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Casas, Lyle; Ulep, Valerie Gilbert

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DISCUSSION PAPER SERIES NO. 2024-23

What Determines the Decline of Wasting in the Philippines?

Lyle Daryll D. Casas and Valerie Gilbert T. Ulep

Philippine Institute for Development Studies

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CONTACT US: RESEARCH INFORMATION DEPARTMENT Philippine Institute for Development Studies

18th Floor, Three Cyberpod Centris - North Tower EDSA corner Quezon Avenue, Quezon City, Philippines What Determines the Decline of Wasting in the Philippines?

Lyle Daryll D. Casas Valerie Gilbert T. Ulep

PHILIPPINE INSTITUTE FOR DEVELOPMENT STUDIES UNITED NATIONS CHILDREN'S FUND

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Abstract

In the past three decades, the prevalence of child wasting in the Philippines has generally fluctuated between 6% and 8%. As a result, the country fell short of the 2022 Philippine Plan of Action for Nutrition target of 5%. However, between 2013 and 2018, the decline in the wasting prevalence (-2.3 percentage points) in the Philippines was sharp and statistically significant. Still, the numbers remain substantial, with 800,000 children in the Philippines still affected by wasting who could be at risk for mortality. Thus, this progress must be sustained to meet future targets, including the Sustainable Development Goals (3.7%). Using the 2013 and 2018 rounds of the National Nutrition Survey (NNS), we identified the factors contributing to this decline during these periods using the Oaxaca-Blinder decomposition model. We found that total energy, wealth quintile, and maternal nutrition status have sufficient statistical evidence to determine weight-for-height Z-score (wasting) and the improvement in economic outcomes of household (wealth), maternal nutrition status, and energy intake could explain in part the improvement in the wasting status of children in the Philippines between 2013 and 2018. Sustaining public efforts for maternal and child characteristics including the underlying determinants such as socioeconomic characteristics are important in further reducing the wasting prevalence in the country. Further studies to examine other factors including child morbidity and diet diversity are recommended to assess if it could explain the rest of the gap in wasting prevalence during this period.

Keywords: nutrition, wasting, Oaxaca-Blinder decomposition, Philippines

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What Determines the Decline of Wasting in the Philippines?

Lyle Daryll D. Casas and Valerie Gilbert T. Ulep¹

Introduction

Wasting, a form of child malnutrition characterized by low weight for height, affects around 7% or 45 million children under five in the world (UNICEF 2023; World Health Organization 2006). In developing countries, undernutrition, including wasting, is responsible for around 3.1 million childhood deaths annually, accounting for 45% of all child deaths (Black et al. 2013).

In the past three decades, the prevalence of child wasting in the Philippines has generally fluctuated between 6% and 8%. As a result, the country fell short of the 2022 Philippine Plan of Action for Nutrition target of 5%. However, from 2013 to 2018, there was a statistically significant decline in wasting prevalence. According to the Food and Nutrition Research Institute (FNRI), wasting prevalence decreased from 8% in 2013 to 5.7% in 2018 (See Figure 1).



Figure 1. Prevalence of childhood wasting in the Philippines, 1989-2021

Source: Authors' illustration of data from the Philippine National Nutrition Surveys (DOST-FNRI)

While wasting prevalence has significantly declined, the numbers remain substantial, with 800,000 children in the Philippines still affected by wasting. The 2021 Global Burden of Disease Study indicates that malnutrition (including wasting) accounts for around 3.3% total disability-adjusted life years (DALYs) among children under five years old in the Philippines. Further, child wasting ranked 5th in the top risk factors for disease burden in children (Institute for Health Metrics and Evaluation 2024). Therefore, wasting increases the risk of disease and death and decreases economic productivity.

¹ LDC and VGU are Research Specialist and Senior Research Fellow at the Philippine Institute for Development Studies, respectively.

The recent decline in wasting prevalence is a welcome development. Still, this progress must be sustained to meet future targets, including the Sustainable Development Goal (SDGs) of reducing wasting to 3.7% by 2030 (NEDA 2022). Understanding the drivers behind this decline in wasting prevalence in the Philippines is crucial for sustaining progress, developing effective policies, and allocating resources efficiently. This study aims to identify and quantify the drivers behind the decline in wasting prevalence in the Philippines. Using the 2013 and 2018 rounds of the National Nutrition Survey (NNS) conducted by the FNRI, we identified the factors contributing to this decline during these periods using the Oaxaca-Blinder decomposition model. This approach allowed us to examine various factors, such as improvements in health, nutrition programs, economic conditions, and other sociodemographic factors, that have influenced the reduction in wasting prevalence. By understanding these drivers, we can better inform future policies and interventions to sustain and accelerate this positive trend.

Materials and Methods

Data

In this study, we used the National Nutrition Survey (NNS), a nationally representative survey conducted by the Food and Nutrition Research Institute (FNRI). The NNS is composed of several modules: (1) socio-economic, (2) anthropometric, (3) biochemical, clinical, and health, (4) maternal health and nutrition, infant and child feeding (IYCF) practices, and (5) food security, and government program participation. Detailed methodologies and standard procedures for each survey component can be accessed at the FNRI website (DOST-FNRI 2014, 2019).

Our analysis focused on children aged 0-59 months and used anthropometric, dietary, sociodemographic, food security, and maternal data. The final sample for the descriptive statistics included 29,586 children, 12,952 from the 2013 round, and 16,634 from the 2018 round. These are data from children with complete individual and anthropometric data. For the regression and the decomposition model, the final sample included 3,657. This sample was limited only to those children with complete data on other components. The maternal and dietary modules of the survey are not administered to all the survey respondents.

