Examining the relationship of the *Pantawid Pamilyang Pilipino Program* (4Ps) with wasting and stunting status among children experiencing poverty in the Philippines: a cross-sectional study

by

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A thesis

presented to the University of Waterloo

in fulfillment of the

thesis requirement for the degree of

Master of Science

in

Public Health and Health Systems

Waterloo, Ontario, Canada, 2022

# Author's Declaration

This thesis consists of material all of which I authored or co-authored: see Statement of Contributions included in the thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

# Statement of Contributions

I, Monica Bustos, wrote and assembled the three chapters included in this thesis under the supervision of Dr. Warren Dodd, with comments and feedback from Dr. Lincoln Lau, Dr. Sharon Kirkpatrick, and Dr. Joel Dubin. Chapter 1 and 3 were completed as part of fulfilling program requirements and were not intended for publication.

*Chapter 2:*

This study was conducted in collaboration with a Philippine-based non-governmental organisation, International Care Ministries. Helena Manguerra, Kendall Wilson, Mia Choi, Joy Kimmel, and Daryn Go provided technical and analytical support for me to be able to access and use the monitoring and evaluation data for secondary data analysis. Nikki Abrera and Jesce dela Cruz provided guidance around understanding important details on data collection and the sample study that helped inform data cleaning and analysis decisions.

Chapter 2 is a manuscript that was written for publication. This chapter was written and revised under the supervision of Dr. Warren Dodd, with further assistance and feedback from Dr. Lincoln Lau, Dr. Sharon Kirkpatrick, and Dr. Joel Dubin.

# Abstract

*Background*: In the Philippines, poverty is one of the main risk factors driving acute (wasting) and chronic (stunting) undernutrition among children. Previous research has pointed to the potential of social protection and conditional cash transfer programs to support the nutritional outcomes of children by improving the underlying determinants of health and nutrition. One such conditional cash transfer program in the Philippines is the *Pantawid Pamilyang Pilipino Program* (4Ps), which serves as the main social protection program in the country and aims to improve health and educational outcomes of children experiencing poverty.

*Objectives*: The conditionalities and entitlements from 4Ps has the potential to support the nutrition of children in participating households. Moreover, recognizing the similarities and differences in the drivers of and prevention approaches for wasting and stunting, it is important to understand the association of this conditional cash transfer program with these conditions. In collaboration with International Care Ministries (ICM), the objective of this study was to understand the association between household enrollment in 4Ps with wasting status and stunting status among children experiencing extreme poverty in the Philippines.

*Methods*: Secondary data analysis was conducted on cross-sectional survey data from ICM participants. A sample of 3,005 children aged between 6 months to 12 years were included in the analysis. Descriptive statistics were calculated to compare the sociodemographic characteristics of children from households enrolled and not enrolled in 4Ps, as well as children who were wasted and stunted. Two multilevel logistic regression models were used to estimate the association between household enrolment in 4Ps with wasting status and stunting status.

*Results*: Results from the descriptive statistics indicated that children in households enrolled in 4Ps had household heads with fewer years of education and more household members. In addition, there were no differences between the wealth and food insecurity of children from households enrolled and not enrolled in 4Ps. The regression modelling showed that there was no association between household enrollment in 4Ps and wasting status in children (adjusted OR=1.05; 95% CI=0.79-1.39). Conversely, household enrollment in 4Ps was significantly associated with stunting status (adjusted OR=0.50; CI=0.31-0.78), but this effect was moderated by geography type. Among children from households enrolled in 4Ps living in urban mountains, the odds of stunting were higher by a factor of 2.48 (95% CI=1.32-4.61) compared to children from households enrolled in 4Ps living in coastal

areas. Similarly, children from households enrolled in 4Ps living in rural plains had higher odds of stunting by a factor of 2.24 (95% CI=1.30-3.82) compared to children from households enrolled in 4Ps living in coastal plains.

*Conclusion*: This cross-sectional study provides insight on the potential association of 4Ps with wasting and stunting among children. Findings indicate that 4Ps may not be able to address the underlying drivers of wasting. The results for wasting are consistent with previous research evaluating the relationship between 4Ps and wasting, but are different in contrast to the observed effects of unconditional cash transfers on wasting in different contexts. The effect moderation of geography type between the relationship of household enrollment in 4Ps and stunting in children may suggest that program benefits from 4Ps are not equitably distributed or that underlying risk factors may differ across different areas in the Philippines. The findings for stunting are aligned with previous research that have seen variation in the effects of 4Ps across different communities in the Philippines. Overall, these findings highlight implications for increasing adaptive capacity in 4Ps, ensuring an equivalent increase in supply-side resources, and integrating direct nutritional treatment to maximize the impact that this program can have on improving the nutritional outcomes of children experiencing poverty.

# Acknowledgements

The completion of this project would not have been possible without the support of various mentors, colleagues, friends, and family members. Thank you for allowing me the space and time to work on this thesis.

First, I am grateful for the mentorship of my supervisor, Dr. Warren Dodd. Thank you for your guidance and encouragement throughout this project as you continuously challenge me to think critically about topics related to global health and international development. Your commitment to conducting research that centers and prioritizes community partnerships and relationships has significantly contributed to my understanding of community-based research and practice. Thank you for introducing me to a group of like-minded individuals, for fostering a supportive and caring learning environment, and for enabling me to lead and take ownership of my work and research.

I am also thankful for the support of my committee members – Dr. Lincoln Lau, Dr. Sharon Kirkpatrick, and Dr. Joel Dubin. Lincoln, thank you for providing guidance around the possible research and study opportunities using the ICM dataset. I greatly appreciated your insight on the importance of contextualizing the findings from this work. Sharon, thank you for your thoughtful feedback on many aspects of this work and for sharing your expertise on food security, nutrition, and measure development. I have since appreciated the complexities with which measures are created and will continue to assess public health research with the critical lens that your courses and mentorship have taught me. Joel, thank you for coming onboard halfway through this project to provide statistical support and inform my modelling approach. Thank you for kindly answering my questions about R, for guiding the model building approach, and for helping me interpret the results from the models.

I am thankful for the financial support provided by the Canadian Institute for Health Research and the University of Waterloo. Thank you for awarding me with the CIHR Banting and Best Canada Graduate Scholarship and the President's Graduate Scholarship to pursue this work.

Many thanks to the staff from ICM who provided the foundation for the data sources of this study. Thanks to Helena, Mia, and Kendall, who lent an hour of their time every Monday in early 2021 to help me learn R and supported me as I merged and cleaned datasets. Thank you for your patience as I stumbled on R code and for sharing your favourite snippets with me. Thanks to Joy and Daryn for providing technical and analytical support for data cleaning and merging, and to Nikki and

# Dedication

To my grandparents – Lola Ruby and Lolo Adol; Lola Pilar and Lolo Pastor.

*Taos-puso kong pagmamahal at pasasalamat.*

My sincerest love and gratitude.

# Table of Contents

# List of Figures

# List of Tables

# List of Abbreviations

| | |
|---|---|
| 4Ps | *Pantawid Pamilyang Pilipino Program* |
| BAZ | BMI-for-age z-score |
| DOST-FNRI | Department of Science and Technology – Food and Nutrition Research Institute |
| DSWD | Department of Social Welfare and Development |
| HAZ | Height-for-age z-score |
| HHS | Household Hunger Scale |
| ICC | Intraclass Correlation Coefficient |
| ICM | International Care Ministries |
| PMT | Proxy Means Test |
| UNICEF | United Nations Children's Fund |
| WHO | World Health Organization |
| WHZ | Weight-for-height z-score |

# Chapter 1

# Introduction and Background

## 1.1 Defining acute and chronic undernutrition

Undernutrition is defined as the insufficient intake of energy and nutrients to meet an individual's needs to maintain good health (Black et al., 2008; WHO, 2021). The UNICEF conceptual framework of child nutrition indicates that access to nutrient-rich food, appropriate childcare practices, and a healthy environment directly influence the nutritional outcomes of children (UNICEF, 2013). The conceptual framework also indicates that food, caretaking, and healthy environments are affected by the interplay of social, economic, and political factors, which demonstrates the complexity and multilevel nature of the determinants and drivers of nutritional outcomes among children. In children, undernutrition can manifest in both acute and chronic conditions which are monitored through wasting and stunting, respectively. Current estimates suggest that 49.5 million children under 5 years are wasted, while 149 million are stunted globally (Global Nutrition Report, 2020).

Wasting and stunting in childhood have detrimental effects on long-term social, economic, and health outcomes, especially among populations experiencing poverty (Bhutta et al., 2017; Black et al., 2020). Wasting, defined as low weight-for-height, is an acute condition of undernutrition that is associated with events that create shocks of food insecurity or sudden illness onset (Richter et al., 2017). These shocks are often linked with environmental disasters or conflict situations, wherein food production and access to markets are disrupted and healthcare and sanitation services collapse (Bahwere, 2014). In emergency and humanitarian contexts, preventing wasting involves interventions such as social protection programs, distribution of food and nutrition packages, and providing health services to affected populations (De Pee et al., 2015; Lenters et al., 2013). Wasting is most often treated through the provision of ready-to-use supplementary or therapeutic foods alongside relevant micronutrient supplements and medication (Bergeron & Castleman, 2012; De Pee et al., 2015). Severe cases of wasting are correlated with increased risk for mortality and susceptibility for disease and infection, requiring urgent care and treatment (Black et al., 2013; Lenters et al., 2016)..

In contrast, stunting, defined as low height-for-age, is associated with prolonged exposures to poor developmental conditions which start in utero and continue over the first two post-natal years (Black et al., 2013; Stewart et al., 2013). Direct risk factors for stunting include inadequate prenatal and antenatal healthcare resources as well as prolonged exposure to food insecurity (Stewart et al.,

2013). Additionally, previous research has observed that poor complementary feeding during the first 6-24 months is a risk factor for stunting (Bhutta et al., 2013; Stewart et al., 2013). In contrast to wasting, there is no immediate treatment available for stunting, and interventions directed towards addressing stunting are focused on prevention through supporting the improvement of the longstanding socioeconomic determinants of health (Bergeron & Castleman, 2012). Stunting is also correlated with poorer cognitive and educational outcomes in adolescence, as well as higher susceptibility to chronic disease in adulthood (de Onis & Branca, 2016; Harper et al., 2003). These long-term negative health outcomes associated with stunting create pathways for intergenerational cycles of poverty within households as it creates socioeconomic challenges and reduces economic productivity in later adulthood (Arlinghaus et al., 2018; Delisle, 2008; Harper et al., 2003; Nandy et al., 2017). For these reasons, it is imperative that children are provided with the proper resources to attain healthy nutritional outcomes and ensure high quality of health and wellbeing across the life course.

## 1.2 Prevalence and determinants of child undernutrition in the Philippines

In the Philippines, minimal improvement has been made in addressing child undernutrition over the past two decades (Capanzana et al., 2020; Global Nutrition Report, 2020; Mbuya et al., 2021). Between 2010 to 2019, the Philippines sustained an average annual economic growth of 6% (World Bank, 2021a); however, while poverty declined from 23% in 2015 to 17% in 2018, an estimated 18 million Filipinos continue to have insufficient resources to meet their daily needs (Philippine Statistics Authority, 2019; World Bank, 2021b). As a consequence of widespread poverty and income inequality, undernutrition continues to be prevalent in the Philippines especially among populations experiencing extreme poverty and in the lowest income groups.

Poverty and socioeconomic status are major determinants of undernutrition in the Philippines. The most recent data available from the 2018 Expanded National Nutrition Survey indicated that the prevalence of stunting and wasting were highest among households in the poorest income quintiles and in rural areas (DOST-FNRI, 2020). Among children under 5 years of age, the prevalence of stunting in the poorest quintile was 46%, compared to 13% among the wealthiest quintile (DOST-FNRI, 2020). The estimates are similar for children under 5 years of age who are wasted, where prevalence was 8% among the poorest groups, compared to 4% in the wealthiest groups (DOST-FNRI, 2020). Geographically, the prevalence of stunting was 34% in rural settings and 26% in urban

areas, while the prevalence of wasting was 7% in rural settings compared to only 5% in urban areas (DOST-FNRI, 2020). In addition, households where fisherfolks or farmers were the household head experienced the highest poverty incidence in the Philippines in 2018, and were found to have children with a higher prevalence of stunting and wasting compared to other households (Capanzana et al., 2018; Philippine Statistics Authority, 2020). Previous research in the Philippines has also indicated that larger households and severe food insecurity are negatively associated with height-for-age and weight-for-age z-scores of children, while household income is positively associated with height-for-age z-scores (Ieiri et al., 2020).

The risks of wasting and stunting are further exacerbated by subregional factors such as extreme weather events and regional conflict. The Global Climate Risk Index showed that the Philippines was the fourth country most affected by extreme weather events between 2000 and 2019 (Eckstein et al., 2021). It is anticipated that varying areas within the Philippines will experience more intense precipitation, higher risks of typhoons, and greater possibilities of droughts (Delina & Cagoco-Guiam, 2018; Yumul et al., 2011). Not only do these extreme weather events bring shocks of food insecurity and illness that increase the risk of undernutrition, but it also has long-term effects by disrupting social development through the reallocation of resources away from health and social services (Delina & Cagoco-Guiam, 2018; Rameshshanker et al., 2021). Moreover, ongoing regional conflict in the Mindanao region (south) has led to an increase in internally displaced people who do not have adequate food and shelter (Collado, 2019, 2020). The effects of persistent extreme weather events and prolonged regional conflict affect underlying factors of nutrition that increase the onset of wasting. Additionally, sustained exposure to the long-term effects of these events could also increase the risk of stunting.

The Filipino government has launched multiple programs with the mandate to improve the nutritional outcomes of children such as the formation of the National Nutrition Council, the development of the Philippine Plan of Action for Nutrition, and the country's participation in UNICEF's Scaling Up Nutrition Initiative (Barba, 2000; Scaling Up Nutrition, 2017). However, the stark contrast between the prevalence of undernutrition in the poorest and wealthiest groups in the Philippines is reflective of how widening income inequality in the country contributes to a disproportionate burden of poor health outcomes among people experiencing poverty. Moreover, subregional contexts that exacerbate the risks on the underlying drivers of health and nutrition create further disparities in health outcomes among people experiencing poverty. It is critical that focus is

directed towards supporting the health outcomes of populations experiencing extreme poverty as household poverty and low socioeconomic status limit households' access to healthy and nutritious food (Black et al., 2017; Black et al., 2013). Furthermore, poor maternal health and child undernutrition also contribute to the cyclical nature of intergenerational poverty experienced among low-income households (Arlinghaus et al., 2018; Delisle, 2008; Harper et al., 2003). These social risk factors are further compounded by under-resourced healthcare and social service structures which impede the provision of social and economic support for communities and households experiencing poverty in the Philippines (Luu et al., 2022; NNC, 2018; Richter et al., 2017; Sanoussi et al., 2020).

## 1.3 Conditional cash transfer programs and the nutritional outcomes of children

Conditional cash transfer programs are interventions designed to improve the social and economic status of households and individuals experiencing poverty (Adato et al., 2011). Conditional cash transfers mainly operate through the provision of financial incentives upon participants' completion of health- and education-related program requirements. First implemented in countries across Latin America, conditional cash transfers have become a popular approach to provide social assistance and protection (Sugiyama, 2011). Previous research indicates that national-level conditional cash transfers programs such as the *Bolsa Familia Programme* (Brazil), *Juntos* (Peru), and *Progresa-Oportunidades-Prospera* (Mexico) can potentially improve nutritional and health outcomes among children (García-Guerra et al., 2019; Pérez-Lu et al., 2017; Rasella et al., 2013).

Conditional cash transfers have been considered as a nutrition-sensitive approach to supporting the nutritional outcomes of children (Bhutta et al., 2013; De Pee et al., 2015). Nutrition-sensitive interventions are programs that indirectly impact nutritional outcomes by addressing the underlying conditions that contribute to improved nutrition such as initiatives that focus on women's empowerment, agriculture, food systems, education, and social protection (Bhutta et al., 2013). Previous reviews have indicated that conditional cash transfers can improve the overall health outcomes of children through increasing health service utilisation, expanding immunisation coverage, and improving nutritional outcomes (Manley et al., 2020; Owusu-Addo & Cross, 2014). In particular, cash transfers have been theorized to influence the nutritional outcomes of children through pathways related to food security, women's empowerment, caretaking practices, and healthcare use and access (de Groot et al., 2017; Leroy et al., 2009). A recent systematic review indicated that cash transfer

4

programs had a small but significant effect on reducing stunting and improving linear growth through increasing consumption of animal-sourced foods, improving dietary diversity, and reducing the incidence of diarrhea (Manley et al., 2022). Additionally, cash transfers implemented in humanitarian contexts were found to have mostly positive effects on preventing acute undernutrition and encouraging weight gain in children (Van Daalen et al., 2022).[1] However, among studies that compared the impact of cash transfers with in-kind food transfers, cash transfers alone did not always provide significant improvements on nutritional outcomes (Doocy et al., 2020). While these reviews indicate that cash transfers have a generally positive impact on the nutritional outcomes of children, both highlighted that programme and participant factors, such as conditionalities and transfer amounts, as well as children's baseline nutritional status and household socioeconomic status, influence the observed nutritional impacts.

Adaptive social protection strategies have more recently been discussed as a response to increasing climate related disasters and the disproportionate impact that these disasters have on populations experiencing poverty (Bowen et al., 2020; Johnson et al., 2013). Through integrating principles of disaster risk reduction and climate change adaptation, adaptive social protection programs aim to build adaptive capacity and climate resilience among households and populations experiencing poverty through leveraging existing social safety nets such as cash transfers, food and in-kind supports, and targeted subsidies (Bowen et al., 2020; Johnson et al., 2013; Kuriakose et al., 2013). In particular, cash transfers have been argued to contribute to adaptive capacity during climate related emergencies by supporting populations meet basic needs, helping populations respond to climate-related shocks, assisting in managing risks, investing in adaptive capacity resources, and facilitating mobility and livelihood transitions (Pega et al., 2015; Wood, 2011). While the intended impacts of adaptive social protection and cash transfers are expected to positively affect the underlying determinants of health and nutrition, more evidence is needed to understand the program factors that can effectively contribute to the prevention of poor nutritional outcomes among children during cases of emergencies and crisis.

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[1] Humanitarian contexts were defined as settings experiencing complex emergencies (e.g., conflict, extreme weather events, etc.).

