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The Determinants of the Socioeconomic Inequality and the Trajectory of Child Stunting in the Philippines

Valerie Gilbert T. Ulep, Jhanna Uy, Lyle Daryll D. Casas, Mario V. Capanzana, Alice Nkoroi, Rene Gerard Galera Jr., Maria Evelyn Carpio, and Frederich Tan

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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

publications@pids.gov.ph
(+632) 8877-4000

https://www.pids.gov.ph

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Lyle Daryll D. Casas
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Maria Evelyn Carpio
Frederich Tan

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Abstract

About a third of Filipino children are stunted or chronically malnourished. However, there is a paucity of evidence on the socioeconomic inequalities of stunting in the Philippines. This study has two objectives. First, we discuss the wide range of determinants that explain the large socioeconomic disparity in stunting. Second, we model the trajectory of stunting until 2030 should the country expand the coverage of key nutrition and health interventions. Based on our previous decomposition analysis, maternal nutritional status and education factors, quality of prenatal care, and child diet are significant drivers of the disparity. Furthermore, using a compartment-based model, we expect a 10-percentage point reduction in the prevalence of stunting with expansive promotion of infant and young child feeding (IYCF) practices and complementary food interventions. Addressing the socioeconomic disparity in child stunting and universal provision of nutrition and health interventions puts the country on track of its 2030 Sustainable Development Goal (SDG) target.

Keywords: undernutrition, child stunting, stunting projection, Philippines

Acknowledgments

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Introduction

Physical height has sparked interest among economists, health scientists, and decision makers. Overwhelming empirical studies suggest that height is a strong determinant of human capital and is a predictor of economic productivity (Case & Paxson, 2008; Chakravarty et al., 2019; Victora et al., 2008).

Filipino children are failing to reach their growth potential compared to children living in other countries. In 2019, about 29% (about 3.7 million) of under-five children are stunted, way above the average prevalence for upper-middle-income countries (14%). Many countries around the world have recorded a large decline in stunting in the past two to three decades. Even South Asia and Sub-Saharan African countries known to have high levels of stunting have experienced significant decline (Smith & Haddad, 2015). In contrast, the Philippines only recorded a modest 0-1% decline in the last three decades. Vietnam and China, for example, recorded 5-6% annual decline (UNICEF et al., 2020; Vaivada et al., 2020). As a result, the Philippines fell short of its 2015 Millennium Development Goal (MDG) and is bound to fail the 2030 Sustainable Development Goal (SDG) without path-breaking interventions. In addition, the negative impact of COVID-19 will exacerbate the problem of chronic malnutrition. The disruptions in economic activities and decline in access to essential health and nutrition services will have unprecedented impact on nutritional status of Filipino children (Headey et al., 2020)

The problem of child stunting in the Philippines is reinforced by the large inequity across socio-economic classes. In 2015, about 50% of poorest Filipino children were stunted compared to 14% among their richest counterparts (UNICEF et al., 2021).

The Philippine government has identified stunting as a threat to the country's long-term economic prosperity. Chronic malnutrition is included in the country's national socio-economic agenda. The Philippine Plan of Action for Nutrition (PPAN) 2017-2022 and Philippine Development Plan (PDP) aim to reduce stunting prevalence from 29% in 2018% to 22% by 2022 (NEDA, 2017; NNC, 2017). However, this ambitious target could be hardly achieved without addressing the large socio-economic disparity and sustaining public sector investments of critical health and nutrition interventions. In this paper, we discuss a wide range of factors that explain the large socio-economic disparity in child stunting drawn from our previous study[2] and model the trajectory of child stunting prevalence should the country expand the service coverage of key nutrition interventions.

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[1] VGU, JU, and LDC are Research Fellow, Supervising Research Specialist, and Research Analyst of the Philippine Institute for Development Studies (PIDS), respectively. MC is the former Director of Food and Nutrition Research Institute (FNRI). AN, RGG, MEC, and FT are technical contributors and reviews from the Nutrition Technical Team, UNICEF Philippines Country Office.
[2] The results and discussion on the determinants of the disparity in child stunting largely draws from the research article by the same authors in 2021 (Ulep, V., Uy, J., & Casas, L. (2021). What explains the large disparity in child stunting in the Philippines? A decomposition analysis. Public Health Nutrition, 1-36. doi:10.1017/S136898002100416X).

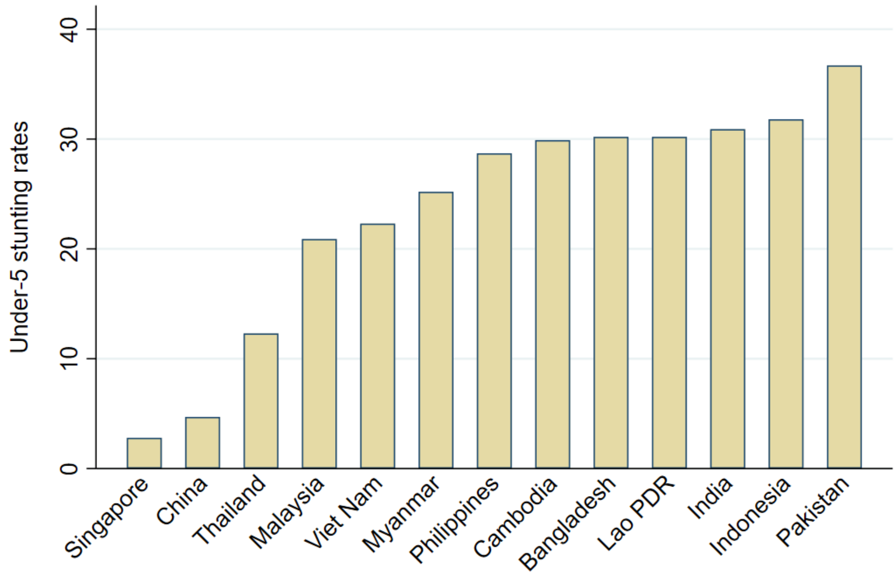
Background

Stunting in the Philippines

Stunting, or being too short for one's age is a marker of chronic malnutrition. It predicts poorer cognitive and educational outcomes (Branca & Ferrari, 2002; Crookston et al., 2011)[3], and lower wages (Barker, 2005; LaFave & Thomas, 2016)[4] and poorer health in adult life (Hoddinott et al., 2013; Victora et al., 2008)

In 2019, about 29% of Filipino children (or about 3.7 million) were considered too short for their age, which is extraordinarily high compared with countries of similar income level.[5] In 2015, the prevalence of stunting in lower and middle-income countries were 27% and 13%, respectively. The Philippines has one of the highest stunting prevalence in ASEAN only to next to Lao PDR and Indonesia. Countries like Vietnam, Cambodia, and Myanmar although their national income per capita are lower than the Philippines, have relatively better stunting prevalence (see **Figure 1**).[6]

Figure 1. Under-5 stunting rates in selected countries, 2020



Source: Authors' analysis of UNICEF (2021) data

Note: Selected countries include the ASEAN member states, other lower-middle income (Pakistan, India, and Bangladesh) and high income (China) countries for comparison.

[3] Using the Cebu Longitudinal Survey (Philippines), Mendez and Adair (1999) find that stunting at age 2 years was associated with significant deficits in cognitive test Z-scores at age 8 year (−0.14 SD). Severe stunting at age 2 year was associated with significant deficits in cognitive test performance 8 and 11 years even after multivariate adjustment (Mendez and Adair 1999). In another study using the same data, Daniels and Adair (2004) finds that among girls, a 1-SD increase in height for age score at 2 years was associated with 40% lower adjusted odds of late vs. on-time enrollment. Among boys, greater height for age score was associated with 44% greater adjusted odds of early enrollment and 32% lower odds of late enrollment(Daniels and Adair 2004).

[4] Using the Cebu Longitudinal Survey (Philippines), Carba et al (2007) finds that Among Filipino males no longer in school, higher height-for-age Z-score at age 2 was associated with a 40% increase in likelihood of formal work compared to not working. In females, each 1 unit increase in Z-score was associated with 0.2 higher likelihood of formal vs. informal work (Carba, Tan, and Adair 2009).

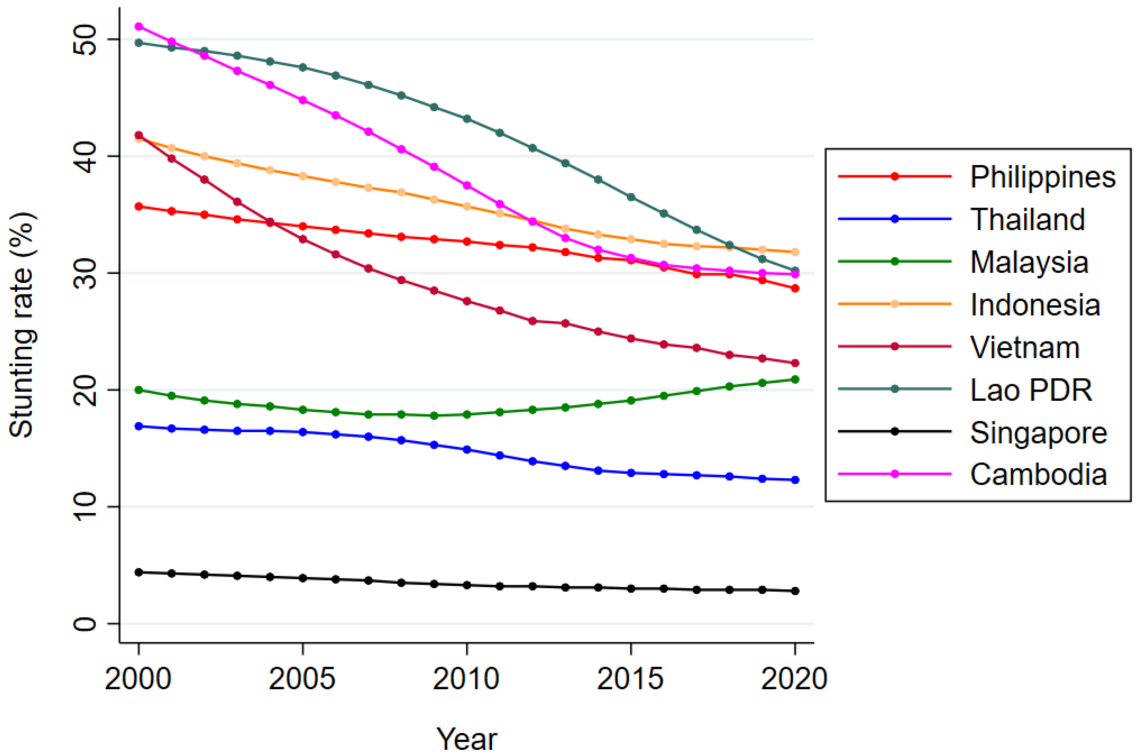
[5] The country is classified as lower middle income transitioning to become upper middle-income.

[6] In addition to ASEAN countries, we included South Asian countries as comparator. Most south Asian countries have economic growth like the Philippines, but with historically known to have notoriously high level of stunting.

The prevalence of stunting in the Philippines has modestly improved in the last three decades. Most low and middle-income countries recorded large declines even in South Asian and Sub-Saharan African countries[7] notoriously known to have high levels of chronic malnutrition. From 1990 to 2018, the average annual decline in stunting prevalence in the Philippines was about 1%.

Figure 2 shows the trend in the prevalence of stunting in the Philippines with comparator countries in the region. High performing countries such as China and Viet Nam recorded an annual reduction of 5% and 6%, respectively. In the early 1990's, the prevalence of stunting of China and the Philippines were almost the same, but the former was reduced by more than half in the last three decades. Viet Nam was successful in reducing stunting prevalence by three-fold during the same period (see **Figures 3 and 4**).[8]

Figure 2. Under-5 stunting rates in selected ASEAN countries, 2000-2020

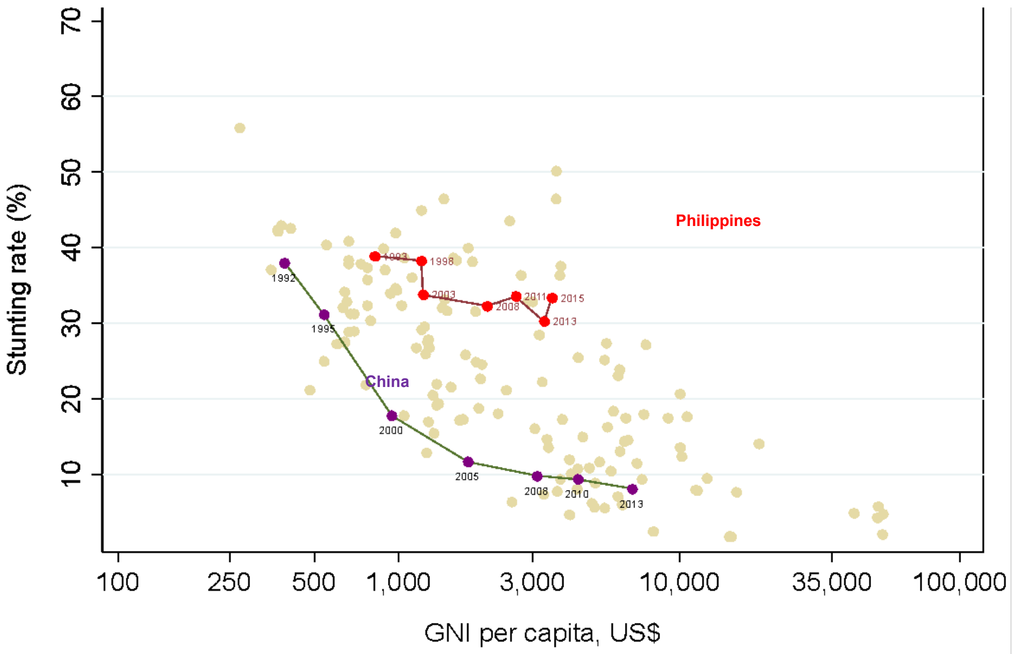


Source: Authors' analysis of UNICEF (2021) data

[7] There has been global progress on reducing rates of child stunting. Econometric analysis of 116 countries between 1970 and 2012 identified several drivers of stunting reduction, including access to safe water, improved sanitation, gender equality, women's education, and nutritious food availability, with governance and income growth providing a supporting environment (Smith & Haddad, 2015). The proportion of young children (< 2 years old) in Sub-Saharan Africa who are stunted fell by 1.3 percentage points annually between 2005 and 2014 on average. Buisman et al (2019) suggest that the fall in stunting in Sub-Saharan Africa has not been driven by better feeding practices, nor by reduced prevalence of diarrhea. Improved access to maternity care does correlate with improved nutritional status (Buisman et al., 2019).