Description of the Wasting Variable

Wasting is defined as having lower than two standard deviations from the reference weightfor-height for the child's height, age, and sex based on the 2006 Child Growth Standards of WHO (Philippine Statistics Authority 2008). Trained data collectors measured the child's weight using a digital weighing scale, taking two measurements recorded to the nearest 0.1 kg. They took a third measurement if the difference between the first two measurements exceeded 0.3 kg. For infants and restless young children, they weighed the mother, tared the scale, and finally had the caregiver carry the child to take the weight measurement (Food and Nutrition Research Institute 2014, 2018). They obtained the height using a stadiometer for subjects two years and above and a medical plastic infantometer for children younger than two years. They took two measurements for each child and recorded to the nearest 0.1 cm, and a third one was taken in case the difference between the first two measurements was greater than 0.5 cm (Food and Nutrition Research Institute 2014, 2018). We calculated the weight-for-height z-scores using the user-defined Stata package "zscore06" designed by Leroy (2011). The package requires age, sex, height, and weight information from the survey, compares this to the WHO Child Growth Standards, and categorizes the children into wasting categories. We used the continuous weight-for-height z-score as the outcome variable in the multiple regression and Oaxaca decomposition. For the descriptive analysis, we classified children as severely wasted when a child's weight-for-height z-score is less than -3 standard deviations (SD) below the median, moderately wasted when the z-score is less than -2SD but greater than or equal to -3SD, and overweight-for-height/obese when the z-score is greater than +2SD.

We chose the variables to include in the model based on the UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition (See **Figure 2**) and the availability of data from the NNS. The framework classifies determinants as immediate, underlying, and enabling.





Source: UNICEF 2021

Enabling determinants are political, financial, social, cultural, and environmental conditions that enable good nutrition for children and women (UNICEF 2021). We identified enabling determinants: wealth quintile, geographic location, and various maternal characteristics such as the mother's age, civil status, and educational attainment. We determined the wealth quintile using a principal components analysis of household assets. Geographic location refers to the region where the child resides. We used the continuous number for the mother's age. We categorized mothers' civil status as single, married, widowed, or separated/annulled/divorced.

For educational attainment, we classified mothers as having achieved an education level below or above high school.

We included food security, access to drinking and sanitation facilities, and the mother's timely prenatal care as underlying determinants. These determinants encompass the food, practices, and services available to children and women in their households, communities, and environments to enable good nutrition (UNICEF 2021). We measured food security using the Food Insecurity Experience Scale (FIES), classifying households as either food-secure or food-insecure. For access to drinking and sanitation facilities, we categorized households as having improved, unimproved, or no facilities for water and sanitation (surface water and open defecation, respectively). We classified mothers as having timely prenatal care (PNC) if they received PNC services within the first trimester.

Diet and care are immediate determinants. In this study, we included the child's dietary intake, measured in terms of energy (calories). Trained nutritionist-dietitians estimated this intake using a 24-hour food recall for the NNS (DOST-FNRI 2022).

Data Analysis

We began our analysis with descriptive statistics to examine the prevalence of wasting in children across select covariates in the 2013 and 2018 cohorts. In addition, we assessed the change in wasting status using kernel density and Victora curve plots of the weight-for-height Z-score between 2013 and 2018. Kernel density plots of weight-for-height Z-scores comprehensively describe wasting severity in the population. This approach offers more detailed insights than comparing prevalence values, which may obscure variations in weight-for-height Z-scores within the population. We adapted Victora or growth-f mean curve fitted using polynomial regression.

We then run a multivariable linear regression model to investigate the determinants of wasting (y = weight-for-height Z-score). In the model, we controlled for the child's individual characteristics (age, sex), geographic location, access to water and sanitation facilities, food security, dietary intake (energy), and other sociodemographic and maternal characteristics (x^n). We also controlled the time effects using a dummy variable for the survey year.

$$y = \beta_0 + \beta_{x^n} + \dots + \beta_{x^{year}} + \varepsilon_i$$

Following the regression model, we decomposed the gap in mean weight-for-height Z-score between the 2013 and 2018 groups using the Oaxaca-Blinder two-fold decomposition model To quantify the contribution of the explanatory variable in explaining the gap in mean weight-for-height Z-score between 2013 and 2018 (Headey and Hoddinott 2015; Headey, Hoddinott, and Park 2016, 2017; Woodruff et al. 2017). The change in weight-for-height z-score is decomposed into the following components: differences in the values of the nutritional factors, also known as the gap in endowments (or the explained component) and differences in the values of the effects of these nutritional factors on the outcome, known as the gap in coefficients (or the unexplained component). The coefficients gap represents the difference accounted for by the magnitude of the coefficients in the model and not by the value of the coefficients themselves. Hence, these are unexplained differences in the model (O'Donnell et al. 2008). The decomposition of interest is the gap in endowments, which may be further

decomposed into each nutritional factor of interest. The resulting value is the contribution of the nutritional factor in describing the change in weight-for-height z-scores. The difference between the mean weight-for-height Z-score in 2013 and 2018 is equal to:

$$y^{2013} - y^{2018} = [E(X_{2013}) - E(X_{2018})]'\beta^* + [E(X_{2013})'(\beta_{2013} - \beta^*) + E(X_{2018})'(\beta^* - \beta_{2018})]$$

X2013 and X2018 are explanatory variables examined at the means for the 2013 and 2018 groups, and β * are nondiscriminatory coefficient vectors. This results in a two-fold decomposition:

$$y^{2013} - y^{2018} = E + U$$

The first component is the part of the outcome differential explained by the group differences in the predictors (E), and the second is the unexplained part (U) (Jann 2008).

$$E = [E(X_{2013}) - E(X_{2018})]'\beta^*$$

$$U = [E(X_{2013})'(\beta_{2013} - \beta^*) + E(X_{2018})'(\beta^* - \beta_{2018})]$$

We determined the statistical significance at p < 0.05. We accounted for the complex design of the NNS rounds using the survey weights provided in the NNS dataset. We conducted all our analysis using Stata MP 16.0.

