted in 2003 but not in 2011 "catch-up"		Not stunted in 2003 but stunted in 2011 "stunted later"		Total		
	n	%	n	%	n	%	n	%	n	%	p-value
Ever Breastfed											0.713
No	15	5.19	4	1.38	0	0	6	2.08	25	8.65	
Yes	161	55.71	34	11.76	12	4.15	57	19.72	264	91.35	
Total	176	60.9	38	13.15	12	4.15	63	21.8	289	100	
Child was given colostrum											0.141
No	11	4.17	2	0.76	3	1.14	6	2.27	22	8.33	
Yes	150	56.82	32	12.12	9	3.41	51	19.32	242	91.67	
Total	161	60.98	34	12.88	12	4.55	57	21.59	264	100	
Child was exclusively breastfed											0.480
No	114	52.05	30	13.7	9	4.11	36	16.44	189	86.3	
Yes	15	6.85	8	3.65	2	0.91	5	2.28	30	13.7	
Total	129	58.9	38	17.35	11	5.02	41	18.72	219	100	
Birth Spacing											0.008*
Single Child	84	28.97	9	3.1	4	1.38	23	7.93	120	41.38	
Less than 2 years	48	16.55	22	7.59	5	1.72	19	6.55	94	32.41	
2 years & above	44	15.17	7	2.41	3	1.03	22	7.59	76	26.21	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Child who had deworming											0.623
No	111	38.28	22	7.59	6	2.07	43	14.83	182	62.76	
Yes	65	22.41	16	5.52	6	2.07	21	7.24	108	37.24	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Child who had immunization											0.985
No	23	7.93	5	1.72	2	0.69	9	3.1	39	13.45	
Yes	153	52.76	33	11.38	10	3.45	55	18.97	251	86.55	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Household level											
Locality											0.521
Rural	96	33.92	23	8.13	8	2.83	41	14.49	168	59.36	
Urban	75	26.5	14	4.95	3	1.06	23	8.13	115	40.64	
Total	171	60.42	37	13.07	11	3.89	64	22.61	283	100	
Household size											0.356
<5 Members	46	15.86	15	5.17	4	1.38	16	5.52	81	27.93	
>=5 Members	130	44.83	23	7.93	8	2.76	48	16.55	209	72.07	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	

(Table 3). Continued.

Variable	Dependent Variables										
	Not Stunted in 2003 & 2011		Stunted in 2003 & 2011 "persistently stunted"		Stunted in 2003 but not in 2011 "catch-up"		Not stunted in 2003 but stunted in 2011 "stunted later"		Total		
	n	%	n	%	n	%	n	%	n	%	p-value
Dwelling Unit											0.015*
Single House	162	60.69	36	12.41	11	3.79	56	19.31	265	91.38	
Duplex	10	3.45	0	0	0	0	2	0.69	12	4.14	
Apt	1	0.34	0	0	1	0.34	0	0	2	0.69	
Shanties	2	0.69	2	0.69	0	0	6	2.07	10	3.45	
Others	1	0.34	0	0	0	0	0	0	1	0.34	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Tenure status of dwelling											0.100
Own	141	48.62	34	11.72	10	3.45	54	18.6	239	82.41	
Rent	5	1.72	1	0.34	2	0.69	2	0.69	10	3.45	
Free	30	10.34	3	1.03	0	0	8	2.76	41	14.1	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Tenure status of the lot											0.316
own	55	19.64	15	5.36	3	1.07	22	7.86	95	33.93	
rent	18	6.43	2	0.71	1	0.36	3	1.07	24	8.57	
free	84	30	13	4.64	6	2.14	33	11.79	136	48.57	
squat	14	5	7	2.5	0	0	4	1.43	25	8.93	
Total	171	61.07	37	13.21	12	4.14	62	22.14	280	100	
Toilet											0.045*
No Toilet	27	9.31	13	4.48	2	0.69	17	5.86	59	20.34	
Not water sealed	15	5.17	6	2.07	1	0.34	5	1.72	27	9.31	
Water sealed	134	46.21	19	6.55	9	3.1	42	14.48	204	70.34	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Electricity											0.017*
No	33	11.38	15	5.17	5	1.72	24	8.28	77	26.55	
Yes	136	46.9	21	7.24	7	2.41	39	13.45	203	70	
No electricity in the area	7	2.41	2	0.69	0	0	1	0.34	10	3.45	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Source of drinking water											0.463
Piped	121	41.72	21	7.24	8	2.76	43	14.83	193	66.55	
Not Piped	55	18.97	17	5.86	4	1.38	21	7.24	97	33.45	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Sex of household head											0.316
Male	168	57.93	38	13.1	11	3.79	63	21.72	280	96.55	
Female	8	2.76	0	0	1	0.34	1	0.34	10	3.45	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	

(Table 3). Continued.

