Rwanda Nutrition Situation Analysis and Policy Implications

ACKNOWLEDGEMENT

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CURRENCY EQUIVALENTS

(Exchange Rate Effective: December 31, 2017)

Currency Unit	=	Rwandan Franc (RWF)
RWF XX	=	US$1
US$	=	SDR 1

FISCAL YEAR

July 1 - June 31

ABBREVIATIONS AND ACRONYMS

ANC	Antenatal Care
BMI	Body Mass Index
CT	Cash transfers
CHWs	Community Health Workers
DHS	Demographic and Health Survey
DPEM	District Plans to Eliminate Malnutrition
HB-CC	The Home / Community Based Child Care
HAZ	Height-for-age z-scores
IFPRI	International Food Policy Research Institute
MIGEPROF	Ministry of Gender and Family Promotion
NECDP	National Early Childhood Development Program
SBCC	Social and Behavior Change Communication
SUN	Scaling Up Nutrition
VUP	Vision Umurenge Program
UNICEF	United Nations Children's Fund
WHO	World Health Organization

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Executive Summary

Rwanda has made dramatic progress in improving child survival, reducing poverty levels, increasing agricultural production, and improving environmental health, and has consistently outperformed other countries in the region on many indicators of socio-economic development. However, there has been only modest progress in reducing stunting or chronic malnutrition, with stunting declining from 48 percent in 2000 to 38 percent in 2015. While there was an accelerated decline in stunting prevalence between the last two surveys, there remain significant wealth and geographic disparities. Children in the bottom two wealth quintiles experienced modest improvements in stunting between 2010 and 2015, those in rural households were more likely to be stunted, and the highest levels of stunting were concentrated in the western districts.

This analysis sought to examine the key determinants associated with stunting in Rwanda, and to present the policy implications for accelerating the reduction in stunting. Between 2000 and 2015, there were encouraging trends in the underlying determinants of malnutrition (i.e. access to adequate food, environmental health and care practices) among Rwandese children. The most significant improvements occurred in coverage of care practices (i.e., antenatal, birth, and postnatal). Despite these improvements significant gaps persist. According to the 2014/2015 DHS, 34 percent of children under two years of age have a minimally acceptable diet, showing a small increase since 2010 but below levels observed in 2005; adequacy in environmental health declined slightly between 2010 and 2015, from 39 to 37 percent; and 24 percent received adequate care, in comparison to 18 percent in 2010. Only 4 percent have access to all three components.

While the trends over the five years between the last two surveys were generally encouraging the rates of improvement need to be accelerated to have a more discernible impact on stunting. The utilization of and access to multiple services and resources, maternal characteristics, birth outcomes, household poverty, and area of residence were significant determinants of stunting.

A clear implication from the findings was that interventions to improve childhood growth need to be implemented in tandem across sectors and need to be harmonized to ensure not only increased coverage levels but that each child is able to benefit from all interventions. Furthermore, given the observed geographic and wealth disparities, greater efforts are needed to target districts with high levels of stunting and households in the bottom two wealth quintiles. Interventions across social protection and health sectors can play a significant role in accelerating stunting reduction in Rwanda. Key recommendations include:

I. *Health*: (a) improving the health and nutrition situation of pregnant and lactating women; (b) ensuring adequate food intake and micronutrient status in children, particularly those from poor and vulnerable households; (c) improving caregiver understanding of appropriate child feeding and care practices; and (d) strengthening the community health worker program to improve the delivery of interventions at the community level.

II. *Social protection*: (a) strengthening of existing mechanisms to ensure identification, targeting, referral, and tracking of the most vulnerable mothers and children; (b) providing incentive schemes to encourage and increase participation in health and behavior change

interventions and purchase of nutritious food commodities; and (c) ensuring participation of vulnerable mothers and households in community education campaigns and demonstration sessions.

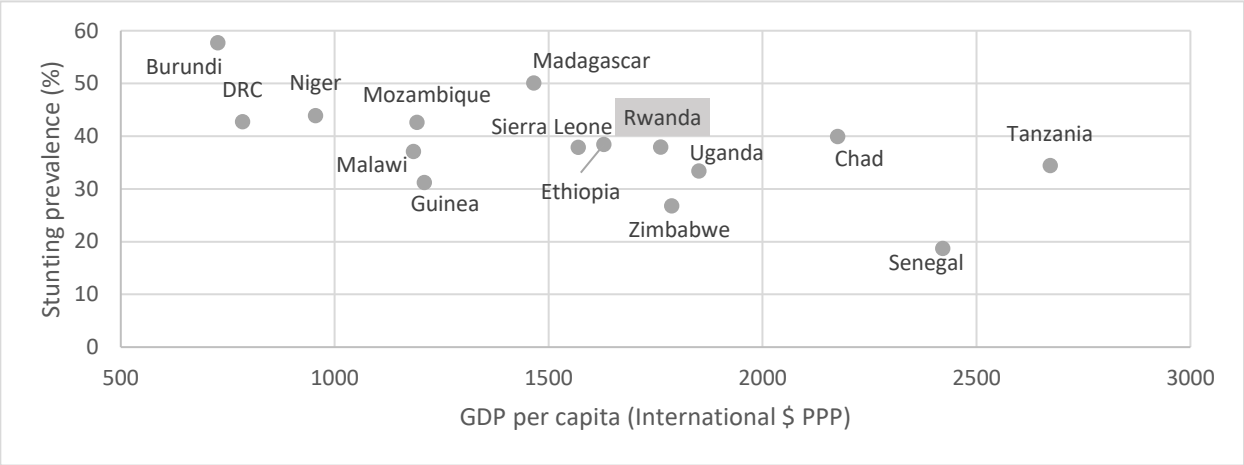
Rwanda Nutrition Situation Analysis

Introduction

1. **Rwanda has made dramatic progress in improving child survival, reducing poverty levels, increasing agricultural production, and improving environmental health.** Rwanda has consistently outperformed other countries in the region on many or most of these critical aspects of socio-economic development. Over the past fifteen years there has been a steep decline in under-five mortality with the current rate (50 per 1000 live births) surpassing the 2015 averages for Africa (83) and Low-Income Countries (76). Rwanda has also experienced a rapid drop in poverty levels and increases in agricultural production. With the country's economy growing at more than eight percent per year, the share of the population below the national poverty line dropped from 59 to 45 percent during 2001-2011. Rwanda has also seen a small reduction in inequality, with higher growth in consumption in rural areas during 2006-2011. The country's score on the Global Hunger Index--a composite indicator of undernourishment and child mortality---dropped by about 40 percent during 2000-2017 (IFPRI, 2013). The average per capita calorie intake increased by almost 20 percent over the past decade (FAOSTAT, 2014).

2. **The nutrition situation among young children however remains a major outlier requiring Rwanda to redouble its efforts.** Overall progress in reducing the prevalence of undernutrition in children under five has been steady but generally slow since 2000. While childhood stunting has declined at an accelerated rate (2010-2014), the country could not attain the 18 percent stunting target for 2018. Moreover, the decline in undernutrition has benefitted most those in the higher wealth quintiles, with the poorest groups experiencing only limited progress over the past fifteen years. The stunting rate remains at a stubbornly high level of about 38 percent (2015), placing Rwanda among the countries in Africa with relatively high rates of undernutrition. Compared to other countries at similar socio-economic levels (Figure 1), the prevalence of stunting in Rwanda is higher than in neighboring countries (e.g. Tanzania: 34.4; Uganda: 33.4) and is double the level of countries which have introduced major programs to tackle child undernutrition (e.g. Senegal: 18.7).

Figure 1: Prevalence of stunting and GDP per capita, Rwanda and selected low-income African countries



Source: World Development Indicators

3. **The Government of Rwanda is cognizant of these issues, and has made a strong, high-level commitment to accelerate the reduction in stunting.** Recognizing the multi-sectoral nature of the malnutrition problem, the government has recently established a National Early Childhood Development Program (NECDP) within the Ministry of Gender and Family Protection (MIGEPROF) to ensure high-level coordination of all nutrition programs, under the leadership of the Prime Minister. The NECDP has prepared a consolidated multi-sectoral Single Action Plan for accelerating the reduction in childhood stunting and investing in the early years that was recently endorsed by the social cluster ministers. The NECDP aims to provide a platform to coordinate government and donor-supported interventions on nutrition. Rwanda has been an active member of the Scaling Up Nutrition (SUN) global alliance and is striving to mainstream interventions in different programs to maximize the impact on stunting. The government requested Bank support to take stock of the current situation and to identify priority interventions for inclusion in a World Bank funded stunting prevention and reduction program, building on the nutrition analyses in the 2015 Poverty Assessment Report as well as the extensive Stakeholder and Action Mapping for Rwanda 2014/2015 exercise carried out in collaboration with numerous partners.

4. **This study has two major objectives.** First, to better understand trends, patterns and determinants of child malnutrition in Rwanda with a focus on stunting. Second, to identify appropriate strategies and policies to accelerate the reduction in stunting. The preparation of this study has run in parallel to the design and delivery of three complementary Bank operations in social protection, health and nutrition and agriculture that aim to contribute to turning the tide on stunting in Rwanda. The study has been conducted in consultation with Rwandese stakeholders and other development partners, building on existing analytic and programmatic work to ensure ownership and foster greater collaboration.

5. **The report is divided into two sections.** The first section provides a comprehensive, up-to-date picture of undernutrition among Rwandese children. It analyzes the nature, scope and geographic distribution of undernutrition among children, highlighting socioeconomic and geographic disparities

and trends over the past fifteen years, as wells as examining the underlying determinants of stunting. The second section lays out the main policy and programmatic priorities.

SECTION I

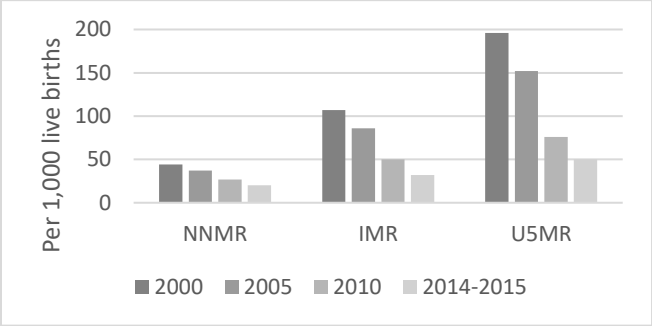
Trends and Patterns in Childhood Stunting

Summary of trends and patterns in stunting

- **The moderate pace of decline in stunting between 2000 and 2015 belies the rapid scale-up of health services and the impressive gains made in child and maternal mortality.**
- **Stunting is disproportionately high among poor and rural children, and the pace of decline has been slower among these groups.**
- **Stunting increases sharply for children after six months, the age when most children are introduced to complementary foods.**
- **Children of higher birth order and shorter birth intervals are more likely to be stunted.**
- **Stunting prevalence varies by maternal education and nutritional status.**

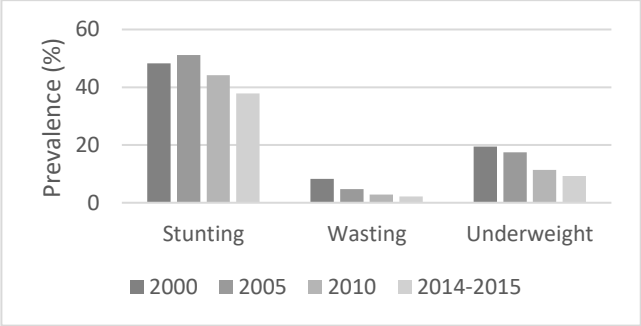
6. **While Rwanda has made dramatic progress in improving infant and child survival, stunting rates remain persistently high, as can be seen in Figures 2 and 3 below.** With the rapid scale up of basic health services and overall improvement in socio-economic conditions, the under-five mortality rate dropped sharply from 196 (2000) to 50 (2015) per 1,000 live births. Likewise, the infant mortality rate declined from 107 to 32 per 1,000 live births during the same period. While the decline in the neonatal mortality rate was somewhat slower, Rwanda also experienced over a 50 percent drop from 44 to 20 per 1,000 live births. Most impressively, since 2000 the maternal mortality ratio dropped steeply from 1,071 to 210 maternal deaths per 100,000 live births, reflecting the expansion in access to critical safe motherhood interventions and broad improvements in the performance of the health system in Rwanda. These overwhelmingly positive results reflect a combination of mutually reinforcing factors, including strong political will, ambitious targets, and commensurate resources.

Figure 2: Trends in child mortality,2000-2015[1]



Source : Rwanda DHS 2000, 2005, 2010, & 2014-2015

Figure 3: Trends childhood undernutrition, 2000-2015



Source : Rwanda DHS 2000, 2005, 2010, & 2014-2015

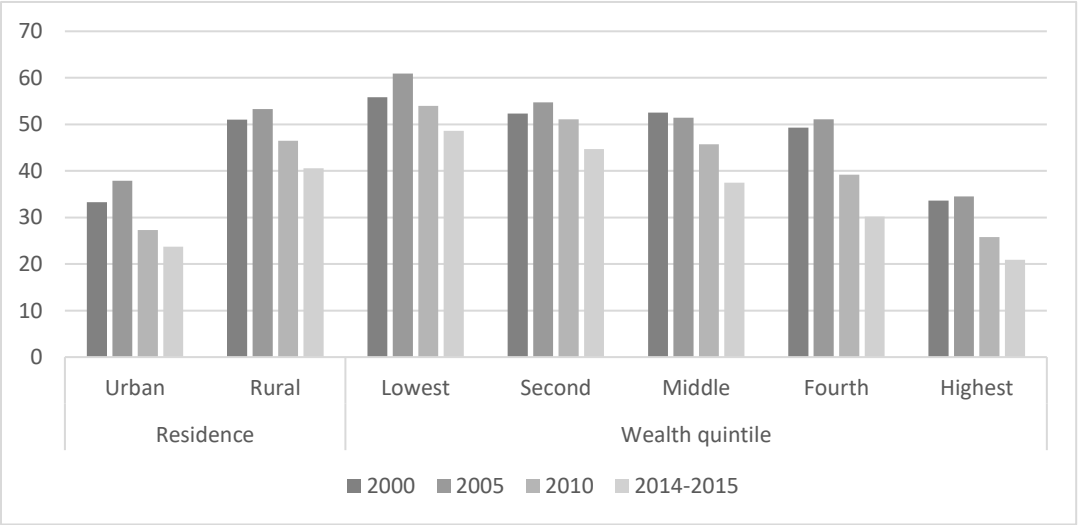
7. **Prevalence of undernutrition among children under five has also declined, but at a much slower pace.** The proportion of children under five who are wasted (too thin for height), which captures

[1] NNMR=neonatal mortality rate; IMR=infant mortality rate; U5MR=under-five mortality rate

acute malnutrition, fell from 8.3 to 2.2 percent, and underweight (too thin for age) declined from 19.5 percent to 9.3 percent between 2000 and 2015. Both wasting and underweight are below the WHO severity thresholds, with Rwanda having made impressive progress in these areas. While stunting (too short for age), which reflects long-term, *chronic malnutrition*, also declined at a steady pace, and at an accelerated rate during 2010-2015, more than one in three children (roughly 38 percent) are still stunted (2014/2015 Demographic and Health Survey, DHS). These child growth patterns are strong predictors of the health and productivity of future generations and of human capital development and run the risk of undermining economic prospects and the country's rapid growth trajectory.

8. **Stunting affects the poor and underserved disproportionately, and progress in reducing stunting in these groups has been slow.** Like many other countries in Sub-Saharan Africa, prevalence of stunting in Rwanda is much higher among rural residents (40.6 percent), compared to their urban counterparts (close to 24.0 percent), and among the poorest twenty percent of the population (about 49.0 percent), compared to the richest twenty percent (roughly 21.0 percent), as seen in Figure 4. The average annual rate of reduction between 2005 and 2015 is much lower among rural residents (about 3.0 percent) and the poorest 20 percent of the population (roughly 2.0 percent), compared to those residing in urban areas and the richest 20 percent (5.0 percent).

Figure 4: Disparities in stunting prevalence by wealth and residence, 2000-2015

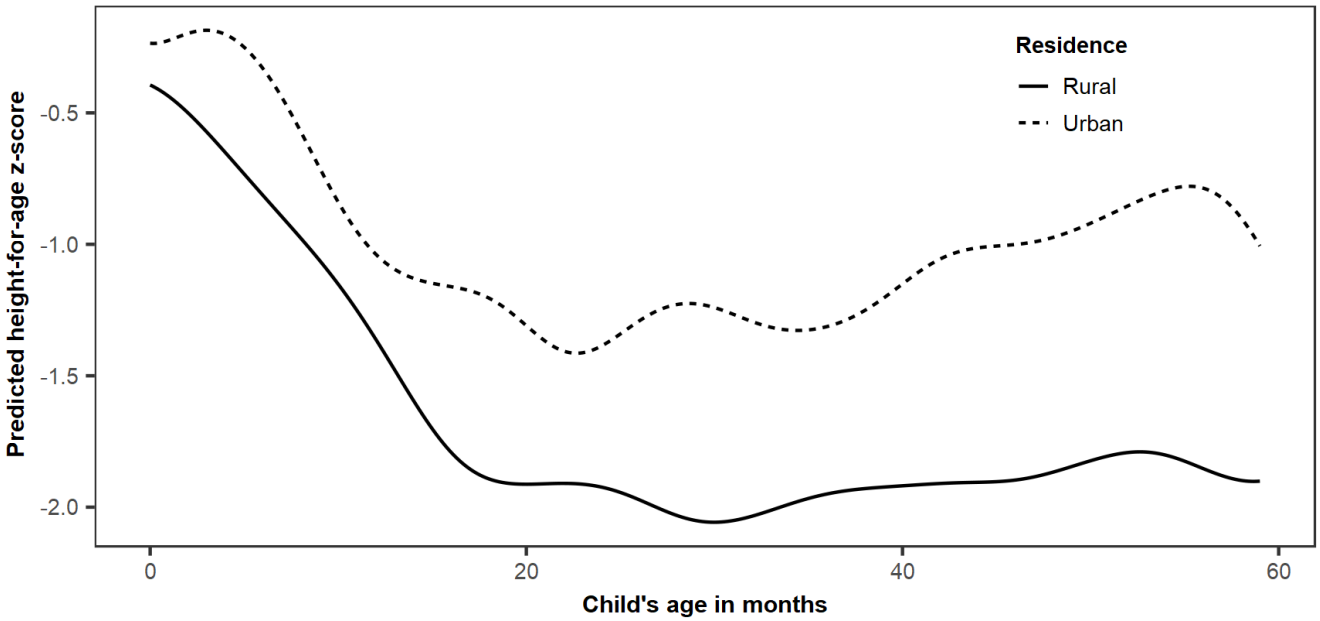


Source: Rwanda DHS 2000, 2005, 2010, & 2014-2015

9. **Children in urban households were only slightly taller at birth than their rural counterparts but these differences worsen over time**. Height-for-age z-scores (HAZ) increase progressively after about 12 months, reflecting earlier nutritional deficiencies among rural children (Figure 5). A similar pattern can be observed when comparing children from households in the top wealth quintile with those in the bottom wealth quintile (Figure 6).

