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SPRING Strengthening Partnerships, Results, and Innovations in Nutrition Globally

A Landscape Analysis of Anemia and Anemia Programming in Sierra Leone

December 2015

This document is a desk review and does not necessarily reflect the views of Government of Sierra Leone.

About SPRING
The Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) Project is a five-year USAID-funded Cooperative Agreement to strengthen global and country efforts to scale up high impact nutrition prac tices and policies and improve maternal and child nutrition. The project is managed by JSI Research & Training Institute, Inc., with partners Helen Keller International, the Manoff Group, Save the Children, and the International Food Policy Research Institute.

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Contents

Acronyms

ACT	artemisinin-based combination therapy
ANC	antenatal care
DHS	Demographic and Health Surveys
FHCI	Free Health Care Initiative
HKI	Helen Keller International
IDA	iron deficiency anemia
IFA	iron-folic acid
IPTp	intermittent preventive treatment in pregnancy
IRS	indoor residual spraying
ITN	insecticide-treated net
IYCF	infant and young child feeding
LLIN	long-lasting insecticide treated net
MIS	Malaria Indicator Survey
MCHW	Maternal and Child Health Week
MNPs	micronutrient powders
MAFFS	Ministry of Agriculture, Forestry, and Food Security
MOHS	Ministry of Health and Sanitation
NAWG	National Anemia Working Group
NFNIP	National Food and Nutrition Implementation Plan
NFNSP	National Food and Nutrition Security Policy
NGO	nongovernmental organization
NHSSP	National Health Sector Strategic Plan
NMCP	National Malaria Control Programme
NMSP	National Malaria Strategic Plan
RBP	Retinol Binding Protein
RNCH	Reproductive, Newborn and Child Health
SLDHS	Sierra Leone Demographic and Health Survey
SLMN	Sierra Leone Micronutrient Survey
SP	sulfadoxine-pyrimethamine
SPRING	Strengthening Partnerships, Results, and Innovations in Nutrition Globally

STH	soil-transmitted helminth
SUN	Scaling Up Nutrition
UNICEF	United Nations Children's Fund
USAID	U.S. Agency for International Development
VAS	vitamin A supplementation
WASH	water supply, sanitation, and hygiene
WHO	World Health Organization
WRA	women of reproductive age

Executive Summary

Background and Methods

The Sierra Leone Ministry of Health and Sanitation (MOHS) and Scaling Up Nutrition (SUN) Secretariat requested that the U.S. Agency for International Development's Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) project provide technical support in conducting a landscape analysis to describe the anemia situation in Sierra Leone. The objectives of the analysis were to better understand the factors that contribute to anemia, to track the progress of anemia and anemia-related programs, and to identify anemia-related policies. The analysis provides information on the anemia situation in Sierra Leone to guide multi-sectoral and multi-stakeholder anemia prevention and control efforts.

This landscape analysis used multiple strategies to capture the current situation in Sierra Leone with respect to anemia and anemia-related programming. The analysis compiled data from the most recent national surveys on anemia prevalence and related behaviors: the 2008 and 2013 Sierra Leone Demographic and Health Survey (SLDHS), the 2013 Malaria Indicators Survey (MIS), and the 2013 Sierra Leone Micronutrient Survey (SLMN). In addition, a literature review of published and grey literature was conducted to find relevant surveys or studies that reported additional, but not necessarily nationally representative, indicators. To assess policies and programs currently in place, the relevant databases and websites were searched for documents, reports, and policies. Finally, to gain further understanding of the association between anemia-related factors and anemia outcomes, logistic regressions were run using 2013 SLDHS data to calculate odds ratios for both children under five years and women of reproductive age (WRA). It is important to note that these data were collected prior to the Ebola outbreak; as a result, this landscape analysis does not account for the widespread effects of the outbreak and may not fully capture Sierra Leone's current situation.

Findings

In Sierra Leone, there was little to no improvement in anemia in children aged 6–59 months and women of reproductive age (WRA) between 2008 and 2013, while some improvements have been seen among pregnant women (62 to 54 percent) during the same time period (SLDHS 2008, 2013). Based on 2013 SLDHS data, anemia is highest among younger children (6-24 months) and adolescent girls (15-20 years). Looking at regional variations, anemia is lowest in the WRA living in the western region (31 percent) compared to the eastern, northern, and southern regions. In children, the prevalence of anemia is highest in the northern region (83 percent) and lowest in the western region (71 percent). SLDHS data show that between 2008 and 2013, the prevalence of anemia among women decreased in the western region, urban areas, the richest segments of the population, and among households with higher maternal education, and conversely increased in all other regions, rural areas, and among households that were poorer and had lower maternal education. Similar patterns were not seen for children, with anemia remaining high across sociodemographic factors between SLDHS 2008 and 2013 data. Results from the logistic regressions (summarized in Appendix V) using SLDHS 2013 data are consistent with existing knowledge about anemia causes and vulnerability: among children, some of the most robust predictors of anemia status appear to be age (with older children being less vulnerable than infants) and stunting. Similar to anemia prevalence rates, a relationship between subregion and anemia is apparent for women of reproductive age, with those living in the western region having the lowest odds of being anemic. Women in younger age groups are more vulnerable to anemia, with adolescent girls faring the worst.

The findings of the landscape analysis indicate that a larger portion of anemia is likely the result of malaria, other infections, and general inflammation rather than nutritional deficiencies; but infections alone are unlikely to be the

only cause of anemia. Malaria is endemic in Sierra Leone and is likely a large contributor to anemia; the regions with the highest prevalence of malaria also tend to have the highest prevalence of anemia (MIS 2013).

Another factor for high anemia burden may be prevalence and intensity of soil-transmitted helminths (STH) and schistosomiasis. In Sierra Leone, cross-sectional surveys of preschool children in 2010 found STH infections to be low according to WHO's classification, with the exception of hard-to-reach villages where prevalence of hookworm was classified as moderate; prevalence of schistosomiasis ranged from 11.2 percent to 33.5 percent, also categorized as moderate (Hodges 2012). Sentinel surveillance studies comparing 2013 schistosomiasis prevalence to baseline levels in 2010 found a 67.2 percent reduction in infection, from 49.7 percent to 16.3 percent. Similarly, the percentage of children with moderate and heavy infections had declined to 3.3 percent and 1.2 percent, respectively. Considerable improvements on STH/SCH have occurred in the last decade, but anemia remains high and as the country nears low prevalence and light intensity, the impact of STH/SCH control on anemia diminishes.

The high prevalence of anemia is associated with the high prevalence of general inflammation found in these populations (SLMNS 2013), which may be caused by diarrheal disease and lower respiratory infections, in addition to malaria and helminthic infections. Increases in open defecation may have facilitated the increase in the incidence of infection and inflammation, leading to a further exacerbation of anemia (WHO/UNICEF 1990 and 2010).

While iron deficiency is considered to be a major contributor to anemia worldwide, it is not a likely driver of anemia in Sierra Leone due to the low levels of iron deficiency found in this population (SLMNS 2013). Further studies should be carried out to confirm this finding, such as testing the bioavailable content of iron in drinking water.

In addition to other immediate, underlying, and basic causes of anemia, hemoglobinopathies (genetic blood disorders), such as sickle cell disease, may play a contributing role to the high prevalence of anemia. Further exploration of this connection in Sierra Leone would be advantageous (Piel 2013).

Infection control programs can contribute to the reduction of anemia in Sierra Leone. While coverage of malaria prevention strategies has increased, there is a need to continue to strengthen these efforts. Focusing on improvements in malaria diagnosis and treatment will also likely result in greater reductions in anemia prevalence (SLDHS 2008, 2013). Deworming program coverage in preschool children, school-age children, and adults have reached high coverage levels since 2009 and should continue to be implemented and strengthened to even higher levels. STH and schistosomiasis prevalence and intensities have fallen from high/moderate and heavy to moderate/low and light, respectively (Sesay et al. 2014; Hodges et al. 2012). Increased incidence of general inflammation and infections can be addressed with water supply, sanitation, and hygiene (WASH) programs. The WASH sector must deal with issues of availability, access, and utilization of safe water, as well as sanitation and hygiene practices. In particular, there is a need to address gaps in coverage of safe water and sanitation facilities in rural areas.

Food and nutrition interventions still remain an important factor in reducing anemia in the short and long term. Iron-folic acid (IFA) during pregnancy remains an important intervention despite the apparently low levels of iron deficiency in WRA and children under five. Iron requirements increase dramatically during pregnancy and the provision of daily IFA reduces anemia and improves birth outcomes. The percentage of women reporting taking IFA during their last pregnancy has increased, but further improvements are needed.

Despite high coverage of biannual vitamin A supplementation among children, vitamin A deficiency remains a moderate public health problem as defined by the World Health Organization, and additional strategies should be

considered. Other food and nutrition strategies, such as increased intake of fortified food products, like wheat flour (with iron), and vegetable oil (with vitamin A), continue to remain important for prevention of anemia and improving overall wellbeing. However, consumption of fortified flour and vegetable oil was found to be low in poor and rural households in Sierra Leone. Aside from issues related to cost, availability and accessibility of these products, few individuals were aware of the benefits associated with consuming these fortified foods (SLMN 2013).The promotion of nutrition-sensitive agricultural interventions at both household and commercial levels may thus contribute to progress in the reduction of micronutrient deficiencies.

Lastly, promoting women's empowerment efforts, including increased education and literacy, delayed age of first childbirth with family planning programs, and adequate spacing between births for WRA, will ultimately reduce anemia over the long-term. Given that iron deficiency may not be the main driver of anemia in Sierra Leone, an integrated approach appears to be even more important.

Discussion

In Sierra Leone, anemia is considered a severe public health problem as defined by the World Health Organization. Population-based national survey data indicate iron deficiency does not appear to be a major driver of anemia in Sierra Leone. Two key causes of anemia identified were malaria and general inflammation. Other direct (e.g. genetic variations, other infections) and indirect (e.g. inadequate birth spacing, education) factors likely also contribute to anemia but have either not been measured or are difficult to quantify. Programs to prevent and control anemia have improved between 2008 and 2013, but significant efforts are needed to meet the anemia reduction targets set forth in Sierra Leone's National food and Nutrition Implementation Plan (NFNIP). Recognizing the interplay between nutrition, infection and hygiene, integrated and complementary interventions will be needed to meet global and country-specific anemia reduction targets. Building on Sierra Leone's commitment as a SUN country, coordinating anemia efforts across government sectors, with multiple stakeholders and at multiple levels, can contribute to anemia prevention and control efforts in Sierra Leone.

Background

Anemia, or low levels of hemoglobin, is one of the most common public health problems in the world today. It affects 25 percent of the world's population—or more than 1.6 billion people (Benoist et al. 2008). Anemia in pregnancy increases the risk of preterm delivery, low birth weight, and maternal and child mortality; it reduces the cognitive and physical development of children, causes fatigue, and reduces the physical stamina and productivity of people of all ages. The prevalence and burden of anemia disproportionately affect young children under five, pregnant women, and women of reproductive age (WRA). Globally, 43 percent of children under five, 38 percent of pregnant women and 29 percent of WRA are anemic (Stevens et al. 2013).

Globally, about half of all anemia has been attributed to iron deficiency, a condition caused by inadequate intake or low absorption of iron (Stoltzfus et al. 2004). Iron deficiency anemia (IDA) alone contributes to over 100,000 maternal deaths and 591,000 perinatal deaths each year (Stoltzfus et al. 2004). IDA is more common during pregnancy and in infancy, when iron requirements are higher (Stoltzfus, et al. 2004). Other causes of anemia include malaria, helminthic infections (primarily hookworm and schistosomiasis), other micronutrient deficiencies, chronic infections including HIV and tuberculosis, causes related to reproduction and contraception, and genetic disorders such as thalassemia and sickle cell anemia (Balarajan et al. 2011). These underlying causes are functionally linked and act synergistically to exacerbate the effects of anemia. Due to its multi-factorial causation, anemia prevention and treatment activities should use a multi-sectoral and integrated approach to identify and address specific causes in given settings and populations.

There are several strategies to managing anemia, all of which require the inclusion of social and behavior change activities, including:

- Malaria prevention, diagnosis and treatment: malaria control and prevention includes activities related to vector control, such as distributing insecticide treated nets (ITNs) or long-lasting insecticide treated nets (LLINs); conducting indoor residual spraying (IRS); controlling larvae; providing intermittent preventive treatment in pregnant women (IPTp), infants and children; and effectively diagnosing and treating malaria.
- Helminth prevention and control: biannual mass drug administration of antihelminthic medication to children and pregnant women.
- Food-based approaches: promotion of dietary diversity, national and subnational mass food fortification initiatives, and biofortification of foods, such as pro-vitamin A cassava and high-iron pearl millet and sorghum.
- Infant and young child feeding (IYCF): promote excusive breastfeeding and complementary feeding interventions.
- Micronutrient supplementation: iron–folic acid (IFA) supplementation to pregnant women and adolescent girls to ensure adequate growth and development of the fetus, vitamin A supplementation (VAS) to children, and use of micronutrient powders (MNPs) and supplements.
- Delayed cord clamping and family planning: delayed cord clamping is used to increase iron stores in the newborn. Family planning interventions include delaying the first pregnancy and adequate spacing between pregnancies.
- Water supply, sanitation, and hygiene (WASH) interventions: improve the quality of the water supply, sanitation facilities, and hygiene information to reduce inflammation.

The U.S. Agency for International Development's (USAID's) Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) project supports country and global level activities to address anemia. This landscape analysis was conducted in collaboration with the Government of Sierra Leone and the Scaling Up Nutrition (SUN) movement. It provides a background of the multiple factors contributing to anemia in Sierra Leone and highlights the various strategies and policies in place to prevent and control anemia. The analysis will form the evidence base to guide multi-sectoral and multi-stakeholder anemia efforts to raise awareness and to strengthen anemia programming.

Findings of the landscape analysis are presented in three sections: 1) Trends in anemia prevalence among children and WRA between 2008 and 2013; 2) The prevalence of risk factors for anemia which include malaria, helminth infection, micronutrient deficiencies, general inflammation, and the status of related programs;[1] and 3) Description of the policy environment in Sierra Leone. The landscape analysis concludes with a discussion section which includes a summary of findings and next steps.

[1]Programs that are related to malaria prevention and control, deworming, food-based nutrition, micronutrient supplementation, family planning, and water supply, sanitation, and hygiene

Methods

This landscape analysis used multiple strategies to capture the current situation in Sierra Leone with respect to anemia and anemia-related programming. The analysis compiled data from the most recent national surveys on anemia prevalence and related behaviors: the 2008 and 2013 Sierra Leone Demographic and Health Survey (SLDHS), and the 2013 Sierra Leone Micronutrient Survey (SLMN). The SLDHS and the SLMN are independent, cross-sectional surveys. The sample sizes are shown in Table 1. The table also includes data from the 2013 Malaria Indicator Survey (MIS). It is important to note that these data were collected prior to the Ebola outbreak; as a result, this landscape analysis does not account for the widespread effects of the outbreak and may not fully capture Sierra Leone's current situation.