Results

Prevalence of wasting among children under five across various covariates in 2013 and 2018

Table 1 summarizes the descriptive analyses of wasting prevalence across key covariates in the 2013 and 2018 NNS. From 2013 to 2018, the prevalence of severe wasting decreased from 2.8% to 1.3%, moderate wasting decreased from 5.1% to 4.7%, and overweight decreased from 5.0% to 3.9%. We observed larger decreases in severe wasting compared to moderate wasting.

We observed the same pattern across age groups. For instance, for the younger age group (0-23 months), severe wasting decreased from 4.4% to 2.1%, and moderate wasting decreased from 6.9% to 5.8%. However, for the older age group (24-59 months), severe wasting decreased from 1.9% to 0.8%, but moderate wasting slightly increased from 4.0 to 4.1%. These patterns were observed across all sex categories, sanitation and drinking facilities, food security, wealth quintile, and other maternal characteristics.

	·	2013		2018			
Variable		(N=12,952)			(N=16,634)		
variable	Severely	Moderately	Overweight-	Severely	Moderately	Overweight-	
	wasted	wasted	for-height	wasted	wasted	for-height	
All sample (n, %)	366 (2.8)	655 (5.1)	654 (5)	212 (1.3)	775 (4.7)	642 (3.9)	
Age (mean)	1.9	2.3	2.4	1.8	2.5	2.9	
0-23 mos	211 (4.4)	332 (6.9)	278 (5.8)	122 (2.1)	332 (5.8)	193 (3.4)	
24-59 mos	155 (1.9)	323 (4)	376 (4.6)	90 (0.8)	443 (4.1)	449 (4.1)	
Sex at birth							
Male	209 (3.1)	341 (5.1)	356 (5.3)	135 (1.6)	426 (5)	340 (4)	
Female	157 (2.5)	314 (5)	298 (4.7)	77 (1)	349 (4.3)	302 (3.7)	
Sanitation (Toilet)							
Improved	286 (2.8)	475 (4.6)	564 (5.5)	179 (1.2)	677 (4.6)	615 (4.1)	
Unimproved	31 (2.5)	75 (6)	43 (3.5)	16 (2)	45 (5.7)	21 (2.6)	
Open Defecation	47 (3.6)	98 (7.4)	43 (3.3)	17 (1.9)	47 (5.2)	6 (0.7)	
Water (Drinking Water)							
Improved	227 (2.9)	427 (5.5)	345 (4.4)	196 (1.2)	713 (4.5)	624 (3.9)	
Unimproved	45 (2.9)	65 (4.1)	56 (3.6)	13 (1.7)	49 (6.4)	16 (2.1)	
Surface Water	20 (5)	26 (6.4)	16 (4)	3 (2.6)	7 (6)	2 (1.7)	
Total energy (mean calories)	573.6	735.5	1088.7	594	614	1006.6	
Food Security							
Food Secure	62 (2.2)	121 (4.3)	223 (8)	51 (1)	174 (3.5)	329 (6.6)	
Food Insecure	303 (3)	532 (5.3)	428 (4.2)	160 (1.4)	599 (5.2)	312 (2.7)	
Wealth Index					· · ·		
Poorest	129 (3.5)	209 (5.8)	113 (3.1)	98 (1.7)	329 (5.7)	104 (1.8)	
Poor	69 (2.4)	141 (4.9)	105 (3.7)	53 (1.3)	194 (4.9)	102 (2.6)	
Middle	72 (2.8)	139 (5.4)	112 (4.3)	29(1)	121 (4.1)	119 (4)	
Rich	54 (2.6)	109 (5.2)	134 (6.4)	19 (0.9)	67 (3.1)	138 (6.3)	
Richest	38 (2.3)	48 (2.9)	186 (11.3)	13 (0.8)	58 (3.4)	179 (10.6)	
Prenatal Check-up							
Not on-time	50 (3.7)	87 (6.5)	56 (4.2)	41 (1.9)	111 (5.1)	50 (2.3)	
On-time	142 (3.7)	255 (6.7)	222 (5.8)	70 (1.6)	217 (4.9)	144 (3.2)	
Mother's age (mean)	30.6	31.4	30.9	30	30.8	31.4	
Mother's Civil Status							
Single	33.0 (3.7)	43.0 (4.8)	58.0 (6.5)	13.0 (1.7)	36.0 (4.6)	28.0 (3.6)	
Married	202.0 (2.7)	385.0 (5.1)	357.0 (4.7)	102.0 (1.3)	356.0 (4.5)	303.0 (3.8)	
Live-in	12.0 (2.3)	31.0 (5.8)	26.0 (4.9)	4.0 (1.1)	15.0 (4.2)	17.0 (4.8)	
Widow/Widower	87.0 (3.1)	154.0 (5.5)	163.0 (5.9)	76.0 (1.4)	278.0 (5.3)	169.0 (3.2)	
Separated/Annulled/Divorced							
Mother's Nutritional Status	190 (2.9)	359 (5.5)	297 (4.5)	117 (1.4)	410 (5)	253 (3.1)	
Underweight	44 (3.5)	116 (9.2)	47 (3.7)	30 (2.2)	117 (8.6)	21 (1.5)	
Normal	55 (2.5)	87 (3.9)	140 (6.3)	34 (1)	115 (3.3)	153 (4.4)	
Overweight	41 (2.6)	44 (2.8)	116 (7.3)	11 (1)	37 (3.2)	83 (7.2)	
Obese							
Mother's Educational	259 (3.1)	485 (5.8)	344 (4.1)	91 (1.6)	310 (5.5)	101 (1.8)	
Attainment							
Below high school	74 (2.2)	124 (3.7)	253 (7.5)	103 (1.2)	373 (4.4)	412 (4.9)	
High-school graduate	366 (2.8)	655 (5.1)	654 (5)	212 (1.3)	775 (4.7)	642 (3.9)	

Table 1. Descriptive statistics of wasting prevalence among children aged 0-59 months in
this sample across key covariates, 2013 and 2018

Source: Authors' analysis of data from Food and Nutrition Research Institute

Change in select determinants of nutrition status between 2013 and 2018

We observed improvement in select determinants of wasting between 2013 and 2018. The radar chart in Figure 3 below shows the increase (or improvement) in the coverage of improved drinking and toilet facilities, food security, and maternal education. In the 2013 dataset, around 82-83% of the children belonged to households with improved toilet and drinking facilities, which increased to 92-95% in the 2018 dataset. Similarly, the number of children from food-secure households in 2013 increased from 23% to 33% in 2018. On-time prenatal checkup coverage, however, showed a slight decrease from 74% in 2013 to 69% in 2018. For the maternal nutrition status, we noted a slight increase (1-5 percentage points) from 2013 to 2018 in children with mothers having normal and overweight BMI.