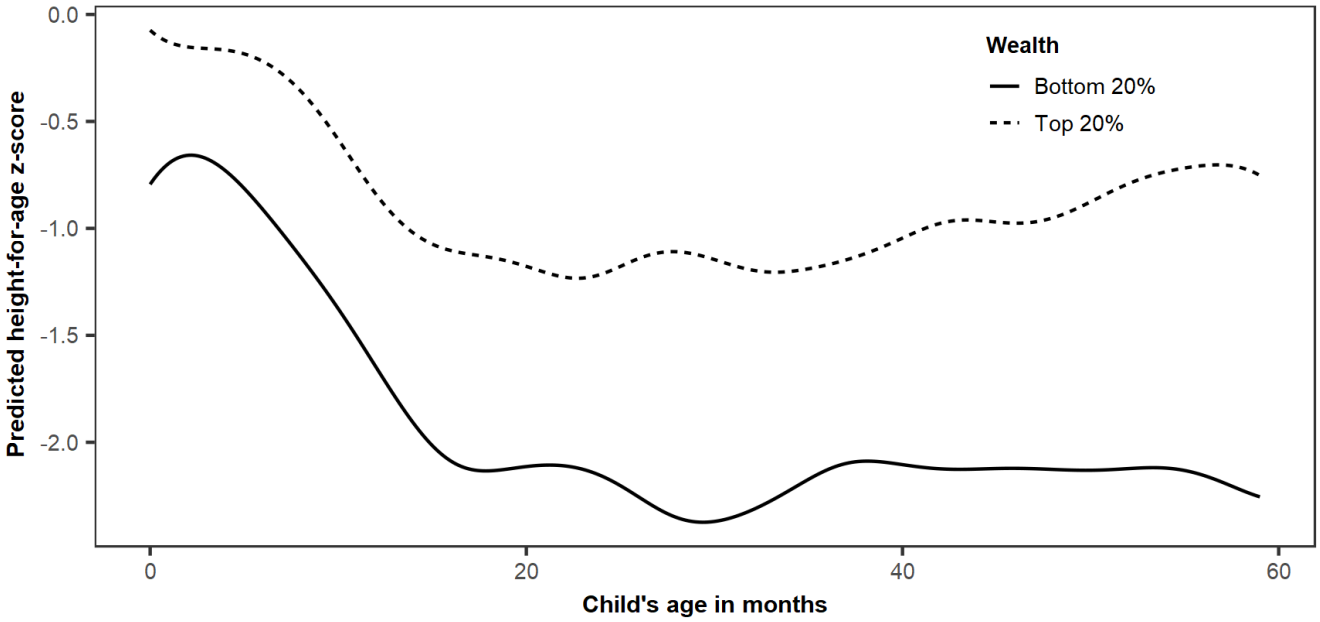
10. **Disparities in stunting rates have been increasing with children from the bottom two wealth quintiles having rates which are nearly double those of children from the top two wealth quintiles**, (Figure 7). However, even one quarter of children from the top two wealth quintiles are stunted, suggesting that poverty is not the only predictor of child undernutrition. As described in the 2015 Poverty Assessment Report the geographic distribution of stunting is only partially related to poverty. Using data from the most recent DHS survey and Integrated Household Living Conditions Survey (EICV 4), Figure 8 illustrates the geographic distribution of stunting and poverty. While poverty was most prominent in districts in the western and southern provinces, most districts had stunting levels of high or very high public health significance (>30 percent and >40 percent). Only one area, the urban district of Kicukiro, had a stunting prevalence considered to be of low significance, with three surrounding districts (Nyarugenge, Gasabo, and Rwamagana) and Kirehe in the southeast having levels considered of medium significance.

Figure 5: Disparities in height-for-age z-score trends by residence



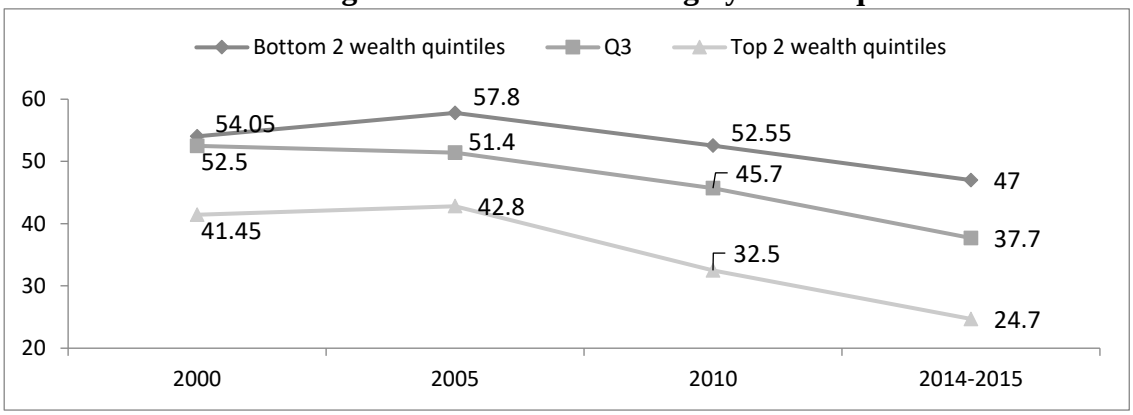
Source: Authors' calculation using data from Rwanda DHS 2014-2015

Figure 6: Disparities in height-for-age z-score trends by wealth



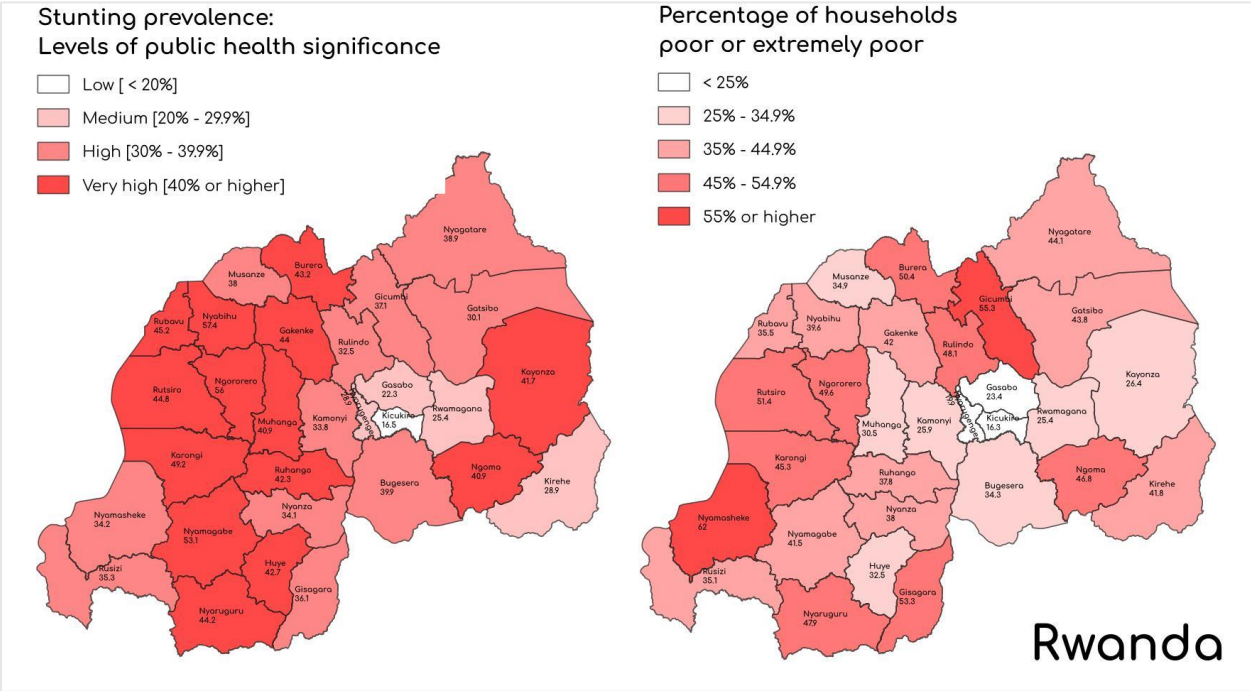
Source: Authors' calculation using data from Rwanda DHS 2014-2015

Figure 7: Trends in stunting by wealth quintile



Source: Authors' calculation using data from Rwanda DHS 2000, 2005, 2010, and 2014-2015

Figure 8: Stunting prevalence and poverty rates by district

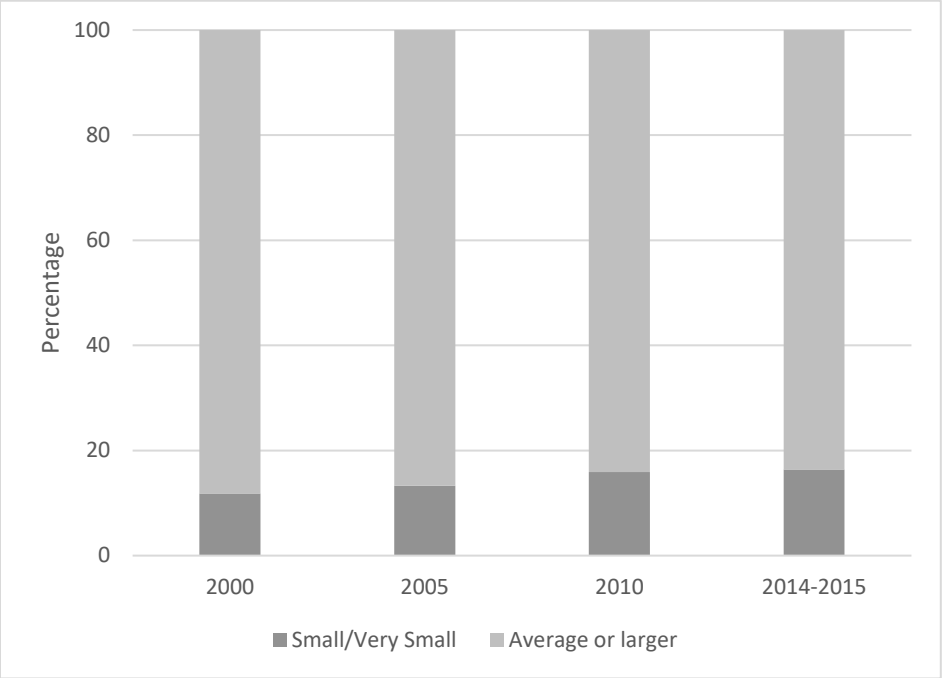


Source: Rwanda DHS 2014-2015 and EICV 4

11. **Child's size at birth, which raises the probability of being stunted, has declined**. Using mother's subjective impressions of the size of their children at birth, there is an increase in the proportion of mothers reporting their children to be small or very small, from 12 (2000) to 16 (2015) percent (Figure 9). While birth size was based on mothers' reports, this has been shown to be a good predictor of outcomes related to birth weight, particularly in settings with poor quality birthweight data (Haque, Tisha, & Huq, 2015; Sreeramareddy, Shidhaye, & Sathiakumar, 2011). Moreover, there is some corroboration of these impressions when one examines trends in the HAZ of recently born children that were higher in 2010 than in 2015 and this remained true for newborns through to infants about 6-8 months of age (Figure 10). Increased risk of small birth size is linked to poor maternal nutrition before and during pregnancy (Black et al., 2013).

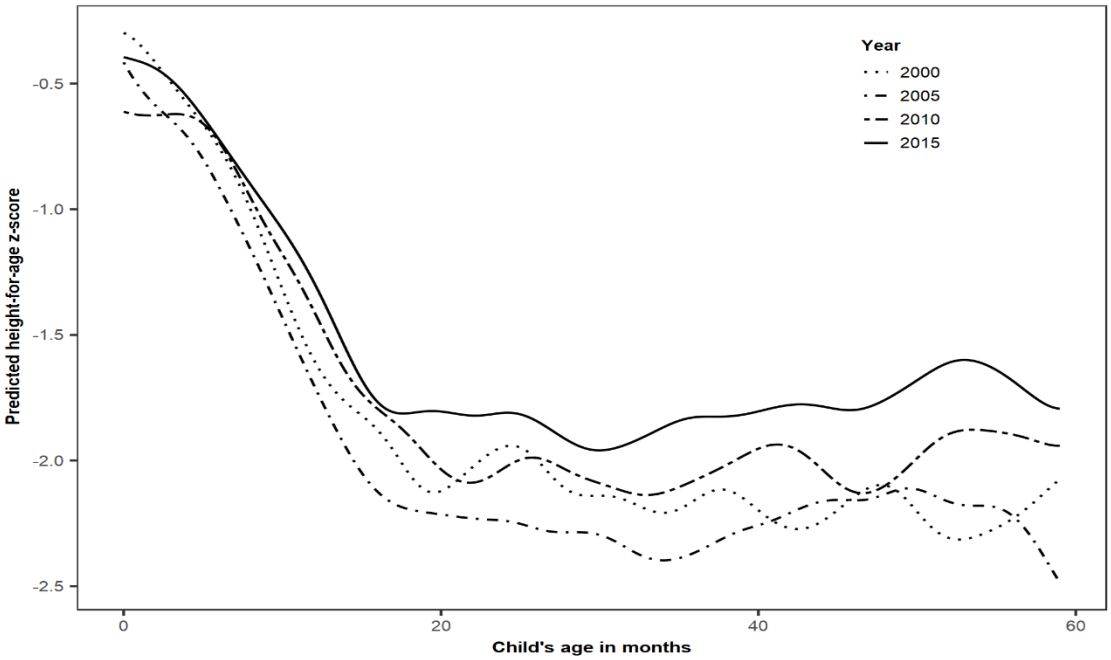
12. **The early and exclusive breastfeeding practices in Rwanda protect infants during the first six months of life.** Once children are weaned, there is a progressive rise in the probability of stunting in subsequent months (Figure 11), which is associated with the introduction of complementary foods, growing micronutrient deficits and increased exposure to infections and diseases. Nevertheless, the probability of stunting is lower for all age groups in 2014-2015 in comparison to previous surveys (Figure 11) which is consistent with the accelerated reduction in stunting rates discussed above.