Table 1. Study Population Analyzed, 2008 and 2013

Population	SLDHS 2008	SLDHS 2013	SLMN 2013	MIS 2013
Children 6–59 months old (total sample)	**4,521**	**9,563**	**839**	**6016**
Children 6–23 months	1,695	3,324	390	NA
Children 6–23 months with hemoglobin results	858	1,619	234	1875
Children 24–59 months	2,827	6,239	449	NA
Children 24–59 months with hemoglobin results	1,798	3,619	298	4141
Women 15–49 years old (total sample)	**7,374**	**16,658**	**1,123**	**7656**
WRA with hemoglobin results	3,365	7,870	512	NA
WRA who were pregnant during anemia test	281	667	122	NA

NA=Not applicable

In addition, SPRING conducted a literature review of published and grey literature to find relevant smaller-scale surveys or studies that reported additional, but not necessarily nationally representative, indicators. Using the Ovid platform, the project searched the following databases from inception to March 20, 2015: Ovid MEDLINE, Cochrane Database of Systematic Reviews, Cochrane Central Register of Controlled Trials, CAB Abstracts, and Global Health Archive. The detailed search strategy is included in Appendix I. In brief, the search terms included the following subjects: anemia, various micronutrient deficiencies, malaria in adults, in children, as well as in pregnancy, and helminthic infections. These terms were combined with the term "Sierra Leone". For the landscape analysis, SPRING included studies that were published after 2000. The search resulted in 953 articles. After removal of duplicates, the titles and abstracts of 560 articles were screened; 53 articles were accepted for full text screening. Finally, nine studies were considered relevant to the landscape analysis because they reported data on prevalence of anemia or anemia-related programs. The project also included relevant studies that subject area experts sent. At the conclusion of the review, the search resulted in only a few studies on anemia and its related programs in Sierra Leone.

To assess policies and programs in place, a number of sources were consulted. The Sierra Leone Ministry of Health and Sanitation (MOHS) website was used to identify and collect official documents relating to policies and programs. These are listed in Appendix II. The World Health Organization's (WHO's) Global Database on the Implementation of Nutrition Actions (WHO 2015) and the Sierra Leone page of the SUN movement website were

searched for relevant policy and program information. In addition, SPRING conducted in–person interviews with stakeholders about existing anemia control programs in 2014. Key stakeholders included individuals from United Nations agencies, international nongovernmental organizations (NGOs), and local partners. For a full list of individuals and their organizations, please see Appendix III.

We evaluated the trend in anemia prevalence by looking at changes in overall prevalence among children under five years and WRA between 2008 and 2013, as well as in population subgroups based on geographic or socioeconomic characteristics. We also wanted to understand the determinants of anemia using multiple regressions of various predictors on anemia in both WRA and children under five years. The 2013 SLDHS data was used because the raw data is publically available. The variables that were included in the regression model included a combination of socioeconomic factors and various program coverage indicators. The construction of the variables and their description is shown in Appendix IV.

Population-based Survey Findings

Trends in Anemia Prevalence among Children and Women of Reproductive Age between 2008 and 2013

Anemia is a critical public health problem in Sierra Leone. Both the 2013 SLDHS and the 2013 SLMN indicate high prevalence rates of anemia among children 6–59 months and WRA (Table 2). The overall prevalence of anemia in children under five years is above 75 percent in both these surveys. The prevalence of anemia in non–pregnant WRA is relatively similar between the two surveys; the prevalence of anemia in pregnant women was 54 percent (95 percent CI: 52 – 57 percent) in the 2013 SLDHS and 70 percent (95 percent CI: 63 – 76 percent) in the 2013 SLMN (Table 2). The raw data from these surveys would have to be compared to further examine this difference (raw data from SLMN is not publicly available).

Table 2. Prevalence of Anemia by Population Groups, SLDHS 2013, SLMN 2013 and MIS 2013

	SLDHS 2013	SLMN 2013	MIS 2013
Children 6–59 Months	80	76	10*
Non–pregnant Women Aged 15–49	42	45	ND
Pregnant Women Aged 15–49	54	70	ND

** MIS 2013 reported the prevalence of severe anemia (Hb <8 g/dL) among children aged 6–59 months; ND=No data*

Anemia prevalence in children aged 6–59 months (76 to 80 percent) and WRA (45 percent in both years) did not improve between 2008 and 2013 (Table 3). Anemia in pregnant women has declined from 62 percent in 2008 to 54 percent in 2013. The high prevalence rates of anemia among children 6–59 months and WRA can also be seen across various subgroups (Table 3). Most notably, the prevalence of anemia among children is highest in the eastern and northern regions. It is high in both urban and rural areas as well as across all wealth quintiles, though it was slightly lower in urban areas and amongst the richest quintile. These data indicate that anemia is highly prevalent in the general population.

The overall prevalence of anemia for women is 45 percent in 2013, and this rate did not change since 2008 (Table 3). There have been shifts in anemia trends in WRA within key population characteristics between 2008 and 2013. Most notably, the western region saw a significant fall in anemia prevalence, from 50 percent in 2008 to 31 percent in 2013 while the northern and southern region saw notable increases during the same time period. There appear to be socioeconomic factors at play that are influencing anemia prevalence. A substantive disparity is observed between urban and rural areas and between the richest 20 percent and lower wealth quintiles in 2013, whereas 2008 data show anemia prevalence more evenly spread out across these categories. Some of these differences can be explained by the fact that the western region is almost entirely urban, with 80 percent of its population classified in the country's highest quintile (SSL and ICF International 2014).

Table 3. Prevalence of Anemia in Children Aged 6-59 Months and WRA by Background Characteristics, SLDHS 2008 and 2013

Background Characteristic	Children 6–59 Months			WRA		
	2008 (%) N=2,653	2013 (%) N=5,238	Relative Percentage Change, 2008–2013	2008 (%) N=3,365	2013 (%) N=7,870	Relative Percentage Change, 2008–2013
Residence						
Urban	72.7	72.4	0	46.7	36.8	-21
Rural	77.1	82.3	7	44.5	49.2	+11
Region						
Eastern	74.4	80.7	8	43	44.2	+3
Northern	79.3	83.4	5	45.2	50	+11
Southern	72.1	76.8	7	42.8	49.1	+15
Western	72.2	71.3	-1	49.9	30.7	-38
Wealth index quintile						
Poorest	78.7	80.9	3	43.4	50.6	+17
Second	76.7	82.3	7	47.4	48.7	+3
Middle	79.1	83.3	5	45.8	48.3	+5
Fourth	73.6	79.4	8	43.8	45.2	+3
Richest	68.7	69.4	1	45.7	34.1	-25
Mother/woman's education						
None	77.4	80.6	4	45.1	47	+4
Primary	76.6	82.8	8	43.5	47.4	+9
Secondary+	70.7	75.5	7	46.5	39.4	-15
Children 6–59 Months						
Age in months						
6–8	83	87.1	5	NA	NA	NA
9–11	80	83.3	4	NA	NA	NA
12–17	86.8	83.1	-4	NA	NA	NA
18–23	76.1	85.1	12	NA	NA	NA
24–35	78.2	79.4	2	NA	NA	NA
36–47	73	78.8	8	NA	NA	NA
48–59	67.7	75.6	12	NA	NA	NA
Sex						

Background Characteristic	Children 6–59 Months			WRA		
	2008 (%) N=2,653	2013 (%) N=5,238	Relative Percentage Change, 2008–2013	2008 (%) N=3,365	2013 (%) N=7,870	Relative Percentage Change, 2008–2013
Male	76.3	80.6	6	NA	NA	NA
Female	75.5	79.2	5	NA	NA	NA
WRA						
Age in years						
15-49	NA	NA	NA	50.6	49.5	-2
20-29	NA	NA	NA	45.8	44.2	-3
30-39	NA	NA	NA	44.6	43.6	-2
40-49	NA	NA	NA	39.8	41.7	5
Number of children ever born						
0	NA	NA	NA	49.7	44.1	-11
1	NA	NA	NA	45.4	43.7	-4
2-3	NA	NA	NA	46.7	45.4	-3
4-5	NA	NA	NA	41.6	43.3	4
6+	NA	NA	NA	42.5	47.2	11
Maternity status						
Pregnant	NA	NA	NA	62.3	54	-13
Breastfeeding	NA	NA	NA	44.9	48.5	8
Neither	NA	NA	NA	43.1	42.2	-2
Smoking status						
Smokes cigarettes/tobacco	NA	NA	NA	38.9	43.4	12
Does not smoke	NA	NA	NA	46.1	44.9	-3
Total	**75.9**	**79.9**	**5**	**45.2**	**44.8**	**-1**

Sources: Statistics Sierra Leone and ICF Macro 2009; Statistics Sierra Leone and ICF International 2014. NA=Not applicable

SPRING also compared anemia prevalence between children 6–23 months and children 24–59 months because younger children are particularly susceptible to anemia (Soares Magalhães and Clements 2011) (Figure 1). Anemia prevalence is slightly higher in children 6–23 months. In both age groups, the majority of cases are classified as moderate, and their severity profile has not changed with time. The 2013 MIS reported a similar prevalence of severe anemia defined in the study as hemoglobin< 8 g/dL (3 percent) in children aged 6–23 months. The

majority of WRA are classified as mildly anemic and almost no women are severely anemic. The breakdown of anemia by severity remained relatively unchanged between 2008 and 2013 (Figure 1).

Figure 1. Anemia Prevalence in Children 6–23 Months, Children 24–59 months, and WRA by Severity, SLDHS 2008 and 2013

Sources: Statistics Sierra Leone and ICF Macro 2009; Statistics Sierra Leone and ICF International 2014. Anemia severity is defined as follows: Mild, 10.0-10.9 g/dL; Moderate, 7.0-9.9 g/dL; Severe, <7.0g/dL.

The SLMN also reported anemia prevalence among pregnant women of 70 percent. Disaggregated data did not show any differences in prevalence of anemia by age, urban vs. rural residence, region, educational level, or household wealth. However, pregnant women with malaria infection had a significantly higher prevalence of anemia (87.6 percent) than women without malaria (64.4 percent). The regression of anemia on various predictors was done to explore whether there were any socioeconomic or program coverage characteristics that could explain the high prevalence of anemia in children under five years and WRA. Among children, the significant predictors of anemia status appear to be age (with older children being less vulnerable than infants) and stunting. Among WRA, statistically significant predictors relate to the region where people live (with people in the western region associated with lower odds of being anemic), and age (adolescents were at greater odds of being anemic compared with older age groups). The tables of regression coefficients for children under five and WRA are found in Appendix V.

Prevalence of Risk Factors for Anemia and Status of Anemia Control Programs

This section presents the prevalence of various risk factors for anemia and the programs to control those risk factors. SPRING looked at the following areas and related programs: malaria, helminth infections, general inflammation, micronutrient deficiencies, infant and young child feeding, and family planning.

Interventions and programs to prevent and control anemia largely focus on the most vulnerable groups: pregnant women, WRA, and children. Anemia interventions for pregnant women are provided largely through antenatal care (ANC) visits. A minimum ANC package should include IFA supplementation, deworming, and IPTp with Fansidar (sulfadoxine-pyrimethamine). Children primarily receive care via binannual child health days and clinic

wellness visits. The Free Health Care Initiative (FHCI), introduced by the government in 2010, provides free health care for all pregnant and lactating women and children under five years.

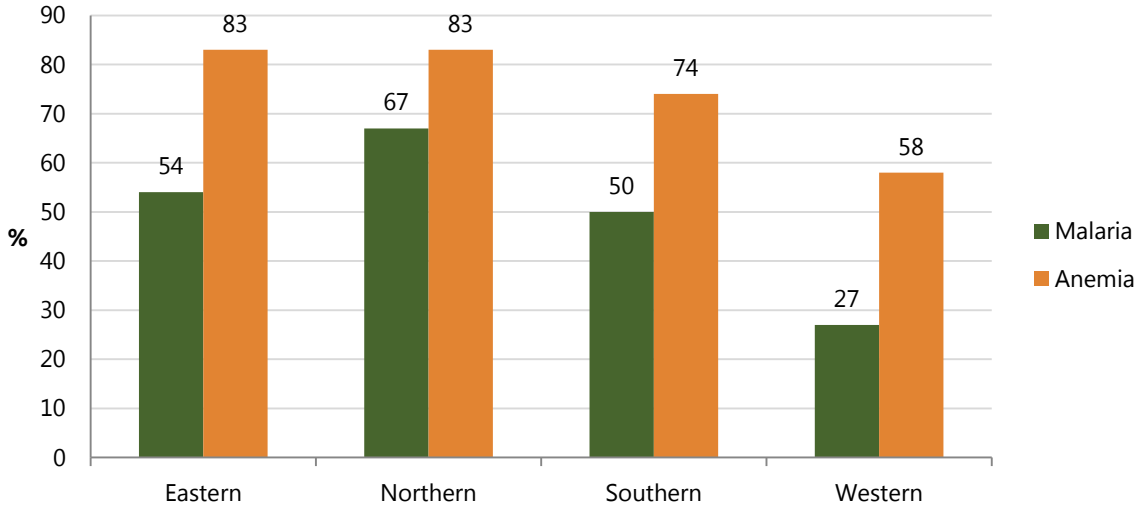
Malaria and its Prevention and Treatment

Malaria-related anemia can be broadly attributed to decreased red-blood cell production and excessive blood cell destruction and iron losses (Balarajan et al. 2011). Malaria is endemic to Sierra Leone and is the main cause of anemia, with children under five and pregnant women at the highest risk.

Malaria Prevalence

The latest nationwide survey to collect data on the prevalence of malaria infection in children 6–59 months and WRA was conducted in 2013 as part of the SLMN. Malaria prevalence among children (measured using rapid diagnostic tests) reveals a wide degree of variation across regions. The highest malaria burden for children is in the northern region (67 percent), followed by the eastern (54 percent) and southern (50 percent) regions. Malaria likely accounts for a substantial portion of anemia in Sierra Leone. Figure 2 presents regional prevalence rates of malaria and anemia among children 6–59 months. A relationship between malaria and anemia is apparent, as regions with higher malaria prevalence (northern and eastern regions) also show high anemia prevalence; those with lower malaria incidence indicate a smaller anemia burden. The SLMN also found that children under five years with malaria had a higher prevalence of anemia compared with those without malaria (88.2 percent and 63 percent, respectively). There are few reports in the literature that describe the range of malaria prevalence by geographic area: current estimates range from a low 6 percent in the city of Bo in the southern region, to 63 percent in Bombali and Tonkolili districts of the northern region (Appendix VI). These regional studies demonstrate that the prevalence of malaria is high.

