Landscape Analysis of Anemia and Anemia Programming in Northern Ghana

JUNE 2023

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Recommended Citation

USAID Advancing Nutrition. 2023. *Landscape Analysis of Anemia and Anemia Programming in Northern Ghana.* Arlington, VA: USAID Advancing Nutrition.

Photo Credit: This woman carries okra from her fields near Tamale, Ghana. (courtesy of USAID Ghana)

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Acknowledgements

USAID Advancing Nutrition acknowledges Denish Moorthy, Senior Technical Advisor, USAID Advancing Nutrition and member of the USAID Advancing Nutrition Anemia Task Force, and Prof. Abdulai Abubakar of the School of Public Health, Department of Global and International Health, of the University for Development Studies in Tamale, who led the landscape analysis and put together this report. We acknowledge our Senior Technical Advisor, Sascha Lamstein, for providing technical backstopping from conception of the study to the writing of the report.

The project also duly acknowledges the following for their various contributions in the planning and conduct of the landscape analysis:

- Erin Milner, Bureau for Global Health, USAID Washington
- Maureen Malave, USAID Ghana
- Lutuf Abdul-Rahman, USAID Ghana
- Abdul-Kahad Amadu, USAID Ghana
- Omar Dary, Bureau for Global Health, USAID Washington,
- Selorme Kofi Azumah, USAID Advancing Nutrition Ghana
- Alhassan Issahaku, USAID Advancing Nutrition Ghana
- Mohammed Nurudeen Salifu, USAID Advancing Nutrition Ghana

Finally, the project acknowledges the immense support of regional and district health officials in the Northern, Upper East, Upper West, and North East regions, who facilitated access to various resources and data and shared expert views, leading to the compilation of this report.

Acronyms

ACT	artemisinin-based combination therapy
AGP	alpha-1-acid glycoprotein
ANC	antenatal care
ASBC	USAID Accelerating Social and Behavior Change
CHPS	Community Health Planning and Services
CRP	C-reactive protein
DHIMS-II	District Health Information Management System
DHS	Demographic and Health Survey
FP	family planning
GBD	Global Burden of Disease
GHS	Ghana Health Service
GSS	Ghana Statistical Service
Hb	hemoglobin
HIV	human immunodeficiency virus
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
MICS	Multiple Indicator Cluster Survey
MNS	Micronutrient Survey
MOH	Ministry of Health
NMCP	National Malaria Control Programme
OPD	outpatient department
PW	pregnant women
RBC	red blood cell
RDT	rapid diagnostic test
UNICEF	United Nations Children's Fund
USAID	U.S. Agency for International Development
WASH	water, sanitation, and hygiene
WHO	World Health Organization
WRA	women of reproductive age

Executive Summary

Introduction

The prevalence and burden of anemia disproportionately affect young children under five, pregnant women (PW), and women of reproductive age (WRA). Anemia in pregnancy increases the risk of preterm delivery, low birthweight, and maternal and child mortality. The iron deficiency, which is a main cause of anemia, reduces the cognitive and physical development of children, causes fatigue, and reduces the physical stamina and productivity of people of all ages (Balarajan et al. 2011). The purpose of this landscape analysis was to better understand the status of anemia, likely causes of anemia, and current anemia programming in the four regions of northern Ghana (Northern, Upper East, Upper West, and North East regions). These regions are often referred to as the Northern Belt. Based on those findings, we were asked to suggest appropriate interventions to prevent and address anemia in these regions.

Methods

We used a mix of quantitative and qualitative methods. We conducted a desk review of existing reports, surveys, and data, including the Strengthening Partnerships, Results, and Innovations in Nutrition Globally (SPRING) project's 2016 report *Landscape Analysis of Anemia and Anemia Programming* (SPRING 2016), the 2017 Ghana Micronutrient Survey (MNS), the 2019 Malaria Indicator Survey (MIS), and the District Health Information Managements System (DHIMS-II). In addition, we reviewed the latest reports and policies on anemia programs and health sector capabilities from the Ministry of Health (MOH) and the Ghana Health Services (GHS). We supplemented our desk review with key informant interviews.

We explored the prevalence of anemia; prevalence of primary risk factors of anemia and coverage of interventions to address them; coverage of interventions that indirectly address anemia; and health sector capacity, which includes presence of relevant policies, availability of relevant commodities; availability of adequate and consistent funding; and availability of training opportunities and supportive supervision for health workers.

As indicated above, the geographic focus of this landscape analysis is on four regions in the north of Ghana—Northern, North East, Upper East, and Upper West. This is commonly referred to as the Northern Belt. It is important to note that the North East region was carved out of the Northern region in 2018 (Akweiteh Allotey 2018). Therefore, data collected before that time, namely the 2014 Ghana Demographic and Health Survey (DHS) and the 2017 Ghana Micronutrient Survey (MNS), present information for just three regions—Northern, Upper East, and Upper West. For our analysis and prioritization purposes we present data from the DHS and MNS for the former Northern region for both the Northern and North East regions. Fortunately, we were able to collect data from the DHIMS-II and conduct interviews with key stakeholders from what are now two distinct regions.

After collecting and collating the information, we mapped our findings, juxtaposing anemia and its causes against their corresponding interventions to visually inspect if program actions were matching the causes of anemia.

Findings

Anemia Prevalence

The national anemia prevalence among children under five years of age was 35.6 percent, 21.7 percent among WRA, and 42 percent among PW (University of Ghana et al. 2017). In the Northern Belt, 53.2

percent of children under five, 27.6 percent of WRA, and 43.5 percent of PW were found to be anemic (University of Ghana et al. 2017).

Prevalence of the Primary Causes of Anemia

The national prevalence of malaria by rapid diagnostic test (RDT) and microscopy was 23 and 14.1 percent, respectively (2019 MIS). The corresponding prevalence in the Northern, Upper East, and Upper West regions was 18.7 and 13 percent, 30.6 and 9.8 percent, 22.6 and 10.5 percent, respectively (Ghana Statistical Service [GSS] and ICF 2020).

Studies from the four northern regions report a prevalence of helminthic infection ranging from 0.7 percent to 74 percent among school-aged children 5–16 years, children aged 2–15 years, PW, and the general population 1–77 years of age (Dassah et al. 2022; Fuseini et al. 2010; de Gruijter et al. 2005; Akosah-Brempong et al. 2021; Tibambuya, Ganle, and Ibrahim 2019; Bogoch et al. 2012). Relatedly, nearly half of children under five (46 percent) nationally demonstrated infection or inflammation. We were unable to identify data for WRA or PW or from northern Ghana (University of Ghana et al. 2017).

Deficiencies in micronutrients, particularly iron, but also vitamin A, riboflavin, folate, and vitamin B12, can also cause anemia. Vitamin A deficiency is a public health problem in all the regions of northern Ghana. Folate deficiency is widespread nationally as well as in northern Ghana, although vitamin B12 deficiency is more prevalent than folate deficiency in that region.

The 2017 MNS reported higher prevalence of iron deficiency (ID) and iron-deficient anemia (IDA) in children under five (39.6 and 29 percent, respectively) and WRA (21.5 and 15.4 percent, respectively) in all the regions of northern Ghana when compared to the national average for children under five (21.5 percent and 12.2 percent, respectively) and WRA (14 percent and 9 percent, respectively) (University of Ghana et al. 2017). Given the high levels of infection and inflammation in the country, iron deficiency is likely a result of both functional deficiency resulting from infection or inflammation which prevents absorption and absolute iron deficiency result from inadequate intake of iron supplements and/or iron-rich foods and storage of iron. Between 34 and 56 percent of the anemia in Ghana is due to iron deficiency, including both functional deficiency resulting from infection or inflammation and reduced iron intake and storage (i.e., absolute iron deficiency). Half of the anemia or more is due to other causes.

Finally, there are several genetic disorders that affect the Hb concentration and can result in anemia. Sickle cell disease and homozygote α-thalassemia both result in severe anemia. Sickle cell trait—while resulting in mild anemia—offers protection against malaria. Although less severe than homozygous α-thalassemia, heterozygous α-thalassemia can also cause low Hb concentrations. The 2017 MNS reported the prevalence of sickle cell trait in children under five and α-thalassemia (both homozygous and heterozygous) in the Northern (7.2 and 37.5 percent, respectively), Upper East (6.4 and 20.1 percent, respectively), and Upper West (12.2 and 30.7 percent, respectively) regions. In the Northern Belt, 7.2 and 31.6 percent of WRA had the sickle cell trait or α-thalassemia, respectively (University of Ghana et al. 2017). These figures are higher than the national averages.

Coverage of Anemia Prevention and Control Interventions

Strategies to prevent and control anemia include testing for and diagnosis of anemia as well as interventions that directly and indirectly affect the causes of anemia: malaria prevention and control, prevention and control of helminth infections, micronutrient supplementation and fortification, delayed cord clamping, family planning (FP) services, counseling on relevant individual and household practices, and screening for and counseling on genetic disorders.

With regard to testing for and diagnosis of anemia, our key informants reported that anemia diagnosis at the CHPS is done by identifying clinical signs (pallor) or by the use of hemoglobin color strips (Whitehead et al. 2019b). Both methods have been recognized as having poor sensitivity and specificity, and results need to be confirmed using blood sampling and measurement in a hemoglobinometer and/or hematology auto analyzer (Karakochuk et al. 2019). Furthermore, CHPS personnel report frequent shortages of hemoglobin color strips.

Regarding malaria prevention and control measures, we found that only about half of WRA in the Northern (49.5 percent), Upper East (56.1 percent), and Upper West (44.9 percent) regions reported having seen or heard a malaria message in the past 6 months (GSS and ICF 2020). According to the 2014 DHS, the prevalence of households owning an ITN or receiving IRS was 68 percent; the percentage of children and PW who had slept under a bednet the previous night or in a household receiving IRS was 54 percent for children and 50 percent for PW; and the percentage of women receiving two or more doses of an antimalarial was 68 percent (GSS, Ghana Health Service [GHS], and ICF International 2015).

Related to the prevention and control of helminth infections, at the national level, a little over a third (37.3 percent) of children 24–59 months of age received deworming medication in the 6 months preceding the survey (University of Ghana et al. 2017). Among children 6–59 months of age rates are similar in the Upper East region (34.6 percent), but much lower in the Northern and Upper West regions (13.5 percent and 13.3 percent, respectively) (GSS and ICF 2020).

Water, sanitation, and hygiene (WASH) services are also important for the prevention of infection. While the percentage of households with an improved source of drinking water is high in most of the regions, it is only 77.6 percent in the Northern region. The percentage of households with basic drinking water service is significantly lower in northern Ghana compared to the national average (84 percent)—66.2 percent in the Northern region, 44.3 percent in the Upper East region, and 76.9 percent in the Upper West region (GSS and ICF 2020).

The percentage of households with an improved source of drinking water was lower in the Northern region (77.6 percent) versus the Upper East and Upper West regions (91.8 and 98.4 percent, respectively) (GSS and ICF 2020). The percentage of households with an improved sanitation facility was low in all three regions—38.3 percent in the Northern region, 27.6 percent in the Upper East region, and 33.2 percent in the Upper West region—with the percentage of households practicing open defecation being 48.1, 69.9, and 43.9 percent in the Northern, Upper East, and Upper West regions, respectively (GSS and ICF 2020).

With regard to micronutrient supplementation and fortification, we found that intake of supplements is low in Ghana with the exception of iron-folic acid (IFA) by pregnant women. According to the 2017 MNS, 68.2 percent of PW reported having taken IFA supplements for more than 3 months during their most recent pregnancy (University of Ghana et al. 2017). Regional disaggregated data from the DHIMS-II suggest that rates are significantly lower in northern Ghana. However, it is worth noting that the percentage of women who attended at least four antenatal care (ANC) visits was 92 percent in the Northern region, 76 percent in the Upper East region, 75 percent in the Upper West region, and 58 percent in the North East region (MOH 2022). However, nearly three quarters (74 percent) of the households in the Northern region, less than half (43 percent) of those in the Upper East region, and only 17 percent of those in the Upper West region reported using vegetable oil, which is fortified with vitamin A in Ghana (University of Ghana et al. 2017).

Efforts have been made to train traditional birth attendants on delayed cord clamping; however, according to the *Health Sector Annual Programme of Work—2021 Holistic Assessment Report*, the percentage of mothers who received skilled delivery services in the North East is 71.9 percent. The percentages for Northern, Upper East, and Upper West regions are slightly higher—75.8, 81.8, and 76.7 percent, respectively (MOH 2022).

We were unable to find data on the provision of FP services. To our knowledge there is no national effort to screen for or counsel on genetic disorders.

Counseling on and promotion of individual and household practices is important for the prevention and control of anemia. Counseling can be provided independently and during other routine FP, ANC, and child health services (e.g., well- and sick-child visits, growth monitoring and promotion (GMP) sessions). In terms of care practices, we only found national estimates on handwashing practices. Only 15.9 percent of handwashing was done at a sink or a fixed basin; most often, handwashing was done at a site around dwelling (63.7 percent) (University of Ghana et al. 2017). Most households (85.9 percent) had either soap or detergent available at the site of handwashing (University of Ghana et al. 2017).

Breastfeeding can prevent infection as well as micronutrient deficiencies. Breastfeeding practices are relatively high, though there is room for improvement—69 percent of mothers in the Northern Belt reported initiating breastfeeding in the first hour after the child's birth, 99 percent reported continued breastfeeding of children 12–15 months of age are still breastfed, and 95 percent reported feeding children 6–8 months of age complementary foods the day before the survey. However, only 53 percent of children 6-23 months of age were fed the minimum meal frequency and only 25 percent were fed a sufficiently diverse diet (University of Ghana et al. 2017).

Finally, delaying and spacing pregnancies is another way to prevent anemia. FP acceptance rate is lower in the North East (21.6 percent) and Northern regions (28 percent) compared to the national average of 33.8 percent (MOH 2022). The rates are higher than the national average in the Upper East (35.8 percent) and Upper West (46 percent) (MOH 2022). This is consistent with findings from the 2014 DHS, which found that, nationally, the percentage of married WRA who reported using a method of contraception was 26.7 percent. According to the DHS, rates were similar in the Upper East (23.7 percent) and Upper West (25.2 percent) regions, but significantly lower in the Northern region (11.2 percent) (GSS, GHS, and ICF International 2015).

Factors Affecting Anemia Prevention and Control

We also assessed several factors that can affect anemia prevention and control efforts: the policy environment, information systems, commodities and supply chain logistics, financial resources, and human resources. Ghana has a number of relevant policies in place that directly and indirectly support anemia prevention and control. Adherence to these policies, however, is contingent upon a number of other factors. District-level officials interviewed felt good about the quality of data on health facility services that are collected and reported by the DHIMS-II. However, several key indicators are not included in the DHIMS-II—helminth prevalence in WRA and PW, micronutrient deficiencies in PW, and delayed cord clamping. However, they reported that stock-outs of relevant supplies are common and laboratories are poorly equipped to diagnose anemia. Finally, while trainings have been conducted on anemia prevention and control, opportunities for on-the-job training through supportive supervision and learning during review meetings are limited due to funding constraints.

