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Précis of nutrition of children and women in Haiti: analyses of data from 1995 to 2012

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Between 1995 and 2012, many surveys including child and maternal nutrition indicators were conducted in Haiti. While many questions emerged from the results of those surveys, they have remained unanswered, in particular as they pertain to the determinants of poor children's and women's nutrition in Haiti. The purpose of this paper is to fill that gap and provide policymakers, program managers, and readers interested in nutrition issues in Haiti with information on (1) the trends and determinants of infant and young child feeding and food practices; (2) micronutrient deficiencies among children and women; (3) the status of severe acute malnutrition in children; (4) associations among women's empowerment, access to health care, water, and sanitation and child nutrition; (5) the current community-based early child care and nutrition initiatives; and (6) the status of nutrition governance in the country. By looking at many sources of data, including previously published and new data, we provide insight into major predictors of child malnutrition and associations among child feeding practices, maternal nutrition, and child growth outcomes. We also show that important progress has been made recently in the governance of nutrition programs and in child and maternal nutrition indicators, a result of effective evidence-based advocacy, partnerships, and design, implementation, and scale-up of nutrition-specific and sensitive interventions.

Keywords: nutrition; children and women; progress; governance; Haiti

Introduction

In Haiti, malnutrition among children and women has been a major public health problem. The country has the highest rates of underweight and wasting among children in the Latin American and Caribbean region.[1] This has been a cause of major worry for the government and its development partners because, globally, it is agreed that 45% of child deaths are attributable to malnutrition.[2] In Haiti, child mortality, estimated at 86 per 1000 live births, remains high.[3] Maternal malnutrition has been also a concern barely addressed by policies and programs over the past 20 years.

Between 1995 and 2012, four nationally representative surveys were conducted. All included indicators of children's and women's nutrition. Many questions have emerged from the results of those surveys, but remained unanswered, in particular as they pertain to the determinants of poor children's and women's nutrition in Haiti. In this paper we sought to answer the following questions about Haiti using studies already published or accepted for publication in other peer-reviewed journals and unpublished data collected during field visits:

(1) What are the trends and determinants of children's nutritional status?
(2) What are the trends and determinants of infant and young child feeding and food practices?
(3) What are the trends and determinants of micronutrient deficiencies among children?
(4) What is the status of severe acute malnutrition in children?

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(5) What are the associations among women's empowerment, access to health care, water, sanitation, and child nutrition?
(6) What are the trends of women's nutrition and anemia status?
(7) What are the current community-based early child care and nutrition initiatives?
(8) What is the status of nutrition governance in the country?

To answer these questions, we used the following methodologies:

(1) Secondary data analysis of Haiti Demographic and Health Surveys (HDHS) national data sets.
(2) Implementation of a nationally representative household survey of child nutritional status using Standardized Monitoring and Assessment of Relief and Transitions (SMART) methodology.
(3) Site visits and interviews with leading implementing agencies working to improve maternal and child nutrition in Haiti.
(4) Semistructured interviews and document reviews.
(5) Multivariate analyses to identify relationships between the various potential determinants of the primary outcome variables (stunting and height-for-age *Z*-score (HAZ); wasting and weight-for-height *Z*-score (WHZ); underweight and weight-for-age *Z*-score (WAZ); anemia; and hemoglobin).
(6) In addition, potential determinants of the child health outcomes were examined at the department level, as well as the national level. These department-level analyses were done to assess whether and how the determinants of child malnutrition differ by region of the country, and/or by rural or urban environments.
(7) Baseline surveys to inform program planning and implementation were conducted.
(8) Review of published and unpublished papers and reports that could be found.

Three HDHS surveys have been carried out since 1995 with datasets available for public use. The HDHS 1995–1996, 2000, and 2005–2006 samples included 4994, 9678, and 10,038 households, respectively. The SMART survey was conducted in March 2012. It included 6500 households. All the surveys applied two-stage sampling methodologies using the same national household sampling frame maintained and updated postearthquake by the Haitian Institute of Statistics. After rural–urban stratification, random clusters of at least 25 households were selected from each sampling area. Information was collected on households, women and men of reproductive age, and children under age 5 within sampled households. Informed consent was obtained from all survey participants prior to data collection. The SMART was approved by the Haitian Ministry of Health and Population (MOPHP). Permission to use the HDHS dataset was obtained from ICF International. Variables were organized on the level of the child, the woman/mother and the household as follows:

Child-level variables

Infant and young child feeding indicators. We used the updated WHO infant and young child feeding (IYCF) indicators (World Health Organization, 2010) in our analyses. Four indicators were calculated with some modifications as explained below due to limitations in available data.

(1) *Introduction of solid, semisolid, or soft foods*: Proportion of children aged 6–8 months who received solid, semisolid, or soft foods in the previous 24 hours.
(2) *Minimum dietary diversity (MDD)*: Proportion of breastfed and non-breastfed children aged 6–23 months who received foods from at least four of seven food groups in the previous 24 hours. The seven food groups defined by the WHO guidelines included grains, roots and tubers, legumes and nuts, dairy products (milk, infant formula, yogurt, cheese), flesh foods (meat, liver or organ meats, fish, poultry), eggs, vitamin-A–rich fruits and vegetables, and other fruits and vegetables. There was no minimum quantity of food required to be counted as meeting the food group.
(3) *Minimum meal frequency (MMF)*: Proportion of breastfed and non-breastfed children aged 6–23 months who received solid, semisolid, or soft foods at least the minimum number of times in the previous 24 hours. For breastfed children, the minimum number of

times was two for children aged 6–8 months and three for age 9–23 months. For non-breastfed children, the minimum number of times was four, but for breastfed children milk feeds were counted in addition to solid, semisolid, or soft foods. It was not possible to calculate this indicator for 86 of 430 non-breastfed children for whom the number of milk feeds would determine whether they met the indicator. We excluded these 86 children from multivariate analyses after running sensitivity analyses based on multiple scenarios.

(4) *Minimum acceptable diet (MAD)*: Proportion of breastfed children aged 6–23 months who achieved both MDD and MMF in the previous 24 hours. Proportion of non-breastfed children who received at least two milk feedings and at least four food groups out of six categories (exclude milk products from the list above) and MMF in the previous 24 hours. Given that the HDHS dataset does include the number of milk feeds per day, it was not possible to calculate this indicator for any non-breastfed children who received milk. Multivariate analysis was restricted to breastfed children only.

Growth indicators. Weight and height were measured and recorded for all children under 5 in a subsample of households in each survey year. WAZ, HAZ, and WHZ scores were calculated using the World Health Organization (WHO) Child Growth Standards Macro for SPSS. Underweight, stunting, and wasting were defined as WAZ < -2.0, HAZ < -2.0, and WHZ < -2.0 standard deviations (SDs) below the WHO reference median, respectively.

Anemia. Hemoglobin was measured from finger- or heel-prick blood sample using a Hemocue portable photometer. All hemoglobin values were adjusted for altitude. Anemia in children aged 6–59 months was classified by hemoglobin (Hb) level as none (Hb $\geq$ 11.0 g/dL), mild (Hb 10.0–10.9 g/dL), moderate (Hb 7.0–9.9 g/dL), or severe (Hb $<$ 7.0 g/dL).

Illness in previous 2 weeks. Recent episodes of illness including diarrhea and fever can influence dietary intake and nutrient losses in the child. We used the DHS variable for mothers who reported child having diarrhea, fever, or ARI (report of both cough and fever) in the 2 weeks before the survey.

Access to health care. Access to health care for the child was assessed by whether the mother reported currently having an MOPHP child health card. Per MOPHP protocols, all children aged 0–59 months who access health care in Haiti should receive a "Road to Health" card and receive routine growth monitoring and infant feeding counseling from healthcare workers. It was assumed that children with a card accessed the health system at least once. Children of mothers who reported a lost card or never having received a card were classified as not having a health card.

Woman/mother-level variables

Anemia. Anemia classification in women aged 15–49 depended on pregnancy status. Pregnancy was self-reported in the HDHS. Women who were uncertain about pregnancy were classified as not pregnant. Anemia in nonpregnant women was classified by hemoglobin level as none (Hb $\geq$ 12.0 g/dL), mild (Hb 11.0–11.9 g/dL), moderate (Hb 8.0–10.9 g/dL), or severe (Hb $<$ 8.0 g/dL). For pregnant women the classification was none (Hb $\geq$ 11.0), mild (Hb 10.0–10.9 g/dL), moderate (Hb 7.0–9.9 g/dL), or severe (Hb $<$ 7.0 g/dL).

Body mass index (BMI). Women's weight and height were measured as part of the survey. BMI was classified according to WHO definitions (normal 18.5–24.9 kg/m^2, underweight $<$ 18.5 kg/m^2, overweight $\geq$ 25.0 kg/m^2).

Access to antenatal care (ANC). Based on WHO-focused ANC guidelines (WHO 2002), we classified children born to mothers who reported the recommended four or more ANC visits as meeting guidelines compared to those with three or fewer visits who did not meet guidelines.

Education level. Women who self-reported receiving no formal education were classified as "none," those with any primary school as "primary," and those with any secondary or more as "secondary$^+$."

Current work status. Women self-reported whether or not they were currently employed in the informal or formal sector.

Empowerment. Variables of empowerment include two types: (1) those whose higher value suggests greater evidence of empowerment—control-over-money index (categories of purchases that the woman has control over funds to purchase, alone or in cooperation with someone else), household decision-making index (categories of decision making that the woman contributes to alone or jointly with someone else), and community-integration index (issues that the woman reports discussing/meeting with other community members about); and (2) those whose higher value suggests less evidence of empowerment such as gender role–opinion index (statements regarding women's attitude around inequality in gender roles that the woman agrees with).

Household characteristics

Residence. Classification as urban or rural was based on the DHS variables.

Department. As of 2003, Haiti is organized into 10 political departments (Nord-Ouest, Nippes, Sud-Est, Nord, Nord-Est, Artibonite, Centre, Sud, Grand-Anse, and Ouest), which serve as the basis for the DHS sampling frame. Ouest department includes the greater Port-au-Prince metropolitan area, and approximately one-third of the country's total population. For cross-survey comparisons, data from Grand-Anse and Nippes were combined to reflect the pre-2003 departmental structure.

Access to water and sanitation. Included variables reflect consistent access to safe, clean drinking water and sanitary practices related to fecal material. The source of drinking water often relates to the quality of water consumed by household members. Improved sources of water included a protected tap in the home or yard, protected pump, springs or wells, rainwater, and bottled water. Unimproved sources included unprotected wells or springs, surface water such as river or lake water, and water sold from tankers or by other street vendors. All households that used a means of water treatment such as boiling, addition of bleach or chlorine, solar disinfection, or household filter were classified as improved, regardless of the source type. Distance from the water supply reflects the ease of access households have to drinking water and relates to their likelihood of consistently accessing that supply. Access to water was categorized based on time it took to reach the primary water source from the home.

Toilet facilities were classified as improved if the household had a pit latrine with a slab or flush toilet that was not shared with other households and nonimproved if no toilet facility was present, if an open pit was used, or if any type of toilet was shared with another household. Disposal of stool reflects the method used by the household to dispose of the stools of the youngest child in the household. A stool was considered appropriately contained if the child used a toilet or latrine, the stool was put into a toilet or latrine, or the stool was buried. Stools that were rinsed, left out into the open, or thrown into the garbage were classified as not contained.