Figure 9: Mothers' impressions of children's birth size, 2000-2015



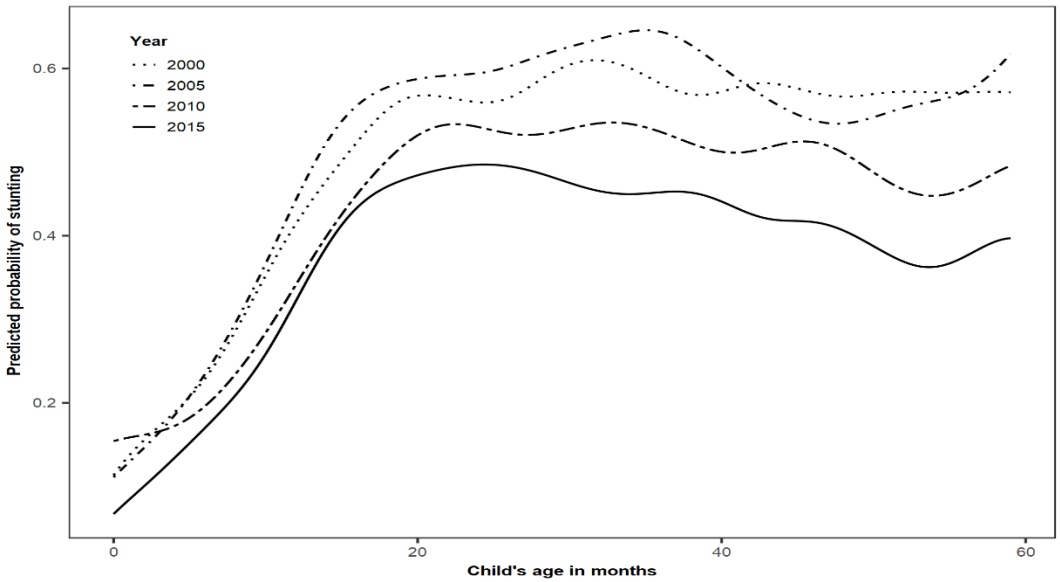
Source: Authors' calculations from Rwanda DHS 2000, 2005, 2010, & 2014-2015

Figure 10: Trends in predicted HAZ by age, 2000-2015



Source: Authors' calculations from Rwanda DHS 2000, 2005, 2010, & 2014-2015

Figure 11: Trends in predicted probability of stunting by age, 2000-2015

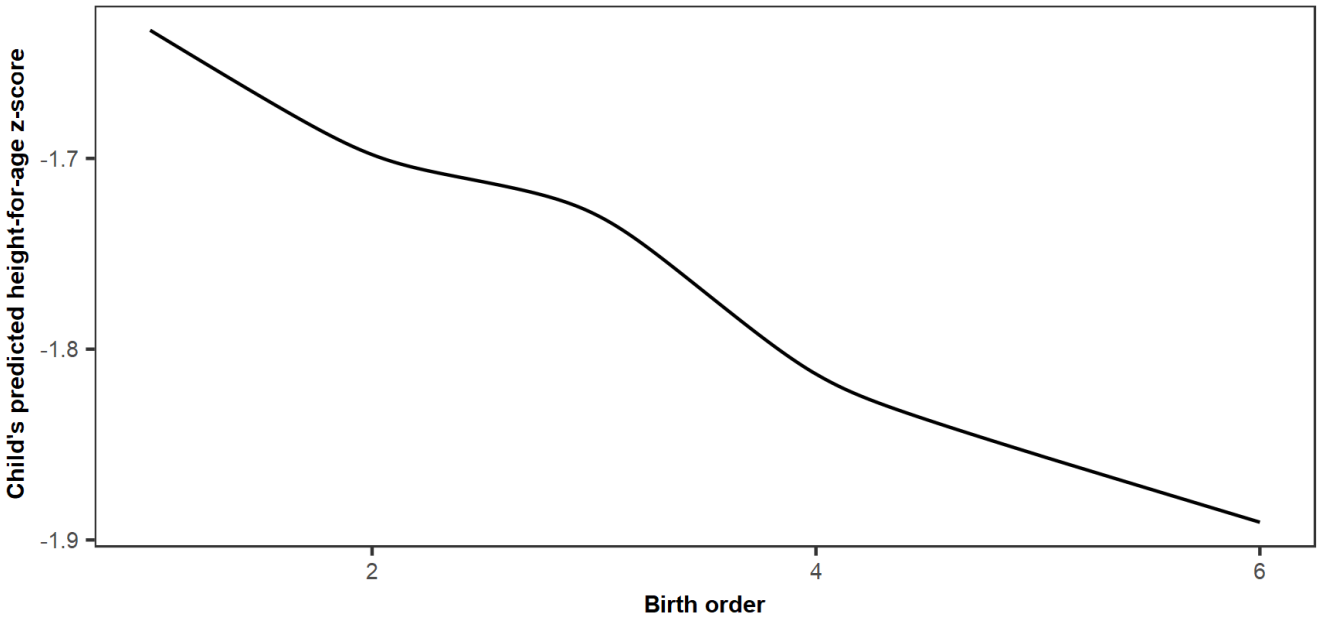


Source: Authors' calculations from Rwanda DHS 2000, 2005, 2010, & 2014-2015

13. **Stunting also rises with birth order and total fertility, as households expand their family size and become increasingly challenged to cope with the nutritional needs of their growing number of children.** Using the pooled sample of children under five from the four surveys, there is a clear and positive relationship with increasing birth order and lower predicted HAZ (Figure 12), and this relationship is more pronounced among the lower wealth quintiles (Figure 13)[2]. Among poor households, over 40 percent of children in the first two birth orders are stunted; rising to about 47 percent for third order; and climbing to nearly 50 percent for fourth order births. Among non-poor households, this pattern is less marked, as they are better able to cope with their expanded families. Stunting rises to roughly 29 percent for fifth order births, from 25 percent for previous birth orders. Increased number of births may also be accompanied by shorter birth intervals, which in turn increase the risk of preterm and low-birthweight babies and result in the premature weaning of children. Increased births, and associated shorter birth intervals, increase the risk for small-for-gestational age births, a significant factor for stunting, and may cause increased undernutrition and morbidity among women (Bhutta et al., 2008). Figure 14 depicts predicted HAZ by number of years since previous birth. Birth intervals of less than two years are associated with lower predicted HAZ, and thus increased likelihood of stunting. The positive association between stunting and fertility can also be seen in Figure 15, which depicts recent patterns in a group of countries in sub-Saharan Africa, including Rwanda.

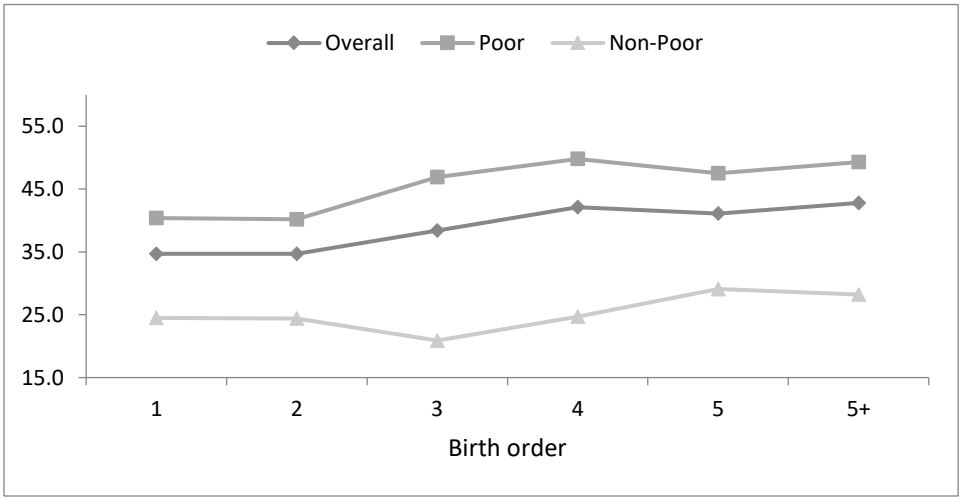
[2] While there were positive bivariate associations between higher birth order and stunting prevalence, these associations were not significant when controlling for other factors in the multivariate regression models.

Figure 12: Predicted HAZ by birth order



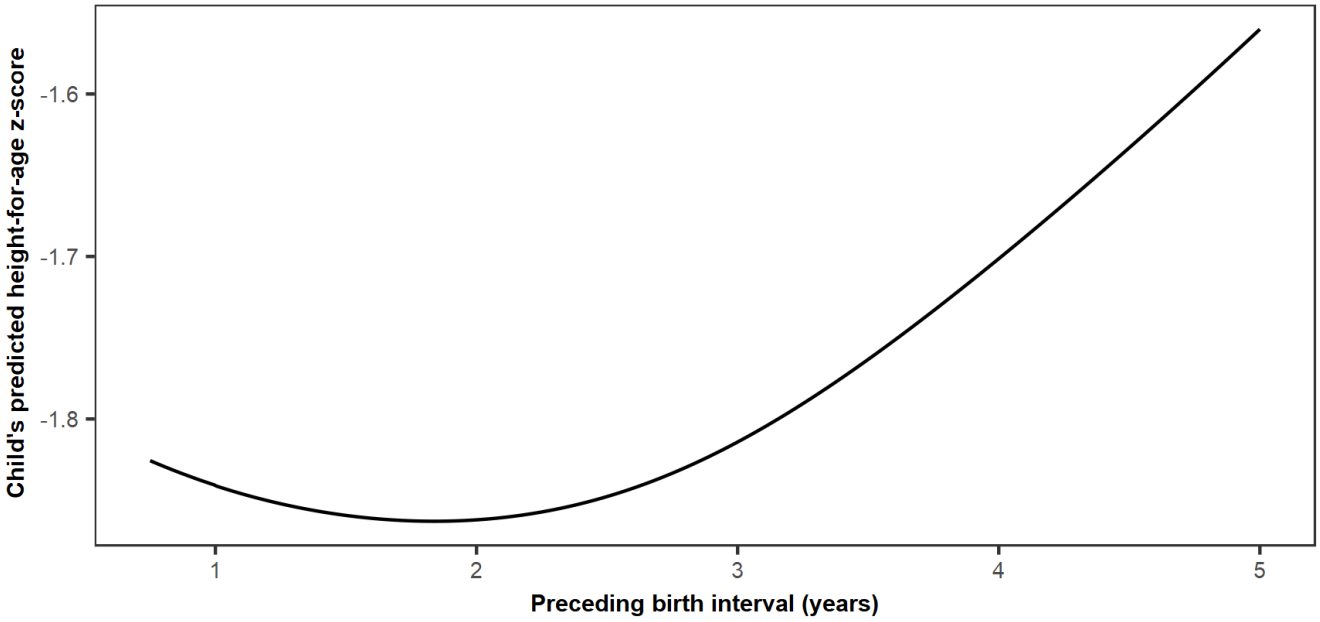
Source: Authors' calculations using pooled data from Rwanda DHS 2000, 2005, 2010, & 2014-2015

Figure 13: Stunting prevalence by birth order and wealth, 2015



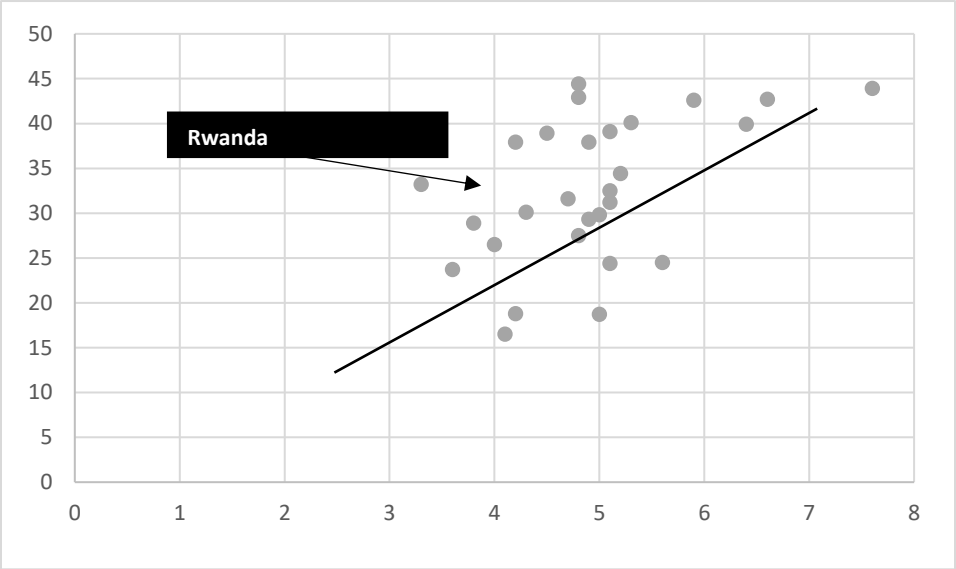
Source: Authors' calculations using Rwanda DHS 2014-2015 data

Figure 14: Predicted HAZ by birth interval



Source: Authors' calculations, pooled data from Rwanda DHS 2000, 2005, 2010, & 2014-2015

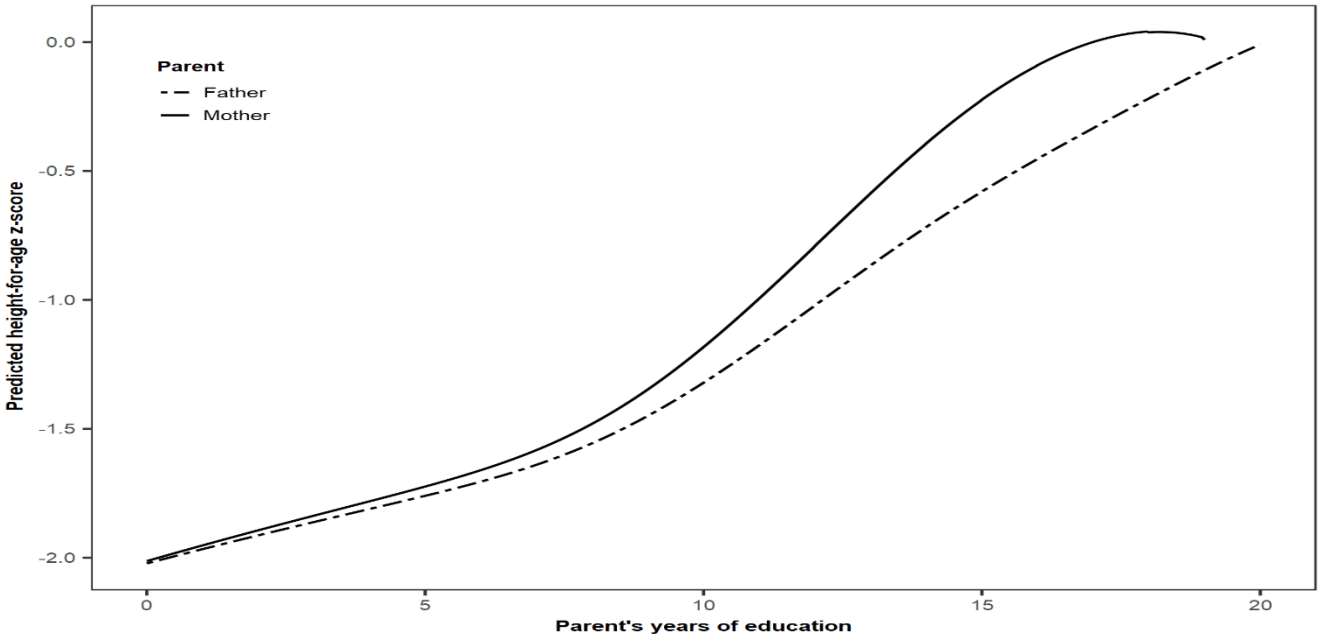
Figure 15: Stunting vs total fertility in a group of Sub-Saharan African countries



Source: Authors' calculations, pooled data from Rwanda DHS 2000, 2005, 2010, & 2014-2015

14. **Stunting rates also vary by mother's education level and health/nutrition status.** Children of Rwandese mothers who have no education or primary schooling have stunting levels (slightly over 40 percent) that are double those of children whose mothers have attained a secondary or higher education (roughly 19 percent). There is a generally positive association between mother's years of education and greater HAZ, with mother's educational level being more likely than father's education to be associated with increased HAZ (Figure 16). These patterns are consistent with findings from other research. For example, a review of studies examining the key determinants of stunting decline found a strong positive association between higher levels of parental education and increased HAZ (Headey, Hoddinott, & Park, 2017). Mothers who are more educated are likely more empowered to seek care, appropriately utilize information and mobilize resources for care of their children (Caldwell, 1979; Mosley & Chen, 1984; Ruel, Habicht, Pinstrup-Andersen, & Gröhn, 1992). Likewise, children of poorly nourished mothers (i.e. those with low Body Mass Index, BMI) have higher stunting rates than children of well-nourished mothers (Figure 17). Children of mothers who were short (<145cm) were also more likely to be stunted when compared with children of mothers with normal height (145cm-160cm).[3] The positive association between maternal nutritional status and child nutritional status has been well documented in the literature (Keino, Plasqui, Ettyang, & Van Den Borne, 2014).

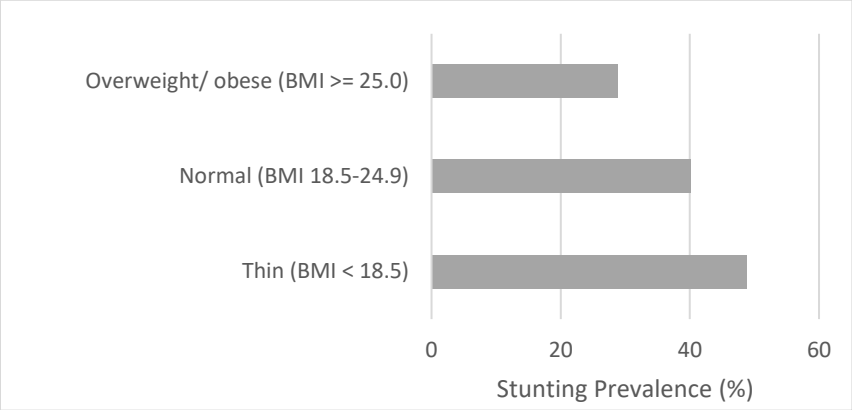
Figure 16: Predicted HAZ by parents' years of education



Source: Authors' calculations, pooled data from Rwanda DHS 2000, 2005, 2010, & 2014-2015

[3] These associations remained significant in multivariate models, with children of obese/overweight having a 9 percent decreased probability of stunting and children of short mothers having a 22 percent increased probability of stunting.

Figure 17: Stunting prevalence by mother's nutrition status



Source: Authors' calculations, pooled data from Rwanda DHS 2000, 2005, 2010, & 2014-2015

15. **This section provided an overview of stunting among Rwandese children over the 2000-2015 period**. While there was an encouraging declining trend, the current national stunting rate of about 38 percent remains among the highest on the African continent and is out of synch with Rwanda's overall socio-economic performance and potential. Most of the benefits of the drop in stunting rates have accrued to the better off. Children from the lowest wealth quintiles continue to be disadvantaged by: (i) high poverty and inequality; (ii) mothers' relatively modest education levels, poor nutritional status, and high parity; and (iii) geographic location. The next section applies the UNICEF conceptual framework of malnutrition to better understand and further disentangle the complex set of factors which contribute to these persistently high stunting rates in Rwanda.