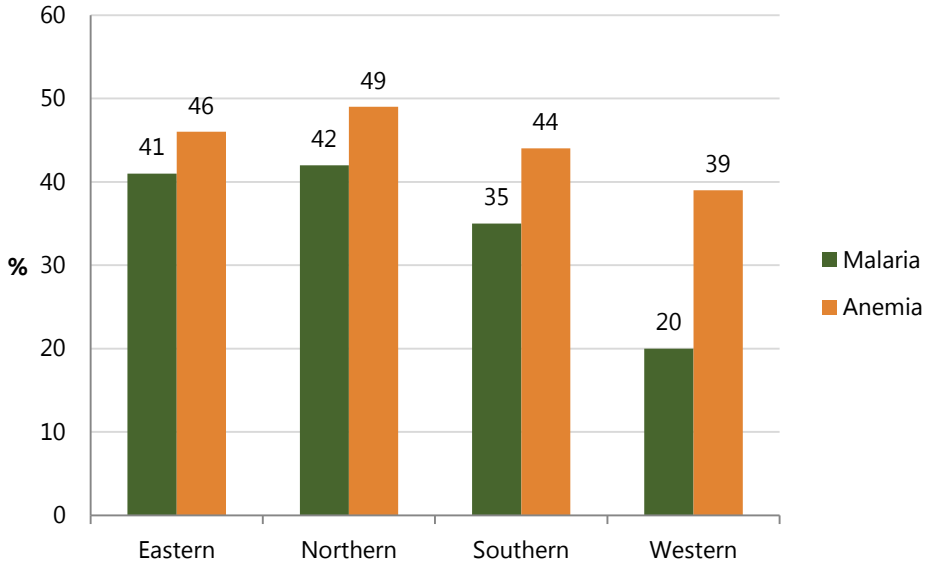
Figure 2. Prevalence of Malaria and Anemia among Children 6–59 Months by Region, MIS 2013



Source: MIS 2013

Figure 3 illustrates regional prevalence rates of malaria and anemia among non-pregnant WRA. Again, a relationship between malaria and anemia burden can be seen. Regions with high incidence of malaria have equally high burdens of severe anemia. The SLMN also assessed anemia and malaria among pregnant women and non-pregnant women aged 15–49 years. Among the malaria-positive pregnant women, the prevalence of anemia was 87.6 percent; among the malaria-negative pregnant women, the prevalence of anemia was 64.4 percent. Among the malaria-positive and -negative WRA, the prevalence of anemia was 54.4 percent and 39.3 percent, respectively.

Figure 3. Prevalence of Malaria and Anemia among Women Aged 15–49 by Region, MIS 2013

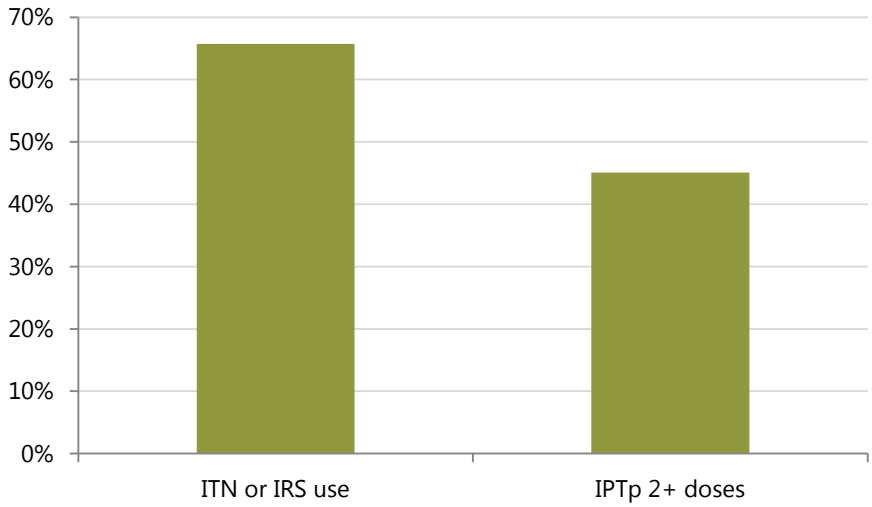


Source: MIS 2013

Malaria Prevention and Treatment

The use of ITNs is strongly recommended for children and pregnant and non-pregnant women to help prevent the transmission of malaria. The 2013 SLDHS showed that roughly 50 percent of children under five and 53 percent of pregnant women slept under an ITN the night before the survey. These percentages are nearly double those recorded in 2008 (Figure 4).

Figure 4. Insecticide-treated Net/Indoor Residual Spraying Use and Intermittent Preventive Treatment in Pregnancy among Women during Last Pregnancy, 2013 SLDHS



Definitions: ITN or IRS use: Percentage of households that owned at least 1 ITN and/or received IRS in the past 12 months IPTp. Among women with a live birth in the past two years, percentage who received sulfadoxine-pyrimethamine /Fansidar two or more times during their last birth

Sierra Leone has made more targeted efforts to increase access to and use of LLINs—a subset of ITNs that are factory-treated mosquito nets that remain effective for three to five years—to all households. In November 2010, a one-week National Integrated Maternal and Child Health Campaign resulted in the distribution of more than three million LLINs to households in Sierra Leone, with the goals of universal possession of LLINs and an increase

to 80 percent in use among at-risk populations. Six months after the campaign, 87 percent of households reported owning at least one LLIN. Among those households, 80 percent of children under five and 88 percent of pregnant women reported sleeping under an LLIN the night before the survey (MOHS 2011). The 2013 SLDHS reported that among households who owned an ITN, 73 percent of children under five and 78 percent of pregnant women slept under an ITN the night before the survey. Table 4 disaggregates the ITN data by region, showing considerable improvements across the eastern, northern, and southern regions in both ownership and use by children under five and pregnant women. In the western region—where the endemicity of malaria is lower—the increase in ITN ownership between 2008 and 2013 was more moderate than in other regions. Use of ITNs actually declined among children under five and remained about the same in pregnant women.

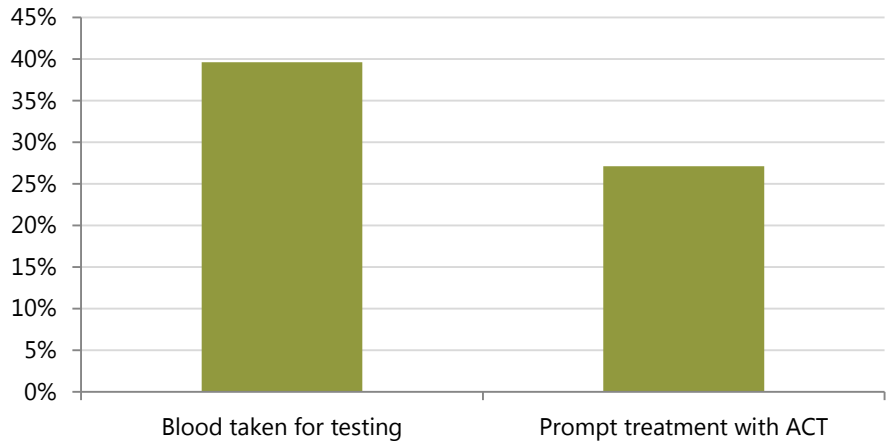
Table 4. Percentage of Households Owning an Insecticide-treated Net and among Those Who Own One, Percentage of Children Under five and Pregnant Women 15–49 Who Slept Under One the Previous Night, by Region, SLDHS 2008 and 2013

	2008			2013		
	Owned	Children	Pregnant Women	Owned	Children	Pregnant Women
Eastern	34	65	68	64	76	81
Northern	35	58	72	65	72	79
Southern	45	62	75	77	76	82
Western	34	62	51	47	55	54
Total	37	61	70	64	73	78

Roughly 45 percent of pregnant women receive IPTp for malaria in Sierra Leone. This includes at least two doses of SP/Fansidar during pregnancy, with at least one dose received during an ANC visit. This is a remarkable improvement since 2008, when just 10 percent of pregnant women received IPTp (SSL and ICF Macro 2009).

Data are not available from 2008 on testing and treatment of malaria in children, and in 2013, adequate care was low. While 70 percent of children with fever were taken for treatment promptly, 27 percent of them received an antimalarial (or 19 percent of all children with fever), which may indicate underdiagnosis or undertreatment. Although some fever cases are not caused by malaria, the low level of malaria testing (40 percent) suggests that treatment of fever with artemisinin-based combination therapies (ACTs) is low for reasons other than negative malaria test results (Figure 5).

Figure 5. Selected Child Malaria Control Indicators, 2013



Definitions: Blood taken for testing: Among children under five with fever in the past two weeks, percentage whose blood was taken for testing Prompt treatment with ACT: Among children under five with fever in the past two weeks, those who received an ACT the same or next day. Source: Statistics Sierra Leone and ICF International 2014

Helminth Infection and Its Control

Intestinal helminths, such as hookworms, can lead to gastrointestinal blood loss, poor nutrient absorption, inhibition/suppression of appetite, and general inflammation. These symptoms can aggravate iron deficiency and anemia, particularly in children (Albonjco et al. 1998) and pregnant women (Steketee 2003).

Prevalence of Helminthic Infections

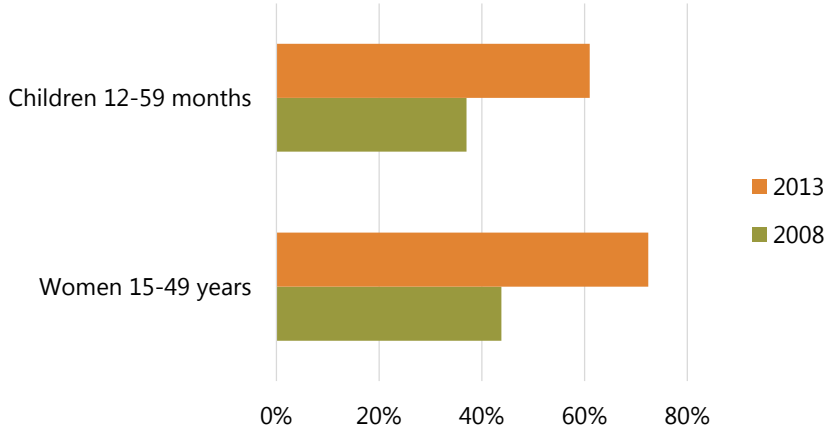
A national mapping of soil-transmitted helminths (STH) and schistosomiasis in 2008 showed that the prevalence of any STH infection was 39 percent and prevalence of schistosomiasis was 18 percent; the prevalence of individual helminthic infections ranged from 3 to 33 percent (Appendix VI). Soil-transmitted helminthic infections were evenly distributed across the country, with hookworms clustering in the western coastal areas and the northeast district Koinadugu. The northeast of the country was heavily affected by schistosomiasis. Sentinel surveillance was carried out in 15 schools with a high prevalence of schistosomiasis (≥ 50 percent) and moderate or high prevalence of hookworm (≥ 20 percent). Results from sentinel surveillance done six months after mass drug administration reported a fall in helminth prevalence ranging from 45 percent to 65 percent for different types of helminth infections (Appendix VI). Recent data indicate that while schistosomiasis prevalence and intensity have fallen dramatically over the last decade, they continue to be of public health significance in the northeastern regions and hookworm persists in hard to reach areas (Hodges 2012c). Similar findings on prevalence of helminthic infections have been reported from other studies done after initiation of a national program of school-based mass drug administration. In some regional studies, the prevalence of ascariasis in some hard-to-reach sites showed increases despite mass drug administration. A study hypothesized that the increase in ascariasis may have been due to insufficient supplies of mebendazole. This highlights the importance of monitoring and evaluation to allow for midcourse corrections in program implementation.

Helminth Infection control

In Sierra Leone, deworming treatments for children 12–59 months are given during the biannual mass campaigns for VAS with effective coverage rates (Hodges 2012a). Additionally, national school-based deworming campaigns are conducted for older school-age children. Ninety percent of schools in districts with high prevalence of STH are administering albendazole as part of the deworming campaign. Mass drug administration through the Neglected Tropical Diseases Control Program have consistently achieved high coverage rates of over 80 percent in preschool

age, school age and adult populations since 2009 (Koroma 2010; Hodges 2012a). The most recent national survey indicated that in 2013, 61 percent of children 12–59 months and 72 percent of pregnant women received deworming treatment in the previous six months and during their last pregnancy, respectively (Figure 6).

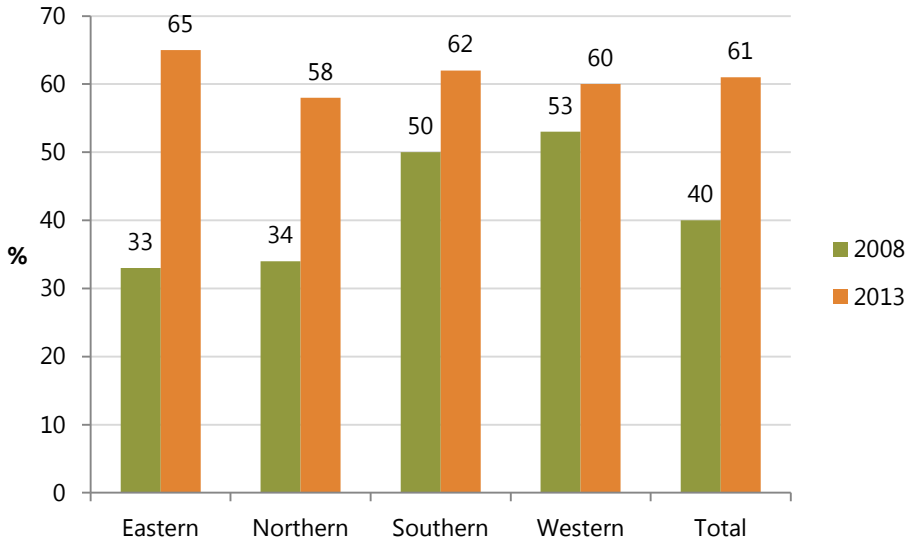
Figure 6. Routine Deworming and Deworming During Pregnancy, SLDHS 2008 and 2013



Medication given in past six months for children and during last pregnancy for women. Sources: Statistics Sierra Leone, and ICF Macro 2009; Statistics Sierra Leone, and ICF International 2014

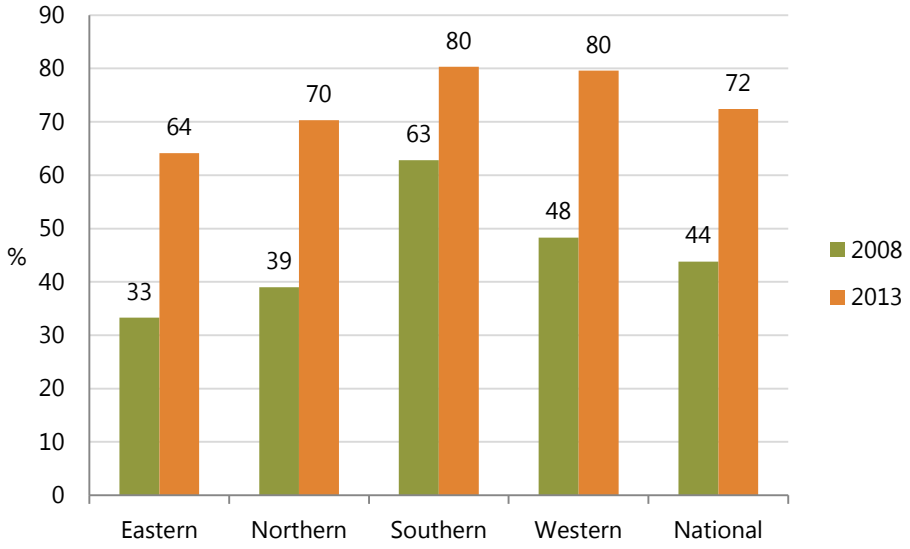
A comparison between the coverage of children's deworming program in 2008 and 2013 shows large improvements across regions—especially in the eastern and northern regions (Figure 7). A similar trend is apparent among pregnant women, as shown in Figure 8. However, in 2008 the Maternal and Child Health Week (MCHW) was cancelled, so these improvements should be viewed with caution.