Non-governmental Programs and Services

There are several relevant projects that have been or are currently being implemented in the region. USAID Advancing Nutrition is USAID's flagship multi-sectoral nutrition project, which seeks to improve the nutritional status and health of vulnerable populations around the globe. In Ghana, the project works in the four regions in northern Ghana that have been prioritized for this landscape analysis. The project is addressing several of the secondary determinants and drivers of anemia by working to improve the quality and reach of nutrition services. The project has supported the four Regional Health Directorates of the Ghana Health Service to train 34 master trainers from the 17 program districts on IYCF, Anemia Prevention and Control (APC), and Community-Based Management of Acute Malnutrition (CMAM). The 34 master trainers cascade these trainings to frontline health workers across the 17 districts in the four regions of north Ghana. In addition, the project has supported community-level social and behavior change activities, including but not limited to cooking demonstrations, community durbars, and video screenings, and is working to strengthen community structures including mother-to-mother support groups (MtMSGs) and village savings and loans associations (VSLAs).

The USAID Accelerating Social and Behavior Change (ASBC) project supports the GHS Health Promotion Division (HPD) in accelerating the adoption of key lifesaving health behaviors among WRA, newborns, youth and children under five. The project uses mass media and community engagement to reach the population with its messages. Anemia, as a topic, will be addressed through ASBC's interventions once it is prioritized by communities, who are being reached through ongoing community engagement activities and action plans. In the Nadowli Kaleo district of the Upper West region, the Japan International Cooperation Agency (JICA) has supported three health centers and three hospitals to construct laboratories, which has helped in improving their capacity to diagnose anemia. World Vision Ghana, through their 1000 Days of life project, is promoting the cultivation and consumption of micronutrient rich fruits and vegetable to enhance nutrition during pregnancy and the first two years of life.

Conclusions

The national prevalence of anemia in children (36 percent) and WRA (22 percent) indicate that anemia is a moderate public health problem; in contrast, it is a severe problem among PW (45 percent). The prevalence for the four northern regions combined indicate that that anemia is a severe public health problem for children under five and PW, and a moderate public health problem for WRA.

The main causes of anemia in children under five appear to be due to general inflammation, iron deficiency, and presence of α-thalassemia. Among WRA, the main causes appear to be general inflammation, iron and folate deficiency, and presence of α-thalassemia. Among PW, we do not have high quality data on different causes but assuming that the causes in WRA would persist in pregnancy implies that the main causes are general inflammation, iron and folate deficiency, and presence of α-thalassemia.

The primary interventions to address inflammation include helminth prevention and control, water supply and sanitation services, and counseling on individual and household WASH practices. When we assessed WASH efforts in the region, it appeared that there are adequate sources of improved water supply and the main challenges remain in improved sanitation facilities (which has a fair coverage) and efforts to make the districts open defecation-free.

Interventions to address iron and folate deficiencies include distribution of iron supplements to children and IFA supplements to PW and WRA, including adolescent girls, as well as counseling to promote or encourage delayed cord clamping, the intake of supplements, and the consumption of fortified and biofortified foods. The ANC and IYCF programs are working well in the region, providing a strong platform for delivery of services and information to PW and children under five. However, funding shortages has resulted in frequent stock-out of commodities such as IFA supplements and outreach services.

Recommendations

Based on our review of existing data on anemia prevalence and its causes, the coverage of interventions for the prevention and control of anemia, and insights from key informants interviewed at the district and regional level, we have the following recommendations:

1. **Pay more attention to the implementation of interventions for children under five:** With high prevalence of anemia and lagging indicators on intervention, children under five should be prioritized first, followed by interventions for PW and WRA. The burden of disease is higher in children under five and the interventions for that age group have lower coverage.

2. **Focus on population-specific causes of anemia:** The causes of anemia do not vary significantly between the various regions. However, among children, it would be appropriate to focus efforts on the reduction of iron deficiency and inflammation and mitigating effects of α-thalassemia on anemia. Among WRA and PW, the focus should be on iron and folate supplementation and fortification, reduction of inflammation, and mitigating impact of α-thalassemia on anemia.
3. **Prioritize Northern and North East regions before the Upper West and Upper East regions:** All the regions of northern Ghana show a higher anemia prevalence as compared to the national average. However, based on district-level DHIMS-II data, we advise that the Northern and North East regions are prioritized before the Upper West and Upper East regions.
4. **Prioritize interventions** to address the high prevalence of general inflammation such as the provision of water and sanitation services; promotion of hygiene practices; malaria case finding and treatment; distribution of ITNs, IRS, and IPTp; and deworming. An emphasis should be placed on reducing open defecation and promoting open defecation–free communities while continuing to maintain access to improved water sources. Revisit prioritization of interventions by monitoring of process and impact indications from surveys and DHIMS-II.
5. **Continue and address challenges with existing interventions** such as the distribution of supplements (Iron and Vitamin A in children, IFA in PW, weekly IFA in WRA), promotion of healthy dietary practices, and mass fortification of flour and oil. In particular, there needs to be a renewed focus on IFA supplementation among PW and WRA and iron supplementation in children under five as well as further investigation into factors related to consumption. While ANC services are generally strong in all regions, the facilities should ensure that PW receive the full package of preventive anemia services. Intermittent IFA supplementation for all WRA is another key strategy to increase the iron stores in women who may become pregnant. While Vitamin A deficiency is low, the coverage of vitamin A supplementation is also low in the four regions. Encourage caretakers of children under five to bring their children biannually to the local facility to receive their vitamin A supplement, which has contributed to low rates of vitamin A deficiency in children, alongside, fortification of cooking oil with vitamin A.
6. **Use a variety of platforms** such as ANC, child health days, and outreach programs to promote healthy dietary practices. Iron, vitamin A, folate, and vitamin B12 deficiency remain major nutritional contributors to anemia in children, WRA, and PW. GHS can promote their 4-star diet and the consumption of local food products rich in vitamin A, iron, and folate. The Agriculture Department could assess the feasibility of using biofortified foods like vitamin A–rich orange-fleshed sweet potato.
7. **Conduct training in supply chain management:** Our key informants repeatedly brought up the role of unavailable drugs and commodities for programming, either as a result of insufficient planning or due to non-availability of the commodities from the regional and national health directorates. While the latter is outside the purview of CHPS or district health workers, the former can be instituted as a process within regular procurement mechanisms within the GHS. This can be done as a training course in supply chain management, introducing health workers to principles of demand planning, forecasting, and timely requisition of commodities and drugs. National or regional shortage of commodities may also play a role in disruption of services to the population.
8. **Strengthen information systems to meet needs:** The GHS uses the following indicators for monitoring anemia programs: hemoglobin concentration in children and PW, IFA and vitamin A intake, and use of RDTs, microscopy, and antimalarials. However, the metrics and the

denominators used to describe these risk factors and interventions vary, from all facility attendees to those who were tested. These differences do not allow for calculation of comparable prevalence. Data from different sectors can be repurposed to monitor anemia burden and program coverage. Additionally, data altogether lacking on the prevalence of helminth infestation in WRA and PW, micronutrient status in PW, delayed cord clamping, and genetic disorders.

9. **Continue to strengthen governance and coordination:** The flow of information between the regional and district health personnel remains strong. This could be expanded to an interregional level, with review meetings between the leaders of the four regions, if that is not already being done. However, there are tradeoffs to allocation of resources from the government. IF there is a choice to be made to spend public resources on these sharing meetings or program implementation, there should be steps taken to ensure that program funding is protected and external sources of funds should be sought to facilitate these meetings.
10. **Leverage donor funding:** Donor-driven programming can be implemented within the structure of government policies and priorities. The GHS and other agencies of the Government of Ghana can engage donor support by identifying their preferred priorities that could use the aid of donors.
11. **Advocate for additional government funding:** With a strong human resource component in the health system of northern Ghana, there is a case to be made to the policymakers at the national level to increase health sector funding for the four regions of northern Ghana to build infrastructure and capacity for anemia and nutrition programs.
12. **Design and conduct a comprehensive national survey:** An assessment of anemia and its causes should ideally come from a single national survey that is representative of the regions and collects data of the prevalence of anemia and its causes—infections, nonspecific inflammation, genetic disorders, and micronutrient deficiencies—to allow for a comprehensive overview of the drivers of anemia in Ghana. Measuring the prevalence of all the causes of anemia in the same survey allows us to ascertain the proportion contribution of various causes to the anemia prevalence, using statistical methods like the population attributable fractions (Yimgang et al. 2021). This would be critical to then prioritizing the interventions to use to reduce anemia in the various subnational areas, targeted to the main cause of anemia in a specified area.

Background

Anemia, or low levels of hemoglobin, remains a persistent public health problem around the world. The prevalence and burden of anemia disproportionately affects children under five, PW, and WRA. Anemia in pregnancy increases the risk of preterm delivery, low birthweight, and maternal and child mortality. Iron deficiency, which is the main cause of anemia, impairs the cognitive and physical development of children, causes fatigue, and reduces the physical stamina and productivity of people of all ages (Balarajan et al. 2011).

Globally, the prevalence of anemia in 2019 was 40 percent, 30 percent, and 36 percent among children aged 6–59 months, non-PW aged 15–49 years, and PW, respectively (Stevens et al. 2022). The prevalence of anemia in children aged 6–59 months exceeded 70 percent in 11 countries and, among all women aged 15–49 years, it exceeded 50 percent in 10 countries (Stevens et al. 2022). Other studies have previously estimated global anemia prevalence between 23 percent (Gardner and Kassebaum 2020) to 33 percent (Kassebaum et al. 2014). Anemia decreases the oxygen carrying capacity of the organism, thus impacting critical aspects of human function and development.

Reducing anemia prevalence has become an enduring target for strategies to improve global health. Historically, goals on the reduction of iron deficiency anemia have been endorsed by Heads of State, ministers in the World Declaration and Plan of Action from the World Summit for Children in 1990 and in the World Declaration and Plan of Action for Nutrition from the International Conference on Nutrition in 1992 (WHO 2001). The World Health Assembly selected as one of its 2012 nutritional targets to reduce the anemia prevalence in women of childbearing age by 50 percent by 2025 (WHO 2014a).

The presumption in many circles is that anemia is synonymous with iron deficiency or that iron deficiency is at least the cause of 50 percent of anemia cases (Lopez et al. 2016). However, recent estimates indicate that anemia due to iron deficiency may perhaps be as low as 25 percent or 37 percent in preschool children and WRA, respectively (Petry et al. 2016). 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 causes of anemia are often classified as non-nutritional (e.g., genetic disorders that affect the Hb concentration, parasitism, malaria and other infection/inflammation factors, and/or blood loss) or nutritional (e.g., due to deficiencies in iron, vitamin A, riboflavin, folate, and/or vitamin B_{12}). In 2010, according to Global Burden of Disease (GBD) study, four of the five highest-ranking causes of anemia were non-nutritional: two hemoglobinopathies (sickle cell disorders and thalassemias), hookworm disease, and malaria. Nevertheless, the GBD continued ranking iron deficiency as the leading cause of anemia, although the causal attribution model did not incorporate iron status data or explain if the deficiency was dietary (low iron intake or low bioavailability) or functional (impaired iron absorption and mobilization because of infection or inflammation). It was estimated by assigning as the residual cause of anemia after other causes had been assigned (Kassebaum et al. 2014). These underlying causes are functionally linked and act synergistically to exacerbate the effects of anemia.

Due to its multifactorial causation, anemia prevention and treatment activities should use a multi-sectoral, integrated approach to identify and address specific causes in given settings and populations. For this landscape analysis, we looked at the following interventions, which can directly or indirectly address the aforementioned causes of anemia:

- malaria prevention and control, including activities related to vector control such as distributing insecticide treated nets (ITNs) or long-lasting insecticide treated nets (LLINs); indoor residual spraying (IRS); controlling larvae; providing intermittent preventive treatment in PW (IPTp); and malaria testing, diagnosis, and treatment

- prevention and control of helminth infections, which typically involves conducting biannual mass administration of antihelminthic medication to children and its preventive use in pregnancy, as well as the increasing the availability of and access to of water supply, sanitation, and hygiene (WASH) such as clean drinking water and improved sanitation facilities
- micronutrient supplementation and fortification, which includes providing IFA supplements to PW and adolescent girls and vitamin A supplementation to children as well as food-based approaches, including national and subnational mass food fortification initiatives and biofortification of foods such as orange-fleshed sweet potato and iron enriched beans
- delayed cord clamping, which is used to increase iron stores in the newborn
- FP services, particularly the provision of contraceptives
- screening for and counseling on genetic disorders
- counseling on individual and household practices for the prevention and control of anemia such as optimal water supply, sanitation, and hygiene (WASH) practices; the use of micronutrient supplements and powders; the intake of fortified and biofortified foods; exclusive breastfeeding; complementary feeding; consumption of a diverse diet; delayed cord clamping; FP; and care-seeking.

Objectives

The aim of this landscape analysis of anemia and anemia programming was to explore the status of anemia in the four regions of northern Ghana (Northern, Upper East, Upper West, and North East) and its likely causes, and to suggest interventions to prevent and address anemia. The specific objectives were to—

1. Describe the burden and the various factors associated with anemia in four regions of northern Ghana (Northern, North East, Upper East, and Upper West), using statistics on anemia and its causes among children under five years of age (children under five), PW, and WRA (15–45 years of age).
2. Describe the program interventions being carried out by various sectors to prevent and control anemia in the northern regions of Ghana, including the key stakeholders; summarize their current performance; describe the strengths and weaknesses of the interventions, with a focus on the policy, environment, coordination between stakeholders, and the existing capacity (technical, logistic, and human resources) of the various institutions.
3. Use the information to develop a list of evidence-based, practical, and actionable interventions to address anemia in women and children in the northern regions of Ghana.

Methods

For this landscape analysis we conducted a desk review of available, recent, and relevant documents and consulted with key informants. Our methods, the data sources, and the process of data analysis are detailed below.

Geographic Scope

As indicated above, the geographic focus of this landscape analysis is on four regions in the north of Ghana—Northern, North East, Upper East, and Upper West. This is commonly referred to as the Northern Belt.

It is important to note that the North East region came into existence in 2018, when it was carved out from Ghana's Northern region (Akweiteh Allotey 2018). Therefore, data collected before that timely, namely DHS and the MNS, present information for just three regions—Northern, Upper East, and Upper West. Reports published after 2020 reports data from the Northern and North East regions separately.

Data Collection

For this analysis we conducted a desk review of published documents, reviewed available data, and interviewed key informants from the four regions.

Desk Review of Literature, Reports, and Administrative Data

The primary source of information for this landscape analysis was our desk review of existing literature, reports, and administrative data.

We reviewed the following reports as indicated below:

- From the 2014 Demographic and Health Surveys (DHS) we collected information on the prevalence of malaria among children age 6–59 months; coverage of programs related to dietary intake, and malaria treatment and prevention among women and children; FP, maternal and child health, and nutrition.
- From the 2017 Ghana Micronutrient Survey (MNS) we collected additional information on anemia prevalence and etiology as well as program coverage data. The MNS reported both national-level data and disaggregated data from the Northern Belt, which was the term that the MNS authors used to refer to the Northern, Upper West, and Upper East regions. The report also provided some information disaggregated by the four regions.
- The 2019 Malaria Indicator Survey (MIS) we collected information on anemia and malaria prevalence in children 6–59 months, malaria prevention and treatment activities for children and PW, and indicators of behavior change communication messages, knowledge, and practices regarding malaria. Data included regional estimates for the Northern, Upper West, and Upper East regions separately.
- We used data from 2020-2022 from the District Health Information Management System (DHIMS-II) to calculate regional- and district-level anemia prevalence among outpatient department (OPD) visits by children 6–59 months of age. In the case of data from PW, the numerator is number of cases of anemia and the denominator is the number of PW in whom hemoglobin was measured, and this is reported at two time points—ANC registration and at or around 36 weeks of pregnancy.