Underlying Determinants of Childhood Stunting

Summary of underlying determinants of childhood stunting

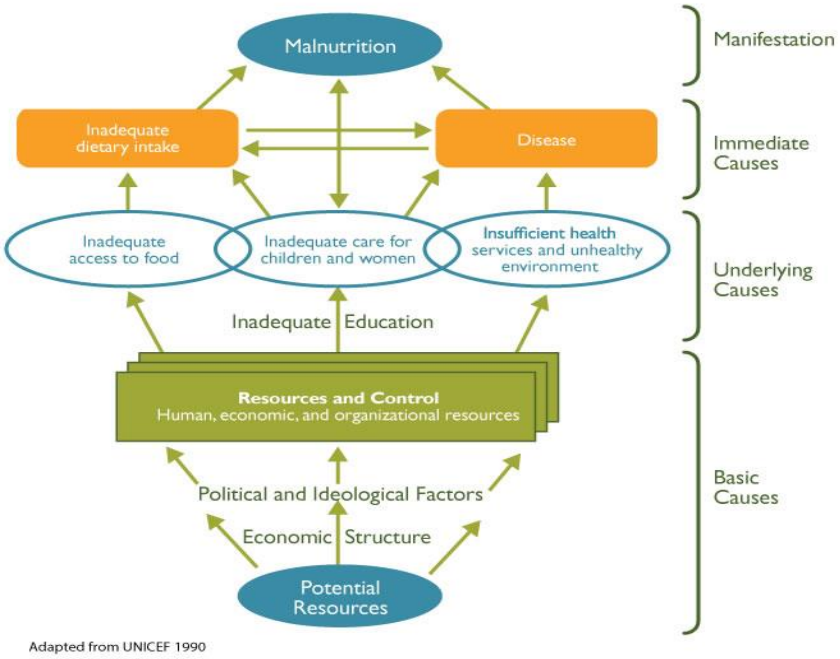
- **Only 18 percent of children 6-23 months old are adequately fed a diverse diet.**
- **The proportion of children living in households with improved water or sanitation facilities increased significantly between 2000 and 2015, but less than 40 percent live in households with both.**
- **There have been significant improvements in care practices between 2000 and 2015, but only 24 percent of children under two years of age benefit from all four key practices: mothers attending four ANC visits during pregnancy, facility delivery, early initiation of breastfeeding, and sleeping under insecticide treated bednet.**
- **Very few children 0-23 months old have adequate care, adequate food, and live in an improved household environment.**
- **Children with both adequate food and adequate care had the lowest stunting prevalence.**
- **Synergies between adequate care, adequate food, and improved household environment were associated greater reductions in the probability of being stunted.**

16. **The UNICEF conceptual framework of the determinants of malnutrition is used to better understand the underlying causes of the high stunting rate in Rwanda.** In the framework, child undernutrition is caused not only by a lack of adequate quantity and quality of food, but also by frequent illnesses, poor maternal and child care practices, substandard access to health services and unhealthy environments.[4] The framework defines inadequate food intake and frequent diseases as the immediate causes of malnutrition, while food insecurity at the household level (quantity, diversity, and frequency of food intake), inadequate care and feeding practices for children, and insufficient, inaccessible and inadequate health services and unhealthy household and surrounding environment are considered to be the underlying causes (Figure 18).

17. **The consequences of undernutrition can be devastating**. In the short term, undernutrition increases the risk of mortality and morbidity, and in the longer term, the consequences of stunting extend to adulthood, increasing the risk of poor pregnancy outcomes (including newborns who are small for gestational age), impaired cognition that results in poor school performance, reduced economic productivity and earnings, and future risk for overweight contributing to the rise in communicable diseases, such as hypertension and cardiovascular diseases. Conversely, according to the framework, good nutritional status will prevail if children have access to adequate quantity and quality of foods, receive age-appropriate care, live in a healthy environment with access to safe water and sanitation and have access to high quality health services. The expected benefits will be maximized if children have simultaneous access to adequate food, high quality child care, and a healthy environment, given the mutually reinforcing nature of these interventions, and the framework's assumption of non-substitutability between the underlying causes. For example, improving access to food will have a greater impact if children are in good health and live in a healthy environment and are able to better absorb nutrients from food. The next section turns to a discussion of the three main underlying causes of undernutrition of Rwandese children, drawing on results from the last four DHS surveys.

[4] UNICEF's Approach to Scaling Up Nutrition for Mothers and their Children, June 2015.

Figure 18: UNICEF Framework for Malnutrition



Adequacy of Diet

While 87 percent of infants are exclusively breastfed, only 18 percent of 6-24 months old children benefit from a minimum acceptable diet

18. **After a considerable decline between 2005 and 2010, the proportion of children under two with an adequate diet has generally stagnated, with roughly one third of children under two considered well nourished (Figure 19, "Adequate feeding")**. The prevalence of exclusive breastfeeding for infants under six months of age has been relatively high since 2000 and remains at 85-87 percent (Figure 19). By contrast, for children 6-24 months old, there has been little improvement in their food intake. Less than one in three children 6-24 months old consume a minimally diverse diet of four or more food groups, and less than half are fed the minimum number of times. Only 18 percent of children 6-24 months old are considered to have a minimum acceptable diet during 2010-2015 (Figure 20). As a result of these feeding practices, stunting is maintained at low levels for infants under six months (10-13 percent) but climbs to 37 percent for 6-24 months old with an unacceptable diet (Figure 21). Even children who benefit from a minimum acceptable diet have stunting rates of about 30 percent. These figures suggest that while a minimum acceptable diet is critical, it is not sufficient, and must be considered in the context of other critical factors in the UNICEF framework.

Figure 19: Trends in feeding behaviors among children 0-24 months old

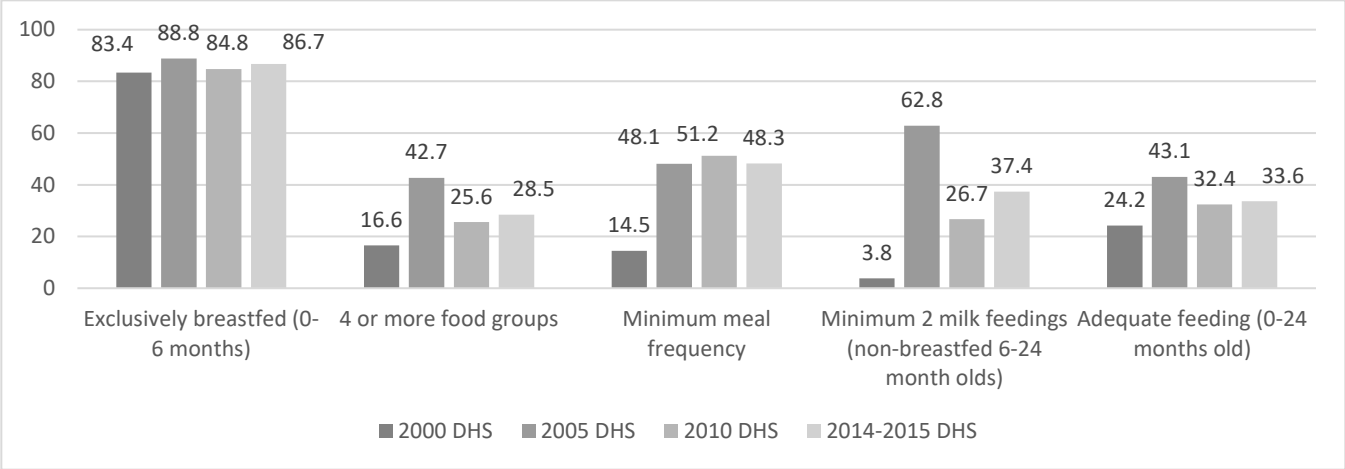


Figure 20: Trends in food adequacy, 2000-2015

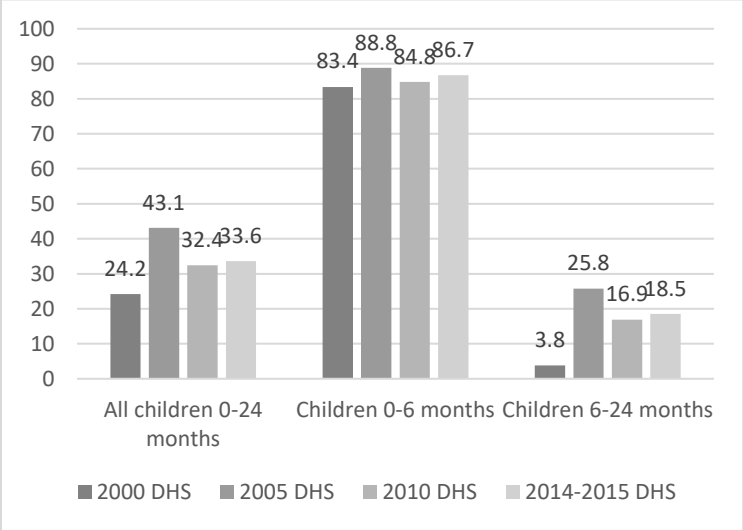
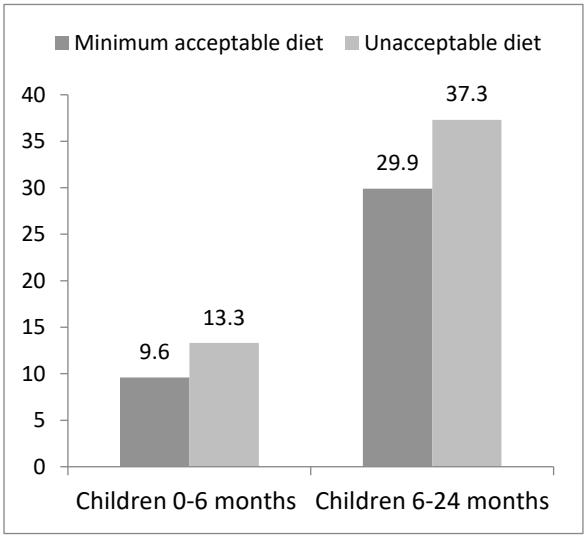


Figure 21: Stunting prevalence by food adequacy, 2015



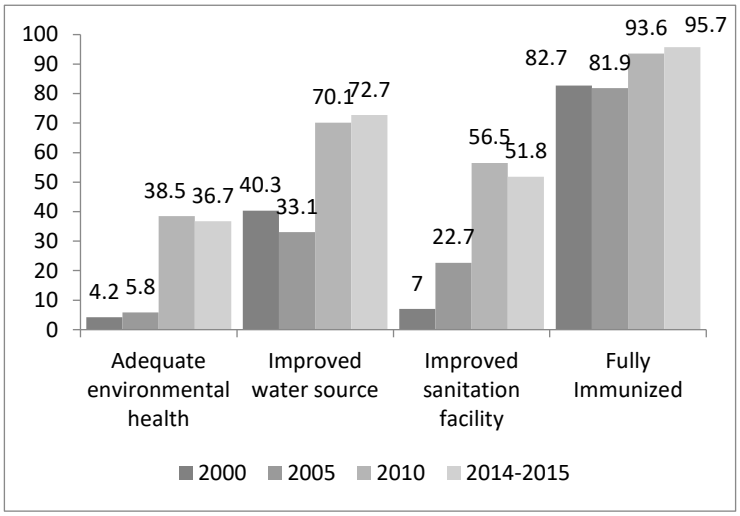
Source: Authors' calculations using Rwanda DHS data

Adequacy of environmental health and health services

19. **While access to water is relatively high and Rwanda has reached near universal coverage for age-appropriate childhood immunization, only half of children under two live in a household with access to improved sanitation, and just over one third have access to all three dimensions of environmental health (Figure 22).** There have been significant and dramatic increases in access since 2000. Between 2010 and 2015, there has been a slight improvement in access to water (i.e. from 70 to 73 percent), a further maintenance of the high level of full immunization, but a slight decline in access to

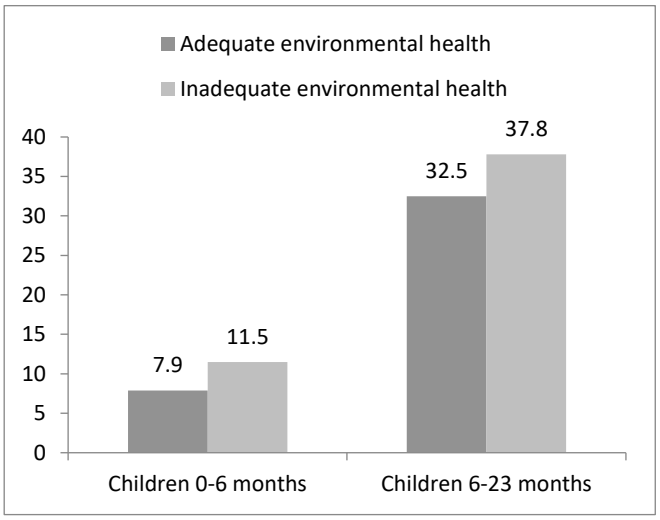
improved, non-shared toilet facilities.[5] Among children under six months old, stunting prevalence is higher for those with inadequate environmental health (8 vs 11 percent). Compared with children under six months old, stunting prevalence is four times higher for 6-24 months old who live in households with inadequate environmental conditions. Even children who reside in households with adequate environmental conditions, still suffer from stunting (32 percent, Figure 23), underscoring the multi-sectoral and complex nature of child undernutrition, and the need to address all three underlying causes.

Figure 22: Trends in adequacy in environmental health



Source: Authors' calculations, Rwanda DHS data

Figure 23: Stunting by environmental health adequacy



Source: Authors' calculations, Rwanda DHS 2014-2015

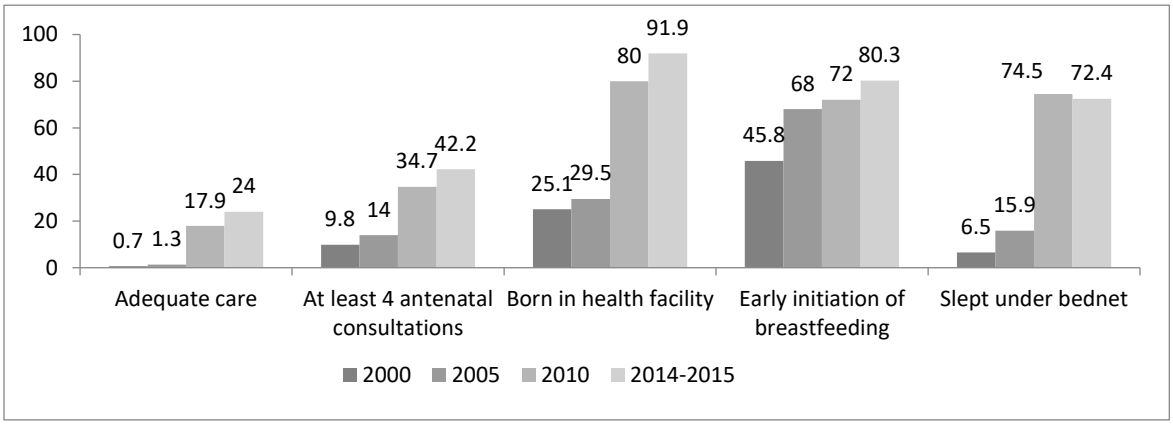
Adequacy of care practices

20. **The prevalence of good care practices for mothers and children reflect a generally improving picture but still relatively low coverage of some critical services.** The proportion of women who receive all four recommended antenatal care visits rose from about 10 to 35 percent between 2000 and 2010, and to 42 percent in 2015 (Figure 24). However, this remains relatively low. The use of bed nets for children increased significantly during 2000-2015 but continues to hover at over 70 percent. During 2010-2015, the proportion of infants born in a health facility has increased substantially from about 80 to 92 percent, as has the early initiation of breastfeeding (i.e. from 72 to over 80 percent). The proportion of newborns who receive postnatal care within two days of birth increased five-fold but is still only 20 percent (Annex I, Table 2). Likewise, the proportion of mothers who receive postnatal care within two days of delivery more than doubled to reach about 43 percent. When taking into account access to all four interventions depicted in Figure 24, *less than one-quarter of all Rwandese children benefit from all these good care practice*s. Children born in a health facility have stunting rates which are about 11

[5] Immunization status was grouped under environmental health to be consistent with how the UNICEF framework was operationalized in the 2015 Rwanda Poverty Assessment Report.

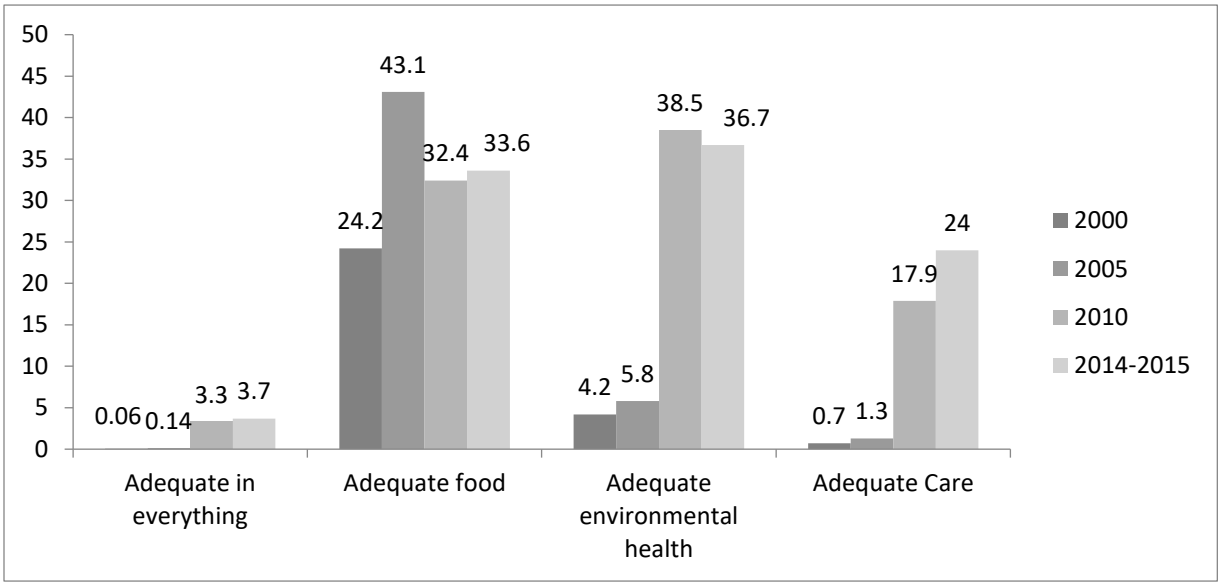
percentage points lower than children born at home, and those who slept under a mosquito net have stunting rates that are three percentage points lower than those who did not (Annex I, Table 3).