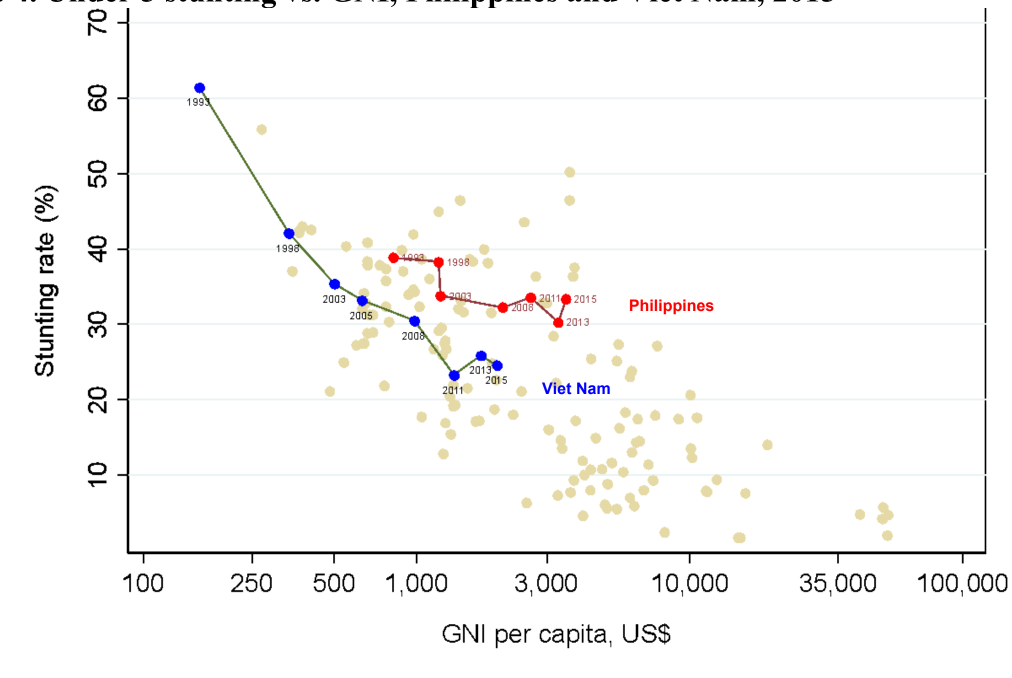
[8] Vietnam has made remarkable progress in improving child nutrition over the past three decades. After the introduction of Vietnam's Doi Moi economic policies in the mid-1980s, the country's economic performance has vastly improved. While the rapid economic growth in Vietnam has made a significant impact on social and health outcomes, the reduction in child stunting can be attributed to the following: prioritization of nutrition by the national government, policies designed to improve infant and child feeding practices, and efforts to reduce micronutrient deficiencies (Keefe, 2016).

Figure 3. Under 5 stunting vs. GNI, Philippines and People's Republic of China, 2015



Source: World Development Indicators (2015)
Note: Red (Philippines); Violet (PRC); Khaki (Other countries).

Figure 4. Under 5 stunting vs. GNI, Philippines and Viet Nam, 2015



Source: World Development Indicators
Note: Red (Philippines); Violet (PRC); Khaki (Other countries).

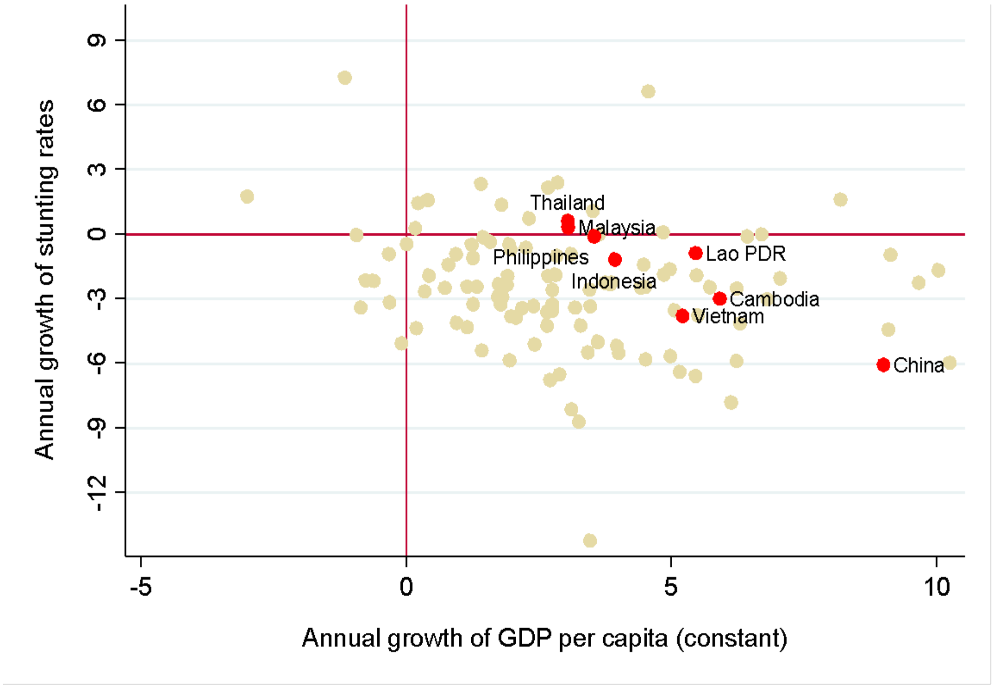
The paradox of economic growth and stunting

The rapid improvement in national income over the years in the Philippines did not result in a large improvement in chronic malnutrition. In theory, macro-economic growth can possibly reduce chronic malnutrition (Pritchett & Summers, 1996; Ravallion, 1990; Smith & Haddad, 2002). Economic growth could reduce chronic malnutrition in two different ways. First, economic growth has a positive impact on wealth, maternal education, and food security through increasing investments, generating jobs, and boosting employment. Second, as the economy improves, so do public spending and investments in the health and education sector. These routes are likely to directly affect the reduction of chronic malnutrition. However, there is growing empirical evidence that says otherwise.[9] Macro-economic growth does not automatically trickle down and will result in large reduction in chronic malnutrition rates (Krishna et al., 2018; Li et al., 2020; Subramanyam et al., 2011).

Figure 5 shows the negative relationship between GDP per capita and stunting growth rates of countries highlighting countries in the ASEAN region. In general, as GDP per capita of countries increases, prevalence declines. However, this is not the case in the Philippines. While the country's GDP per capita (in real terms) has increased by 3-4% annually from 2000 to 2015, the annual reduction hovered only at 0-1%. This suggests that the growth in income does not commensurate with the decline in chronic malnutrition. A similar pattern is observed in the country's 17 regions. **Figure 6 s**hows the growth in regional GDP per capita and growth in stunting prevalence. Of the 17 regions in the Philippines, 12 registered growths in regional GDP per capita (in real terms), but the prevalence of stunting most regions increased.

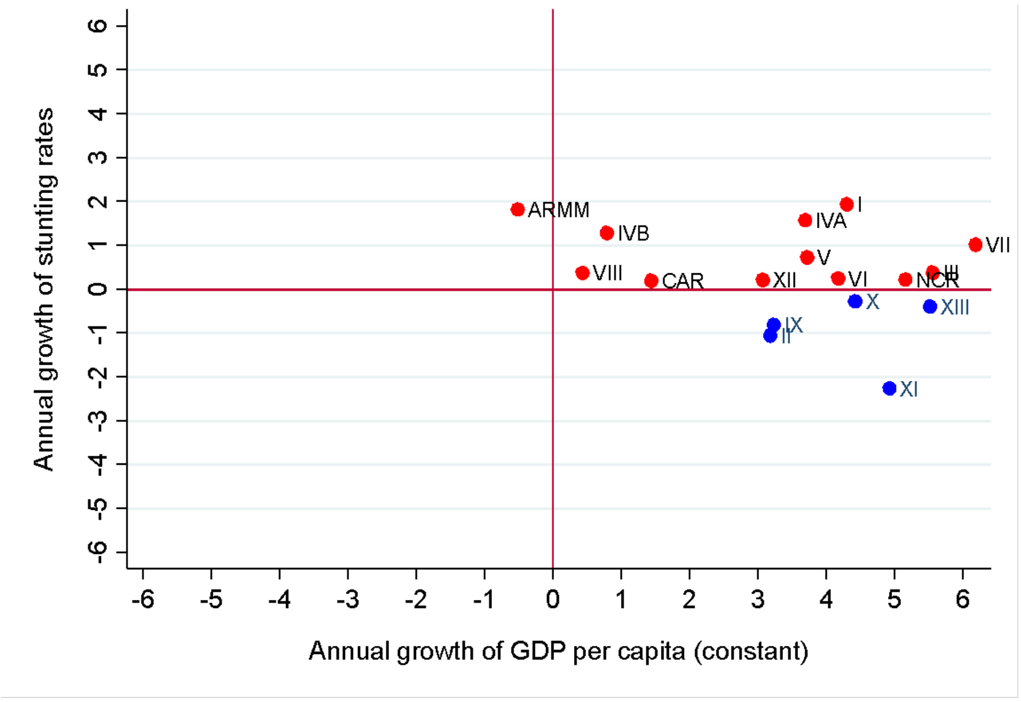
[9] According to Vollmer et al. (2014), there was no association between the mean changes in the prevalence of stunting and average the mean rise in GDP per capita at the country level. While a 5% rise in GDP per capita was seen to be associated with stunting (OR 0.99 [95% CI 0.989-0.995]), if additional variables are considered, the association found is not significant (Vollmer et al. (2014).

Figure 5. Growth rates of GDP per capita and stunting rates by country, (2000-2015)



Source: Raw data from the World Development Indicators (World Bank, 2018) and Philippine Statistics Authority (PSA, 2018)

Figure 6. Growth rates of GDP per capita and stunting rates by Philippine regions, (2000-2015)

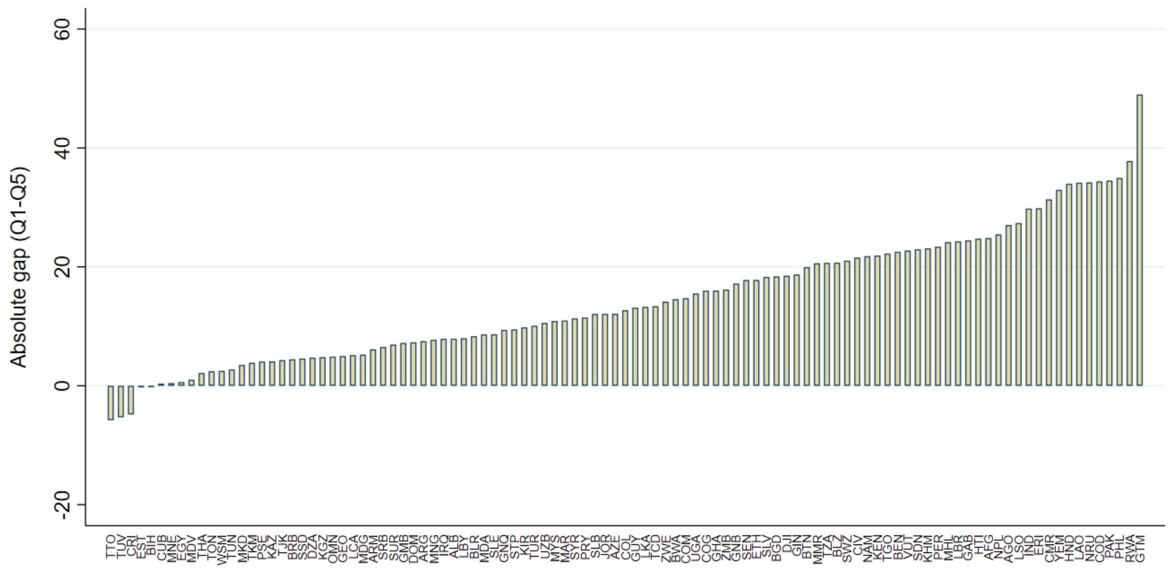


Source: Raw data from the Philippine Statistics Authority and the Food and Nutrition and Research Institute. Note: annualized stunting data from FNRI were interpolated.