Figure 7. Deworming of Children 12–59 Months by Region, SLDHS 2008 and 2013



Sources: Statistics Sierra Leone, and ICF Macro 2009; Statistics Sierra Leone, and ICF International 2014

Figure 8. Deworming of Pregnant Women Aged 15–49 by Region, 2008 and 2013



Sources: Statistics Sierra Leone, and ICF Macro 2009; Statistics Sierra Leone, and ICF International 2014

Micronutrient deficiencies, Fortification, and Supplementation

Micronutrient deficiencies are common in settings where the population relies on starch-heavy staple foods and consumes few animal products and other nutrient-rich foods. Deficiencies in micronutrients can lead to anemia because micronutrients are an integral part of red blood cells (iron) (Abbaspour, Hurrell, and Kelishadi 2014), transport iron throughout the body (vitamin A) (Michelazzo et al. 2013), and are required for the formation and maturation of red blood cells (folate and vitamin B12) (Simpson et al. 2010). Vitamin A deficiency is also a contributor to anemia; while the mechanism by which vitamin A supports hemoglobin and iron status has not been fully established, evidence exists of a causal association between vitamin A and iron metabolism (Bloem et al. 1990)(Balarajan et al. 2011). Vitamin A may also play an important part in erythropoiesis (production of red blood cells).

Prevalence of Micronutrient Deficiencies

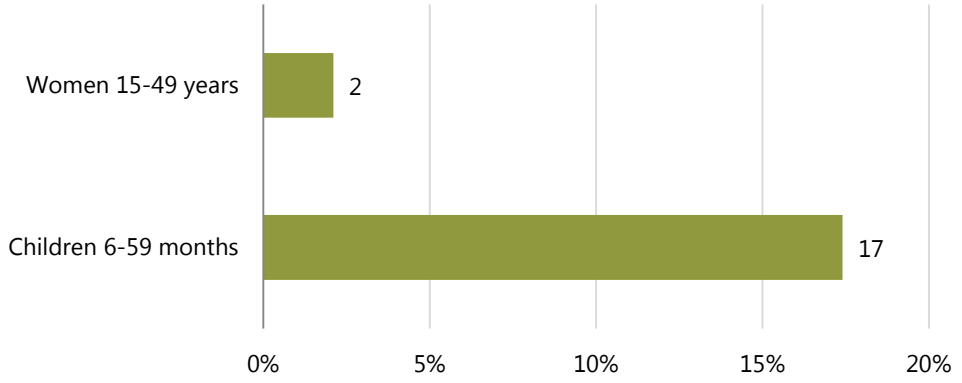
The 2013 SLMN reports that iron deficiency anemia (IDA) prevalence and iron deficiency prevalence appears to be low in Sierra Leonean women (6 percent and 8 percent, respectively) and children (4 percent and 5 percent, respectively) (Table5). Plasma ferritin was used to evaluate iron deficiency among children and WRA. Iron deficiency was defined as the plasma ferritin value in children and WRA being less than 12 µg/L and 15 µg/L, respectively. IDA in children 6–59 months of age was defined as hemoglobin < 11 g/dL and ferritin < 12 µg/L; similarly, IDA in WRA was defined as hemoglobin < 12 g/dL and ferritin < 15 µg/L. Micronutrient values were adjusted for inflammation. Vitamin A deficiency among WRA is very low (2 percent), but the problem affects nearly one fifth of all children under five (17 percent) (Figure 9). Retinol Binding Protein (RBP) measurements were used to measure vitamin A deficiency. The authors of the SLMN did not find any difference in individual RBP values or in the prevalence of vitamin A deficiency after adjusting for inflammation. They decided to present unadjusted RBP levels.

Table 5. Prevalence of Anemia, Iron Deficiency and Iron Deficiency Anemia in Children 6–59 Months and Women Aged 15–49, 2013 SLMN

	Anemia	Iron deficiency	Iron deficiency anemia
Children 6–59 Months (%)	76.3	5.2	3.8
Non-pregnant Women 15–49 (%)	44.8	8.3	6.1

The low prevalence of iron deficiency suggests that factors other than iron deficiency are likely contributing to anemia in Sierra Leone, especially in children. The SLMN did not collect data on the prevalence of iron deficiency and IDA in pregnant women.

Figure 9. Vitamin A Deficiencies in Children 6–59 Months and Women 15–49 Years, 2013 SLMN



Vitamin A deficiency defined as RBP<0.70 µmol/L, data are unadjusted for inflammation. Source: SLMN 2013.

The SLMN also assessed deficiencies for Vitamin B12 and Folate in WRA. Vitamin B12 deficiency was rare, affecting less than 1 percent of WRA, while folate deficiency was very high among WRA (79 percent).

Mass Food Fortification and Biofortification

The 2013 SLMN reported household consumption of commercial vegetable oil and bread. Both commercial vegetable oil and bread consumption were highest in urban areas, wealthier households and in the western regions. Average household consumption of oil and bread was 20 ml and 70 grams respectively. This suggests that these two fortified foods may not serve as the main source of dietary micronutrients.

Biofortification—the process of breeding and delivering staple food crops with higher micronutrient content to improve the nutrient content of staple foods—is being promoted through agricultural extension workers, with the Ministry of Agriculture, Forestry, and Food Security (MAFFS) providing technical support. A good source of vitamin A is the orange-fleshed sweet potato, a biofortified crop. Sierra Leone has also been identified as a potentially suitable candidate for the biofortification of rice with zinc and cassava with vitamin A, based on the production and consumption of the crops and the prevalence of the relevant micronutrient deficiencies (Asare-Marfo 2013).

Micronutrient Supplementation

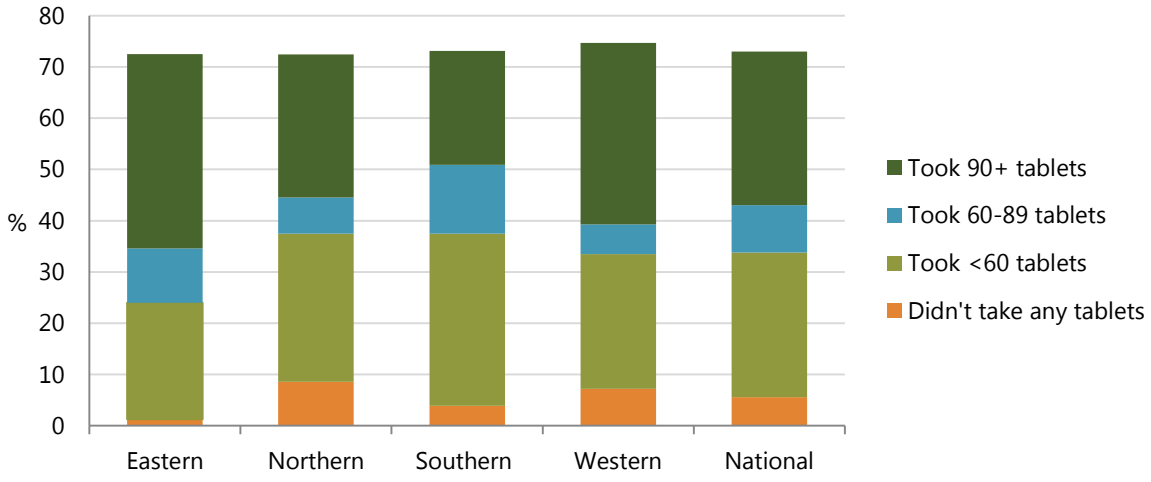
Improving dietary diversity to increase micronutrient intake is not always possible, given issues such as availability, cost, accessibility, and acceptability of nutrient-rich foods. For young children and pregnant women in particular, consumption of nutrient-rich or fortified foods may not be enough to increase micronutrient intake given the small quantities typically consumed. Therefore, micronutrient supplementation, including iron folate

supplementation, vitamin A supplementation, and micronutrient powders, plays a pivotal role in helping women and children meet their micronutrient needs.

Iron Folate Supplementation

IFA supplements are given to pregnant women through the health system. Although ANC coverage in Sierra Leone (97 percent) is high, compliance and shortages of supplies remain major challenges to adherence to the recommended supplement regimen in pregnancy. Figure 10 shows the percentage of WRA who reported taking iron supplements during their last pregnancy, disaggregated by the number of iron pills consumed. The percentage of women who did not take any iron pills ranged from 1 percent (eastern region) to 9 percent (northern region), while the percentage of women who took the recommended 90+ iron tablets ranged from 22 percent (southern region) to 38 percent (eastern region).

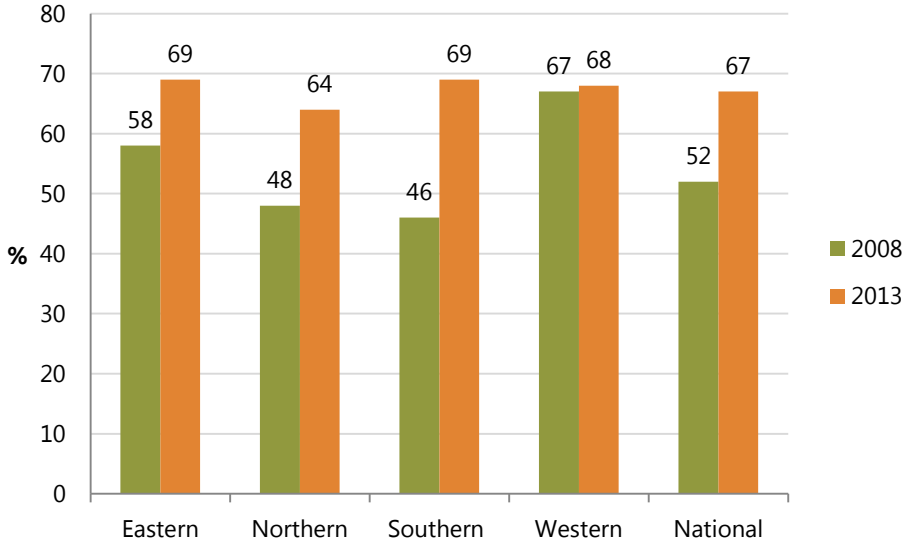
Figure 10. Among Women 15–49, Percent Who Reported Taking Iron Supplements During Last Pregnancy, by Region, SLDHS 2013



Sources: Statistics Sierra Leone, and ICF International 2014

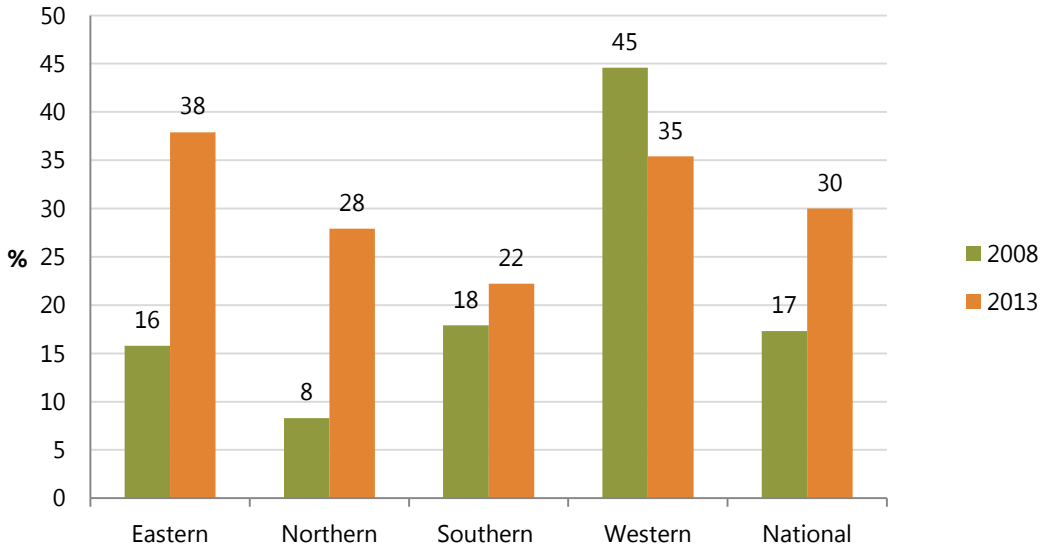
Figures 11 and Figure 12 compare the percentage of women who took any iron supplements and 90+ iron supplements during their last pregnancies. Notable improvements are observed across all regions, except in western region where the percentage of women consuming any iron supplements during pregnancy remained unchaged; in the western region, women taking 90+ iron supplements actually decreased from 45 percent to 35 percent.

Figure 11: Among Women 15–49, Percent Who Reported Taking Any Iron Supplements During Last Pregnancy, by Region, SLDHS 2008 and 2013



Sources: Statistics Sierra Leone, and ICF Macro 2009; Statistics Sierra Leone, and ICF International 2014

Figure 12: Among Women 15–49, Percent Who Reported Taking 90+ Iron Supplements During Last Pregnancy, by Region, SLDHS 2008 and 2013



Sources: Statistics Sierra Leone, and ICF Macro 2009; Statistics Sierra Leone, and ICF International 2014

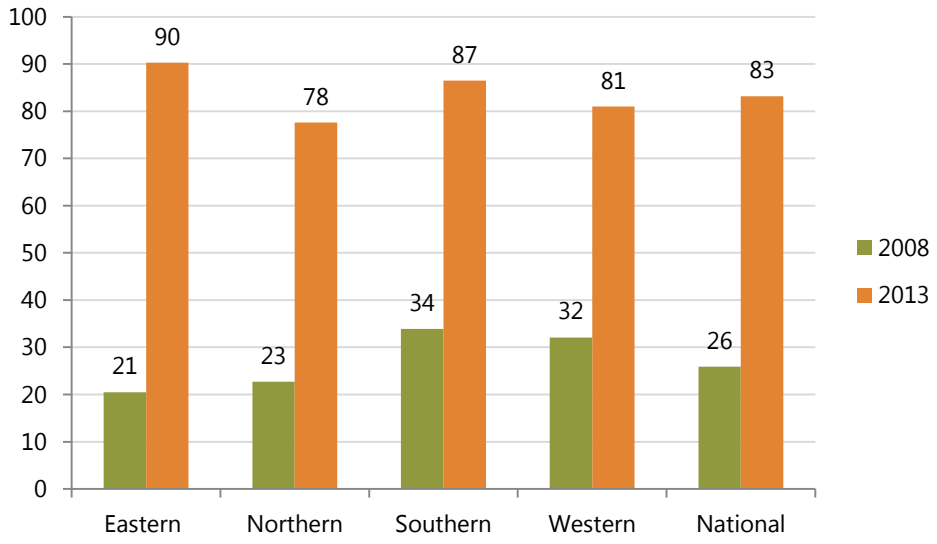
SPRING developed a method for making a rapid, initial assessment of the strengths and weaknesses of the distribution to and consumption of IFA supplements by pregnant women through ANC programs based on secondary analysis of SLDHS data. It identifies four sequential points at which IFA supplementation programs commonly falter. The results of the analysis are shown in Appendix VII. From the analysis, the biggest falter point appears to be the consumption of an adequate number of IFA tablets; 91 percent of women who attended ANC and consumed at least one tablet did not consume IFA per the WHO-recommendation, which states that women should consume IFA for 180 days or more during pregnancy. Given that only 45 percent of pregnant women

attended ANC during the first trimester, efforts to promote ANC earlier in pregnancy may increase the number of those consuming IFA according to WHO standards.