Figure 24: Trends in good care practices, 2000-2015



21. **When combining all three underlying factors of child undernutrition--- adequacy of food intake, environmental health and child care practices--- it can be seen that only a small fraction of Rwandese children benefit from access to all interventions (Figure 25).** While there have been significant improvements in access to key services since 2000, more progress is necessary to dramatically reduce stunting in Rwanda. According to the 2014/2015 DHS, 34 percent of children under two years of age have a minimally acceptable diet, showing a small increase since 2010 but below levels observed in 2005; adequacy in environmental health declined slightly between 2010 and 2015, from 39 to 37 percent; and 24 percent received adequate care, in comparison to 18 percent in 2010. *Only 4 percent had access to all three critical areas—adequate food, adequate environmental health and adequate care*.

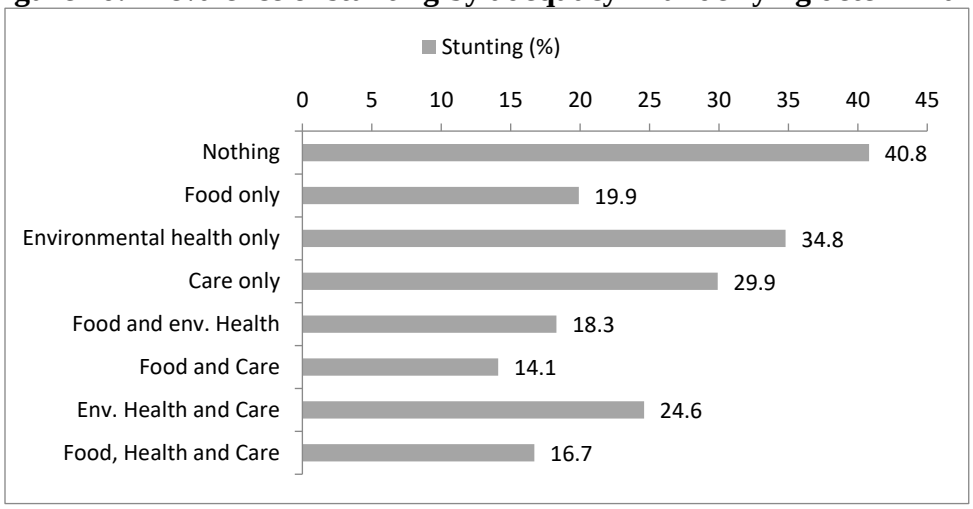
Figure 25: Trends in adequacy in underlying determinants of malnutrition



Source: Authors' calculations, Rwanda DHS 2000, 2005, 2010, & 2014-2015 data

22. **Stunting rates are lowest (14 percent) when children have access to adequate food and care practices.** As seen in Figure 26, stunting prevalence for children with adequate food intake is the lowest (about 20 percent), followed by those with access to care (about 30 percent) and those with adequate environmental health (about 35 percent). *When combining food intake and environmental health, stunting drops to about 18 percent; while adequacy in all three underlying determinants is associated with a stunting prevalence of nearly 17 percent*.

Figure 26: Prevalence of stunting by adequacy in underlying determinants



Source: Authors' calculations, Rwanda DHS 2014-2015 data

Associations between determinants and stunting in Rwanda

23. **Using the UNICEF framework, along with pooled data from the 2000, 2005, 2010, and 2014-2015 rounds of the DHS, the associations between factors identified in the framework and stunting using bivariate and multivariate regression models were examined.** The multivariate models aim to estimate and explain the association of adequacy in the different underlying factors for childhood malnutrition and their synergies with the probability of stunting, while controlling for different child, maternal, and household factors. The analysis extends the earlier work done in the context of the Poverty Assessment Report by incorporating data from four rounds of the DHS survey (2000, 2005, 2010, and 2014/2015). First, multivariate logistic regression models using the pooled sample from all four surveys examined the *contribution of the individual covariates in each set of underlying factors* (e.g., diet diversity, adequate meal frequency, antenatal care attendance, etc.) to the probability of stunting. Second, another model was applied to examine the *contribution of the composite indicators* for each underlying factor and their interactions to the probability of stunting. Third, decomposition analysis was conducted to assess how changes and differences in levels of adequacy in the underlying factors may explain differences and changes in stunting prevalence across income groups, urban/rural residence, district level stunting prevalence (below and above national average), and over time between the 2000 and 2014-2015 surveys. The full results from the multivariate regressions are presented in Table 4 of Annex I. Decomposition results for change in stunting prevalence over time and the difference in stunting prevalence between high and low stunting districts are presented and discussed in Annex II.

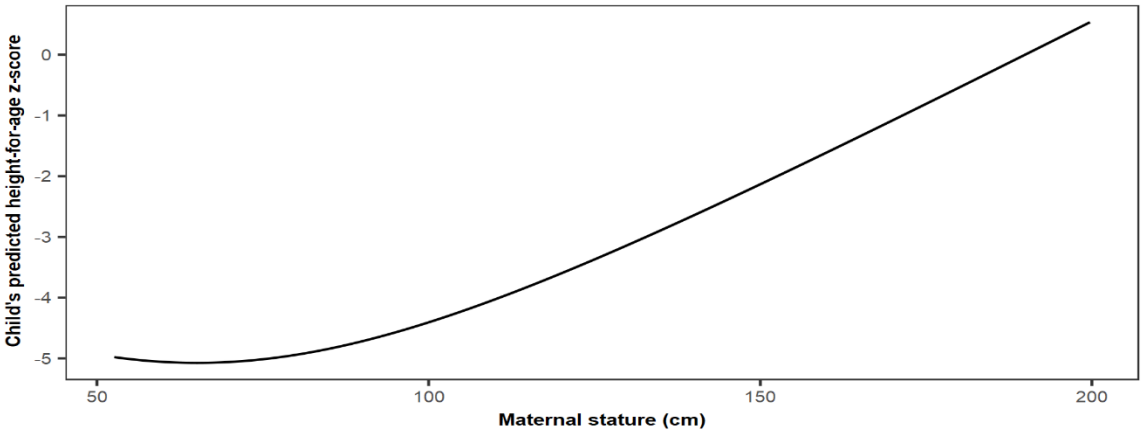
24. **When examining the association of individual interventions with the probability of a child being stunted, care interventions had a significant association with the likelihood of stunting.** All the care interventions had the expected association of a reduced likelihood of stunting, but only the associations of stunting with antenatal care visit and facility deliveries are statistically significant. Having four or more antenatal care visits is associated with a 4 percent reduction in the probability of being stunted. Likewise, delivering in a health facility is associated with a similar reduction in the risk of being stunted. This is encouraging, as there have been dramatic increases in both interventions over the past 15 years.[6] Nevertheless, the proportion of women who have access to four or more antenatal care visits remains relatively low (40 percent), highlighting considerable room for improvement.

25. **Maternal characteristics exhibit strong associations with the likelihood of being stunted among Rwandan children.** Children whose mothers were overweight were less likely to be stunted (i.e. 9 percent lower probability). This may indicate that children of such mothers may be less likely to suffer from food insecurity and have improved access to calorie-dense foods. Children whose mothers were of short stature (<145cm, with reference to women 145 to 159.9cm tall) had profoundly increased risk of

[6] From the latest survey, women across wealth quintiles deliver in health facilities at a high rate (85 percent in poorest, 98 percent in richest). Similar levels of coverage were observed among urban and rural settings (97 percent and 91 percent). The proportion of women who receive all four recommended antenatal care visits rose from 10 to 42 percent during 2000-2015 with limited disparities between the poor and non-poor.

stunting, with their probability increasing by 22 percent. Conversely, children of mothers who are relatively tall (>=160cm) were 14 percent less likely to be stunted. Children of short mothers are more likely to suffer intrauterine growth restriction during pregnancy and complications during birth. Being born to taller mothers reduces such risks for a child and makes it more likely that the child will achieve better growth (Figure 27).

Figure 27: Predicted height-for-age z-score by mother's stature



Source: Authors' calculations, pooled Rwanda DHS 2000, 2005, 2010, & 2014-2015 data

26. **Children who were characterized by their mothers to be small or very small at birth had significantly increased probability of being stunted (13 percent).** This is likely related to maternal well-being and conditions before and during pregnancy, and further underscores the need to ensure that women remain healthy, are well nourished, and have adequate and effective access to essential services before and during pregnancy.

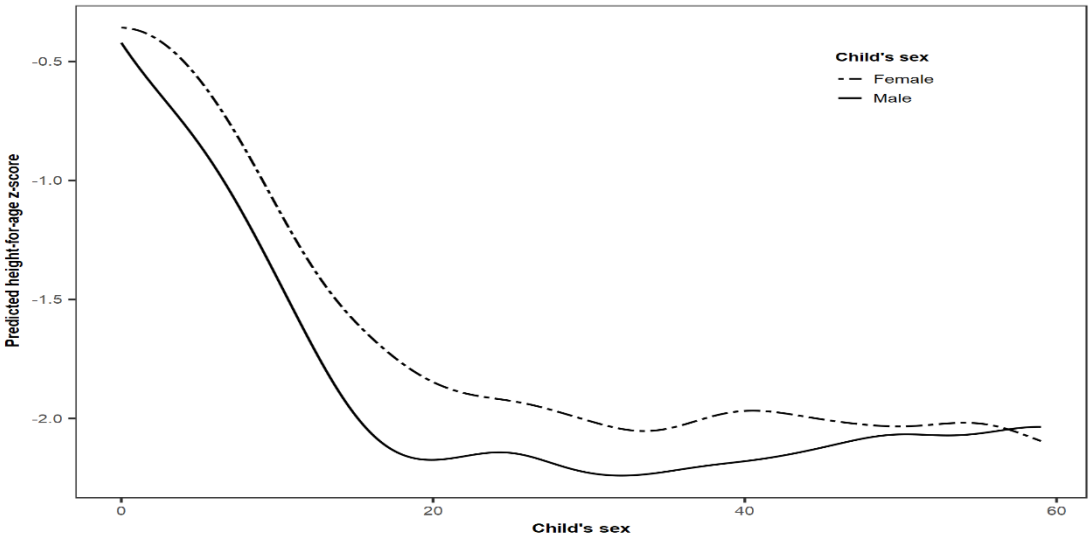
27. **Other important characteristics with significant association to stunting were mother's education and a child being male.** While having at least some primary education is positively associated with reduced stunting, higher levels of education (i.e. above secondary) are associated with significantly lower risk of stunting.[7]

28. **Newborn boys tend to be shorter than their female counterparts, and this advantage is maintained throughout early childhood (Figure 28).** This difference in height was also observed among older age cohorts. Previous studies from sub-Saharan Africa and some Asian countries have found similar findings, showing that boys are more likely to be stunted, although no clear mechanism has been identified for this difference (Keino et al., 2014; Rakotomanana, Gates, Hildebrand, & Stoecker, 2017; Wamani, Åstrøm, Peterson, Tumwine, & Tylleskär, 2007). Interestingly, mothers are more likely to report girls than boys as being small or very small at birth. Understanding how the difference in

[7] Women with higher than secondary education had children with 26 percent reduced probability of stunting. However, there were very few children of such women, representing less than 1 percent of the sample. Nevertheless, there is broad evidence that increased levels of women's education tend to have beneficial effects on children's health and well-being.

stunting arises between boys and girls in Rwanda will be important for undertaking effective interventions to ensure continued progress in improving the nutritional status of all children.

Figure 28: Predicted HAZ in boys and girls by age, Rwanda



Source: Authors' calculation using data from Rwanda DHS 2000, 2005, 2010, and 2014-2015

29. **When the associations between the probability of being stunted and the composite indicators (i.e. adequate food, adequate care, and adequate environment) for the framework components were examined, there is considerable agreement with the associations found to the individual interventions.** Having adequate food alone or adequate environmental health alone was not associated with a significant difference in the probability of being stunted but having only adequate care was associated with a statistically significant 8 percent decline. The analyses also illustrated that synergies among the components were associated with reduced stunting. For example, having both adequate environmental health and adequate care practices was the most impactful combination, reducing the probability of stunting by 12.5 percent. Even for children who may lack adequate care, having both adequate food and adequate environmental health benefited from a 7 percent reduction in the probability of being stunted. The same sociodemographic and maternal characteristics remained significant when examining the association of stunting with the composite indicators, with urban residence now becoming significantly related to a reduced likelihood of stunting.

Decomposing differences and changes in stunting

30. **There are clear differences in stunting prevalence across areas of residence and wealth, as well as significant declines in stunting over the past 15 years**. To understand whether and how differences in adequacy in the framework components and underlying characteristics can explain differences and changes in stunting prevalence, stunting prevalence was decomposed, by groups defined in terms of *poverty, geography, residence, and time*. In the first grouping, children living in households in the bottom three wealth quintiles were classified as poor; and the second grouping identified by if a child resides in a district with stunting prevalence below or above the national average. The third grouping decomposed differences in stunting prevalence between rural and urban areas. Finally, in the fourth grouping, we decomposed the difference in stunting between the 2000 and 2014-2015 survey, to ascertain whether changes in levels of adequacy in the framework components explain the significant decline in stunting observed in the 15 years between the surveys. The decomposition was done using the Oaxaca-Blinder technique. This method has been widely used to explain wage differentials, as well as differences in health service utilization and outcomes. Results for the decompositions for wealth and urban/rural residence are presented below. The results for the decompositions by wealth and area of residence are discussed in the text, with full table of results presented in Annex I. Results for the decomposition models for time and district level stunting explained a small proportion of the variation in stunting prevalence, and are described in Annex II.

Decomposition by wealth

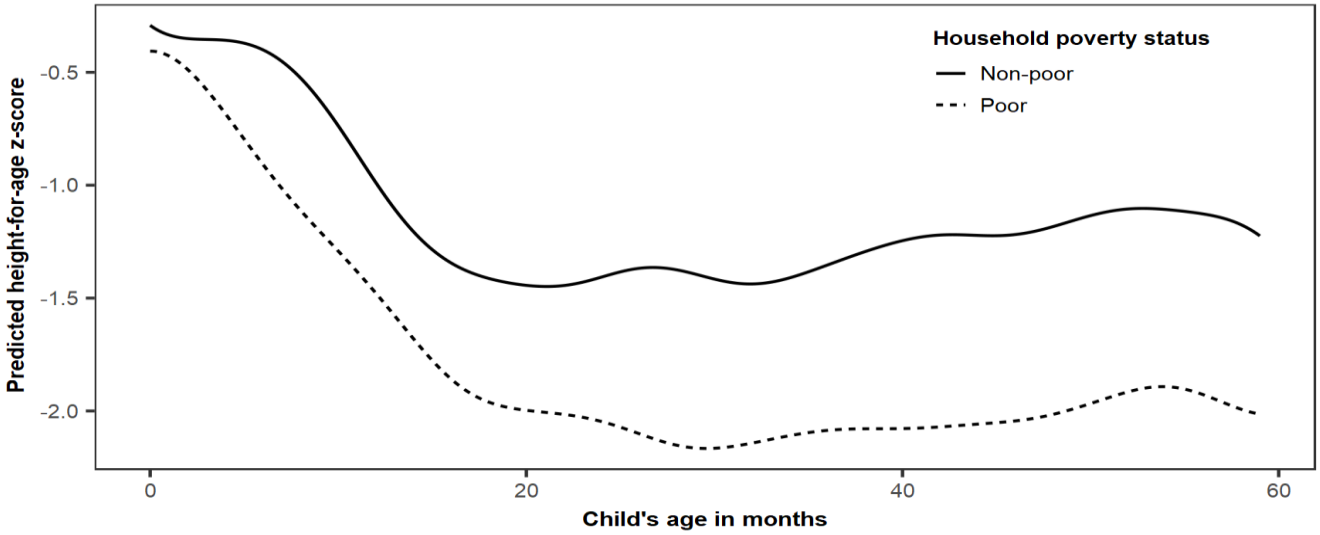
Summary: Key determinants of difference in stunting prevalence between poor and non-poor households

- **Poor children were more likely to have greater height deficits than non-poor children.**
- **Coverage of adequate care, feeding, and environmental health indicators were likely to be lower for poor children.**
- **Maternal characteristics, along with care practices, explained a significant proportion of the difference in stunting.**

31. **There were significant differences in stunting prevalence between the poorer and richer households**. Across all four surveys, children under two years from poorer households had significantly higher stunting rates (37.3 percent vs 29.5 percent in 2000; 41.2 percent vs 34 percent in 2005; 39.3 percent vs 23.1 percent in 2010; 34.5 percent vs 21.9 percent in 2014-2015). Poor children are more likely to be born shorter, and this height deficit increases as they age (Figure 29). Differences in stunting rates by wealth over the 2000-2015 period show that poor households are considerably worse off in terms of the adequacy of all three components-- environmental health, food intake, care practices. While the gap increased for adequacy in food intake between the surveys (Figure 30), it decreased for adequacy of

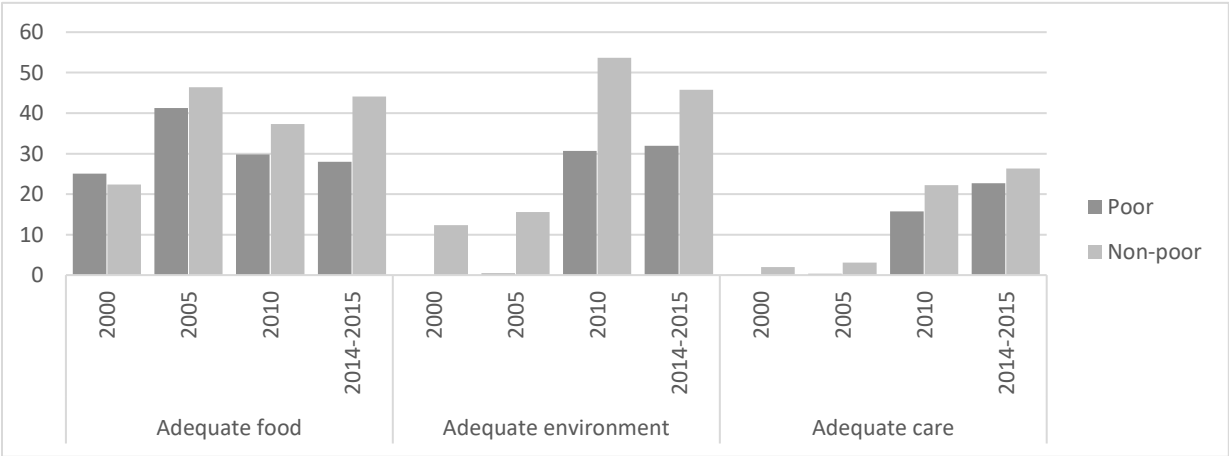
environmental health and care.[8] In spite of the gains in these two components, the poor still face significant gaps across the board.