Figure 3. Coverage (%) of select determinants of nutrition status, 2013 and 2018

Source: Author's visualization

Change in nutritional status between 2013 and 2018: Kernel density and Victora curve

Figure 4 (left) shows the kernel density plot of the Z-score in 2013 and 2018. The left tail of the distribution is thinner in 2018 than in 2013, especially in the tail beyond -3, which indicates the distribution of wasting z-score has shifted. This corroborates the decrease in prevalence

reported in Table 1 and provides the additional context that the depth of wasting decreased in 2018 vs. 2013, as the overall weight-for-height z-score distribution has shifted rightward. Similarly, **Figure 4** (right) shows the Victora plot of weight-for-height z-score vs. age stratified by survey year. An individual point in the scatterplot represents a child in the survey, while the lines represent Lowess smoothed curves that summarize the individual points. The scatterplot shows that the dispersion of weight-for-height z-scores is similar across age, which suggests that the distribution of weight-for-height z-score for children below the age of 1.





Source: Authors' illustration

Note: For Figure b (right): an individual point represents a child, and lines represent lowess smoothed curves.

Linear probability model

Our sample for the regression model included 3,675 children aged 0-59 months with complete anthropometric, socio-demographic, dietary, and maternal characteristic data. Table 2 shows the coefficients from the regression model, which is interpreted as the weight-for-height Z-score (dependent variable) change per one unit increase or category of the independent variable.

Among the variables, the total energy intake (calories), belonging to rich households, and having an underweight mother were significant predictors of wasting (weight-for-height Z-score). Belonging to rich households increases the Z-score by around 0.374-0.531, making the Z-score closer to the median (normal). We observed the same direction with the association of total energy (in calories, measured as a continuous variable). On the other hand, having an underweight mother would decrease the Z-score by 0.391, making the Z-score farther from the median (wasted).

Variabla	Coofficient	SE	n valua	95% Confidence Interval			
v al lable	Coefficient	SE	p-value	LB	UB	*	
Age	0.006	0.050	0.905	-0.093	0.105		
Sex (ref: Male)							
Female	-0.165	0.097	0.088	-0.355	0.025		
Region (ref: NCR)							
Region I	-0.655	0.348	0.060	-1.337	0.028		
Region II	-0.471	0.253	0.063	-0.968	0.026		
Region III	-0.196	0.239	0.413	-0.664	0.273		
Region V	-0.520	0.254	0.041	-1.018	-0.022	**	
Region VI	-0.180	0.254	0.479	-0.677	0.318		
Region VII	-0.246	0.285	0.388	-0.804	0.312		
Region VIII	-0.281	0.283	0.321	-0.835	0.274		
Region IX	-0.439	0.281	0.118	-0.990	0.112		
Region X	-0.324	0.247	0.189	-0.808	0.159		
Region XI	-0.248	0.244	0.310	-0.727	0.231		
Region XII	-0.368	0.262	0.160	-0.882	0.145		
CAR	-0.220	0.225	0.328	-0.662	0.221		
ARMM	-0.176	0.253	0.487	-0.672	0.320		
CARAGA	-0.562	0.279	0.044	-1.110	-0.015	**	
CALABARZON	-0.250	0.243	0.304	-0.726	0.227		
MIMAROPA	-0.264	0.270	0.329	-0.794	0.266		
Total energy (kcal)	0.000	0.000	0.010	0.000	0.000	**	
Toilet (ref: Improved)							
Unimproved	0.053	0.116	0.646	-0.174	0.281		
Open Defecation	-0.063	0.119	0.599	-0.296	0.171		
Drinking Water (ref:							
Improved)							
Unimproved	0.114	0.114	0.318	-0.110	0.338		
Surface Water	0.167	0.212	0.430	-0.248	0.582		
Food Security (ref: Secure)							
Food insecure	-0.087	0.077	0.262	-0.239	0.065		
Wealth quintile (ref: poorest)							
Poor	0.266	0.179	0.138	-0.085	0.618		
Middle	0.110	0.102	0.279	-0.090	0.310		
Rich	0.374	0.127	0.003	0.125	0.623	***	
Richest	0.531	0.164	0.001	0.210	0.853	***	
Mother's age	0.000	0.004	0.949	-0.008	0.009		
Mother's civil status	0.047	0.028	0.092	-0.008	0.101		
Mother's nutritional status							
Underweight	-0.391	0.124	0.002	-0.634	-0.148	***	
Overweight	0.090	0.102	0.377	-0.110	0.291		
Obese	0.239	0.150	0.112	-0.056	0.534		
Mother's education (ref:							
below HS)							

Table 2. Ordinary least squares regression coefficients using linear probability model

Above high school	0.037	0.111	0.738	-0.180	0.254
Mother's prenatal on time					
(ref: not ontime)					
Ontime PNC	-0.070	0.111	0.526	-0.289	0.148
Survey Year	0.026	0.020	0.189	-0.013	0.064
Constant	-52.549	39.509	0.184	-130.011	24.912

Source: Authors' analysis of data from Food and Nutrition Research Institute Note: *** p<.01, ** p<.05

We conducted separate regression models for the younger and older age groups, both years pooled, and 2013 and 2018, both age groups (See **Appendix A**). We observed that between age groups, the total energy intake, wealth quintile, and access to improved drinking water facilities seemed to be a significant predictor of wasting only in the younger age group, and the mother's nutrition status was a consistently significant predictor in both groups. Meanwhile, comparing 2013 and 2018 with both age groups in the model, we observed that the total energy intake was a significant predictor only in the 2013 group, the mother's nutrition status (underweight) in the 2018 group, and the wealth quintile was a consistent significant predictor in both years.