DHS wealth index. The DHS wealth index quintile is included in the datasets provided by DHS Measure. It is derived for each dataset using factor analysis based on household size, water source, type of toilet, primary cooking method, materials used in housing construction, and ownership of household assets. More information on construction of the DHS wealth index can be found in publications on the DHS Measure website.

General methodology

As stated, this paper combines a review of previously published data or data in press and new data (studies or secondary analyses of data not yet published).

Published or in-press data include those presented below under the following headings: (1) child nutrition status and trends,[4] (2) breastfeeding practices and child growth outcomes,[5] (3) protecting and improving breastfeeding practices after the earthquake,[6] (4) complementary feeding (CF) and practices and child growth outcomes,[7] (5) anemia among children 6–59 months old,[8,9] (6) vitamin A and iodine deficiencies among children,[10] and (7) anemia among women 15–49 years old.[9]

New data include those presented below under the following headings: (1) improving child-complementary foods through a community-based approach; (2) vitamin A supplementation and deworming; (3) child severe acute malnutrition; (4) community-based early child care; (5) child nutrition and women's empowerment; (6) child nutrition and access to health services, water, and sanitation; (7) women's nutrition status and trends and nutrition; and (8) governance and nutrition.

By looking at many sources of data, including previously published and new data, we sought to determine major predictors of child malnutrition and associations among child feeding practices and maternal nutrition with child growth outcomes. We also sought to assess the progress in governance of nutrition programs and in child and maternal nutrition indicators in Haiti. Following the 2010 earthquake, significant advocacy efforts and major investments in social sectors (health, nutrition, water/sanitation/hygiene, education, food security, poverty alleviation) have been made by the government and its partners throughout the country to address, in part, children's and mothers' malnutrition issues.

The overarching aim pursued is to fill the gap in knowledge related to the determinants of poor children's and women's nutrition in Haiti and provide policymakers, program managers, and readers interested in nutrition issues in that setting with information on the trends and determinants of infant and young child feeding and food practices; micronutrient deficiencies among children and women; the status of child severe acute malnutrition; associations among women's empowerment, access to health care, water, and sanitation, and child nutrition; the current community-based early child care and nutrition initiatives; and the status of nutrition governance in the country.

The language used in this paper, therefore, tends often to be programmatic, which actually reflects, in part, its nature to give an overview of the nutrition issues in Haiti, share field experiences, describe programs implemented on the ground, and highlight recent political commitment in favor of nutrition in the country.

We described some similarities between DHS and SMART methodologies. In addition, there were no differences between them with respect to basic methods, response rate, residence of participants, and sex of respondents. However, the mean age of children in the SMART sample was significantly lower than that in the HDHS.[4]

The experimental and/or theoretical methods for each of the published or in-press studies as well as their limitations are described in more detail in the referenced papers. For the new data, we provide under each section paragraphs that describe the design, data collection and management, and the statistical analyses performed.

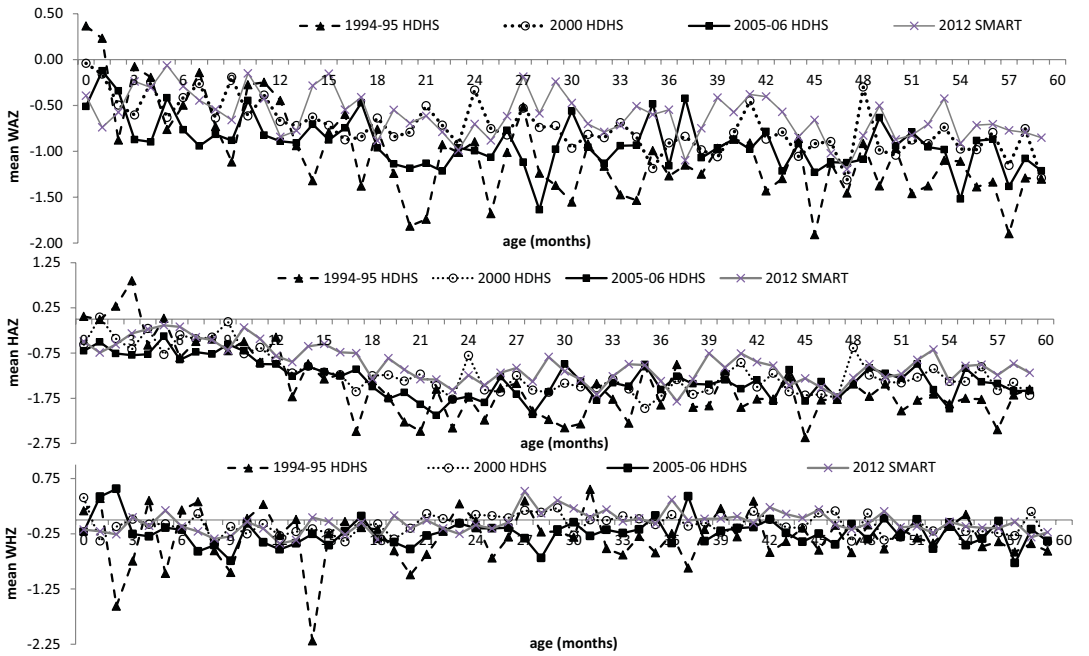

Figure 1. Mean *Z*-scores by age in months and by survey year.

Child nutrition status and trends from 1995 to 2012

In Haiti, children's nutrition status has been monitored every 5 years since 1995 through the HDHS. The results of the surveys undertaken show a decline in undernutrition among children under five between 1995 and 2012. However, this decline was not linear. In fact, underweight, stunting, and wasting rates declined between 1995 and 2000, then increased between 2000 and 2005–2006, and declined again between 2005–2006 and 2012 (Figs. 1 and 2).

HDHS 2012 found 11.4% underweight, 21.9% stunting, and 5.1% wasting among children under five. These figures are statistically significantly lower than the HDHS 2005–2006 findings, which were respectively 18.1%, 29.7%, and 10.1%. The rural–urban gap in child undernutrition rates has also reduced. Stunting, which is associated with long-term child development and economic impacts, was 33.6% in rural and 18.6% in urban areas in 2005–2006, compared to 24.8% and 15.5% in 2012, respectively.[4]

In 2010, Haiti was hit by two major disasters—earthquake and cholera. Nonetheless, earthquake- or cholera-related mortality cannot explain the reported decline in child undernutrition. The earthquake directly affected only a few areas of the country, and an effective treatment protocol for severely malnourished children with cholera was developed and implemented in a timely way to avert deaths.[11]

Following the earthquake, major investments were made in health, nutrition, food security, and water, sanitation, and hygiene (WASH). At the same time, the country received billions of dollars to support the economy, restore infrastructures, and support recovery. There is also evidence that access to basic services (health, WASH, and nutrition) improved between 2006 and 2012.[4] Therefore, the observed decline in child malnutrition was likely the outcome of synergies and improvements made in various sectors that had positive effects on women's and children's health and nutrition status before and after the earthquake.

Child feeding and food practices

The WHO and UNICEF recommend that infants be put on the breast in the first hour following birth, that they be breastfed exclusively during the first 6 months of life, and that age-appropriate and nutrient-dense complementary foods be introduced in their feeding at 6 months while breastfeeding continues for 2 years and beyond. Appropriate IYCF practices could prevent 19% of all deaths under 5 years of age in the developing world.[12]

Assessing the impact of breastfeeding on growth requires controlling sufficiently for potential confounders. At the same time, breastfeeding is a

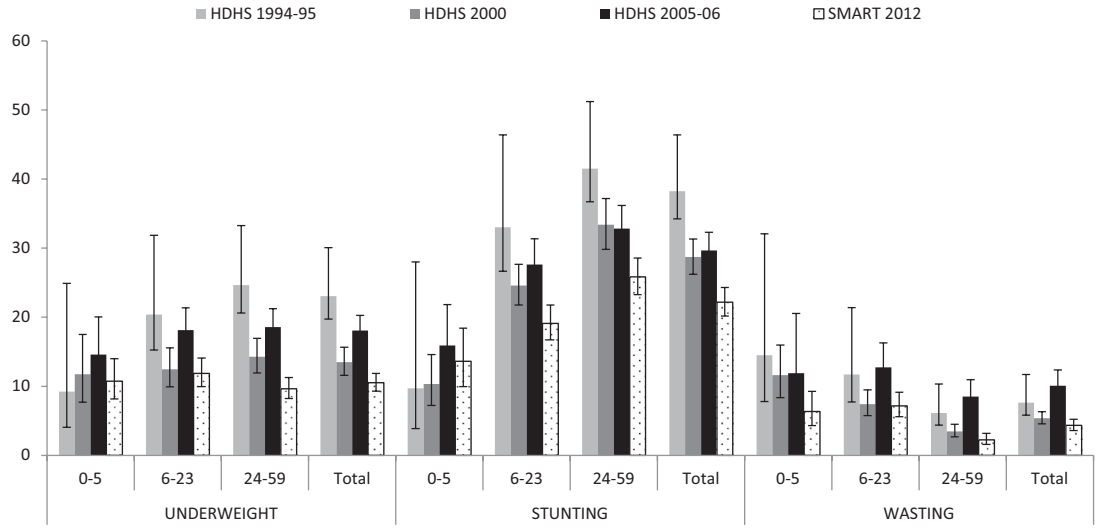

Figure 2. Prevalence of growth faltering by age group (children 0–59 months).

potential confounder in analysis of other nutrition parameters. For example, if good breastfeeding parameters are not included in analysis of the impact of CF on growth, this could affect conclusions. It is therefore important to consider these factors so that there is not a misunderstanding of how the data can and cannot be used to inform program decisions.

Breastfeeding practices and child growth outcomes

An estimated 1.30–1.45 million child deaths globally could be prevented each year with improved breastfeeding practices.[13] An analysis of country-level trends in eight Latin America and Caribbean (LAC) countries over the last two decades showed improved duration of breastfeeding in all countries except Haiti, where average duration of breastfeeding declined by 1.2 months between 1994–1995 and 2005–2006.[1] Despite this overall negative trend, several subgroups of women in Haiti demonstrated a positive increase in breastfeeding duration across the 10-year period, including those with more education, those living in urban environments, and those employed in manual or service occupations.[1]

Haiti's national nutrition policy prioritizes breastfeeding, but limited data have been available to inform strategy. In an effort to address this gap, we recently described national trends in early initiation of breastfeeding (ErlBF) and exclusive breastfeeding (EBF), using HDHS data from 1994–1995 to 2005–2006; examined determinants of ErIBF and EBF; and described the relationship between these breastfeeding practices and growth outcomes among Haitian infants and young children.[5]

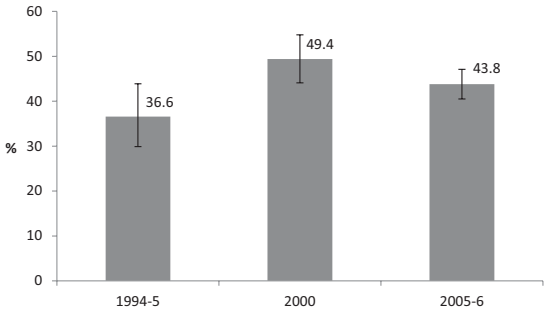

Figure 3. Early initiation of breastfeeding among children 0–23 months old by year of survey (HDHS 1995–1995, 2000, and 2005–2006). Data for HDHS 2012 still not available.