Inequalities in stunting

In the Philippines, the prevalence of stunting varies across socio-economic classes. In 2015, about 49% of children belonging to the lowest quintile (Q1) were stunted compared to 14% among children belonging to the top quintile (Q5) (UNICEF, 2021). The 34-percentage point absolute difference between poorest (Q1) and the richest (Q5) makes the Philippines as one of the countries with the highest level of disparity. Among 103 countries with available data on stunting by socio-economic status, the Philippines ranked third with the highest absolute gap between Q1 and Q5 only next to Guatemala and Rwanda (see **Figure 7**). Absolute gap has a significant relationship between the aggregate stunting prevalence. This suggests the importance of reducing the gap across socio-economic classes to improve the aggregate prevalence.

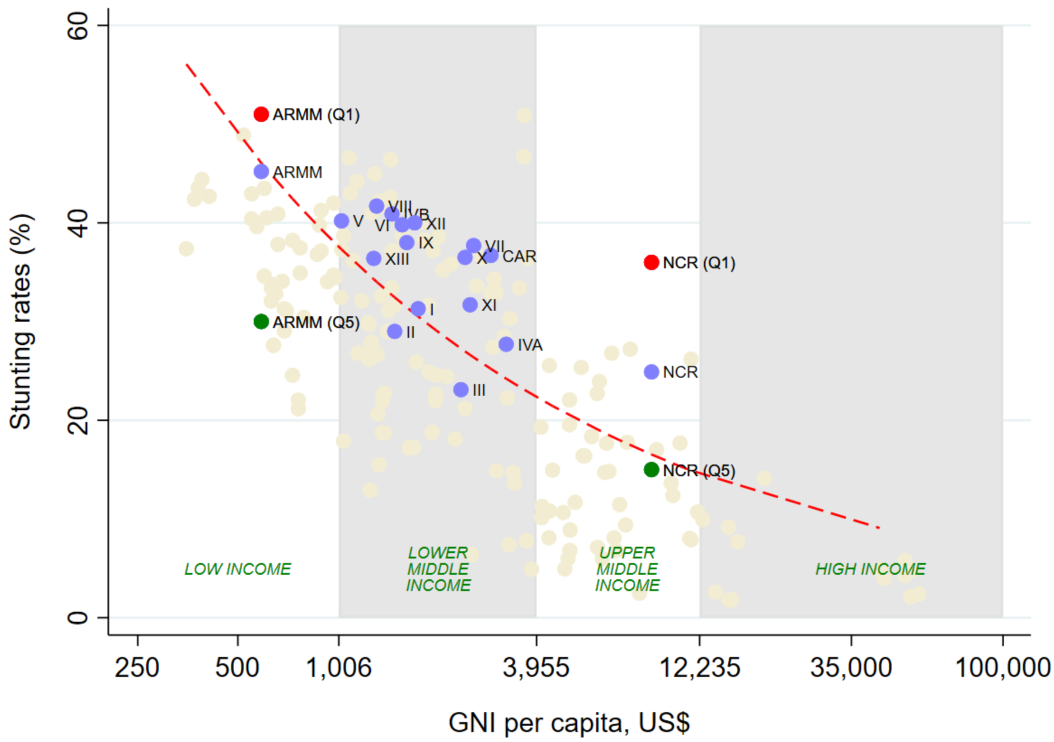
Figure 7. Gap in stunting prevalence between Q1 and Q5



Source: Authors' analysis of UNICEF (2021) data

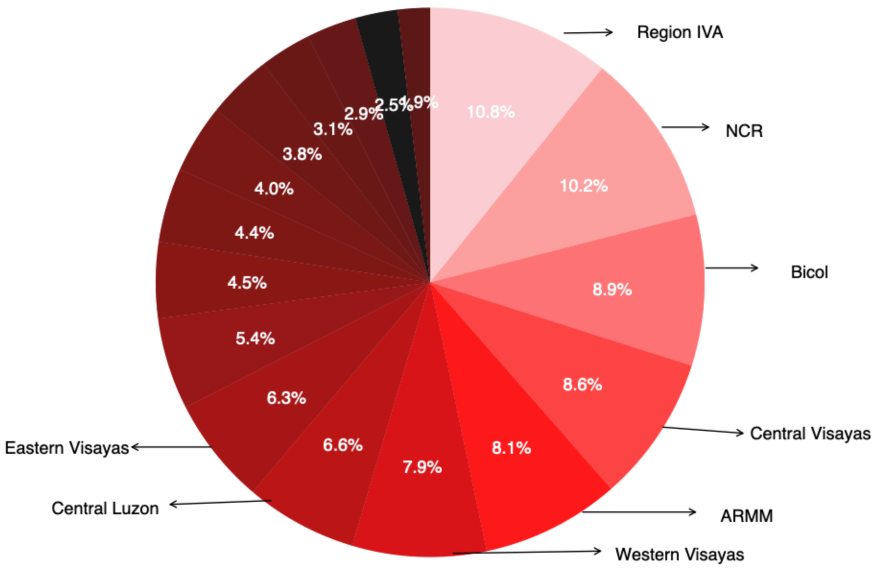
Even within geographical locations, the disparity across socio-economic status is extraordinarily large. In the National Capital Region (NCR), the county's economic center with a regional GDP per capita like a UMIC, the difference in the prevalence is about 20 percentage points. The high prevalence of stunting among the poorest (Q1) in NCR suggests that even in highly urbanized areas, stunting remains a major challenge (see **Figure 8)**. Around 20% of stunted children in the Philippines are in the NCR and Region IV-A (see **Figure 9**). In BARMM, the country's least prosperous region, the large disparity is a challenge. The prevalence among children belonging to the Q1 is even higher than countries with notoriously high stunting prevalence.

Figure 8. Prevalence of stunting by country and Philippine region, (2015)



Source: Authors' analysis of raw data from World Development Indicators (World Bank, 2018) and National Nutrition Survey (DOST-FNRI, 2015)

Figure 9. Distribution of stunted children across Philippine regions (2015)

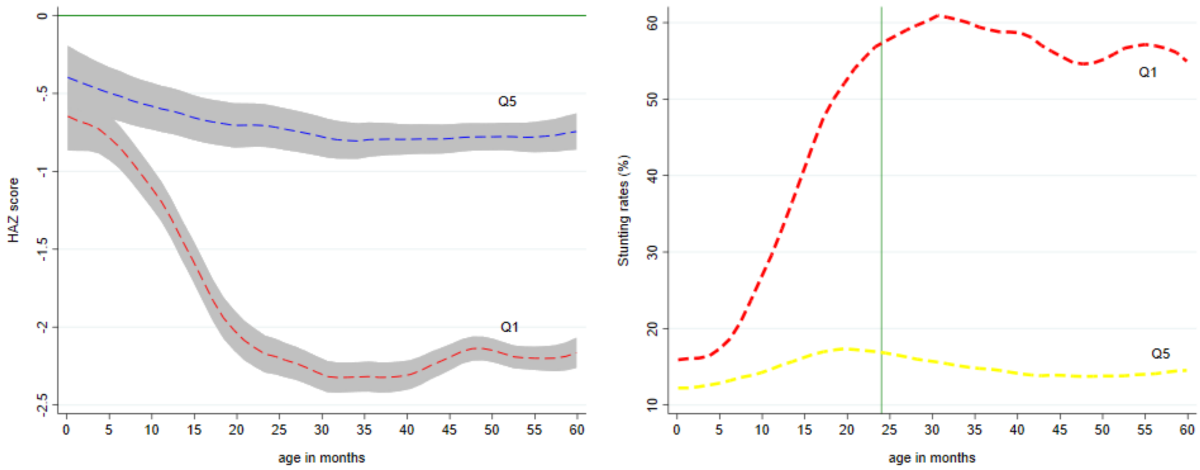


Source: Authors' analysis of the National Nutrition Survey (DOST-FNRI, 2015)

Inequalities in the time of growth faltering

Understanding the timing of growth of faltering[10] has implications for developing appropriate interventions**. Figure 10 (left)** shows the height for age (HAZ) score of children under five by age and socio-economic status. The HAZ is the standard deviation (SD) of a particular child with respect to the median of a reference population (i.e., WHO growth standards). A child is considered normal if the HAZ score is not two standard deviations (SDs) below or above the median. While the average HAZ scores of Filipino neonatal infants (first month) were within the normal range, a slight gap between poor and non-poor was already observable.[11] Although this gap is narrow during the neonatal period, the gap began to accelerate very rapidly after 5 months. **Figure 10 (right)** shows the sharp acceleration of the gap between Q1 (poorest) and Q5 (richest) until 24 months after which it remained stable.

Figure 10. Height for age z-score, by age and socio-economic status



Source: Authors' analysis of the 2015 National Nutrition Survey (DOST-FNRI, 2015)

Methods

Objective A: Determinants of the large disparity in child-stunting across socioeconomic classes

Using the 2015 National Nutrition Survey (NNS), we used Oaxaca-Blinder decomposition to explain the possible drivers of socioeconomic disparity in child stunting in the Philippines (see Ulep, Uy, and Casas, 2021).[12]

[10] The term 'faltering growth' or 'failure to thrive' is widely used to refer to a slower rate of height and weight gain in childhood than expected for age and sex (NICE 2022, p.20).
[11] However, not statistically significant.
[12]Ulep, V., Uy, J., & Casas, L. (2021). What explains the large disparity in child stunting in the Philippines? A decomposition analysis. Public Health Nutrition, 1-36. doi:10.1017/S136898002100416X.

Objective B: The trajectory of stunting

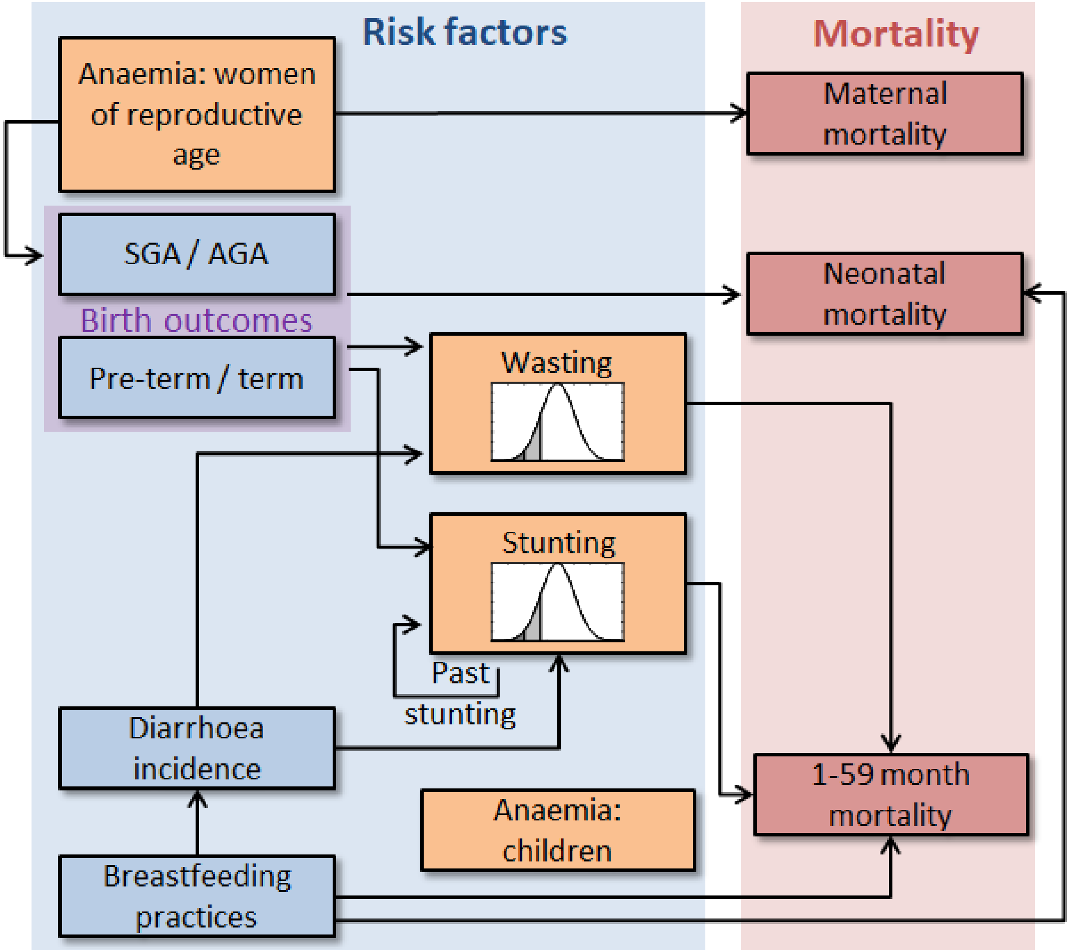
a. Epidemiologic model

The Optima model is a dynamic and compartmental model, which tracks the number of women of reproductive age (15-49 years) in a population, who can become pregnant and give birth. After birth, children are then tracked until five years of age across the following five (5) age groups: < 1 month, 1–5 months, 6–11 months, 12–23 months and 24–59 months. Children in each age group are categorized by height-for-age status, weight-for-height status, anemia status, breastfeeding practice, and economic status (poverty level). Here, we considered those who are food insecure as poor (Pearson et al., 2018)

Children are excluded from the cohort model when they turn five (5) years old or by death which may happen at any age. Children in the <1-month age group could die because of diarrhea, pneumonia, meningitis, asphyxia, sepsis, prematurity, and other causes, while children in all other age groups can die of diarrhea, pneumonia, measles, and other causes. The relative risks of dying from each cause are related to the child's breastfeeding and height-for-age (e.g., stunting status). Several risk factors for stunting are modelled in the study: birth outcomes (e.g., pre-term birth or SGA), stunting in a previous age group, suboptimal feeding practices (e.g., age-appropriate breastfeeding and complementary foods), and incidence of diarrhea. **Figure 11** shows the relationship of several factors and how it affects the health status of the child. For instance, changes in breastfeeding practices directly affect mortality and diarrhea. It also indirectly affects mortality because of the reduction in stunting, which eventually affects mortality (Pearson et al., 2018).