Variable	Dependent Variables										
	Not Stunted in 2003 & 2011		Stunted in 2003 & 2011 "persistently stunted"		Stunted in 2003 but not in 2011 "catch-up"		Not stunted in 2003 but stunted in 2011 "stunted later"		Total		
	n	%	n	%	n	%	n	%	n	%	p-value
Educational attainment of household head											0.119
None	2	0.69	0	0	0	0	3	1.03	5	1.72	
Elementary Level	72	24.83	23	7.93	5	1.72	35	12.07	135	46.55	
High School level	72	24.83	10	3.45	6	2.07	21	7.24	109	37.59	
College level	30	10.34	5	1.72	1	0.34	5	1.72	41	14.14	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Working status of household head											0.331
Nonworking	11	3.79	1	0.34	0	0	1	0.34	13	4.48	
Working	165	56.9	37	12.76	12	4.14	63	21.72	277	95.52	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Number of children below 5 years old in the household											0.050*
Only child	84	28.97	9	3.1	4	1.38	23	7.93	120	41.38	
2 or more	92	31.72	29	10	8	2.76	41	14.14	170	58.62	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	
Number of Dependents (<15 years & >=65 years old)											0.001*
<5 dependents	154	53.1	25	8.62	7	2.41	46	15.86	232	80	
5 & above dependents	22	7.59	13	4.48	5	1.72	18	6.21	58	20	
Total	176	60.69	38	13.1	12	4.14	64	22.07	290	100	

*significant at 0.05.

stunted by 4.3 compared to those households with only one child. The odds of being persistently stunted is 16.5 times higher if the child was underweight in 2003. The household-level factors that might predict persistent stunting in both years include having more dependents and children below 5 years old in the household.

Meanwhile, the presence of electricity and usage of a water-sealed toilet in the household decreases the odds of persistent stunting. Column 2 looks at what could have helped the child move out of stunting; however, none of the factors had a significant effect on the dependent variable. Column 3 looks at the factors that might have pushed a healthy child to become stunted in 2011. The odds of being stunted in 2011 is 8.7 times higher if the child is living in a barong-barong or shanties. The significant factors that could have prevented the child from being stunted in 2011 include the presence of electricity and usage of a water-sealed toilet in the household.

DISCUSSION

This study included 290 children aged 0 to 23 months old who were included in both the 2003 and 2011 survey periods. It can be observed that in 2003, about 17.2% were stunted. What is alarming is the increase in stunting rate in 2011, wherein about 22.1% of those children who had normal status in 2003 became stunted in 2011. Our findings revealed that the mean age of those who were stunted later was 9.7 months, which was lower than the persistently stunted and catch-up group. This implies that those children who were stunted then might have been exposed to poor diet, and infections. This finding supports the results of several studies wherein growth faltering appears to be particularly pronounced from 12-24 months [22, 23]; a period that coincides with the introduction of complementary foods. It has been postulated that the age of 0 to 2 years is the window of opportunity for interventions [24]. This age is the period when children must be given nutrient-dense foods to cope – up with the demands of speedy growth.