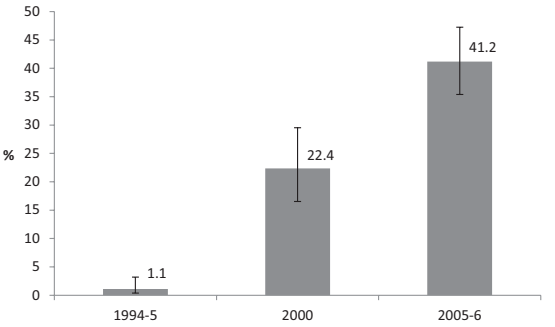

Figure 4. Exclusive breastfeeding (EBF) among children 0–5 months by year of survey (HDHS 1994–1995, 2000, and 2005–2006). Preliminary report of HDHS 2012 indicates that the rate of EBF among children under 6 months is 39.7%. Database not available for in-depth analysis.

We found no change in ErIBF across surveys (36.6% in 1994–1995; 49.4% in 2000; and 43.8% in 2005; Fig. 3). EBF among 0- to 5-month-olds increased sharply from 1.1% in 1994–1995 to 22.4% in 2000 and 41.2% in 2005–2006 (Fig. 4). Breastfeeding patterns among children 0–5 months by age group and year of survey are shown in Table 1. Child age at the time of survey (OR 1.73; $P = 0.027$), lower maternal education (OR = 2.14, $P = 0.004$), and residence in the Artibonite Department (OR 0.31; $P = 0.001$) were associated with ErIBF among children 0–23 months. Age group and department were significant predictors of EBF among children 0–5 months. ErIBF was associated with higher WAZ (ES 0.22; $P = 0.033$) and HAZ (ES 0.20; $P = 0.044$). There was no statistically significant relationship between EBF and growth (Table 2). The 10-year ErIBF and EBF trends in Haiti echo global and regional trends. ErIBF and EBF are related practices but with different determinants in the Haitian context. The primary limitations of this study are the cross-sectional survey design and the use of recall data to assess breastfeeding practices. More details on other limitations are given elsewhere.[5]

Protecting and improving breastfeeding practices after the earthquake

After the January 2010 earthquake and the large number of displaced people it caused, there was a major worry that the harsh living conditions in the camps would negatively affect the already poor IYCF practices in Haiti. There was also a concern that many young children (0–11 months) had lost their mothers or were separated from them and

Table 1. Breastfeeding (BF) pattern among children 0–5 months by age group and year of survey (HDHS 1994–1995, 2000, and 2005–2006)

	<2				2–3				4–5				Total			
	n	%	95% CI		*n*	%	95% CI		*n*	%	95% CI		*n*	%	95% CI	
								1994–1995								
Not BF	1	1.7	0.2	11.9	7	1.5	6.3	22.6	9	7.6	1.5	30.8	16	5.8	2	15.19
EBF	1	1.7	0.2	11.2	1	0.1	1.1	7.5	1	0.8	0.1	5.4	3	1.1	0.4	3.21
BF + water only	6	9.8	3.4	24.8	3	0.7	3.2	13	3	2.6	0.8	8.6	13	4.5	2.2	8.84
BF + other milks	17	26.1	7.6	60.4	0	0	0	0	4	3.9	0.5	23.6	21	7.6	2.5	21.09
BF + other liquids/juice	25	37.7	17.3	63.6	9	1.5	8.6	36.2	2	1.8	0.4	7.1	36	12.6	6.3	23.34
BF + complementary feeding (CF)	15	23.1	9	47.7	83	59.7	80.8	92.3	95	83.4	66.6	92.7	194	68.5	57.3	77.89
Total	65	100	100	100	103	100	100	100	115	100	100	100	283	100	100	100
								2000								
Not BF	2	1.6	0.4	5.9	7	3.9	1.6	9	8	4	1.6	9.6	18	3.3	1.8	5.7
EBF	63	41.2	26.4	57.8	40	21.4	14.3	30.8	19	9.2	5.1	16.2	123	22.4	16.5	29.5
BF + water only	18	11.8	6.6	20.1	19	10.2	6.2	16.4	11	5.4	3	9.8	49	8.8	6.4	12.1
BF + other milks	8	4.9	2.3	10.3	27	14.4	5.8	31.4	18	8.5	5.1	14	52	9.5	5.4	16.2
BF + other liquids/juice	24	15.5	4.9	39.2	8	4.3	2.4	7.5	21	10.4	6.2	16.8	53	9.7	5.9	15.6
BF + CF	38	25	17.5	34.5	87	45.8	36	56	129	62.4	50.6	72.9	254	46.3	39.3	53.4
Total	154	100	100	100	189	100	100	100	207	100	100	100	549	100	100	100
								2005–2006								
Not BF	0	0	0	0	1	0.4	0.1	2.5	4	2.2	0.7	6.2	5	0.9	0.3	2.3
EBF	101	60.8	51.4	69.4	89	41.6	32.8	50.9	48	24.3	17.6	32.6	238	41.2	35.4	47.2
BF + water only	22	13.4	8.7	20.3	26	12	7.9	17.7	26	13.3	8.5	20	74	12.8	10	16.4
BF + other milks	14	8.3	4.1	15.9	13	6.1	3	12	11	5.6	3	10.4	38	6.6	4.3	9.9
BF + other liquids/juice	10	5.9	2.8	11.8	11	5.1	2.6	10	23	11.7	6.8	19.5	44	7.6	5.3	10.7
BF + CF	19	11.6	5.7	22.2	74	34.9	27.3	43.3	85	42.9	33.9	52.4	179	30.9	25.9	36.5
Total	166	100	100	100	214	100	100	100	198	100	100	100	577	100	100	100

would need appropriate feeding and care. In addition, the risk that the country would be flooded with donations of infant formula and milk products, leading to uncontrolled distribution and encouragement of unhygienic bottle feeding and increased risk of diarrhea and mortality among infants, was high.

To protect optimal infant feeding practices, it was decided to establish spaces, called baby tents, where mothers could receive antenatal and postnatal counseling and safely breastfeed, and where children 0–11 months old who had no possibility to breastfeed could access safe ready-to-use infant formula (RUIF) for a limited duration (maximum 6 months). This experience has been described in detail elsewhere.[6]

In summary, the baby tents operated 6–7 days per week. Activities included registration and assessment of the feeding and nutritional status of new mother–infant pairs and pregnant women; individual nutrition counseling of pregnant and breastfeeding women; counseling caretakers of

Table 2. Summary of results of multivariate linear regression models of the relationship between breastfeeding practices and child anthropometry,[1] 2005–2006 HDHS

		WAZ				HAZ				WHZ			
	n	Coeff.[a]	95% CI		*P*-value	Coeff.[a]	95% CI		*P*-value	Coeff.[a]	95% CI		*P*-value
Early initiation of BF[b] (0–23 months)	996	0.22	0.02	0.42	0.033	0.20	0.01	0.40	0.044	0.16	–0.05	0.38	0.13
Exclusive BF[c] (0–5 months)	253	0.16	–0.29	0.62	0.48	–0.09	–0.52	0.33	0.67	0.25	–0.12	0.61	0.19

[a]Estimated regression coefficient and 95% CI for EIBF or EBF in models predicting the specified growth outcome when other variables in the model are adjusted for.
[b]Models adjusted for child sex, age group, birth type, mother BMI, wealth, residence, department, mother education level, mother antenatal visit, current breastfeeding status.
[c]Models adjusted for child sex, age group, birth type, mother BMI, wealth, residence, department, mother education level, mother antenatal visit.
WAZ, weight-for-age *Z*-score; HAZ, height-for-age *Z*-score; WHZ, weight-for-height *Z*-score.

non-breastfeeding infants eligible for RUIF on feeding with RUIF; psychosocial support and growth monitoring; and group education on specific health and nutrition topics.

Overall, 193 baby tents were established in 2010 and 2011. They were attended by 180,499 infant–mother pairs and 52,503 pregnant women. Of the 180,499 infants (0–11 months) enrolled, 54% (96,886) were under 6 months, the age for which EBF is the international recommendation. Seventy percent of infants under 6 months (excluding those receiving RUIF) participating in the program were reported to be exclusively breastfed. Furthermore, of the remaining infants under 6 months whose mothers reported they received mixed feeding (i.e., breast milk plus other foods or liquids; 29,127), 10% moved to EBF before the end of their stay in the program. RUIF was provided in 2010 to only 13% of all infants younger than 12 months old participating in the program (8787) for a maximum of 6 months because they were deemed to have "no possibility to breastfeed." The results of this experience showed that the baby tents approach used in Haiti made an important contribution to protecting and improving infant feeding practices after a major emergency and could serve as a best practice in future disasters.

CF practices and child growth outcomes

The Haitian National Nutrition Policy identifies the promotion of optimal CF practices as a priority action to prevent childhood malnutrition. This is because liquid, semisolid, and solid foods are introduced early for 23.7% of infants less than 6 months, and the quality of those fed to children 6–23 months is often suboptimal.[3]

Specific recommendations for CF practices include feeding a variety of developmentally appropriate nutrient-dense foods at age-appropriate frequency depending on the breastfeeding status of the child.[14,15] Providing education around these IYCF practices with or without food supplements is an effective strategy for reducing the risk of stunting and improving developmental outcomes among children in low-income countries.[16]

In Haiti, CF practices for children 6–23 months have not changed since 1995. We used data from the 2005–2006 HDHS to describe the prevalence and determinants of WHO-recommended feeding practices among Haitian children aged 6–23 months and to describe the relationship between these feeding practices and child growth outcomes. More details on these analyses are given elsewhere.[7]

In summary, we found that 87.3% of 6- to 8-month-olds received soft, solid, or semisolid foods in the previous 24 hours in 2005–2006. This is similar to rates found in 1995–1996 (88.1%) and 2000 (88.9%). Proportions of children aged 6–23 months who received food groups in the previous 24 hours by age group are shown in Figure 5. Table 3 shows these proportions by department. MDD, MMF, and MAD were achieved in 29.2%, 45.3%, and 17.1% of children 6–23 months, respectively.