## 1.4 The *Pantawid Pamilyang Pilipino Program* (4Ps)

The *Pantawid Pamilyang Pilipino Program* (4Ps) is the Philippines' main social protection and welfare program. Launched in 2007, 4Ps is a conditional cash transfer program that aims to support poverty alleviation among populations in the lowest income level within the country. 4Ps is implemented through the Department of Social Welfare and Development (DSWD) and intends to improve health and educational outcomes within low-income households (DSWD, 2008, 2019b). Households enrolled in 4Ps are entitled to receive cash transfers, food assistance, and health and educational grants upon meeting eligibility criteria and completing program requirements (see Figure 2.1 in Chapter 2 for a full list of program conditionalities and entitlements) (DSWD, 2008, 2019b). The target population for 4Ps is identified through *Listahanan*, a registry compiled by the DSWD (DSWD, 2019b). Household eligibility is assessed through a proxy means test (PMT), a statistical model that uses proxy indicators of a household's income to determine the poverty level of the household. Households are included in *Listahanan* if they reach a cut-off threshold level of poverty based on the results of the PMT (DSWD, 2019b; Fernandez, 2012). Additional household eligibility requirements for 4Ps enrollment include living in a poor geographic area as estimated by the Family Income and Expenditure Survey, and either having a child of 0-18 years of or a woman who is pregnant age in the household (Orbeta et al., 2014; Peñalba, 2019).

As of June 2020, DSWD estimated that 4 million active households were receiving 4Ps entitlements, representing 97.6% of the 4.4 million target households outlined in the annual expenditure program of the national government for 2020 (DSWD, 2020). Earlier evaluations by the DSWD and the World Bank suggested that 4Ps contributes to improved health service utilisation and increased school attendance among children, and reduced short-term poverty to help participants afford their basic needs (Acosta & Velarde, 2015; Orbeta et al., 2014). Based on the purported success of 4Ps, the program was institutionalized in 2019 through the signing of the *Pantawid Pamilyang Pilipino* Act (No. 11310), ensuring the annual implementation of the program (*An Act Institutionalizing the Pantawid Pamilyang Pilipino Program (4Ps)*, 2019; Dodd et al., 2022; Ranada, 2019).

While 4Ps has been praised for its impact on the health and education of children, it also has several weaknesses that limit the program's impacts on supporting the nutritional outcomes of children. First, the targeting system from which 4Ps identifies eligible households, *Listahanan*, has

not been updated since it was first created in 2009, which limits the enrollment of newly eligible households into the program (Cho et al., 2020; Dadap-Cantal et al., 2021). Previous reports have indicated that while the number of enrolled households has increased from 2008 to 2018, the number of women and children has since declined (Cho et al., 2020). Moreover, the proportion of households that are in the lowest income quintile among 4Ps participants has decreased from 75% in 2009 to 46% in 2017 (Acosta & Velarde, 2015; Cho et al., 2020). Another factor that limits the impacts of the program is the amount of the cash transfer, which, has remained the same since 2008 and, thus, is declining in value due to inflation (Cho et al., 2020). Weak service delivery has also been a challenge wherein the uptake and utilisation of conditionalities has varied across different areas. For example, the Economic Research Institute (2019) found that some participants did not find the information shared through the educational Family Development Sessions to be helpful given the lecture-based delivery of the sessions. The ability of program administrators to efficiently implement 4Ps may also vary given limited resources across different areas of the Philippines (Peñalba, 2019). For example, the requirement for 4Ps participants to meet health-related conditionalities may increase the demand on health systems, posing challenges for settings where health care capacity is low and there is no equivalent investment in supply-side resources (Conchada & Tiongco, 2014). Previous research has also noted that dysfunction and inefficiencies stitched within institutional and political dynamics in the Philippines have limited the structural changes necessary to fully see the transformational impacts of 4Ps (Dadap-Cantal et al., 2021).

## 1.5 Connecting the *Pantawid Pamilyang Pilipino Program (4Ps)* to nutritional outcomes of children

The Theory of Change for 4Ps demonstrates the pathways through which different program components (conditionalities and entitlements) could potentially lead to expected outcomes that are associated with the prevention of undernutrition and improvements in the nutritional outcomes of children within participating households (see Figure 2.2 in Chapter 2 for the 4Ps Theory of Change). Health-related conditionalities, including required health care service visits for mothers and children, could provide preventive services that reduce the risk of undernutrition. Moreover, the requirement to attend Family Development Sessions, which provide information on health and wellbeing, family dynamics and parenting, and awareness on community and social issues, could enhance overall care practices for children. Lastly, the entitlements (cash transfers, rice subsidy) provided to 4Ps

participants upon completion of required conditionalities, could also provide additional socioeconomic support towards accessing health services, purchasing food items, and improving housing and sanitation facilities. Overall, the combination of both the conditionalities and entitlements are expected to provide families with the resources to cope with shocks (e.g., extreme weather events, economic challenges) as well as attain resources to create healthy environments that are supportive of the growth and development of children.

The potential impact of 4Ps on the nutritional outcomes of children has been previously identified and evaluated. Wasting, an acute condition that is associated with sudden shocks of food insecurity and illness, is prevalent in the Philippines due to regular occurrences of extreme weather events in the form of seasonal typhoons (Edwards et al., 2021). As such, there have been opportunities by which 4Ps has been leveraged to address emergency situations and mitigate negative health outcomes among affected populations. For example, during the emergency response to Typhoon Haiyan (2013), the 4Ps targeting system (*Listahanan*) was used by the World Food Programme and UNICEF to identify households in need of assistance (Aldaba, 2019; Bowen, 2016). In addition, to better respond to the needs of enrolled households, 4Ps developed a provision that suspended the requirement to meet conditionalities for a period of three months during disasters and calamities (Bowen, 2016). While these initiatives signal that social protection implementation in the Philippines is transitioning towards a more adaptive approach, evaluations of the Typhoon Haiyan response have indicated that the targeting and disbursement of aid during shocks and emergencies can be further improved by creating policies and systems that can more efficiently mobilize emergency social protection responses (Aldaba, 2019; Bowen, 2016).

Additionally, stunting, a chronic condition of undernutrition, continues to be prevalent in the Philippines due to persistent poverty that leads to poor prenatal conditions, insufficient food security and diversity, as well as inadequate water, sanitation, and hygiene availability in the household environment (Capanzana et al., 2020). Mixed results have been observed in relation to 4Ps impact on stunting among children. A previous randomized controlled trial (RCT) using data from 2011 indicated that 4Ps was associated with lower stunting rates among children in communities where 4Ps was implemented compared to communities where 4Ps was not implemented (Kandpal et al., 2016). Specifically, severe stunting was observed in this study to be lower by 10.2% among children in households that were enrolled in 4Ps compared to children in households not enrolled in 4Ps. However, follow up evaluations of 4Ps in 2013 and 2017 did not show that 4Ps was effective in

reducing stunting (Orbeta et al., 2014; Orbeta et al., 2021). In contrast to earlier findings, the most recent impact evaluation produced by the DSWD, which stratified analyses by residence (i.e., urban or rural), age, and sex of the child, indicated that children in households enrolled in 4Ps were more likely to be stunted compared to children who were not enrolled in 4Ps (Orbeta et al., 2021). Further, these evaluations were unable to capture the effect of 4Ps on the poorest households because of limitations in evaluation designs after 4Ps was fully implemented nationwide (Cho et al., 2020; Kandpal et al., 2016).

While there are differences in the direct drivers that lead to wasting and stunting among children, recent research has highlighted that these conditions occur under similar contexts and share common risk factors (Briend et al., 2015; Sadler et al., 2022; Thurstans et al., 2022). Underlying factors that are associated with contexts of poverty and resource-constrained settings, such as poor maternal nutrition, low birthweight, and poor feeding practices, have been associated with both wasting and stunting among children (Schoenbuchner et al., 2019; Thurstans et al., 2022). As both wasting and stunting are mainly driven by factors that are associated with poverty and low socioeconomic status, there is potential for 4Ps conditionalities and entitlements to support the social determinants of health among households experiencing poverty to prevent wasting and stunting among children.

## 1.6 Study rationale and objectives

While some previous research has assessed the effects of unconditional cash transfers on acute undernutrition in children (Asfaw et al., 2017; Bliss et al., 2018; Fenn et al., 2015; Grellety et al., 2017; Houngbe et al., 2019; Langendorf et al., 2014), there has been limited investigation into the associations between conditional cash transfers, including 4Ps, and acute undernutrition in children. Further, the mixed results on the relationship between 4Ps and chronic undernutrition, in addition to the exclusion of the poorest households in previous evaluations of 4Ps, provides further motivation for subsequent study into the association between 4Ps and chronic undernutrition in children. Additionally, limited research has considered the potential relationship between 4Ps and both acute and chronic undernutrition in the same study population (Cho et al., 2020). To address these limitations of previous research, a cross-sectional study can provide a preliminary and foundational understanding of the potential relationship between 4Ps and undernutrition in children, which can provide direction for future research.

The conditionalities and entitlements of 4Ps have the potential to provide households experiencing extreme poverty with the income and resources to prevent wasting and stunting in children. Thus, the first objective of this thesis was to compare the sociodemographic characteristics of children (6 months to 12 years of age) according to household enrollment in 4Ps. To achieve this objective, descriptive statistics (frequency, proportion, mean, standard deviation) were calculated to characterize the sociodemographic factors of children, and estimates between groups were compared using the Wilcoxon rank sum test, chi-square test, and Fisher's exact test. Descriptive statistics were calculated to determine the differences in sociodemographic characteristics between children in households enrolled and not enrolled in 4Ps to understand patterns in sociodemographic factors that may contribute to the association between 4Ps with the nutritional status of children. Moreover, calculating these descriptive statistics is important as delayed updates in *Listahanan* may introduce differences between children in households enrolled and not enrolled in 4Ps. The second objective of this thesis was to examine whether household enrollment in 4Ps was associated with the odds of wasting status and stunting status among children experiencing extreme poverty in the Philippines using multilevel regression modelling. Multilevel regression modelling was conducted to assess the association between 4Ps and the nutritional status of children while controlling for known confounders and potential effect moderators that may influence the relationship between these variables.

## 1.7 Overview of research methodologies and approach

This study was conducted in partnership with International Care Ministries (ICM), which is a non-governmental organization based in the Philippines. Cross-sectional data were drawn from ICM's operational surveys to conduct secondary analysis. At the time data were collected (2018-19), ICM implemented poverty alleviation and nutritional interventions across 10 regional bases in the Visayas (central island group) and Mindanao (south island group) with households experiencing extreme poverty. Data were cleaned and managed in consultation with ICM staff. Descriptive statistics (frequencies, proportions, means, and standard deviation) were examined to compare sociodemographic information of children. Multilevel logistic regression were conducted to examine the association between household enrollment in 4Ps and wasting and stunting status among children while controlling for known confounders and effect moderators.

## 1.8 Positionality statement

The inequitable power dynamics in global health research and the need to decolonise practices within this discipline have been emphasized in the literature (Abimbola et al., 2021; Büyüm et al., 2020; Khan et al., 2021). A step towards challenging power dynamics within existing research approaches is through practicing reflexivity and recognizing one's positionality in relation to the research agenda and priorities (Walt et al., 2008). While this has been widely practiced in qualitative research, limited quantitative studies have included this consideration (Jafar, 2018). As this research is situated within global health and relates to the health outcomes of children experiencing poverty, it is relevant to reflect on the ways through which my own personal background and experiences have shaped this research. In order to identify and reflect on my positionality, I recognize that the following aspects have influenced this research: 1) my personal identity, 2) my relationship to the research topic and study sample, and 3) the research context and process (Holmes, 2020; Savin-Baden & Howell-Major, 2013).

I entered the MSc program after having recently completed my undergraduate degree in Health Studies at the University of Waterloo. Although I had previous experiences working with Dr. Warren Dodd, I was a novice researcher in the area of global health, international development, and quantitative methodologies. As I had basic background knowledge and skills in these areas, I significantly benefitted from the help and guidance provided by my supervisor, thesis committee members, and our organizational partners.

This work was also informed by my personal identity as a first-generation immigrant of Filipino ethnicity with relatively stable financial status. I moved to Toronto from Manila with my family at the age of 15. As I came to understand the systemic and political factors that informed my parents' decision to emigrate out of the Philippines, I realized that we held the privilege of affording the financial and economic costs of leaving a societal context where institutions meant to serve the public interest did not appropriately do so. My interest in international development grew from recognizing the intersections between this privilege and the complex structural factors that formed my experiences. Subsequently, I was drawn to global health, which harmonized both my interests in public health and my curiosity about the broader contexts and settings in which experiences of health and wellbeing are shaped. My personal identity and experiences, therefore, have influences on my

perspectives on the government institutions and political structures in the Philippines, topic areas in which this research is based.

The research topic of this study emerged due to the COVID-19 pandemic and the availability of secondary data that could be applicable towards an MSc thesis while being mindful of the research priorities of our organizational partner (International Care Ministries). While previous courses have provided me with background knowledge in public health nutrition and food security, I had limited experience conducting independent research on this topic. My own interests in food systems, health, and nutrition, alongside hearing stories from my mom about her previous experiences working with children who were undernourished in the Philippines, became a point of closer personal connection. Moreover, having grown up in Manila during my childhood and adolescence, my perceptions on populations experiencing poverty have undoubtedly been shaped by living in a context where vivid and stark inequity was almost accepted as the norm and often remained unquestioned. As such, my understanding of the health outcomes of populations experiencing poverty have required me to reflect on my biases and assumptions to limit the influence on this research.

Lastly, it is important to note the research process and context in which this work was conducted. As the COVID-19 pandemic restricted international travel, all of the work that I completed for this study (i.e., data cleaning, exploratory analyses, regression modelling, thesis writing) was conducted remotely from the Philippines, mostly in Mississauga, Canada, which is part of the Treaty Lands and Territory of the Mississaugas of the Credit. Moreover, this study was made possible through my enrollment as a student at the University of Waterloo, which is situated in the traditional territory of the Neutral, Anishinaabeg and Haudenosaunee peoples. The main campus is situated on the Haldimand Tract, the land granted to the Six Nations that includes six miles on each side of the Grand River. While the physical context where I worked and studied was vastly different from where the data were collected and where the research topic was situated, I was prompted to reflect on my identity as an immigrant settler which led to a broader understanding of the shared colonial history between these places. I recognize that my positionality and privilege as an immigrant settler in what is now known as Canada has influenced my understanding of this research.

Moreover, this research project was based on secondary data analysis of monitoring and evaluation data collected shared by our organizational partner in the Philippines. Having been unable to travel to the Philippines, I have relied on anecdotal accounts and operational guideline documents

from our organizational partner to gain an understanding of the context from which the data were collected and organized. As such, I recognize that I do not have a true understanding of the context where this data were collected and have not worked directly with participants who provided data for this study. In addition, the partnership with International Care Ministries required me to be thoughtful about meaningful and reciprocal collaboration as a graduate student undergoing training at a Canadian institution working together with a non-governmental organization that operates in the Philippines.

I recognize that the above factors have influenced the planning, analysis, and overall messages of this thesis. Throughout the completion of this project, I have aimed to practice reflexivity to recognize how my own personal biases have shaped this study. I recognize that the opportunity to engage in this work was afforded to me by the privileges I hold, which are founded on and upheld by systems of inequity and histories of colonisation. Beyond this thesis, I commit to challenging these structures through the work and research I hope to continue pursuing in global health.

# Chapter 2
# Examining the relationship of the *Pantawid Pamilyang Pilipino Program* (4Ps) with wasting and stunting status among children experiencing poverty in the Philippines: a cross-sectional study

## 2.1 Introduction

In the Philippines, minimal improvements have been made in addressing wasting and stunting in children, which are the two main indicators of acute and chronic undernutrition (Capanzana et al., 2020; Global Nutrition Report, 2020; Mbuya et al., 2021). While the country experienced steady economic growth between 2010 to 2019 (World Bank, 2021a), an estimated 17.6 million Filipinos continue to have insufficient resources to meet their daily needs (Philippine Statistics Authority, 2019). Further, widening income inequality in the Philippines contributes to a disproportionate burden of poor health outcomes among people experiencing poverty. The most recent data available from the 2018 Expanded National Nutrition Survey indicated that the prevalence of wasting and stunting was highest among households in rural areas and in the poorest income quintiles (DOST-FNRI, 2020). Among children under 5 years of age, the prevalence of wasting in the poorest quintile was 8%, compared to 4% among the wealthiest quintile (DOST-FNRI, 2020). The estimates are similar for children under 5 years of age who are stunted, where prevalence was 46% among the poorest groups, compared to 13% in the wealthiest groups (DOST-FNRI, 2020). Geographically, the prevalence of wasting was 7% in rural settings compared to 5% in urban areas, while the prevalence of stunting was 34% in rural settings and 26% in urban areas (DOST-FNRI, 2020). Overall, these consistent patterns indicate that socioeconomic status and geography are critical correlates of undernutrition among children in the Philippines.

To support poverty alleviation among populations in the lowest income levels in the Philippines, the *Pantawid Pamilyang Pilipino Program* (4Ps) was launched in 2007 and has become the main social protection and welfare program in the country. Led by the Department of Social Welfare and Development (DSWD), 4Ps is a conditional cash transfer program that aims to improve health and educational outcomes within low-income households (DSWD, 2008, 2019b). The target population for 4Ps is identified through *Listahanan*, a registry compiled by the DSWD (DSWD, 2019b). Household eligibility is assessed through a proxy means test (PMT), a statistical model that uses proxy indicators of a household's income to determine the household's poverty level. Households are included in *Listahanan* if they meet a cut-off threshold level of poverty based on the results of the

PMT (DSWD, 2019b; Fernandez, 2012). Additional household eligibility requirements for 4Ps enrollment include living in a poor geographic area as estimated by the Family Income and Expenditure Survey, and either having a child of 0-18 years of age or a woman who is pregnant in the household (Orbeta et al., 2014; Peñalba, 2019). Upon meeting eligibility criteria and completing program requirements, households enrolled in 4Ps are entitled to receive cash transfers, food assistance, and health and educational grants (see Figure 2.1) (DSWD, 2008, 2019b).