Oaxaca-Blinder decomposition model

Table 3 summarizes the results of the Oaxaca-Blinder decomposition model. The mean Z-score in 2013 and 2018 were -0.599 and -0.301, respectively, with a mean difference of -0.298. These were all statistically significant (p < 0.05). The mean difference in Z-score that could be explained by the observable data (or due to the endowments or the explained part) was 44%, which was statistically significant.

_	coefficient	SE	p-value	95% Co Inte	%	
				LB	UB	contribution
Year 2013	-0.599	0.086	0.000	-0.767	-0.430	
Year 2018	-0.301	0.052	0.000	-0.403	-0.200	
Raw differential	-0.298	0.100	0.003	-0.494	-0.101	
due to endowments	-0.130	0.044	0.003	-0.215	-0.044	44%
due to coefficients	-0.168	0.109	0.124	-0.382	0.046	56%

Table 3. Summary result of Oaxaca decomposition analysis showing the mean differencesin weight-for-height Z-scores from 2013 and 2018

Source: Authors' analysis of data from Food and Nutrition Research Institute

For the endowments or explained component, **Table 4** shows the contribution of each factor in the weight-for-height Z-score differentials between 2013 and 2018. The wealth quintile (richest), the mother's nutrition status (underweight), and total energy were the significant drivers that could explain the gap in mean weight-for-height Z-score between 2013 and 2018. The wealth quintile (being in the richest quintile) contributed the highest at 31%, followed by the mother's nutrition status (underweight at 14%) and the total energy intake at 13%.

Detween 2015 and	1 2010 (Chuow		explained	componer	u()	1	
				95% Co	nfidence	0/2	
Variable	coefficient	SE	p-value	Inte	erval	contribution	
				LB	UB	contribution	
Age	-0.0005	0.0054	0.9280	-0.0112	0.0102	0%	
Sex (ref: Male)							
Female	-0.0073	0.0059	0.2150	-0.0189	0.0042	6%	
Region	0.0050	0.0068	0.4620	-0.0084	0.0185	-4%	
Total Energy	-0.0172	0.0080	0.0310	-0.0329	-0.0016	13%	
Toilet (ref: Improved)							
Unimproved	0.0038	0.0072	0.6030	-0.0104	0.0180	-3%	
Open Defecation	-0.0017	0.0113	0.8780	-0.0240	0.0205	1%	
Drinking Water (ref:							
Improved)							
Unimproved	0.0080	0.0119	0.5000	-0.0153	0.0314	-6%	
Surface Water	0.0061	0.0066	0.3610	-0.0069	0.0190	-5%	
Food Security (ref: Secure)							
Food insecure	-0.0115	0.0121	0.3390	-0.0352	0.0121	9%	
Wealth quintile (ref: poorest)							
Poor	0.0020	0.0065	0.7530	-0.0106	0.0147	-2%	
Middle	0.0022	0.0039	0.5780	-0.0055	0.0098	-2%	
Rich	-0.0052	0.0084	0.5340	-0.0218	0.0113	4%	
Richest	-0.0407	0.0145	0.0050	-0.0692	-0.0123	31%	
Mother's age	0.0004	0.0046	0.9220	-0.0085	0.0094	0%	
Mother's civil status	-0.0192	0.0116	0.0990	-0.0419	0.0036	15%	
Mother's BMI (ref: Normal)						0%	
Underweight	-0.0246	0.0104	0.0180	-0.0450	-0.0042	19%	
Overweight	-0.0078	0.0066	0.2420	-0.0208	0.0052	6%	
Obese	-0.0008	0.0034	0.8120	-0.0075	0.0059	1%	
Mother's education (ref:							
below HS)							
Above high school	-0.0147	0.0461	0.7490	-0.1052	0.0757	11%	
Mother's prenatal on time							
(ref: not ontime)							
Ontime PNC	-0.0059	0.0087	0.4980	-0.0228	0.0111	5%	

 Table 4. Contribution of each factor in the differences in weight-for-height Z-score between 2013 and 2018 (endowments or explained component)

Source: Authors' analysis of data from Food and Nutrition Research Institute

Discussion

We described the prevalence of wasting and identified the determinants of wasting and the drivers of the decline in wasting prevalence between 2013 and 2018. The prevalence of severe and moderate wasting generally declined from 2013 (2.8% and 5.1%) and 2018 (1.3% and 4.7%), with a larger decrease (1.5 percentage points) noted in severe wasting. This pattern is seen across all covariates examined, which could be linked to the noted improvements in select determinants of nutrition status. The total energy intake, wealth quintile, and mother's nutrition status were shown to be associated with wasting. On the other hand, the significant drivers that could explain 44% of the difference (-0.298) in the mean weight-for-height Z-score between 2013 and 2018 were the same factors: wealth quintile (23%) and maternal undernutrition (14%) and total energy intake (8%).