Figure 29: Predicted HAZ in children from poor and non-poor households by age, 2014-2015



Source: Authors' calculations, Rwanda 2014-2015 data

Figure 30: Trends in percentage of children with adequate food, environmental health, and care, 2000-2015



Source: Authors' calculations, Rwanda DHS 2000, 2005, 2010, 2014-2015

32. **The decomposition model that considered differences in coverage of the individual interventions explained a significant proportion of the difference in stunting between poor and**

[8] Children in non-poor households were 16.3 percentage points more likely to have adequate food in 2015 than their poor counterparts, compared to a difference of 7.1 in 2010.

non-poor households.[9] While differences in care practices explain some of this difference, differences in maternal characteristics had more significance in explaining the difference in stunting prevalence. The results indicate that 77 percent of the difference in stunting prevalence can be explained by the model covariates. However, the only significant interventions were delivery in a health facility and sleeping under a bed net, accounting for only 15 percent of the explained difference. The more significant explanatory factors were differences in maternal characteristics such as maternal stature, body mass index (BMI), and lack of education, accounting for 44 percent of the explained difference. Mother's education level has been shown to be associated with improved child health and nutritional outcomes in other contexts.[10] Differences in urban residence between the poor and non-poor accounted for an additional 19 percent of the explained difference. These results suggest that while immediate interventions can address availability, access, and utilization of key health and nutrition services, broader policies to ensure increasing female enrollment and educational attainment are critical in the long-term to improve the nutritional and health status of vulnerable children from poor households. In the short-term, interventions are needed to improve women's knowledge about proper care and feeding practices, as well as to empower them to seek care and utilize preventive services before and during pregnancy.

Decomposition by urban and rural residence

Summary: Key determinants of difference in stunting prevalence between children in rural and urban households

- **Poverty is significant in explaining the difference in stunting prevalence between rural and urban children.**
- **Lack of maternal education, along with maternal height, were also significant in explaining the difference in stunting.**

33. **The decomposition model that considered differences in coverage between urban and rural areas also explained a substantial proportion of the difference in childhood stunting.** The results in Table 5 indicate that the models using individual interventions, or the composite indicators explain 80 percent and 75 percent, respectively of the difference in stunting between urban and rural areas. Of the individual interventions, only differences in health facility delivery offered a significant explanation for the difference in stunting between children from urban and rural households, accounting for only 9 percent of the explained difference.[11] Differences in wealth and mother's lack of education were also significant, accounting for 30 percent and 10 percent of the difference, respectively.[12] While Rwanda has done well in expanding access to education and expanding the number of years of compulsory education, gaps persist in terms of school completion and quality of learning. For example, only 10 percent of

[9] Children from households in the bottom two wealth quintiles were less likely to have been delivered in a health facility (45 vs 62 percent), less likely to have slept under an insecticide treated bed net (31 vs 46 percent), and were more likely to live in rural areas (3.9 vs 34 percent) and have mothers with no education (29 vs 14 percent).

[10] Ruel et al. 1992*; Kabubo-Mariara et al 2009.*

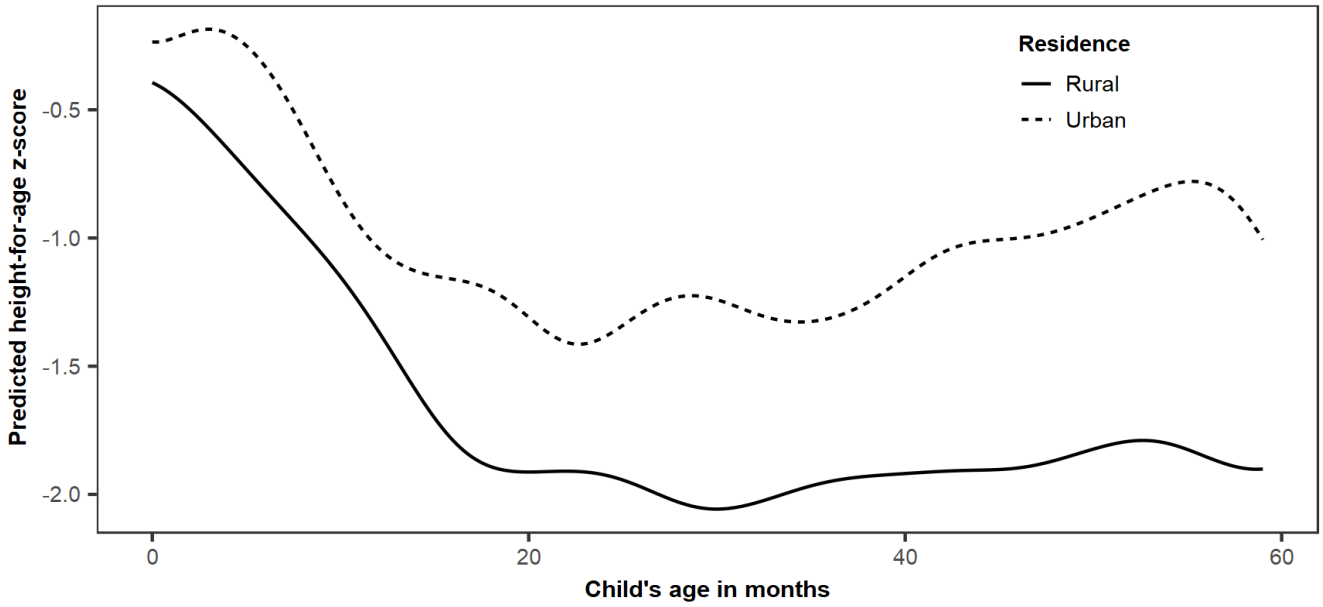
[11] This observation is in line with global evidence [to add reference]

[12] In the model using composite indicators, sociodemographic characteristics such as wealth and mother's lack of education were also found to be significant in explaining this difference.

mothers of children under two in rural areas had at least some secondary education in contrast to 35 percent of mothers of children 2 years and younger in urban households.[13] In the composite model, differences in maternal height of 160cm or greater is now significant, explaining 16 percent of the difference in stunting prevalence. Greater maternal height may be indicative of long-term improved nutrition of the woman, which in turn increases the chances for better birth outcomes and healthier growth in future offspring. Conversely, shorter maternal height may suggest inadequate nutrition of the mother during her childhood, which in turn predisposes their newborns to stunting. As seen in Figure 31 recently

34. born children in urban areas were taller than their rural counterparts. Moreover, while growth faltering starts right after birth for children in rural households, this does not happen until after about 6 months of age for urban children, likely tied to the start of weaning and current levels of inadequate complementary feeding practices.

Figure 31: Predicted HAZ among urban and rural children by age



Source: Authors' calculations, Rwanda DHS 2014-2015 data

35. **The analysis in this part of the report aimed to assess whether and how specific interventions and UNICEF framework components may relate to differences and changes in stunting prevalence**. Of the framework components, *adequate care figured most prominently in explaining differences in stunting* prevalence. In the initial models looking at the synergies between interventions, having both adequate care and environment was the most significant, reducing the probability of stunting by 12.5 percent. When we examine each component according to their underlying interventions, care interventions, particularly four or more ANC attendance and facility delivery, remained most important

[13] Authors' calculations, Rwanda DHS 2014-2015 data

in explaining differences and changes in stunting prevalence. Maternal characteristics such as height, BMI, and education where also important explanatory factors.

Summary of key messages

- **Synergies among the framework components were important in determining stunting status.**
- **Maternal characteristics were found to explain a substantial percentage of the stunting burden.**
- **Child's size at birth was found to also contribute to the likelihood of being stunted.**
- **Poverty and area of residence also contributed to the likelihood of stunting.**

36. **Synergies among the framework components were important in determining stunting status**. Care interventions, particularly coverage of 4 or more ANC visits during pregnancy, were significant in reducing the probability of stunting. Interactions between the three components were associated with significantly reduced probability of stunting. The results indicate that there are complex, interrelated factors that influence chronic malnutrition among young children in Rwanda. Interactions between care practices, adequacy of food and feeding practices, and improved coverage of environmental health interventions were associated with significantly reduced probability of stunting.

37. **Maternal characteristics were found to explain a substantial percentage of the stunting burden.** Maternal stature and maternal Body Mass Index (BMI) were important contributors to the probability of child stunting. The link between short stature and increased stunting is well documented in the global literature, and is linked to the physiological process of intrauterine growth restriction and birth complications as well as epigenetic factors. This may also be the result of poor nutrition and health of the woman during childhood, and points to the need to intervene early to stem the intergenerational transmission of malnutrition. Maternal BMI may also be indicative of household food security. Lower BMI was linked to increased stunting, while higher BMI was associated with decreased stunting.

38. **Mother's education level was a significant factor in child stunting**. Children of mothers with some education, especially some secondary education, are less likely to be stunted. Mother's level of education may inform ability to understand and engage in proper care, feeding, and hygiene practices. While Rwanda has done well in terms of expanding access to education, and increasing female enrollment, efforts to reduce barriers to secondary education for poor and vulnerable girls will be important. In the short term, supporting interventions to improve understanding of care, feeding, and hygiene practices will be important, particularly for women from poor and rural households and those with lower levels of education.

39. **Child's size at birth was found to also contribute to the likelihood of being stunted.** Children who were small or very small at birth were more likely to be stunted. Prior stunting has been shown to be a strong predictor of being stunted in older age groups. Small size at birth can be a result of inadequate

maternal health and nutrition before and during pregnancy, as well as prevalence of infections. Interventions to prevent and treat infections (intermittent preventive treatment in pregnancy, deworming), ensure micronutrient sufficiency (i.e. iron and folic acid supplementation, multiple micronutrient supplements), and increase caloric intake of women before, during, and immediately after pregnancy (i.e. balanced energy protein supplementation) will be critical to addressing the health and nutritional status of pregnant and lactating women.

40. **Poverty and area of residence also contributed to the likelihood of stunting.** Poor and rural households, in addition to being resource constrained, are also more likely to have mothers with lower or no education. Mothers in these households may be targeted for interventions to increase knowledge about maternal and child health and nutrition, improve access to and utilization of health services, and, for those who are or have young children vulnerable to malnutrition, interventions to supplement inadequate levels of food intake.

Key Limitations

41. While the analysis used data from nationally representative surveys, these are cross-sectional in nature and limit our ability to make assertions of causal links between the determinants and stunting. However, the findings on the association between the determinants and stunting are similar to findings from other studies. Another limitation is that the DHS surveys only provide self-reported responses on coverage of interventions and availability of certain resources (i.e. improved latrine, clean water), and not the quality of these interventions or the use of these resources. The analysis also did not consider other factors, such as women's empowerment, which could have a significant relationship with childhood stunting. Finally, the analysis was quantitative in nature and could be supplemented with reviews of nutrition related programs and policies to shed further light on the nutrition landscape in Rwanda between 2000 and 2015.

42. The next section discusses the policy implications stemming from the analysis. It presents briefly both the broad implications and the more specific ones by sector. The final section also suggests areas for further research.

SECTION II

Policy Implications

43. Based on the findings presented above and drawing on experiences and lessons from ongoing programs in Rwanda and on global knowledge key policy implications are summarized in this final section of the report.

44. **Interventions to improve childhood growth need to be implemented in tandem across sectors and harmonized to ensure not only increased coverage levels but that each child is able to benefit from all interventions.** While improvements in access to clean water and improved sanitation may

require investments in infrastructure, some improvements in care, feeding, and hygiene practices can be achieved through proven and cost-effective behavior change communication interventions at the household, community, and facility levels. Further work is needed to learn what combination and sequence of interventions will have the greatest impact. For example, convergence in Peru was facilitated by focusing on seven high-impact interventions that all local governments were incentivized to deliver.

45. **Greater efforts are needed to improve targeting.** The government has prioritized 13 districts with some of the highest rates of stunting and poverty for support under the Bank-funded stunting prevention and reduction program. Within these districts, there is a need for better targeting of children and women from the poorest and most vulnerable households. While the VUP targeting mechanism has been instrumental in targeting poor households through the social protection program, complementary targeting strategies may also need to be considered, given the increased risk of stunting among children in the bottom two wealth quintiles, and the lower level of indicators of the underlying determinants of stunting among these children.

46. **District capacity to plan, implement and monitor multi-sectoral programs needs to be bolstered.** The District Plans to Eliminate Malnutrition (DPEM), developed through consultations across sectors and with partners in each district, are intended to guide multisectoral action to prevent and reduce malnutrition. While these plans are developed annually in each district, capacity to plan, implement, and monitor activities varies widely across districts. Kirehe, a district in the southeast of the country, achieved significant reductions in child stunting between 2010 and 2015 (from 51 to 29 percent), an accomplishment attributed to strong political will and accountability at all administrative levels, effective mobilization of resources, and strong collaboration with development partners to implement and continually assess progress on its DPEM. Lessons could be drawn from the Kirehe experience to implement effective multisectoral actions to improve child nutrition in the most highly affected districts.

47. **Given the pervasive nature of stunting it will be important to undertake large scale communication campaigns.** While there is a clearer correlation between lower coverage of the key determinants and greater stunting in poor households, there are still considerable levels of stunting even in the higher wealth quintiles. This shows that coverage alone is not sufficient to ensure impact on stunting. Broader communication campaigns combined with interventions to change feeding, hygiene, and sanitation practices may improve the impact of increased coverage of key interventions.

Nutrition specific interventions

48. **Interventions to improve the nutritional status of women are critical to improving child nutritional status and birth outcomes.** Intervening in the first 1000 days, including the period before the child is born, is key to reducing stunting. Cost-effective interventions for improving maternal nutrition and birth outcomes exist, such as iron folate supplementation, balanced energy protein supplementation, deworming, and malaria treatment, and are already being implemented in Rwanda (Bhutta et al., 2008). However, given the low coverage of four or more antenatal care visits during pregnancy, many women do not benefit from these interventions. Timely initiation and increased number of antenatal visits

provide opportunities to screen for nutritional and health issues, allowing for early and appropriate intervention to improve birth outcomes and reduce risks of stunting. While nearly all women received at least one antenatal care visit during their most recent pregnancy, half of the visits were initiated after four months of pregnancy. Interpersonal counseling and behavior change communication could improve the earlier uptake of antenatal care (Hagey, Rulisa, & Pérez-Escamilla, 2014). Early detection of pregnancy could also be key to promoting early initiation of antenatal care. Pregnancy testing by community health workers (which is currently being piloted), coupled with appropriate counseling to encourage ANC attendance, has the potential to improve timely initiation of ANC and completion of 4 or more visits during pregnancy. For poor women who face financial barriers to accessing services, strategies to ensure enrollment in the community health insurance program and to incentivize attendance at health facilities will be essential.

49. **Interventions to improve mothers and households' understanding of appropriate child feeding and care practices as well as hygiene practices will also be important.** Given the importance of addressing multiple determinants simultaneously, SBCC interventions to sustain and further raise the early and exclusive breastfeeding for infants under six months and improve complementary feeding among children 6 to 24 months old will be critical. Among food secure populations, providing SBCC on proper complementary feeding has been associated with a 0.25 z-score difference in height-for-age (Bhutta et al., 2008). For poor or food-insecure households, education may need to be coupled with the provision of supplementary foods to children and pregnant or lactating women to be effective. Studies have also shown that SBCC strategies are most effective when the messaging is consistent, focused, and delivered with intense and prolonged engagement with the target population (SPRING Project, 2014) The Government of Rwanda is currently providing supplementary food to children in the two lowest socioeconomic quartiles (*ubudehe* 1 and 2), and to pregnant and lactating women in *ubudehe* 1. This support to poor households needs to be complemented by effective SBCC strategies to ensure appropriate use of the provided foods and improved uptake of appropriate feeding and care practices. Furthermore, the ongoing revamping of the SBCC strategy to make it truly multisectoral, with inputs from health, agriculture, social protection, and other sectors, and with proposed multiple communication channels (i.e. interpersonal communication, community meetings, health facilities, mass media) is a step in the right direction.

50. **The Community Health Worker (CHW) program is critical for community-level health and nutrition interventions in Rwanda. The Government of Rwanda recognizes that efforts to improve child care, feeding, and health service utilization hinge on ensuring that the CHW program remains performant and sustainable.** The CHW program is the foundation for the delivery of a wide range of Reproductive Maternal Newborn Child and Adolescent Health (RMNCAH) interventions and activities, including support for community maternal and neonatal health, nutrition, and family planning. CHWs play an important role in accompanying pregnant women to facilities for regular checkups and for safe institutional deliveries, identifying malnourished children, ensuring prompt referral to health facilities, and being agents for SBCC interventions. They are critical to improving access to health services, especially in rural areas

51. **CHWs, particularly those trained in maternal health (*agents de santé maternelle*), need to be better trained, equipped, and incentivized to ensure that all pregnant women benefit from the four recommended antenatal care visits and postnatal care for women and their newborns**. Reforming the existing program requires consideration of several key issues, including incentive structure (remuneration versus volunteerism); adoption of new models that foster sustainability (e.g., cooperatives, franchises); and integration of mobile technology platforms for better tracking of children vulnerable to malnutrition.