- The 2021 Health Sector Annual Programme of Work, which is referred to as the Holistic Assessment Report, provided us with information on the health workforce and the numbers of various types of health facility visits.

While we could not find population-based coverage information for all districts, we were able to use proxy data that gave us an indication of coverage. For example, in a district with a high rate of first visits for ANC, the percentage of these visits where IFA supplements were provided can serve as a proxy for a population-based coverage estimates.

We also reviewed the latest reports and policies related to anemia, including:

- 2020 revision of the *National Health Policy: Ensuring Healthy Lives for All*
- 2020 edition of Ghana's *Roadmap for Attaining Universal Health Coverage 2020–2030*, revised edition
- 2018 *Child Health Standards and Strategy, 2017–2025*
- 2020 edition of the *Ghana Reproductive, Maternal, Newborn, Child and Adolescent Health and Nutrition (RMNCAH&N) Strategic Plan 2020–2025*

Key Informant Interviews

We supplemented information from surveys and performance reports from the Ministry of Health (MOH) with information provided by key informants at the regional and district levels on the implementation of anemia control programs. We pre-selected key informants from the four regions district and regional offices of the Ghana Health Service (GHS), including officers who handled information related to anemia, nutrition, health information, School Health Education Program, and infectious diseases, as well as officers in other ministerial departments that carried out work related to anemia—Environmental Health (for WASH information), and Ghana Education Service. We also reached out to USAID implementing partners carrying out activities related to anemia in the northern regions. The list of key informants is given in **Annex 1**.

Data Analysis

Information is presented for each of the four regions of northern Ghana (Northern, North East, Upper East, and Upper West). When the only available data came from the 2014 DHS and the MNS, which were conducted before the North East region was carved out of the Northern region, we present data from the Northern region for both the Northern and North East regions. Reports published after 2020 reports data from the Northern and North East regions separately.

Information is disaggregated, when possible and appropriate, for the three population subgroups (children under five, WRA, and PW).

After collecting and collating the information, we carried out a prioritization process to arrive at our recommendations for future implementation in the four regions. We took into consideration the following:

1. Anemia prevalence
2. Prevalence of the primary causes of anemia
3. Coverage of anemia prevention and control interventions

In our prioritization, we visualized the geographical distribution of anemia and overlaid the distribution of the primary causes of anemia over it. We also mapped the coverage of anemia prevention and control interventions specific to the various causes they are designed to address. This gave us a picture of whether the interventions are being appropriately targeted to the main cause of anemia in that region or district.

In regions where we did not have information on one or more domain, we have indicated the absence of information, and suggested the collection of information needed to make an informed choice. However, for the purpose of our prioritization process, we used the data from the region geographically closest (i.e., the 2017 MNS has one estimate of biomarker status for all three northern regions; the same value was applied to the three regions separately) or in the indicator used for measurement (i.e., DHIMS-II data use the attendance at the facility as the denominator, which we used as a proxy for population-level estimates, though we recognize the limited generalizability from facility-level data).

We then evaluated whether the regions or district had the capacity to implement and monitor these interventions. To determine capacity we considered the following systems-related factors that can affect anemia prevention and control efforts:

- the policy environment
- information systems
- commodities and supply chain logistics
- financial resources
- human resources.

We used the colors green, yellow, orange, and red to indicate an increasing order of urgency (green=least urgent, to red=most urgent) in addressing the prevalence of anemia, its causes, the coverage of interventions to reduce anemia, and the systems-related factors that can affect anemia prevention and control efforts.

Findings

Our findings are presented in four sections: 1) Prevalence of Anemia; 2) Prevalence of the Primary Causes of Anemia; 3) Coverage of Anemia Prevention and Control Interventions; and 4) Factors Affecting Anemia Prevention and Control.

Anemia Prevalence

The DHS and MIS present data on anemia prevalence determined using single-drop capillary samples measured on the HemoCue Hb 201+ device. The MNS used both pooled capillary and venous blood measured on the HemoCue Hb 301 device. Data from the DHIMS-II come directly from health facilities. Key informants explained that in health facilities anemia diagnosis is typically based on a clinical examination for pallor and/or hemoglobin test strips, where available. Neither of these methods are reliable, confirmatory methods for diagnosing anemia. In addition, there is a large literature on differences in venous and capillary blood (Karakochuk et al. 2019; Whitehead et al. 2019; Neufeld et al. 2019), which suggests that anemia rates are overestimated when capillary blood is used.

Table 1 lists the data sources for and measures of the prevalence of anemia, and program coverage information, as appropriate, at various levels—national, regional, and district—in the various population groups.

Table 1. Data on Anemia Prevalence

Characteristics	DHS 2014	MNS 2017	DHIMS-II 2022	MIS 2019
Method of measurement of anemia				
Single-drop capillary	√			√
Pooled capillary		√		
Venous blood		√		
Population groups				
Children 6–59 months		√	√	√
Non–pregnant Women 15–49		√	√	
Pregnant Women		√	√	
Geographical focus				
National	√	√		√
Regional	√	√		√
District			√	

Table 2 reports the latest available anemia prevalence in children 6–59 months, PW, and WRA. According to the 2017 MNS (University of Ghana et al. 2017), the national prevalence of anemia in children, defined as hemoglobin < 11 g/dL, was 36 percent and in WRA, which is defined as < 12 g/dL,

was 22 percent. This indicates that anemia is a moderate public health problem. However, it is a severe problem among PW, where 45 percent of pregnant women are anemia (hemoglobin < 11 g/dL).

Data for the Northern Belt was higher: 53.2 percent among children 6-59 months, 27.6 percent among WRA, and 43 percent among PW (University of Ghana et al. 2017). Most anemia was mild or moderate (34.9 and 21.3 percent for children under five and WRA, respectively). The proportion of children with severe anemia (< 7 g/dL) was 0.7, and for women (< 8 g/dL) was 0.4 percent. These data suggest that anemia is a severe public health problem in northern Ghana for children under five and PW, a moderate public health problem for WRA.

According to the 2019 MIS, the prevalence of children under five with hemoglobin < 8 g/dL[1] was 3.6 percent (GSS and ICF 2020). It was 9.6, 1.9, and 3.6 percent for the Northern, Upper East, and Upper West regions, respectively. These data would suggest a significant decline in the prevalence of anemia among children 6-59 months. However, with recent evidence reporting large variations in values obtained using drops of capillary blood, the lower prevalence reported by the MIS compared to the MNS might be due to systematic error of machine and blood collection methods (De la Cruz-Gongora et al. 2022; Whitehead et al. 2017; 2019).

Table 2. Anemia Prevalence in Children 6–59 Months and Non-pregnant WRA in (Percentage) at the National and Regional Levels (MNS 2017)

Characteristics	Children 6–59 Months	WRA	PW
Northern Belt	53.2	27.6	43
National, any anemia	35.6	21.7	42
National, by severity of anemia			
Mild	17.8	14.3	-
Moderate	17.0	7.0	-
Severe	0.7	0.4	-

**Data for North East are unavailable in surveys before 2020 as the North East region was then part of the Northern region. ND, no data.

Although the results are not comparable with the MNS 2017, we have included the estimated anemia prevalence at two points in pregnancy—first at registration with the ANC clinic and at 36 weeks of pregnancy from three years (2020-2022)—based on the DHIMS-II data from each of the four northern regions (**Table 3**). These are simple averages of the districts. They are not weighted averages. They indicate higher values in the Northeast and Northern region at ANC registration and at 36 weeks. The latest district data from 2022 show wide variation in prevalence of anemia in pregnancy, ranging from 31–65 percent at ANC registration to 30–61 percent at 36 weeks. The districts of Gushiegu, Mamprugu-Moagduri, and Karaga, all in the Northern region, report the highest anemia prevalence (in descending order) at ANC registration. The districts of Karaga, Gushiegu, and Nadowli-Kaleo, also all in the Northern region, report the highest anemia prevalence (in descending order) at 36 weeks. In terms of change in anemia prevalence between registration and 36 weeks, the anemia prevalence increased in Karaga (Northern region), Sagnarigu (Upper West region), and Nadowli-Kaleo (North East region). Given hat we know about measurement error in anemia diagnosis (Karakochuk et al. 2019; Whitehead

[1] The 2019 MIS uses a cutoff of 8.0 g/dL in children to classify malaria-related anemia because the effectiveness of malaria prevention and treatment is seen at levels below 8.0 g/dL.

et al. 2019; Neufeld et al. 2019), it is likely that the differences among districts result from differences in the skills of the personnel or performance of each HemoCue machine and not real biological differences that can be used for programmatic decisions. We consider these methodological issues in prioritization.

Table 3. Anemia Prevalence in Pregnancy (Percentage) at ANC Registration and at 36 Weeks from 17 Districts (DHIMS-II 2020–2022)

Districts, by Region	2020		2021		2022	
	At ANC Registration	At 36 weeks	At ANC Registration	At 36 weeks	At ANC Registration	At 36 weeks
Northern*	**47**	**42**	**46**	**43**	**48**	**44**
Gushiegu	61	60	69	64	65	55
Karaga	50	41	43	55	55	61
Nanton	34	36	34	31	35	30
Mion	45	37	51	33	46	34
Sagnarigu	42	50	42	50	42	45
Yendi	48	27	40	24	43	41
North East*	**50**	**41**	**49**	**46**	**55**	**45**
East Mamprusi	53	45	47	53	47	43
Mamprugu-Moagduri	48	37	51	40	63	47
Upper East*	**43**	**46**	**42**	**36**	**45**	**38**
Bawku Municipal	38	47	43	42	48	43
Bawku West	52	61	48	48	50	43
Garu	41	39	38	23	44	36
Tempane	42	36	40	32	38	32
Upper West*	**41**	**41**	**42**	**42**	**45**	**40**
Daffiama-Bussie-Issa	46	47	39	51	37	37
Nadowli-Kaleo	35	41	39	40	49	50
Sissala East	32	37	34	33	31	32
Sissala West	42	45	46	51	51	47
Wa East	49	37	50	35	55	36

* Average anemia prevalence for selected districts in the region.

Prevalence of the Primary Causes of Anemia

In this section we describe the prevalence of the primary causes of anemia (both non-nutritional and nutrition-related): malaria, helminth infection. Most of the recent nutrition-related information comes from the 2017 MNS, which also has data related to key non-nutrition causes of anemia. Malaria-specific information is also reported in the 2019 MIS and in the administrative databases of DHIMS-II from 2020–2022.

Malaria

Analysis of the health services delivery data also shows that malaria remains the number one cause of health facility visits in Ghana between 2017 and 2021 (2017, 20.3 percent; 2018, 23.5 percent; 2019, 23.8 percent; 2020, 20.3 percent; and 2021, 21.0 percent) (MOH 2022). Malaria causes anemia both directly by destroying red blood cells and indirectly by decreasing production of new red blood cells (Mohandas and An 2012). In Ghana, malaria is not only a substantial contributor to anemia, but also a significant public health problem in its own right. According to the GHS, malaria is the top cause of child mortality and morbidity. As with anemia, children under five and PW are at highest risk for malaria.

The 2019 MIS reported the prevalence of malaria in children by two diagnostic methods–RDT and diagnosis by microscopy. Diagnosis by microscopy is confirmatory. The national prevalence of malaria by RDT and microscopy was 23 and 14.1 percent, respectively. The corresponding prevalence by RDT and microscopy in the Northern, Upper East, and Upper West regions was 18.7 and 13 percent, 30.6 and 9.8 percent, 22.6 and 10.5 percent, respectively.

The DHIMS-II includes data related to malaria prevalence (**Table 4**). It must be noted that these are not representative data but a snapshot from reports from laboratories and primary health care facilities. Therefore, the database does not allow for prevalence estimates as the denominator is the total number of OPD visits. According to these data, during the 2020-2022 period, more than half of cases suspected to have malaria were found to have malaria. Using the ratio of malaria-positive cases per 1,000 OPD visits, we can see that children under five represent more cases per visit than PW.

We can also see from the DHIMS-II data that, among the regions, the Northern and North East regions are most affected, followed by Upper West and Upper East. There is considerable variation in the case positivity and in cases per OPD visit within the regions. In 2022, the districts of East Mamprusi (North East region), Wa East (Upper West region) and Mion (Northern region) show the highest malaria positive proportions among suspected cases of malaria in children under five. When we standardize this indicator to note malaria positive in children under 5 per 1,000 OPD visits, the top three are Mion (Northern region), Wa East (Upper West region) and Nanton (Northern region). Similarly, among PW, malaria positive cases per 1,000 OPD visits, report highest prevalence from Mion, Karaga, and Gushegu, all in the Northern region.

Table 4. Malaria Prevalence (per 1,000 OPD visits) among Children under 5 and Pregnant Women (DHIMS-II 2020–2022)

District	2020			2021			2022		
	Malaria positive among suspected cases (%)	Malaria positive in children under 5 per 1,000 OPD visits	Malaria positive in PW per 1,000 OPD visits	Malaria positive among suspected cases (%)	Malaria positive in children under 5 per 1,000 OPD visits	Malaria positive in PW per 1,000 OPD visits	Malaria positive among suspected cases (%)	Malaria positive in children under 5 per 1,000 OPD visits	Malaria positive in PW per 1,000 OPD visits
Northern	**64**	**141**	**34**	**56**	**127**	**35**	**59**	**129**	**34**
Gushiegu	60	121	41	57	116	33	60	108	37
Karaga	65	131	39	52	129	56	56	128	52
Nanton	79	197	30	63	163	31	65	160	27
Mion	74	241	51	60	198	54	68	216	53
Sagnarigu	50	51	10	54	62	7	65	56	5
Yendi	56	106	30	47	94	28	43	106	28
North East	**63**	**105**	**11**	**67**	**120**	**8**	**72**	**123**	**13**
East Mamprusi	44	82	13	60	129	8	76	145	8
Mamprugu-Moagduri	82	127	8	75	112	8	67	101	17
Upper East	**55**	**97**	**16**	**53**	**93**	**16**	**54**	**94**	**16**
Bawku Municipal	55	48	11	61	52	10	66	81	10
Bawku West	57	103	9	49	79	7	45	86	8
Garu	44	90	27	42	90	31	45	84	23
Tempane	65	145	19	62	150	16	61	125	22
Upper West	**59**	**122**	**26**	**54**	**113**	**22**	**58**	**117**	**22**
Daffiama-Bussie-Issa	55	114	27	54	128	32	59	139	24
Nadowli-Kaleo	46	68	15	43	69	25	46	68	30

District	2020			2021			2022		
	Malaria positive among suspected cases (%)	Malaria positive in children under 5 per 1,000 OPD visits	Malaria positive in PW per 1,000 OPD visits	Malaria positive among suspected cases (%)	Malaria positive in children under 5 per 1,000 OPD visits	Malaria positive in PW per 1,000 OPD visits	Malaria positive among suspected cases (%)	Malaria positive in children under 5 per 1,000 OPD visits	Malaria positive in PW per 1,000 OPD visits
Sissala East	56	80	44	49	60	18	51	57	13
Sissala West	62	124	14	59	116	12	64	124	18
Wa East	75	222	28	64	192	25	72	198	26

Helminthic Infections

Hookworm and other worms can lead to anemia by causing gastrointestinal blood loss, poor nutrient absorption, inhibition/suppression of appetite, and general inflammation, all of which can also aggravate iron deficiency and anemia, both in children (Albonjco et al. 1998) and PW (Steketee 2003).