Vitamin A Supplementation

VAS is delivered to children 6–59 months through biannual mass campaigns and is integrated within routine health services. VAS is also promoted through mass media, health system and community structures. In Sierra Leone, Post Event Coverage Surveys have reported consistently high coverage rates for VAS. In 2005, Bendech et al. found a 95.0 percent national VAS coverage in children 6-59 months, with some variation across districts. A 2011 national Post Event Coverage Survey found high (91.8 percent) and equitable coverage for VAS among all districts and age groups between 6-59 months (Hodges et al. 2013). Another survey, conducted shortly after the Maternal and Child Health Week in 2012, found a 91.9 percent VAS coverage in Sierra Leone, distributed equitably across age groups, sex, religion and occupation (Sessay et al. 2014). Figures reported in the 2008 and 2013 SLDHS showed substantially lower national VAS coverage, at 26 percent and 83 percent, respectively. However, only one round of VAS had been implemented in 2008, and data collection for the 2013 SLDHS did not fall within six months of the previous mass campaign for VAS.

Figure 13. Percentage of Children 6–59 Months Given Vitamin A Supplementation, by Region and Total, SLDHS 2008 and 2013



Sources: Statistics Sierra Leone, and ICF Macro 2009; Statistics Sierra Leone, and ICF International 2014

Micronutrient Powders

A promising strategy is "point-of-use" fortification with Micronutrient Powders (MNPs) where a single-serving sachet of premixed micronutrients is added to a child's food to increase its nutritional value. Evidence from efficacy studies has shown that MNPs improve iron status and reduce anemia (De-Regil et al. 2011). The World Health Organization recommends distributing MNPs to children 6–23 months of age if the prevalence of anemia in a country is greater than 20 percent (WHO 2011). In 2013, UNICEF completed a feasibility study on the introduction of home fortification using MNPs to inform a pilot program to be introduced in select districts before its scale-up to other districts. The pilot (30-day trial) of the program was originally planned for September 2014, but has been postponed due to the Ebola outbreak. Findings from the feasibility study indicate an overall willingness among mothers, fathers, grandmothers, and healthcare providers to try adding MNPs to children's food (Micronutrient Project, UNICEF, and Irish Aid 2013).

General Inflammation and Its Control

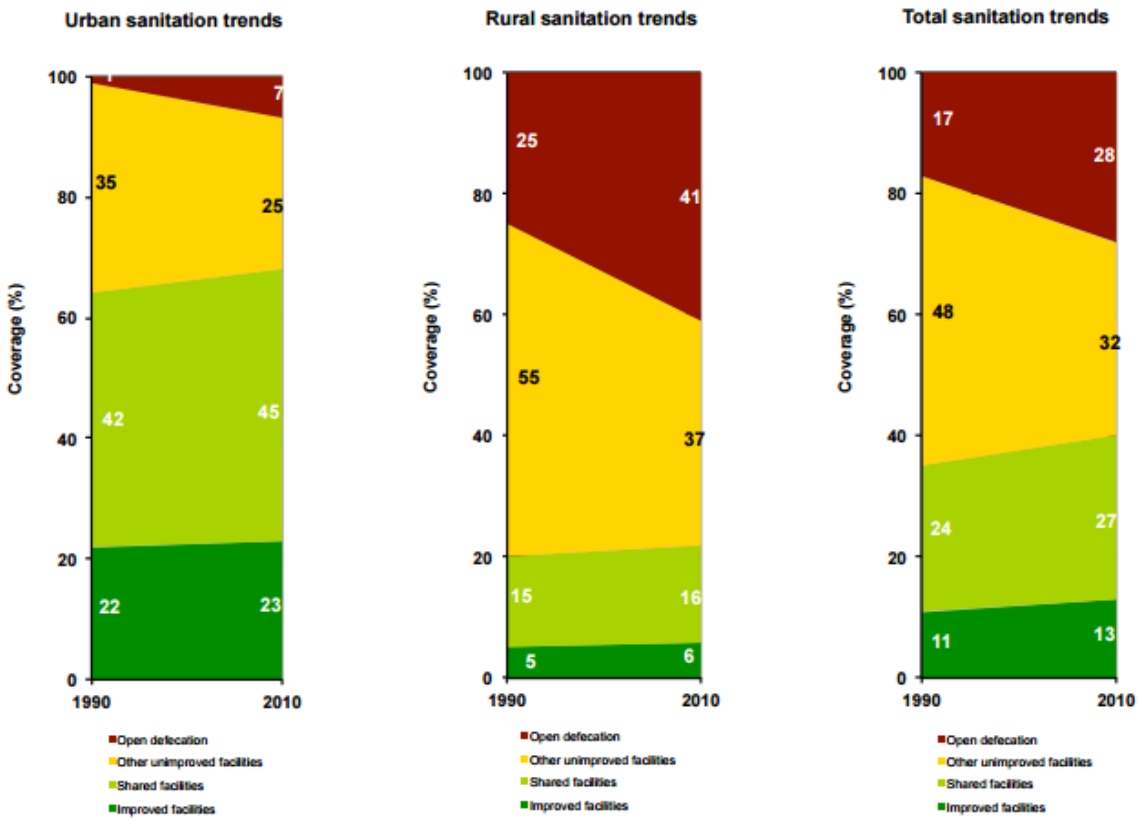
A number of diseases and infections, such as diarrhea and lower respiratory infections, affect child growth and development through the mechanism of chronic inflammation and environmental enteropathy (Ngure et al. 2014). General inflammation indirectly impacts iron metabolism; one of the better known pathways by which it does so is through the hormone hepcidin. Increase in hepcidin results in lower iron absorption and decreased release of iron from iron stores in the reticuloendothelial system. In the absence of hepcidin measurements, the two main markers of inflammation that can be measures are C-reactive protein and alpha1-acid-glucoprotein.

The SLMN measured inflammation using the biomarkers C-reactive protein andalpha1-acid-glucoprotein. At least one of these markers was found in 72 percent of preschool children. The survey also found that 30 percent of the children had diarrhea in the two weeks preceding the survey and 10 percent had a lower respiratory infection. The link between generalized inflammation and anemia has been established. The high prevalence of inflammation could point to the need to reduce illnesses and other factors likely leading to high levels of these inflammatory markers (Ganz 2011).

Water, Sanitation and Hygiene Interventions for General Inflammation

Substantial differences exist between rural and urban access to improved sources of drinking water and improved toilets or latrines. In 2008, 83 percent of urban households had access to an improved source of drinking water compared with 34 percent of rural households; 21 percent of urban households had access to an unshared, improved toilet or latrine facility compared with 6 percent of rural households. Figure 14 shows the change in sanitation trends from 1990 to 2010. Nearly one in three households does not have access to a toilet or latrine. Open defecation is a considerable challenge in Sierra Leone, with a greater increase in open defecation in rural areas than in urban areas. Access to improved sanitation facilities has remained the same over the past decade. The Community-led Total Sanitation (CLTS) program was established to lead community education and engagement to eliminate the practice of open defecation through the introduction of latrines and other sanitation facilities.

Figure 14. Sanitation trends in Sierra Leone, by Area and Total, WHO/UNICEF 1990 and 2010



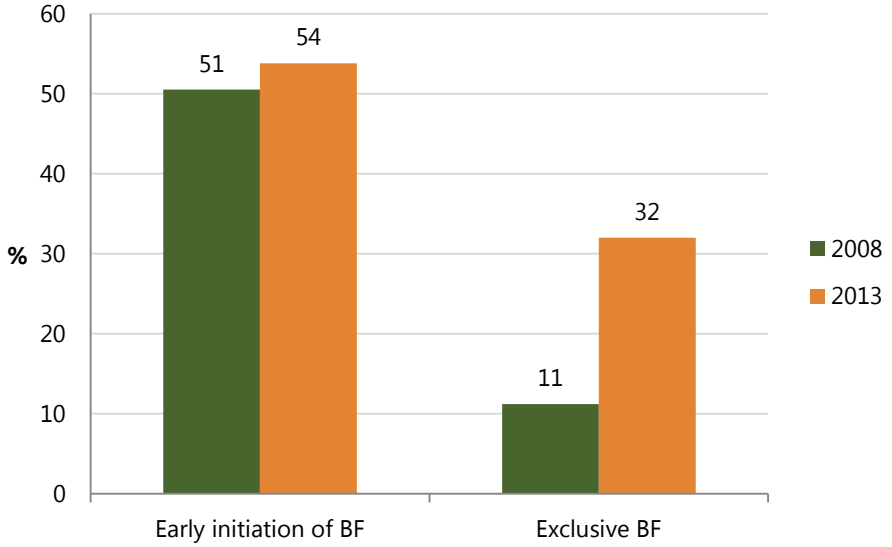
Source: WHO/UNICEF 2012.

Other Programs that Affect Anemia Status

Infant and Young Child Feeding Practices

The World Health Organization recommends exclusive breastfeeding for the first six months of life, followed by continued breastfeeding until 24 months in combination with safe and nutritionally adequate complementary foods. Infant and young child feeding (ICYF) practices outlined in the 2002 WHO/United Nations Children's Fund (UNICEF) Global Strategy on Infant and Young Child Feeding set the standard for global action in support of optimal breastfeeding, complementary feeding, and related maternal nutrition and health. Exclusive breastfeeding supports optimal growth and development for the first six months of life. Furthermore, breastfeeding plays a protective role against infections which are, in turn, associated with decreased iron levels, suppressed erythropoiesis (the process that produces red blood cells), and lower hemoglobin concentration (Bhutta et al. 2008). Nearly all children (96 percent) under six months of age are breastfed in Sierra Leone, but only 32 percent are exclusively breastfed. While the rate of exclusive breastfeeding remains low, it has increased nearly three-fold since 2008 (Figure 15). Forty-two percent of children are exclusively breastfed, with 89 percent being continually breastfed at one year of age, according to the SLMN. In addition, two-thirds of the children were breastfed in the first hour after birth.

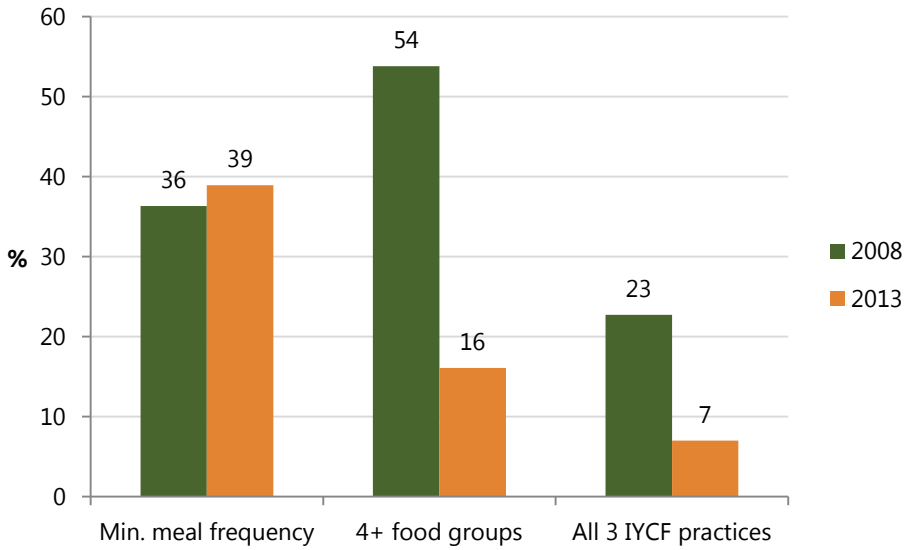
Figure 15. Selected World Health Organization/United Nations Children's Fund Indicators on Breastfeeding Practices in Sierra Leone, SLDHS 2008 and 2013



Sources: Statistics Sierra Leone and ICF Macro 2009; Statistics Sierra Leone and ICF International 2014

After six months of age, breastmilk is no longer able to provide adequate nutrition for children and solid or semisolid complementary foods should be introduced in addition to continued breastfeeding from age six months to 24 months. Early introduction of complementary foods (before six months) increases the risk of exposure to pathogens that may increase the risk of infection. Sierra Leone has made improvements in breastfeeding practices, but much more improvement in these practices is needed. Infant and young child feeding behaviors declined between 2008 and 2013 (Figure 16). Sixty-two percent of children 6–9 months of age were breastfed and consuming complementary foods in 2013 compared with 73 percent in 2008.

Figure 16. Selected Complementary Feeding Indicators among Children 6–23 Months, SLDHS 2008 and 2013



All questions refer to consumption the day and night previous to the survey. Minimum meal frequency is defined according to WHO/UNICEF guidelines; see http://data.unicef.org/nutrition/iycf for more information. Sources: SSL, MHS, and ICF Macro 2009; SSL, MHS, and ICF International 2014.

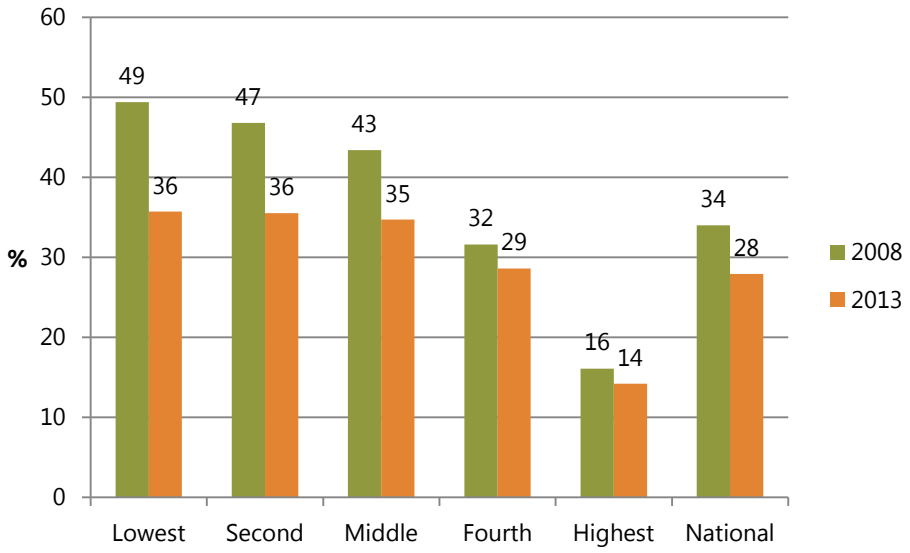
The SLMN reported a lower prevalence (42 percent) of one or more best practices for complementary feeding. The survey also reported that 35 percent of children under-two years met the standardized criteria for minimum dietary diversity, 26 percent met the criteria for minimum meal frequency, and 13 percent of the children ate a minimum acceptable diet.

Family Planning

Family planning enables women and couples to decide when to start a family and the number and spacing of their children. For women, birth spacing plays an important role in their vulnerability to anemia, as increased spacing between births allows them to replenish depleted iron stores. The World Health Organization recommends that countries reduce marriage before the age of 18 and create understanding and support to reduce pregnancy before the age of 20 (WHO 2011). In addition, the timing of pregnancy has a critical influence on anemia prevalence among WRA. The additional iron requirements during pregnancy can be an extra burden in adolescence, when iron requirements are already higher than they are for older women. Due to these factors, the shifting of fertility preferences and use of family planning may influence anemia trends (Begum and Dewey 2010).

Teenage pregnancy and motherhood are widely pervasive in Sierra Leone; 34 percent of all pregnancies occur among adolescent girls (SLDHS, 2008) and 26 percent of girls age 15–19 have already had a birth (MICS, 2010). In Sierra Leone, as with other developing countries, the trend is toward later childbirth and smaller families. As Figure 17 indicates, the proportion of women age 15–19 giving birth declined between 2008 and 2013. What is particularly remarkable is that this decline is highest among women in the two lowest wealth quintiles.