Nutrition sensitive social protection interventions

52. While most of the key nutrition-specific interventions for ensuring maternal and child health and nutrition are implemented in the health sector, social protection schemes can play an important role to ensure that the most vulnerable mothers and children are able to access these interventions and complementary services. Key areas where social protection can make an important contribution are described below.

53. **Strengthen existing social protection mechanisms to ensure identification, targeting, referral, and tracking of the most vulnerable mothers and children, particularly those in poor and rural households.** In principle, there are linkages between different cadres of community workers and schemes through which vulnerable households can be referred from one to another for accessing services and receiving information. However, it is not clear how this is practically applied, and how such referrals are tracked. Formalizing and strengthening these linkages between community health workers, VUP caseworkers, friends of the families and other cadres of proximity service providers would help ensure that the most vulnerable mothers and children have access to a full range of critical services, including participation in health and nutrition programs.

54. **Provide household incentives, such as in-kind and cash transfers, to encourage health seeking behavior, increase participation in behavior change interventions and facilitate the purchase of food commodities.** Cash transfers (CT) have been associated with increased uptake of health and nutrition services and significant improvements in child nutritional status (Groot, Palermo, Handa, Peter, & Amber, 2017). Evidence from programs in Kenya, Malawi, Ghana, and other countries found that CT increased household healthcare spending, utilization of preventive health services for children, antenatal care utilization, and care seeking. These programs can also improve access to food in vulnerable households (Kamakura & Mazzon, 2015). Cash transfer programs in Ethiopia, Kenya, Lesotho, Malawi, Mozambique, South Africa, Uganda, and Zambia resulted in improved household food security and food diversity as a majority of the transfers were spent on food (Groot et al., 2017). Programs in Colombia, Nicaragua, and Mexico have been associated with greater linear growth and reduced stunting in children (Bhutta et al., 2008). Social behavior change communication interventions are classic accompanying measures of CT schemes and can be used to improve mothers' and households' understanding of proper care, feeding, and hygiene behaviors that will promote better growth in vulnerable children. In Rwanda, a CT program targeting women and children from poor and rural households, accompanied by improved health services and social behavior change communication programs, could help reduce disparities in stunting among children from the top and bottom wealth quintiles.

55. **Ensure participation of vulnerable mothers and households in community education campaigns and demonstration sessions.** CHWs and other proximity service providers engage in community-level health and hygiene education activities. However, it is unclear how vulnerable women and children are targeted. Appropriate mechanisms are necessary to provide outreach to this group, perhaps through schemes being piloted in a few communities. The Home / Community Based Child Care (HB-CC) implemented under gender and child-sensitive public works (expanded Public Works) scheme offers services directly to vulnerable mothers and children, including parenting education, cooking demonstration, early stimulation, access to nutritious food and nutrition commodities. CHWs could use the HB-CC groupings as platforms to meet vulnerable mothers and children to offer group-based services and to ensure children and mothers are attending to key nutrition services.

Additional Research

56. While the results of this analysis provide the basis for undertaking a multi-sectoral program for stunting reduction in Rwanda, the analysis also identified several areas that require further research. These include:

(i) Identifying factors explaining gender differentials in stunting and determining how they can be addressed.
(ii) Understanding differences in stunting prevalence among high and low stunting districts.
(iii) Documenting economic, financial and geographic barriers faced by poor and vulnerable women and households in accessing health services and proposing options for addressing them.

57. There is significant difference in stunting risk among boys and girls in Rwanda, and further examination of the underlying causes of this difference will add to the body of evidence on this phenomenon and inform improvements in interventions for both genders. A greater risk of stunting among boys has been observed in data from many countries, particularly in South Asia and Sub-Saharan Africa. However, the mechanism for this observed difference in risk is poorly understood. Some studies suggest that male children are more susceptible to morbidity in early life, and thus this increased morbidity affects their ability to benefit fully from early nutrition. Other studies have also suggested that gender preferences in certain cultures may translate to differences in the care and feeding of male and female children, although this could affect both genders depending on the cultural context.

58. The difference in stunting prevalence among low stunting and high stunting districts was poorly explained by the data used in this analysis. Further quantitative analysis using data from various sources to better capture differences in contextual factors along with data on depth and quality of interventions in these districts, complemented with qualitative data on barriers to, appropriateness of, and acceptability of interventions may help to better explain the observed difference in stunting prevalence.

59. Children from poor and vulnerable households face significantly increased risk of stunting. Some of the key factors for this increased risk include lower access and utilization of services, as well

potentially worse maternal nutrition. Further research is needed to understand the types of barriers such households face in accessing and utilizing services.

Conclusion

60. Rwanda has made consistent progress toward reducing childhood malnutrition and needs to intensify and accelerate progress. An important window of opportunity exists to re-energize the national agenda and revamp the national strategy. There is high-level political commitment to eliminating malnutrition in the country. There is a solid body of global evidence about what works. Development partners are supporting the government to scale up interventions across the country's 30 districts. Rwanda can build on its successes in different spheres to tackle stunting full force, as it has done for other major development challenges.

Table 1: Trends in food adequacy among children under 2 years of age, 2000-2015 [14]

	RDHS 2000		RDHS 2005		RDHS 2010		RDHS 2015	
Adequate Food	%	N	%	N	%	N	%	N
Children < 6								
1. Child exclusively breastfed	83.4	690	88.8	423	84.8	345	86.7	326
Children 6 – 23								
1. Child has minimum meal frequency *And*	14.5	1,998	48.1	1,122	51.2	1,158	48.3	1,117
2. Child has minimum dietary diversity *and (only if not breastfed)*	16.6	1,998	42.7	1,122	25.6	1,158	28.5	1,117
3. Child receives minimum 2 milk feedings per day	3.8	164	62.8	94	26.7	93	37.4	72
Minimum acceptable diet	3.8	1,998	25.8	1,122	16.9	1,158	18.5	1,117
All Children 0-23								
Adequate Food Intake	24.2	2,688	43.1	1,545	32.4	1,503	33.6	1,443

Table 2: Trends in adequate care practices for children under 2 years of age, 2000-2015

	RDHS 2000		RDHS 2005		RDHS 2010		RDHS 2015	
Adequate Care	%	N	%	N	%	N	%	N
1. 4 or more antenatal consultations	9.8	2,688	14	1,545	34.7	1,503	42.2	1,117
2. Born in health facility	25.1	2,688	29.5	1,545	80	1,503	91.9	1,117
3. Postnatal child care within first 2 days	n.a	n.a	n.a	n.a	4.1	1,503	19.9	1,117
4. Postnatal maternal care within first 2 days	2.9	2,688	3.9	1,545	17.8	1,503	43.3	1,117
5. Slept under net last night	6.5	2,688	15.9	1,545	74.5	1,503	72.4	1,117
6. Early initiation of breastfeeding	45.8	2,688	68	1,545	72	1,503	80.3	1,117
Adequate care (all six included)	n.a	n.a	n.a	n.a	0.6	1,503	4.5	1,117
Adequate care (postnatal child care excluded)	0	2,688	0	1,545	3.2	1,503	10	1,117

[14] Calculations were based on sample of youngest children under two years of age living with their mother in their usual household at the time of the survey

Adequate care (postnatal child and mother care excluded)	0.7	2,688	1.3	1,545	17.9	1,503	24	1,117

Table 3: Trends in stunting prevalence by adequacy of care practices

	RDHS 2000		RDHS 2005		RDHS 2010		RDHS 2015	
Incidence of stunting (%)	Yes	No	Yes	No	Yes	No	Yes	No
1. 4 or more antenatal consultations	25.8	35.7	36.7	38.9	30.7	35.4	27.3	32.2
2. Born in health facility	25.1	37.9	35.5	39.9	31.4	43	29.2	40.7
3. Postnatal child care within first 2 days	n.a	n.a	n.a	n.a	29.5	33.9	27.3	30.8
4. Postnatal maternal care within first 2 days	38.7	34.5	38	38.6	31	34.3	27.4	32.3
5. Slept under mosquito net	20.2	35.7	35.2	39.2	32.3	37.9	29	33.2
6. Early initiation of breastfeeding	35.6	33.9	36.9	42.2	32.2	37.8	29.5	32.7
Adequate care (all six included)	n.a	n.a	n.a	n.a	13.6	33.9	23.5	30.5
Adequate care (postnatal child care excluded)	n.a	n.a	n.a	n.a	29.6	33.9	20.6	31.2
Adequate care (postnatal child and mother care excluded)	5.1	34.9	27.1	38.8	27.2	35.2	23.3	32.3

Table 4: Regression results: Effect of framework interventions on expected change in probability of stunting, controlling for background characteristics

	All interventions Change in probability of stunting	Standard error	Framework components Change in Probability Of stunting	Standard error
Food				
Breastfed	0.005	0.037	n.a	n.a
Milk feedings	-0.012	0.007	n.a	n.a
Diverse diet (4+ food groups)	-0.017	0.018	n.a	n.a
Adequate meal frequency	0.001	0.016	n.a	n.a
Environment and health			n.a	n.a
Improved source of water	0.008	0.017	n.a	n.a
Improved sanitation	-0.01	0.019	n.a	n.a
Age-appropriate immunization	-0.042	0.022	n.a	n.a
Care			n.a	n.a
Four or more ANC visits	-0.041*	0.019	n.a	n.a
Delivered in health facility	-0.04*	0.020	n.a	n.a
Early initiation of breastfeeding	-0.026	0.017	n.a	n.a
Postnatal checkup within two days of delivery (for mother)	-0.044	0.025	n.a	n.a

Slept under ITN	-0.038	0.021	n.a	n.a
Framework components				
Adequate food only	n.a	n.a	-0.027	0.020
Adequate environment only	n.a	n.a	0	0.023
Adequate care only	n.a	n.a	-0.081*	0.037
Adequate food and environment only	n.a	n.a	-0.073*	0.035
Adequate food and care only	n.a	n.a	-0.131	0.068
Adequate environment and care only	n.a	n.a	-0.125*	0.048
Adequacy in all	n.a	n.a	-0.035	0.057
Sociodemographic characteristics				
Small birth size	0.132***	0.023	0.129***	0.020
Birth interval	-0.007	0.007	-0.007	0.006
Birth order	0.012	0.008	0.006	0.006
Wealth quintile				
Poorest	reference	reference	reference	reference
Poorer	0.024	0.023	0.01	0.019
Middle	-0.035	0.023	-0.04*	0.019
Richer	-0.045	0.025	-0.055**	0.020
Richest	-0.048	0.030	-0.055*	0.024
Mother's education				
None	reference	reference	reference	reference
Less than primary	-0.039*	0.019	-0.031	0.016
Complete primary	-0.046	0.025	-0.028	0.021
Less than secondary	-0.047	0.034	-0.073**	0.028
Complete secondary	-0.032	0.072	-0.082	0.057
Higher	-0.255*	0.099	-0.186*	0.087
Mother's age	-0.002	0.002	0.001	0.002
Maternal stature				
145 to 159.9cm	reference	reference	reference	reference
<145cm	0.22***	0.054	0.181***	0.047
>=160cm	-0.143***	0.015	-0.123***	0.012
Male household head	0.01	0.020	0.014	0.016
Boy	0.096***	0.014	0.082***	0.012
Urban residence	-0.051	0.029	-0.053*	0.025
Mother's BMI				
Normal (18.5 to 24.9)	reference	reference	reference	reference
Thin (<18.5)	0.07*	0.033	0.05	0.028
Overweight or obese (>=25)	-0.093***	0.024	-0.067**	0.019
Pregnant or postpartum	0.009	0.038	0.005	0.027
Survey year				
2000	reference	reference	reference	reference
2005	0.045*	0.022	0.032	0.018
2010	0.052	0.029	-0.005	0.019

2014-2015	0.06	0.031	-0.031	0.020

*Regressions accounted for clustering and complex sampling design of the DHS surveys, as well as controlling for survey year and child's age by using child's age-in-months dummies. Statistical significance: * p<.05; ** p<.01; *** p<.001*

Table 5: Results of Oaxaca-Blinder decompositions by Poverty and urban/rural residence

	Oaxaca-Blinder Decompositions							
	Poor/non-poor				**Urban/rural**			
	Individual interventions		*Framework components*		*Individual interventions*		*Framework components*	
	Difference:	-0.121	Difference:	-0.102	Difference:	0.152	Difference:	0.1265
	Explained:	-0.093	Explained:	-0.069	Explained:	0.122	Explained:	0.0946
	Unexplained:	-0.028	Unexplained:	-0.033	Unexplained:	0.030	Unexplained:	0.0320
	Explained	**SE**	**Explained**	**SE**	**Explained**	**SE**	**Explained**	**SE**
Food								
Breastfed	0	0.002	n.a	n.a	0.001	0.003	n.a	n.a
Milk feedings	-0.004	0.002	n.a	n.a	0.005	0.003	n.a	n.a
Diverse diet (4+ food groups)	-0.003	0.003	n.a	n.a	0.003	0.003	n.a	n.a
Adequate meal frequency	0	0.001	n.a	n.a	0	0.000	n.a	n.a
Environment and health								
Improved source of water	0.002	0.004	n.a	n.a	-0.002	0.005	n.a	n.a
Improved sanitation	-0.006	0.004	n.a	n.a	0	0.001	n.a	n.a
Age-appropriate immunization	-0.001	0.001	n.a	n.a	0	0.001	n.a	n.a
Care			n.a	n.a			n.a	n.a
Four or more ANC visits	-0.002	0.001	n.a	n.a	0.002	0.001	n.a	n.a
Delivered in health facility	-0.008*	0.004	n.a	n.a	0.011*	0.005	n.a	n.a
Early initiation of breastfeeding	-0.001	0.001	n.a	n.a	0.001	0.001	n.a	n.a
Postnatal checkup within two days of delivery (for mother)	0	0.001	n.a	n.a	0.001	0.001	n.a	n.a
Slept under ITN	-0.006*	0.003	n.a	n.a	0.007	0.004	n.a	n.a

Framework components								
Adequate food	n.a	n.a	-0.001	0.001	n.a	n.a	0	0.001
Adequate care	n.a	n.a	-0.003**	0.001	n.a	n.a	0.002	0.001
Adequate environment	n.a	n.a	-0.003	0.003	n.a	n.a	0.001	0.002
Sociodemographics								
Small birth size	-0.003*	0.001	-0.003**	0.001	0.001	0.002	0.002	0.001
Birth interval	0.001	0.001	0.001	0.001	-0.001	0.001	-0.001	0.001
Birth order	-0.002	0.001	-0.001	0.001	0.004	0.003	0.002	0.003
Wealth quintile								
Poorest	n.a	n.a	n.a	n.a	0.006	0.003	0.008*	0.003
Poorer	n.a	n.a	n.a	n.a	0.007**	0.002	0.006*	0.002
Middle	n.a	n.a	n.a	n.a	-0.001	0.002	-0.001	0.002
Richer	n.a	n.a	n.a	n.a	-0.001	0.001	-0.002	0.001
Richest	n.a	n.a	n.a	n.a	0.026*	0.011	0.023*	0.009
Mother's education								
None	-0.013**	0.005	-0.013**	0.004	0.012*	0.005	0.01*	0.00
Less than primary	-0.004	0.003	-0.004	0.002	0.004	0.003	0	0.00
Complete primary	0.002	0.002	0.003	0.002	-0.001	0.001	0	0.00
Less than secondary	0.003	0.004	-0.001	0.003	-0.004	0.005	0	0.00
Complete secondary	0.002	0.003	-0.001	0.002	-0.003	0.004	0	0.00
Higher	-0.003	0.002	-0.002	0.002	0.006	0.004	0	0.00
Mother's age	0.001	0.001	0	0.001	-0.002	0.002	0.002	0.002
Maternal stature								
145 to 159.9cm	0.002	0.002	0.001	0.001	-0.003	0.002	-0.001	0.002
<145cm	-0.001	0.001	-0.002**	0.001	0	0.001	0	0.001
>=160cm	-0.016***	0.003	-0.013***	0.002	0.018	0.005	0.015***	0.003
Male household head	0	0.000	0	0.000	0	0.000	0	0.000
Boy	-0.001	0.002	-0.001	0.001	0.001	0.002	0	0.001
Urban residence	-0.018*	0.007	-0.019	0.006	n.a	n.a	n.a	n.a
Mother's BMI								
Normal (18.5 to 24.9)	-0.001	0.001	0	0.000	0	0.001	0	0.000
Thin (<18.5)	-0.001	0.002	-0.001	0.002	0.001	0.003	0.001	0.002
Overweight or obese (>=25)	-0.012***	0.003	-0.008***	0.002	0.016	0.004	0.011	0.003
Pregnant or postpartum	0	0.001	0	0.000	0	0.001	0	0.000

*Regressions accounted for clustering and complex sampling design of the DHS surveys, as well as controlling for survey year and child's age by using child's age-in-months dummies. Statistical significance: * p<.05; ** p<.01; *** p<.001*

ANNEX II

Additional decomposition results

Decomposition by district level stunting prevalence

Summary: Key determinants of difference in stunting prevalence between low and high stunting districts

- **Between 2010 and 2015, there was marked improvement in the height of recently born children in high stunting districts.**
- **Attendance at a postnatal care visit by a woman and maternal BMI explained some of the difference in stunting prevalence.**
- **However, a majority of the difference in stunting prevalence remained unexplained.**

61. **The decomposition model that considered differences in coverage between low and high stunting districts did not adequately explain differences in childhood stunting.** [15] As shown in Table 6, more than 70 percent of the difference remained unexplained in both the individual intervention and composite indicator models. Of the explained difference, timely postnatal checkup for a woman after delivery as well as maternal overweight each account for 10 percent in the individual interventions model. In the model with the composite indicators for the framework components, differences in being in the second wealth quintile and maternal overweight accounted for 10 percent and 15 percent, respectively, of the explained difference in stunting between low and high stunting districts. Possibly encouraging is *the observed improvement in the height gap of recently born children in high stunting districts that may indicate that improvements in nutrition outcomes was most impactful in areas with the highest prevalence, a promising sign that more targeted interventions are likely to have greater impacts in those areas* (Figures 32 and 33, Figures 34 and 35). [16]

[15] Between the 2005 and 2010 surveys, administrative boundaries were redrawn in Rwanda. Thus, geographic designations of regions in 2000 and 2005 surveys no longer matched those in the 2010 and 2014-2015 surveys. Since this decomposition involves assigning districts by levels of stunting, the data was limited to the latest two rounds of the DHS survey (2010 and 2014-2015) to ensure comparable geographic designations. For this decomposition, districts were classified based on whether district stunting prevalence among children under 24 months old was lower than the national average among that population. This was done separately in each survey before pooling the data. Stunting prevalence in low stunting districts was 23.6 percent, compared with 41 percent in high stunting districts.