Extensive evidence, including multi-country studies, supports our findings on the association of wealth quintile and mother's nutrition status with wasting. Studies prove that children from poor households are more likely to be wasted, and our findings show that belonging to richer households will increase the weight-for-height Z-scores. Sufficient financial resources give the children an increased advantage of optimal nutrition by ensuring access to healthcare services and adequate food (Darteh, Acquah, and Darteh 2017; Harding, Aguayo, and Webb 2018; Pham et al. 2021). Also, it is known that mothers belonging to richer households have higher odds of being educated with the proper child-feeding and rearing practices ((Chowdhury et al. 2020; Habtamu, Chilo, and Desalegn 2022; Li et al. 2020; Saleem et al. 2023; Singh, Srivastava, and Chauhan 2020). Having an underweight mother decreases the child's weight for height Z-score, resulting in greater wasting. This is consistent with other studies (Ali et al. 2017; Blankenship et al. 2020; Harding et al. 2018; Lawal et al. 2023; Singh et al. 2020). Total energy intake, a statistically significant predictor, refers to the quantity (in calories) of a child's diet. This finding is consistent with the UNICEF's framework on child nutrition determinants, as child diet is an immediate determinant (UNICEF 2021). However, for wasting, it is also important to note that the diversity of diet (quality), more than the quantity, as evidenced by the total energy intake, is more important. This is consistent with other studies, as dietary diversity score turns out to be significantly associated with wasting (Khamis et al. 2019; Nair, Augustine, and Konapur 2015). In addition, it is noteworthy that breastfeeding and morbidity history of the child (illness) are also consistent predictors of wasting in other studies, especially in younger years. Positive effects of food in adequate quantity and quality could go to waste when a child gets sick without prompt treatment or interventions, because the absorption of these nutrients would be suboptimal (Elhady et al. 2023; Ruel and Alderman 2013). Due to the current limitations of the data, the dietary diversity score, feeding practices, and morbidity history of the child (illness) could not be accounted for in the model.

The improvement in the degree of wasting (or the decline in wasting prevalence) between 2013 and 2018 was partly explained (44%, p < 0.05) by our analysis. Around 31% of this part was due to improvements in the economic status of the households, which is also linked to the mother's nutrition status (19%) and the child's total energy intake (13%). The decline in wasting prevalence may be due to the improvements in these domains between 2013 and 2018.

The Philippines's economic situation improved between 2013 and 2018 with an average annual growth rate of 6.6%. The total gross domestic product in 2013 grew by 60% in 2018 (Philippine Statistics Authority OpenStat 2024). Poverty rates have declined as well during the same period (Philippine Statistics Authority 2022). Mother's nutrition status, on the other hand, may have improved between 2013 and 2018. Our findings show a slight increase in the percentage of

children with mothers having normal and overweight BMI. This is supported by published statistics showing a decreasing trend in nutritionally at-risk pregnant women from 25% in 2013 to 20% in 2018 (DOST-FNRI 2019). A slight decrease is seen also in the proportion of adult women with chronic energy deficiency (10.5% to 8.0% from 2013 to 2018, respectively) (DOST-FNRI 2014, 2019). Mothers' nutrition status could be traced back to their socioeconomic status as well, as having more resources is likely to result in food security, with optimal diet and nutrition that could also translate to improvements in the child's nutrition (Islam et al. 2016; Ramadhani et al. 2021).

While our analysis only explained part of the difference in wasting between 2013 and 2018, it is important to note that (1) other factors we were not able to include in the model may have also driven this decline and (2) the other factors included in the model, despite having no sufficient statistical evidence to prove their contribution to the gap, may still have an impact in further reducing the wasting prevalence.

First, child illness or morbidity history, which was not measured in the model due to data limitations, may also explain this decline. Investments have been in place for increased access to improved water and sanitation, which could reduce avertable food and water-borne illnesses. From 2013 through 2018, there has been a notable increase in the provision of safely managed water and sanitation services, rising from 46% to 47% and 54% to 59%, respectively. Similarly, the incidence of open defecation, which is linked to child malnutrition due to illness, has been decreasing during this period (WHO and UNICEF JMP 2024). This supports our findings on increased access to improved water and sanitation facilities between 2013 and 2018 (See Figure 3).

Second, other determinants such as food security and other maternal services and practices (e.g., maternal education, access to health services) may be effective in improving child nutrition outcomes despite showing insufficient statistical evidence in this analysis. This may be because there was no statistically significant difference or huge improvements between 2013 and 2018, or during this time, the decline was attributed to other factors and not these factors.

Over the years, the Philippine government has invested huge amounts in health and nutrition by implementing various maternal and child health programs. Health spending per capita among children under five increased from approximately 4,000 in 2013 to 6,000 in 2018 (Philippine Statistical Authority 2024). Sustaining these efforts is the passage of the First 1,000 Days law in 2018, which emphasizes the critical period of pregnancy to the first 24 months of life, strengthening the government's roles and priorities in delivering interventions for this critical life stage (Republic Act No. 11148). This was followed by the passage of the Universal Health Care law in 2019, aiming to provide Filipinos access to comprehensive health services (with a focus on preventive or primary care) with financial risk protection (Republic Act No. 11223). We attempted to examine factors that may have caused the sharp decline in wasting prevalence between 2013 and 2018, which could inform policymakers and program implementers on what interventions to sustain and recalibrate to maximize investments and further reduce the wasting burden in the Philippines.

Strengths and Limitations

Our study has several limitations. First, this study does not provide evidence of the causality between the identified factors and wasting. This is because the current available dataset is cross-sectional and not longitudinal data. Thus, we were also unable to organize the dataset as

panel data. Nevertheless, the time effects between 2013 and 2018 were still accounted for by including in the model a dummy variable on the survey year. Second, other important variables that could predict wasting and the decline in prevalence based on the UNICEF Conceptual Framework on Malnutrition including but not limited to: child illness, infant and young child feeding indicators, and other maternal and child health services, were not included in the model due to limitations in the available data. Third, the study was limited to a quantitative analysis of the NNS, and in the future qualitative studies such as focus group discussions and interviews with public and non-public nutrition policymakers and experts may also be done to help provide context to these results. Despite these documented limitations in the data, this dataset is the largest and only national survey that collects detailed anthropometric measurements for children in the country (Patalen et al. 2020). Thus, we believe that the results of this study will still inform recommendations for programs and policies aiming to sustain the decline in wasting prevalence.