In this model, children in each age group are categorized based on their height for age: more than 3 standard deviations below the global norm ('severely stunted'), 2–3 standard deviations below the norm ('moderately stunted'), 1–2 standard deviations below the norm ('mildly stunted', and less than one standard deviation below the norm ('normal'). Breastfeeding practice is categorized as none, partial (i.e., liquids and solids in addition to breastmilk), predominant (i.e., breast milk supplemented by other liquids), and exclusive breastfeeding (Pearson et al., 2018)

Figure 11. The relationship between risk factors and mortality



Source: Pearson et al. (2018)

b. Interventions to reduce stunting

We considered six (6) nutrition-specific interventions in reducing child stunting or chronic malnutrition: (1) micronutrient supplementation among pregnant mothers (iron and folic acid supplementation), (2) balanced energy-protein supplementation among poor pregnant mothers, (3) zinc supplementation among children, (4) infant and young child feeding (IYCF) practices, (5) a set of complementary foods among poor children aged 6-23 months to increase minimum acceptable diet (MAD), and (6) Water, Sanitation, and Handwashing (WASH) interventions.

c. Model parameters

Our model was populated using the most recent available data for the Philippines. The 2020-2030 projections of live births were taken from the UN Population Division database. Causes and levels of child mortality, birth outcomes, stunting prevalence, types of breastfeeding practices in each age group and were obtained from analyzing various data sources such as the death registry of the Philippine Statistics Authority (PSA), Institute for Health Metrics and Evaluation (IHME), National Nutrition Survey (NNS), and Demographic Health Survey (DHS). The following are the six interventions included in the model**:**

- **Provision of balanced energy protein supplementation to the 40% poorest pregnant women.** In 2018, 30% of the 40% poorest (4th and 5th quintile group) pregnant women are nutritionally at risk (DOST-FNRI, 2018). Balanced energy-protein supplementation improves birthweight and reduces the incidence of infants born small for their gestational age attributed to maternal undernutrition (PSA, 2017). In the 2017-2022 PPAN, a national supplementary feeding program for pregnant and lactating mothers is included as one of the core strategies. The national supplementation feeding program follows the WHO's Essential Nutrition Action (ENA), which recommends balanced energy and protein dietary supplementation to reduce the risk of stillbirth and small for gestational age neonates.
- **Iron and Folic Acid/micronutrient supplementation to all pregnant women.** In 2015, around 13% of pregnant women received both iron and folic acid (DOST-FNRI, 2015). The DOH includes the provision of iron and folic acid as part of the country's micronutrient supplementation for pregnant women to prevent maternal anemia, puerperal sepsis, low birth weight and preterm birth.[13] Iodized oil must also be given to pregnant and lactating women in areas endemic to iodine deficiency disorders with poor access to adequately iodized salt. Strengthening the public provision of micronutrient supplements for pregnant and lactating women is one of the core strategies in 2017-2022 PPAN.
- **Package of intervention to improve complementary feeding to poor children aged 6-23 months.** In 2018, only 11% of children from poor households aged 6-23 months are only meeting their MAD requirements (DOST-FNRI, 2018). We assume that the target population for the interventions is only for poor children. Comprehensive programs in improving complementary feeding, particularly among the poor significantly improves child's height. To provide adequate, quality, and diverse complementary food to poor children aged 6-23 months, the government can adopt a set of intervention to increase supply of high quality and adequate complementary diet such as direct provision of home food to completely food insecure households with children aged 6-23 months and the provision of Ready-to-Use Supplementary Food (RUSF). The 2017-2022 PPAN provide includes strategy to improve complementary feeding practices through demand and supply-side supplementary provisions to children aged 6-23 months.
- **Zinc supplementation to all children.** In 2017, only 24% of children received zinc supplementation in treating diarrhea (PSA, 2017). Since zinc is essential for many biological processes (e.g., cellular growth and metabolism), a deficiency in this micronutrient can greatly increase a child's risk of morbidity and mortality by limiting their ability to grow and reduce their resistance to infections. Provision of zinc supplementation in 0-59 months is a strategy in micronutrient supplementation in the 2017-2020 PPAN and reinforced in a DOH administrative order.[14]
- **Promotion of infant and young child feeding (IYCF) practices.** The interventions include demand generation activities targeting one or more pregnant women and children (e.g., individual, or population-based intervention). An IYCF intervention can be delivered in health facilities, community or mass media (Lassi et al., 2020; Mashreky et al., 2015; Sanghvi et al., 2013; WHO, 2007). These interventions are expected to increase exclusive breastfeeding and age-appropriate complementary feeding rates. Exclusive breastfeeding until six (6) months decreases mortality and decreases stunting

[13] This is also reinforced in the DOH AO No. 2010-010 or the Revised Policy on Micronutrient Supplementation
[14] AO 2007-0045 on Zinc Supplementation and Reformulated Oral Rehydration Salt in the Management of Diarrhea among Children, and AO No. 2008-0029 on the Strategy for the Maternal, Newborn, Child Health, and Nutrition (MNCHN).

by decreasing incidence of diarrhea. IYCF promotion interventions must be complemented with supply-side interventions. Here, we assume that the target population for IYCF interventions are pregnant women and children (aged 6-23 months). Also, children not meeting MAD are the target population.

- **Promotion of Water, Sanitation, and Handwashing (WASH).** In 2017, about 95% 78%, and 89% improved water source, improved sanitation facility, and handwashing facility with soap and water, respectively. Unsanitary conditions have been linked with malnutrition through multiple mechanisms and pathways such as repeated diarrhea or infection.

Table 1 shows the baseline values of six (6) nutrition and health interventions. The model includes the amount spent on an intervention to its estimated coverage. For each intervention, this requires a unit cost with an assumption about the marginal costs with increasing intervention coverage in a linear fashion. Each intervention implemented will improve health outcome (e.g., stunting) according to effect size of interventions according to the literature. We calculated the annual cost of balanced energy protein supplement, micronutrient supplement, and zinc supplementation per woman/children. While unit cost of complementary feeding and promotion of IYCF are from Word Bank and WHO, respectively. Because of data limitation, the unit costs from the Department of Health (DOH) do not include delivery or administration costs.

Table 1. Baseline values of cost-effective interventions

Interventions to reduce stunting	Target population	Baseline	Cost
Balanced energy protein supplementation	Pregnant women below poverty line	30% of poorest pregnant women are nutritionally at risk (DOST-FNRI, 2018)	Php 5,670 per woman (based on DOH unit cost)
Iron and folic acid supplementation/micronutrient supplementation	Pregnant women	13% of pregnant women were given with iron and folic acid combined (DOST-FNRI, 2015)	Php 162 per woman (based on DOH unit cost)
Provision of complementary food for poor children (a wide range of supply-side interventions)	Children aged 6-23 months	11% of 6-23 mos. old poor children who meet the minimum acceptable diet (DOST-FNRI, 2018)	Php 2,500 per child
Zinc supplementation	Children aged 1-59 months	24% of children received Zinc supplementation (PSA, 2017)	Php 50 per child (based on DOH unit cost)
Promotion/education campaign of IYCF interventions (exclusive breastfeeding for 6 months and complementary and partial feeding)	Children aged <23 months; pregnant mothers	13% of 6-23 mos. old Filipino children are meeting the minimum acceptable diet (MAD) (DOST-FNRI, 2018)	Php 250 per pregnant mother (UNICEF, WHO)
WASH interventions	All children	95% improved water source; improved sanitation facility; and 89% with handwashing facility (PSA, 2017)	

Table 2 shows the difference in the hypothetical increase in coverage of different cost-effective interventions. In **scenarios A and B**, we increase the service coverage of interventions related to pregnancy, i.e., provision of balanced energy protein supplements among nutritionally at-risk poor pregnant women and micronutrient supplementation regardless of socio-economic status. In **scenarios C and D,** we increase the service coverage of IYCF promotion, a wide range of supply-side provision of complementary food among the poor, and zinc supplementation. Lastly, in **scenario E**, we combine all the six (6) interventions.

Table 2. Hypothetical coverage of interventions

Scenario	Intervention package
Scenario A (interventions for pregnant women)	• Provision of balanced protein supplement to all poor pregnant women who are nutritionally at risk by 2025 and sustained until 2030.
Scenario B (pregnant women interventions)	• Provision of balanced protein supplement to all poor pregnant women who are nutritionally at risk by 2025 and sustained until 2030. • Increase iron-folic acid supplementation for pregnant women by increasing coverage of multiple micronutrient supplementation from 50% by 2025 to 90% 2030.
Scenario C (intervention for children)	• Increase IYCF education campaign in health facilities, communities, and mass media by 50% by 2025 and 95% by 2030. • Provide a wide-range complementary feeding intervention (e.g., direct supply-side provisions) to increase MDD to 50% of the poor population by 2025 and 95% by 2030.
Scenario D (intervention for children)	• Increase IYCF education in health facilities, communities, and mass media by 50% by 2025 and 95% by 2030. • Provide complementary feeding to 50% of the poor population by 2025 and 95% by 2030. • Increase zinc supplementation to 50% by 2025 and 95% by 2030. • Increase all WASH interventions to at least 95%
Scenario E (pregnant women and child interventions)	• Provision of balanced protein supplement to all poor pregnant women who are nutritionally at risk by 2025 and sustained until 2030. • Increase multiple micronutrient supplementation for pregnant women by increasing coverage of multiple micronutrient supplementation from 50% by 2025 to 90% 2030. • Increase IYCF education in health facilities, communities, and mass media by 50% by 2025 and 95% by 2030. • Provide a wide range of complementary feeding interventions (e.g., direct supply-side provisions) to increase MDD to 50% of the poor population by 2025 and 95% by 2030.Increase Zinc supplementation to 50% by 2025 and 95% by 2030. • Increase all WASH interventions to at least 95%

Results and Discussion

The section is divided into two parts. The first part draws from the findings of Ulep, Uy, and Casas in 2021 on socio-economic disparity. The second part presents the results of the modelling exercise on the trajectory of child stunting in the Philippines.

A. Determinants of socio-economic disparity in child stunting

When compared to children from non-poor households, Filipino children from poor households had a significantly greater prevalence of stunting (45 percent vs. 32 percent). **Table 3** shows the difference between poor and non-poor children in terms of key socio-demographic and health and nutrition indicators.

Children from low-income or poor households are more likely to have mothers who have not completed at least a high school education and who have not gotten post-natal care. Also, children from low-income households are more likely to score higher on the food insecurity scale and have less adequate and diverse food intake. They are also more exposed to an unhealthy environment as they have no access to clean drinking water and sanitation. Mothers of children in poor households are less likely to receive timely, high-quality prenatal care and postnatal care services, such as iron supplements and immunization, in terms of healthcare access.