These program conditionalities and entitlements have the potential to address the underlying determinants of children's nutritional outcomes such as supporting food security, increasing the use of maternal and child healthcare services, and improving caregivers' knowledge and awareness around health and nutritional practices (de Groot et al., 2017; Leroy et al., 2009). Indeed, the Theory of Change for 4Ps demonstrates the pathways through which different program components (conditionalities and entitlements) could potentially lead to improvements in child nutritional outcomes within recipient households (see Figure 2.2). Overall, a combination of both the conditionalities and entitlements are expected to provide families with the resources to cope with extreme shocks as well as attain resources to create healthy environments that are supportive of children's growth and development.

The potential impact of 4Ps on the nutritional outcomes of children has previously been identified and evaluated (Cho et al., 2020; Kandpal et al., 2016; Orbeta et al., 2014, 2021). Recognizing that wasting is associated with sudden shocks of food insecurity and illness (e.g., associated with extreme weather events, conflict, displacement), there have been opportunities to leverage 4Ps to address emergency situations and mitigate negative health outcomes among affected populations. For example, during the emergency response to Typhoon Haiyan (2013), the 4Ps targeting system (*Listahanan*) was used by the World Food Programme and UNICEF to identify households in need of assistance (Aldaba, 2019; Bowen, 2016). In addition, to better respond to the needs of enrolled households, 4Ps developed a provision that suspended the requirement to meet conditionalities for a period of three months during disasters and calamities (Bowen, 2016).

The association between 4Ps and stunting status has also been previously explored. Stunting, a chronic condition of undernutrition, continues to be prevalent in the Philippines due to consistent poverty that leads to poor prenatal conditions, insufficient food security and diversity, and inadequate water, sanitation and hygiene practices in the household environment (Capanzana et al., 2020). Mixed

15

results have been observed in relation to 4Ps impact on stunting among children. A previous randomized controlled trial using data from 2011 indicated that 4Ps was associated with lower stunting rates among children in communities where 4Ps was implemented compared to communities where 4Ps was not implemented (Kandpal et al., 2016). Severe stunting was observed to be lower by 10.2% among children in households that were enrolled in 4Ps compared to children in households not enrolled in 4Ps. However, follow up evaluations of 4Ps in 2013 and 2017 did not show that 4Ps was effective towards addressing stunting (Orbeta et al., 2014; Orbeta et al., 2021). In contrast to earlier findings, the most recent impact evaluation produced by the DSWD indicated that children in households enrolled in 4Ps were more likely to be stunted compared to children who were not enrolled in 4Ps (Orbeta et al., 2021). Notably, these evaluations were unable to capture the effect of 4Ps on the poorest households because of limitations in evaluation and study design (Cho et al., 2020; Kandpal et al., 2016).

While some previous research has assessed the effects of unconditional cash transfers on acute undernutrition in children (Asfaw et al., 2017; Bliss et al., 2018; Fenn et al., 2015; Grellety et al., 2017; Houngbe et al., 2019; Langendorf et al., 2014), there has been limited investigation into the associations between conditional cash transfers, including 4Ps, and acute undernutrition in children. Further, the mixed results on the relationship between 4Ps and chronic undernutrition, in addition to the exclusion of the poorest households in previous evaluations of 4Ps, provides further motivation for subsequent study into the association between 4Ps and chronic undernutrition in children. Additionally, limited research has considered the potential relationship between 4Ps and both acute and chronic undernutrition in the same study population (Cho et al., 2020). To address these limitations of previous research, a cross-sectional study can provide a preliminary and foundational understanding of the potential relationship between 4Ps and undernutrition in children, which can provide direction for future research.

Overall, 4Ps has the potential to improve acute and chronic undernutrition outcomes among children in the Philippines. However, previous evaluations provide mixed results in terms of 4Ps responsiveness to address shocks associated with wasting, as well as the ability of 4Ps to sustainably provide households with the resources to prevent stunting. As such, this study had two objectives: 1) to compare the characteristics of children (6 months to 12 years of age) according to household enrollment in 4Ps; and 2) to examine whether household enrollment in 4Ps was associated with the wasting status and stunting status among children experiencing extreme poverty in the Philippines.
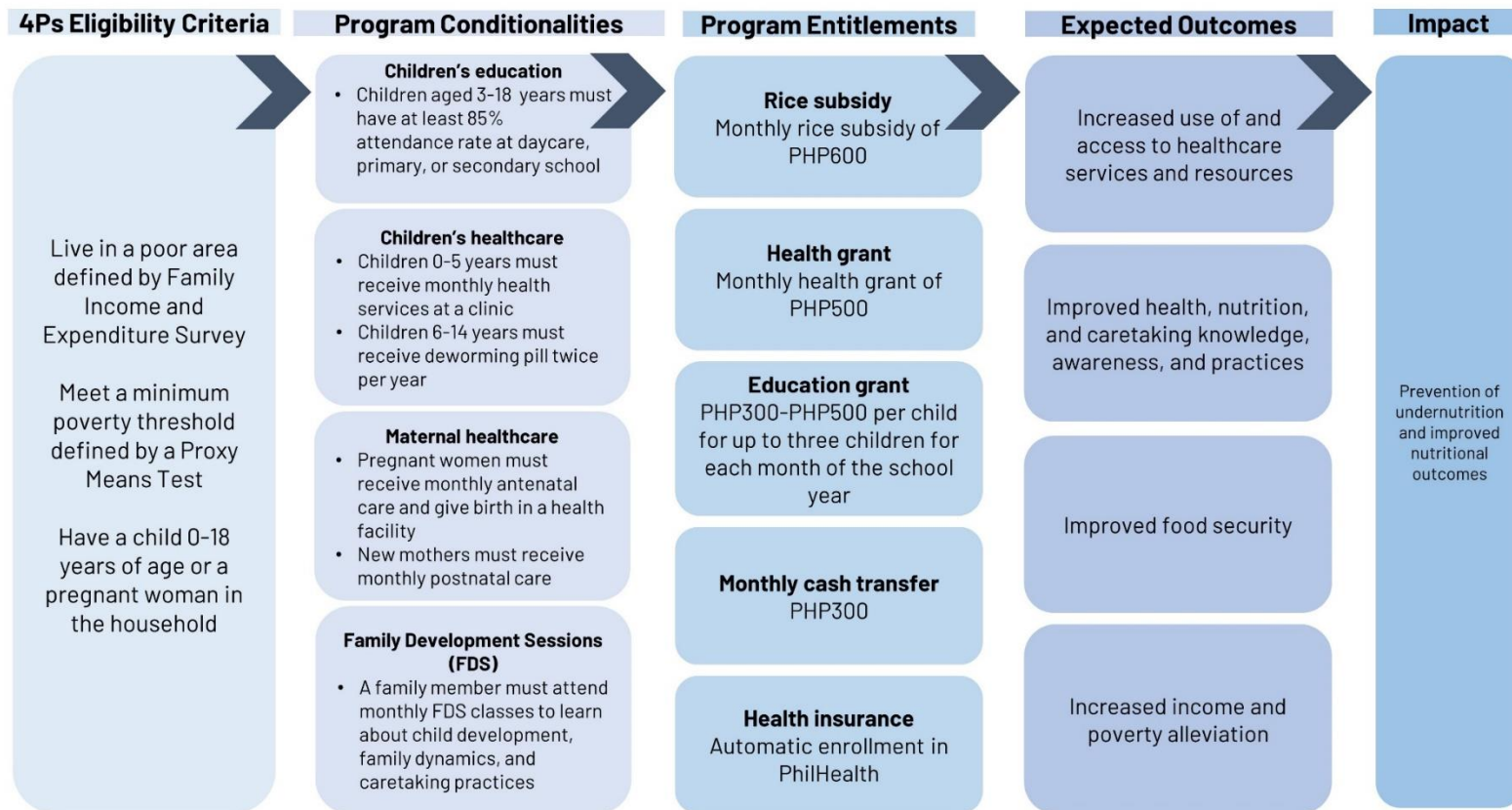
**Figure 2.1.** Program conditionalities. entitlements, expected outcomes, and potential impact on children's nutritional status of the *Pantawid Pamilyang Pilipino Program* (4Ps) (adapted from Dodd et al., 2022 and Cho et al. 2020)

The Family Income and Expenditure Survey is one of the sources of data for poverty estimation in the Philippines and is conducted by the National Statistics Office every three years (DSWD. 2008). The Proxy Means Test is a statistical model where a collection of indicators are used to determine a household's level of poverty (DSWD, 2019b). PhilHealth is the National Health Insurance Program of the Philippines
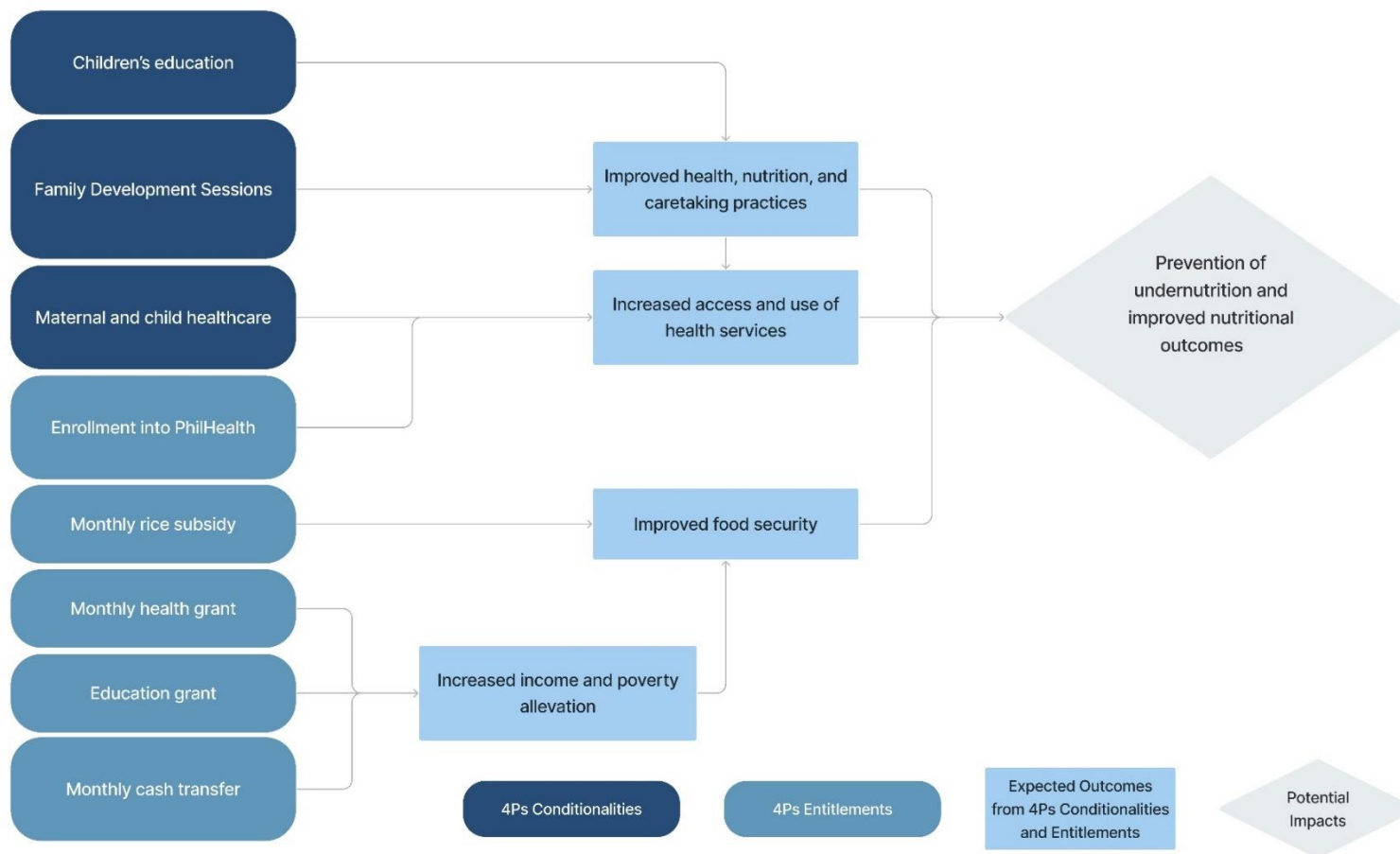
**Figure 2.2** Conceptual model of the conditionalities, entitlements, expected outcomes, and potential impacts on child nutrition of the *Pantawid Pamilyang Pilipino Program* (4Ps) (adapted from Cho et al., 2020)

PhilHealth is the National Health Insurance Program of the Philippines for which 4Ps participants receive free healthcare services.

4Ps, *Pantawid Pamilyang Pilipino Program*

## 2.2 Methods

### 2.2.1 Study setting, context, and partnership

This study was conducted in partnership with International Care Ministries (ICM), a non-governmental organization (NGO) based in the Philippines. ICM works with households experiencing extreme poverty, operationally defined as households that earn less than $0.50USD or ₱22PHP per person per day. The organization works across the Visayas (central island group) and Mindanao (southern island group) regions within resource-constrained communities and slums. As part of its poverty alleviation programming, ICM addresses child undernutrition by conducting anthropometric screening of children and providing a nutritional home-based feeding program for children who are identified as acutely undernourished (Lau et al., 2020). The data used for this study were collected as part of the routine monitoring and evaluation activities.

### 2.2.2 Study design, sample population, and data collection

This study was a secondary data analysis of cross-sectional baseline household survey data collected through ICM's routine monitoring and evaluation activities between May 2018-April 2019. ICM uses an asset-based poverty score card to determine a household's eligibility to participate in its poverty alleviation program. As such, the sample in this study is not randomly selected and is based on a minimum level of poverty as determined by ICM's poverty assessment. Although the population is not a random sample, ICM's targeting mechanism and eligibility criteria is similar to that of the 4Ps *Listahanan*, wherein household eligibility is determined according to a poverty score (Dodd et al., 2022). As such, households who participate in ICM's programming have a similar sociodemographic profile to households who are eligible to be included in *Listahanan*.

To collect baseline data, trained surveyors interviewed a representative of the household about the demographic and socioeconomic characteristics of the household. The household representative responded to questions on behalf of their household and other household members. Informed oral consent was acquired from respondents prior to survey administration, and only respondents who provide consent were surveyed. In households with children 12 years of age and under, anthropometric measures were collected by health trainers who measured children's weight using a weighing scale, and children's length/height were measured using an Allen stick (Gordoncillo et al., 2019; Talavera et al., 2021). Recumbent length was measured among children under 2 years of age, and standing height was measured among children 2 years and over.

Data were merged, cleaned, and reviewed in consultation with ICM staff (see Appendix A). Children who were under 6 months and over 12 years of age, had incomplete sociodemographic information, or had extreme outliers (weight-for-height, BMI-for-age, and height-for-age z-scores > 6 or < -6) were excluded from the final dataset (see Table 2.1).

This study was reviewed and approved by the University of Waterloo Office of Research Ethics (Appendix B) (ORE #43368)**.**

**Table 2.1.** Summary of data cleaning and study participant exclusion from merging ICM's poverty alleviation and nutrition interventions operational data

| Exclusion criteria | Number of children excluded |
|---|---|
| Different households[a] | 80 |
| Age of child > 12 years | 50 |
| Age of child < 6 months | 74 |
| Sex of child is missing | 53 |
| Geography type is missing | 24 |
| Age of parent is missing | 12 |
| WHZ <- 6 | 0 |
| WHZ > 6 | 13 |
| BAZ < -6 | 0 |
| BAZ > 6 | 23 |
| HAZ <- 6 | 62 |
| HAZ > 6 | 25 |
| Total | 416[b] |

WHZ, weight-for-height z-score; BAZ, BMI-for-age z-score; HAZ, height-for-age z-score

[a] As children can be registered in ICM nutrition programming by community members other than their parents (i.e., aunt, uncle, neighbor, cousin), these children were excluded from the analysis as they may not belong to the same household as the main participant who brought them to the nutritional screening sessions. As such, the sociodemographic information provided may not be reflective of the child's household.

[b] The total does not equal 396 as more than one exclusion criteria could apply to a child.

### 2.2.3 Variables of interest

*Dependent variables*

Wasting status and stunting status were the two main dependent variables in this study. Wasting status and stunting status were used as binary outcome variables for two different regression models. Wasting status was determined using the weight-for-height (WHZ) and BMI-for-age (BAZ) of children, which were calculated using measured weight and height. Stunting status was determined using the height-for-age (HAZ) of children using the measured height. The calculation of WHZ, BAZ, and HAZ used the World Health Organization (WHO) Reference Growth Standards for children under 5 years of

age and 5-19 years of age, respectively and using the zscorer package in R (Myatt & Guevarra, 2019; World Health Organization, 2006). As per the WHO child growth standards, children with a WHZ of <-2 and a BAZ of <-2 were categorized as wasted, and children with a HAZ of <-2 were categorized as stunted.

*Independent variable*

The main independent variable of interest was household enrollment in 4Ps, which was measured as a binary self-reported response variable from the ICM survey. Households enrolled in 4Ps are required to complete various health and education related conditionalities in order to receive monetary cash transfers (see Figure 2.1) (Cho et al., 2020; DSWD, 2019a). First, the conditionalities include monthly antenatal and postnatal care which could improve the developmental growth of infants and young children (Acosta & Velarde, 2015; Cho et al., 2020). Second, 4Ps participants are required to attend monthly Family Development Sessions which cover topics on health and wellbeing, family dynamics and parenting, and awareness on community and social issues (Acosta & Velarde, 2015; Asian Development Bank, 2020; Cho et al., 2020; Peñalba, 2019). Upon completion of these conditionalities, 4Ps participants are entitled to benefits (i.e., cash transfers, food subsidies) that could also provide additional support towards accessing health services, purchasing food items, and improve housing and sanitation facilities (Acosta & Velarde, 2015; Cho et al., 2020).

*Covariates*

Control variables were included in the analysis to consider potential confounding effects. The identification of variables to be included in the analysis was informed by the UNICEF Framework on the determinants of child undernutrition as well as the implementation of 4Ps (Cho et al., 2020; UNICEF, 2013). The sex and age of children were included to control for individual-level and biological factors that may confound the relationship between 4Ps enrollment and the nutritional outcomes of children. The age and sex of children may affect the odds of being stunted or wasted, as intra-household dynamics influence the resources received by children in the household (Javier et al., 2015). Further, the most recent round of the National Nutrition Survey in the Philippines identified that the prevalence of stunting and wasting was higher among infants and young children compared to older children (DOST-FNRI, 2020). The age of a child may also influence the type of conditionalities that households enrolled in 4Ps are required to meet and the entitlements that the household receives, as the health and educational requirements for children are age-dependent (Peñalba, 2019).