Table 4: Determinants of Persistent Stunting, Catch up Growth and Stunting Later on

	Stunted in 2003 & 2011 "persistently stunted"		Stunted in 2003 but not in 2011 "catch-up"		Not stunted in 2003 but stunted in 2011 "stunted later"	
	Odds Ratio	P-value	Odds Ratio	P-value	Odds Ratio	P-value
Individual Level						
Age (mos)	1.171524	0.000*	-	-	0.9659002	0.109
Birth space:						
Single child (reference)						
<2 years	4.277778	0.001*	-	-	1.445652	0.305
>=2 years	1.484848	0.462	-	-	1.826087	0.087
Weight status:						
Normal (reference)						
Overweight	-	-	-	-	1.428571	0.685
Underweight	16.47059	0.000*	-	-	1.428571	0.496
Household Level						
Dwelling:						
Single House (reference)						
Duplex	-	-	-	-	0.5785714	0.489
Apt	-	-	-	-	-	-
Shanties	4.5	0.139			8.678571	0.009*
Others	-	-	-	-	-	-
Number of children below 5 years old in the household	1.551171	0.049*	-	-	1.095349	0.638
5 & above dependents	6.849769	0.008*	-	-	2.73913	0.005*
Electricity:						
No (reference)						
Yes	0.3397059	0.006*			0.3943015	0.004*
No electricity in the area	0.6285714	0.589	-	-	0.1964286	0.140
Toilet:						
No toilet (reference)						
Not water sealed	0.8307692	0.753	-	-	0.5294118	0.291
Water Sealed	0.2944891	0.003*	-	-	0.4978051	0.050*

*significant at 0.05.

Exclusive breastfeeding is the mantra of all nutrition experts because the nutrients in breast milk are believed to sustain the nutrient requirements of the infant for the first 6 months. However, in our study, there was a significant difference in the mean age when commercial milk was introduced to the different categories of children. Children who were of normal height and those in the catch-up group were given commercial milk at a later age (5.2 and 6.5 months) compared to those who were stunted later (4.5 months). There is substantial evidence that dairy protein stimulates an effect on linear growth and weight gain in children with malnutrition [25]. Increasing access to dairy products can be beneficial to the long-term health & nutrition of children aged 6 months and over when accompanied by appropriate breastfeeding practices [26].

Further, our study found out that the introduction of several complementary foods such as water, am water, water with sugar and soup were given below 6 months to children regardless of their stunting status. These types of complementary foods are considered as energy-dense nutrient-poor foods. During the first 6 months, exclusive breastfeeding must be practised except in cases where there is diarrhoea [27]. Studies

conducted in rural Bangladesh and India among children below 2 years of age suggest that the lack of knowledge about the time of initiation of complementary feeding, dietary diversity, and nutritional knowledge increases the risk factors of stunting [14, 28]. The drivers of persistent stunting in our study are a combination of factors at the individual and household level. Our research found out that households with 2 or more children below 5 years old, more dependents and short birth interval might explain a child remaining stunted through middle childhood. Children belonging to households with more than two under-five children were more likely to be stunted than the others because as the number of children increases, the caring time given to the each is divided [29]. One study found out that those children who do not get sufficient maternal stimulation to optimize his neurological development are at risk for stunting [30]. More dependents in the household likewise cause strain on family resources such as food and healthcare [31]; may lead to low levels of dietary intake for each household member [32]; and increases risk for spread of diseases such as respiratory infections and diarrhea due to overcrowding which may eventually lead to malnutrition [33]. Short birth spacing may also be attributed to inadequate feeding practices, both breast and complementary [34]. Some mothers opt to stop breastfeeding upon reconceiving. This is similar to a previous Philippine study on risk factors of stunting and wasting among children wherein children with a birth interval of less than two years are at a disadvantage [35]. Being underweight is also a determinant of persistent stunting. Underweight is a manifestation of malnutrition. It also increases the likelihood of illness since malnutrition suppresses immunity [36]. Children who are stunted may have suffered from chronic malnutrition early on in their lives as a result of repeated infections, poor feeding practices and inadequate nutrition that prevent infants and young children from getting the nutrients they need to thrive [15]. On the other hand, socio-economic variables at the household level like the presence of electricity and use of water-sealed toilets may have prevented persistent stunting in a child. Access to safe water and sanitation are strongly linked to stunting reduction [37].