Conclusion

Between 2013 and 2018, the decline in the wasting prevalence (-2.3 percentage points) in the Philippines was sharp and statistically significant. However, the prevalence remains substantial translating to around 800,000 children in the Philippines who could be at risk for mortality. Examining the drivers of this decline is crucial to sustain public efforts and investments to further reduce the wasting prevalence aiming to reach our 2030 Sustainable Development Targets. We found that total energy, wealth quintile, and maternal nutrition status have sufficient statistical evidence to determine weight-for-height Z-score (wasting) and the improvement in economic outcomes of household (wealth), maternal nutrition status, and energy intake could explain in part the improvement in the wasting status of children in the Philippines between 2013 and 2018. Sustaining public efforts for maternal and child characteristics including the underlying determinants such as socioeconomic characteristics are important in further reducing the wasting prevalence in the country. Further studies to examine other factors including child morbidity and diet diversity are recommended to assess if it could explain the rest of the gap in wasting prevalence during this period.

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Appendix

	pooled 2013 and 2018, all age groups	2013, all age groups	2018, all age groups	pooled 2013 and 2018, 0- 23mos	pooled 2013 and 2018, 24-59 mos	2013, 0-23 mos	2018, 0-23 mos	2013, 24-59 mos	2018, 24-59 mos
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Outcome	wfhz	wfhz	wfhz	wfhz	wfhz	wfhz	wfhz	wfhz	wfhz
Age	0.00602	-0.0115	0.00579	0.00171	-0.354	-0.284	0.0174	-0.0115	-0.361
	(0.12)	(-0.11)	(0.11)	(0.02)	(-0.97)	(-1.32)	(0.21)	(-0.03)	(-0.93)
Sex									
Female (ref: Male)	-0.165	-0.0760	-0.180	-0.0834	-0.300	0.00268	-0.0909	-0.268	-0.337
	(-1.71)	(-0.54)	(-1.63)	(-1.22)	(-1.31)	(0.01)	(-1.23)	(-1.28)	(-1.26)
Region									
Region I	-0.655	-0.200		-0.468	-1.062	-0.175		-0.788	
	(-1.88)	(-0.54)		(-1.39)	(-1.44)	(-0.37)		(-1.57)	
Region II	-0.471	0.757*	-0.611*	-0.173	-0.986	0.853	-0.296*	0.387	-1.074
	(-1.86)	(2.03)	(-2.15)	(-1.21)	(-1.63)	(1.85)	(-1.97)	(0.59)	(-1.65)
Region III	-0.196	-0.00623	-0.220	-0.0901	-0.410	-0.256	-0.0956	-0.384	-0.377
	(-0.82)	(-0.02)	(-0.82)	(-0.51)	(-0.75)	(-0.54)	(-0.50)	(-0.97)	(-0.65)
Region V	-0.520*	0.0164	-0.622*	-0.207	-0.972	-0.116	-0.249	-0.417	-1.064
	(-2.05)	(0.04)	(-2.15)	(-1.43)	(-1.72)	(-0.21)	(-1.79)	(-0.99)	(-1.72)
Region VI	-0.180	0.243	-0.263	0.153	-0.681	0.509	0.0706	-0.778	-0.664
	(-0.71)	(0.63)	(-0.93)	(1.13)	(-1.25)	(1.02)	(0.51)	(-1.42)	(-1.15)
Region VII	-0.246	0.389	-0.429	0.0753	-0.836	0.406	-0.106	-0.179	-0.903
	(-0.86)	(1.24)	(-1.37)	(0.43)	(-1.28)	(0.96)	(-0.60)	(-0.46)	(-1.25)
Region VIII	-0.281	0.263	-0.381	0.0733	-0.859	0.0467	0.0575	0.307	-0.992
	(-0.99)	(0.83)	(-1.19)	(0.59)	(-1.29)	(0.12)	(0.43)	(0.54)	(-1.37)
Region IX	-0.439	0.322	-0.623	-0.0434	-1.121	0.394	-0.190	-0.476	-1.249
	(-1.56)	(0.81)	(-1.92)	(-0.26)	(-1.78)	(0.74)	(-1.21)	(-1.02)	(-1.83)
Region X	-0.324	0.335	-0.520	-0.0240	-0.932	0.202	-0.139	0.158	-1.078

Appendix A. OLS regression coefficients using linear probability model for various models