Although there are no national data on prevalence of helminthic infection, we identified six subnational or hospital-based studies that report the prevalence of helminthic infection (**Table 5**). According to these studies helminthic infection ranges from 0.7–74 percent in different age groups (Dassah et al. 2022; Fuseini et al. 2010; de Gruijter et al. 2005; Akosah-Brempong et al. 2021; Tibambuya, Ganle, and Ibrahim 2019; Bogoch et al. 2012). Hookworm infection and schistosomiasis (caused by the schistosome worm) have been reported in all areas, with the exception of Kpalsogu community in Kumbungu district where a massive deworming campaign for children was undertaken (Akosah-Brempong et al. 2021). This information suggests that the population of the Northern Belt is highly affected by parasitism.

Table 5. Subnational and Regional Studies in Northern Ghana That Report Prevalence of Hookworm Infections and Schistosomiasis

Author Year	Region	District or Community	Design	Age	N	Findings (as %, Unless Indicated Otherwise)
Dassah et al. 2022	Upper East	Nakolo in the Kassena-Nankana East district	Cross-sectional study	School-aged children 5–16 years	336	Urinary schistosomiasis = 12.8
Fuseini et al. 2010	Upper East	Kassena-Nankana district	Cross-sectional study	Pregnant women	300	Overall helminths = 23 Soil-borne: Hookworm = 7 Strongyloides Stercoralis = 2.3 Ascaris lumbricoides = 0.7

Author Year	Region	District or Community	Design	Age	N	Findings (as %, Unless Indicated Otherwise)
						Trichostrongylus = 0.7 Water-borne: *Schistosoma mansoni* = 12.3
de Gruijter et al. 2005	Upper East	Bolgatanga and Garu districts	Cross-sectional study	All population 1-65 years	378	Hookworm *Ankylostoma duodenale* = 19.6 *Necator americanus* = 73.5 Both = 16.9
Akosah-Brempong et al. 2021	Northern	Kpalsogu in Kumbugu district	Cross-sectional study	Children aged 2–15 years	120	No schistosomiasis or soil transmitted helminths found in Kpalsogu (due to mass drug administration campaign)
Tibambuya, Ganle, and Ibrahim 2019	Northern	West Gonja district	Cross-sectional study	Pregnant women	433	Helminth infection at ANC initiation = 31.2
Bogoch et al. 2012	Northern	Tolon/Kumbungu district	Cross-sectional study	All population 1-77 years	208	Urinary schistosomiasis = 6.8

Inflammation

Inflammation is measured by elevated levels of two acute phase proteins—C-reactive protein (CRP) and/or alpha-1-acid glycoprotein (AGP). Increased CRP indicates the presence of an infectious agent or inflammation during the incubation period[2]. During early convalescence[3] both CRP and AGP are elevated. During late convalescence only AGP is elevated.

The 2017 MNS measured CRP and AGP in children under five. The survey used CRP > 5 mg/L and AGP > 1 g/L to denote acute and chronic inflammation, respectively. Nationally, 46 percent of children under five had an elevated CRP or AGP with 2.8 percent being in the incubation period, 17.7 percent in early convalescence, and 25.5 percent in late convalescence (University of Ghana et al. 2017). The MNS did not collect data on inflammation among WRA nor does it report regional disaggregation of these indicators.

The MNS 2017 survey also conducted bivariate associations between anemia and malaria (anemia prevalence was 54.7 percent versus 31.2 percent in children with and without malaria), diarrhea, or fever in the past 2 weeks prior to the survey, generalized infection (anemia prevalence of 52.5 percent versus 26.2 percent in children with and without infection), iron deficiency (anemia prevalence of 57.1 percent versus 29.2 percent in children with and without iron deficiency), and Vitamin A deficiency (anemia prevalence of 49.6 percent versus 31.3 percent in children with and without vitamin A deficiency). It also noted that women in early and late convalescence had significantly higher rates of

2 The incubation period is the time between the onset of infection and presence of inflammation.
3 Convalescence, which is often split into the early and late phase, is the period of recovery from the infection and reduction in inflammation.

anemia as compared to women without any increases in inflammatory markers (University of Ghana et al. 2017).

Micronutrient Deficiencies

Deficiencies in micronutrients, particularly iron, but also vitamin A, riboflavin, folate, and vitamin B12, can also cause anemia. The 2017 MNS reported the deficiency of micronutrients in children under five and WRA, as outlined in **Table 6** (University of Ghana et al. 2017). Vitamin A deficiency is a public health problem in all regions of northern Ghana. Folate deficiency was widespread nationally as well as in the four northern regions, although vitamin B12 deficiency was more prevalent in the northern regions of Ghana.

The 2017 MNS reported higher prevalence of iron deficiency (ID) and iron-deficient anemia (IDA) in children under five (39.6 and 29 percent, respectively) and WRA (21.5 and 15.4 percent, respectively) in all the regions of northern Ghana when compared to the national average for children under five (21.5 percent and 12.2 percent, respectively) and WRA (14 percent and 9 percent, respectively) (University of Ghana et al. 2017). Given the high levels of infection and inflammation in the country, iron deficiency is likely a result of both functional deficiency resulting from infection or inflammation which prevents absorption and absolute iron deficiency result from inadequate intake of iron supplements and/or iron-rich foods and storage of iron.

If the results of anemia prevalence presented in Table 2 are correct, it can be deduced that between 34 and 56 percent of the anemia in Ghana is due to iron deficiency. Half of the anemia or more is due to other causes.

Table 6. Prevalence of Micronutrient Biomarkers in Children 6–59 Months and Non-pregnant WRA (Percentage) at the National and Regional Level (2017 MNS)

Characteristics	National		Northern Belt (Northern, Upper East, Upper West regions)	
	Children 6–59 months	WRA	Children 6–59 months	WRA
All anemia	35.6	21.7	53.2	27.6
Iron deficiency anemia (serum ferritin < 12 µg/l and anemia per population hemoglobin cutoff)	12.2	8.9	29.0	15.4
Iron deficiency (serum ferritin < 12 µg/l)	21.5	13.7	39.6	21.5
Vitamin A deficiency (retinol binding protein < 0.70 µmol/L)	20.8	NA	30.6	NA
Vitamin A deficiency (modified relative dose response [MRDR] ≥ 0.060)	6.7	4.6	NA	NA
Folate deficiency (serum folate < 10 nmol/L)	NA	53.8	NA	50.8
Vitamin B12 deficiency (serum B12 < 150 pmol/L)	NA	6.9	NA	13.5

NA, not available.

Genetic Disorders

Genetic disorders that that affect the Hb concentration and occur at frequencies greater than those from random mutation are predominantly associated with resistance to *Plasmodium falciparum* malaria

(Piel et al. 2010; Taylor, Parobek, and Fairhurst 2012). They include the abnormalities of Hb synthesis (β- and α-thalassemia and sickle cell anemia) and structure (Hb S, C, and E), of red blood cell (RBC) enzymes (glucose-6-phosphate dehydrogenase [G6PD] deficiency), and of the RBC membrane abnormalities (hereditary spherocytosis, elliptocytosis, and ovalocytosis). Sickle cell disease and homozygote α-thalassemia both result in severe anemia. Sickle cell trait—while resulting in mild anemia—offers protection against malaria. Although less severe than homozygote α-thalassemia, heterozygous α-thalassemia can also cause low Hb concentrations.

From a public health perspective, the importance of these inherited red cell abnormalities as causes of anemia depends upon the specific genetic condition, the pattern of inheritance and the populations, geographic areas, and settings examined (Barrera-Reyes and Tejero 2019). Each year, an estimated 500,000 children are born with severe anemia from genetic disorders of the RBC, with 80 percent in low- or middle-income countries (LIMCs) of sub-Saharan Africa, the Mediterranean region, the Middle East, and South and Southeast Asia (Piel et al. 2010).

According to the 2017 MNS, the national prevalence of sickle cell disease in children under five is 1.3 (University of Ghana et al. 2017) (**Table 7**). The 2017 MNS also reported a disaggregate prevalence of sickle cell trait in children under five years in the Northern (7.2 percent), Upper East (6.4 percent), and Upper West (12.2 percent) regions. The percent of children who exhibit the sickle cell trait (i.e., proportion of children carrying only one abnormal allele of the hemoglobin beta gene) is 12.6 percent. The prevalence of sickle cell disease in WRA is below 1 percent. The proportion of women nationally with sickle cell trait is 13.0 percent, 7.2 percent in the Northern Belt.

The prevalence of homozygote α-thalassemia in children under five and WRA is 3.3 and 4.4 percent, respectively. Although low, these rates are still important especially when one considers the prevalence of heterozygous α-thalassemia, which is 27.4 percent among children under five and 30.1 percent among WRA. In the Northern Belt, we only have data on α-thalassemia which includes both homozygote and heterozygote α-thalassemia. The prevalence of α-thalassemia among WRA is 31.6 percent and among children under five it is 31.1 percent (37.5 percent in the Northern region, 20.1 percent in the Upper East region, and 30.7 percent in the Upper West region) (University of Ghana et al. 2017).

Table 7. Prevalence of Genetic Disorders Causing Anemia in Children 6–59 Months and Non–pregnant WRA (Percentage) at the National and Regional Level (2017 MNS)

Characteristics	National		Northern Belt (Northern, Upper East, Upper West regions)	
	Children 6–59 months	WRA	Children 6–59 months	WRA
Sickle cell disorder	13.9	13.5	NA	NA
Sickle cell disease (severe)	1.3	0.5	NA	NA
Sickle cell trait (mild)	12.8	13	7.5	7.2
α-thalassemia	30.7	34.5	31.1	31.6
Homozygous (severe)	3.3	4.4	NA	NA
Heterozygous (mild)	27.4	30.1	NA	NA

NA, not available.

Coverage of Anemia Prevention and Control Interventions

Testing for and Diagnosis of Anemia

Accurate determination of hemoglobin concentration and anemia prevalence requires venous blood, and collection of venous blood for anemia diagnosis cannot be widely implemented due to staffing and resource constraints. We asked key informants about the capacity for analysis of anemia, methods of anemia diagnosis, and the challenges in identifying anemia at various levels of the health system. Testing for hemoglobin (Hb) in PW is part of routine service during ANC clinic visits; it is mandatory for new registrants to have their Hb level checked. At 29 and 36 weeks of gestation, the process is supposed to be repeated. The measurement of hemoglobin is usually done using the HemoCue analyzer at all primary care facilities. However, some secondary and tertiary facilities have standard laboratories, and therefore use hematology analyzers. Samples are usually drawn from a drop of blood taken from a finger prick or heel prick in the case of children age 6–11 months. The results of the tests done at ANC registration, 28 weeks of gestation, and 36 weeks of gestation are entered in to DHIMS-II. There is no routine Hb testing for children under five and WRA. However, Hb may be measured in children and adults as part of clinical care at facilities, depending on their clinical condition. The results of these tests for children under five are also supposed to be entered in the DHIMS-II database.

Our key informants reported that anemia diagnosis at the CHPS is done by identifying clinical signs (pallor) or by the use of hemoglobin color strips (Whitehead et al. 2019b). Both methods have been recognized as having poor sensitivity and specificity, and results need to be confirmed using blood sampling and measurement in a hemoglobinometer and/or hematology auto analyzer (Karakochuk et al. 2019). CHPS personnel report frequent shortages of hemoglobin color strips. This leads to gaps in measurement of hemoglobin for CHPS attendees—some CHPS facilities ration the strips by only measuring Hb in PW at the ANC clinics while others report using the strips until they run out, and then hemoglobin in all population groups is left unmeasured. In the North East region, the testing capacity is limited to laboratories at a couple of facilities, with the rest of the CHPS depending on HB color strips which are often in short supply.

Malaria Prevention and Control

Strategies for malaria control include use of insecticide-treated nets (ITNs) (a factory-treated net that does not require any further treatment) and indoor residual spraying (IRS).

When the 2019 MIS respondents were asked whether they had seen or heard a malaria message in the past 6 months, the national average was 59 percent, which was similar to the proportion in the Northern (49.5 percent) and Upper East (56.1 percent) regions and higher than reported in the Upper West (44.9 percent) region. Among WRA who had seen or heard a malaria message in the past 6 months, about 79.6 and 23.1 percent nationally reported seeing it on TV and radio, respectively. This was also similar to the proportion of respondents who reported seeing it on the TV and radio in the Northern (72.5 and 56.3 percent) region and higher than in the Upper East (49.3 and 35.4 percent) and Upper West (47.4 and 39.9 percent) regions (GSS and ICF 2020).

The 2019 MIS found that 73.7 percent of households reported owning at least one ITN (GSS and ICF 2020), which is up from 68.3 percent reported by the 2014 DHS (GSS, GHS, and ICF International 2015). According to the MIS, the percentage of children and PW who slept under an ITN the previous night was 54.2 percent for children, and 48.7 percent, respectively (GSS and ICF 2020). This is up from rates reported by the 2014 DHS—46.6 percent and 43.3 percent, respectively (GSS, GHS, and ICF International 2015). Across the board, rates are higher in the Northern, North East, and Upper East regions, according to the 2019 MIS (GSS and ICF 2020).

Other strategies are contingent upon children, PW, and WRA seeking care for intermittent preventive treatment of PW (IPTp) and diagnosis and treatment of malaria with artemisinin-based combination therapy (ACT). Appropriate care-seeking behavior when needed for the various causes of anemia can lead to timely treatment or prevention of anemia.

The *Health Sector Annual Programme of Work—2021 Holistic Assessment Report* presents data on ANC coverage and the use of outpatient services. ANC is a government service highly relevant to the prevention and control of anemia. The ANC platform serves as a critical link between the health services and the PW. The platform is central to the coverage of critical interventions for the PW and the newborn child, including IPTp, ACT, ITN distribution, deworming, supplementation as well as the counseling and promotion of anemia prevention practices. The proportion of mothers who received ANC at least one ANC visit and at least four ANC visits, receive skilled delivery services, and receive postnatal care) in the North East is 95.2 and 58 percent, respectively. The percentages for Northern are 96.8 and 92.5 percent; for Upper East they are 84.1 and 75.7 percent; and for Upper West they are 85.8 and 74.8 percent (MOH 2022).