In 2011, the increased prevalence of stunting to 35% from 17.2% in 2003 is alarming. About 22% or 64 children who had an average height in 2003 has faltered and became stunted in 2011. Our findings revealed that the factors that could have pushed a healthy child to be stunted in 2011 are related to the household's living conditions. The living conditions are very important factors needed for the proper growth of the child [38]. Our results revealed that children living in poor environmental conditions have a higher risk of becoming stunted. One study pointed out that poverty, combined with undernutrition is associated with stunting [39]. In our study, living in shanties is a determinant of stunting in 2011. Children who are residing in poor quality houses are more likely to be stunted [40]. Likewise, the presence of electricity and usage of water-sealed toilets in the household could have prevented the child from becoming stunted in 2011. These determinants are markers of household poverty. It has been posted that in South Asia, the poor diets of children in the first 2 years of life, the status of nutrition of women before and during pregnancy which includes food security and poverty, and poor conditions of households and communities are significant determinants of stunting [41].

LIMITATIONS

This study has several limitations. First, the NNS was not designed to capture the growth and development of children longitudinally. However, some survey periods use the same master sample; thus, the opportunity to track the children who were initially assessed in an earlier survey period is possible. The population is also small; therefore, caution is advised when making conclusions based on the results of this study. Second, due to the limitations of the dataset, we do not have data on wealth classification. We used variables such as dwelling, availability of electricity, improved water source and type of toilet facility as proxy indices of wealth.

Further, we were not able to link the children's data with their mother's profile. Food intake was not available in the 2011 updating survey. Thus, limiting our analysis on socio-demographic and environmental factors at the child and household-level factors that affect stunting.

CONCLUSION

This study confirmed that child growth is multifactorial. Our findings suggest that the drivers of stunting are both at the individual and household level. The most important factors to be addressed since these issues are persistently occurring in both survey periods are: being underweight at an early age, a high number of dependents and children below 5 years old in the household, short birth spacing, unavailability of

sanitary toilets and electricity. Effective policies and programs to alleviate stunting involves an understanding of these causal determinants. The multiple dimensions of child stunting as revealed by our study, provided many pathways for technical and strategic solutions. However, it suggests that singular interventions may yield limited impacts on reducing stunting rates. Thus, the Philippine law on the first 1000 days which was recently passed addresses the problem of intensified and integrated programs for mothers and children, however, consideration must also be on improving sanitation both at the environment and household levels. These results could be useful in crafting area and problem-specific interventions.

ACKNOWLEDGEMENTS

Wargin Longalong, Keith Tanda and Marvin Toledo have contributed significantly in the study's data analysis.

REFERENCES

[1] Improving Child Nutrition: The achievable imperative for global progress [Internet]. 2013 [cited February 7, 2019]. Available from: https://www.unicef.org/nutrition/files/Nutrition_Report_final_lo_res_8_April.pdf

[2] ASEAN Average Height [Internet]. 2014 [cited February 8, 2019]. Available from: https://bit.ly/2TFifj2

[3] Sizing Up: The stunting and child malnutrition problem in the Philippines [Internet]. 2015. Available from: https://bit.ly/2CjJR2m

[4] Food and Nutrition Research Institute. 8th National Nutrition Survey. Philippines: Department of Science and Technology; 2013.

[5] Food and Nutrition Research Insitute. 2015 Updating of the Nutritional Status of Filipino Children and Other Population Groups. Philippines: Department of Science and Technology; 2015.

[6] Achievement of the Health-related Millennium Development Goals in the Western Pacific Region 2016: Transitioning to the Sustainable Development Goals [Internet]. WHO Press. 2016 [cited March 15, 2019]. Available from: https://iris.wpro.who.int/bitstream/handle/10665.1/13441/WPR-2016-DHS-011-en.pdf

[7] Stunting in a nutshell [Internet]. [cited March 18, 2019]. Available from: https://www.who.int/nutrition/healthygrowth-proj_stunted_videos/en/

[8] Repositioning Nutrition as Central to Development: A Strategy for Large-scale Action [Internet]. 2006. Available from: https://books.google.com.ph/books?hl=en&lr=&id=PRPc32wCLjMC&oi=fnd&pg=PR3&ots=Vc5qFuSsoD&sig=cWwv8bAm5sQg_1itp7k_7njqEZY&redir_esc=y#v=onepage&q&f=false

[9] Long-term consequences of stunting in early life [Internet]. 2011 [cited Oct]. Available from: https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1740-8709.2011.00349.x

[10] Roth DE, Krishna A, Leung M, Shi J, Bassani DG, Barros AJD. Early childhood linear growth faltering in low-income and middle-income countries as a whole-population condition: analysis of 179 Demographic and Health Surveys from 64 countries. The Lancet Global Health 2017; 5(12): e1249-e57. https://doi.org/10.1016/S2214-109X(17)30418-7