Household sociodemographic variables including the education of the household head, the age of the household head, and the number of household members were included to control for confounding effects of household characteristics. First, parents who are older and who have more years of education have been seen to be protective against stunting and wasting, as these characteristics may contribute to stronger health and nutritional caretaking practices (Ieiri et al., 2020; Khan et al., 2019). In addition, larger households have been associated with increased likelihoods of wasting and stunting in children given the need to redistribute resources within the household, which may limit the appropriate level of nutritional requirements for all children (Ieiri et al., 2020; Khan et al., 2019; Wolde et al., 2015).

Additional variables were also included in the analysis to account for the influence of wealth and food insecurity on the relationship between 4Ps and wasting and stunting. First, the wealth status of households was included in the analysis as the cash transfers from 4Ps may increase household income and assets. Moreover, higher socioeconomic status is associated with having lower risks for undernutrition (Charmarbagwala et al., 2004; Pongou et al., 2006). As such, increasing financial resources within the household could potentially be associated with reducing the odds of wasting and stunting. Additionally, the food insecurity status of households was also included in the analysis as food and cash transfers received from 4Ps may contribute to improved food security in the household that could subsequently support the nutritional outcomes in children. In addition, food insecurity is one of the direct drivers of wasting and stunting among children, and may also confound the relationship between 4Ps and wasting and stunting (Moradi et al., 2019). The wealth of the household was measured using a calculated Wealth Index score, while experiences of hunger and food insecurity were assessed using the Household Hunger Scale as described in the following section.

Lastly, geography type was included in the model as the distribution of wasting and stunting varies across different locations in the Philippines with increased prevalence of wasting and stunting in rural areas (Capanzana et al., 2018; DOST-FNRI, 2020). In addition, an interaction term between geography type and household enrollment in 4Ps was included because the heterogeneous implementation of the program as well as varying experiences of 4Ps participants across different regions of the country (Conchada & Tiongco, 2014; Dodd et al., 2022; Peñalba, 2019) may moderate the effects of 4Ps in influencing stunting and wasting status among children.

*Additional measures*

**Wealth Index**

A Wealth Index was constructed using the asset-based and poverty-related indicators in the ICM dataset. The Wealth Index was constructed using principal component analysis and through adapting the methods outlined in the Demographic Health Survey (DHS) to produce a Wealth Index for this population (Rutstein & Johnson, 2004; Vyas & Kumaranayake, 2006). The Wealth Index is the key proxy measure for household socioeconomic status because of the availability of asset-based indicators in household surveys such as the DHS and the Multiple Indicator Cluster Surveys (Poirier et al., 2020; Vyas & Kumaranayake, 2006).

The indicators included in the Wealth Index for this study consisted of appliance (television, radio, electric fan, phone, motorcycle) and furniture (bed) ownership, as well as housing materials (roof, flooring, walls) and structures (size, ownership status, water supply source, toilet type, electricity). The first principal component loadings, which estimated 16.0% of the variance (eigenvalue =4.006), were used to calculate a weighted Wealth Index score for each household (Vyas & Kumaranayake, 2006). The Wealth Index was evaluated to ensure internal coherence and construct validity of the measure (see Appendix C).

**Household Hunger Scale**

The hunger and food insecurity related questions in the ICM dataset were adapted from the Household Hunger Scale (HHS), which was developed from the Household Food Insecurity Access Scale (HFIAS) by the US Agency for International Development (Ballard et al., 2011; Leroy et al., 2015). The HHS captures the universal experiences of the quantity dimension of food security by assessing the severe experiences of food shortage and actual experiences with hunger. The HHS was developed for the purpose of monitoring and evaluation as well as to produce comparable results across contexts (Leroy et al., 2015).

Respondents were asked three questions related to hunger and food insecurity status of their household: 1) Over the last month, did your household go a whole day and night without eating?; 2) Over the last month, did your household have no food to eat of any kind?; and 3) Over the last month, did your household go to sleep at night hungry? For each of these questions, respondents selected one of six responses with assigned values (see Appendix D). The values were summed for each of the three questions and each household received a score ranging from 0 to 6. The score was categorized into three

indicators: 1) little to no hunger in the household (0-1); 2) moderate hunger in the household (2-3); and 3) severe hunger in the household (4-6).

### 2.2.4 Statistical analyses

*Descriptive statistics*

Descriptive statistics were calculated to determine the differences in sociodemographic characteristics of children in households enrolled and not enrolled in 4Ps to provide insight into the patterns in sociodemographic factors through which 4Ps may potentially be associated with the nutritional status of children. Moreover, calculating these descriptive statistics is important as delayed updates in *Listahanan* may introduce differences between children in households enrolled and not enrolled in 4Ps. For categorical variables, the frequency and proportion were calculated, while for continuous variables, the mean and standard deviation were calculated to characterize the sociodemographic characteristics of children included in the study. To compare the sociodemographic factors between children in households enrolled and not enrolled in 4Ps as well as children with and without wasting and stunting, continuous variables were tested using Wilcoxon rank sum test, while categorical variables were tested using Pearson's chi-square test and Fisher's exact test. Overall, 95% confidence intervals were calculated for continuous variables and a p-value of <0.05 was used to determine statistical significance and assess differences between groups. No adjustments were made for multiple testing.

*Regression modelling*

As participants in the study resided across multiple ICM regional bases in the Visayas and Mindanao regions of the Philippines, this study used multilevel mixed-effects regression modelling to account for unique geographical factors and potential clustering effects (Raudenbush & Bryk, 2002). Two separate multilevel logistic regression models were conducted to model the association of household enrollment in 4Ps (*ref*: not enrolled in 4Ps) on wasting status (*ref*: not wasted) and stunting status (*ref*: not stunted), respectively, while controlling for sociodemographic factors that were theorized to confound or moderate the relationship between 4Ps and the nutritional status of children (see Table 2.2). Guided by the Theory of Change of 4Ps, the reference categories were determined by the intention to model the category of the independent variable (enrolled in 4Ps) that is theorized to be associated with the dependent variable of interest (a child with wasting or a child with stunting). Models were fitted using maximum likelihood

estimation and analyses were conducted using the lme4 package in R Version 4.1.0 (Bates et al., 2015; R Core Team, 2021).

In the multilevel models, individual children and their household characteristics formed level 1, while specific ICM regional bases formed level 2. Analyses also examined a two-level model to account for within-household clustering through grouping by the household level using unique household level identifiers. A three-level model was also examined wherein through grouping households within regional bases. However, both models did not converge and indicated poor model fit, which may indicate that there is limited heterogeneity among households in the dataset. Additionally, the theory-driven models were interested in accounting for geographical heterogeneity and variation between the relationship in 4Ps enrollment and wasting and stunting status. As such, the multilevel models were not grouped according to households and two-level regression models grouped by regional bases were conducted.

Regression modelling was conducted by first examining an intercept-only model, followed by models that included main effects and interaction effects. Model 1 is the intercept-only model with no explanatory variables, and the Intraclass Correlation Coefficient (ICC) was calculated to determine the proportion of the variance in wasting status and stunting status that was attributable to differences between regional bases. Model 2 is the random intercept model with main effects, while Model 3 is the random intercept model including main effects and interaction effects between household enrollment in 4Ps and geography type. An additional two models were analysed where the continuous variables were standardized as preliminary modelling indicated that rescaling variables improved model fit and convergence (Model 4 and 5).

Deviance statistics for a likelihood-ratio test and the Akaike Information Criterion (AIC) were calculated to determine the most appropriate model for interpretation. The likelihood-ratio test calculates a deviance statistic for the null and hypothesized model to determine the importance of additional fixed effects to improve model fit (Raudenbush & Bryk, 2002). A higher deviance statistic indicates poorer model fit. The AIC measures a model's goodness of fit that is a function of the likelihood function adjusted for the number of fixed effect variables in the model (Hox et al., 2018), penalizing models with additional predictors that do not sufficiently contribute to the model's fit. A smaller AIC indicates better model fit. Model selection was first informed by the likelihood-ratio test to determine the model with lowest deviance. Subsequently, the AIC of the models were reviewed to confirm selection of the model with the smallest AIC value.

Statistical significance was determined using a p-value of 0.05 and 95% confidence intervals for the log-odds estimates were calculated with no adjustment made for multiple testing. The log-odds estimates and confidence intervals for the models selected for interpretation were converted to the unstandardized value before exponentiating to interpret the corresponding odds ratios. The hypothesized models for the regression analysis are specified below. Binned residual plots were constructed wherein predicted probabilities were plotted against average residual values of binned observations to assess model fit (Gelman & Hill, 2007).

Model 1:
$$\eta_{ij} = \gamma_{00} + \mu_0$$

Model 2:
$$\eta_{ij} = \gamma_{00} + \gamma_{01}GEOGTYPE_j + \gamma_{10}SEX_{ij} + \gamma_{20}AGE_{ij} + \gamma_{30}WI_{ij} + \gamma_{40}HHAGE_{ij} + \gamma_{50}HHED_{ij} + \gamma_{60}MEM_{ij} + \gamma_{70}FOOD_{ij} + \gamma_{80}4P_{ij} + \mu_0$$

Model 3:
$$\eta_{ij} = \gamma_{00} + \gamma_{01}GEOGTYPE_j + \gamma_{10}SEX_{ij} + \gamma_{20}AGE_{ij} + \gamma_{30}WI_{ij} + \gamma_{40}HHAGE_{ij} + \gamma_{50}HHED_{ij} + \gamma_{60}MEM_{ij} + \gamma_{70}FOOD_{ij} + \gamma_{80}4P_{ij} + \gamma_{81}4P_{ij} * GEOGTYPE_j + \mu_0$$

Model 4:
$$\eta_{ij} = \gamma_{00} + \gamma_{01}GEOGTYPE_j + \gamma_{10}SEX_{ij} + \gamma_{20}\frac{AGE_{ij} - \overline{AGE}}{\sigma_{AGE}} + \gamma_{30}\frac{WI_{ij} - \overline{WI}}{\sigma_{WI}} + \gamma_{40}\frac{HHAGE_{ij} - \overline{HHAGE}}{\sigma_{HHAGE}} + \gamma_{50}\frac{HHED_{ij} - \overline{HHED}}{\sigma_{HHED}} + \gamma_{60}\frac{MEM_{ij} - \overline{MEM}}{\sigma_{MEM}} + \gamma_{70}FOOD_{ij} + \gamma_{80}4P_{ij} + \mu_0$$

Model 5:
$$\eta_{ij} = \gamma_{00} + \gamma_{01}GEOGTYPE_j + \gamma_{10}SEX_{ij} + \gamma_{20}\frac{AGE_{ij} - \overline{AGE}}{\sigma_{AGE}} + \gamma_{30}\frac{WI_{ij} - \overline{WI}}{\sigma_{WI}} + \gamma_{40}\frac{HHAGE_{ij} - \overline{HHAGE}}{\sigma_{HHAGE}} + \gamma_{50}\frac{HHED_{ij} - \overline{HHED}}{\sigma_{HHED}} + \gamma_{60}\frac{MEM_{ij} - \overline{MEM}}{\sigma_{MEM}} + \gamma_{70}FOOD_{ij} + \gamma_{80}4P_{ij} + \gamma_{81}4P_{ij} * GEOGTYPE_j + \mu_0$$

Wasting model: where $\eta_{ij} = logit(P_i) = log\left(\frac{P_i}{1-P_i}\right)$, $P_i = Pr(\eta_{ij} = 1 \; wasted)$, for child $i$ in regional base $j$

Stunting model: where $\eta_{ij} = logit(P_i) = log\left(\frac{P_i}{1-P_i}\right)$, $P_i = Pr(\eta_{ij} = 1 \; stunted)$, for child $i$ in regional base $j$

**Table 2.2.** Summary of dependent variables, independent variables, and covariates included in analysis to examine the relationship between household enrollment in the *Pantawid Pamilyang Pilipino Program* and wasting and stunting status in children (6 months-12 years)

| Dependent variables | Variable type | Definition/Measure |
|---|---|---|
| Wasting status | Binary | Not wasted: Children 6-59 months: WHZ $\geq$ -2 or Children 60-144 months: BAZ $\geq$ -2 *(reference)* <br> Wasted: Children 6-59 months: WHZ < -2 or Children 60-144 months: BAZ < -2 |
| Stunting status | Binary | Not stunted: HAZ $\geq$ -2 *(reference)* <br> Stunted: HAZ < -2 |
| **Independent variable** | | |
| Household enrollment in 4Ps | Binary | Not enrolled in 4Ps *(reference)* <br> Enrolled in 4Ps |
| **Covariates** | | |
| Age of child | Continuous | Months |
| Sex of child | Binary | Female *(reference)* <br> Male |
| Age of household head | Continuous | Years |
| Education of household head | Continuous | Years |
| Number of household members | Continuous | Number of individuals in household |
| Level of food insecurity and hunger | Categorical | HHS = 0-1: Little to no hunger *(reference)* <br> HHS = 2-3: Moderate hunger <br> HHS = 4-6: Severe hunger |
| Wealth | Continuous | Wealth Index score |
| Geography type of residence | Categorical | Costal *(reference)* <br> Urban mountain <br> Urban plain <br> Rural mountain <br> Rural plain |

4Ps=*Pantawid Pamilyang Pilipino Program*; HHS=Household Hunger Scale; WHZ=weight-for-height z-score; BAZ=BMI-for-age z-score; HAZ=height-for-age z-score

## 2.3 Results

### 2.3.1 Characteristics of children in the study sample

A total of 3,401 screened children were included in this study. After data cleaning, the analytic sample consisted of 3,005 children across 10 regional bases wherein ICM works (see Table 2.1). Overall, the sample was almost equally divided between male (n=1,569; 52.2%) and female (n=1,436; 47.8%) children with an average age of 60 months (SD=34.2) (see Table 2.3). The mean age of the household head was 38 years (SD=10.7) with a mean of 8.1 years of education (SD=3.6). The mean number of household members across the sample was 5.2 people (SD=1.8), with very few children having experienced severe (n=32; 1.1%) and moderate (n=294; 9.8%) hunger. Over half of the children in the sample were not enrolled in 4Ps (n=1,823; 60.8%). Overall, most children lived in rural mountain areas (n=1,322; 44.3%) with only a few children in the sample residing in urban slums (n=124; 4.1%). Across the different regional bases where ICM operated, Dipolog (n=519; 17.3%) had the largest number of children and Kalibo (n=95; 3.2%) had the fewest number of children in the sample.

Differences were observed between children in households enrolled in 4Ps and children in households not enrolled in 4Ps (see Table 2.4). On average, children in households enrolled in 4Ps were older (70 months; SD=36.4). Moreover, children in households enrolled in 4Ps belonged in households where the head of the household was older (41 years; SD=9.4) and had fewer years of education (7.7 years; SD=3.5). Children in households enrolled in 4Ps also belonged in larger households (5.91 members; SD=1.9) compared to households that were not enrolled in 4Ps (4.7 members; p=<0.001). No significant differences were observed between children in households enrolled and not enrolled in 4Ps in relation to the Wealth Index score and the Household Hunger Scale. Statistically significant differences were observed in the distribution of children across various geography types and different regional bases. Among the children in households enrolled in 4Ps, most were located in Dipolog (n=299; 25.3%), and among the children in households not enrolled in 4Ps, most were located in Koronadal (n=282; 15.5%).

**Table 2.3.** Sociodemographic characteristics of children included in the study to examine the relationship between household enrollment in the *Pantawid Pamilyang Pilipino Program* and wasting status and stunting status in children (6 months-12 years) (n=3005)

| Variable | n = 3,005 | | |
|---|---|---|---|
| | **n; Mean** | **95% CI** | **%; SD** |
| **Sex of child** | | | |
| Female | 1,436 | N/A | 47.79% |
| Male | 1,569 | N/A | 52.21% |
| **Age of child (months)** | 60 | (59, 62) | 34.19 |
| **Age of household head (years)** | 38 | (37, 39) | 10.74 |
| **Education of the household head (years)** | 8.1 | (7.9, 8.2) | 3.63 |
| **Number of household members** | 5.19 | (5.1, 5.3) | 1.81 |
| **Wealth Index score** | -1.00 | (-1.1, -0.94) | 1.79 |
| **Household Hunger Scale Category** | | | |
| Little to no hunger in household | 2,679 | N/A | 89.15% |
| Moderate hunger in household | 294 | N/A | 9.78% |
| Severe hunger in household | 32 | N/A | 1.06% |
| **Household Enrollment in 4Ps** | | | |
| No 4Ps | 1,823 | N/A | 60.76% |
| Has 4Ps | 1,182 | N/A | 39.33% |
| **Geography type of area of residence** | | | |
| Coastal | 336 | N/A | 11.18% |
| Urban mountain | 344 | N/A | 11.45% |
| Rural plain | 869 | N/A | 28.92% |
| Rural mountain | 1,332 | N/A | 44.33% |
| Urban slum | 124 | N/A | 4.13% |
| **Regional base** | | | |
| Bacolod | 194 | N/A | 6.46% |
| Bohol | 339 | N/A | 11.28% |
| Cebu | 174 | N/A | 5.79% |
| Dipolog | 519 | N/A | 17.27% |
| Dumaguete | 238 | N/A | 7.92% |
| General Santos | 367 | N/A | 12.21% |
| Iloilo | 281 | N/A | 9.35% |
| Kalibo | 95 | N/A | 3.16% |
| Koronadal | 395 | N/A | 13.14% |
| Palawan | 403 | N/A | 13.41% |

SD, standard deviation; CI, confidence interval; 4Ps, *Pantawid Pamilyang Pilipino Program*