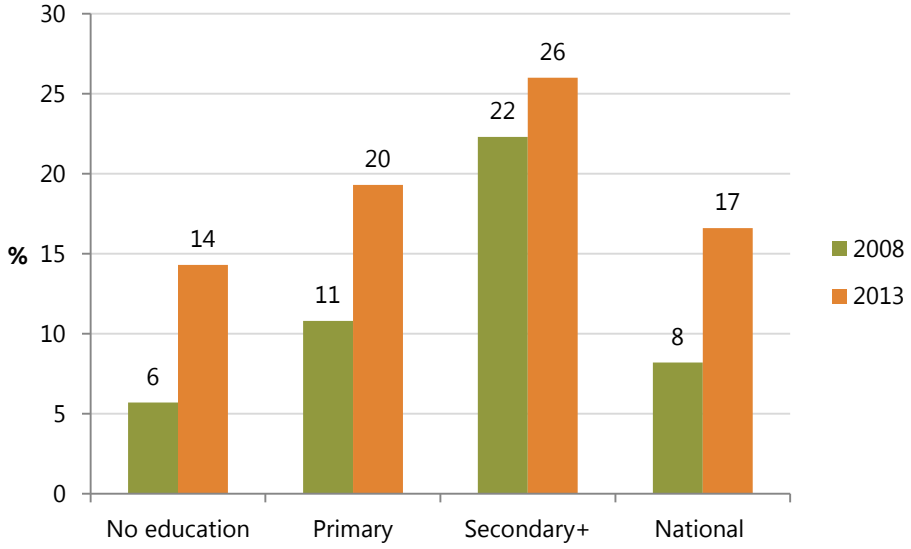
Figure 17. Percentage of Women Age 15–19 Who Have Begun Childbearing, by Wealth Quintile and Total, SLDHS 2008 and 2013



Sources: Statistics Sierra Leone and ICF Macro 2009; Statistics Sierra Leone and ICF International 2014

Contraception use among married women in Sierra Leone has increased, though it still remains very low. In 2013, 17 percent of currently married women used a contraceptive method. The prevalence of contraception is positively correlated with educational attainment, with usage rates among women with secondary education or higher at 26 percent compared to 14 percent among women with no education (Figure 18).

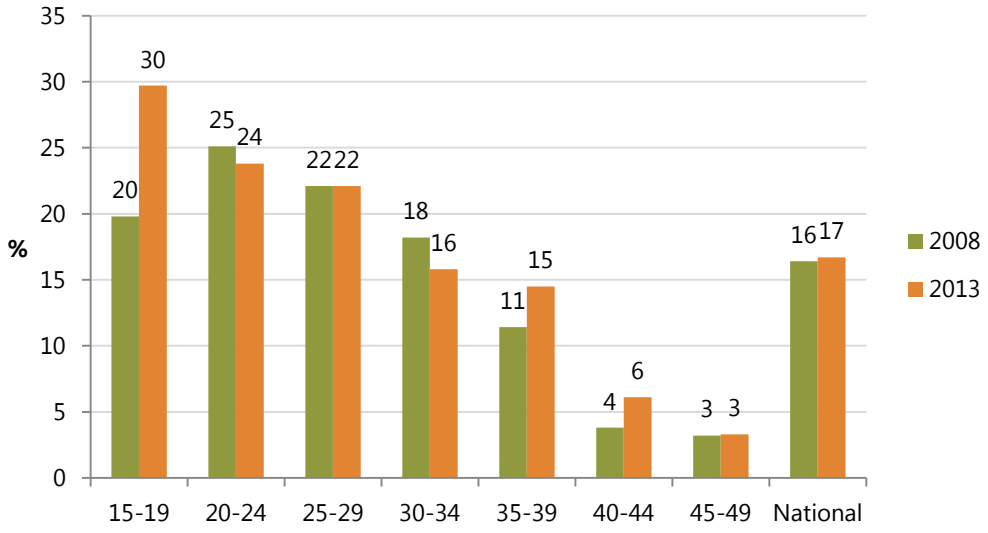
Figure 18.Percentage of Married Women Currently Using Contraception (Contraception Prevalence Rate), by Education Level and Total, SLDHS 2008 and 2013



Sources: Statistics Sierra Leone and ICF Macro 2009; Statistics Sierra Leone and ICF International 2014.

The proportion of women who wanted a contraceptive method for birth spacing but were not using one remained unchanged among all women; however, this percentage actually increased substantially among married adolescent women, proving that adolescents require special attention for family planning and anemia interventions (Figure 19).

Figure 19.Percentage of Married Women with Unmet Need for Family Planning, by Age and Total, 2008 and 2013



Sources: Statistics Sierra Leone and ICF Macro 2009; Statistics Sierra Leone and ICF International 2014.

Policy Environment in Sierra Leone

Sierra Leone has a strong policy environment with a forward thinking strategic direction that should ultimately contribute to reductions in anemia. The Agenda for Prosperity 2013-2018 (Third Poverty Reduction Strategy) is the overarching policy that aims for Sierra Leone to become a middle-income country by 2035. In its aspiration to achieve high economic growth, maintain significant progress on governance indicators, and sustain improvements

in human development indicators, the policy outlines critical strategies in health, nutrition, disease control, agriculture, and water and sanitation to attain its goals—which also address the direct and underlying causes of anemia. Although the recent Ebola epidemic has undermined the country's stability and has had a detrimental impact on social services and human development, the National Ebola Recovery Strategy for Sierra Leone 2015-2017 aims to refocus efforts on the Agenda for Prosperity as the main anchor for the medium and long term effects of Ebola, while addressing immediate recovery in health, education, food security, WASH, social protection, and the economy.

The National Health Sector Strategic Plan 2010-2015 (NHSSP) and the Reproductive, Newborn, and Child Health (RNCH) Policy 2011-2015 are aligned with the Agenda for Change, the Second Poverty Reduction Strategy 2008-2012. The NHSSP aims to strengthen the health care systems and improve the access, quality, equity, efficiency, and inclusiveness of health services. The RNCH Policy places an emphasis on interventions that are important for anemia reduction efforts, including protection and promotion of exclusive breastfeeding, prevention and treatment of malnutrition, age-appropriate complementary feeding, and improvement in the nutritional status of pregnant and lactating women. Specific objectives are elaborated in the Reproductive, Newborn, and Child Health (RNCH) Strategy 2011-2015 which focuses on adolescent/youth friendly health services, including nutrition and quality ANC that encompasses integration of family planning, nutrition, malaria, and HIV/AIDS/STIs.

The RNCH Strategy lists specific targets for antenatal care, family planning, breastfeeding, complementary feeding, malaria prevention (IPTp and ITN), WASH, and treatment of diarrhea and pneumonia. However, the Strategy does not set targets for vitamin A supplementation and multiple micronutrients for children 6-59 months, deworming in pregnancy, IYCF counseling services in health facilities, and consumption of animal source foods by children 6-23 months.

The National Malaria Control Programme (NMCP), which is under the Directorate of Disease Prevention and Control, manages all malaria control efforts in the country. It also identifies and promotes a number of preventive and control strategies such as active case management, minimum vector control, promotion of the use of ITNs, IRS, and environmental sanitation. The National Malaria Strategic Plan 2011-2015 (NMSP) is the guiding document for the implementation of the NMCP. The NMSP's main objective is to reduce malaria morbidity and mortality by 50 percent and 25 percent, respectively. The NMSP discusses preventative and control efforts, including appropriate treatment of malaria, promotion of and improved access to ITNs, IRS, and environmental sanitation. The national policy guidelines for IPTp require that women take at least two doses of sulfadoxine-pyrimethamine (SP)—an antimalarial drug also known as Fansidar—in the second and third trimesters of pregnancy during routine ANC visits. The national malaria program does not collect indicators or data on anemia, though the 2013 MIS presented data on severe anemia in children 6–59 months of age. Malaria prevention and control activities are also incorporated within the NHSSP; however, more efforts need to be made to increase awareness of the link between malaria and anemia.

The National Food and Nutrition Security Policy (NFNSP) 2012-2016 was validated and launched in June 2015. The NFNSP acknowledges the complex and multifactorial causes of undernutrition, and the critical need for multi-sectoral action to address these challenges. The overall goal of the NFNSP is to contribute to the improved health and social and economic wellbeing of Sierra Leoneans, particularly women, children, and other nutritionally vulnerable groups. Its objective is to improve the nutritional status of the population, especially among infants and young children and pregnant and lactating women. Several interventions that will contribute to reductions in anemia are featured prominently in the NFNSP anemia targets have been established (Table 6). Anemia prevention activities include the following strategies: promote compliance of IFA supplementation among pregnant women; sustain mass and routine distribution of vitamin A to children 6–59 months and deworming

medication to children 12–59 months; promote food diversification, fortification of widely consumed foods, and research on biofortification; and introduce MNPs for children 6–59 months. While the cost analysis of the NFNSP has been done, only certain key components of the nutrition action plan are funded. And though anemia is clearly featured in the plan, funding for anemia activities is limited.

The National Food and Nutrition Security Policy Implementation Plan (NFNIP) translates the goals, objectives, and strategies from the NFNSP and lays out the priority areas and activities to be implemented under a common results framework and budget. Recognizing the interplay between nutrition, infection and hygiene, the NFNIP reflects the need for different stakeholders and sectors of government to collaborate to address these issues. With the involvement of relevant line ministries, local government, and other stakeholders, seven priority areas to address the underlying causes of malnutrition in Sierra Leone have been identified. Key interventions under the seven priority areas include improved indicators for breastfeeding and complementary feeding, micronutrient intake, diarrhea and parasite control, treatment of acute malnutrition, household food security, maternal nutrition, the nutritional status of people living with HIV and AIDS/TB, and the reduction of non-communicable diseases. Although a standalone policy on deworming has not been developed in Sierra Leone, strategies for deworming are discussed in the NFNIP.

In 2012, the MOHS, jointly with the Sierra Leone Standards Bureau, called for the mandatory fortification of widely consumed foods such as wheat flour, salt, and vegetable cooking oil as part of the interventions to control vitamin and mineral deficiencies in the country. The standards for the fortification of oil, wheat flour and salt are mandatory, and similar efforts are in progress to fortify maize, and rice with iron. The National Food Fortification Alliance was also established to work closely with industry and food-importing agencies and to monitor the standards of imported and domestically produced foods in accordance with Economic Community of West African States protocol.

Additional policies and strategies relevant to anemia control and prevention efforts are in place in Sierra Leone. The National Water and Sanitation Policy, adopted in 2008, aims to achieve a target of 74 percent for improved drinking water supply and 66 percent for improved sanitation by 2015. However, to our knowledge, no implementation plan exists for operationalization of strategies. The 2009 National Guideline and Strategy on Infant and Young Child Feeding works to improve the health and nutritional status of infants and children through the promotion of optimal maternal and child nutrition. The National HIV/AIDS Strategic Plan 2011 – 2015 and the National HIV Prevention Strategy 2011-2015 aim to strengthen measures to prevent HIV infection and mitigate its impact. The National Leprosy and Tuberculosis Control Strategic Plan 2007-2011 focuses on the expansion of appropriate TB treatment. The National Sustainable Agriculture Development Plan 2010-2030 links to nutrition objectives, including the promotion of improved food processing and preservation methods and the diversification of crops that are grown and consumed.

Table 6. Anemia Targets Outlined in the 2012–2016 National Food and Nutrition Security Policy Implementation Plan

	Description	Baseline 2012	Target 2016
Outcome Indicator	% of children 6–59 months with anemia	76	51
	% of women 15–49 years with anemia	45	36

Note: Baseline levels used in 2012 were derived from the 2008 SLDHS survey.

National and District-level Coordination

The Directorate of Food and Nutrition is housed within the MOHS, led by a nutrition expert with a team of 10 staff members assigned to various nutrition activities such as IYCF, micronutrient deficiency reduction, nutrition surveillance, clinical nutrition, and integrated management of acute malnutrition. Key activities of the NFNSP are being carried out in partnership with WHO (nutrition surveillance), WFP (targeted supplementary feeding programs), and UNICEF (MNPs). The Directorate has an action plan to reduce stunting, but a similar action plan for anemia has not yet been developed.

Sierra Leone has strong political commitment for nutrition, joining the Scaling Up Nutrition (SUN) movement in 2012 and making nutrition a priority in the Agenda for Prosperity. Parliamentary oversight committees on health, agriculture, gender, and education support their respective committees in the enactment of pro-food and nutrition legislation and in ensuring that programs, strategies, and policies have an impact on women and children's nutrition. The SUN Movement provides a robust platform for coordination across sectors and stakeholders in Sierra Leone. Under SUN, a National Food and Nutrition Security Steering Committee has been established in the Office of the Vice President. The Committee is comprised of key technical experts from relevant government ministries, research institutions, United Nations agencies, development partners, the private sector, NGOs, and civil society and meets on a quarterly basis. The NFNSP calls on several ministries to support improved nutrition and its implementation plan provides step-by-step guidance for coordination between the MOHS and the MAFFS, among other entities.

While structures exist at the national level, coordinating activities and support for multi-sectoral anemia programming and capacity building at the district level are a bit more difficult. Services in Sierra Leone have mostly been decentralized to district councils. Ward councilors are introducing nutrition programs, but not systematically. District councils are responsible for coordinating all activities at the district level and receive a budget for primary health activities. In practice, fiscal decentralization is limited and most decisions surrounding personnel, supervision, and reporting of health programs are made at the national level. According to the NFNSP, each district council is working toward the development of a single integrated development plan. Additionally, a District Food and Nutrition Council is supposed to be established in each district.

In addition to all of the relevant government entities, a wide range of development partners have committed funding or have mandates for activities that could contribute to improving nutrition and reducing anemia in Sierra Leone. Examples of stakeholders include United Nations agencies, such as UNICEF, WFP, WHO, and FAO; international NGOs, such as Helen Keller International (HKI), Action Against Hunger, Save the Children, ACDI/VOCA and International Medical Corps (IMC) implementing the Sustainable Nutrition and Agriculture Promotion (SNAP) project, Concern Worldwide, Welthungerhilfe; and local partners, such as Focus 1000. Though there are small organizations and projects such as Medical Assistance Sierra Leone and the Sickle Cell Carers' Network (Kono District), focusing on anemia specifically, there are many more larger organizations and donors working on wider nutrition-specific activities and/or other underlying causes of anemia. Examples of organizations working in malaria or other parasites include BRAC, CARE, Catholic Relief Services, Centers for Disease Control and Prevention, Develop Africa, Doctors Without Borders, HKI, Red Cross, and World Hope. BRAC, CARE, Marie Stopes, and others are working in family planning. Organizations working in WASH include but are not limited to IMC, IRC, World Hope, Life for Relief and Development. In addition to the USAID-funded SNAP partners above, other NGOs and institutions are involved in nutrition-sensitive agriculture (e.g., Sierra Leone Agricultural Research Institute, Concern, and WorldFish).