Table 3. Descriptive statistics

Variable	Category	All	Poor	Non-poor	p-value
Stunting	% Stunted	38.5	45.0	32.0	0.000***
Child's sex	% Female	52.3	52.8	51.8	0.758
Child's age	Ave. Age in months	17.7	17.7	17.7	0.981
Maternal height	Ave. Height in cm	151.5	150.6	152.3	0.250
Female as household head	% Female	1.8	1.9	1.6	0.450
Maternal education	% Below high school	38.8	58.1	23.6	0.000***
Maternal age at birth	Ave. Age in years	30.1	30.6	29.8	0.023***
High systolic blood pressure of mother	% with 140mmhg or above	2.7	3.2	2.3	0.208
Maternal Body Mass Index (BMI)	% Underweight	13.6	15.0	12.5	0.128
	% Normal	46.5	51.3	42.8	0.000***
	% Overweight	28.0	25.7	29.6	0.057
	% Obese	11.8	7.9	14.8	0.000***
Food insecurity score	% Low	24.6	10.9	33.3	0.000***
	% Medium	34.8	33.5	35.7	0.000***
	% High	40.5	55.6	31.0	0.000***
Minimum Meal Frequency (MMF)	% with MMF	94.0	91.6	95.6	0.000***
Minimum Dietary Diversity (MDD)	% with MDD	29.4	23.7	32.8	0.000***
Breastfeeding within the first hour of life	% Yes	65.9	68.4	64.0	0.09
Handwashing before preparing the food of the child	% Always	89.5	88.2	90.5	0.102
Dispose garbage by dumping or throwing	% Yes	18.8	25.9	13.3	0.000***
Availability of safe drinking water	% Yes	61.9	47.1	73.4	0.000***
Availability of toilet (categorical)	% None	9.6	20.2	1.3	0.000***
	% Yes, water sealed	84.6	70.7	96.0	0.000***
	% Yes, not sealed	5.8	9.1	2.7	0.000***
Post-natal care	% Yes	91.4	85.8	95.4	0.000***
Timely prenatal care	% Yes	78.2	75.4	80.5	0.000***
Quality of prenatal care	% Low	32.7	44.4	23.7	0.000***
	% Medium	28.5	30.1	27.2	0.000***
	% High	38.8	25.5	49.1	0.000***
Place of delivery	% Home	21.2	33.1	12.0	0.000***
	% Government hospital	37.8	32.6	42.8	0.000***
	% Government clinics	12.7	17.4	9.1	0.000***
	% Private hospital/clinic	28.1	17.0	36.8	0.000***
Complete DPT vaccine	% Yes	58.9	54.8	62.1	0.000***
Iron supplementation in children	% Yes	19.4	15.1	22.8	0.000***
Vitamin A supplementation in children	% Yes	68.9	71.5	66.8	0.031***
Deworming	% Yes	60.7	66.7	56.1	0.000***

Source: Ulep, Uy, and Casas (2021)

Table 4 shows the average treatment effects (ATE) from the linear probability model to assess the stunting determinants. ATE in a linear probability model is the difference in the proportion of stunted and stunted children.

The only non-modifiable characteristics that were significant were sex and maternal height. The likelihood of stunting is reduced by 10.5 percentage points by being a female. It is also reduced by 2.3 percentage points for every unit (cm) increase in maternal height. Compared to mothers with at least a high school education, those with less education increase the likelihood of stunting by 5.9 percentage points. In addition, mothers with normal BMIs are less likely to give birth to stunted children than underweight or overweight mothers (11.4 and 16.3 percentage points, respectively).

Table 4. Average Treatment Effects using Linear Probability Model

Variables	Stunted
Female sex	-0.105***
	(-5.05)
Child's age	0.0577
	(1.71)
Child age squared	-0.00112
	(-1.19)
Maternal Height	-0.0225***
	(-11.76)
Civil status married (Ref: single)	0.0248
	(0.66)
Civil status separated/widowed	0.175*
	(2.17)
Female household head	0.0476
	(0.59)
Maternal education below high school	0.0587*
	(2.51)
Maternal age at birth	-0.000112
	(-0.84)
Maternal high blood pressure	0.00345
	(0.05)
Body Mass Index normal (Ref: Underweight)	-0.114***
	(-3.56)
Body Mass Index overweight	-0.163***
	(-4.65)
Body Mass Index obese	-0.201***
	(-4.70)
Food insecurity medium (Ref: low food insecurity)	-0.0495
	(-1.75)
Food insecurity high	-0.00749
	(-0.26)
Minimum Meal Frequency (MMF)	-0.146**
	(-3.30)
Minimum Dietary Diversity (MDD)	-0.038*
	(-2.93)
Breastfeeding within the first hour	0.00757

	(0.34)
Handwashing always (Ref: never)	0.0837
	(1.59)
Handwashing sometimes	0.0287
	(0.44)
Garbage disposal	-0.00868
	(-0.31)
Safe drinking water	-0.0396
	(-1.77)
Toilet facility sealed (Ref: No)	-0.0308
	(-0.82)
Toilet facility not sealed	0.0940
	(1.70)
On time prenatal care	-0.0431
	(-1.67)
Quality of prenatal care medium (Ref: low)	-0.0200
	(-0.75)
Quality of prenatal care high	-0.0624*
	(-2.29)
Place of delivery government hospital (Ref: home)	-0.00164
	(-0.07)
Place of delivery government clinic	0.0371
	(1.12)
Place of delivery private facility	-0.0371
	(-1.11)
Complete DPT vaccine	-0.0284
	(-1.32)
Iron supplementation in children	-0.0609*
	(-2.27)
Vitamin supplementation in children	-0.0171
	(-0.74)
Post-natal care	-0.0405
	(-0.98)
Deworming	-0.00123
	(-0.05)
High socio-economic status	-0.0114
	(-0.46)

Note: t statistics in parentheses; * p<0.05; ** p<0.01 *** p<0.001
Source: Ulep, Uy, and Casas (2021)

Table 5 illustrates the results of the Oaxaca Blinder decomposition model for stunting. The decomposition seeks to quantify how much each predictor contributes to explaining the difference in stunting prevalence between poor and non-poor children. The gap is decomposed into three parts: the first, known as the endowment effect (E), claimed that the gap was caused by differences in the distribution of determinants between the poor and non-poor; the second, known as the coefficient effect (C), claimed that the gap was caused by differences in the effect of determinants between the groups; and the third, known as the interaction between the two - endowment effect and coefficient effect (CE).

There is a 13-percentage point absolute difference in the frequency of stunting among children from poor households and those from non-poor households (45 percent vs. 32 percent). There was a significantly significant mean difference in the rates of stunting between the groups (p value is less than 0.01). This disparity accounted for the explained part (~82%). The rest is influenced by the unexplained and interaction terms, although these terms are not statistically significant. The endowment effect (E) of the gap will only be presented due to the lack of significance of the two parts.

Table 5. Summary result of Oaxaca decomposition analysis showing the mean differences in stunting

	Coefficient	SD	p-value	% Contribution
Mean prediction high (H):	0.45	0.02	0.00	
Mean prediction low (L):	0.32	0.01	0.00	
Raw differential (R) {H-L}:	0.13	0.02	0.00	
- due to endowments or explained (E):	0.11	0.02	0.00	82%
- due to unexplained (C):	0.01	0.03	0.76	7%
- due to interaction (CE):	0.02	0.03	0.59	12%

Source: Ulep, Uy, and Casas (2021)

Table 6 illustrates how variations in each determinant's distribution each individually led to the first part of the gap (endowment effect).

The significant factors influencing stunting disparity among children between the poor and non-poor were maternal education, nutrition status, and height, iron supplementation in children, quality prenatal care, and dietary diversity score. Maternal height was the biggest factor in the gap for stunting, accounting for 26%. This was followed by maternal education (18%), body mass index (17%), quality of prenatal care (12%), dietary diversity (12%), and iron supplementation for children (5%).

Table 6. Contribution of each factor in poor & non-poor differentials in stunting (endowments or explained component)

Variable	Coef.	p-value	95% Confidence Interval Lower limit	95% Confidence Interval Upper limit	% Share to the gap
Female sex	0.00	0.56	0.00	0.00	-1%
Child's age	-0.01	0.42	-0.04	0.02	-11%
Child age squared	0.01	0.36	-0.01	0.04	12%
Maternal Height	0.03***	0.00	0.02	0.04	26%
Civil status married (Ref: single)	0.00	0.67	0.00	0.00	1%
Civil status separated/widowed	0.00	0.19	-0.01	0.00	-2%
Female household head	0.00	0.63	0.00	0.00	0%
Maternal education below high school	0.02***	0.04	0.01	0.04	18%
Maternal age at birth	0.00	0.76	0.00	0.00	-1%
Maternal high blood pressure	0.00	0.47	0.00	0.00	1%
Body Mass Index normal (Ref: Underweight)	-0.01	0.05	-0.02	0.00	-8%
Body Mass Index overweight and obese	0.02***	0.00	0.00	0.03	17%
Food insecurity medium (Ref: low food insecurity)	0.00	0.22	0.00	0.01	2%
Food insecurity high	0.01	0.56	-0.01	0.02	5%
Minimum Meal Frequency (MMF)	0.00	0.18	0.00	0.01	4%
Dietary Diversity Score	0.01***	0.01	0.00	0.02	12%
Breastfeeding within the first hour	0.00	0.36	0.00	0.00	1%
Handwashing always (Ref: never)	0.00	0.36	-0.01	0.00	-2%
Handwashing sometimes	0.00	0.69	0.00	0.00	0%
Garbage disposal	0.00	0.92	-0.01	0.01	0%
Safe drinking water	0.01	0.25	-0.01	0.02	8%
Toilet facility sealed (Ref: No)	-0.01	0.52	-0.04	0.02	-10%
Toilet facility not sealed	0.01	0.24	-0.01	0.02	7%
On time prenatal care	0.00	0.20	0.00	0.01	3%
Quality of prenatal care medium (Ref: low)	0.00	0.24	-0.01	0.00	-2%
Quality of prenatal care high	0.01***	0.04	0.00	0.03	12%
Place of delivery government hospital (Ref: home)	0.00	0.48	-0.01	0.00	-2%
Place of delivery government clinic	0.00	0.69	-0.01	0.01	-1%
Complete DPT vaccine	0.00	0.70	0.00	0.01	1%
Iron supplementation in children	0.01***	0.03	0.00	0.01	5%
Vitamin supplementation in children	0.00	0.34	0.00	0.00	-1%
Postnatal care	0.01	0.41	-0.01	0.02	5%
Deworming	0.00	0.95	-0.01	0.01	0%

Source: Lifted in full from Ulep, Uy, and Casas (2021, p.3000)

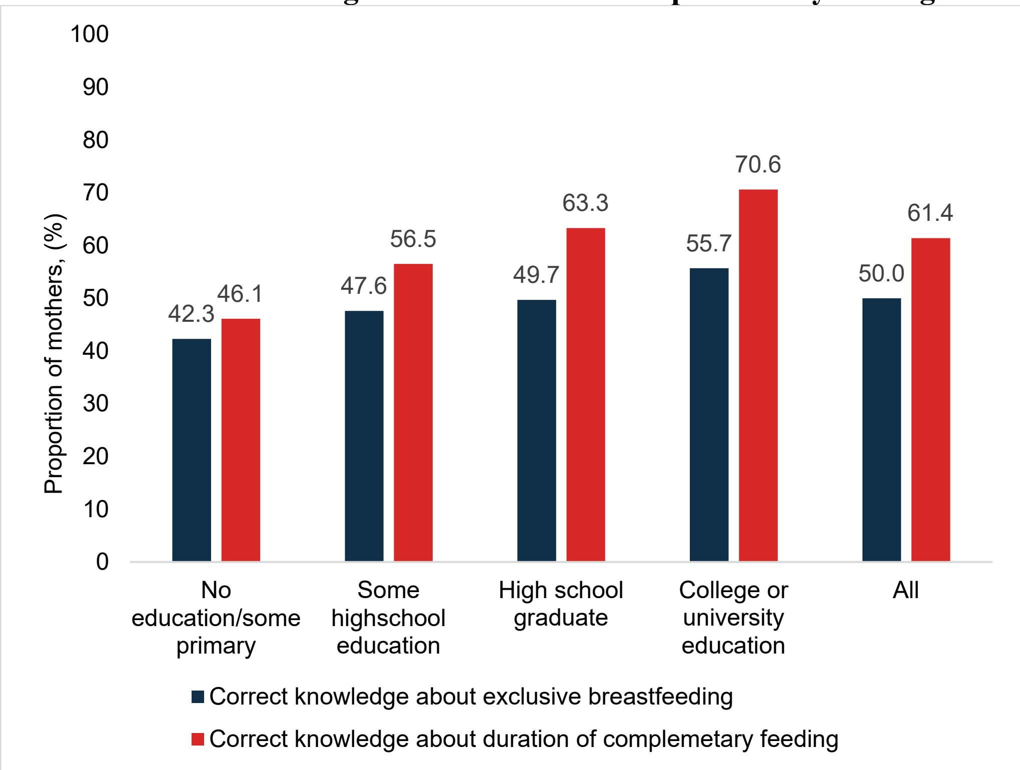
We found a significant socio-economic disparity in stunting among Filipino children during the critical post-natal period 6-23 months. Based on our analysis, the significant drivers that explain the large disparity are the following: maternal height, BMI, and education, quality of mother's prenatal care, iron supplementation for children, and diversity of child's diet.