[11] Leroy JL, Ruel M, Habicht JP, Frongillo EA. Linear growth deficit continues to accumulate beyond the first 1000 days in low- and middle-income countries: global evidence from 51 national surveys. J Nutr 2014; 144(9): 1460-6. https://doi.org/10.3945/jn.114.191981

[12] Nkurunziza S, Meessen B, Van Geertruyden J-P, Korachais C. Determinants of stunting and severe stunting among Burundian children aged 6-23 months: evidence from a national cross-sectional household survey, 2014. BMC Pediatrics 2017; 17(1): 176-. Available from: https://www.ncbi.nlm.nih.gov/pubmed/28743238

[13] Aguayo VM, Nair R, Badgaiyan N, Krishna V. Determinants of stunting and poor linear growth in children under 2 years of age in India: an in-depth analysis of Maharashtra's comprehensive nutrition survey. Matern Child Nutr 2016; 12 Suppl 1(Suppl Suppl 1): 121-40. Available from: https://www.ncbi.nlm.nih.gov/pubmed/27187911

[14] Ahmed AMS, Ahmed T, K Roy S, Alam N, Hossain MI. Determinants of Under Nutrition in Children under 2 years of age from Rural Bangladesh 2011; 49. https://doi.org/10.1007/s13312-012-0187-2

[15] Global Nutrition Targets 2025: Stunting policy brief [Internet]. 2014. Available from: https://apps.who.int/iris/bitstream/handle/10665/149019/WHO_NMH_NHD_14.3_eng.pdf?ua=1

[16] Philippine Plan Of Action For Nutrition 2017-2022: A call to urgent action for Filipinos and its leadership [Internet]. Available from: http://www.nnc.gov.ph/phocadownloadpap/6thNationalConference_of_DCNPCs/PPAN%20and%20DCNPCs.pdf

[17] Gibson RS. Principles of Nutritional Assessment. Second Revised Edition ed. New York, United States: Oxford University Press Inc; 2005 May 19, 2005.

[18] WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development [Internet]. 2006.

[19] Food and Nutrition Research Insitute. 7th Updating National Nutrition Survey. Philippines: Department of Science and Technology; 2011.

[20] Official Concepts and Definitions for Statistical Purposes [Internet]. 2003 [cited March 6, 2019]. Available from: http://nap.psa.gov.ph/glossary/terms/indicatorDetails.asp?strIndi=51

[21] International statistical classification of diseases and related health problems [Internet]. 2004. Available from: https://www.who.int/classifications/icd/ICD10_2nd_ed_volume2.pdf?ua=1.

[22] Nshimyiryo A, Hedt-Gauthier B, Mutaganzwa C, Kirk CM, Beck K, Ndayisaba A, *et al*. Risk factors for stunting among children under five years: a cross-sectional population-based study in Rwanda using the 2015 Demographic and Health Survey. BMC Public Health 2019; 19(1): 175. https://doi.org/10.1186/s12889-019-6504-z

[23] Derso T, Tariku A, Biks G, Wassie M. Stunting, wasting and associated factors among children aged 6–24 months in Dabat health and demographic surveillance system site: A community based cross-sectional study in Ethiopia 2017; 17. https://doi.org/10.1186/s12887-017-0848-2

[24] Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, de Onis M, *et al*. Maternal and child undernutrition and overweight in low-income and middle-income countries. Lancet 2013; 382(9890): 427-51. https://doi.org/10.1016/S0140-6736(13)60937-X

[25] Hoppe C, Molgaard C, Michaelsen KF. Cow's milk and linear growth in industrialized and developing countries. Annu Rev Nutr 2006; 26: 131-73. https://doi.org/10.1146/annurev.nutr.26.010506.103757

[26] Choudhury S, Headey DD. Household dairy production and child growth: Evidence from Bangladesh. Econ Hum Biol 2018; 30: 150-61. https://doi.org/10.1016/j.ehb.2018.07.001

[27] World Health Organization. Why can't we give water to a breastfeeding baby before the 6 months, even when it is hot? 2014 [Available from: https://www.who.int/features/qa/breastfeeding/en/