**Table 2.4.** Descriptive statistics (frequency, proportion, mean, standard deviation) of household sociodemographic characteristics and geographic distribution of children (6 months-12 years) in households enrolled and not enrolled in the *Pantawid Pamilyang Pilipino Program* (n=3005)

| Variable | Has 4Ps N = 1,182 (39.33%) | | | No 4Ps N = 1,823 (60.67%) | | | p-value |
|---|---|---|---|---|---|---|---|
| | n; Mean | 95% CI | %; SD | n; Mean | 95% CI | %; SD | |
| **Sex of child** | | | | | | | 0.2 |
| Female | 581 | N/A | 49.15% | 855 | N/A | 46.90% | |
| Male | 601 | N/A | 50.85% | 968 | N/A | 53.10% | |
| **Age of child (months)** | 70 | (68, 72) | 36.39 | 54 | (53, 56) | 31.18 | **<0.001** |
| **Age of household head (years)** | 41 | (40, 41) | 9.43 | 36 | (36, 37) | 11.12 | **<0.001** |
| **Education of the household head (years)** | 7.7 | (7.5, 7.9) | 3.47 | 8.3 | (8.2 ,8.5) | 3.71 | **<0.001** |
| **Number of household members** | 5.91 | (5.8, 6.0) | 1.86 | 4.72 | (4.6, 4.8) | 1.62 | **<0.001** |
| **Wealth Index score** | -1.04 | (-1.1, -0.94) | 1.73 | -0.98 | (-1.1, -0.90) | 1.83 | 0.5 |
| **Household Hunger Scale Category** | | | | | | | >0.9 |
| Little to no hunger in household | 1,056 | N/A | 89.34% | 1,623 | N/A | 89.03% | |
| Moderate hunger in household | 114 | N/A | 9.64% | 180 | N/A | 9.87% | |
| Severe hunger in household | 12 | N/A | 1.02% | 20 | N/A | 1.10% | |
| **Geography type of area of residence** | | | | | | | **<0.001** |
| Coastal | 142 | N/A | 12.01% | 194 | N/A | 10.64% | |
| Urban mountain | 161 | N/A | 13.62% | 183 | N/A | 10.04% | |

30

| | | | | | | |
|---|---|---|---|---|---|---|
| Rural plain | 285 | N/A | 24.11% | 584 | N/A | 32.04% |
| Rural mountain | 556 | N/A | 47.04% | 776 | N/A | 42.57% |
| Urban slum | 38 | N/A | 3.21% | 86 | N/A | 4.72% |
| **Region of residence** | | | | | | <0.001 |
| Bacolod | 47 | N/A | 3.98% | 147 | N/A | 8.06% |
| Bohol | 92 | N/A | 7.78% | 247 | N/A | 13.55% |
| Cebu | 49 | N/A | 4.15% | 125 | N/A | 6.86% |
| Dipolog | 299 | N/A | 25.30% | 220 | N/A | 12.07% |
| Dumaguete | 76 | N/A | 6.43% | 162 | N/A | 8.89% |
| General Santos | 153 | N/A | 12.94% | 214 | N/A | 11.74% |
| Iloilo | 107 | N/A | 9.05% | 174 | N/A | 9.54% |
| Kalibo | 23 | N/A | 1.95% | 72 | N/A | 3.95% |
| Koronadal | 113 | N/A | 9.56% | 282 | N/A | 15.47% |
| Palawan | 223 | N/A | 18.87% | 180 | N/A | 9.87% |

SD, standard deviation; CI, confidence interval; 4Ps, *Pantawid Pamilyang Pilipino Program*

The proportion of wasting in the sample was 9.3% (n = 280) and the proportion of stunting was 49.9% (n = 1,500) (see Table 2.5 and Table 2.6). Among the children with wasting, 6.4% and 2.5% experienced moderate and severe hunger, respectively, compared to 10% and 0.9% (p-value=0.009) of children who were not wasted. In addition, the majority of children who were wasted lived in Dipolog (n=49; 17.5% of all wasted children in the sample), with the smallest proportion of wasted children residing in Cebu (n=10; 3.6%).

Children who were stunted lived in households where the household head had fewer years of education (7.7 years; SD=3.7) compared to the average years of education of household heads among children who were not stunted (8.45 years; p-value<0.001). On average, children who were stunted were from slightly larger households (5.3 members; SD=1.8) compared to children who were not stunted (5.1 members; p-value<0.001). Moreover, children who were stunted were from households with a lower average Wealth Index score (-1.2; SD=1.75) compared to children who were not stunted (-0.8; p-value<0.001). Most children who were stunted resided in rural mountain areas (n= 732; 47.6%) and lived in Dipolog (n=274; 17.8%).

**Table 2.5**. Descriptive statistics (frequency, proportion, mean, standard deviation) of sociodemographic characteristics of children (6 months-12 years) according to wasting status (n=3005)

| Variables | Not wasted, n = 2,725 (90.68%) | | | Wasted, n = 280 (9.32%) | | | |
|---|---|---|---|---|---|---|---|
| | n; Mean | 95% CI | %; SD | n; Mean | 95% CI | %; SD | p-value |
| **Sex of child** | | | | | | | **0.002** |
| Female | 1,277 | N/A | (46.86%) | 159 | N/A | (56.79%) | |
| Male | 1,448 | N/A | (53.14%) | 121 | N/A | (43.21%) | |
| **Age of child (months)** | 59.56 | (58, 61) | (33.61) | 67.33 | (63, 72) | (38.74) | **0.003** |
| **Age of household head (years)** | 37.93 | (37, 39) | (10.71) | 38.67 | (37, 40) | (11.02) | 0.2 |
| **Education of the household head (years)** | 8.12 | (8.00, 8.30) | (3.66) | 7.73 | (7.30, 8.10) | (3.30) | 0.2 |
| **Number of household members** | 5.18 | (5.10, 5.20) | (1.81) | 5.28 | (5.10, 5.50) | (1.86) | 0.4 |
| **Wealth Index score** | -0.99 | (-1.10, -0.93) | (1.79) | -1.11 | (-1.30, 0.89) | (1.84) | 0.2 |
| **Household Hunger Scale Category** | | | | | | | **0.009** |
| Little to no hunger in household | 2,424 | N/A | (88.95%) | 255 | N/A | (91.07%) | |
| Moderate hunger in household | 276 | N/A | (10.13%) | 18 | N/A | (6.43%) | |
| Severe hunger in household | 25 | N/A | (0.92%) | 7 | N/A | (2.50%) | |
| **Household Enrolment in 4Ps** | | | | | | | 0.2 |
| No 4Ps | 1,664 | N/A | (61.06%) | 159 | N/A | (56.79%) | |
| Has 4Ps | 1,060 | N/A | (38.94%) | 121 | N/A | (43.21%) | |
| **Geography type of area of residence** | | | | | | | 0.11 |
| Coastal | 291 | N/A | (10.68%) | 45 | N/A | (16.07%) | |
| Urban mountain | 313 | N/A | (11.49%) | 31 | N/A | (11.07%) | |
| Rural plain | 795 | N/A | (29.17%) | 74 | N/A | (26.43%) | |
| Rural mountain | 1,213 | N/A | (44.51%) | 119 | N/A | (42.50%) | |
| Urban slum | 113 | N/A | (4.15%) | 11 | N/A | (3.93%) | |
| **Region of residence** | | | | | | | **0.019** |
| Bacolod | 173 | N/A | (6.35%) | 21 | N/A | (7.50%) | |
| Bohol | 323 | N/A | (11.85%) | 16 | N/A | (5.71%) | |
| Cebu | 164 | N/A | (6.02%) | 10 | N/A | (3.57%) | |
| Dipolog | 470 | N/A | (17.25%) | 49 | N/A | (17.50%) | |
| Dumaguete | 208 | N/A | (7.63%) | 30 | N/A | (10.71%) | |
| General Santos | 338 | N/A | (12.40%) | 29 | N/A | (10.36%) | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Iloilo | 250 | N/A | (9.17%) | 31 | N/A | (11.07%) |
| Kalibo | 83 | N/A | (3.05%) | 12 | N/A | (4.29%) |
| Koronadal | 350 | N/A | (12.84%) | 45 | N/A | (16.07%) |
| Palawan | 366 | N/A | (13.43%) | 37 | N/A | (13.21%) |

SD, standard deviation; CI, confidence interval; 4Ps, Pantawid Pamilyang Pilipino Program

**Table 2.6.** Descriptive statistics (frequency, proportion, mean, standard deviation) of sociodemographic characteristics of children (6 months-12 years) according to stunting status (n=3005)

| Variables | n; Mean | 95% CI | %; SD | n; Mean | 95% CI | %; SD | p-value |
|---|---|---|---|---|---|---|---|
| | **Not stunted, n = 1,505 (50.10%)** | | | **Stunted, n = 1,500 (49.92%)** | | | |
| **Sex of child** | | | | | | | **<0.001** |
| Female | 781 | N/A | (51.89%) | 655 | N/A | (43.67%) | |
| Male | 724 | N/A | (48.11%) | 845 | N/A | (56.33%) | |
| **Age of child (months)** | 60.74 | (59, 62) | (34.24) | 59.82 | (58, 62) | (34.15) | 0.3 |
| **Age of household head (years)** | 38.14 | (38, 39) | (10.88) | 37.85 | (37, 38) | (10.60) | 0.6 |
| **Education of the household head (years)** | 8.45 | (8.30, 8.60) | (3.55) | 7.71 | (7.50, 7.90) | (3.67) | <0.001 |
| **Number of household members** | 5.05 | (5.00, 5.10) | (1.78) | 5.33 | (5.20, 5.40) | (1.83) | <0.001 |
| **Wealth Index score** | -0.80 | (-0.89, -0.71) | (1.82) | -1.21 | (-1.30, .1.10) | (1.75) | <0.001 |
| **Household Hunger Scale Category** | | | | | | | 0.095 |
| Little to no hunger in household | 1,350 | N/A | (89.70%) | 1,329 | N/A | (88.60%) | |
| Moderate hunger in household | 145 | N/A | (9.63%) | 149 | N/A | (9.93%) | |
| Severe hunger in household | 10 | N/A | (0.66%) | 22 | N/A | (1.47%) | |
| **Household Enrolment in 4Ps** | | | | | | | 0.5 |
| No 4Ps | 905 | N/A | (60.13%) | 918 | N/A | (61.20%) | |
| Has 4Ps | 600 | N/A | (39.87%) | 582 | N/A | (38.80%) | |
| **Geography type of area of residence** | | | | | | | **0.008** |
| Coastal | 171 | N/A | (11.36%) | 165 | N/A | (11.00%) | |
| Urban mountain | 182 | N/A | (12.09%) | 162 | N/A | (10.80%) | |
| Rural plain | 467 | N/A | (31.03%) | 402 | N/A | (26.80%) | |
| Rural mountain | 618 | N/A | (41.06%) | 714 | N/A | (47.60%) | |
| Urban slum | 67 | N/A | (4.45%) | 57 | N/A | (3.80%) | |
| **Region of residence** | | | | | | | **0.007** |
| Bacolod | 82 | N/A | (5.45%) | 112 | N/A | (7.47%) | |
| Bohol | 165 | N/A | (10.96%) | 174 | N/A | (11.60%) | |
| Cebu | 88 | N/A | (5.85%) | 86 | N/A | (5.73%) | |
| Dipolog | 251 | N/A | (16.68%) | 268 | N/A | (17.87%) | |
| Dumaguete | 134 | N/A | (8.90%) | 104 | N/A | (6.93%) | |
| General Santos | 176 | N/A | (11.69%) | 191 | N/A | (12.73%) | |
| Iloilo | 166 | N/A | (11.03%) | 115 | N/A | (7.67%) | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Kalibo | 54 | N/A | (3.59%) | 41 | N/A | (2.73%) |
| Koronadal | 184 | N/A | (12.23%) | 211 | N/A | (14.07%) |
| Palawan | 205 | N/A | (13.62%) | 198 | N/A | (13.20%) |

SD, standard deviation; CI, confidence interval; 4Ps, Pantawid Pamilyang Pilipino Program

## 2.3.2 Associations between 4Ps and the wasting status and stunting status of children

The ICC for the intercept only model (Model 1) of both wasting (ICC=1.34%) and stunting (ICC=0.56%) indicated that a small proportion of the variances in stunting and wasting status were attributable to differences between regional bases (Tables 2.7 and 2.8). Although these ICCs were low, multilevel mixed-effects regression models grouped by regional bases were maintained as it was theorized that households from similar regional bases would share comparable characteristics and differ in their baseline odds of wasting and stunting status. Binned residual plots indicated that plotting the average residuals against expected values were within the 95% confidence limits indicating appropriate model fit (see Appendix E).

The standardized main effects model (Model 4) was determined as the most appropriate model for wasting based on deviance tests and evaluating the AIC, which indicated that the interaction effects between geography type and 4Ps did not enhance model fit (see Appendix F). Overall, male children had lower odds of wasting (adjusted OR=0.70; 95% CI=0.54-0.89) compared to female children. Children who were experiencing moderate (adjusted OR=2.07; 95% CI=1.11-3.86) and severe levels of hunger (adjusted OR=2.29; 95% CI=1.35-3.94) had higher odds being wasted compared to children who experienced little to no hunger. Children who lived in urban mountains (adjusted OR=0.57; 95% CI=0.35-0.96), rural plains (adjusted OR=0.64; 95% CI=0.42-0.96), and rural mountains (adjusted OR=0.61; 95% CI=0.41-0.89) also had lower odds of being wasted compared to those who lived in coastal areas. [2] While holding all other variables constant, the regression model indicated that there was no association between household enrollment in 4Ps and wasting status among children (adjusted OR= 1.05; 95% CI=0.79-1.39).

The standardized interaction effects model (Model 5) was determined as the most appropriate model for stunting based on deviance test statistics and the AIC, which indicated that interaction effects between household enrollment in 4Ps and geography type improved model fit (see Appendix F). Male children had a higher odd of stunting (adjusted OR=1.39; 95% CI=1.20-1.62) compared to female children. Moreover, the education of the household head (adjusted OR=0.96; 95% CI=0.94-0.98), the number of household members (adjusted OR=1.12; 95% CI=1.07-1.17), and the wealth of the household (adjusted OR=0.90; 95% CI=0.86-0.94) were associated with stunting among children.

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[2] Age of the child was also statistically significant, but its estimates and confidence interval were very close to the null (adjusted OR=1.01; CI=1.00-1.01). Thus, overinterpretation of this finding should be cautioned.

While holding all other variables constant, the odds of stunting were lower (adjusted OR=0.50; 95% CI=0.31-0.78) among children from households enrolled in 4Ps compared to children from households that were not enrolled in 4Ps. However, the odds of stunting were higher when the interaction between geography type and household enrollment in 4Ps was included. Among children from households enrolled in 4Ps living in urban mountains, the odds of stunting was higher by a factor of 2.48 (95% CI=1.32-4.61) compared to children from households enrolled in 4Ps living in coastal areas. Similarly, children from households enrolled in 4Ps living in rural plains had a higher odds of stunting by a factor of 2.24 (95% CI=1.30-3.82) compared to children from households enrolled in 4Ps living in coastal plains. While the odds of stunting were also higher for children from households enrolled in 4Ps living in rural mountains and urban slums, these were not significantly different from children from households enrolled in 4Ps living in coastal areas.

**Table 2.7.** Fixed and random effects estimates and model information criteria from multilevel logistic regression model of household enrollment in 4Ps on wasting status of children controlling for sociodemographic and geographic variables (n=3005)

| | Model 1 | | | Model 2 | | | Model 3 | | | Model 4 [ab] | | | Model 5 [a] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Predictors* | *Log-odds* | *SE* | *95% CI* | *Log-Odds* | *SE* | *95% CI* | *Log-Odds* | *SE* | *95% CI* | *Log-Odds* | *SE* | *95% CI* | *Log-Odds* | *SE* | *95% CI* |
| **Intercept** | -2.28 *** | 0.09 | (-2.47, -2.10) | -1.78 *** | 0.45 | (-2.65, -0.90) | -1.84 *** | 0.46 | (-2.74, -0.94) | -1.52 *** | 0.25 | (-2.02, -1.03) | -1.62 *** | 0.29 | (-2.19, -1.04) |
| **Fixed effects** | | | | | | | | | | | | | | | |
| **Level 2** | | | | | | | | | | | | | | | |
| **Geography type** | | | | | | | | | | | | | | | |
| Coastal | | | | | | | *Reference* | | | | | | | | |
| Urban mountain | | | | -0.55 * | 0.26 | (-1.06, -0.04) | -0.45 | 0.35 | (-1.14, 0.24) | -0.55 * | 0.26 | (-1.06, -0.04) | -0.45 | 0.35 | (-1.15, 0.24) |
| Rural plain | | | | -0.45 * | 0.21 | (-0.86, -0.04) | -0.48 | 0.28 | (-1.03, 0.06) | -0.45 * | 0.21 | (-0.86, -0.04) | -0.48 | 0.28 | (-1.03, 0.06) |
| Rural mountain | | | | -0.50 * | 0.19 | (-0.88, -0.12) | -0.34 | 0.26 | (-0.85, 0.18) | -0.50 * | 0.19 | (-0.88, -0.12) | -0.34 | 0.26 | (-0.86, 0.18) |
| Urban slum | | | | -0.50 | 0.36 | (-1.21, 0.22) | -0.45 | 0.47 | (-1.36, 0.47) | -0.50 | 0.37 | (-1.21, 0.22) | -0.45 | 0.47 | (-1.36, 0.47) |
| **Level 1** | | | | | | | | | | | | | | | |
| **Sex of child** | | | | | | | | | | | | | | | |
| Female | | | | | | | *Reference* | | | | | | | | |
| Male | | | | -0.36 ** | 0.13 | (-0.62, -0.11) | -0.36 ** | 0.13 | (-0.61, -0.11) | -0.36 ** | 0.13 | (-0.62, -0.11) | -0.36 ** | 0.13 | (-0.61, -0.11) |
| **Age of child (months)** | | | | 0.01 ** | 0.00 | (0.00, 0.01) | 0.01 ** | 0.00 | (0.00, 0.01) | 0.20 ** | 0.06 | (0.07, 0.33) | 0.20 ** | 0.06 | (0.08, 0.33) |
| **Age of household head (years)** | | | | -0.00 | 0.01 | (-0.01, 0.01) | -0.00 | 0.01 | (-0.01, 0.01) | -0.00 | 0.07 | (-0.14, 0.14) | -0.00 | 0.07 | (-0.14, 0.13) |
| **Education of household head (years)** | | | | -0.03 | 0.02 | (-0.07, 0.01) | -0.03 | 0.02 | (-0.07, 0.01) | -0.10 | 0.07 | (-0.24, 0.04) | -0.10 | 0.07 | (-0.24, 0.04) |
| **Number of household members** | | | | 0.02 | 0.04 | (-0.06, 0.09) | 0.02 | 0.04 | (-0.06, 0.09) | 0.03 | 0.07 | (-0.10, 0.17) | 0.03 | 0.07 | (-0.10, 0.17) |
| **Wealth Index** | | | | -0.04 | 0.04 | (-0.12, 0.04) | -0.03 | 0.04 | (-0.11, 0.04) | -0.07 | 0.07 | (-0.21, 0.08) | -0.03 | 0.04 | (-0.11, 0.05) |
| **Household Hunger Scale** | | | | | | | | | | | | | | | |
| Little to no hunger | | | | | | | *Reference* | | | | | | | | |
| Moderate hunger | | | | 0.73 * | 0.32 | (0.11, 1.35) | 0.75 * | 0.32 | (0.13, 1.38) | 0.73 * | 0.32 | (0.11, 1.35) | 0.75 * | 0.32 | (0.13, 1.38) |
| Severe hunger | | | | 0.83 ** | 0.27 | (0.30, 1.37) | 0.84 ** | 0.27 | (0.31, 1.38) | 0.83 ** | 0.27 | (0.30, 1.37) | 0.84 ** | 0.27 | (0.31, 1.38) |