Maternal nutritional status and education factors contribute the largest in the disparity in stunting. These factors include non-modifiable factors such as child's sex and maternal height, as well as modifiable factors such as maternal education and nutrition (as measured by height and BMI). The large contribution of maternal height on offspring linear growth is supported by overwhelming empirical evidence (Addo et al., 2013; Hambidge et al., 2012; Hernández-Díaz et al., 1999; Khatun et al., 2019; Ozaltin et al., 2010; Stockman, 2012). While it is true that genetics partly plays a role, non-genetic factors, including nutritional-related influences strongly explain the association. Because undernourished mothers are more likely to be impoverished and live in cramped conditions, complementary feeding is not optimal (Addo et al., 2013). The cognitive development of undernourished women is usually compromised (Kakietek et al., 2017). This finding therefore builds the case of preventing stunting as an intergenerational investment in human capital.

In terms of child's sex, it is found that females were less likely to be stunted, and this is consistent with other empirical studies. This may be associated due to biological differences (Bork & Diallo, 2017; Thurstans et al., 2020; Wamani et al., 2007).

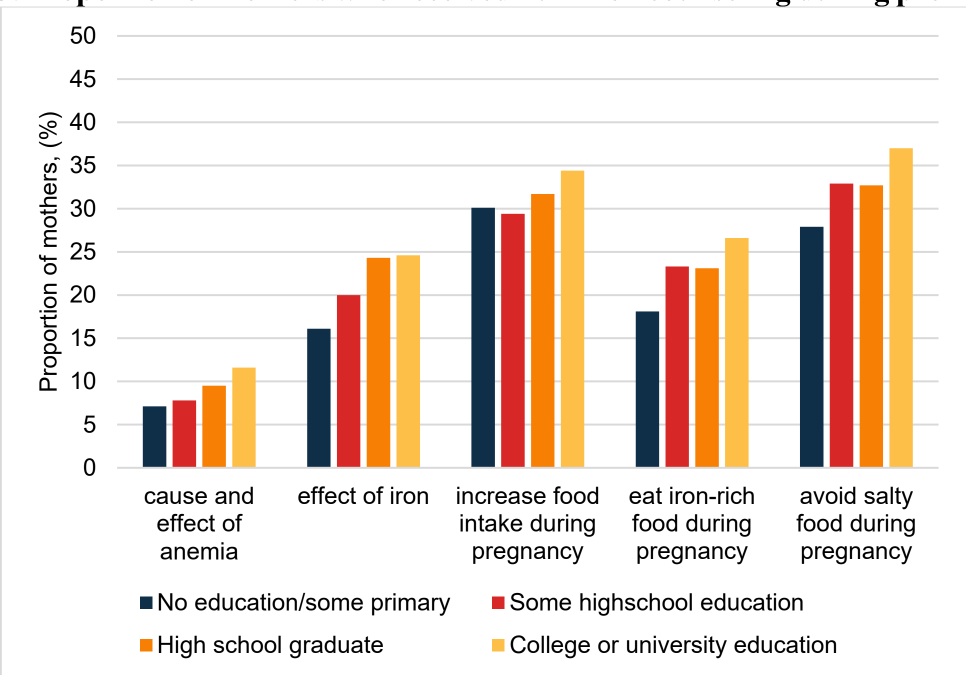
Maternal education and nutrition are considered as important factors explaining differentials in under-five stunting. The relationship of maternal education and stunting is mediated by possible social and cognitive pathways. First, mothers who have had formal education may know more about feeding and rearing children. Second, education may give mothers access to a wider network of contacts who are knowledgeable about the advantages of good newborn and young child feeding practices. The mother has direct access to a wealth of knowledge about how to treat the child if they get sick. In other words, robust social capital is created by maternal education (Vikram, 2018). Third, education gives women a higher status and socially desirable abilities that facilitate social interactions with other high-status individuals, such as professionals in the health care industry (Joshi, 1994). **Figure 12** shows that mothers with less formal education are also less likely to have correct knowledge about optimal child feeding practices, and **Figure 13** shows that they are less likely to receive vital nutrition information during counseling.

Figure 12. Proportion of mothers with correct knowledge about the optimal duration of exclusive breastfeeding and when to start complementary feeding



Source: Authors' analysis of National Nutrition Survey 2015 (DOST-FNRI, 2015)

Figure 13. Proportion of mothers who received nutrition counseling during prenatal visits

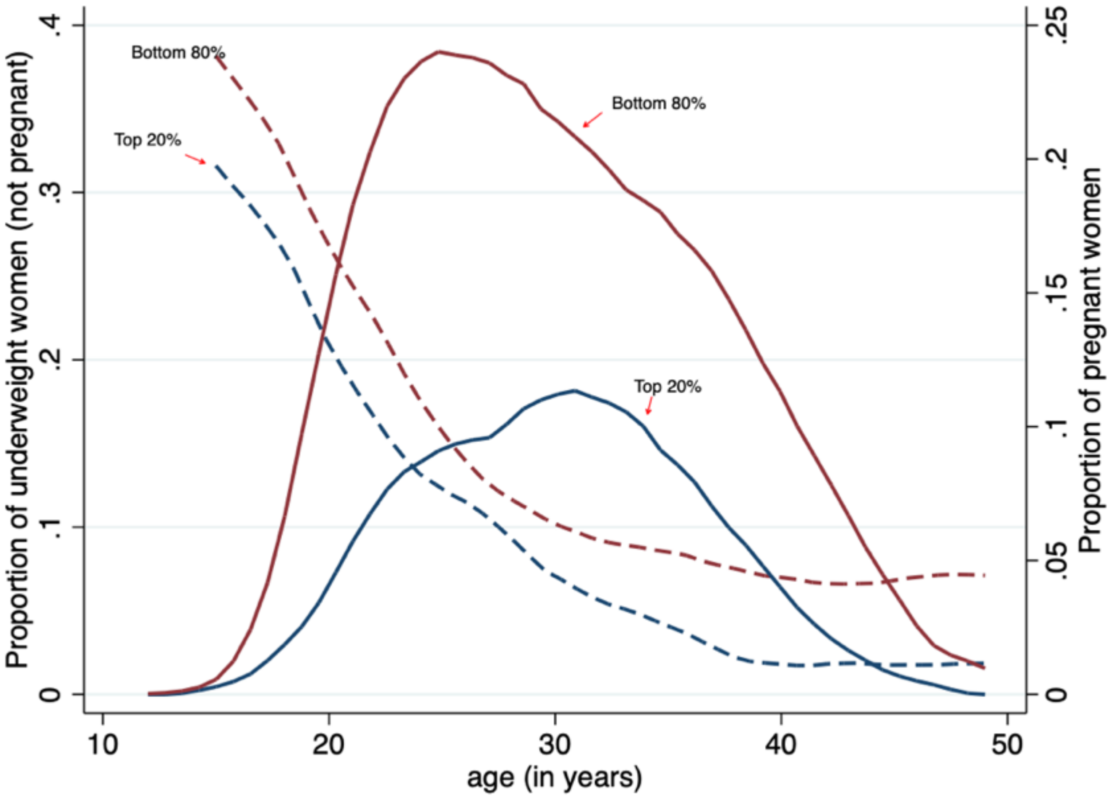


Source: Authors' analysis of National Nutrition Survey 2015 (DOST-FNRI, 2015)

Another modifiable maternal factor that contributes to the gap is BMI. **Figure 14** shows that a large proportion of poor mothers (22%) were underweight during the peak of child-bearing age (early 20s). In contrast, the proportion of underweight among non-poor mothers (7%), while considered high among younger mothers, was significantly lower during the peak of child-bearing age (30 years old).

Stunting in children is linked to the maternal BMI, according to empirical studies. The process by which a child's underweight status influences later anthropometric failure may have begun while the infant was still *in utero*. Infants are more likely to have low birthweights due to the intrauterine intergenerational transmission[15] of maternal underweight during pregnancy, which increases the risk of childhood undernutrition (Martorell et al., 2002; Mbuya et al., 2010). Also, overnutrition explains the socio-economic disparity in stunting. Physiologic and metabolic factors in over nourished mothers could negatively affect fetal growth and development (Blankenship et al., 2020; Hoffman et al., 2000).

Figure 14. Proportion of underweight women and proportion of pregnant women, by age



Source: Authors' analysis of National Nutrition Survey 2015 (DOST-FNRI, 2015)

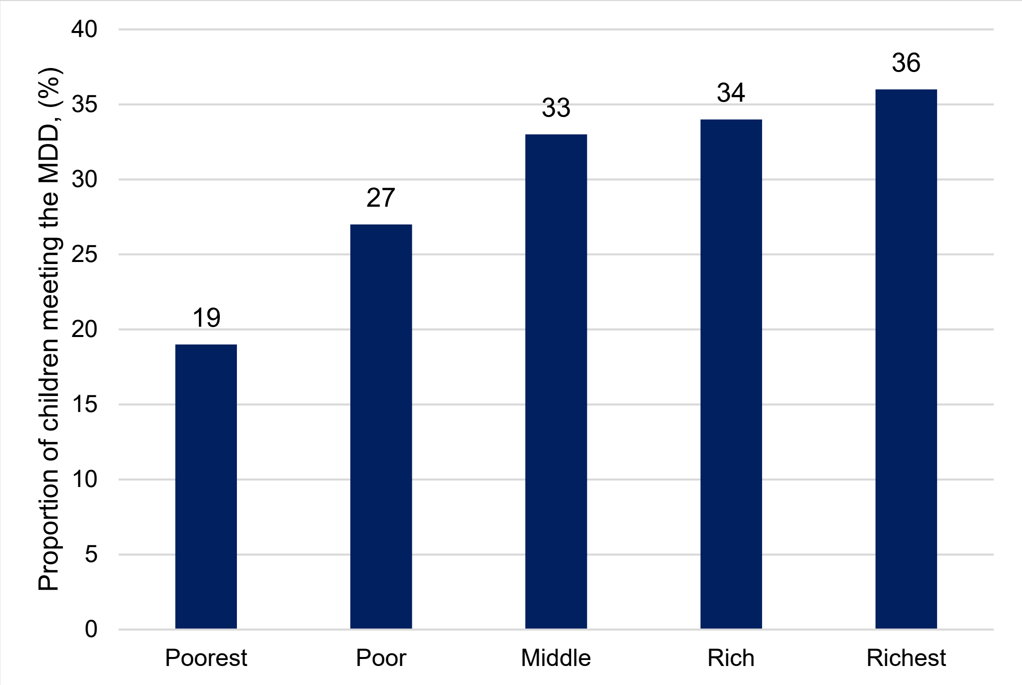
Having quality prenatal care was also found to be an important factor contributing to the disparity in child stunting. Prenatal care (PNC) programs serve as an avenue to identify high-risk mothers and introduce nutritional and educational interventions such as information on food hygiene, diet, and lifestyle advice (Forero-Ramirez et al., 2014). Moreover, it is during prenatal care visits that the mother is given knowledge on the right measures to take to ensure optimal nutrition for her and her child, given appropriate supplements, and prepared for the correct child feeding and rearing practices when the child is born. If a mother have complete and high-quality prenatal care, she will be monitored and any problem that she might encounter can be resolved as soon as possible. This explains that mothers who received high quality

[15] The in-utero environment of underweight mothers is usually stressful for the infant, which increases the risk of having a low birthweight (LBW). Based on systemic reviews, underweight mothers were at increased risk of having an LBW infant (RR 1.48, 95% CI 1.29-1.68, and RR 1.52, 95% CI 1.25-1.85, respectively).

prenatal care have a lesser chance of their child being stunted. However, the gap between the poor and non-poor may be associated with their ability to access these services.

Another important factor is the frequency and quality of diets of young children 6-23 months. For children 6-23 months, disparity in stunting between poor and non-poor households were largely driven by dietary diversity and iron supplementation. Dietary diversity is a crucial factor in determining dietary quality; it is linked to better diet nutritional adequacy when more food groups and food items are consumed (Hatløy et al., 1998; Torheim et al., 2004). A dietary imbalance during early childhood can affect their linear growth. From the age of six months, breastfeeding is no longer able to meet the energy requirements of children (Rakotonirainy et al., 2018). Hence, consumption of adequate complementary foods is essential. In the Philippines, only 30% of children aged 6-23 months were meeting the Minimum Dietary Diversity (MDD) with large disparity across socio-economic class. Only 19% of the poorest Filipino children are meeting their MDD compared to 36% for their richest counterparts (see
Figure 15).