[28] Menon P, Bamezai A, Subandoro A, Ayoya MA, Aguayo V. Age-appropriate infant and young child feeding practices are associated with child nutrition in India: insights from nationally representative data. Matern Child Nutr 2015; 11(1): 73-87. https://doi.org/10.1111/mcn.12036

[29] Dewana Z, Fikadu T, Facha W, Mekonnen N. Prevalence and Predictors of Stunting among Children of Age between 24 to 59 Months in Butajira Town and Surrounding District, Gurage Zone, Southern Ethiopia 2017; 11. https://10.0.85.7/1791-809X.1000518

[30] Ajao KO, Ojofeitimi EO, Adebayo AA, Fatusi AO, Afolabi OT. Influence of family size, household food security status, and child care practices on the nutritional status of under-five children in Ile-Ife, Nigeria. Afr J Reprod Health 2010; 14(4 Spec no.): 117-26. Available from: https://europepmc.org/abstract/med/21812205

[31] Menezes RC, Lira PI, Leal VS, Oliveira JS, Santana SC, Sequeira LA, *et al*. Determinants of stunting in children under five in Pernambuco, northeastern Brazil. Rev Saude Publica 2011; 45(6): 1079-87. Available from: https://www.ncbi.nlm.nih.gov/pubmed/22124738

[32] Khan MMA, Khattak SA. Malnutrition and Associated Risk Factors in Pre-School Children (2-5 Years) in District Swabi (NWFP)-Pakistan. Journal of Medical Sciences 2010. Available from: https://scialert.net/abstract/?doi=jms.2010.34.39

[33] Bogale TY, Bala ET, Tadesse M, Asamoah BO. Prevalence and associated factors for stunting among 6-12 years old school age children from rural community of Humbo district, Southern Ethiopia. BMC Public Health 2018; 18(1): 653. Available from: https://www.ncbi.nlm.nih.gov/pubmed/29793479

[34] María García Cruz L, González Azpeitia G, Reyes Súarez D, Santana Rodríguez A, Loro J, Serra-Majem L. Factors Associated with Stunting among Children Aged 0 to 59 Months from the Central Region of Mozambique 2017; 9: 491. https://doi.org/10.3390/nu9050491

[35] Ricci JA, Becker S. Risk factors for wasting and stunting among children in Metro Cebu, Philippines. Am J Clin Nutr 1996; 63(6): 966-75. https://doi.org/10.1093/ajcn/63.6.966

[36] Bourke CD, Berkley JA, Prendergast AJ. Immune Dysfunction as a Cause and Consequence of Malnutrition. Trends in Immunology 2016; 37(6): 386-98. Available from: https://www.ncbi.nlm.nih.gov/pubmed/27237815

[37] Cumming O, Cairncross S. Can water, sanitation and hygiene help eliminate stunting? Current evidence and policy implications. Matern Child Nutr 2016; 12(Suppl Suppl 1): 91-105. Available from: https://www.ncbi.nlm.nih.gov/pubmed/27187910

[38] Nurturing care for early childhood development: a framework for helping children survive and thrive to transform health and human potential [Internet]. 2018. Available from: https://apps.who.int/iris/bitstream/handle/10665/272603/9789241514064-eng.pdf?ua=1

[39] Fotso JC, Madise N, Baschieri A, Cleland J, Zulu E, Mutua MK, *et al*. Child growth in urban deprived settings: does household poverty status matter? At which stage of child development? Health Place 2012; 18(2): 375-84. https://doi.org/10.1016/j.healthplace.2011.12.003

[40] Bukusuba J, Kaaya AN, Atukwase A. Predictors of Stunting in Children Aged 6 to 59 Months: A Case-Control Study in Southwest Uganda. Food Nutr Bull 2017; 38(4): 542-53. Available from: https://doi.org/10.1177/0379572117731666

[41] Krishna A, Mejia-Guevara I, McGovern M, Aguayo VM, Subramanian SV. Trends in inequalities in child stunting in South Asia. Matern Child Nutr 2018; 14(Suppl 4): e12517. https://doi.org/10.1111/mcn.12517

Received on 13-06-2019 Accepted on 10-07-2019 Published on 31-08-2019

https://doi.org/10.6000/1929-4247.2019.08.03.1