Non-breastfed children were more likely to achieve MDD than breastfed children of the same age (37.3% vs. 25.8%, $P < 0.001$). The proportion of children achieving MMF varied significantly by age ($P < 0.001$). Children with overweight mothers

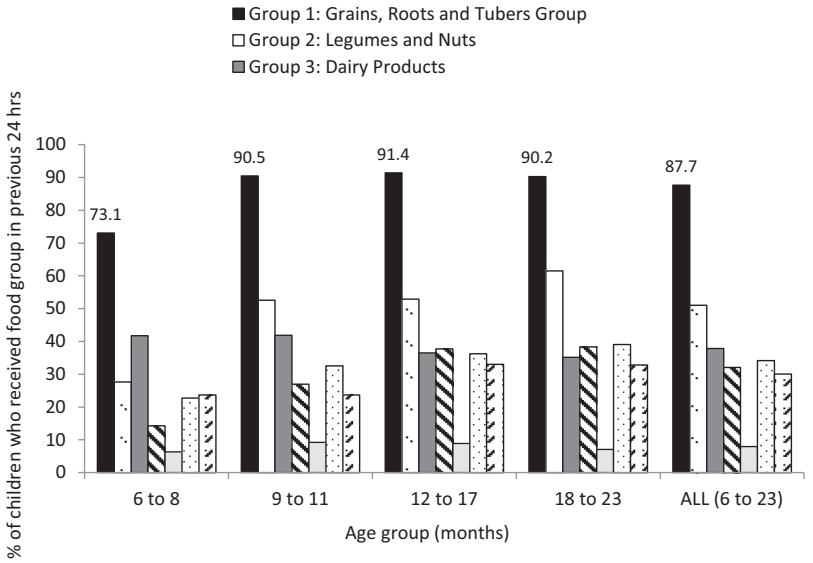

Figure 5. **Proportion of children age 6–23 months living with mother who received food groups in previous 24 hours by age group, HDHS 2005–2006.**

were more likely to achieve MDD, MMF, and MAD (OR 2.08, $P = 0.012$; OR 1.81, $P = 0.02$; and OR 2.4, $P = 0.01$, respectively) than children of normal weight mothers. Odds of achieving MDD and MMF increased with household wealth. Surprisingly, among children of mothers with secondary education, achieving MDD and MAD were associated with lower mean WAZ and HAZ compared to those who did not achieve it (MDD: −0.52 WAZ, $P = 0.008$; −0.57 HAZ, $P = 0.003$; MAD: −0.76 WAZ, $P = 0.019$; −0.64 HAZ, $P = 0.003$; Table 4).

Our in-depth analyses of the 2005–2006 HDHS data showed that CF practices were mostly inadequate and contributed to growth faltering among Haitian children 6–23 months old. This is in line with recent WHO findings showing that consumption of MAD with dietary diversity reduced risks of stunting and underweight, whereas MMF reduced underweight.[17] The limitations of the study are described in detail elsewhere.[7]

Improving child complementary foods through a community-based approach

The persistence of high rates of undernutrition and anemia among children 6–23 months in Haiti has led researchers and program implementers to seek innovative options to improve their complementary foods. One of those options was the use of multiple micronutrient powders (MNPs). Although MNPs have been shown to be effective in increasing hemoglobin levels, attempts to introduce them have been limited in both time and scale.[18]

Since 2010, UNICEF has introduced the use of MNPs to improve complementary foods for children 6–23 months among its priority interventions, and the MOHPH has adopted their use in its national nutrition policy. A community-based approach was chosen as the major distribution channel, and partnerships were established with experienced nongovernmental organizations that have strong community ties and community health workers (CHWs) to deliver the product and monitor its use within families. Data were collected monthly using forms developed for the purpose. The number of children receiving the supplement was then computed using Excel. Short interviews were also conducted with mothers of children and professionals delivering the program to get their general perceptions. Caregivers were given 60 sachets of MNPs, a ration enough for 2-month supplementation for each child. Field supervisors undertook weekly home visits to monitor and encourage consumption.

Since its inception, the program has reached 466,180 children 6–23 months old in the 10 departments of the country. Professionals delivering the program and mothers of children who received the

Table 3. Proportion of children age 6–23 months living with mother who received food groups in previous 24 hours by department, HDHS 2005–2006

	Ouest				Artibonite				Centre				Nord				Nord-Est			
	n	%	95% CI		*n*	%	95% CI		*n*	%	95% CI		*n*	%	95% CI		*n*	%	95% CI	
Group 1: grains, roots, and tubers	542	87.2	83.4	90.2	309	85.7	77.1	91.5	193	86.9	80.2	91.6	164	91.8	86.5	95.2	63	88.0	79.6	93.2
Group 2: legumes and nuts	540	44.7	38.7	50.8	307	63.8	53.1	73.3	192	51.2	41.9	60.3	164	54.6	46.3	62.6	63	55.6	46.4	64.4
Group 3: dairy products	542	52.3	45.3	59.2	309	36.9	28.3	46.5	193	26.3	18.7	35.7	164	37.0	27.8	47.3	62	29.2	21.7	38.0
Group 4: flesh foods	538	30.2	24.2	37.0	309	42.7	30.9	55.4	192	16.7	10.8	24.9	164	34.0	24.2	45.3	62	36.2	27.6	45.8
Group 5: eggs	539	6.4	4.2	9.4	309	7.4	4.2	12.5	193	7.1	4.3	11.7	163	10.9	6.3	18.2	63	8.3	4.8	13.9
Group 6: vitamin A–rich fruits and vegetables	542	28.3	22.3	35.1	309	45.8	35.9	56.1	193	37.6	28.3	47.9	164	32.4	25.0	40.9	63	30.1	23.4	37.7
Group 7: other fruits and vegetables	542	26.7	20.8	33.6	309	34.4	24.7	45.6	193	49.1	38.6	59.7	164	27.0	19.6	35.9	63	22.6	14.7	33.0
	Nord-Ouest				Sud				Sud-Est				Nippes				Grand-Anse			
	n	%	95% CI		*n*	%	95% CI		*n*	%	95% CI		*n*	%	95% CI		*n*	%	95% CI	
Group 1: grains, roots, and tubers	107	86.2	76.5	92.3	100	88.6	81.5	93.2	105	93.1	87.7	96.2	45	92.7	85.4	96.5	73	82.3	74.9	87.9
Group 2: legumes and nuts	107	46.2	37.9	54.8	100	43.8	35.4	52.6	105	54.9	45.3	64.2	45	51.8	37.7	65.6	73	42.6	34.3	51.2
Group 3: dairy products	107	29.5	20.3	40.8	100	37.5	29.0	46.9	105	17.1	10.8	26.2	45	29.2	20.2	40.3	73	22.8	15.0	33.1
Group 4: flesh foods	107	30.0	23.8	37.2	100	39.4	28.5	51.5	105	27.2	19.5	36.6	45	34.2	23.5	46.8	73	31.5	17.9	49.3
Group 5: eggs	107	13.1	7.5	21.9	100	10.4	6.6	16.0	105	11.9	5.8	22.9	45	1.1	0.2	7.1	73	5.3	2.5	10.9
Group 6: vitamin A–rich fruits and vegetables	107	29.9	18.7	44.1	100	40.7	30.5	51.8	105	25.0	16.3	36.4	45	31.6	21.2	44.1	73	38.4	29.0	48.9
Group 7: other fruits and vegetables	107	29.4	21.4	38.8	100	35.4	28.8	42.6	105	15.6	8.9	26.0	45	21.7	13.9	32.3	73	19.1	12.7	27.8

WAZ, weight-for-age Z-score; HAZ, height-for-age Z-score; WHZ, weight-for-height Z-score.

MNPs reported appreciation and good acceptance of MNPs as per the following few quotes:

> A child was born in October 2009. He was brought to Doco after the earthquake by his mother when he was 4 months old. After some time, his mother left him in the care of his grandmother and returned to Port-au-Prince. He was very skinny and looking sick. It took a little time to convince his grandmother that the vitamin powder would help him. Since he has had 8 months of daily vitamin powder in his cooked meal, he has improved. We don't see any of this being sold in the markets. The mothers use it. They hope to get more.—A mother

> I'm so grateful for the mother's groups meetings because it's where I received the vitamin powder. Thanks to what I learned there, I make

Table 4. Summary of results from multiple linear regression models between IYCF indicators and mean anthropometric outcomes, HDHS 2005–2006

		Low education				High education				All			
		n	*B*	95% CI	*P*-value	*n*	*B*	95% CI	*P*-value	*n*	*B*	95% CI	*P*-value
							WAZ						
Minimum dietary diversity (MDD)[a]	6–23 months	552	0.158	–0.125 0.441	0.27	201	–0.523	–0.91 –0.137	0.008	754	0.009	–0.227 0.245	0.94
Minimum meal frequency (MMF)[a]	6–23 months	544	–0.133	–0.378 0.111	0.28	182	–0.067	–0.536 0.402	0.78	726	–0.066	–0.255 0.124	0.49
Minimum acceptable diet (MAD)[b]	6–23 months	444	0.143	–0.256 0.542	0.48	134	–0.759	–1.389 –0.129	0.019	578	–0.066	-0.394 0.261	0.69
							HAZ						
MDD[a]	6–23 months	552	0.245	–0.055 0.545	0.11	201	–0.57	–0.938 –0.202	0.003	754	0.016	–0.248 0.28	0.91
MMF[a]	6–23 months	544	-0.179	–0.466 0.109	0.22	182	0.245	–0.182 0.673	0.26	726	–0.035	–0.26 0.19	0.76
MAD[b]	6–23 months	444	0.03	–0.334 0.394	0.87	134	–0.642	–1.063 –0.22	0.003	578	–0.146	–0.455 0.164	0.36
							WHZ						
MDD[a]	6–23 months	552	0.031	–0.28 0.343	0.84	201	–0.327	–0.762 0.107	0.14	754	–0.011	–0.276 0.254	0.94
MMF[a]	6–23 months	544	–0.062	–0.339 0.215	0.66	182	–0.239	–0.764 0.287	0.37	726	–0.063	–0.316 0.189	0.62
MAD[b]	6–23 months	444	0.149	–0.328 0.626	0.54	134	–0.595	–1.435 0.245	0.16	578	–0.424	0.405 –0.05	0.96

[a]Models adjusted for child's sex, age group, birth type, mother's BMI, wealth, residence, region, mother antenatal visit, current breastfeeding status.
[b]Models adjusted for child's sex, age group, birth type, mother's BMI, wealth, residence, region, mother antenatal visit.
WAZ, weight-for-age Z-score; HAZ, height-for-age Z-score; WHZ, weight-for-height Z-score.

sure my daughter eats a balanced diet and gets all the nutrients she needs. She's all right now. She's solid.—Another mother

Children have seemed to move out of the program a little faster—since we started this program about a year ago.—Data manager of a rural nutrition rehabilitation program

Some kids don't like it so mothers put it in juice rather than food or in a little part of the food and not in the whole bowl. Then they eat it. The hemoglobin of some of these children is so high now! They were not this good before vitamins every day.—Nurse manager of nutrition programs

The mothers were very happy with the powdered vitamins and thanked us for what they saw in the children. They noted an increase in appetite; they were sleeping better, their skin looked pretty and even the occasional diarrhea was not happening. Even school-aged children would come home asking, "Did they bring vitamins for me?—Field supervisor

This study was limited to evaluating children who received MNPs and collecting the views of their caregivers and the staff delivering the program. It did not make an attempt to establish a relationship between the consumption of MNPs and biological outcomes such as hemoglobin or iron status levels, for example.

Child micronutrient status

Anemia among children 6–59 months old

Childhood anemia is a major public health problem worldwide. It is associated with serious consequences including growth retardation, impaired motor and cognitive development, and increased morbidity and mortality.[19] Estimates suggest that 47.4% of children under 5 years of age globally are anemic.[20] In Haiti, the 2005–2006 nationally representative survey showed that 60.6% of children 6–59 months (approximately 610,000 children) and 75% of children 6–23 months were anemic.[3] Up-to-date data on childhood anemia and its predictors have been lacking in Haiti. This hindered the design of programs and limited their effectiveness.