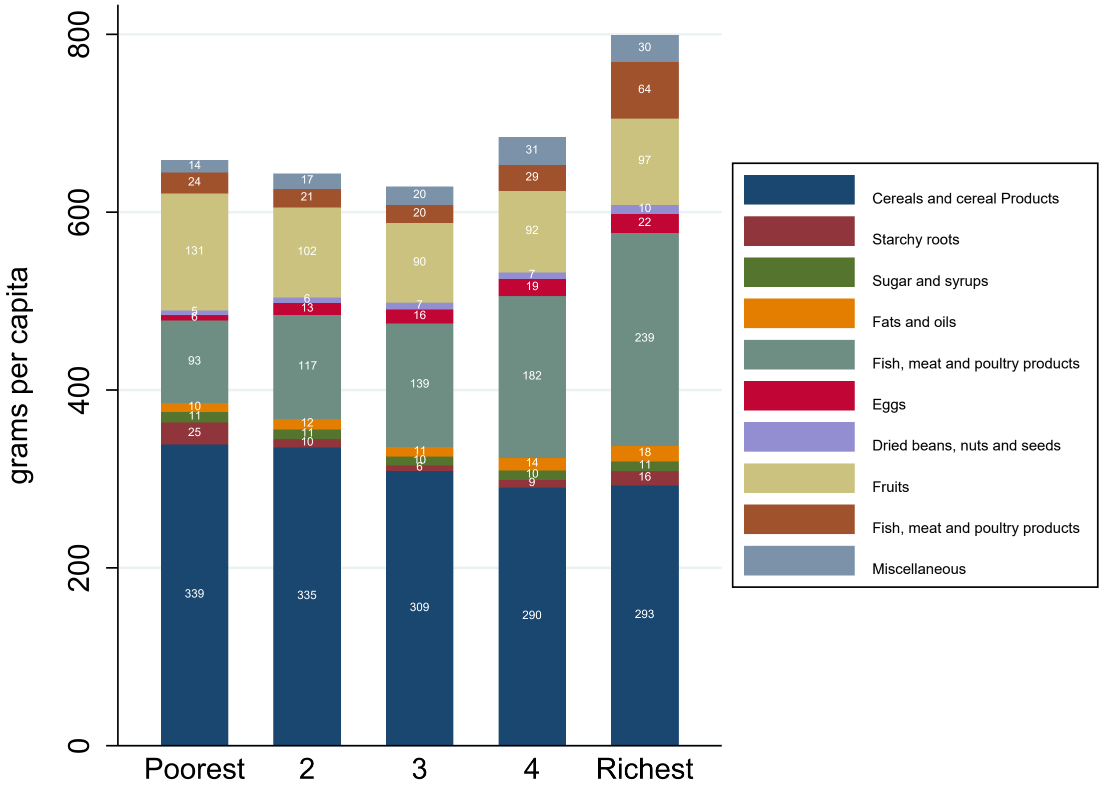
Figure 15. The proportion of children 6-23 months old meeting the Minimum Dietary Diversity



Source: Authors' analysis of 2015 National Nutrition Survey

Figure 16 shows the quantity of food items by socio-economic status. Adjusted for household size, poorer households with under-five children are less likely to consume food relatively to their richer counterparts. In addition to the large gradient in total food consumption, the distribution of food items is also variable across socio-economic status. The per capita consumption of carbohydrates such as cereal, rice and starchy root crops is noticeably lower among the rich. However, consumption of protein is significantly lower among the poor. For example, per capita consumption of eggs among the richest quintile is almost 4 times larger compared to the poorest counterpart. Also, there is a large difference in the consumption of meat and poultry products.

Figure 16. Food consumption per capita, by socio-economic status



Source: Authors' analysis of National Nutrition Survey (2015)

Another significant contributor to the infant and young child feeding domain is iron supplementation for children. Failure to supplement iron in the diet may contribute to stunting or to the undernutrition of the child. The non-poor mothers, given that they have more access to healthcare services (or pre and postnatal care), have higher chances of supplementing their diets with iron because they can get advice and counselling from the healthcare providers; while most of the poor, if not given free, or if cannot be accessed easily, would not be able to have iron supplements.

B. Trajectory of stunting in the Philippines

Figure 17 shows the projected stunting prevalence by different scenarios. The model suggests that without increasing key nutrition and health interventions, the prevalence of stunting will hover at 30% range in the next 10 years. Large and sustained expansion of coverage of balanced energy protein supplementation among nutritionally at risk and micronutrient supplementation **(Scenarios A and B)** will have negligible impact on the prevalence of stunting. What will drive the significant decline in stunting prevalence is to aggressively expand the promotion of IYCF coupled with a set of interventions on complementary feeding (e.g., direct supply provision of complementary food among households and RUTF with children aged 6-23 months), as demonstrated in **Scenario C** and to some degree the expansion of Vitamin A and Zinc supplementation as demonstrated in **Scenario D**. If the country expands the promotion of IYCF in the medium to long-term, the prevalence of stunting could decline 30% to 19% by 2030. This allows the country to achieve its SDG target for stunting by 2030 **(see Appendix A)**.

Figure 17. Projected prevalence of stunting, 2018-2030

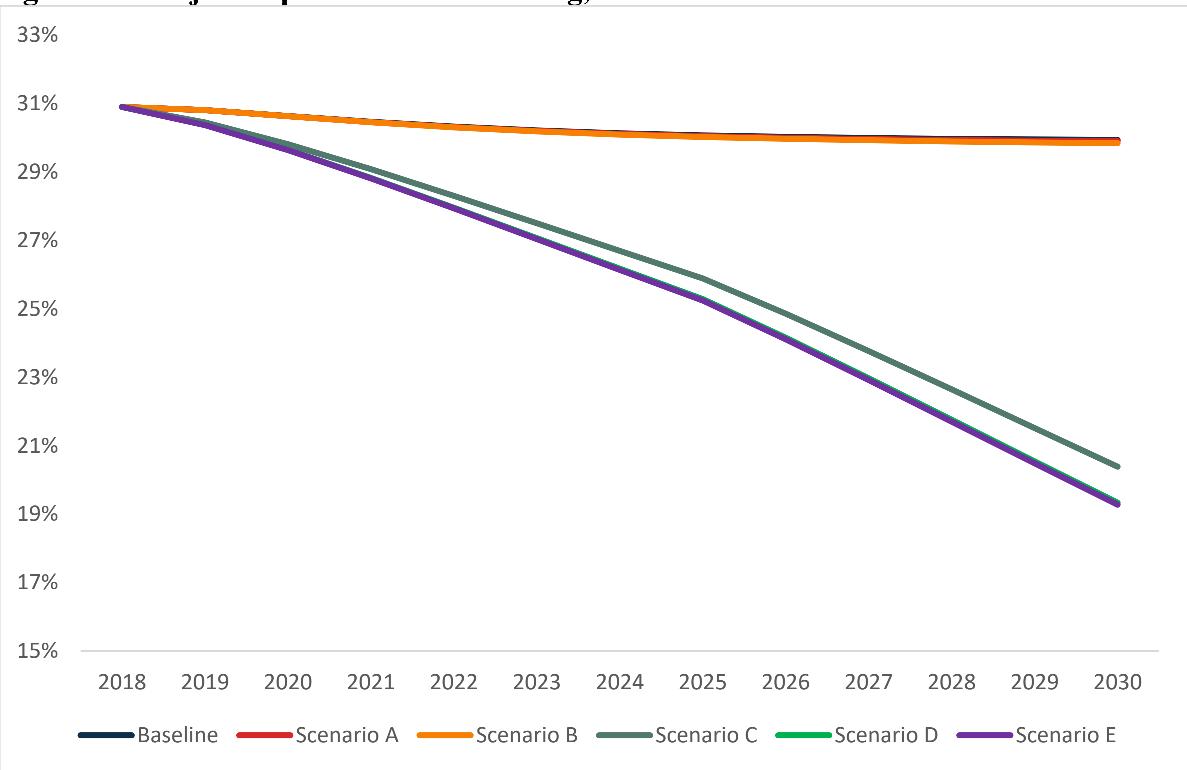
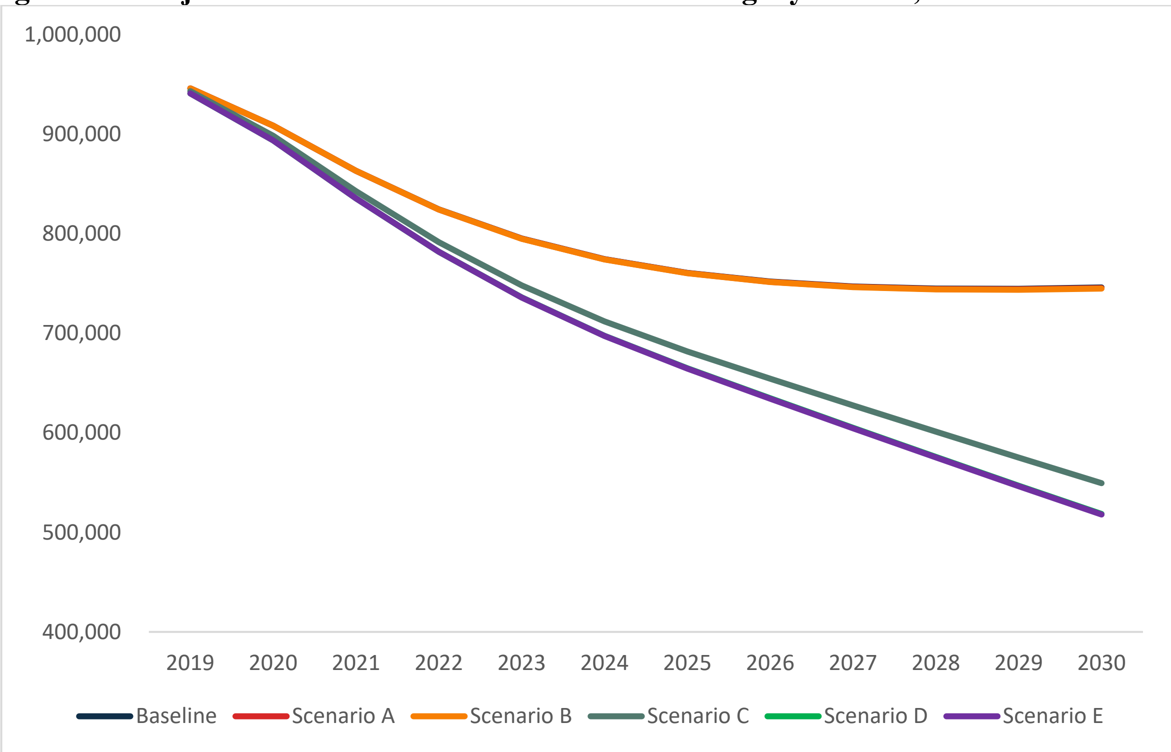


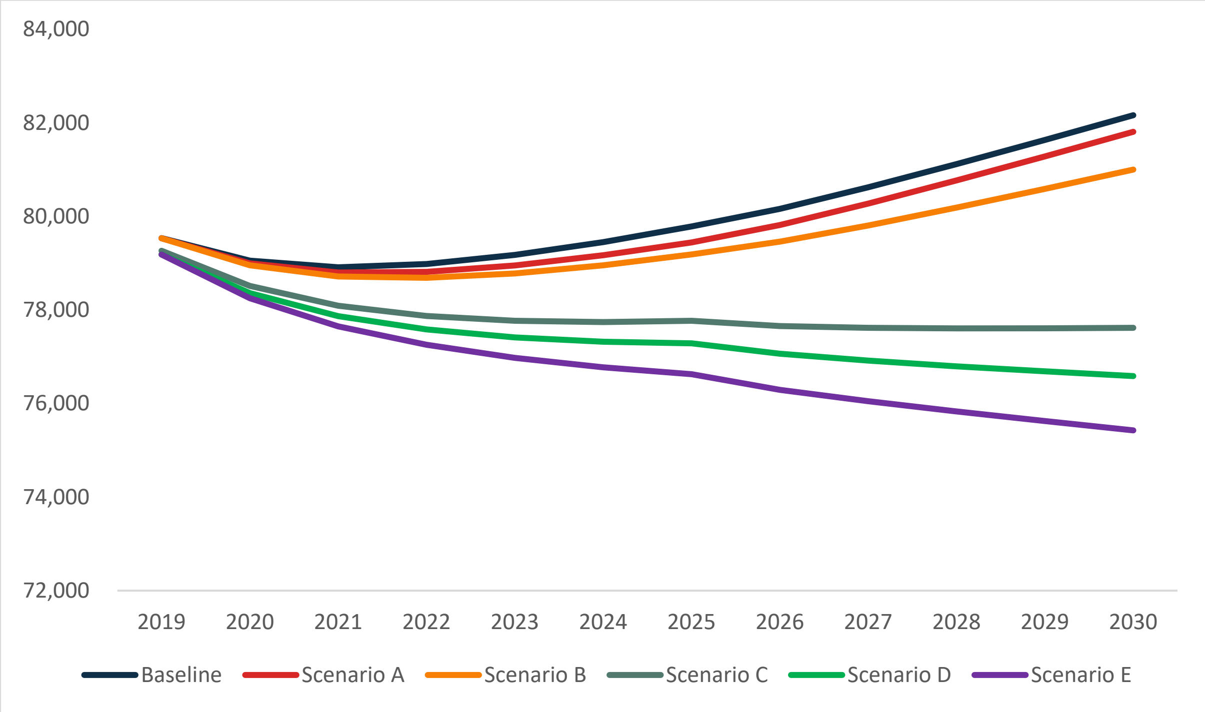
Figure 18 shows the projected number of stunted children turning at the age of five years old by scenario. Ideally, children should not be chronically malnourished or stunted before they turn five years old as this would have enormous repercussions throughout their adult life. Without any intervention, the cumulative number of stunted children turning at the age of five is expected to reach 9.6 million by 2030. If the country aggressively promotes IYCF and increase the service coverage of a set of interventions on complementary feeding among poor children (e.g., direct supply provision of complementary food among households and RUTF with children aged 6-23 months), cumulative number of stunted children will decline to 8.6 million. Hence, the country prevented almost a million children from being stunted. While the adoption of pregnancy-related interventions (e.g., provisions of balanced protein supplement and MMS) will not have significant decline in the stunting prevalence, but it can reduce the absolute number of stunted children.in the country **(see Appendix B).**

Figure 18. Projected number of stunted children turning 5 years old, 2019-2030



Sustained expansion of cost-effective interventions will have a significant impact on child mortality. **Figure 19** shows under-5 child deaths by scenario in the medium to long-term should nutrition interventions are adopted and implemented. Without any aggressive nutrition intervention, the absolute number of child deaths will continue to increase. However, continuous promotion of IYCF and expansion zinc supplementation will reverse this trend. Both interventions will avert almost 30,000 cumulative child deaths until 2030 (**see Appendix C).**

Figure 19. Projected number of under-5 five mortality, by scenario, 2019-2030



How much is the expected cost of expanding the coverage of different nutrition intervention**?** **Table 7** shows the annual cost (in USD millions) for each intervention under each scenario. Among the six interventions, promotion of IYCF practices accounts for the most expensive intervention amounting to 61.1 million USD in 2020 and could increase around three-fold come 2030. This is followed by public provision of complementary foods at 32.5 million USD in 2022 up to 92.8 come 2030. This suggests that government spending with regard to improving the stunting situation of the country should increase and focus on this intervention, which is also found to be the most effective. Public allocation of funds should also be geared to foresee the increase in the costs of these interventions in the coming years.