| | Est. | SE | 95% CI | Est. | SE | 95% CI | Est. | SE | 95% CI | Est. | SE | 95% CI | Est. | SE | 95% CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Household enrollment in 4Ps** | | | | | | | | | | | | | | | |
| Not enrolled in 4Ps | | | | | | | | *Reference* | | | | | | | |
| Enrolled in 4Ps | | | | 0.05 | 0.14 | (-0.23, 0.33) | 0.19 | 0.33 | (-0.46, 0.85) | 0.05 | 0.14 | (-0.23, 0.33) | 0.19 | 0.33 | (-0.46, 0.85) |
| **Interaction effects** | | | | | | | | | | | | | | | |
| Urban mountain x Enrolled in 4Ps | | | | | | | -0.20 | 0.50 | (-1.18, 0.79) | | | | -0.19 | 0.50 | (-1.18, 0.79) |
| Rural plain x Enrolled in 4Ps | | | | | | | 0.12 | 0.41 | (-0.69, 0.93) | | | | 0.12 | 0.41 | (-0.69, 0.93) |
| Rural mountain x Enrolled in 4Ps | | | | | | | -0.35 | 0.38 | (-1.10, 0.40) | | | | -0.35 | 0.38 | (-1.10, 0.40) |
| Urban slum x Enrolled in 4Ps | | | | | | | -0.09 | 0.75 | (-1.56, 1.38) | | | | -0.09 | 0.75 | (-1.56, 1.38) |
| **Random effects** | *Est.* | *SE* | *95% CI* | *Est.* | *SE* | *95% CI* | *Est.* | *SE* | *95% CI* | *Est.* | *SE* | *95% CI* | *Est.* | *SE* | *95% CI* |
| Variance of random intercepts (regional base) | 0.04 | 0.09 | (-0.14, 0.23) | 0.06 | 0.10 | (-0.14, 0.25) | 0.05 | 0.10 | (-0.14, 0.25) | 0.06 | 0.10 | (-0.14, 0.25) | 0.05 | 0.10 | (-0.14, 0.25) |
| ICC | 0.01 | | | | | | | | | | | | | | |
| **Model information criteria** | | | | | | | | | | | | | | | |
| Deviance | 1859.19 | | | 1817.80 | | | 1815.43 | | | 1817.80 | | | 1815.42 | | |
| AIC | 1863.19 | | | 1847.80 | | | 1853.43 | | | 1847.80 | | | 1853.42 | | |

\* p<0.05   \*\* p<0.01   \*\*\* p<0.001

Ni = 3005, where i = number of children; Nj = 10, where j = number of regional bases

[a] Continuous variables in the regression model are standardized and scaled to support model fit and convergence, [b] Model selected for interpretation

**Table 2.8.** Fixed and random effects estimates and model information criteria from multilevel logistic regression model of household enrollment in 4Ps on stunting status of children controlling for sociodemographic and geographic variables (n=3005)

| Predictors | Model 1 | | | Model 2 | | | Model 3 | | | Model 4[a] | | | Model 5[ab] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Log-Odds | SE | 95% CI | Log-Odds | SE | 95% CI | Log-Odds | SE | 95% CI | Log-Odds | SE | 95% CI | Log-Odds | SE | 95% CI |
| Intercept | -0.02 | 0.06 | (0.13 – 0.10) | -0.07 | 0.28 | (-0.61, 0.48) | 0.08 | 0.29 | (-0.48, 0.65) | 0.10 | 0.18 | (-0.25, 0.46) | 0.31 | 0.20 | (-0.08, 0.71) |
| **Fixed effects** | | | | | | | | | | | | | | | |
| **Level 2** | | | | | | | | | | | | | | | |
| **Geography type** | | | | | | | | | | | | | | | |
| Costal | | | | | | | | | *Reference* | | | | | | |
| Urban mountain | | | | -0.11 | 0.16 | (-0.42, 0.21) | -0.51 * | 0.21 | (-0.92, -0.09) | -0.11 | 0.16 | (-0.42, 0.21) | -0.51 * | 0.21 | (-0.92, -0.09) |
| Rural plain | | | | -0.06 | 0.13 | (-0.33, 0.20) | -0.38 * | 0.17 | (-0.72, -0.04) | -0.06 | 0.13 | (-0.33, 0.20) | -0.38 * | 0.17 | (-0.72, -0.04) |
| Rural mountain | | | | 0.15 | 0.13 | (-0.10, 0.40) | -0.00 | 0.17 | (-0.33, 0.32) | 0.15 | 0.13 | (-0.10, 0.40) | -0.00 | 0.17 | (-0.33, 0.32) |
| Urban slum | | | | -0.08 | 0.22 | (-0.51, 0.34) | -0.30 | 0.27 | (-0.82, 0.23) | -0.08 | 0.22 | (-0.51, 0.34) | -0.30 | 0.27 | (-0.82, 0.23) |
| **Sex of child** | | | | | | | | | | | | | | | |
| Female | | | | | | | | | *Reference* | | | | | | |
| Male | | | | 0.33 *** | 0.07 | (0.18, 0.47) | 0.33 *** | 0.08 | (0.18, 0.48) | 0.33 *** | 0.07 | (0.18, 0.47) | 0.33 *** | 0.08 | (0.18, 0.48) |
| **Age of child (months)** | | | | -0.00 | 0.00 | (-0.00, 0.00) | -0.00 | 0.00 | (-0.00, 0.00) | -0.01 | 0.04 | (-0.09, 0.07) | -0.01 | 0.04 | (-0.09, 0.07) |
| **Age of household head (years)** | | | | -0.00 | 0.00 | (-0.01, 0.00) | -0.00 | 0.00 | (-0.01, 0.01) | -0.03 | 0.04 | (-0.12, 0.05) | -0.03 | 0.04 | (-0.11, 0.06) |
| **Education of household head (years)** | | | | -0.04 *** | 0.01 | (-0.07, -0.02) | -0.04 *** | 0.01 | (-0.07, -0.02) | -0.16 *** | 0.04 | (-0.24, -0.08) | -0.16 *** | 0.04 | (-0.24, -0.08) |
| **Number of household members** | | | | 0.11 *** | 0.02 | (0.06, 0.15) | 0.11 *** | 0.02 | (0.07, 0.16) | 0.20 *** | 0.04 | (0.12, 0.28) | 0.20 *** | 0.04 | (0.12, 0.29) |
| **Wealth Index score** | | | | -0.10 *** | 0.02 | (-0.15, -0.06) | -0.11 *** | 0.02 | (-0.15, -0.06) | -0.19 *** | 0.04 | (-0.27, -0.10) | -0.19 *** | 0.04 | (-0.27, -0.11) |
| **Household Hunger Scale** | | | | | | | | | | | | | | | |
| Little to no hunger | | | | | | | | | *Reference* | | | | | | |
| Moderate hunger | | | | 0.54 | 0.28 | (-0.01, 1.08) | 0.53 | 0.28 | (-0.01, 1.08) | 0.54 | 0.28 | (-0.01, 1.08) | 0.53 | 0.28 | (-0.01, 1.08) |
| Severe hunger | | | | 0.33 | 0.19 | (-0.03, 0.70) | 0.35 | 0.19 | (-0.02, 0.72) | 0.33 | 0.19 | (-0.03, 0.70) | 0.35 | 0.19 | (-0.02, 0.72) |
| **Household enrollment in 4Ps** | | | | | | | | | | | | | | | |
| Not enrolled in 4Ps | | | | | | | | | *Reference* | | | | | | |
| Enrolled in 4Ps | | | | -0.18 * | 0.08 | (-0.35, -0.01) | -0.70 ** | 0.23 | (-1.16, -0.25) | -0.18 * | 0.08 | (-0.35, -0.01) | -0.70 ** | 0.23 | (-1.16, -0.25) |

| | Est. | SE | 95% CI | Est. | SE | 95% CI | Est. | SE | 95% CI | Est. | SE | 95% CI | Est. | SE | 95% CI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Interaction effects** | | | | | | | | | | | | | | | |
| Urban mountain x Enrolled in 4Ps | | | | | | | 0.91 ** | 0.32 | (0.28, 1.53) | | | | 0.91 ** | 0.32 | (0.28, 1.53) |
| Rural plain x Enrolled in 4Ps | | | | | | | 0.81 ** | 0.27 | (0.27, 1.34) | | | | 0.81 ** | 0.27 | (0.27, 1.34) |
| Rural mountain x Enrolled in 4Ps | | | | | | | 0.36 | 0.26 | (-0.14, 0.86) | | | | 0.36 | 0.26 | (-0.14, 0.86) |
| Urban slum x Enrolled in 4PS | | | | | | | 0.52 | 0.46 | (-0.39, 1.42) | | | | 0.52 | 0.46 | (-0.39, 1.42) |
| **Random effects** | *Est.* | *SE* | *95% CI* | *Est.* | *SE* | *95% CI* | *Est.* | *SE* | *95% CI* | *Est.* | *SE* | *95% CI* | *Est.* | *SE* | *95% CI* |
| Variance of random intercepts (regional base) | 0.02 | 0.04 | (-0.06, 0.01) | 0.01 | 0.04 | (-0.07, 0.09) | 0.01 | 0.04 | (-0.07, 0.09) | 0.01 | 0.04 | (-0.07, 0.09) | 0.01 | 0.04 | (-0.07, 0.09) |
| ICC | 0.01 | | | | | | | | | | | | | | |
| **Model information criteria** | | | | | | | | | | | | | | | |
| Deviance | 4161.98 | | | 4050.05 | | | 4036.03 | | | 4050.05 | | | 4036.03 | | |
| AIC | 4165.98 | | | 4080.05 | | | 4074.03 | | | 4080.05 | | | 4074.03 | | |

* p<0.05   ** p<0.01   *** p<0.001

Ni = 3005, where i = number of children; Nj = 10, where j = number of regional bases

[a]Continuous variables in the regression model are standardized and scaled to support model fit and convergence; [b]Model selected for interpretation

## 2.4 Discussion

This study investigated the associations between 4Ps and wasting status and stunting status among child experiencing extreme poverty in the Philippines. Findings from the descriptive statistics indicated that children in households enrolled in 4Ps were older, and were members of households where the household head was older and had fewer years of education. Children in households enrolled in 4Ps also belonged to households that were larger compared to children in households not enrolled in 4Ps. Moreover, there was no difference in the wealth status and experiences of food insecurity between children in households enrolled in 4Ps and not enrolled in 4Ps. Findings from the multilevel logistic regression modelling indicated that household enrollment in 4Ps was not significantly associated with the wasting status of children. Conversely, household enrollment in 4Ps was significantly associated with a lower odds of stunting among children, while interaction effects between household enrollment in 4Ps and geography type indicated that geography type may be moderating the effects of 4Ps on the stunting status of children.

The descriptive statistics indicated differences in the characteristics of children in households enrolled and not enrolled in 4Ps. Children in households enrolled in 4Ps may have had a higher susceptibility to a poor nutritional status as they belonged to households that had household heads with fewer years of education and had more household members. Fewer years of education of the household head may be associated with overall lower socioeconomic status within the household (Hossain & Khan, 2018; Vollmer, Bommer, et al., 2017; Vollmer, Harttgen, et al., 2017). Moreover, having more household members may require the redistribution of resources within the household which could limit resources directed to children (Ieiri et al., 2020; Khan et al., 2019; Wolde et al., 2015). No differences were observed for the Wealth Index score and the Household Hunger Scale between children in households enrolled and not enrolled in 4Ps. Explaining this finding in relation to the cross-sectional study design may provide two possible interpretations. On the one hand, and assuming that households enrolled and not enrolled in 4Ps shared similar baseline characteristics in terms of wealth and food insecurity, this finding may indicate that the transfers through 4Ps did not create significant differences in the wealth and food insecurity between children in households enrolled and not enrolled in 4Ps. Alternatively, and assuming that households that received 4Ps had a lower Wealth Index Score and had more severe experiences of hunger at baseline, it could be hypothesized that 4Ps contributed to some improvements in the living conditions of recipient households, which could contribute to a similar wealth and food security status between children in households enrolled and not enrolled in 4Ps. Surprisingly, findings showed that food insecurity was

higher among children without wasting compared to children with wasting. Due to the acute and fluctuating nature of wasting in children, it is possible that children without wasting who were experiencing food insecurity may eventually develop wasting. However, the cross-sectional study design limits the ability to further investigate the temporal relationship between these variables.

Our findings are consistent with a randomized controlled trial that evaluated the effects of 4Ps on the nutritional outcomes of children, wherein no significant association was found with wasting (Kandpal et al., 2016). Other evaluations of 4Ps using regression discontinuity design studies have also indicated that there was no association between household enrollment in 4Ps with the wasting status of children (Orbeta et al., 2014, 2021). Conversely, a difference-in-difference analysis indicated that a conditional cash transfer program in Indonesia significantly reduced wasting among children through improved food consumption (Kusuma et al., 2017). This study highlighted that equivalent supply-side improvements provided through community-level cash transfers, such as infrastructure renovation and equipment procurement, contributed to the observed improvements in children's nutritional status (Kusuma et al., 2017). In other contexts, unconditional cash transfers were provided to households during shocks of food insecurity to prevent acute undernutrition among children (Asfaw et al., 2017; Bliss et al., 2018; Fenn et al., 2015; Grellety et al., 2017; Houngbe et al., 2019; Langendorf et al., 2014). Findings from these studies are mixed: in Niger, reductions in acute undernutrition were associated with the receipt of the cash transfer through reducing poverty and household food security (Bliss et al., 2018; Fenn et al., 2015), while in Burkina Faso, there was no evidence that unconditional cash transfers reduced the cumulative incidence of wasting (Houngbe et al., 2017). Moreover, a systematic review comparing the impact of different types of cash transfer programs indicated that groups receiving cash transfers in addition to food supplementation had larger effects on improving acute undernutrition compared to groups that received cash alone (Little et al., 2021). Overall, these studies indicate that there is the potential for cash transfer programs to direct more resources towards households experiencing poverty and contribute to increasing adaptive capacity during shocks that negatively impact food security and exacerbate illness. However, in the present study, the lack of an observed association between household enrollment in 4Ps and wasting status in children may indicate that the conditionalities and entitlements of the program are insufficient to provide socioeconomic resources that can address the underlying drivers of wasting such as the impact of shocks among households experiencing poverty.

A randomized controlled trial by Kandpal et al. (2016) found similar results wherein the prevalence of stunting was lower in areas where 4Ps was implemented compared to households in communities where 4Ps was not implemented (Kandpal et al., 2016). Similar findings have been observed in Mexico and Peru where the *Progresa-Oportunidades-Prospera* and *Juntos* conditional cash transfer programs, respectively, were associated with a lower prevalence of stunting and a higher height-for-age z-score among children in participating households (Andersen et al., 2015; Fernald et al., 2008). As descriptive statistics from the present study indicated that there were no significant differences in the Wealth Index score and Household Hunger Scale levels between households enrolled and not enrolled in 4Ps, this may provide initial indications that these factors are not important contributors to the association between 4Ps and stunting status for this sample. However, 4Ps could potentially contribute to the improvement of the wealth and food security of children in households enrolled in 4Ps to the point where there are few observable differences between children in recipient and non-recipient households, subsequently supporting the nutrition status of children. While income and savings were not captured as variables in this study, the cash transfers from 4Ps may support the nutrition of children by increasing food accessibility and diversity. Indeed, findings from a longitudinal study in Malawi found that cash transfers were associated with an increased consumption of pulses, dairy, meat, and fish (Miller et al., 2011). In the present study, healthcare use and access of children was not included in the analysis as this information was not collected through ICM's survey; however, healthcare access of children could be an additional mechanism through which household enrollment in 4Ps contributes to reduced stunting outcomes in children. Results from Brazil's *Bolsa Familia Program* highlighted that participation was associated with higher odds of children visiting health centres for preventive services (Shei et al., 2014). These factors may provide insight towards the observed association between household enrollment in 4Ps and stunting in the present study.

Notably, the effect moderation from the interaction terms between geography type and 4Ps may point to implementation challenges within 4Ps programming. Indeed, geographic distance, infrastructure limitations, and gaps in health and social services may mean that children in households enrolled in 4Ps and living in urban mountains or rural plains face greater barriers to accessing 4Ps entitlements compared to children in households enrolled in 4Ps and living in coastal areas. The differences in the association between 4Ps across geography types are similar with findings from a study by Filmer et al. (2021), where communities with relatively more households enrolled in 4Ps

experienced larger increases in the prices of protein-rich foods compared to communities with a lower proportion of households enrolled in 4Ps. The increase in food prices appeared to be influenced by a combination of greater demand for nutritious food as well as the inflow of cash into communities following 4Ps implementation (Filmer et al., 2021). In addition, stunting rates were higher among children in households that were not eligible for 4Ps, and in communities with the highest enrollment rates, the average child's nutritional status worsened after 4Ps was implemented (Filmer et al., 2021).

The different relationships observed between household enrollment in 4Ps and wasting status in children in contrast to stunting status in children may be attributable to the varied combination of prevention and treatment approaches needed to effectively address these two conditions. In theory, 4Ps could contribute to reductions in wasting among children through the provision of cash and subsidies that can assist recipient households to cope with shocks that negatively impact food security and exacerbate illness. However, a recent survey during the COVID-19 pandemic estimated that households enrolled in 4Ps were more likely to experience moderate to severe food insecurity compared to households not enrolled in 4Ps (Angeles-Agdeppa et al., 2022). As such, the conditionalities and entitlements provided through 4Ps may be inadequate to protect households from shocks that can contribute to wasting among children. This highlights the importance of integrating nutrition-specific interventions into 4Ps that would directly treat acute undernutrition if the intended mechanism of 4Ps to prevent wasting is insufficient. Conversely, as stunting is associated with persistent poverty and deprivation, enrollment in 4Ps and the associated conditionalities and entitlements may be able to support improvements to the underlying social determinants that are correlated with stunting in children. However, as indicated by the significance of the interaction term between household enrollment in 4Ps and geography type in the regression models, it may be that these effects are not equally experienced across different areas in the Philippines given heterogenous resource allocation and implementation of 4Ps across different areas (Conchada & Tiongco, 2014) that could potentially contribute to unintended consequences of increasing stunting among children (Filmer et al., 2021; Orbeta et al., 2021).