Discussion

Summary of Findings

In Sierra Leone, anemia prevalence remained high between SLDHS 2008 and 2013 in children aged 6–59 months (76 to 80 percent) and WRA (45 percent in both years). It is imperative that Sierra Leone bring anemia under the threshold for a severe public health problem (40 percent) as defined by the WHO. As it stands, the chances are slim of meeting the World Health Assembly target of reducing WRA anemia by half by 2025. Perhaps due to concerted efforts, the prevalence of anemia in pregnant women reduced slightly from 62 percent in SLDHS 2008 to 54 percent in 2013, with an average of 1.4 percentage point reduction rate per year. Based on 2013 SLDHS data, anemia is highest among younger children (6-24 months) and adolescent girls (15-20 years). Anemia among WRA in 2013 is lowest in the western region compared to the eastern, northern, and southern regions. In children, the prevalence of anemia is highest in the northern region (83 percent) and lowest in the western region (71 percent), though these differences were not statistically significant.

A full understanding of why the prevalence of anemia among children under five years of age and WRA has been stagnant between 2008 and 2013 is unclear. The findings from this landscape analysis indicate that a larger portion of anemia is likely the result of malaria, other infections, and general inflammation rather than nutritional deficiencies. But infections alone are unlikely to be the only cause of anemia. The low levels of iron deficiency found in this population suggest micronutrient deficiencies may play less of a role in Sierra Leone's prevalence of anemia. Further studies should be carried out to confirm this finding. In addition to other immediate, underlying, and basic causes of anemia, hemoglobinopathies may contribute to the high prevalence of anemia. While hemoglobinopathies are not amenable to interventions, it is important to assess the prevalence and impact of this risk factor on anemia in Sierra Leone to understand the extent to which anemia can be reduced.

Programs to prevent and control anemia have improved between 2008 and 2013 but significant efforts are needed to meet the anemia reduction targets set forth in Sierra Leone's NFNIP. Disease prevention and control programs will likely have the greatest impact on anemia. The uptake of malaria prevention strategies is greater than diagnosis and treatment of children with fever. Improvement in malaria case management will likely result in reductions in anemia. Increased malarial treatment of pregnant women, (the coverage was 45 percent in 2013) may also reduce the prevalence of anemia. The 2013 coverage of mass drug administration of antihelminthic drugs for children under five years of age (58 percent) and pregnant women (72 percent) could be increased. An emerging factor contributing to anemia is inflammation and implementation of WASH interventions can reduce the high levels of open defecation and may result in reductions in anemia. The water supply, sanitation, and hygiene sector must deal with issues of availability, access, and utilization of safe water, as well as sanitation and hygiene practices, especially for children aged 6-23 months and for young women, who have a high prevalence of anemia. In particular, there is a need to address gaps in coverage of safe water and sanitation facilities in the rural areas.

Food and nutrition interventions remain an important factor in reducing anemia in the short and long term. IFA during pregnancy remains an important intervention despite the apparently low levels of iron deficiency in WRA and children under five. The iron requirements during pregnancy increase dramatically and the provision of daily IFA prevents anemia and improves birth outcomes. Improvements in the percentage of women reporting taking IFA during their last pregnancy has increased, but further improvements are needed. The practice of delayed cord clamping, which allows for the passage of blood from the placenta to the baby and reduces the risk of iron deficiency in infancy, is currently not included in the RNCH Strategy 2011–2015, and is a potential strategy that can be used to prevent iron deficiency in young children. Vitamin A deficiency remains moderate despite high

coverage of biannual vitamin A supplementation among children. Thus, other food and nutrition strategies play a key role for prevention of anemia and improved overall wellbeing, including fortification of food products, like wheat flour (with iron) and vegetable oil (with vitamin A), and promotion of nutrition-sensitive agriculture interventions at both household and commercial levels.

Lastly, promoting women's empowerment efforts, including increased education and literacy, delayed age of first childbirth with family planning programs, and ensuring adequate spacing between births for WRA, will ultimately reduce anemia over the long-term. Given that iron deficiency may not be the main driver of anemia in Sierra Leone, an integrated approach appears to be even more important.

Next Steps

The NFNSP highlights the need for collaboration by different stakeholders and sectors. An anemia coordinating body can support in-depth analyses to further understand the immediate, underlying and basic causes of anemia. It can also help prioritize activities and resources that can bring anemia under control. Lastly, such a group can monitor the progress of anemia control efforts. Similar approaches have been used in other countries, such as in Uganda, where the development of a multi-sectoral National Anemia Working Group (NAWG) was established. Based on lessons learned from key stakeholders it is important to consider all risk factors for anemia (e.g. WASH and genetic factors), ensure all sector are actively involved with defined roles as early as possible, and include both national and local level representatives. The Uganda experience has been successful in large part due to bringing of stakeholders, who would not interact otherwise, to work towards a common goal, coupled with a high national endorsement.

There are over 20 government ministries in Sierra Leone and a partnership between various government sectors, within and outside the Ministry of Health and Sanitation, is crucial to achieve progress and reduce the anemia burden among Sierra Leoneans. Building on Sierra Leone's commitment as a SUN country, anemia can be addressed by working across government sectors (e.g. MoHS, MAFF, Ministry of Education, Youths and Sports, Ministry of Finance and Development, and Ministry of Social Welfare, Gender and Children's Affairs), with multiple stakeholders (UN, government civil society, Business and donor networks), and at multiple levels (national, district, and community). If brought together to look at how their work can address anemia, such a diverse group of interests could develop and carry out coordinated multi-sectoral anemia efforts.

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Appendix I

Sierra Leone Landscape Analysis Search Strategy March 20, 2015

Database(s): **Ovid MEDLINE(R)** 1946 to March Week 3 2015**, EBM Reviews - Cochrane Database of Systematic Reviews** 2005 to February 2015**, EBM Reviews - Cochrane Central Register of Controlled Trials** February 2015**, CAB Abstracts** 1910 to 2015 Week 11**, Global Health** 1910 to 2015 Week 11

Searches	Results
(exp Anemia, Hypochromic/ or anemia.mp. or exp Anemia, Macrocytic/ or exp Anemia, Sickle Cell/ or exp Anemia/ or exp Anemia, Iron-Deficiency/ or exp Anemia, Megaloblastic/ or exp nutritional status/ or nutritional deficiency/ or exp Micronutrients/ orhypochromic an?emia.mp. or hypochromic erythrocytes.mp. or ferritin.mp. or exp Ferritins/ or iron deficiency.mp. or exp Receptors, Transferrin/ or vitamin b12.mp. or vitamin b12 deficiency.af. or exp Vitamin B 12/ or cyanocobalamine.mp. or exp Vitamin B 12 Deficiency/ or vitamin a deficiency.mp. or exp Vitamin A Deficiency/ or (night blindness or xerophthalmia).af. or exp Folic Acid/ or exp Folic Acid Deficiency/ or folate deficiency.mp. or neural tube defects.mp. or exp Neural Tube Defects/ or exp Ferritins/bl or exp *ferritins/ or exp *apoferritins/ or exp transferrin/ or transferrin.mp. or (b12 or folate$ or "folic acid").mp. or exp Vitamin A/ or vitamin A.mp. or retino$.mp. or exp Zinc/ or zinc deficiency.mp. or exp Helminths/ or exp Nematode Infections/ or exp Ascariasis/ or exp Cestoda/ or exp Trichuriasis/ or exp Trichuris/ or exp Helminthiasis/ or exp Ancylostomatoidea/ or exp Filariasis/ or exp Microfilaria/ or exp Fasciola hepatica/ or exp Filarioidea/ or exp Wuchereria bancrofti/ or exp Strongyloides ratti/ or exp Strongyloides/ or exp Strongyloides stercoralis/ or exp Enterobius/ or exp Necator/ or exp Necator americanus/ or schistosomiasis.mp. or (roundworm or round worm or round-worm or roundworms).mp. or hookworm.mp. or tapeworm.mp. or whipworm.mp. or filaria.mp.) and (sierra leone.mp. or exp Sierra Leone/)	875
(malaria.af. or exp Malaria/ or plasmodium.af. or plasmodi$.af.) and ((pregnancy or pregnan* pr pregnan$).af. or exp pregnancy/ or women of reproductive age.mp. or exp Adolescent/ or exp Adult/ or women of reproductive age.mp. or exp Women's Health/ or women.mp. or exp Women/) and (sierra leone.mp. or exp Sierra Leone/)	109
1 or 2	953
remove duplicates from 3	560

Appendix II

Policies and Strategies Reviewed for Sierra Leone Landscape Analysis

Nutrition

National Food and Nutrition Security Policy 2012-2016

National Food and Nutrition Security Implementation plan 2012–2016

Health

National Health Policy

National Health Sector Strategic Plan 2010–2015

Reproductive and Child Health Policy

Reproductive, Newborn and Child Health Strategic Plan 2011–2015

Malaria

National Malaria Control Policy

National Malaria Control Strategic Plan 2011–2015

Water and Sanitation

National Water and Sanitation Policy

Appendix III

Key Stakeholders interviewed for the Sierra Leone Landscape analysis

Name	Sector
Aminata S. Koroma	MOHS - Directorate of Food and Nutrition
Dr. Mohamed Foh	SUN Secretariat, OVP
Hannah Yankson	WHO
Marian Bangura	WFP
Meeting on the Food-based Dietary Guidelines	FAO
Faraja Chiwile	UNCIEF
Dr. Elizabeth, Pascal and Mesfin	SNAP
Foday Sawi	MOHS – Deputy Minister of Health 2
Sofia Goinhas	HKI
Boi-Jenneh Jalloh	USAID
Melrose Tucker	FOCUS 1000
Dr. Lynda Foray	Reproductive Health – MOHS
Patricia Bah	School and Adolescent Health – MOHS
Paula Molloy	Irish Aid
Anita Kargo and Omo (HKI program staff)	Visit to the Hill Station Health Center
Dr. Kendeh	DHM
Nelson Fofana	Malaria M and E Officer, MOH
Mariatu Koroma	MEST
Dr. Zed Bahsoon	BENNiMiX Food Company CEO

Appendix IV

Description of Variables Used in the Landscape Analysis

Previous literature on the determinants of anemia prevalence in developing countries informed the selection of variables used in this landscape analysis. In addition, coverage for anemia-related programs in Sierra Leone informed the choice of variables. The construction of the variables and their descriptions are shown in Table IV.

Table IV. Description of Variables Used in the Landscape Analysis

Variable Name	Type	Description
Anemia	Categorical	This variable is defined based on adjusted hemoglobin levels. Hemoglobin levels are adjusted for altitude among children and women, as well as for smoking status in the latter[2]. Anemia prevalence has been divided into four categories based on hemoglobin levels: severe, moderate, mild, and no anemia. The hemoglobin cut-off levels among children and pregnant women and non-pregnant women are as follows: **Children and pregnant women** Severe anemia- <7.0 g/dL Moderate anemia- 7.0-9.9 g/dL Mild anemia- 10.0-10.9 g/dL No anemia- ≥11g/dL **Non-pregnant women** Severe anemia- <7.0 g/dL Moderate anemia- 7.0-9.9 g/dL Mild anemia- 10.0-11.9 g/dL No anemia- ≥12g/dL
Iron deficiency (ID)	Categorical	This variable is defined based on plasma ferritin levels. Ferritin values are adjusted for inflammation. The cut-off levels are as follows: **Children 6-59 months**: <12µg/L **Non-pregnant women**: <15µg/L
Iron deficiency anemia (IDA)	Categorical	This variable is defined based on hemoglobin and plasma ferritin levels: **Children 6-59 months**: low hemoglobin (<11g/dL) and low plasma ferritin (<12µg/L) **Non-pregnant women**: low hemoglobin (<12g/dL) and low plasma ferritin (<15µg/L)
Vitamin A deficiency	Categorical	This variable is defined as retinol binding protein <0.70 umol/L.
Vitamin B12 deficiency	Categorical	This variable is defined as plasma B12 <150pmol/L.

[2] Compared with people living at sea levels, those living at higher altitudes have higher hemoglobin and hematocrit levels due to lower partial pressure of oxygen. Similarly, smoking increases hemoglobin levels because it interferes with the blood's capacity to transfer oxygen. Hemoglobin was adjusted for altitude and smoking in SLDHS and SLMN.

Variable Name	Type	Description
Folate deficiency	Categorical	This variable defined as plasma folate <10 nmol/L.
Malaria	Categorical	Malaria status was assessed using rapid diagnostic tests that detected *P. falciparum*, as this particular parasite accounts for all severe cases and 95 percent of all cases in Sierra Leone.
Regions	Four categories: eastern, northern, southern, and western	Geographic areas remained consistent across the three surveys. Furthermore, SLDHS 2013 collected data stratified at the district level, one level below the region.
Wealth	5 categories: poorest, poorer, middle, richer, and richest	Wealth quintiles were generated using principal components analysis.
Age groups women	7 categories: 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, and 45–49	WRA were categorized into 5-year intervals, 15 years to 49 years.
Age groups children	Categorical–2 categories: between six and 23 months, between 24 and 59 months	Children were divided into two groups depending on whether they were between six and 23 months or between 24 and 59 months.
Highest education level	Categorical–Four categories: no education (reference group), primary, secondary, and higher.	This referred to the respondent's level of education and the mother's education in case of children.
Place of residence	Dummy – 0 for urban and 1 for rural	Urban was defined as 0 and rural was defined as 1.
Bed net use	Dummy–0 if a child/WRA did not sleep under a bed net the previous night and 1 if he/she did	Among WRA and children, this was defined as whether the respondent said she/her child slept under a bed net the previous night.
Bed net ownership	Dummy–1 if household owns bed net and 0 if it does not own one	Among WRA and children, bed net ownership was explored at the household level. Of the respondents who reported that their household owns a bed net, further analysis examined how many of them slept under the bed net the previous night.
Hormonal contraceptive use	Dummy–1 if the woman was using at the time of the survey and 0 if not	Among non-pregnant women, she used pills, an intrauterine device, injections, or implants as a contraceptive method.
Deworming during pregnancy	Binary	Among women who gave birth in the past five years, drugs for intestinal parasites' was assessed as "yes" if the respondent had received at least one dose of deworming medication during her last pregnancy.
Antimalarial prophylaxis during pregnancy	Binary	Among women who gave birth in the past five years, she was assessed as "yes" if the woman had intermittent preventive treatment against malaria during her last pregnancy.
Iron supplementation during pregnancy	Binary	Among women who gave birth in the past five years, this was determined by whether the woman was given or bought iron tablets or syrup during her last pregnancy.
Number of days of iron supplementation	Four categories: never, less than 30, 30-60,more than 90	Among women who gave birth in the past five years, the number of days a woman took iron supplementation during her last pregnancy was divided into three categories: never, less

Variable Name	Type	Description
		than 90 days, and 90 days or more.
Minimum dietary diversity	Binary	Dietary diversity refers to the child receiving 4+ of the following food groups: • Grains, roots and tubers • Legumes and nuts • Dairy products (milk, yogurt, and cheese) • Flesh foods (meat, fish, poultry, and liver/organ meats) • Eggs • Vitamin A-rich fruits and vegetables • Other fruits and vegetables
Minimum meal frequency	Binary	Minimum meal frequency defined as: • two times for breastfed infants 6–8 months • three times for breastfed children 9–23 months • 4 times for non-breastfed children 6–23 months
Vitamin A in last six months	Binary	This was assessed by a single "yes/no" question indicating whether the child had received a vitamin A supplement in the six months preceding the survey. This information was collected for children 6–59 months of age.
Deworming in the last six months.	Binary	A single "yes/no" question that indicated whether the child had received deworming medication in the six months preceding the survey assessed drugs for intestinal parasites.
Improved source of drinking water	Binary	This variable is defined using WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation's definition for improved sources of drinking water, which include: • Piped water into dwelling • Piped water to yard/plot • Public tab or standpipe • Tube well or borehole • Protected dug well • Protected spring • Rainwater
Improved sanitation	Binary	This variable is defined using WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation's definition for improved sanitation, which include: • Flush toilet • Piped sewer system • Septic tank • Flush/pour flush to pit latrine • Ventilated improved pit latrine • Pit latrine with slab • Composting toilet

Sources: Statistics Sierra Leone and ICF Macro 2009; SLMN 2013; Statistics Sierra Leone and ICF International 2014.