The report also presented data indicating that the use of outpatient services increased from 29.9 million visits nationally in 2020 to 34.8 million in 2021, with 14.1 million (6 percent) being new visits (MOH 2022). This translates to an increase from 0.9 visits per capita in 2020 to 1.13 in 2021. However, the number of OPD visits per capita for Northern, North East, and Upper East regions was lower, at 0.76, 0.55, and 1.08, respectively; in Upper West region it was higher, at 1.34 visits per capita. The report cites several factors for increased use of health care facilities—introduction of the National Health Insurance Scheme (NHIS), implementation of CHPS, availability of human resources, and investment in health infrastructure.

According to the DHS, the percentage of women receiving two or more doses of an antimalarial was 67.5 percent (GSS, GHS, and ICF International 2015). In 2019, according to the MIS, this had increased to 80.2 percent (GSS and ICF 2020). Consistent with the lower number of OPD visits per capita, rates of IPTp coverage are lower in the Northern Region. They are higher in the North East and Upper East regions (GSS and ICF 2020).

In **Table 8** we present more recent data from the 2019 MIS on malarial prevention and treatment, nationally and for the Northern, Upper East, and Upper West regions (GSS and ICF 2020).

Table 8. Malaria Prevention (2019 MIS)

Characteristics	National	Northern	Upper East	Upper West
Percentage of households with an ITN	73.7	85.4	87.8	77.9
Percentage of households supplied with ITN by health care worker during 2018 mass distribution campaign	66.8	67.7	64.4	35.3
Percentage who slept under an ITN last night	43.2	51.6	65.8	55.3
Percentage of children under 5 who slept under ITN last night	54.1	57.5	67.2	69.3
Percentage of WRA who slept under ITN last night	58.4	69.5	75.9	82.1
Percentage of PW who slept under ITN last night	48.7	61.4	68.2	72.5

Characteristics	National	Northern	Upper East	Upper West
Percentage of households where IRS was done in past 12 months	6	30	14.7	89.8
Percentage of households sprayed by government program	62.4	71.8	65	63.8
Percentage of households with at least one ITN and/or IRS in the past 12 months	75	90.3	90	95.6
Percentage of women age 15-49 with a live birth in the 2 years preceding the survey who, during the pregnancy, received: one or more doses of IPTp-SP / two or more doses of IPTp-SP / three or more doses of IPTp-SP	91.4/80.2/61.0	88.4/77.0/64.5	96.8/89.4/77.4	94.9/87.7/77.8
Percentage of children under 5 with fever for whom advice or treatment was sought the same or next day	40.7	38.2	51.1	36.3
Percentage of children under 5 with fever who had blood taken from a finger or heel for testing	34.1	32.8	70.5	47.1
Percentage of children under 5 with fever who took an antimalarial drug	45.9	62.5	53.7	43.1
Percentage of children who took any ACT	84.5	95.9	91	88.2

Prevention and Control of Helminthic Infections

Helminthic infections cause anemia by two mechanisms: increasing bleeding from the intestine and decreasing the absorption of micronutrients. The process of deworming in program settings involves a biannual ingestion of common anti-helminthic drug, either albendazole or mebendazole to treat the helminth infection. In Ghana, deworming is recommended for children 24 months of age or older. According to the 2017 MNS, more than one-third (37.3 percent) of children 24–59 months of age received deworming medication in the 6 months preceding the survey (University of Ghana et al. 2017). The 2019 MIS reported the percentage of children 6–59 months of age who received deworming medication, even though it is not in line with the health schedule. They found that 38.3 percent of children 6–59 months of age had been given deworming medication in past 6 months. The rate was similar in the Upper East region (34.6 percent), but much lower in the Northern and Upper West regions—13.5 percent and 13.3 percent, respectively (GSS and ICF 2020). We did not find data on deworming among PW or WRA; however, data presented earlier on ANC services indicate the potential for high coverage, at least among PW.

Prevention and Control of Inflammation

WASH services and practices are also important for the prevention of infection (**Table 9**). While the percentage of households with an improved source of drinking water is high in most of the regions, it is only 77.6 percent in the Northern region. The percentage of households with basic drinking water service is significantly lower in northern Ghana compared to the national average (84 percent)—66.2 percent in the Northern region, 44.3 percent in the Upper East region, and 76.9 percent in the Upper West region. Access to improved sanitation facilities—only 27.6 percent in the Upper East region, 33.2

percent in the Upper West region, and 38.3 percent in the Northern region—is also quite low, particularly when compared with the national average of 70.1 percent (GSS and ICF 2020).

Table 9. Indicators for Water and Sanitation (Percentage) at the National and Regional Level (2019 MIS)

Indicator	National	Northern Region	Upper East Region	Upper West Region
Percentage of households with an improved source of drinking water (piped into dwelling/yard/plot, piped to neighbor, public tap/standpipe, tube well or borehole, protected dug well, protected spring, rainwater, tanker truck/cart with small tank, bottled/sachet water)	91.6	77.6	91.8	98.4
Percentage of households with basic drinking water service (defined as drinking water from an improved source, provided water is either on the premises or round-trip collection time is 30 minutes or less.)	84	66.2	44.3	76.9
Percentage of households with an improved sanitation facility	70.1	38.3	27.6	33.2
Percentage of households with basic sanitation service (defined as an improved facilities not shared with other households)	20	13.5	9.4	15.2

Source: 2019 MIS.

The 2017 MNS reported handwashing practices, showing that, nationally, only 15.9 percent of handwashing was done at a sink or a fixed basin, and that the more common (site of handwashing was anywhere around dwelling 63.7 percent). The survey also found that 63.7 percent of the handwashing sites had water available at the site of handwashing, and 85.9 percent of the households had either soap or detergent available at the site of handwashing (University of Ghana et al. 2017).

Nationally, 18.5 percent of households practice open defecation. In northern Ghana rates are much higher—69.9 percent in the Upper East region, 43.9 percent in the Upper West region, and 48.1 percent in the Northern region (University of Ghana et al. 2017).

Micronutrient Supplementation and Fortification

Supplementation

Supplementation—in tablet, liquid, or powder form—is an important strategy for addressing micronutrient deficiencies. Supplementation should be targeted to vulnerable groups whose micronutrient needs are not adequately met from food sources (including fortified and biofortified foods) alone; for example, for PW, as their micronutrient needs are increased during pregnancy. Supplements are most often delivered during ANC visits, well child visits, or immunization campaigns/days.

We were unable to find data on the distribution of IFA supplements; however, as noted earlier, ANC coverage is high in Ghana and, according to key informants, all PW are given a month's supply of IFA tablets, and they have to visit the ANC clinical to restock. They are also counseled and encouraged to consume micronutrient-rich food (4-star diet). Data on intake or consumption of supplements can be found in the section below on **Counseling and Promotion**.

Vitamin A is typically delivered through the health system and administered to children directly. According to the 2017 MNS, 28.5 percent of the children under five received a vitamin A supplement in the six months prior to the survey (University of Ghana et al. 2017). The DHIMS-II data on vitamin A supplementation in 2022 are available and presented in **Table 10**. In 2022, 119 per 1,000 children aged 6–11 months and 356 per 1,000 children aged ≥ 12 months, respectively, were given vitamin A supplements in Northern region; in North East region only 32 and 154 per 1,000 children aged 6–11 and ≥ 12 months, respectively, received vitamin A supplements. Also, among children aged 6–11 and ≥ 12 months in the Upper East region, 49 and 180 per 1,000, respectively, were given vitamin A supplements; in Upper West region only 29 (aged 6–11 months) and 127 (aged ≥ 12 months) per 1,000 were given vitamin A supplements, respectively.

Table 101. Vitamin A Supplementation for Children Aged 6–11 months and ≥ 12 months (DHIMS-II)

District, by Region	2022	
	Children 6–11 Months/1,000	Children ≥ 12 Months/1,000
Northern	119	356
Gushiegu	10	22
Karaga	6	17
Nanton	4	14
Mion	9	20
Sagnarigu	9	33
Yendi	8	25
North East	32	154
East Mamprusi	8	47
Mamprugu-Moagduri	3	14
Upper East	49	180
Bawku Municipal	4	14
Bawku West	5	9
Garu	5	12
Tempane	3	2
Upper West	29	127
Daffiama- Bussie-Issa	5	17

District, by Region	2022	
	Children 6–11 Months/1,000	Children ≥ 12 Months/1,000
Nadowli-Kaleo	2	10
Sissala East	3	13
Sissala West	2	9
Wa East	3	11

Source: DHIMS-II.

Mass Food Fortification

Mass food fortification is one of the strategies used for address some of the deficiencies discussed above, if they are caused by inadequate intakes (USAID 2018). Mass fortification should be considered when micronutrient inadequacy is widespread and appropriate conditions are available for the production, sale, standard enforcement, and monitoring of fortified products. The most commonly fortified foods are staple foods, such as corn flour, wheat flour, and rice; vegetable oil; sugar; milk; and salt (USAID 2018). The choice of foodstuff to fortify (industry-made and widely consumed by the target population) and the formulation of the premix/fortificants (for filling the micronutrient gaps) are two of the most important decisions to make when considering mass fortification (USAID 2018).

The 2017 MNS collected fortified flour samples from households to assess their iron content, and fortified oil samples to assess their vitamin A content. When asked about vegetable oil intake, 74 percent of the households nationally in the survey reported using vegetable oil. The Northern region shows the same use pattern (74 percent), but it is lower in the Upper East (43 percent) and Upper West (17 percent) regions. Among WRA surveyed, 22,2 percent had heard of fortified vegetable oil while only 9 percent had heard of fortified wheat flour (University of Ghana et al. 2017).

Biofortification

Biofortification is another strategy for addressing these deficiencies. Biofortification involves increasing the micronutrient content of common crops and their bioavailability to allow for micronutrient needs to be met through dietary consumption (breeding crops to increase their nutritional value). Examples include increased iron and zinc in biofortified pearl millet and common beans and increased vitamin A in biofortified orange-fleshed sweet potatoes (Turner et al. 2013; Low et al. 2007; Hotz et al. 2012). The integration of biofortified crops into agricultural value chains and food systems requires enhanced efforts to increase the production, acceptability, and processing of these crops.

In Ghana, the crops released include vitamin A-rich cassava, maize, and orange sweet potato, and crops in testing include iron-rich pearl millet. The programs aimed to increase the intake of food made with biofortified crops includes the promotion of orange-fleshed sweet potato, cassava, and maize, which has been led by a stakeholder committee chaired by the Council for Scientific and Industrial Research's Crops Research Institute. Iron-rich pearl millet is being evaluated in field trials.

Delayed Cord Clamping

Delayed cord clamping is an important intervention that allows the passage of blood from the placenta to the baby and reduces the risk of iron deficiency in infancy (McDonald et al. 1996). The World Health Organization (WHO) recommends late cord clamping (approximately 1–3 minutes after birth) unless the neonate is asphyxiated and needs to be moved immediately for resuscitation (WHO 2014b).

Ghana has adopted the policy of delayed cord clamping, which should be done while initiating simultaneous essential newborn care. GHS has included the practice in its job aids for active management of the third stage of labor. At present, there are no data available on the practice of delayed cord clamping in Ghana.

However, while efforts have been made to train traditional birth attendants on this practice, it is still highly contingent upon deliveries being attended by skilled health workers. The *Health Sector Annual Programme of Work—2021 Holistic Assessment Report* found that the proportion of mothers who received skilled delivery services in the North East is 71.9 percent. The percentages for Northern, Upper East, and Upper West regions are 75.8, 81.8, and 76.7 percent, respectively (MOH 2022).

Family Planning Services

The timing of pregnancy can be an especially important influence on anemia prevalence among women of reproductive age, as additional iron requirements for pregnancy can be exacerbated in adolescence, where iron requirements are higher than for older women. In addition, childbirth itself can lead to blood loss and if pregnancies are timed too closely together, the capacity for the body to replenish red blood cells is diminished. Because of these factors, the shifting of fertility preferences and use of FP may influence anemia trends (Begum and Dewey 2010).

We do not have data on service provision or utilization; however, nationally, the number of persons accepting the use of FP methods increased by 14 percent, from 2.2 million in 2020 to 2.5 million in 2021, bringing the national FP acceptance rate to 33.8 percent. In the North East (21.6 percent) and Northern (27.8 percent) regions acceptance rates are lower than the national rate; the rate in the Upper East (35.8 percent) and Upper West (46 percent) is higher (MOH 2022). According to the 2014 DHS, nationally, the percent of married WRA who were using a method of contraception was 26.7 percent. It was similar in the Upper East (23.7 percent) and Upper West (25.2 percent) regions, but significantly lower in the Northern region (11.2 percent) (GSS, GHS, and ICF International 2015).

Screening for and Counseling on Genetic Disorders

We found no information on programs to screen for or counsel on genetic disorders that can lead to anemia.

Counseling on Individual and Household Practices

Households and individuals must also play a role in preventing and controlling anemia. Counseling can play an important role in promoting optimal WASH practices; intake of supplements as well as fortified and biofortified foods; exclusive breastfeeding; complementary feeding; consumption of a diverse diet; delayed cord clamping; FP; and care-seeking. Counseling can be provided during ANC, FP, and child health visits. IYCF counseling is an important program or service of the government, delivered during growth monitoring and promotion, at child wellness clinics, as well as during community groups such as mother-to-mother support groups (M2MSG) and Village Savings and Loan Associations (VSLA) group meetings.

A number of indicators that are used to assess the IYCF practices can contribute anemia reduction: intake of micronutrient supplements, consumption of fortified foods, early initiation of breastfeeding, continued breastfeeding at 1 year, introduction of appropriate complementary foods, minimum dietary diversity (based on consumption of least five of eight defined food groups), minimum meal frequency (based on consumption of solid, semi-solid, or soft foods a minimum number of times), minimum acceptable diet (combination of minimum dietary diversity and minimum meal frequency), and acceptable diet the day before the interview.

The 2017 MNS asked about the use of iron tablets or syrup as well as multivitamins in children under five in the six months prior to the survey; 22.5 percent of mothers reported using iron supplements for children under five (University of Ghana et al. 2017). Among the WRA, the proportion of women who had taken iron (22.0 percent), folic acid (12.8 percent) or multivitamin (16.2 percent) supplements in the prior six months was low. IFA coverage was high—68.2 percent reported having taken IFA supplements for more than 3 months during their most recent pregnancy, with 26.9 percent reporting receiving a vitamin A supplement after their most recent delivery (University of Ghana et al. 2017). Among PW, 73.4 percent reported consuming iron or folic acid supplements for more than 3 months. Similarly, 68.2 percent of non-pregnant WRA reported consuming iron or folic acid supplements during her last pregnancy for 90 days or more (University of Ghana et al. 2017).

However, regional disaggregated data from the DHIMS-II suggest that rates are significantly lower in northern Ghana (**Table 11**). The DHIMS-II reports the consumption of IFA per 1,000 PW who attended the facility. In the Northern region, 105 per 1,000 PW consumed IFA three times in a week and 58 per 1,000 women consumed IFA six times a week. The DHIMS-II also reports the consumption of IFA by adolescent girls. In the Northern region, 133 adolescent girls per 1,000 consumed IFA three to six times per week. In the North East region only 19 per 1,000 PW reported consuming IFA three times per week and only 10 per 1,000 reported consuming IFA six times in a week. Meanwhile, 26 per 1,000 adolescent girls consumed IFA at least three times per week. In the Upper East region, 37 and 29 per 1,000 consumed IFA three and six times per week, respectively, while 40 per 1,000 adolescent girls consumed IFA at least three times per week. There were 26 and 17 per 1,000 PW who consumed IFA three and six times a week, respectively, and 17 per 1,000 adolescent girls who consumed IFA at least three times per week in the Upper West region.