Table 7. Annual cost of interventions (in USD millions), by scenario

		2022	2024	2026	2028	2030
Scenario A	Balanced energy-protein supplementation	28.2	30.6	31.8	31.8	31.8
Scenario B	Balanced energy-protein supplementation	28.2	30.6	31.8	31.8	31.8
	Iron and folic acid/micronutrient supplementation	2.8	3.6	4.8	6.2	7.7
Scenario C	IYCF	61.1	80.0	105.6	137.8	170.0
	Public provision of complementary foods	32.5	43.4	57.6	75.2	92.8
Scenario D	IYCF	61.1	80.0	105.6	137.8	170.0
	Public provision of complementary foods	32.5	43.4	57.6	75.2	92.8
	WASH intervention	2,516	3,775	4,404	4,404	4,404
	Zinc supplementation	4.5	5.5	7.1	9.2	11.4
Scenario E	Balanced energy-protein supplementation	28.2	30.6	31.8	31.8	31.8
	IYCF	61.1	80.0	105.6	137.8	170.0
	Multiple micronutrient supplementation	2.8	3.6	4.8	6.2	7.7
	Public provision of complementary foods	32.5	43.4	57.6	75.2	92.8
	WASH interventions	0.5	0.6	0.6	0.6	0.6
	Zinc supplementation	4.5	5.5	7.1	9.2	11.4

Note: 1 USD = 48 PHP

We examined the medium to long-term trajectory of stunting in the Philippines under different intervention scenarios. We modelled the trajectory should key health and nutrition interventions are adopted and implemented. The six (6) interventions in the study are the following: balanced energy-protein supplementation during pregnancy, antenatal multiple micronutrient supplementation, a set of interventions on complementary feeding among poor children (e.g., direct supply provision of complementary food among households and RUTF with children aged 6-23 months), zinc supplementation, promotion of exclusive breastfeeding, and promotion of improved infant and young child feeding (IYCF) practices.

Balanced protein-energy supplementation is the provision of supplements wherein protein constitutes less than 25% of the total caloric content. Giving these to pregnant women, especially the undernourished, has been known to encourage gestational weight gain and improve outcomes in pregnancy (WHO, 2019). Existing studies suggest that this improves fetal growth and may be a contributor in the reduction of stillbirth, LBW infants, small-for-gestational age (SGA) infants, and neonatal death, especially when the mother is undernourished and in developing countries (Imdad & Bhutta, 2011a; Kramer, 2000; PSA, 2017; Stevens et al., 2015; WHO, 2019)

Multiple micronutrient supplementation in pregnant women may be a desirable approach in improving pregnancy outcomes through optimal maternal nutrition status. This is characterized by supplementing other micronutrients to aid in deficiency due to inadequate intake of meat, fruits, and vegetables. Deficiencies of these nutrients are common among pregnant women because of their increased needs and requirements, and interventions to avoid such deficiency should be in place to achieve better outcomes. Evidence suggests that this is linked to the reduction of the risks of having low birth weight in most developing countries. MMS also reduces the incidence of infants born small for gestational age and prematurity (Baumgartner, 2017; Fall et al., 2009; Kawai et al., 2011; WHO, 2020).

Similarly, zinc is known to have an essential role in child growth and metabolism. Zinc deficiency may lead to lower resistance to illnesses and hamper linear growth (WHO, 2013). Moreover, it has also been recommended as an effective strategy in reducing morbidity incidence due to diarrhea and other infectious diseases. Evidence suggests that Zinc supplementation should be just a part of a more widespread approach to improve the nutritional status of children due to its limited impact (Brown et al., 2009; Imdad & Bhutta, 2011b; Ramakrishnan et al., 2009; Sandstead, 1991).

Improving infant and young child feeding at the community level is important to improve growth and development of children (UNICEF, 2017). IYCF program for 6-23 months includes continued breastfeeding and appropriate complementary feeding. These interventions have significant impact to health outcomes such as reduction in diarrhea incidence, mortality, and odds of stunting (Imdad et al., 2011; Lamberti et al., 2011)

Exclusive breastfeeding is characterized by the infant receiving solely breastmilk for the first six months of life. This means that no other liquids and solids are allowed, not even water, for breast milk already has all the nutrients an infant would need in the first six months of life. After that period, adequate complementary feeding while continuing breastfeeding is suggested. This protects the child against diarrhea and common illnesses. Empirical studies also suggest that in low and middle-income countries, an association between exclusive breastfeeding and reduced risk for undernutrition (e.g., stunting and wasting) has been found (Kuchenbecker et al., 2015; Laksminingsih, 2018; Scherbaum & Srour, 2016)

In the Philippines, only 60% infants less than 6 months old are exclusively breastfed in 2019. Among these, only 35.1% continued to be exclusively breastfed from birth until their 6^{th} month (DOST-FNRI, 2019). Recent data shows higher proportion of infants receiving timely initiation of breastfeeding (69.2% in 2018 compared to 51.9% in 2011); however, not all of these infants are continuously being exclusively breastfed until their 6^{th} month, which is in contrast to what is recommended. The country should continue on efforts to educate mothers on optimal breastfeeding practices in order to achieve the optimal nutrition status of children at an early age.

A set of interventions on complementary feeding among poor children (e.g., direct supply provision of complementary food among households and RUTF with children aged 6-23 months) is the provision of solid foods and other liquids along with breast milk, when it is no longer sufficient. This covers the period from 6 to 24 months of age. It is a very critical stage of growth because inappropriate feeding may lead to nutrient deficiencies and illnesses which will contribute to poor nutritional outcomes such as undernutrition (e.g., stunting, wasting). In developing countries, there are successful strategies for complementary feeding provision and empirical evidences prove that interventions like this, together with educational strategies have a potential to improve nutritional status and reduce the risk of stunting (Imdad et al., 2011; Lassi et al., 2013).

The country may be recording an increasing number of children receiving timely complementary foods, but an important metric to look at is the meal frequency and diversity of these foods. In the country, 74.2% of children aged 6 months received timely complementary foods in 2019 compared to 66.9% in 2018 (DOST-FNRI, 2019). However, in terms of the Minimum Acceptable Diet (MAD), only 13% of Filipino children aged 6-23 months are meeting their minimum acceptable diet. This indicates that although we have a rising numbers of children receiving complementary foods, only 13% of them have a diverse diet and achieve the minimum meal frequency. Achieving minimum meal frequency and having diverse diet is also included in the WHO complementary feeding guidelines.

The two interventions focused on targeting pregnant women (e.g., balanced energy protein supplementation and antenatal multiple micronutrient supplementation) are included in Scenario A and B of the projection. Based on the findings, these are not enough to reduce stunting prevalence (remaining at around 30% in 2030) significantly to meet the targets. To have a significant reduction in stunting prevalence, the interventions targeted to pregnant women should be coupled with all other interventions targeted for the children (e.g., complementary feeding, vitamin A and Zinc supplementation, exclusive breastfeeding, and improving IYCF practices), with focus on IYCF interventions. The results showed that in scenarios where IYCF was introduced, significant reduction was seen, and this may be the main driver. Should the country expand the promotion to 50% by 2025 and almost universal coverage (95%) by 2030, IYCF is expected to significantly reduce the prevalence of stunting from 30% to 19% by 2030.

Conclusion

In this paper we have discussed the drivers of the large socio-economic disparity in child stunting, and we have examined the possible trajectory of child stunting should key nutrition and health interventions are universally implemented. Maternal nutritional status and education factors, quality of prenatal and post-natal care, and diets of young children 6-23 months explain the large socio-economic disparity. This is consistent with the modelling exercise as it revealed that for the country to achieve significant decline in the prevalence of stunting, it requires large and sustained investment in the medium to long-term, particularly investment in improving the diets of children 6-23 months and promotion of IYCF practices.

To reduce the socio-economic gap, maternal education is an important determinant of stunting that needs to be addressed. Mothers with higher education will then be more aware and equipped with information on how to improve their own nutritional status, better child feeding and rearing practices, and may also have better jobs and income, which in turn will have an impact on child's nutrition. Also, the government should focus on providing equal access to quality prenatal care. Having access to quality prenatal care services will result in the close monitoring of nutrition of the mother during pregnancy and she may be provided with interventions that would improve her and the child's nutrition status. Interventions to improve the child's nutrition status that have a large impact on the reduction of the aggregate stunting prevalence is the improvement of the child's diet during 6-23 months and optimal infant and young child feeding (IYCF) practices. These include the promotion of exclusive breastfeeding and age-appropriate complementary feeding and should be complemented with a set of interventions on complementary feeding (e.g., direct supply provision of complementary food among households and RUTF with children aged 6-23 months).

In general, non-poor mothers are less likely to have a stunted child because they have relatively good nutrition status, good education, and access to quality prenatal care. Hence, equitable allocation and implementation of key health and nutrition intervention is critical.

Being unable to address the social determinants that contribute to the disparity in the prevalence of stunting, and fragmented interventions addressing the three domains (maternal nutritional status and education factors, quality of prenatal and post-natal care, and diets of young children 6-23 months/optimal IYCF practices) may be the cause of the slow decline and stagnation. Therefore, focusing on the domains and packaging it as a continuum of interventions, and prioritizing malnutrition in the government's broader multi-sectoral development agenda is recommended.

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Appendices

Appendix A. Projected prevalence of stunting

Scenario	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline	31%	31%	31%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Scenario A	31%	31%	31%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Scenario B	31%	31%	31%	30%	30%	30%	30%	30%	30%	30%	30%	30%	30%
Scenario C	31%	30%	30%	29%	28%	27%	27%	26%	25%	24%	23%	22%	20%
Scenario D	31%	30%	30%	29%	28%	27%	26%	25%	24%	23%	22%	21%	19%
Scenario E	31%	30%	30%	29%	28%	27%	26%	25%	24%	23%	22%	20%	19%

Appendix B. Projected number of stunted children at the age of 5 years old (in thousands)

Scenario	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline	946	909	863	824	795	775	761	752	747	745	745	746
Scenario A	946	909	863	824	795	774	760	752	747	744	744	745
Scenario B	946	909	863	824	795	774	760	751	746	744	744	745
Scenario C	943	898	843	792	748	712	682	654	628	601	575	549
Scenario D	941	894	836	782	736	698	665	635	605	576	547	518
Scenario E	941	894	836	782	736	697	665	634	605	575	546	518

Appendix C. Projected number of under-5 five mortality

Scenario	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Baseline	79,533	79,051	78,911	78,982	79,175	79,450	79,784	80,160	80,620	81,116	81,632	82,161
Scenario A	79,532	78,995	78,799	78,814	78,950	79,167	79,442	79,816	80,273	80,767	81,280	81,806
Scenario B	79,532	78,952	78,714	78,686	78,779	78,953	79,185	79,459	79,805	80,187	80,587	80,999
Scenario C	79,264	78,511	78,090	77,871	77,767	77,740	77,768	77,656	77,616	77,605	77,607	77,618
Scenario D	79,185	78,359	77,868	77,582	77,412	77,321	77,285	77,064	76,915	76,795	76,687	76,586
Scenario E	79,184	78,249	77,649	77,254	76,974	76,772	76,625	76,292	76,048	75,831	75,625	75,426