[16] In 2010, the gap in the height of recently born children was about 0.5 standard deviations (Figure 31). This difference in height at birth was maintained through early childhood. However, this height gap in recently born children had been narrowed to about 0.25 standard deviations in the 2014-2015 survey (Figure 32). Compared to the data for low stunting districts, there is a much more noticeable rightward shift in the height-for-age z-score distribution of children in high stunting districts from 2010 to 2014/2015.

62. **While there was an accelerated decline in the national stunting prevalence between the 2010 and 2014/15, roughly half of Rwanda's 30 districts experienced a rise in stunting prevalence among children under two years of age**. There was little difference in the coverage of underlying determinants, and difference in stunting prevalence was not explained by the difference in these determinants. Antenatal care visits, postnatal checkup, size at birth, meal frequency, and maternal stature were significant determinants for stunting in districts that experienced increased prevalence, while birth size, maternal stature, and immunization were significant in districts with stunting declines between the two surveys. Further research is needed to understand the reasons why stunting declined in some districts but worsened in other districts.

Figure 32: Predicted HAZ in children in low and high stunting districts by age, 2010

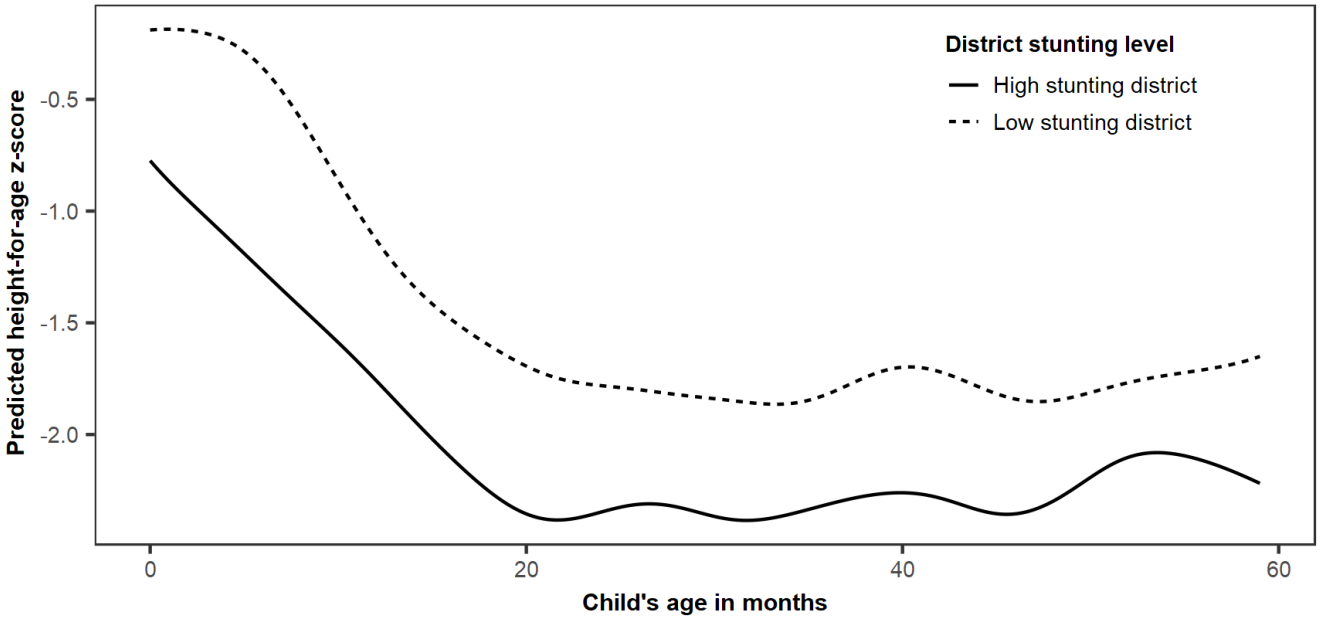


Figure 33: Predicted HAZ in children in low and high stunting districts by age, 2015

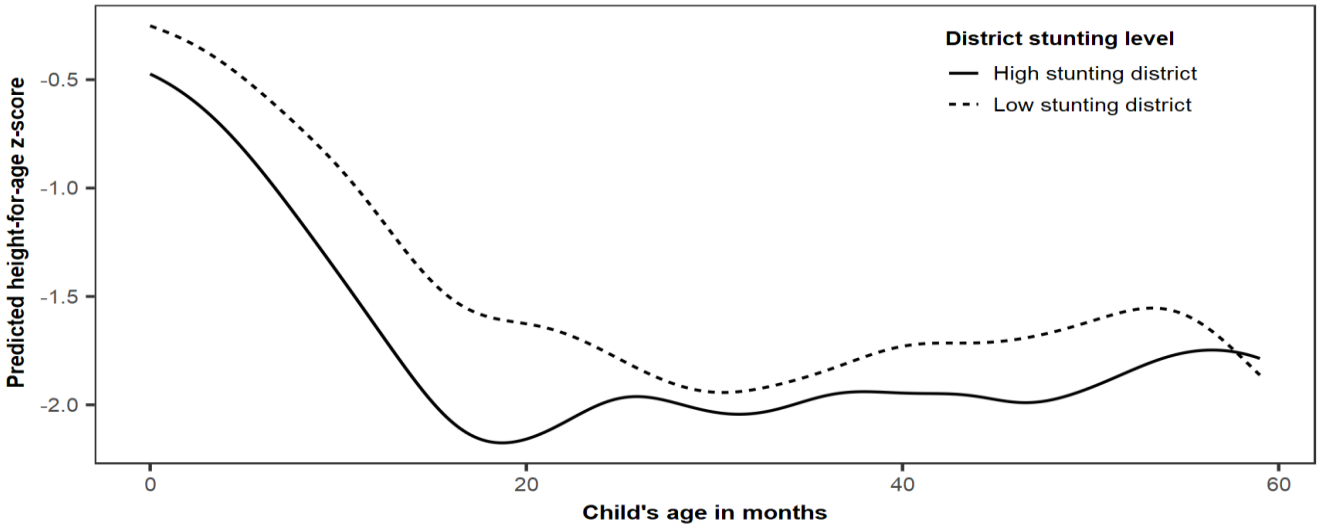


Figure 34: Shifts in height-for-age z-score distribution, low-stunting districts

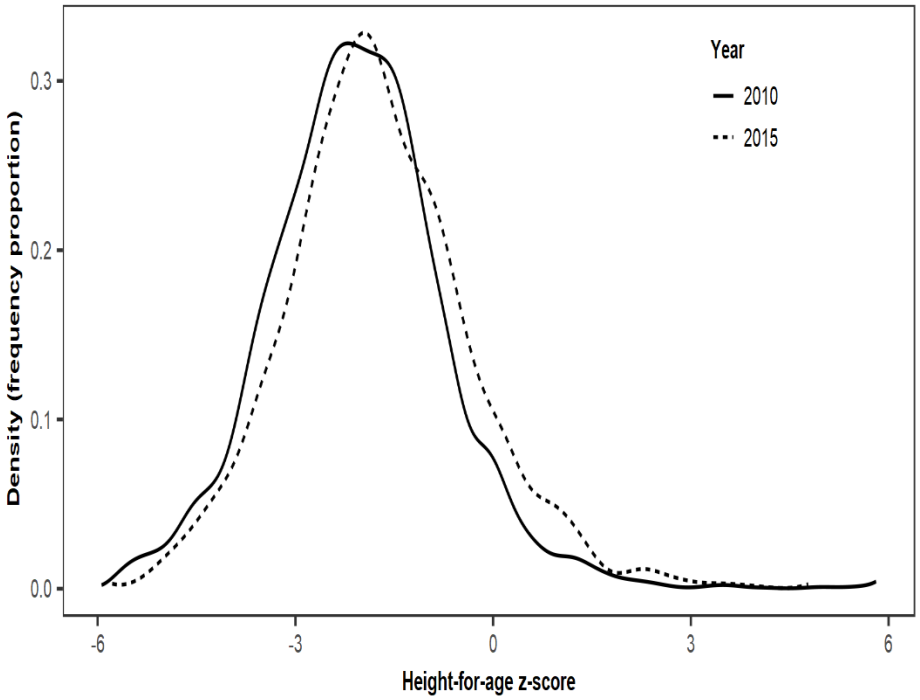
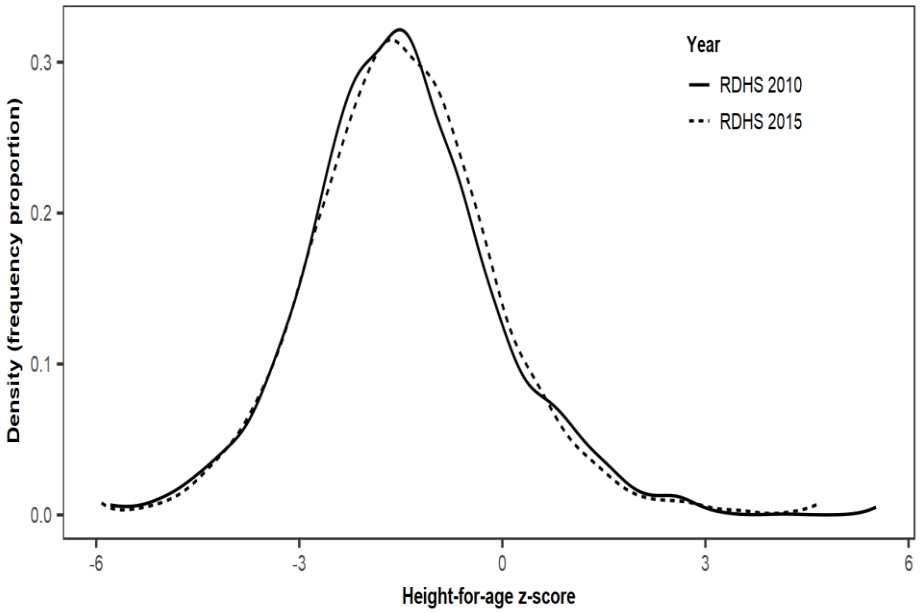


Figure 35: Shifts in height-for-age z-score distribution, high-stunting districts



Decomposition of change in stunting over time

Summary: Key determinants of change in stunting prevalence between 2000 and 2015

- **Given variations in coverage of interventions and prevalence of care and feeding practices, a greater difference in stunting prevalence was expected.**
- **Child caring practices explained significant proportion of the change in stunting prevalence.**
- **Birth order also accounted for a significant proportion of the change in stunting, indicating that improved uptake of family planning interventions may have played a role.**
- **Maternal characteristics and child's size at birth were also found to account for significant proportions of the change in stunting.**

63. **The decomposition model that considered the change in coverage over time (2000-2014/2015) predicted a greater difference in stunting prevalence than what was observed in Rwanda during this period.**[17] As discussed in previous sections of this report, there have been many improvements in the underlying components of the UNICEF framework. This has been accompanied by a modest decline

[17] The model using individual interventions explained more than 150 percent of the difference in stunting prevalence among children under two years old between 2000 and 2015. This implies that, given differences in the covariates being modeled, a larger difference in stunting prevalence would be expected.

in stunting in Rwanda, from 48 (2000) to 38 percent (2015). The rate of reduction in stunting prevalence has accelerated between 2010 and 2015, highlighting the concerted effort made by the Rwandan government with support of its development partners. Given the substantial improvements in the coverage of individual interventions as well as impressive strides in overall socio-economic conditions there may have been be some inefficiencies and challenges that inhibited them from having a greater impact on reducing stunting. To understand if and how improvements in coverage of the framework interventions may help explain the decline in stunting prevalence, a decomposition analysis was conducted using the 2000 and 2014-2015 datasets.

64. **The model with the individual interventions found that care practices were most significant in explaining the change in stunting.** The increased coverage of four or more ANC visits between 2000 and 2015 accounted for 30 percent of the explained difference in stunting prevalence. Increased facility deliveries accounted for 73 percent of the explained difference. Birth order was also significantly associated with the change in stunting prevalence, accounting for 20 percent of the explained difference. In the 2000 survey, 47 percent of children under 2 were birth order 3 or higher, compared with 32 percent in 2014-2015 survey. This is consistent with the overall steep drop in fertility rates over this period, from about a total fertility rate of 6.0 to slightly over 4.0 children per woman. Fewer children likely implies greater birth spacing, delayed weaning of young children, and more resources available to ensure their adequate health and nutrition. Small birth size was also significant, accounting for 7 percent and 15 percent of the explained difference in the intervention and composite indicator models, respectively.

Table 6: Results of Oaxaca-Blinder decomposition by district stunting level and time

	Oaxaca-Blinder Decompositions							
	High stunting/Low stunting (pooled 2010 & 2015)				**Time (between 2000 & 2015)**			
	Individual interventions		*Framework components*		*Individual interventions*		*Framework components*	
	Difference:	0.200	Difference:	0.180	Difference:	0.039	Difference:	0.041
	Explained:	0.058	Explained:	0.041	Explained:	0.059	Explained:	0.026
	Unexplained:	0.142	Unexplained:	0.139	Unexplained:	-0.020	Unexplained:	0.016
	Explained	**SE**	**Explained**	**SE**	**Explained**	**SE**	**Explained**	**SE**
Food								
Breastfed	0	0.000	n.a	n.a	0	0.000	n.a	n.a
Milk feedings	0.005	0.003	n.a	n.a	0.005	0.005	n.a	n.a
Diverse diet (4+ food groups)	0.002	0.003	n.a	n.a	0.001	0.003	n.a	n.a
Adequate meal frequency	-0.001	0.001	n.a	n.a	-0.005	0.007	n.a	n.a
Environment and health								
Improved source of water	0.002	0.003	n.a	n.a	-0.003	0.007	n.a	n.a
Improved sanitation	0	0.000	n.a	n.a	0.003	0.012	n.a	n.a
Age-appropriate immunization	0.002	0.002	n.a	n.a	0.004	0.005	n.a	n.a
Care			n.a	n.a			n.a	n.a
Four or more ANC visits	0	0.001	n.a	n.a	0.018*	0.007	n.a	n.a
Delivered in health facility	0.001	0.003	n.a	n.a	0.043*	0.019	n.a	n.a
Early initiation of breastfeeding	0.001	0.001	n.a	n.a	-0.005	0.007	n.a	n.a
Postnatal checkup within two days of delivery (for mother)	0.006*	0.003	n.a	n.a	0.006	0.011	n.a	n.a
Slept under ITN	0.002	0.001	n.a	n.a	-0.005	0.018	n.a	n.a
Framework components								
Adequate food	n.a	n.a	0.001	0.001	n.a	n.a	0	0.002
Adequate care	n.a	n.a	0.002	0.002	n.a	n.a	0.021**	0.006

Adequate environment	n.a	n.a	0	0.001	n.a	n.a	0.007	0.007
Sociodemographics								
Small birth size	0.001	0.002	0.002	0.002	-0.004*	0.002	-0.004*	0.001
Birth interval	0	0.001	0	0.000	0.001	0.005	0.002	0.003
Birth order	0.002	0.002	0.002	0.002	0.012*	0.005	0.007	0.004
Wealth quintile								
Poorest	0.002	0.002	0.002	0.001	0.002	0.002	0.002	0.001
Poorer	0.004	0.002	0.004*	0.002	-0.004	0.002	-0.002	0.001
Middle	0	0.000	0	0.000	0	0.000	0	0.000
Richer	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Richest	0.005	0.004	0.004	0.003	-0.001	0.001	0	0.000
Mother's education								
None	0.002	0.003	0.001	0.003	0.007	0.007	0.008	0.005
Less than primary	0.001	0.002	0	0.001	-0.001	0.005	-0.002	0.003
Complete primary	0.001	0.003	0.001	0.002	-0.001	0.002	-0.001	0.001
Less than secondary	0.002	0.002	0.003	0.002	0	0.001	0	0.001
Complete secondary	0.001	0.001	0.001	0.001	0	0.000	0	0.000
Higher	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001
Mother's age	0	0.000	0	0.000	0.001	0.002		
Maternal stature								
145 to 159.9cm	-0.001	0.001	0	0.001	0	0.001	0	0.001
<145cm	0.001	0.002	0.001	0.001	-0.001	0.001	-0.001	0.001
>=160cm	0.003	0.004	0.001	0.002	-0.005	0.003	-0.004*	0.002
Male household head	0	0.001	0	0.001	0	0.000	0	0.000
Boy	-0.006	0.003	-0.003	0.002	0.002	0.002	0.001	0.002
Urban residence	-0.002	0.005	0	0.005	0.001	0.001	0.002	0.001
Mother's BMI								
Normal (18.5 to 24.9)	0.001	0.001	0.001	0.001	0	0.001	0	0.000
Thin (<18.5)	-0.001	0.001	-0.001	0.001	0.001	0.001	0	0.001
Overweight or obese (>=25)	0.006*	0.003	0.006*	0.002	0.008*	0.003	0.004	0.002
Pregnant or postpartum	0	0.001	-0.001	0.001	0	0.001	0	0.000

*Regressions accounted for clustering and complex sampling design of the DHS surveys, as well as controlling for survey year and child's age by using survey year and child's age-in-months dummies. Statistical significance: * p<.05; ** p<.01; *** p<.001*

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