We carried out a study to determine the prevalence and risk factors of childhood anemia in Fond des Blancs and Villa, a socioeconomically disadvantaged, remote mountainous region of Haiti. Details on this study, including the limitations of its

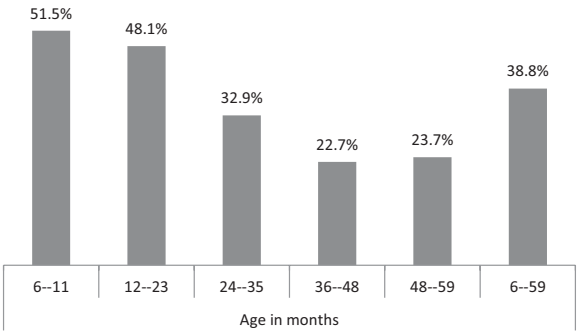

Figure 6. Prevalence of anemia among children by age group. Adapted from Ref. 8.

cross-sectional nature, can be found elsewhere.[8] In summary, children 6–59 months old ($n = 557$) were randomly selected using a two-stage random sampling scheme in 30 of the 69 villages of the area. The list of all villages and 2009 population estimates were used. The first sampling stage was the selection of clusters and the second sampling stage was the selection of households within the clusters.

Hemoglobin levels of children and mothers were measured using the HemoCue® technique. Anemia was defined as hemoglobin <11 g/dL for children and pregnant women and hemoglobin <12 g/dL for nonpregnant women. Weight and height were measured for all children. Age was obtained from a birth certificate or a child health card. Descriptive statistics were calculated. Means (±SD) were derived for hemoglobin and random effects logistic regression modeling was used to determine the risk factors associated with childhood anemia. WAZ, HAZ, and WHZ scores were calculated using the WHO Child Growth Standards. All analyses were performed using Windows SPSS version 20.0.

In our study in Fonds des Blancs, we found anemia in 38.8% of children 6–59 months old. Among them, 23.9% had mild anemia, 14.7% had moderate anemia, and 0.2% had severe anemia. Mean hemoglobin concentration was 11.2 ± 1.2 g/dL. Slightly more boys (42.1%) than girls (35.7%) had anemia. Figure 6 shows the prevalence of anemia among children by age categories. The prevalence of anemia among nonpregnant and pregnant women was 23.9% and 29.2% and mean hemoglobin levels were 12.9 ± 1.5 g/dL and 11.8 ± 1.3 g/dL, respectively. Among the studied children, 4.5% (95% CI: 3.2–6.2) were wasted with 1.1% (95% CI: 0.5–2.4) being severe; 19.8% (95% CI: 16.5–23.6) were stunted; and 9.8% (95% CI: 7.6–12.5) were underweight. In multiple logistic regression analysis, we found that child anemia was associated with age under 24 months (OR = 2.6; 95% CI: 1.7–3.8, $P = 0.000$); stunting (OR = 2.2; 95% CI: 1.4–3.6; $P = 0.005$); and mother's low hemoglobin (OR = 1.8; 95% CI: 1.2–2.9; $P = 0.011$; Table 5).

In addition to this study, we also analyzed data from the nationally representative HDHS 2005–2006 to describe the prevalence and predictors of anemia among Haitian women (15–49 years) and Haitian children (6–59 months) and to draw implications for national nutrition programming. The study methods and limitations are given in detail elsewhere.[9] We found that the prevalences of mild (Hb 11.0–1.9 g/dL), moderate (Hb 8.0–10.9 g/dL), and severe (Hb < 8.0 g/dL) anemia were 19.2%, 21.7%, and 4.4%, respectively, among women 15–49 years and 22.9%, 33.9%, and 2.2% among children 6–59 months. Anemia was more prevalent in urban women (54.4%) and children (65.1%) than rural

Table 5. Risk factors associated with childhood anemia in Haiti[8]

Risk factors	OR	95% CI	*P*-value
Age <24 months	2.6	1.7–3.8	0.000
Sex = male	1.3	0.8–1.9	0.247
WAZ < –2	0.9	0.4–2.2	0.917
WHZ < –2	1.2	0.4–3.3	0.704
HAZ < –2	2.2	1.4–3.6	0.005
Mother's anemia	1.8	1.2–2.9	0.011

OR, odd ratios; CI, confidence interval; WAZ, weight-for-age *Z*-score; WHZ, weight-for-height *Z*-score; HAZ, height-for-age *Z*-score.

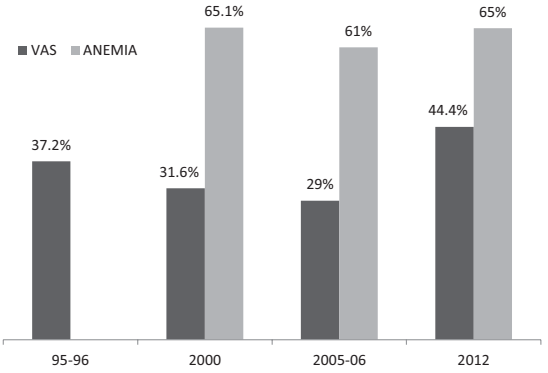

Figure 7. Trends of vitamin A supplementation (VAS) coverage and anemia prevalence among children 6–59 months between 1995–1996 and 2012. No anemia data were collected in 1995–1996.

women (43.1%; $P < 0.001$) and children (55.7%; $P = 0.004$). In multivariate regression models, factors associated with anemia among urban women (birth spacing, $P = 0.027$; overweight BMI, $P < 0.001$; education level, $P = 0.022$) were different from those in rural women (wealth quintile, $P < 0.05$; employment, $P = 0.003$). Anemia in urban and rural children 6–59 months increased with child age ($P < 0.05$) and maternal anemia status ($P = 0.004$; $P < 0.001$). Female gender ($P = 0.007$) and maternal overweight ($P = 0.009$) were associated with reduced risk of anemia in rural children only.[9] Trend data show that anemia prevalence has been consistently high (>60%) among Haitian children 6–59 months since 1995–1996 (Fig. 7).

In conclusion, anemia among young Haitian children is a severe public health problem. Our findings suggest that its determinants are multiple: the need for context-specific rural and urban strategies, reinforcement of anemia prevention in health service reaching women of childbearing age, and targeted interventions for young children. Such interventions could include iron supplementation, which was shown to reduce anemia among children under 2 years by 49% and iron deficiency by 76%; and multiple micronutrient supplementation, which was shown to improve hemoglobin concentration and reduce iron deficiency anemia by 57%.[21,22]

Anemia among school-aged children

Anemia among school children is a prevalent, but often neglected, public health problem in developing countries. Its effects on school attendance and performance have been documented[23,24] and have been shown to affect younger children more profoundly. In Haiti, the prevalence of anemia in this age group has not been assessed, to the best of our knowledge.

To address this, we undertook Hb measurements in 4721 primary school children chosen randomly in 98 schools in three departments of Haiti (Nord-Est, Sud-Est, and Ouest). This was in an effort to set up the baseline for a new UNICEF nutrition (iron supplementation) project implemented in collaboration with PLAN International and the Ministry of Health. Capillary blood samples were collected by finger stick (lancet) from the middle finger of children. The first and second drops were wiped away with clean, dry gauze and then the third drop of blood was used for analysis. Hb was measured using the HemoCue technique. Anemia was defined as Hb < 12 g/dL. Descriptive statistics were calculated using Excel.

We found that 1405 children out of the 4721 tested (30%) were anemic (37% in Ouest, 34.1% in Nord-Est, and 18.2% in Sud-Est). All anemic children were given iron/folic acid (IFA) and deworming tablets to treat the anemia. These results confirm that in Haiti, anemia among school children is prevalent and therefore may call for a school-based supplementation plus deworming program throughout the country.

Challenges have been reported with respect to the reliability and accuracy of Hb levels measured by the HemoCue technique, in particular with respect to sample collection and analysis techniques. However, there is global evidence showing that this method gives accurate results and adequate estimates of population anemia prevalence.

Lack of data makes it difficult to present either trends of anemia or the determinants of low hemoglobin levels in this population group. However, based on global knowledge, we suggest that iron deficiency and helminth infections could likely be two of the major causes of anemia among school children in Haiti.

Vitamin A and iodine deficiencies among children

Vitamin A deficiency among children is associated with increased risks of blindness, xeropththalmia, diarrhea, measles, respiratory infections, and mortality.[25] Iodine deficiency negatively

Table 6. Levels (%) of serum retinol and urinary iodine among children (source Ref. 10)

	Serum retinol among children 6–59 months		
	Median in μmol/L	≥0.70 μmol/L (<0.35 μmol/L)	<0.70 μmol/L (95% CI)
Sample size			
780	0.82	67.98 (1.47)	32.02 (25.81–38.23)
	Urinary iodine concentration among children 6–12 years		
	Median in μg/L	<50 μg/L	<100 μg/L (95% CI)
Sample size			
1199	84	24.82	58.91 (52.39–65.43)

affects mental development and intelligence quotient of children under five[26] as well as academic achievements of school-aged children.[27]

In Haiti, data on vitamin A and iodine status of children are scarce. A study commissioned by UNICEF and the Ministry of Health in 2006 tried to close this gap.[10] Blood samples were collected from children 6–59 months and urine samples were collected from children 6–12 years to measure plasma retinol and urinary iodine, respectively. Capillary blood from the middle finger for children older than 2 years and from the heel for children under 2 years was collected on a filter paper. Alcohol was applied to each collection surface before puncture with a lancet. The time and date of the puncture were then noted and reported. Blood samples were kept in envelopes at a temperature of 20–22 °C, sent by DHL as soon as possible to the United States (Craft Technologies Laboratory), reaching there within 4 days of collection. They were analyzed using high-performance liquid chromatography. Urine samples were sent under dry ice and analyzed in Guatemala (INCAP Laboratory).

Results showed that 32.02% of children (33.7% of boys and 33.3% of girls) had a serum retinol <0.70 μmol/L and hence were vitamin A deficient (Table 6). Of the children 6–12 years tested for iodine, 25% had a median iodine urinary concentration less than 50 μg/L and 59% had less than 100 μg/L. These rates exceed the thresholds of less than 20% and 50%, respectively. The median urinary iodine concentration was 84 μg/L, which is lower than the established minimum standard of 100 μg/L, thus indicating that iodine deficiency was prevalent in this population (Table 6).

Lack of data makes it impossible to present either trends or the determinants of vitamin A deficiency in this population group. Nonetheless, it is likely that poor consumption of vitamin A–rich foods and recurrent infections may explain the low serum retinol observed. Trends cannot be presented for iodine deficiency disorders either. The low percentage of households consuming adequately iodized salt in Haiti (3% in 2005–2006) may explain, in part, the high rates of low urinary iodine concentration reported.

Vitamin A supplementation and deworming

Robust scientific evidence shows that vitamin A supplementation results in significant reduction in vision problems, morbidity, and mortality among children 6–59 months old.[25] Evidence also shows that vitamin A and deworming interventions improve children's vitamin A status and hemoglobin concentrations.[28] This is why, in addition to its positive effect on anemia, deworming is recommended twice a year for children 12–59 months.