Table 11. IFA Supplementation among Pregnant Women and WRA by Regions and Districts (DHIMS-II)

District by Region	2022		
	Number of Women Who Report Taking IFA 3 Times a Week /1,000	Number of Women Who Report Taking IFA 6 Times a Week /1,000	Number of Girls Given IFA/1,000
Northern	**105**	**58**	**133**
Gushiegu	9	3	1
Karaga	4	2	5
Nanton	3	2	2
Mion	3	1	12
Sagnarigu	15	8	7
Yendi	4	3	35
North East	19	10	26
East Mamprusi	5	3	6

District by Region	2022		
	Number of Women Who Report Taking IFA 3 Times a Week /1,000	Number of Women Who Report Taking IFA 6 Times a Week /1,000	Number of Girls Given IFA/1,000
Mamprugu-Moagduri	2	1	1
Upper East	37	29	40
Bawku Municipal	4	3	2
Bawku West	4	4	4
Garu	2	1	4
Tempane	3	2	1
Upper West	26	17	17
Daffiama- Bussie-Issa	1	1	2
Nadowli-Kaleo	3	2	1
Sissala East	3	2	2
Sissala West	2	1	1
Wa East	3	2	3

Source: DHIMS-II.

The 2017 MNS reported IYCF practices for all of Ghana as well as for the Northern Belt (the four regions of the north together). For children aged 6–23 months, more than three-quarters of mothers (78.6 percent nationally) reported initiating breastfeeding in the first hour after the child's birth (68.6 percent in the north) and 7.2 percent initiated breastfeeding more than 12 hours after birth (12.2 percent in the north). Continued breastfeeding was nearly universal (93.1 percent nationally) among children 12–15 months of age (98.7 in the north). Similarly, almost all children aged 6–8 months (94.7 percent nationally) had received complementary foods the day before the survey (94.7 percent in the north). For children 6–23 months of age, almost half (42.3 percent nationally) had a sufficiently diverse diet (24.9 percent in the north), but only one-third (38.3 percent nationally) ate with sufficient frequency (53.3 percent in the north). Within this age group, few children (14.3 percent nationally) had a minimally acceptable diet, an indicator combining diversity and frequency (12.8 percent in the north) (University of Ghana et al. 2017).

Factors Affecting Anemia Prevention and Control

Policies

National policies and strategies influence the implementation of programs that mitigate the risk factors for anemia, and thus, the prevalence of anemia in the population. Policies, which are usually determined at the national level, need to exist. In addition, districts need to adhere to those policies. For that to happen districts and health workers need to be aware of and familiar with them. In this section, we will discuss some of the national policies that have relevance to anemia prevention and control in northern Ghana.

Ghana's National Health Policy 2020 promotes interventions across the life cycle from a multi-sectoral perspective, although the implementation is rooted in the health system (MOH 2020b). The health policy has five objectives:

1. To strengthen the health care delivery system to be resilient
2. To encourage the adoption of healthy lifestyles
3. To improve the physical environment
4. To improve the socioeconomic status of the population
5. To ensure sustainable financing for health

The first three areas—health-care delivery systems, healthy lifestyles, and physical environment—are critical to the implementation of anemia programs, as we will outline here. The first objective serves to increase the availability of accurate, reliable data and information, in real time. In our previous sections on the status of anemia and the risk factors, we report the lack of disaggregated information from the district level, notwithstanding the use of information technology such as the DHIMS-II. One strategy to make the health system resilient is to increase the use of implementation research and the data generated therein to improve health service delivery to the population. In addition, promoting healthy eating and good nutrition helps increase awareness and demand for healthful food and contributes to increased intake of micronutrients. As we report in the section on inflammation, the burden of anemia is eased with the provision of potable water, improved sanitation and hygiene facilities, and knowledge.

Essential preventive services are also included in Ghana's Roadmap for Universal Health Coverage (MOH 2020a). The list of included interventions—growth monitoring; dietary supplementation; immunization; mass residual spraying; prevention and treatment of helminths and vector-borne diseases; screenings for sickle cell disease; FP, antenatal, and postnatal care; and the availability of WASH services—provide a context for evidence-based prioritization of anemia prevention and control interventions.

Ghana's *Child Health Strategies and Standards* document contains updated recommendations at various stages of the life cycle, including preconception care (health education, IFA supplementation, and genetic counseling for sickle cell trait and other hereditary conditions), pregnancy (nutrition counseling, IFA supplementation, malaria prevention and management), postpartum (immediate newborn care, breastfeeding, sickle cell screening), infancy (IYCF, including breastfeeding and complementary feeding, vitamin A supplementation, prevention and treatment of malaria, diarrhea, dysentery, and pneumonia, management of malnutrition and screening for sickle cell disease and red cell enzyme deficiencies, WASH), and for under-5 children (IYCF, supplementation, prevention and management of infectious diseases, WASH) (GHS 2018).

Complementing the National Health Policy of 2020, Ghana's Reproductive, Maternal, Newborn, Child and Adolescent Health and Nutrition (RMNCAH&N) Strategic Plan 2020–2025 identifies major cross-cutting issues which need to be addressed, including the need for well-resourced, skilled personnel; equipment; and logistics; data for decision-making; a functioning referral system; multi-sectoral partnership and community engagement for RMNCAH&N; financing for programs; and emergency preparedness within RMNCAH&N (GHS 2020). The RMNCAH&N Strategic Plan explicitly lists strategic objectives for nutrition, which include strengthen the enabling environment for improved breastfeeding and complementary feeding practices, promoting optimal maternal nutrition, and reducing the burden of anemia and other micronutrient deficiencies among women, infants, children, and adolescents. The strategy also recommends cross-sectoral collaboration with the Ministry of Agriculture on biofortification and dietary diversity, and with the Food and Drug Administration on food fortification. For the first time, addressing a data gap in adolescent anemia, the strategy has set two targets:

1. Reduce the prevalence of anemia in female adolescents from 26.4 to 19 percent between 2018 and 2025
2. Reduce the prevalence of anemia in WRA from 21.7 to 14 percent between 2018 and 2025

Previous policies and strategies, such as the National Nutrition Policy (NNP) of 2014–2017 (Government of Ghana 2013), National Malaria Control Strategy (NMCP) of 2008–2015, and Safe Motherhood Service Protocol (Ghana Health Service 2008), have been incorporated into broader health system policies.

The policies pertaining to anemia prevention and control, from multiple sectors, are only as effective as their implementation. To this end, we address some of the themes included in the National Health Policy and the RMNCAH&N Strategic Plan, with a focus on northern Ghana regions.

Information Systems

We asked key informants about information systems at the CHPS level, district hospitals, and health centers. District-level officials interviewed felt good about the quality of data on health facility services that are collected and reported by the DHIMS-II. They reported reviewing all information received for specific platforms, such as ANC, and if there are any discrepancies in the number of ANC registrants and tests performed, they attempt to correct it in real time. They explained that data from the DHIMS-II can be freely shared between CHPS facilities and the subdistrict level office, making such corrections possible. Some districts regularly monitor interventions and service delivery and hold regular data reviews where any discrepancies in the records are resolved. They explained that this is not always possible due to restrictions on travel and visitation, which might lead to data gaps.

We asked about their use of data to make decisions about the various activities at their level. In Nadowli-Kaleo district in the Upper West region, the data are used to identify subdistricts or facilities with a high burden of anemia and appropriate available interventions are implemented, within their resource constraints (typically low-cost activities such as intensification of health promotion and education/trainings, as interventions that need logistic and funding support are more challenging to implement). An interesting use of the data in this district is to identify and correct any measurement errors by recognizing trends in hemoglobin measurements—for example, if most of the values are higher than what is previously seen. Data are also used to identify the need for training at facilities or subdistrict centers where there is reported decrease in the quality of service.

Regional and district health officers review the performance of districts and facilities and provide them with regular feedback to enhance service delivery. Staff from the regional and district health offices jointly examine the data obtained from facilities, including number of PW who were counseled and who consumed IFA three or six times a week (which is used to estimate IFA distribution against expected targets). Laboratory data on the number of PW who have their Hb checked at registration and at 36 weeks of gestation are also reviewed against expected targets, and feedback is provided accordingly. Supportive supervision is also conducted, during which the various heads at the district level conduct on-the-job coaching for facility staff.

Commodities and Supply Chain Logistics

For anemia prevention and control programs, there should be adequate and consistent supply of the commodities required. Districts are likely to have logistics information on commodity outflow to health clinics. This can be useful to confirm that a needed commodity is available to service providers because, without the commodity, it is not possible to provide the service.

We asked key informants about the status of the supply chain for drugs (antimalarial drugs, IFA supplements, deworming medicine) and commodities essential for anemia prevention and control. We asked them to describe their process for quantification, forecasting, and requisition of commodities that were nearing stock-out. Stock-out seems to be a major issue for supply of essential drugs in most facilities, most commonly with anthelminthic drugs and IFA for weekly supplementation in adolescent girls and daily supplementation in PW.

Funding

Adequate and consistent allocation of resources is essentially for the delivery of quality services and the successful implementation of an intervention or program. We reviewed national allocations to health in the Government of Ghana's annual budget. The share of national budget allocated to the health sector declined from 9 percent in 2020 to 6.6 percent in 2022. (MOH 2022). This is reflected at the CHPS level with shortage of funds for both commodities and programming. Some districts in the Northern region ask PW at the ANC clinic to purchase their IFA supplements as there have been stock-outs in the facility. In the newest region, the North East, funding of anemia prevention programs are largely donor-driven, and any service support to the facilities is limited by availability of funds for training and supportive supervision.

Human Resources

Having enough health facility staff with the appropriate competencies is critical for anemia prevention and control.

We asked key informants about the level of training and capacity of health personnel. Key informants described opportunities for collaborative learning. At the facility level, health care providers share challenges they encounter in the course of service delivery, while colleagues who have faced similar challenges explain how they got around them—helping those experiencing for the first time to will learn how to deal with the challenges should they recur. At the district and regional level, Ghana Health Service has adopted the peer review model whereby during quarterly reviews staff of one district/region will travel to another district/region to conduct the review. In this way, recommended practices or procedures from one district or region are transferred during exit meetings; those who are visiting may learn from the good practices of the host district/region.

District nutrition officers interviewed reported receiving support from the regional Directorates of Health Service in the areas of capacity building, monitoring and evaluation, and feedback and supportive supervision. They also described in-service training on anemia prevention, IYCF, and management of severe acute malnutrition.

With regard to supportive supervision, key informants explained that district unit heads make regular visits, funds permitting, to the facilities to observe staff competency in implementing essential anemia interventions, and provide real-time solutions if they notice any gaps in service. In some regions, the supportive supervision visits are carried out every quarter.

The *Health Sector Annual Programme of Work* reported the proportion of CHPS zones in each region that were considered functional. The term "functional" was defined in 2008 as a health facility or compound "where a community health officer has been assigned and provides a defined package of services to the catchment population, from house to house in the unit area" (MOH 2022). In the North East region the proportion of health facilities considered functional remained below 30 percent for the time period of 2019–2021 (MOH 2022). The proportion of functional CHPS for 2021 for the North East (28 percent) and Northern (43.8 percent) are similar to the national average but are higher in the Upper East (86 percent) and the Upper West (77.5 percent) (MOH 2022). As a result, health care providers are typically overwhelmed (particularly at outreach points in the community and when delivering ANC services) by the number of patients and the services they must provide, which usually affects the quality and completeness of the services they provide as well as their ability to enter data correctly.

Non-Governmental Projects and Programs

USAID Advancing Nutrition

USAID Advancing Nutrition is USAID's flagship multi-sectoral nutrition project, which seeks to improve the nutritional status and health of vulnerable populations around the globe. In Ghana, the project provides technical support and assessment services to advance the Government of Ghana's efforts to improve district planning for equitable delivery of services that promote household resilience and early childhood growth and development. It is implemented in four regions—Northern, Upper East, Upper West, and North East—encompassing 17 districts: Gushegu, Karaga, Mion, Nanton, Sagnarigu, Yendi, Mamprugu-Moagduri, East Mamprusi, Bawku, Bawku West, Garu, Tempane, Daffiama Bussie Issa, Nadowli-Kaleo, Sissala East, Sissala West, and Wa East. The project is addressing several of the secondary determinants and drivers of anemia by working to improve the quality and reach of nutrition services. The project has supported the four Regional Health Directorates of the Ghana Health Service to train 34 master trainers from the 17 program districts on IYCF, Anemia Prevention and Control (APC), and Community-Based Management of Acute Malnutrition (CMAM). The 34 master trainers will be supported by the project to cascade these trainings to frontline health workers across the 17 districts in the four regions of north Ghana. In addition, the project has supported community-level social and behavior change activities, including but not limited to cooking demonstrations, community durbars, and video screenings, and is working to strengthen community structures including mother-to-mother support groups (MtMSGs) and village savings and loans associations (VSLAs).

Accelerating Social and Behavior Change Project

The USAID Accelerating Social and Behavior Change (ASBC) project supports the GHS Health Promotion Division (HPD) with national mass media campaigns. In addition, the project is working at the community level in northern Ghana: in the Northern (Yendi, Mion, Karaga, Gushegu, Nanton, Sagnarigu), North East (East Mamprusi, Mamprugu Moagduri), Upper East (Bawku West, Garu, Tempane), and Upper West (Daffiama Bussie Issa, Nadowli Kaleo, Sissala East, Sissala West, Wa East) regions. The project helps the communities to demand, identify, and implement practical solutions to address barriers to healthy behaviors and practices, with the aim of improving adoption of behaviors related to FP, water, WASH, nutrition, maternal and child health (MCH), malaria prevention and treatment, and public health emergencies. The nutrition behaviors currently prioritized in ASBC's Social and Behavior Change strategy relate to IYCF: mothers initiating breastfeeding within 1 hour after delivery, mothers breastfeeding exclusively for 6 months after birth, and caregivers feeding adequate amounts of diverse, nutritious, age-appropriate foods to children 6–23 months while continuing to breastfeed. Anemia, as a topic, will be addressed through ASBC's interventions once it is prioritized by communities, who are being reached through ongoing community engagement activities and action plans.

In August 2022, ASBC conducted a baseline survey in the zones of influence whose respondents included heads of household, caregivers of children under five, PW/partners, and adolescents/young persons aged 15–24 years. The baseline survey included questions on IFA supplementation to PW, relating to these aspects of IFA: knowledge, behaviors, and practices; drivers of uptake; barriers to uptake; opinion on use. The survey showed that the knowledge of IFA among PW and their partners was high (92.8 percent), and the main source of information on IFA was a health care worker (60.8 percent). Almost all women (99.4 percent) surveyed reported taking the IFA as recommended. Within this survey, use of IFA supplements was reported to be highest among PW in the Upper West region

(68 percent), followed by the Upper East (64.4 percent), Northern (54 percent), and North East (50 percent) regions.

JICA Activity

In the Nadowli Kaleo district, Japan International Cooperation (JICA) has supported three health centers and three hospitals to construct laboratories, which has helped improve their capacity to diagnose anemia.