Appendix V

This Appendix presents the results of regression of anemia on independent socioeconomic and anemia prevention and control program coverage predictors, separately for children under five years and WRA, using data from the 2013 SLDHS. Tables Va and Table Vb show logistic regression results (presented as odds ratios) anemia risk factors in children under five years and in WRA, respectively. These results should be interpreted with a number of caveats. First, SLDHS does not contain an exhaustive list of all of the potential risk factors for anemia (for example, iron deficiency, helminth infections, malaria). Second, these results should not be interpreted as proof of causation because they are based on cross-sectional data. Third, we are unable to calculate the relative contribution of most of the risk factors because there is no national level data on the majority of the factors that lead to anemia and the factors are not independent from each other. In particular, while SLDHS data is rich in certain indicators of socioeconomic status and health indicators, it does not have data on micronutrient deficiencies and helminth infections. With these caveats in mind, the regressions nevertheless provide further insight into which populations may be particularly vulnerable to anemia and may benefit from further targeting.

Table Va. Odds Ratios of Risk Factors for Any Anemia (Hb <11.0g/dL) of Children under Five Years, SLDHS2013 (N=3,609)

Variable	Odds ratio
Household Characteristics	
Region (reference: Western)	
Eastern	1.008
Northern	1.340
Southern	.902
Urban Residence	.783
Religion of Household Head (reference: Muslim)	
Christian	.978
Wealth Quintile (reference: Poorest)	
Second	1.051
Middle	1.205
Fourth	1.006
Richest	.772
Improved Drinking Water/Appropriate Treatment	.944
Unshared, Improved Latrine	.996
Child Characteristics	
Age Group (Reference: 6–12 months)	
12–23 months	.890
24–35 months	.680*
36–47 months	.655*
48–59 months	.625*

Variable	Odds ratio
Male	1.091
Mother's Education Level (Reference: None)	
Primary	1.034
Middle/JSS	.884
Secondary or higher	.521
Slept under Bed Net	1.092
Has Any Health Insurance	1.708
Diarrhea in Past two Weeks	1.084
Fever in Past two Weeks	1.224
Stunted	1.451***

**P-value <0.05; ***P-value =<0.001.*

Table Vb. Odds Ratios of Risk Factors for Any Anemia (Hb <11.0g/dL) of WRA, SLDHS2013 (N=7760)

Variable	Odds ratio
Household Characteristics	
District (Reference: Western)	
Eastern	1.485*
Northern	1.772***
Southern	1.742**
Urban Residence	.862
Religion of Household Head (Reference: Muslim)	
Christian	.770***
Wealth Quintile (Reference: Poorest)	
Second	.911
Middle	.904
Fourth	.915
Richest	.903
Improved Drinking Water/Appropriate Treatment	1.047
Unshared, Improved Latrine	.944
Individual Characteristics	
Age Group (Reference: 15–19)	
20–24	.726***
25–29	.702**
30–34	.628***

Variable	Odds ratio
35–39	.640**
40–44	.569***
45–49	.638**
Currently Pregnant	1.473***
Currently Breastfeeding	1.129
Education Level (Reference: None)	
Primary	.973
Middle/JSS	.848
Secondary or higher	.668
Parity (Reference: No Children)	
1–2 children	1.156
3–4 children	.999
5 or more children	1.124
BMI (Reference: Normal)	
Underweight	1.194
Overweight or Obese	1.047
Slept under Bed Net	.951
Covered by Health Insurance	1.087

**P-value <0.05; **P-value <0.01; ***P-value =<0.001*

Appendix VI

This Appendix presents the results of the systematic review of anemia prevalence and anemia control programs in Sierra Leone

Prevalence of Malaria in Sierra Leone (Regional Studies)

Author Year	Region	Design	Age	Male (%)	N	Findings (values reported in %, unless indicated otherwise)
Gerstl 2010	Médecins Sans Frontières (MSF) facilities in Bo and Pujehun districts in southeast Sierra Leone	Cross-sectional	All ages	no data	417576 consultations	Malaria prevalence - 43.5 (181711 confirmed malaria cases among 417576 consultations in 2008)
Burns 2012	Largo and Towanda refugee camps situated in southeast Sierra Leone	Baseline of an RCT on impact of insecticide-treated polyethylene sheeting on malaria incidence in young children in an area of intense transmission	Children 4–36 months of age	37.5	1666	Overall parasite prevalence - 49.5 (Largo - 54; Towanda - 45)
Ansumana 2013	Kulanda Town and Njai Town sections (neighborhoods) of the city of Bo	Cross-sectional	All ages	no data	5410	Self-reported malaria - 16.8, lab diagnosis of malaria- 6.9
Knoblauch 2014; Winkler 2014	Northern region of Sierra Leone in Bombali and Tonkolili districts, west of Makeni town	Cross-sectional baseline at 2010/ three year follow-up in 2013 after the Addax Bioenergy Sierra Leone project	Children aged 6–59 months;	no data	604	*Plasmodium falciparum* prevalence (2010/2013): 73.8/62.5.
Roth 2015	Lassa Ward of a government hospital in Kenema District of the Eastern province	Hospital-based retrospective chart review	Adult male and female patients	62.9	429	Malaria prevalence (based on discharge diagnosis) - 27.3

Prevalence of Helminthic Infection in Sierra Leone (Regional Studies)

Author Year	Region	Design	Age	Male (%)	N	Findings (values reported in %, unless indicated otherwise)
Gbakima 2007 *	5 Internally Displaced Persons (IDPs) camps in Sierra Leone	Cross-sectional	Adult and children - 178 children < 10 yrs of age	no data	581	Prevalence: Hookworm: 18, *S. mansoni:* 16.7, *A. lumbricoides*: 15, hookworm highest at Parade Ground Camp (50)
Koroma 2010	National survey	Cross-sectional	Children aged 5-16 years of age	50.6	5069	Prevalence of any STH: 39.1, *S. mansoni*: 18.4, hookworm 32.5; *A. lumbricoides*: 7.2, *T. trichura*: 3.3
Hodges 2011	Bo, Bombali, Kenema, Koinadugu, Kailahun, Kono and Tonkolili districts	Cross-sectional of prevalence and intensity	Children aged 9-14 years	51.4	1760	Prevalence of any STH: 33: *S. mansoni*: 40.2, hookworm: 31.2, *A. lumbricoides*: 1.5, *T. trichura:* 2.5
Hodges 2012a BMC	6 districts - Bo (Southern Province), Kailahun, Kenema and Kono (Eastern Province), Tonkolili and Koinadugu (Northern Province).	Sentinel surveillance from 15 schools six months after school-based mass drug administration (MDA) with praziquantel	Children aged 9-14 years	50.8	515	Prevalence fell pre-MDA to post-MDA for *S. mansoni* from 69.0 to 38.2, hookworm: 41.7 to 14.5, *A. lumbricoides* and *T. trichiura* were both very low (<10%).
Hodges 2012b Acta	Phase 1 - Bo, Kailahun, Kenema, Koinadugu, Kono and Tonkolili districts; Phase 2 - 30 sentinel sites from all over the country; Phase 3 - 14 sites from hard-to-reach (HTR) villages	Three cross-sectional studies, as part of routine surveillance Phase 1, November 2009 – pre 7th round of MDA in 17 sentinel sites. Phase 2, November 2010 – pre 9th round of MDA in 30 selected sites Phase 3, February	Children 4-5 years old	48.9	1803	Prevalence of *S. mansoni*: 11.2 Phase 1, pre-MDA 2009, prevalence of any STH: 9.3, *A. lumbricoides*: 0.2, *T. trichiura*: 0.9 and hookworm: 8.4 Phase 2, pre-MDA 2009 prevalence of any STH: 24.9, *A. lumbricoides*: 6.3, *T. trichiura*: 2.6 and hookworm: 16.5 Phase 3, prevalence of any STH: 39.3, *A. lumbricoides*: 17.2, *T. trichiura*: 1.3 and hookworm:

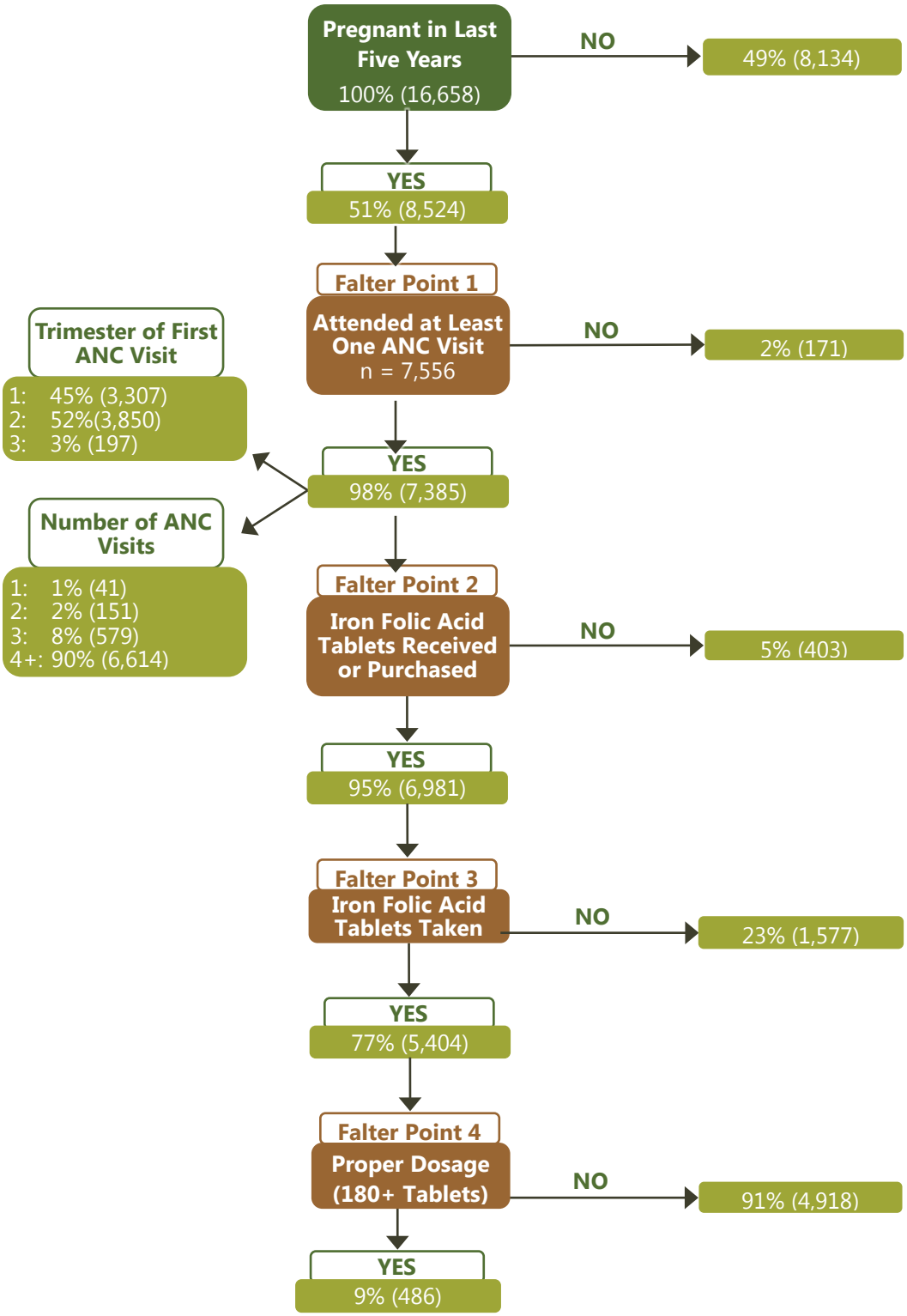
Author Year	Region	Design	Age	Male (%)	N	Findings (values reported in %, unless indicated otherwise)
		2011 – two months post 9th round of MDA, targeting 14 hard-to-reach (HTR) villages.				22.8
Hodges 2012c PLoS	National survey	Cross-sectional	Children aged 9-14 years	53.8	2293	Prevalence of *S. heamatobium*: 2 (moderate prevalence in Bo: 24.6, Koinadugu: 20.4 and Kono: 25.3 districts).
Knoblauch 2014; Winkler 2014	Northern region of Sierra Leone in Bombali and Tonkolili districts, west of Makeni town	Cross-sectional baseline at 2010 and a 3 year follow-up, 2013 after the Addax Bioenergy Sierra Leone (ABSL) project	School-going children aged 10-15 years;	no data	241	Prevalence (2010/13) hookworm: 23.9/28.7, *A. lumbricoides*: 1.1/11.1, *S. mansoni*: 1.7/3.9, *T. trichiura*: 2.2/1.1
Sesay 2014	26 sentinel sites in seven moderately-highly-endemic districts: Kailahun, Kono, Koinadugu, Kenema, Bo, and the northeastern chiefdoms of Tonkolili and Bombali	Cross-sectional	Children aged 10-14 years	49.9	1286	Prevalence of *S. mansoni* infection 16.3, a 67.2 reduction from baseline: 49.7

Appendix VII

SPRING developed a method for making a rapid, initial assessment of the strengths and weaknesses of the distribution and consumption of IFA supplements to pregnant women through ANC programs, based on secondary analysis of DHS data. It identifies four sequential points at which IFA supplementation programs commonly falter: (1) ANC attendance and coverage; (2) receipt of at least one IFA tablet; (3) consumption of one or more IFA tablets; and (4) the consumption of the ideal minimum of 180 IFA tablets. Using this method, an analysis from the 2013 SLDHS indicates that although most women received at least some IFA during pregnancy, the proportion consuming adequate amounts was much lower. Figure VII displays the potential falter points in the ANC system that could lead to inadequate intake.

From the analysis, it is evident that ANC attendance is very high and that a substantive proportion of pregnant women begin ANC early, compared to other DHS countries: 45 percent of women start ANC in the first trimester, and the large majority attend four or more visits. Thus, the ANC platform has significant potential for reaching most pregnant women with IFA, and indeed, 95 percent of women who attended at least one visit received IFA at one point. The biggest falter point appears to be the consumption of adequate number of IFA tablets—91 percent of women who attended ANC and consumed at least one tablet did not consume IFA for the WHO recommendation of 180 days or more. It is unclear from this analysis whether supply or failure to adhere is a major factor. A renewed focus on *adequate* IFA consumption in pregnancy is recommended, along with further investigation into its influencing factors. The second biggest falter point also deserves mention: 23 percent of women who attended ANC and received or purchased IFA tablets did not consume any. In this case, failure to adhere is the problem and should receive particular focus in IFA interventions.

Figure VII. Analysis of falter points related to the distribution and consumption of IFA during pregnancy, 2013



Source: SSL, MHS, and ICF International 2014

SPRING

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