Haiti's vitamin A supplementation program is one of the oldest in the world; it started in 1977. However, single-dose coverage has been consistently low (<50% according to HDHS data; Fig. 7). Data on deworming are scarce. More recently, development partners including UNICEF, the Inter-American Development Bank, the Micronutrient Initiative, and the WHO have been supporting the government of Haiti technically and financially to improve vitamin A and deworming coverage among children. We analyzed data obtained from national campaigns over the next 2 years (2011 and 2012) and computed the proportion of children who received vitamin A and albendazole. These data were collected twice a year using tally sheets prepared jointly by the government and its partners. Using Excel, we created a database and computed the proportion of children who received vitamin A supplements and deworming tablets. We found

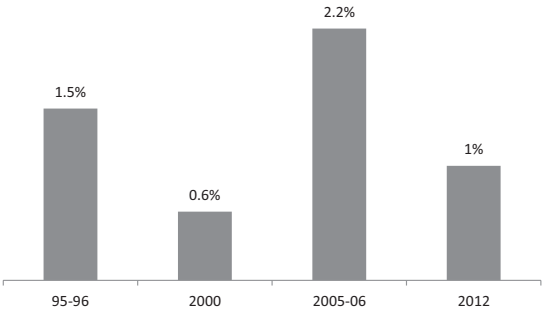

Figure 8. Trends of severe acute malnutrition prevalence among children 6–59 months between 1995–1996 and 2012.

that in 2012, 92% of children 6–59 months were supplemented with vitamin A.[29] In 2011, only 35% of children 12–59 months received one dose of albendazole against 75% in 2012.[29,30] The vitamin A supplementation and deworming program in Haiti still relies heavily on partners to make supplies available and support field delivery, which threatens any long-term perspectives.

There has clearly been some progress in reaching more Haitian children with vitamin A supplements and deworming tablets since 2011. However, these achievements are still fragile and merit continued support from key partners.

Severe acute malnutrition in children under five

Children with severe wasting are nine times more likely to die than those who are not malnourished.[2] It was estimated in 2006 that at any point in time there were about 28,000 children under five with severe acute malnutrition (SAM) in Haiti, which means that about 45,000 cases of SAM were expected throughout the year.[3] Trends of SAM among children 6–59 months in Haiti since 1995 are shown in Figure 8.

Before the earthquake, access to adequate and timely care for these children was limited. There were no guidelines, no nutrition rehabilitation or treatment centers, no trained human capacity, and no state-of-the-art and globally approved therapeutic supplies (milks and ready-to-use therapeutic foods (RUTFs)). Therefore, after the earthquake hit the country, there was a major concern from the government and its development partners that many infants and young children would have increased risk of SAM and mortality.

To make sure that this does not happen, the MOPHP, with the support of the international community, launched an emergency nutrition program for the integrated management of SAM among young children. The program was first implemented in the earthquake-affected areas (Port-au-Prince, Jacmel, Leogane, Petit Goave, and Gonaive) and then quickly expanded throughout the country.

Treatment was provided in nutrition stabilization units (NSUs) for SAM cases with medical complications and outpatient treatment programs (OTPs) for SAM cases without medical complications. NSUs and OTPs were set up within already existing government health facilities as much as possible. Using WHO and UNICEF recommendations, children were considered to have SAM if they had mid-upper-arm circumference (MUAC) < 115 mm and/or weight-for-height/length below three SDs of the WHO child growth standards and/or bilateral pitting edema.[31]

In the NSUs, children received therapeutic milk F-75 and medical complications were treated and monitored by a licensed physician as per the national protocol for integrated management of SAM of the MOPHP.[32] Once stabilized, children were given therapeutic milk F-100 first and then RUTF. Once medical complications were treated, there was no edema and appetite for RUTF was well established, children were transferred to OTPs in the community.

Children without medical complications who passed the appetite test were treated directly in the OTP with RUTF. In addition, children in the OTP received at admission one dose of vitamin A (200,000 IU) if they had no edema and one single dose of folic acid (5 mg), and amoxicillin 125, 250, or 500 mg was given three times a day for 7 days for children weighing <9.9 kg, between 10 and 30 kg, and >30 kg, respectively. At the beginning of the second week, children older than 1 year received one dose of 400 mg of albendazole. Children were discharged from the program when they met the following criteria: absence of bilateral pitting edema for at least 10 consecutive days; weight-for-height/length within two SDs of the median weight-for-height/length of the WHO standards; and MUAC > 115 mm.

A total of 28 NSUs and 293 OTPs were established between 2010 and 2012. We collected data from those centers monthly and computed the total number of children who had access to care in

them annually. We also computed the proportion of deaths, cured children, and defaulters in the program over a period of 3 years. We found that more than 11,250 severely malnourished children 6–59 months were admitted in 2010, more than 15,000 were admitted in 2011, and about 16,000 (including 210 HIV^+) were admitted in 2012. Overall, program outcomes were satisfactory, with recovery rates >75%, death rates <10% (<1% in the OTPs and 7.7% in the NSUs) and defaulters <15%.[29,30,33] Unfortunately, this program also continues to rely on support from partners, in particular its supplies component.

In conclusion, we present evidence that major progress was made in Haiti since 2010 to make timely and effective care available to children suffering from SAM. The challenge is now ensuring that public institutions sustain these services while maintaining quality and enforcing set norms and standards.

Children's nutrition and women's empowerment

Women are often the primary individuals responsible for child health and nutrition. As such, their autonomy and control of resources may influence child care and ultimately infant and young child nutrition outcomes favorably.

In a study on maternal autonomy (defined as a woman's personal power in the household and her ability to influence and change her environment) and child nutrition in India, the authors showed that two dimensions of female autonomy have an independent effect on child growth. Women with higher autonomy as indicated by access to money (odds ratio (OR) = 0.731; 95% CI: 0.546–0.9810) and freedom to choose to go to the market (OR = 0.593; 95% CI: 0.376–0.933) were significantly less likely to have a stunted child.[34]

Using data from the 2005–2006 HDHS, we examined the relationship between women's empowerment and child growth in Haiti. We categorized women's empowerment variables as being related to evidence of empowerment versus resources or settings for empowerment. Setting variables reflect the circumstances of a woman's life and her opportunities to access resources. Variables used for empowerment evidence include (1) control-over-money index (categories of purchases that the woman has control over funds to purchase alone or in cooperation with someone else), (2) gender role–opinion index (statements regarding women's attitude around inequality in gender roles that the woman agrees with), (3) household decision-making index (categories of decision making that the woman contributes to alone or jointly with someone else), and (4) community-integration index (ability to meet and discuss community problems, education, health, and women's issues).

We restricted our analysis to women of childbearing age (15–49 years) who had given birth to a child in the previous 5 years, whose weight and height were measured and recorded during the survey. Child growth outcomes included measures of linear (height-for-age) and ponderal (weight-for-height) growth. HAZ and WHZ scores were calculated using the WHO child growth standards. Stunting and wasting were defined as HAZ < -2.0 and WHZ < -2.0 SD below the WHO reference median, respectively.

Descriptive statistics are presented for index variables. Unadjusted mean HAZ and WHZ were estimated for each level of the covariates using the general linear model and compared to the reference level using a *t*-test. We used multiple linear regression models to assess the relationship between the predictors and each of the two growth outcomes (HAZ and WHZ) after adjusting for the other covariates in the model. Variables that were significant at the $P < 0.2$ level in the univariate analyses were included in the multivariate models. Models were then simplified using backwards elimination.

We found that a one-unit increase in score on the gender index, which indicates less maternal empowerment, was associated with a 0.13-unit decrease in HAZ ($P = 0.002$). A one-unit increase in the community integration and household decision indexes, which indicate higher maternal empowerment, were associated with 0.09- ($P = 0.003$) and 0.07-unit ($P = 0.006$) increases in HAZ, respectively, and a one-unit increase in the control-over-money index, where higher value also suggests greater evidence of empowerment, was associated with a 0.13-unit HAZ increase.

Our findings show that in Haiti, several measures of women's empowerment are significantly associated with child growth outcomes. Attention should, therefore, be given to these measures when planning and implementing child nutrition programs as well as when seeking the participation of women in

those programs. More complex analyses could be needed to show the actual magnitude of the effect of women's empowerment on child growth outcomes. In addition, the concepts of empowerment are sometimes difficult to capture in survey data such as DHS, and thus caution is warranted in interpreting our results.

Child nutrition and access to health services, water, and sanitation

The relationship between child nutrition and access to health services, water, and sanitation has been acknowledged and even given renewed attention recently. For instance, new evidence has shown a strong association between child undernutrition and diseases caused by poor sanitation.[35]

Trends of access to health services and improved drinking water sources as well as latrines in Haiti are shown in Figure 9. These data show significant progress in access to health services and improved drinking water sources and a slow downward trend in the proportion of households having no latrine. As expected, rural areas are worse off than urban areas for all three indicators.

Based on the improvement observed in 2005–2006, we did an in-depth analysis of the 2005–2006 HDHS database. For access to health services, variables were selected to represent access to health care during two different periods—pregnancy and early childhood—namely access to ANC, micronutrient supplements during pregnancy, infant feeding counseling, and the size of the child at birth. We classified children born to mothers who reported at least the recommended four ANC visits versus less than four visits. The variables selected were access to safe clean drinking water and sanitary practices related to fecal material. The 2005–2006 HDHS does not include information on hand washing or other hygiene practices.

The source of drinking water often relates to the quality of water consumed by household members. Improved sources of water include a protected tap in the home or yard; protected pump, springs, or wells; rainwater; and bottled water. Unimproved sources included unprotected wells or springs, surface water such as river or lake water, and water sold from tankers or by other street vendors. All households that used a means of water treatment such as boiling, addition of bleach or chlorine, solar disinfection, or household filter were classified as improved, regardless of the source type. Distance from the water supply reflects the ease of access households have to drinking water and relates to their likelihood of consistently accessing that supply. Access to water was categorized based on the time it took to reach the primary water source from the home.

Child growth–outcome variables are the same as previously described. Unadjusted mean WAZ, HAZ, and WHZ were estimated for each level of the covariates using the general linear model and

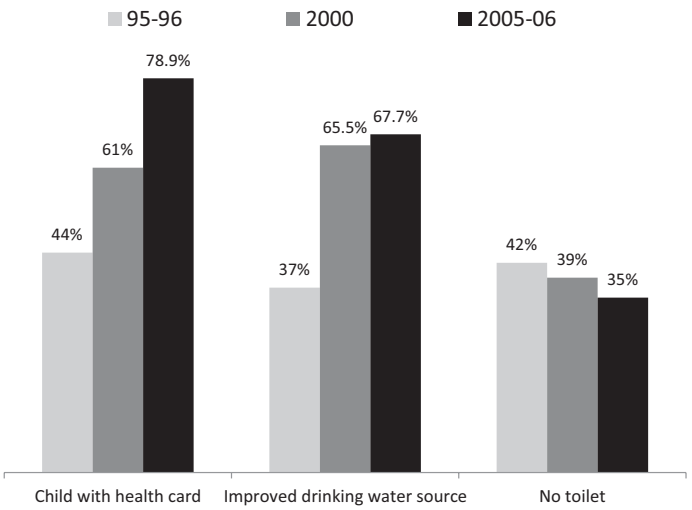

Figure 9. Trends in access to health services and improved drinking water source and no latrine between 1995–1996 and 2005–2006.

compared to the reference level using a *t*-test. Unadjusted prevalence of underweight, stunting, and wasting were estimated for each level of the covariates and compared across the categories using Pearson's χ^2. We used multiple logistic regression to assess the relationship between each predictor and each of the three growth-faltering outcomes (underweight, stunting, wasting) after adjusting for the other covariates in the model.