1000 Days of Life Project

World Vision Ghana through their 1000 Days of Life project is promoting the cultivation and consumption of micronutrient-rich fruits and vegetables to enhance nutrition during pregnancy and the first two years of life.

Discussion

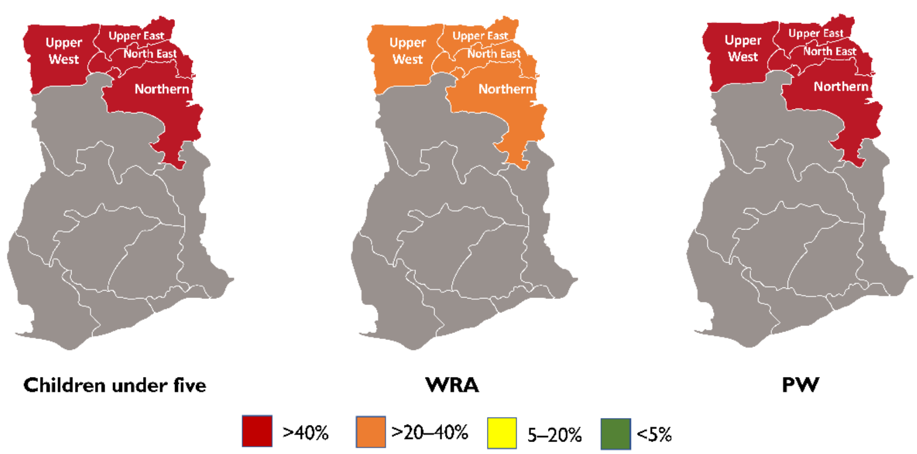
We created geospatial maps to visualize the three domains above in the four regions. We represent regional prevalence and coverage information for each region, unless indicated otherwise. The data of anemia and its causes, when represented regionally comes from the MNS and MIS, and thus the estimates for North East region reflect the reported estimates for the Northern region. The data for the coverage of programs and health system capacity does have some information on the north east region specifically, and we have indicated the same. The maps are color coded as per degrees of severity (for anemia and its causes) or by level of coverage (for anemia interventions). We use the range of green to yellow to orange and finally red to show increasing severity or decreasing coverage, as indicated in the legend in each map. Data in dark grey indicate absence of data. We have developed separate maps for each domain for children under five, WRA, and PW.

In this section, we discuss our findings as they relate to our process of prioritization which focuses on the following considerations: (1) prevalence of anemia; (2) prevalence of primary causes of anemia and coverage of interventions to address them; and (3) health sector capacity.

Prevalence of Anemia

Figure 1 shows the prevalence of anemia in the four regions. These are derived from the MNS, which reports one values for the four regions. Disaggregate district information in the Findings section demonstrates that the anemia prevalence is higher in the Northern and North East regions compared to Upper East and Upper West regions. The MNS used pooled capillary blood that is known to report lower hemoglobin concentrations, so it is likely that the real values may be lower if the hemoglobin concentration were to be determined using venous blood samples.

Figure 1: Anemia Prevalence in Children under five, WRA, and PW in four northern Regions of Ghana



Primary Causes of Anemia and Coverage of Anemia Prevention and Control Interventions

In this section we present the primary risk factors for anemia and the coverage of interventions being implemented in northern Ghana to address them. Coverage is the overall percentage of the target population receiving an intervention, which depends on demand and quality of service delivery. High coverage for an intervention implies there is demand for that service, while low coverage could be caused by lack of demand or other factors.

Malaria Prevalence, Prevention, and Control

Figure 2 shows the prevalence of malaria in children under five, WRA, and PW and **Figure 3** shows the status of malaria intervention (ITN and IRS in households, malaria case finding and ACT treatment in children under five, and more than three doses of IPTp in PW) in four northern regions of Ghana. The data is from the 2017 MNS which reported disaggregate information from the four regions in assessment of malaria using rapid diagnostic testing kits. The malarial burden of disease is relatively mild, though the coverage of the interventions varies by region. The Upper West region shows good coverage of IRS, while the distribution of ITN, malarial case finding and ACT treatment and uptake of more than three doses of IPTp in PW all need to be improved. That said, if malaria is not a significant contributor to anemia, these interventions could be prioritized for malaria prevention and treatment rather than for anemia reduction.

Figure 2: Malaria Prevalence Measured by RDT in Children under Five, WRA, and PW in Four Northern Regions of Ghana (2017 MNS)

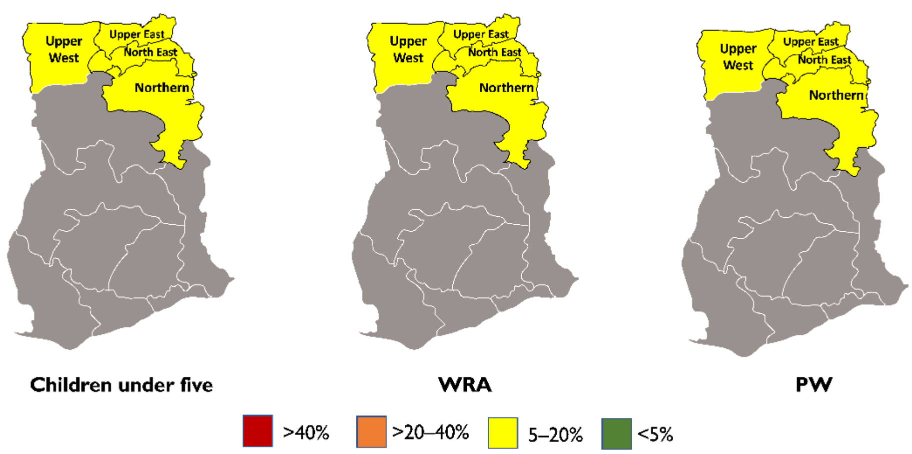
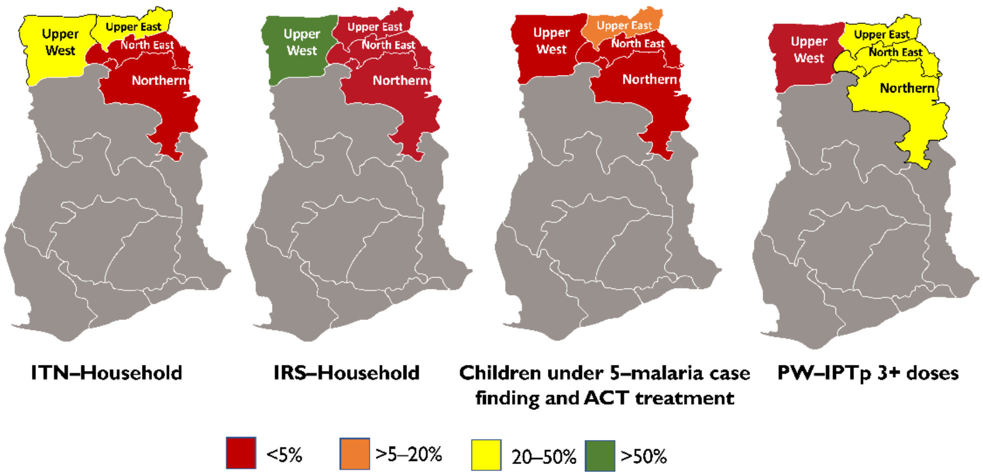


Figure 3: Status of Malaria Interventions (ITN, IRS, Malaria case finding, and IPTp) in Four Northern Regions of Ghana



Helminth Infestation and Deworming

Figure 4 shows the prevalence of helminth infestation in children under five and **Figure 5** shows the status of deworming in four northern regions of Ghana. We only have data on prevalence among children under five from research studies in the North East and Northern regions.

The data on deworming in children under five is from the 2017 MNS and in PW is from the DHS 2014 survey. The data from DHS is a decade old and it is likely that the current deworming among PW is lower, mirroring the status of deworming in children under five. Stock out of deworming pills have led to the lower coverage, and steps need to be taken to strengthen both availability and the supply chain for commodities.

Figure 4: Prevalence of Helminth infestation in Children under five, WRA, and PW in four northern Regions of Ghana

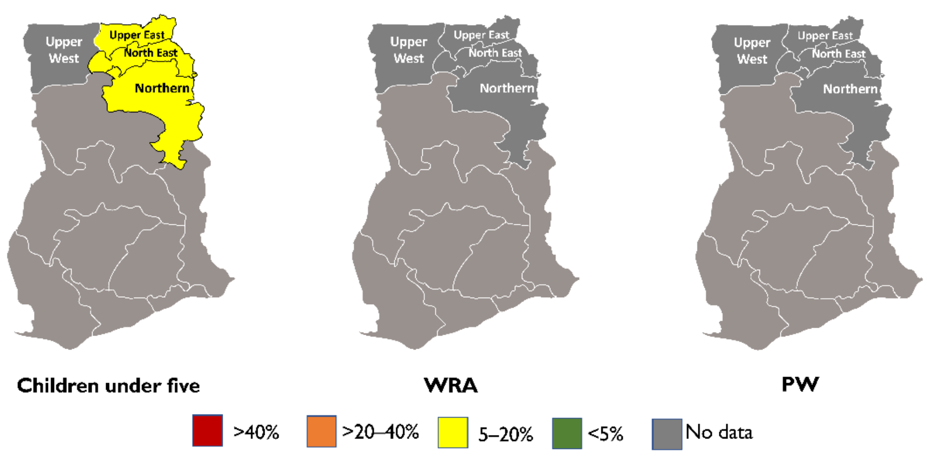
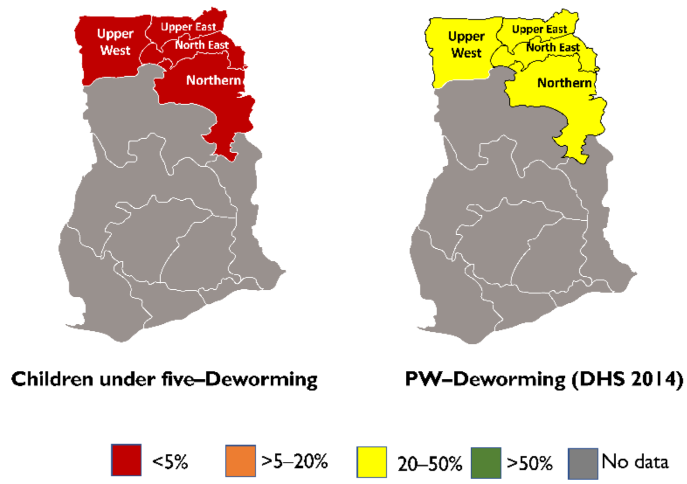


Figure 5: Status of Deworming in Children Under Five and PW in Four Northern Regions of Ghana (DHS 2014)



Inflammation and WASH

Figure 6 shows the prevalence nonspecific and general inflammation in children under five and **Figure 7** shows the status of WASH programs in four northern regions of Ghana. The data on nonspecific inflammation is derived from the 2017 MNS, and it shows a high prevalence of general inflammation nationally. We use the same value for the northern region, until we have better estimates.

One of the primary interventions to prevent infection and inflammation is WASH. The data on WASH programs is derived from the 2019 MIS shows that access to an improved water source has improved though that is not complemented by access to sanitation facilities and improved handwashing (where we extrapolate national estimates from the 2019 MIS, which may be overestimating rates of handwashing). Open defecation remains a major problem in three of the four regions (except Upper East).

Figure 6: Prevalence General Inflammation in Children under five, WRA, and PW in Four Northern Regions of Ghana (national estimate extrapolated to regions)

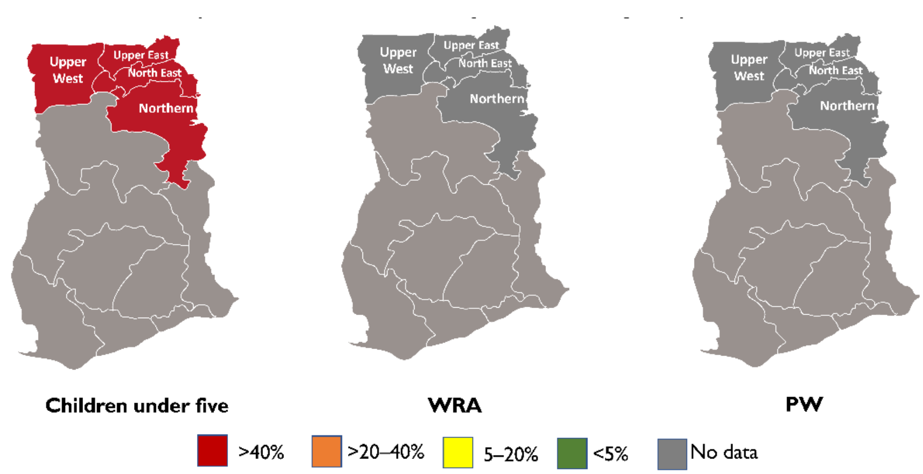
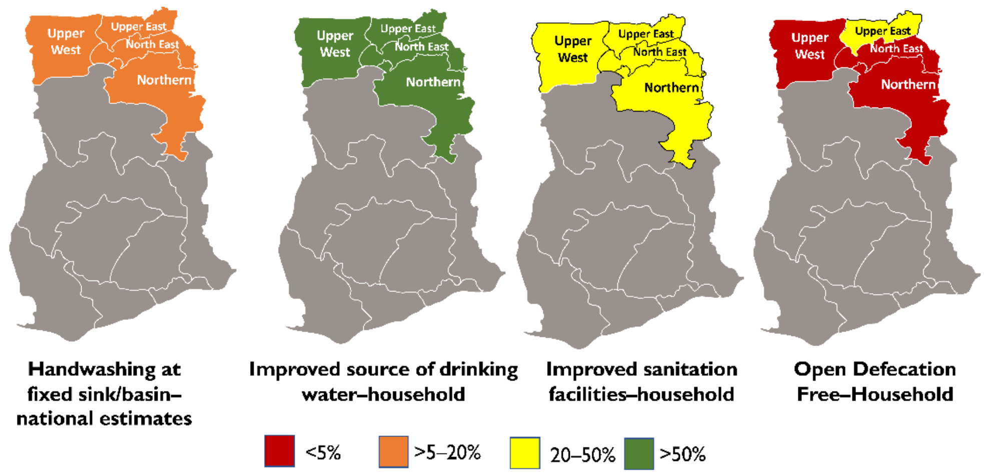


Figure 7: Status of Water and Sanitation Services and Hygiene Practices in four northern Regions of Ghana



Micronutrient Deficiencies and Supplementation

Figure 8, **Figure 9**, and **Figure 10** shows the prevalence of iron, vitamin A, and folate, respectively, in in children under five, WRA and PW in four northern regions of Ghana. Each is important and relevant to the prevention of anemia. **Figure 11** shows the status of supplementation programs in children under five, PW and WRA in four northern regions of Ghana. These data are derived from the 2017 MIS.

Iron deficiency is a cause of anemia in children under five and iron and folate deficiency is a cause of anemia in WRA. However, efforts to address these deficiencies (primarily supplementation) have achieved limited coverage. The supplementation of iron to children under five, IFA to WRA and PW, and vitamin A to children needs to be strengthened.