The overall findings from this study have implications for the implementation of 4Ps in the Philippines. First, in the context of the Philippines where extreme weather events regularly affect the health and livelihoods of people experiencing poverty, policymakers could consider increasing adaptive capacity and climate resilience among participants by incorporating components of climate responsive social protection into 4Ps (Kuriakose et al., 2013). Increasing adaptive capacity may

support the ability of participants to cope with shocks of food insecurity and illness to lower the risks of acute undernutrition. Secondly, as 4Ps programming relies on supply-side provisions from local government units to ensure that hospitals and healthcare services are available for participants to meet conditionalities (DSWD, 2015), the highly decentralized nature of the healthcare system may be associated with variability in the availability and quality of these health services (Dodd et al., 2021; Liwanag & Wyss, 2018; Siy Van et al., 2021). Equivalent investments in supply-side resources across different areas in the Philippines should be prioritized as the lack of appropriate resources to ensure effective implementation may hinder the potential impact of 4Ps conditionalities on improving the nutritional outcomes among children. Lastly, while the 4Ps Theory of Change suggests that the program conditionalities and entitlements can potentially address the underlying drivers of health and nutrition to prevent wasting and stunting among children, it may be important to consider how 4Ps could potentially integrate its operations with treatment services that could directly address child undernutrition (Ulep, 2021).

While this study applied multilevel regression modelling and included a large sample size from a population that has been previously excluded from previous evaluations of 4Ps, there are also several limitations that should be noted. First, the sample in this study was not randomly selected and is not representative of all households experiencing poverty in the Philippines. However, this study sample provides insight on health and nutritional outcomes among households experiencing extreme poverty, which is a population that is often underrepresented in national level surveys and evaluations. Second, the use of a cross-sectional study design does not allow for temporal and causal interpretation of the associations between household enrollment in 4Ps and the nutritional outcomes of children. Third, as the Household Hunger Scale assesses severe experiences of hunger and food insecurity, applying it within a context where populations experience chronic poverty may lead to underestimated measures. However, the Household Hunger Scale was included in the analysis as previous research has indicated that cash transfers are associated with nutritional outcomes among children through reducing food insecurity (Kusuma et al., 2017; Leroy et al., 2010). Fourth, as household enrollment in 4Ps was a self-reported variable in our study, there may have been misclassification bias in the analysis. Finally, due the timing of data collection, this study did not examine the association between household enrollment in 4Ps with wasting status and stunting status among children during the COVID-19 pandemic. As such, this study was not able to capture how the use of 4Ps to respond to food insecurity during COVID-19 might have impacted children's nutritional outcomes. The COVID-

19 pandemic is expected to increase child undernutrition globally, with a disproportionate impact towards children experiencing poverty and living in resource constrained settings (Dodd et al., 2021; Headey et al., 2020). The combined effects from the recent COVID-19 pandemic and worsening emergencies due to climate change are projected to reverse the progress that has been made on improving the nutritional outcomes of children over the last decade. As such, it is imperative that 4Ps and other social protection programs are adequately positioned to respond to the evolving needs of children experiencing poverty in order to support nutritional outcomes and optimum growth and development across the life course.

## 2.5 Conclusion

This study investigated the association between household enrollment in 4Ps with wasting status and stunting status among children experiencing poverty in the Philippines. Household enrollment in 4Ps was not found to be associated with wasting status among children. As such, 4Ps could be further strengthened to provide households with the resources to cope and adapt to emergencies and shocks that contribute to higher risks of wasting. Moreover, 4Ps could integrate targeted nutrition interventions into its programming by referring children to services that provide direct nutritional treatment for children with wasting. In addition, while household enrollment in 4Ps was overall associated with reduced odds of stunting, geography type moderated this effect. Specifically, the odds of stunting in children were higher among children in households enrolled in 4Ps living in urban mountains and rural plains compared to households enrolled in 4Ps living in coastal regions. The differences in the association between 4Ps and stunting status across geographic areas may be attributable to unintended consequences resulting from 4Ps implementation that affect the nutritional status of both children in households enrolled and not enrolled in 4Ps. In addition, supply-side implementation challenges that affect the availability and quality of health services, may hinder the full impact that 4Ps could have on nutritional outcomes. Overall, this study contributes important insight into the differential associations between household enrollment in 4Ps with acute and chronic undernutrition in the Philippines. Future efforts should prioritize the improvement of 4Ps operations to incorporate emergency responsive social protection, integrate direct nutritional services, and strengthen supply-side elements to ensure effective program implementation and delivery across all contexts within the country.

# Chapter 3
# Conclusion

This thesis explored the association between household enrollment in the *Pantawid Pamilyang Pilipino Program* (4Ps) and wasting and stunting status among children experiencing extreme poverty in the Philippines. This research was conducted in partnership with International Care Ministries (ICM) and data were drawn from cross-sectional survey data of ICM's operational surveys. Descriptive statistics were calculated to describe the sociodemographic characteristics of children and were assessed to compare the sociodemographic variables of children in households enrolled and not enrolled in 4Ps. In addition, two multilevel regression models were conducted to estimate the associations between household enrollment in 4Ps and wasting status and stunting status in children while controlling for relevant sociodemographic variables that were theorized to confound and moderate this relationship.

## 3.1 Summary of main findings

Findings from the descriptive statistics indicated that children from households enrolled in 4Ps were older than children from households not enrolled in 4Ps. Moreover, children from households enrolled in 4Ps belonged to households with more household members and had an older household head who had fewer years of education, compared to children from households that were not enrolled in 4Ps. This finding may indicate that children in households enrolled in 4Ps are more likely to experience social conditions that are associated with wasting and stunting compared to children in households not enrolled in 4Ps. Furthermore, there was no evidence that the wealth status and experiences of food insecurity of children from households enrolled in 4Ps differed from children in households not enrolled in 4Ps. This finding may indicate that either there are no significant differences in the wealth and food insecurity between children in households enrolled and not enrolled in 4Ps, or that 4Ps may have contributed to some improvements in these characteristics within recipient households, making the wealth and food insecurity status of children similar to non-recipient households.

Results from the multilevel logistic regression modelling indicated that household enrollment in 4Ps was not significantly associated with the wasting status of children. These findings were similar to previous research and evaluations assessing the association between household enrollment in 4Ps

and wasting (Kandpal et al., 2016; Orbeta et al., 2014, 2021). In other contexts, unconditional cash transfers have been implemented to address acute malnutrition during shocks of food insecurity and illness, but have mixed findings (Bliss et al., 2018; Fenn et al., 2015; Houngbe et al., 2017). Conversely, household enrollment in 4Ps was significantly associated with lower odds of stunting among children while interaction effects between household enrollment in 4Ps and geography type indicated that geography type may be moderating the effects of 4Ps on the stunting status of children. Specifically, the odds of stunting in children were higher among children in households enrolled in 4Ps living in urban mountains and rural plains compared to households enrolled in 4Ps living in coastal regions. These findings are aligned with variations observed in 4Ps implementation in different communities across the Philippines (Filmer et al., 2021).

The regression models indicated differing relationships between household enrollment in 4Ps and wasting status, in contrast to stunting status. The different relationships observed may point to the distinct set of prevention and treatment approaches that are needed to effectively address wasting and stunting among children. According to the Theory of Change, 4Ps could theoretically contribute to prevention in wasting among children through the provision of cash and subsidies that can assist recipient households to cope with shocks of food insecurity and illness onset. However, the absence of an association found in this study could suggest that the conditionalities and entitlements provided through 4Ps may be inadequate to protect households from shocks that can contribute to wasting among children. This finding underscores the importance of integrating direct interventions into 4Ps that would directly treat acute undernutrition if the intended mechanisms of 4Ps to prevent wasting are insufficient. Conversely, as stunting is associated with persistent poverty and deprivation, enrollment in 4Ps and the participation in required conditionalities as well as the receipt of entitlements may be able to support long-term improvements to the socioeconomic determinants that are correlated with stunting in children. However, and as indicated by the significance of the interaction term between household enrollment in 4Ps and geography type in the regression models, it may be that these effects are not equally experienced across different areas in the Philippines given heterogenous resource allocation and implementation of 4Ps across different areas (Conchada & Tiongco, 2014) that could potentially contribute to unintended consequences of increasing stunting among some children (Filmer et al., 2021; Orbeta et al., 2021).

## 3.2 Strengths and limitations

A key strength of this thesis is the research partnership established with ICM. Collaboration with ICM staff through regular meetings and discussions during the development and planning of this thesis allowed for a deeper understanding of the dataset and the programmatic context where data were collected. Ongoing conversations with ICM staff helped to ensure that the research methods were aligned with the strengths and limitations of the dataset, and that important contextual factors were considered when interpreting the results. Overall, this partnership helped to inform the process by which data was cleaned and managed, the development of the research methodology and construction of relevant measures, and the interpretation of key findings.

This study is also not without its limitations. The use of monitoring and evaluation data from ICM means that the study sample was not randomly selected. As such, the study sample is not representative of all households eligible for 4Ps or of all people experiencing poverty in the Philippines. However, the study sample had a specific focus on people experiencing extreme poverty, which are households that would have similar sociodemographic profiles to those who would be eligible for enrollment in 4Ps. As such, this study provides insight into households in the lowest income groups who are often excluded from national-level surveys, research, and evaluations.

Moreover, the use of a cross-sectional study design does not allow for temporal and causal interpretation of the associations between household enrollment in 4Ps and the nutritional outcomes of children. However, the last expansion of 4Ps wherein eligible households were enrolled was conducted in 2014, and following this, the next round of new enrollments was conducted in 2019 (Cho et al., 2020; Dadap-Cantal et al., 2021). As the data for this study were collected in 2018-2019, it may imply that most households in the sample who indicated they were enrolled in 4Ps had been enrolled since at least 2014. However, due to the cross-sectional study design, these findings must be interpreted with care so as not to attribute the significant associations, or lack thereof, of wasting status and stunting status among children to household enrollment in 4Ps.

It is also important to note that the limited variables in the dataset did not allow this study to identify the specific mechanisms through which household enrollment in 4Ps may impact specific outcomes that contribute to improved nutritional status among children. As such, this study was unable to determine the associations among the degree to which households participated in specific 4Ps conditionalities, the extent to which they were able to receive 4Ps entitlements, and the expected

outcomes that would lead to improvements in wasting and stunting status. However, descriptive statistics comparing the characteristics of children from households enrolled and not enrolled in 4Ps may lend initial insights that the transfers received through 4Ps may not be sufficient to translate towards differences in wealth and food insecurity between children in households enrolled and not enrolled in 4Ps.

While the multilevel logistic regression analyses were able to control for important confounding and moderating variables that may affect the relationship between household enrollment in 4Ps and the wasting and stunting outcomes of children, the variables included in this study are all self-reported. Specifically, the information collected for this study was self-reported by the household head, and reporting of household enrollment in 4Ps may contribute to some misclassification bias. Indeed, previous research has observed that some 4Ps participants were unsure about the process through which they were enrolled in the program due to limited transparency of eligibility criteria and enrollment processes (Dodd et al., 2022).

Regarding the measure of food insecurity and hunger used in this study, it should be noted that the Household Hunger Scale (HHS) may have underestimated the measures within this study sample. While the Household Hunger Scale has been validated for use in various cross-cultural contexts (Deitchler et al., 2010), it aims to capture the severe experiences of hunger and food deprivation which limits its ability to understand the broader experiences of food insecurity (Ballard et al., 2011). As such, the application of the HHS in a study sample that experiences chronic poverty, and, subsequently, consistent food insecurity and hunger, may lead to a normative experience of hunger and food insecurity that the HHS is not able to capture. The HHS was retained in the regression analysis as previous research has demonstrated participation in social protection programs is associated with decreased food insecurity and hunger and improved nutritional outcomes in some settings (Kusuma et al., 2017; Leroy et al., 2010)..

Lastly, the data collection period for this study (May 2018 to April 2019) did not allow for the analysis of how 4Ps may have impacted the nutritional outcomes of children during the COVID-19 pandemic. When the COVID-19 outbreak occurred in the Philippines in 2020, varying degrees of lockdown and quarantine were imposed across the country from March to September 2020 (Jiang et al., 2022; Lau et al., 2020, 2022). To address challenges experienced by populations experiencing poverty due to mobility restrictions, the government rolled out the Social Assistance Program (SAP).

The SAP was an unconditional cash transfer program for those affected by the economic shutdown during the COVID-19 quarantine in the Philippines, for which households enrolled in 4Ps were automatically eligible and received a 'top-up' on their existing cash transfers (Cho & Johnson, 2022; Dadap-Cantal et al., 2020). As the present study was not able to include the implementation of the SAP initiative in the analysis, the findings from this study may not represent the current impact of 4Ps and social protection programs on the nutritional outcomes of children in the Philippines.

## 3.3 Contributions to research and practice

This thesis offers contributions to the academic literature by building on research that looks at the distinction between prevention and treatment approaches intended to address acute and chronic undernutrition among children experiencing extreme poverty in resource-constrained settings. While much research has investigated the association between various cash transfer programs and the nutritional outcomes of children (Little et al., 2021; Manley et al., 2020, 2022; Onwuchekwa et al., 2021; Owusu-Addo & Cross, 2014), few studies have investigated these interventions through probing the differences by which these conditions are produced and how they should best be addressed (Bergeron & Castleman, 2012). This research begins to delineate how household enrollment in a conditional cash transfer program is associated with acute and chronic undernutrition among children to begin to understand how 4Ps and other social protection programs can be more responsive towards addressing these conditions.

This thesis also provides contributions towards policymaking and programming of social protection programs. Most directly, this research aims to provide insight into the ability of 4Ps specifically, and conditional cash transfers more broadly, to contribute to preventing the wasting and stunting status of children experiencing extreme poverty. While cash transfer programs have been lauded for their impacts on health and educational impacts among women and children, it is important to recognize that with evolving contexts, these programs must be continuously revised to ensure that the dynamic needs of target populations are appropriately met and addressed. Specific to 4Ps, this thesis offers insight on the association between 4Ps and wasting and stunting to guide further research on the relationship between this program and undernutrition among children.

The findings from this study support the importance of community-based interventions to address the nutritional outcomes of children amid resource-constrained and variable social protection programs. As this study did not find significant associations between household enrollment in 4Ps

and the wasting status of children, this finding highlights the value in supporting community-based nutritional interventions. While social protection programs such as 4Ps target the underlying determinants of nutrition, non-governmental organizations (NGOs) operating in community-based settings, such as ICM, have a direct connection to communities and can provide faster emergency responses to prevent the onset of wasting during shocks of food insecurity and illness. For example, ICM delivers direct nutrition interventions through screening and monitoring children in the areas where they work, and addresses undernutrition by delivering ready-to-use therapeutic foods (Lau et al., 2020) alongside active case finding and referrals to local health facilities for other diseases (e.g., tuberculosis) that are exacerbated by undernutrition (Lau et al., 2020; Lee et al., 2019). Moreover, ICM has created a system that is able to respond to food insecurity shocks and emergencies such as Typhoon Odette (December 2021) and the COVID-19 pandemic (Go et al., 2020; International Care Ministries, 2021, 2022). Overall, this study underscores the continued need for community-based management of undernutrition in resource-constrained settings (i.e., nutrition-specific interventions) to address the nutritional needs of children in combination with improvements to broader social protection programs (i.e., nutrition-sensitive interventions).

In addition, this thesis also provides an example of a collaborative research project between a non-governmental organization (ICM) and a Canadian global health research group. While the focus of this thesis is not directly related to ICM's interventions and programming, a primary goal of this overall project was to collaboratively develop a rigorous process to clean, analyze, and report on secondary data to provide a foundation for subsequent collaborative research activities and intervention programming within ICM. In addition, a secondary output of this research project is the completion of a technical report external to this thesis that will analyze data from ICM's nutritional home-based feeding program to provide insight into the quality of the data and the impacts of the home-based feeding program on children's nutritional status. Overall, this thesis illustrates the opportunities of forming research partnerships through secondary data analysis while practicing shared goal setting and reciprocity.

## 3.4 Implications of findings

The 2021 State of Food Security and Nutrition Report highlights climate variability and extremes as one of the major factors challenging food security and nutrition globally (FAO et al., 2021). Findings from this thesis offers insight for social protection programs across resource-constrained

settings to leverage existing systems in order to respond to climate emergencies and disasters. Adapting cash transfers and other forms of social assistance is critical in the context of evolving climate related emergencies to ensure that children are meeting their nutritional needs. Especially among areas with high risks of extreme weather events which are compounded by resource constraints and poverty, effective adaptive social protection provides a way by which populations can be supported to prepare, cope, and adapt to shocks and prevent poor nutritional outcomes in children that impede growth and development. The incorporation of adaptive social protection will require additional strengthening of supply-side resources that will ensure high-quality services for program participants. In addition, the integration of nutrition-specific services that directly treat acute malnutrition is critical to ensure the health and nutrition of children during shocks of food insecurity and illness.

More specifically, this research has implications for 4Ps programming in the Philippines. The Rapid Nutrition Assessment Survey by the Department of Science and Technology found that more than two thirds of surveyed households experienced moderate to severe food insecurity once COVID-19 lockdown restrictions were implemented in the Philippines (Angeles-Agdeppa et al., 2022). The disproportionate impact of public health emergencies such as COVID-19 on populations experiencing poverty is evident as households in the lowest income group were 1.7 times more likely to be food insecure (Angeles-Agdeppa et al., 2022). Worsening climate change is also expected to increase extreme weather events in the Philippines, which will disproportionately impact the health and livelihoods of individuals and households experiencing poverty. When Typhoon Haiyan occurred in the Philippines in 2013, it was estimated that 1.35 million children and 65,000 pregnant women were at risk of undernutrition (USAID, 2013). Typhoon Odette, the most recent super typhoon to affect the Philippines in December 2021, affected 2.68 million across 10 regions and impacted regions with already high rates of stunting and wasting (World Food Programme, 2021, 2022). This study provides insight into the effects of 4Ps on wasting and stunting among children experiencing extreme poverty in the Philippines and suggests ways by which the existing systems and operations of the program can be leveraged to address these conditions more effectively in the context of growing and evolving emergencies. Moreover, it highlights the need to integrate existing nutritional programming in the Philippines within 4Ps to effectively treat acute undernutrition if the current conditionalities and entitlements provided through the program are insufficient to prevent wasting outcomes among children.