We found that the majority of children under 5 years currently had an MOPHP health card (78.9%). Rates were lowest in Sud-Est (61.0%) and highest in Artibonite (85.9%). Overall, 54.7% of mothers interviewed reported four or more ANC visits during their last pregnancy. Rates of four or more ANC visits were highest in Nord-Est (63.9%), Nord-Ouest (62.3%), and Ouest (61.5%) and lowest in Centre (37.6%) and Sud-Est (36.6%). Overall, 67.74% of the sample had access to an improved source of drinking water. Access to improved water sources was highest in Ouest (85.7%) and lowest in Centre (38.9%). Only 17.8% of the sample had access to water on their own property. About a third of respondents (30.4%) reported traveling more than 30 min to access water. Sud-Est had the highest proportion of households who traveled more than 30 min to access water (52.2%).

Access to improved toilet facilities was low across all departments. Only 12.9% of the overall sample reported using an improved toilet. Access to improved toilets was lowest in Centre department (4.2%). Rates of proper stool disposal varied across departments from lowest in Grand-Anse (27.5%) to highest in Ouest (75.1%). The overall rate was 58.2%.

Among water and sanitation variables, the only statistically significant association was between time to find water and wasting. Contained disposal of stools tended to be protective against stunting (OR 0.71, $P = 0.055$). Diarrhea in the previous 2 weeks was associated with risk of underweight (OR 1.53, $P = 0.024$) and tended to be associated with risk of stunting (OR 1.36, $P = 0.064$). Fever in the previous 2 weeks was associated with higher risk of wasting (OR 1.60, $P = 0.030$).

Regarding access to health care, having a health card was protective against underweight (OR 0.57, $P = 0.001$) and stunting (OR 0.67, $P = 0.017$) compared to children who did not have a health card. Children of mothers with four or more ANC visits had lower risk of stunting (OR 0.70, $P = 0.022$) but higher risk of wasting (OR 1.79, $P = 0.022$) compared to those who reported zero to three visits. There was no association between ANC visits and underweight.

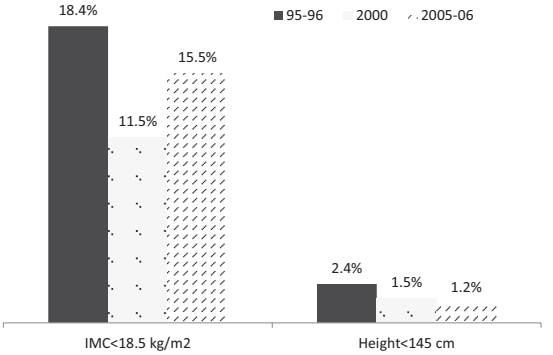

Figure 10. **Trends of undernutrition among women 15–49 years between 1995–1996 and 2005–2006.**

Potential limitations of this study include the lack of variables related to hygiene practices (e.g., hand washing, home cleanliness), its cross-sectional nature, and using the possession of an MOHP card as a proxy for access to health services. The latter might, indeed, over- or underestimate actual access and utilization of health services.

Women's nutrition

Nutrition status and trends from 1995 to 2012

In Haiti, women's nutrition status has been monitored every 5 years since 1995 through the HDHS. More information about survey design, data collection, and data management is available in the HDHS final reports available at http://www.measuredhs.com/What-We-Do/survey-search.cfm?pgtype=main&SrvyTp=country.

The results of the surveys undertaken show a decline in undernutrition among women between 1995 and 2005–2006 (HDHS data for 2012 were not yet available at the time this manuscript was drafted). However, this decline was not linear. In fact, the proportion of women with low BMI (<18.5 kg/m^2) declined between 1995 and 2000, then increased between 2000 and 2005–2006 (Fig. 10). The SMART survey conducted in 2012 showed that 11% of women had a BMI <18.5 kg/m^2.

Not surprisingly, higher rates of undernutrition among women were found in rural areas (21% in 1995–1996, 13% in 2000, and 19% in 2005–2006)

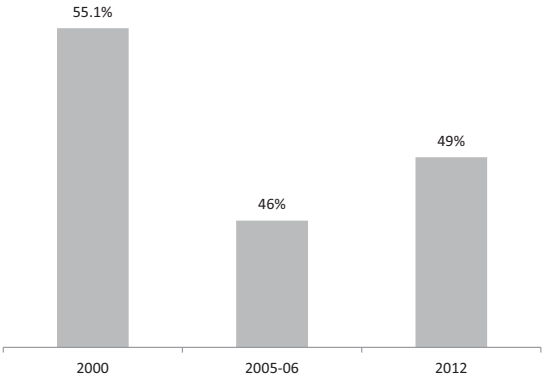

Figure 11. Trends of anemia prevalence among women of reproductive age between 2000 and 2012.

than in urban areas (12% in 1995–1996, 9% in 2000, and 12% in 2005–2006). Similarly, the proportions of women with BMI <18.5 kg/m^2 are higher among those with no education than among those with a secondary or higher education level (21% vs. 10% in 1995–1996; 12% vs. 8% in 2000; and 12% vs. 20% in 2005–2006). These data show that undernutrition among women of childbearing age in Haiti is prevalent ($>10\%$).

Anemia among women 15–49 years old

Anemia among women of reproductive age is a widespread public health problem in low- and middle-income countries that has serious consequences for child development, maternal survival, and adult economic productivity.[36,37] Haiti is among the Latin American and Caribbean countries with the highest prevalence of anemia in women and children.[20] Details on the variables and methodology used as well as the study limitations are given elsewhere.[9] Trends of anemia among women of reproductive age since 2000 are shown in Figure 11.

An in-depth analysis of the 2005–2006 nationally unbiased data[19] showed that anemia among women of reproductive age was associated with poverty, urban location, and education. Prevalence of all levels of anemia was lower in the poorest two quintiles compared to the higher quintiles. Furthermore, women living in urban settings had higher prevalence of any anemia compared to women in rural areas (54.4 vs. 43.1%; $P < 0.001$). Higher levels of education were associated with increased risk of mild anemia in unadjusted models ($P = 0.019$).

Prevalence of anemia in women 15–49 years varied by department ($P = 0.015$). Prevalence of any anemia (mild, moderate, or severe) was highest in Ouest (48.4%) and Artibonite (47.7%) and lowest in Sud-Est (35.3%), Nippes (37.6%), and Nord-Est (38.6%). Prevalence of severe anemia was highest in Ouest (5.5%), Artibonite (4.9%), Sud-Est (4.7%), and Centre (4.6%) and lowest in Sud (1.9%). Moderate anemia was higher among pregnant than nonpregnant women (27.6% vs. 21.2%; $P = 0.039$). Overweight women had lower prevalence of moderate anemia (20.1%) compared to normal (25.3%) or underweight (24.9%) women.

Results from multiple logistic regression models showed a significant interaction between residence and wealth; maternal age or current pregnancy status were not associated with anemia. In urban populations, having fewer than two births in the last 5 years was associated with a 35% reduction in anemia risk compared to two or more. Being overweight was associated with a 38–39% reduced anemia risk compared to having a normal BMI. There was no difference in anemia risk between underweight and normal-BMI women. In rural populations, being in the lowest two wealth quintiles was associated with a 30–35% reduction in anemia risk compared to the highest quintile. In the combined model, the lowest two wealth quintiles were associated with a more than 50% reduction in anemia risk compared to the highest. Maternal employment was protective against any anemia in the rural (OR 0.77, $P = 0.003$) and combined (OR 0.86, $P = 0.018$) but not urban models. Maternal education level was associated with anemia in the urban model only. Urban women with a primary-level education were at higher risk compared to women with secondary or more education (OR 1.29, $P = 0.022$). There was no statistical association between department and women's anemia risk.

In summary, anemia is a severe public health problem among Haitian women of childbearing age (prevalence $>40\%$). In this group, there are important differences in the predictors of anemia, which call for context-specific programmatic interventions and strategies. Such differences need to be considered carefully when efforts are invested in scaling up models and programs to prevent and control maternal anemia in Haiti, keeping in mind that iron supplementation in nonpregnant women of reproductive age could reduce risks of anemia by 27%[38]

and daily iron supplementation to women during pregnancy could reduce anemia at term by 70% and iron-deficiency anemia by 67%.[39]

Community-based early child care and nutrition

As part of an intensive effort to promote scale-up of nutrition activities, starting in May 2011 UNICEF-Haiti provided 18–20 months of financial support, intervention inputs, and technical guidance to five NGOs implementing integrated community health and nutrition programs (ICHN). UNICEF's goal was to learn from the implementation experiences of these model programs and apply learning to build the delivery capacity of the MOPHP and its partners. The primary question was not which interventions to deliver, but rather how to deliver maternal/child health and nutrition interventions as an integrated package at the community level. All five of the UNICEF-supported ICHN programs shared common elements, including the types of interventions and the use of one or more community-based delivery platforms such as health posts, mobile clinics, home visits, and mothers' groups.

Cornell University's Division of Nutritional Sciences was tasked with documenting the design and delivery systems of the ICHN programs and making recommendations that will support scale-up of similar programs by the MOPHP and its partners. In December 2011 and April 2012, a team of two Cornell researchers visited program sites for three of the implementing NGOs and the MOPHP. The Cornell team conducted stakeholder interviews with staff at all levels of the programs; observed program delivery, tools, and data; and interacted with beneficiaries.

Below, we provide a brief description of the ICHN program and share a summary of the findings of the Cornell team.

Program description

Interventions. Three nutrition-specific interventions emphasized in the ICHN programs have been newly introduced or reinforced in Haiti since the 2010 earthquake. These include (1) IYCF counseling, (2) distribution of MNPs for home fortification of complementary foods, and (3) community-based management of acute malnutrition (CMAM) in children under five and pregnant and lactating women.

Other interventions included growth monitoring and counseling (GMC), childhood vaccinations, vitamin A and deworming for children under 5, and distribution of IFA to pregnant women. Some of the UNICEF-funded ICHN programs are implementing new strategies to reach adolescents and other nonpregnant women with IFA.

With the earthquake and subsequent cholera epidemic beginning in late 2010, WASH interventions including treatment of diarrhea with oral rehydration solution (ORS) and zinc have been widely implemented across Haiti. All programs, therefore, implemented cholera prevention and treatment activities. In one site, the NGO built UNICEF-funded WASH infrastructure, including wells and latrines, as part of their ICHN program.

Delivery Platforms. The term *delivery platform* refers to the settings or structures through which interventions are implemented. Several core platforms are shared between ICHN programs including health facilities, mobile clinics, health posts, mothers' clubs, and home visits. Individual delivery platforms are commonly used to deliver multiple interventions. Each of the five programs differs in how the platforms are operationalized.

Health facilities. Most of the ICHN programs have components that are facility-based and delivered by physicians, nurses, and/or nurse auxiliaries. All three levels of clinical providers require postsecondary school training in an MOPHP-approved training program. Haitian physicians complete 5 years of postsecondary training at an accredited medical university and then must complete 1 year of social service training before being licensed to practice independently. Nurses are trained through 4-year courses at public universities and at private schools of nursing. Haitian nurses can elect to complete an additional year of specialized training in community health. The auxiliary is a medical assistant. Accredited 1- to 2-year training courses for auxiliaries are available in several urban centers.