	(-1.32)	(1.00)	(-1.73)	(-0.15)	(-1.54)	(0.45)	(-0.81)	(0.33)	(-1.56)
Region XI	-0.248	0.483	-0.378	0.0206	-0.671	0.262	-0.0681	0.305	-0.786
	(-1.01)	(1.52)	(-1.38)	(0.14)	(-1.21)	(0.68)	(-0.42)	(0.66)	(-1.31)
Region XII	-0.368	0.354	-0.528	-0.139	-0.783	0.545	-0.321	-0.601	-0.824
	(-1.41)	(0.96)	(-1.78)	(-0.78)	(-1.28)	(1.12)	(-1.66)	(-1.24)	(-1.27)
CAR	-0.220	0.146	-0.294	-0.0324	-0.457	0.495	-0.150	-1.155*	-0.402
	(-0.98)	(0.32)	(-1.21)	(-0.21)	(-0.95)	(0.84)	(-0.99)	(-2.00)	(-0.81)
ARMM	-0.176	0.511	-0.357	-0.0419	-0.627	0.380	-0.188	0.314	-0.777
	(-0.69)	(1.36)	(-1.23)	(-0.21)	(-0.99)	(0.81)	(-0.83)	(0.47)	(-1.10)
CARAGA	-0.562*	-0.0104	-0.727*	-0.260	-1.004	0.376	-0.475*	-0.697	-1.026
	(-2.02)	(-0.02)	(-2.34)	(-1.38)	(-1.73)	(0.71)	(-2.44)	(-1.13)	(-1.72)
CALABARZON	-0.250	0.0306	-0.249	0.0521	-0.813	0.161	0.0568	-0.786	-0.711
	(-1.03)	(0.08)	(-0.91)	(0.26)	(-1.39)	(0.30)	(0.27)	(-1.35)	(-1.11)
MIMAROPA	-0.264	0.671	-0.517	0.148	-0.863	0.603	-0.0195	0.661	-1.094
	(-0.98)	(1.77)	(-1.59)	(0.68)	(-1.44)	(1.31)	(-0.08)	(0.97)	(-1.65)
Total Energy	0.000238*	0.000617**	0.000188	0.000362***	0.00000143	0.000838***	0.000303***	0.000114	-0.00000415
	(2.57)	(3.21)	(1.83)	(5.26)	(0.01)	(3.38)	(4.18)	(0.31)	(-0.02)
Toilet (ref: Improved)									
Unimproved (ref: Improved)	0.0534	0.0582	0.165	-0.0444	0.219	-0.295	0.0318	0.504	0.228
	(0.46)	(0.28)	(1.33)	(-0.33)	(1.30)	(-1.06)	(0.19)	(1.14)	(1.12)
Open Defecation	-0.0626	0.0921	-0.0525	0.0498	-0.303	0.324	0.00454	-0.207	-0.137
	(-0.53)	(0.39)	(-0.45)	(0.34)	(-1.34)	(1.12)	(0.03)	(-0.40)	(-0.71)
Drinking Water (ref: Improved)									
Unimproved (ref: Improved)	0.114	0.301	-0.0717	0.256*	-0.0744	0.342	0.113	0.415	-0.216
• <i>í</i>	(1.00)	(1.81)	(-0.46)	(2.06)	(-0.38)	(1.60)	(0.70)	(1.24)	(-0.85)
Surface Water	0.167	0.0176	0.306	0.229	-0.0955	0.221	0.241	-0.319	0.424
	(0.79)	(0.05)	(1.29)	(0.84)	(-0.26)	(0.40)	(0.91)	(-0.77)	(1.03)
Food Security (ref: Secure)									

Food Insecure (ref: Food Secure)	-0.0868	0.195	-0.125	-0.0949	-0.0997	0.136	-0.135	0.336	-0.144
· · · ·	(-1.12)	(1.03)	(-1.49)	(-1.15)	(-0.58)	(0.53)	(-1.55)	(1.22)	(-0.76)
Wealth quintile (ref: poorest)									
Poor (ref: Poorest)	0.266	0.192	0.275	0.162	0.356	0.0237	0.176	0.593	0.350
	(1.48)	(0.93)	(1.31)	(1.80)	(0.95)	(0.09)	(1.84)	(1.47)	(0.81)
Middle	0.110	0.234	0.0359	0.154	-0.0528	0.169	0.0987	0.434	-0.128
	(1.08)	(1.02)	(0.32)	(1.55)	(-0.24)	(0.64)	(0.92)	(0.84)	(-0.54)
Rich	0.374**	0.714*	0.282*	0.383**	0.244	0.599	0.323*	1.185	0.120
	(2.95)	(2.37)	(2.03)	(3.11)	(0.94)	(1.45)	(2.52)	(1.88)	(0.41)
Richest	0.531**	0.598	0.475**	0.589***	0.398	0.591	0.540**	0.935	0.337
	(3.24)	(1.56)	(2.66)	(3.60)	(1.22)	(1.17)	(3.18)	(1.35)	(0.95)
Mother's age	0.000275	-0.00889	0.00157	-0.00320	0.00836	-0.00511	-0.00292	-0.0212	0.0121
	(0.06)	(-0.81)	(0.33)	(-0.56)	(1.32)	(-0.37)	(-0.47)	(-1.00)	(1.73)
Mother's civil status	0.0469	0.0607	0.0448	-0.000458	0.119*	0.0527	-0.0118	0.0345	0.122*
	(1.69)	(1.04)	(1.45)	(-0.02)	(2.21)	(0.64)	(-0.42)	(0.56)	(2.15)
Mother's BMI (ref: Normal)									
Underweight (Ref: Normal)	-0.391**	-0.360	-0.404**	-0.263**	-0.612*	-0.606*	-0.179	-0.111	-0.736*
	(-3.15)	(-1.82)	(-2.85)	(-2.69)	(-2.07)	(-2.23)	(-1.75)	(-0.47)	(-2.20)
Overweight	0.0903	0.225	0.0615	0.288***	-0.218	-0.0416	0.330***	0.718	-0.323
	(0.88)	(1.19)	(0.52)	(3.50)	(-0.95)	(-0.16)	(3.81)	(1.87)	(-1.26)
Obese	0.239	-0.179	0.283	0.140	0.385	-0.988*	0.300	0.768	0.272
	(1.59)	(-0.51)	(1.69)	(0.81)	(1.64)	(-2.02)	(1.75)	(1.81)	(0.97)
Mother's education (ref: below HS)									
Above high school (Ref: below high school)	0.0370	0.0610	0.0424	0.141	-0.0882	0.0285	0.158*	-0.203	-0.114
	(0.33)	(0.34)	(0.34)	(1.93)	(-0.38)	(0.12)	(2.08)	(-0.67)	(-0.41)

Mother's prenatal on time (ref: not ontime)									
PNC ontime (Ref: not on time)	-0.0705	0.183	-0.120	0.0666	-0.203	0.185	0.0308	0.133	-0.217
	(-0.63)	(1.20)	(-0.91)	(1.03)	(-0.96)	(0.94)	(0.45)	(0.49)	(-0.95)
Survey Year	0.0258			0.0292	0.00458				
	(1.31)			(1.34)	(0.16)				
_cons	-52.55	-1.578**	-0.249	-59.76	-8.280	-1.258	-0.601*	-0.599	1.072
	(-1.33)	(-2.88)	(-0.56)	(-1.35)	(-0.15)	(-1.65)	(-2.09)	(-0.46)	(0.55)
N	3675	465	3210	2206	1469	311	1895	154	1315

Source: Authors' analysis of data from Food and Nutrition Research Institute Note: * p<0.05, ** p<0.01, *** p<0.001