## 3.5 Future research

More research is required to better understand the potential impact of 4Ps on both wasting and stunting. First, future work could seek to better understand the pathways and mechanisms by which 4Ps program components (i.e., conditionalities and entitlements) impact the nutritional outcomes of children. In this regard, both quantitative and qualitative research would be beneficial to understand how program components need to be adjusted and revised to better meet the needs of participants. Additionally, more research could be conducted to find program convergence between 4Ps and other nutritional programs in the Philippines to either prevent undernutrition by supporting the social determinants of health or integrating existing treatment interventions into 4Ps. Additional efforts should also be directed towards ensuring that 4Ps is able to respond and adapt to the dynamic needs of its program participants given changing contexts and emergencies.

As the cross-sectional nature of this data limits the causal interpretations of the findings, longitudinal studies are needed to confirm the findings on the association of 4Ps with wasting and stunting. The recent work to update and revise the Listahanan targeting system (DSWD, 2022) could be leveraged to concurrently design a longitudinal cohort study where eligible households are followed before and after their participation in 4Ps. In contrast to a regression discontinuity design, a longitudinal study would be able to assess changes in expected outcomes from 4Ps conditions and entitlements while including households from the lowest income levels.

This study applied multilevel logistic modelling where individual children and their household characteristics formed level 1, while specific ICM regional bases formed level 2. Findings indicated that the Intraclass Correlation Coefficient was small across both wasting and stunting regression models. This warrants further research to understand the variation of wasting and stunting status that is attributable to the differences between regional areas in the Philippines. In addition, this study included geography type (i.e., coastal areas, urban mountains, rural plains, rural mountains, urban slums) as a covariate to understand how the effect of 4Ps on wasting and stunting status is moderated by different geographic areas. Further research could build on the incorporation of regional- and community-level covariates to better understand how variation in the implementation of 4Ps across different areas in the Philippines (e.g., proportion of enrolled participants, availability of and access to bank machines to deliver cash transfers) affects expected program outcomes.

Lastly, while this study did not account for the correlation between wasting and stunting, it should be noted that emerging literature has more recently called for the recognition of the similarities in the pathways through which these conditions occur and the importance of finding convergence between prevention and treatment programs (Gaupholm et al., 2022; Sadler et al., 2022; Thurstans et al., 2022). Wasting and stunting have shared drivers including poor maternal health, inadequate water, sanitation, and hygiene environments, and severe food insecurity. Recognizing the co-occurrence of these conditions could lead to an improved incorporation of treatment and prevention programs within social protection interventions.

## 3.6 Concluding reflections

There is potential for social protection strategies to support the nutritional outcomes of children and promote healthy growth and development during early critical life stages. Moreover, effective implementation of social protection can contribute to breaking intergenerational cycles of poverty by providing a foundation for optimal health and wellbeing throughout the life course among children experiencing poverty. In the context of a worsening climate crisis and other compounding emergencies, social protection programs must be able to adapt to the evolving and dynamic needs of program participants in order to make significant impacts while ensuring the availability of appropriate resources in addition to other necessary treatment services.

In the Philippines, the effects of 4Ps on the nutritional outcomes of children can be significantly strengthened. First, 4Ps could be improved through enhancing the provision of resources towards participants to increase the adaptive capacity of households experiencing poverty in the context of increasing extreme weather events compounded by resource-constrained healthcare systems. Moreover, updating 4Ps to integrate direct nutritional treatment into referral systems and increasing high quality supply-side resources should be considered to maximize the impact of the program on the nutritional outcomes of children.

The rationale behind the institutionalization of 4Ps states that the "highest priority will be given to the enactment of measures that protect and enhance the right of all people to human dignity, reduce social, economic, and political inequalities, and remove cultural inequities by equitably diffusing wealth and political power for the common good" (*An Act Institutionalizing the Pantawid Pamilyang Pilipino Program (4Ps)*, 2019). In a country where inequality and poverty persist, it is evident that these motivations have yet to be realized despite codifying 4Ps into law. Further investment into

structural reforms and enhancing the adaptive capacity of 4Ps should be prioritized in order to improve the health and nutritional outcomes of children experiencing poverty.

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# Appendices

## Appendix A

## Summary of data cleaning and merging

Two datasets from ICM's survey data were used to conduct secondary data analysis for this study. First, the baseline survey from the poverty alleviation programming was used to examine the sociodemographic characteristics of children included in this study. Second, screening data from the nutritional home-based feeding program was used to understand the nutritional status of children who were screened by ICM.

These two datasets were stored separately in the ICM database. From June to July 2021, the datasets were merged using the R software with support from ICM research associates and health coordinators. Data were first merged using participant ID codes followed by matching the names of participants to increase sample size (see Appendix-Table 1). These matches were verified through reviewing the regional base and community identifiers of matches. After the merging process (n= 3,401 children), additional data cleaning was conducted to remove direct and indirect identifiers as well as clean data entry errors. Children with incomplete sociodemographic information and weight-for-height, BMI-for-age, and height-for-age z-scores < -6 and > -6 were excluded from the study (see Table 2.1). After data cleaning, the data available for analysis included data pertaining to 3,005 children across 10 regional bases where ICM works.

**Appendix-Table 1.** Criteria used to merge ICM datasets from Batch 2 and Batch 3 of 2018-2019 (poverty alleviation survey and nutritional operational data) and number of participants merged before data cleaning

| Merging criteria | Number of participants merged |
|---|---|
| Participant ID | 2,912 |
| Participant names | 457 |
| Household member names | 32 |
| Total | 3,401 |

# Appendix B
## Ethics Approval Certificate

# UNIVERSITY OF WATERLOO

## Notification of Ethics Clearance to Conduct Research with Human Participants

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Principal Investigator: Warren Dodd (School of Public Health Sciences)

Student investigator: Monica Bustos (School of Public Health Sciences)

Co-Investigator: Lincoln Lau (International Care Ministries)

Co-Investigator: Helena  Manguerra (International Care Ministries)

Co-Investigator: Kendall Wilson (International Care Ministries)

File #: 43368

Title: Assessing health and nutritional interventions for children experiencing poverty in the Philippines: A retrospective analysis

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The Human Research Ethics Board is pleased to inform you this study has been reviewed and given ethics clearance.

**Initial Approval Date: 08/03/21 (m/d/y)**

University of Waterloo Research Ethics Boards are composed in accordance with, and carry out their functions and operate in a manner consistent with, the institution's guidelines for research with human participants, the Tri-Council Policy Statement for the Ethical Conduct for Research Involving Humans (TCPS, 2nd edition), International Conference on Harmonization: Good Clinical Practice (ICH-GCP), the Ontario Personal Health Information Protection Act (PHIPA), the applicable laws and regulations of the province of Ontario. Both Boards are registered with the U.S. Department of Health and Human Services under the Federal Wide Assurance, FWA00021410, and IRB registration number IRB00002419 (HREB) and IRB00007409 (CREB).

This study is to be conducted in accordance with the submitted application and the most recently approved versions of all supporting materials.

**Expiry Date: 08/04/22 (m/d/y)**

Multi-year research must be renewed at least once every 12 months unless a more frequent review has otherwise been specified. Studies will only be renewed if the renewal report is received and approved before the expiry date. Failure to submit renewal reports will result in the investigators being notified ethics clearance has been suspended and Research Finance being notified the ethics clearance is no longer valid.

Level of review: Delegated Review

Signed on behalf of the Human Research Ethics Board

Joanna Eidse, Research Ethics Officer

This above named study is to be conducted in accordance with the submitted application and the most recently approved versions of all supporting materials.

Documents reviewed and received ethics clearance for use in the study and/or received for information: file: Approved Protocol w Letter_U of T Ethics.pdf file: Confidentiality Agreement for Interns (Monica)_KW.pdf file: OFFICIAL_PRESURVEY_2018_Batch_3.pdf file: OFFICIAL_POSTSURVEY_2018_Batch_3.pdf file: UofT ethics_confirmation of renewal.pdf

Approved Protocol Version 2 in Research Ethics System

**This is an official document. Retain for your files.**

**You are responsible for obtaining any additional institutional approvals that might be required to complete this study.**

# Appendix C

# Overview of Wealth Index Construction

The construction of the Wealth Index adapted the methods from the Demographic Health Survey where Principal Component Analysis (PCA) was used to create a weighted score to assess of study participants (Filmer & Pritchett, 2001; Rutstein & Johnson, 2004; Vyas & Kumaranayake, 2006).

The following steps were taken to construct the Wealth Index for this study:

1) Descriptive statistics (frequencies and proportions) were calculated for each asset-based indicator in the dataset to identify indicators that discriminate households according to socioeconomic status. Indicators that have more than 90% ownership or non-ownership were removed as they would have contributed low weights in the PCA and not contribute to the final score. The final indicators included in the index consisted of appliance (television, radio, electric fan, phone, motorcycle) and furniture (bed) ownership as well as housing materials (roof, flooring, walls) and structures (size, ownership status, water supply source, toilet type, electricity).

2) PCA was conducted to extract the first principal component loadings to use as the weights for indicators. The indicators were standardized and the PCA was analyzed using the covariance matrix. The eigenvalue (4.006) was assessed to determine the percentage of the variation in the total data explained by the principal component (16.0%).

3) Weights were multiplied to the standardized indicators (z-scores) and the score for each indicator was summed to produce an overall Wealth Index for each household. Households were categorized according to quintiles to assess levels of socioeconomic status.

4) Internal coherence was assessed by calculating the frequency and proportion of households that have the asset by income quintile. All indicators followed a consistent trend of increasing or decreasing proportion according to wealth quintile except for having *lawanit* walls, galvanized iron roofs, and dirt floors, but were kept in the index score to increase discrimination of household wealth through the index.

5) Construct validity was assessed by calculating descriptive statistics of child nutritional status, household head's education status, total estimated income, and enrollment in 4Ps by wealth quintile. Malnutrition status, 4Ps enrolment, and household income did not show clear patterns by the income quintiles. However, the years of education of the household head (likely most robust indicator of socioeconomic status in the dataset) showed a consistent positive trend, where, as income quintile increases, so does the mean years of education of the household head.

# Appendix D

# Overview of Household Hunger Scale

The hunger and food insecurity related questions in the ICM dataset were adapted from the Household Hunger Scale (HHS), which was developed from the Household Food Insecurity Access Scale (HFIAS) by the US Agency for International Development (USAID) (Leroy et al., 2015). The HHS uses the last three questions from the nine item HFIAS measure. It captures the universal experiences of the quantity dimension of food access by assessing the severe experiences of food shortage and actual experiences with hunger. The HHS was developed for the purpose of monitoring and evaluation as well as to produce comparable results across contexts (Leroy et al., 2015).

Questions/Indicators:

1) Over the last month, did your household go a whole day and night without eating?
2) Over the last month, did your household have no food to eat of any kind?
3) Over the last month, did your household go to sleep at night hungry?

The response options for each of the questions and their equivalent scores are listed below (Ballard et al., 2011):

**Appendix-Table 2.** Household Hunger Scale (HHS) response options and equivalent scores

| Response option | Score |
|---|---|
| Never | 0 |
| Rarely / Once a month | 1 |
| Once a week / Several days a week / Every day | 2 |

The values are summed for each of the three questions and each respondent will have a score ranging from 0 to 6 (Ballard et al., 2011). The score will then be categorized into three categories as indicated in Table 6 below:

**Appendix-Table 3.** Household Hunger Scale (HHS) cut-off scores

| Household Hunger Scale (score) | Household Hunger Categories |
|---|---|
| 0-1 | Little to no hunger in the household |
| 2-3 | Moderate hunger in the household |
| 4-6 | Severe hunger in the household |

Internal consistency was assessed using Cronbach's alpha. The correlation between the final Household Hunger Scale score and previous household hunger indices as well as the education level of the household head and mother were calculated to assess construct validity. Cronbach's alpha among the three indicators was 0.79 and indicated acceptable internal consistency.

As a proxy of socioeconomic status, the correlation between food insecurity and the number of years of education of household heads was calculated. The correlation between education and the HHS score is negative (-0.122; 95% CI=(-0.155, -0.088), where, as education increases, the HHS score decreases.
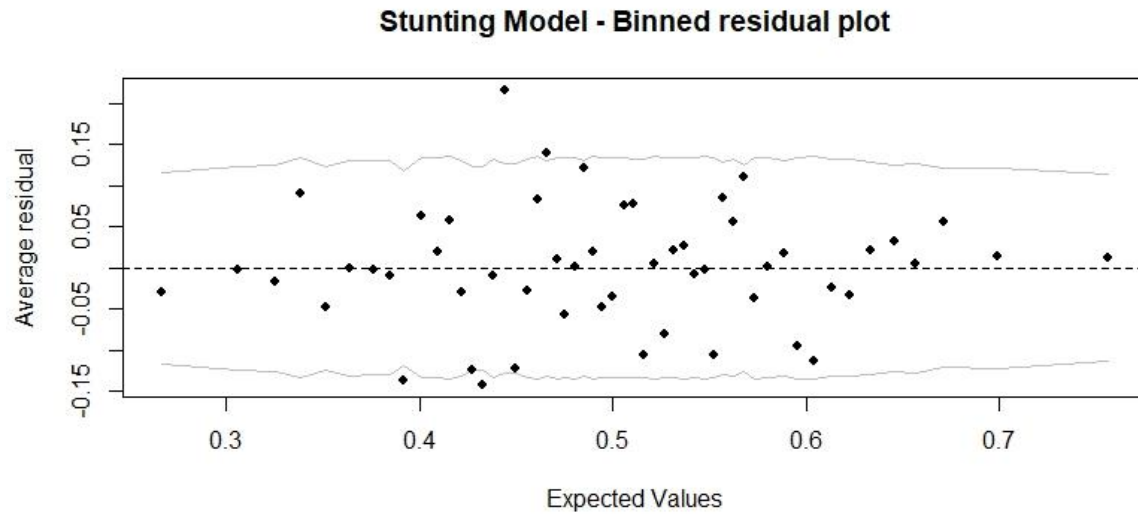
# Appendix E

## Model diagnostics with binned residual plots

Binned residual plots were used to assess overall model fit of the multilevel regression models. Binned residual plots were calculated using the arm package on R[3]. The points in the graph indicate the average residuals of binned observations plotted against the predicted probability for each bin. The grey lines indicate the 95% confidence limit estimated using the standard deviation of each bin's residuals. While there are a few points outside the 95% confidence limits, the models are still appropriate as majority lie within the 95% confidence limits as indicated in Figure 1 and Figure 2. The observed random scatter in the plots also indicate acceptable model fit
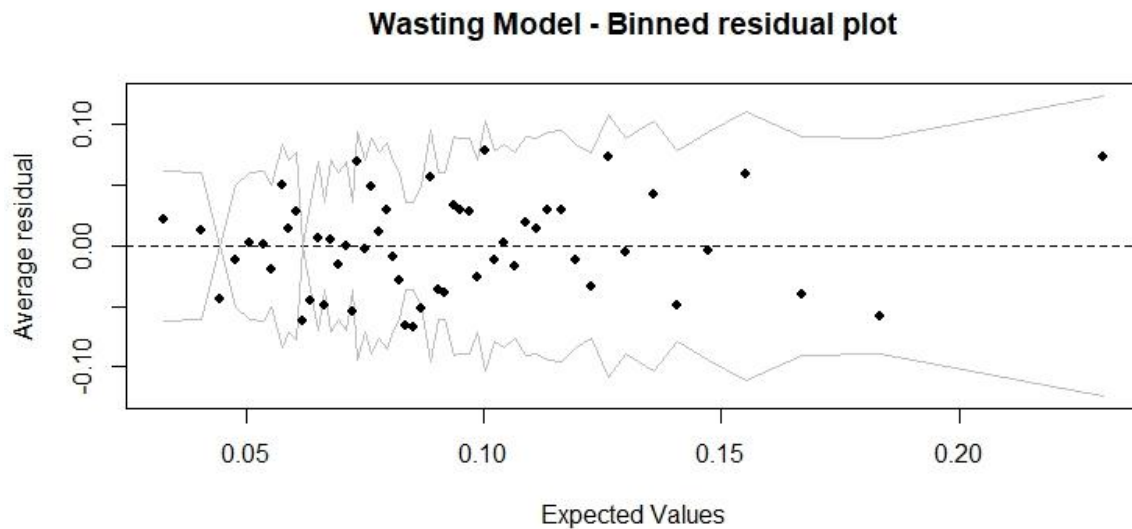


**Appendix-Figure 1.** Binned residual plot of the multilevel logistic model of household enrollment in the *Pantawid Pamilyang Pilipino Program* on wasting status controlling for sociodemographic factors

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[3] https://cran.r-project.org/package=arm

**Stunting Model - Binned residual plot**

**Appendix-Figure 2.** Binned residual plot of the multilevel logistic model of household enrollment in the *Pantawid Pamilyang Pilipino Program* on stunting status controlling for sociodemographic factors

# Appendix F
## Summary of model selection using deviance test statistics

**Appendix-Table 4.** Deviance test statistic between standardized main effects and standardized interaction effects models of household enrollment in 4Ps on wasting status

| Model | No. of Parameters | AIC | BIC | logLik | Deviance | Chisq | Df | Pr(>Chisq) |
|-------|------------------|------|------|--------|----------|-------|-----|-----------|
| Model 3 | 15 | 1817.80 | 1937.92 | -908.90 | 181780 | | | |
| Model 5 | 19 | 1853.42 | 1967.57 | -907.71 | 1815.42 | 2.37 | 4 | 0.67 |

**Appendix-Table 5.** Deviance test statistic between standardized main effects and standardized interaction effects models of household enrollment in 4Ps on stunting status

| Model | No. of Parameters | AIC | BIC | logLik | Deviance | Chisq | Df | Pr(>Chisq) |
|-------|------------------|------|------|--------|----------|-------|-----|-----------|
| Model 3 | 15 | 4080.05 | 4170.17 | -2025.03 | 4050.05 | | | |
| Model 5 | 19 | 4074.03 | 4188.18 | -2018.01 | 4036.03 | 14.02 | 4 | <0.01 |