Mobile clinics. Mobile clinics are clinical outreach activities conducted by nurses, auxiliaries, midwives, or physicians. The MOPHP and NGOs have frequently used mobile clinics to deliver ANC services at the community level. In most mobile clinic models, services and inputs (e.g., antibiotics) are limited to what a single nurse can transport to

a community-identified space such as a school or a church.

Health posts. All three programs visited by the Cornell team have historically used community health posts to implement GMC, health and nutrition education, vaccination, vitamin A, and deworming to children under five. They are staffed by locally recruited CHWs who are trained and supervised to carry out community-level activities.

Mothers' clubs. Mothers' clubs include groups of women from a particular community or locality who meet on a routine basis for health and nutrition education and peer support. These are typically facilitated by a CHW or community volunteer.

Home visits. MOPHP protocols include a home visit within 3 days following delivery for all postpartum women. These visits are tracked and reported to the MOPHP by all implementers. Many sites use CHW home visits to follow up on missed facility, PTA, or PNS visits and to support individuals with HIV/AIDS, tuberculosis (TB), or other serious medical conditions. CHWs across all programs sites visited identified the home visit as the activity with the greatest potential to affect the health status of individual household members. Some programs use nurses, auxiliaries, or other cadres of volunteers to conduct home visits.

Summary of findings

The CHW role is essential for successful integration of services at the community and household levels. Across all program sites, the CHW is the individual in the program structure best positioned to ensure that individual children within the households in their catchment areas access all available services. CHWs with strong institutional support tended to be among the most highly motivated and committed members of the implementation team. CHW turnover was generally lower than turnover for clinical or management-level staff. For services that were delivered at other levels (e.g., health facilities, PTA/PNS), the CHWs played an important role in screening and follow-up.

Multiple delivery platforms are needed to implement a complete preventative package that includes behavior-change counseling. All programs had a minimum of at least two monthly contact points with beneficiaries. While health posts or mobile clinics were efficient for screening, vaccinations, and distribution of inputs, they did not provide a conducive environment for focused behavior-change education and counseling activities.

Volunteers are a common strategy for increasing program reach at the community and household level. Utilizing community members in program delivery can foster community engagement and facilitate peer support for behavior change. Volunteers were used for program delivery but with different expectations around engagement and incentives.

Program monitoring and evaluation (M&E) indicators should include a measure of integration. None of the programs were able to report on the proportion of beneficiaries who received multiple interventions through the ICHN program. Given that the goal of integrated services is to deliver multiple interventions, it is important to measure the degree to which this is achieved.

The MOPHP currently plays a role in training, networking, and reporting systems. MOPHP training curricula were generally considered to be well developed and used by all program sites with some adaptations. Most programs took a training-of-trainers approach by sending senior staff to MOPHP/UNICEF training events and then adapting the content to fit their own delivery structures. All programs routinely reported all required data to the MOPHP. Both MOPHP and donor (e.g., UNICEF) reporting requirements have a strong influence over the design of ICHN program data-collection systems.

Not all NGOs are capable of or positioned to be effective direct MOPHP capacity builders. Throughout discussions related to the future of scale-up of ICHN programs in Haiti, there was emphasis on equipping the MOPHP to be a direct implementer. It was suggested that in order to receive ongoing UNICEF funding support, the role of NGOs would have to shift toward directly building the capacity of the MOPHP. This requires a rigorous analysis of the capacity and experiences of such NGOs before establishing partnerships with them, and in Haiti, not all NGOs are capable or positioned to do this task effectively. In conclusion, all three NGOs observed had a strong programmatic foundation, existing CHW and staffing structures, and positive community relations in their catchment areas. The MOPHP site in Borgne had a history of successful NGO engagement in capacity building. Therefore, it

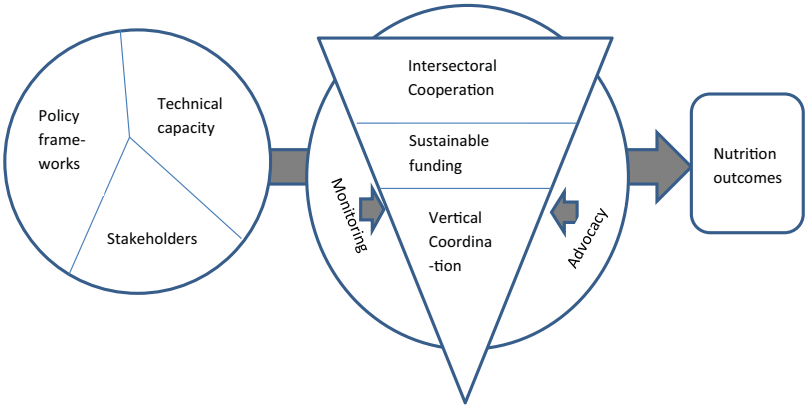

Figure 12. The nutrition governance framework. From Ref. 40.

remains unclear how sites with less existing capacity and solid organization would manage to implement the ICHN strategies. This is particularly relevant to the MOPHP because its decentralized structure adds another layer of complexity in the design of scale-up approaches, as they may need to be adapted or implemented differently based on the local system.

Governance and nutrition

The role of governance of nutrition programs in improving outcomes has recently been of interest and has been carefully examined. Based on evidence from a study in six countries, the U.K. Institute of Development Studies (IDS) spearheaded a series of papers that aimed at identifying the real drivers of nutrition governance, providing government leaders, policymakers, and key stakeholders with tools for better mobilizing commitments, and facilitating cooperation across a wide range of factors.[40] We used the nutrition governance framework developed by IDS (Fig. 12)[40] to analyze the governance of the nutrition program in Haiti.

Intersectoral cooperation

Soon after taking office, President Michel Martelly put in place a national flagship program to fight hunger and malnutrition (Aba Grangou). The program, which is located within the President's offices, is chaired by the first lady, Sophia Martelly. Its executive board is made of members of nine ministries to ensure intersectoral cooperation. The program benefits from technical and financial support from major nongovernmental agencies including UNICEF, the World Food Programme (WFP), the World Bank, the U.S. Agency for International Development (USAID), the European Union, the Canadian International Development Agency (CIDA), the United Nations Development Programme (UNDP), and the Food and Agriculture Organization (FAO). Program partners also include Brazil, nongovernmental national and international organizations, civil society organizations, and religious leaders.

The program quickly helped raise public awareness on hunger and malnutrition, established mechanisms to identify the most at-risk population groups, and implemented interventions to reduce people's vulnerability and suffering. This was achieved because of a personal and publicly expressed commitment of the president and the first lady.

Vertical coordination

Haiti has a Nutrition Division within the Ministry of Health that ensures the technical coordination of the sector. There are two other structures that support coordination among different government and partner levels: the sectoral health table and the national nutrition technical committee. The latter has monthly meeting that brings together all the partners (government, U.N., NGO, and civil society) involved in nutrition programming in Haiti.

A new national nutrition policy was adopted in January 2011, and a bill on large-scale food fortification, including mandatory fortification of salt with iodine, has been recently submitted to the parliament. The country also has a national protocol for the integrated management of acute malnutrition, a strategy on IYCF, and guidelines on micronutrient supplementation. The country is also

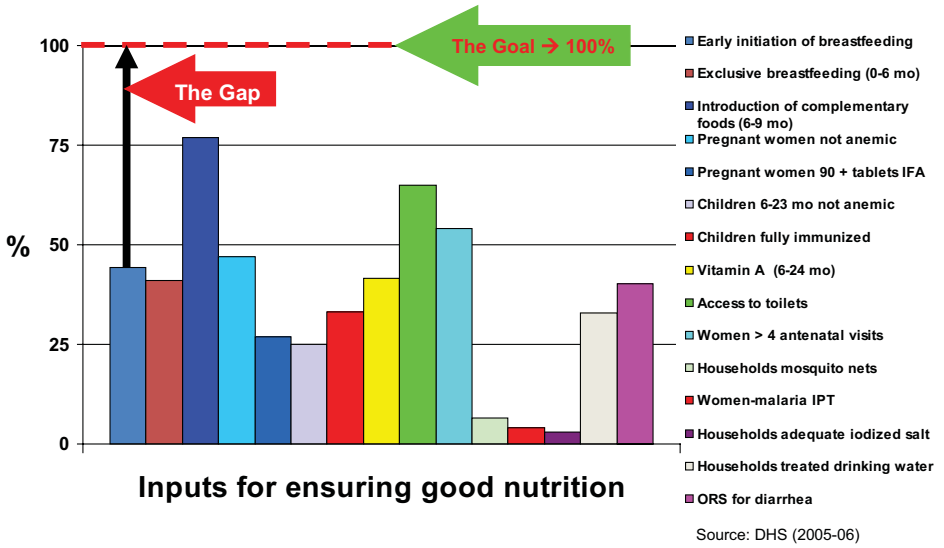

Figure 13. Haiti: gaps in achieving optimal nutrition in children 0–24 months old.

preparing a draft bill on the marketing of breast milk substitutes.

In order to increase capacities at national and departmental levels, the number of professionals working in the public sector (Ministry of Health, Presidency, Food Security) on nutrition increased from 13 to 39. The majority of these (30) work in the departments (decentralized level) and benefit from unprecedented technical, logistical, and financial support to implement and coordinate nutrition programs in their respective regions. The presence of a larger team at the departmental level also facilitated the collection, analysis, and sharing of information with the central level, and thus can guide better decision making and programming.

Sustainable funding

Following the first ever National Nutrition Forum chaired by the first lady and attended by five ministers and three state secretaries in 2011, the government of Haiti established the first nutrition-funding line in the national budget. The country has developed also a budgeted 10-year strategic plan for nutrition in agreement with the main national and international stakeholders and has joined the Scaling Up Nutrition movement to seek means of mobilizing alternative sources of funding.

Traditional nutrition partners in the country (UNICEF, the WFP, the WHO, the World Bank, the Inter-American Development Bank, the Micronutrient Initiative) remain committed to mobilize financial resources in support of the national nutrition program.

Monitoring and advocacy

Data collection to monitor the situation and its analysis and dissemination to inform policy and program actions and advocacy efforts have become one of the priorities of the government and its partners since 2010. With the support from international partners, the government of Haiti has conducted more than a dozen nutrition and food security surveys since June 2010. These include one nationally representative nutrition survey using the SMART methodology and one Demographic and Health Survey. In addition, the government put sentinel sites in place in several communes throughout the country for early detection of malnutrition cases and any significant changes that would require a swift intervention.

Results from the surveys and sentinel systems mentioned have been used widely to monitor and report on progress as well as to advocate with political decision makers so that commitment to nutrition is maintained. They have also been used to advocate with the international community and with donors to mobilize more resources for nutrition. An example of how the data were used for advocacy purposes to accelerate coverage of sensitive and specific nutrition interventions is shown in Figure 13.

Acknowledgments

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Contributions

M.A.A., R.H., I.N.T., and R.J.S. generated the concept of the study. M.A.A. designed the study and wrote the manuscript. A.M., E.D.F., E.B.D., J.E.S.F., J.M.B., Y.K., B.E.M., and J.M.P. contributed to gathering the information and analyzing some of the data. All authors reviewed the manuscript.

Conflicts of interest

The authors declare no conflicts of interest.

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