Figure 8: Prevalence of Iron Deficiency in Children Under Five, WRA, and PW in Four Northern Regions of Ghana

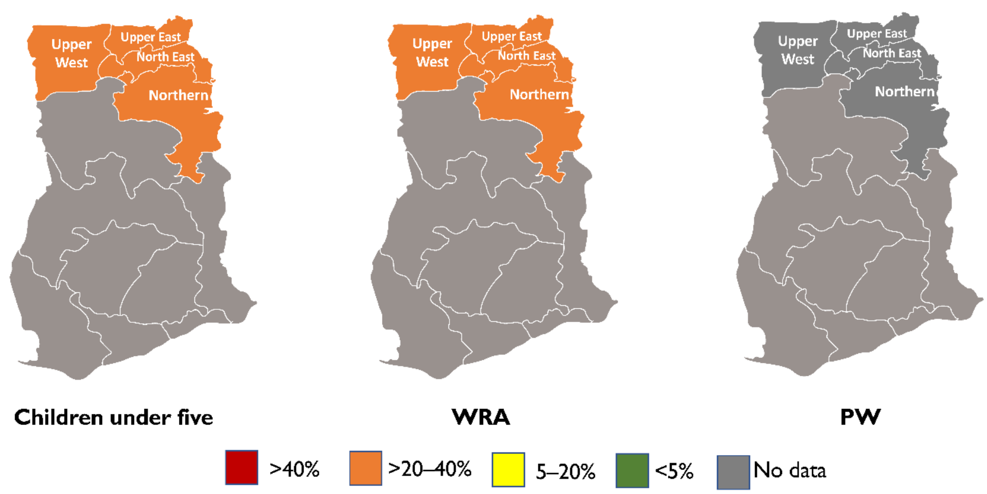


Figure 9: Prevalence of Vitamin A Deficiency in Children Under Five, WRA, and PW in Four Northern Regions of Ghana

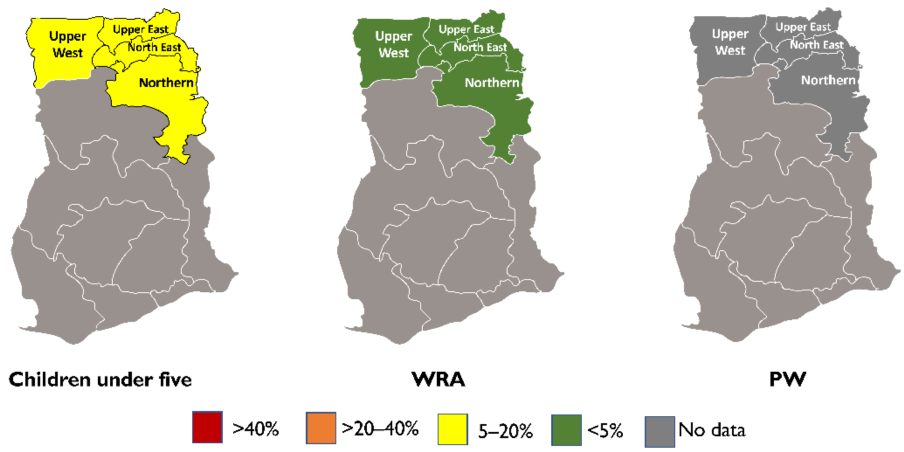


Figure 10: Prevalence of Folate Deficiency in Children Under Five, WRA, and PW in Four Northern Regions of Ghana

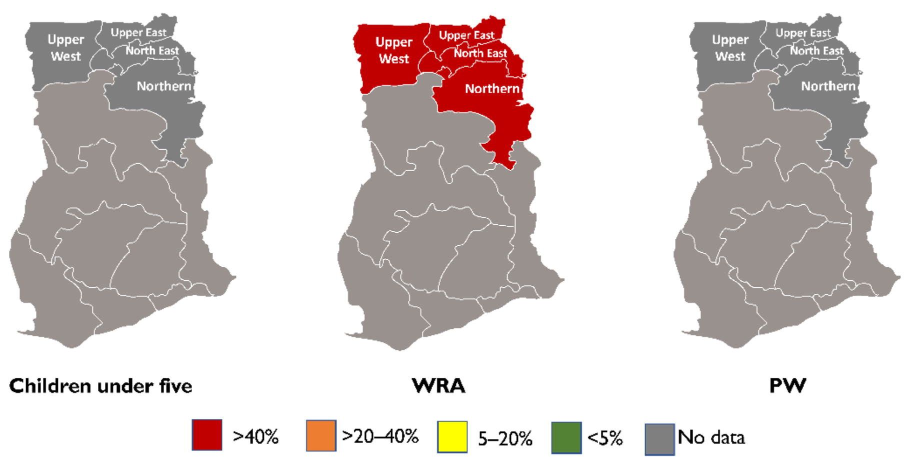


Figure 11: Status of Supplementation Programs in Children Under Five, WRA, and PW in Four Northern Regions of Ghana

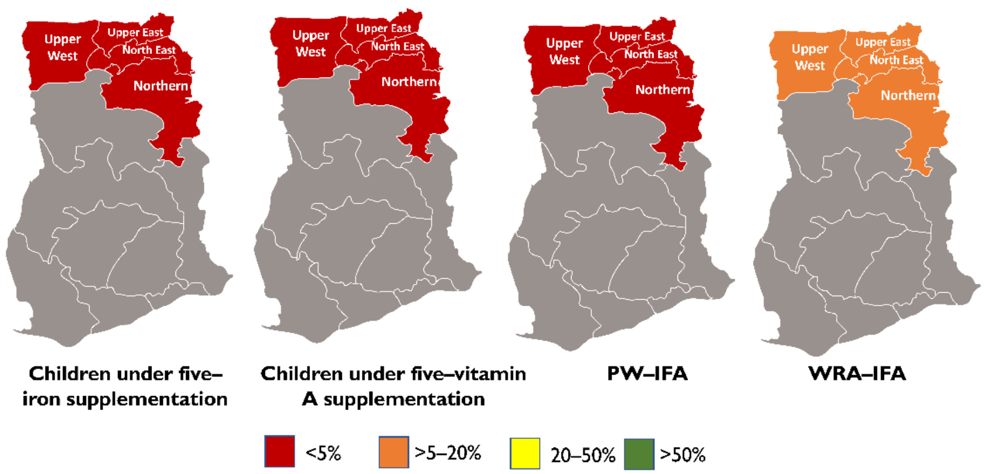
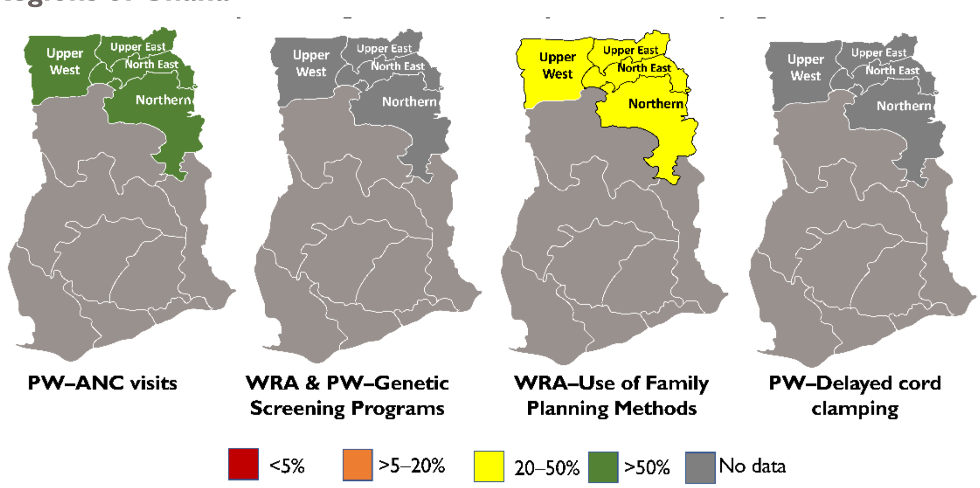


Figure 13 reports the status of several other interventions to address anemia in WRA and PW in four northern Regions of Ghana. These are called indirect intervention as they have indirect effects on anemia like increased access to ANC services and use of FP methods to increase interpregnancy time periods. There needs to be increase efforts to increase coverage of FP methods, though ANC service utilization is excellent in all four regions. There is no data on genetic screening programs and on use of delayed cord clamping in health facilities.

Figure 13: Status of Indirect Anemia Interventions in WRA and PW in Four Northern Regions of Ghana



Health Sector Capacity

We assessed health sector capacity from key informant interviews on four areas: availability of relevant commodities, availability of adequate and consistent funding, and availability of training opportunities and supportive supervision for health workers. We rated them on a sliding scale from poor, fair, good to excellent.

We note that Ghana has robust policies on health and nutrition that govern all aspects of anemia programming. These are updated regularly, and reflect both the government priorities as well as the latest global evidence on anemia programming. However, we were not able to determine the dissemination of and adherence to these policies by districts and health workers.

Among all the domains, we assessed provider skills and training as good, though, even with a well-received system of supportive supervision, lack of funding sometimes does not allow for the supervision and monitoring process to take place. We rated the supply chain for commodities and funding as poor. While most managers reported that funding remained a critical barrier, the lack of resources had ripple effects on the availability of commodities (with respect to both access to adequate supplies and the process of fulfillment of procurement orders). We also assessed public awareness as poor, about interventions as low from the MNS and MIS surveys, for specific micronutrient and preventive malaria interventions, respectively, and used that as a proxy for presumably low knowledge about other anemia interventions, although we would revise our assessment if we had better data on how these other implementations are received.

One of the major challenges remains the lack of data for certain areas—prevalence of helminth infestation in WRA and PW, micronutrient status in PW, facility data on cord clamping, and status of genetic screening programs. Any information that can be collected on these areas would help support future decision-making.

Conclusions and Recommendations

Conclusions

We used multiple sources of information to piece together the landscape of anemia, its causes, and programs to prevent and control it in four regions of northern Ghana—Northern, North East, Upper East, and Upper West. We relied on two main sources of information on the causes of anemia—the 2017 MNS for indicators related to anemia and its causes, and the 2019 MIS for indicators related to malaria and malaria-related interventions.

The national prevalence of anemia in children (36 percent) and WRA (22 percent) indicate that anemia is a moderate public health problem; in contrast, it is a severe problem among PW (45 percent). The prevalence for the four northern regions combined indicate that that anemia is a severe public health problem for children under five and PW, and a moderate public health problem for WRA.

Strategies to prevent and control anemia include interventions that directly and indirectly affect the causes of anemia such as malaria prevention and control, prevention and control of helminth infections, WASH services, micronutrient supplementation, food-based approaches (food fortification and biofortification), antenatal care services, delayed cord clamping, FP services, counseling on relevant individual and household practices, and screening for and counseling on genetic disorders.

Based on our analysis, the main causes of anemia in children under five appear to be due to general inflammation, iron deficiency, and presence of α-thalassemia. Among WRA, the main causes appear to be general inflammation, iron and folate deficiency, and presence of α-thalassemia. Among PW, we do not have high quality data on different causes but assuming that the causes in WRA would persist in pregnancy implies that the main causes are general inflammation, iron and folate deficiency, and presence of α-thalassemia.

The primary interventions to address inflammation include helminth prevention and control, water supply and sanitation services, and counseling on individual and household WASH practices. When we assessed WASH efforts in the region, it appeared that there are adequate sources of improved water supply and the main challenges remain in improved sanitation facilities (which has a fair coverage) and efforts to make the districts open defecation-free.

Interventions to address iron and folate deficiencies include distribution of iron supplements to children and IFA supplements to PW and WRA, including adolescent girls, as well as counseling to promote or encourage delayed cord clamping, the intake of supplements, and the consumption of fortified and biofortified foods. The ANC and IYCF programs are working well in the region, providing a strong platform for delivery of services and information to PW and children under five. However, funding shortages has resulted in frequent stock-out of commodities such as IFA supplements and outreach services.

Recommendations

Based on our review of existing data on anemia prevalence and its causes, the coverage of interventions for the prevention and control of anemia, and insights from key informants interviewed at the district and regional level, we suggest the following:

1. **Pay more attention to the implementation of interventions for children under five:** With high prevalence of anemia and lagging indicators on intervention, children under five should be prioritized first, followed by interventions for PW and WRA. The burden of disease is higher in children under five and the interventions for that age group have lower coverage.

2. **Focus on population-specific causes of anemia:** The causes of anemia do not vary significantly between the various regions. However, among children, it would be appropriate to focus efforts on the reduction of iron deficiency and inflammation and mitigating effects of α-thalassemia on anemia. Among WRA and PW, the focus should be on iron and folate supplementation and fortification, reduction of inflammation, and mitigating impact of α-thalassemia on anemia.
3. **Prioritize Northern and North East regions before the Upper West and Upper East regions:** All the regions of northern Ghana show a higher anemia prevalence as compared to the national average. However, based on district-level DHIMS-II data, we advise that the Northern and North East regions are prioritized before the Upper West and Upper East regions.
4. **Prioritize interventions** to address the high prevalence of general inflammation such as the provision of water and sanitation services; promotion of hygiene practices; malaria case finding and treatment; distribution of ITNs, IRS, and IPTp; and deworming. An emphasis should be placed on reducing open defecation and promoting open defecation–free communities while continuing to maintain access to improved water sources. Revisit prioritization of interventions by monitoring of process and impact indications from surveys and DHIMS-II.
5. **Continue and address challenges with existing interventions** such as the distribution of supplements (Iron and Vitamin A in children, IFA in PW, weekly IFA in WRA), promotion of healthy dietary practices, and mass fortification of flour and oil. In particular, there needs to be a renewed focus on IFA supplementation among PW and WRA and iron supplementation in children under five as well as further investigation into factors related to consumption. While ANC services are generally strong in all regions, the facilities should ensure that PW receive the full package of preventive anemia services. Intermittent IFA supplementation for all WRA is another key strategy to increase the iron stores in women who may become pregnant. While Vitamin A deficiency is low, the coverage of vitamin A supplementation is also low in the four regions. Encourage caretakers of children under five to bring their children biannually to the local facility to receive their vitamin A supplement, which has contributed to low rates of vitamin A deficiency in children, alongside, fortification of cooking oil with vitamin A.
6. **Use a variety of platforms** such as ANC, child health days, and outreach programs to promote healthy dietary practices. Iron, vitamin A, folate, and vitamin B12 deficiency remain major nutritional contributors to anemia in children, WRA, and PW. GHS can promote their 4-star diet and the consumption of local food products rich in vitamin A, iron, and folate. The Agriculture Department could assess the feasibility of using biofortified foods like vitamin A–rich orange-fleshed sweet potato.
7. **Conduct training in supply chain management:** Our key informants repeatedly brought up the role of unavailable drugs and commodities for programming, either as a result of insufficient planning or due to non-availability of the commodities from the regional and national health directorates. While the latter is outside the purview of CHPS or district health workers, the former can be instituted as a process within regular procurement mechanisms within the GHS. This can be done as a training course in supply chain management, introducing health workers to principles of demand planning, forecasting, and timely requisition of commodities and drugs. National or regional shortage of commodities may also play a role in disruption of services to the population.
8. **Strengthen information systems to meet needs:** The GHS uses the following indicators for monitoring anemia programs: hemoglobin concentration in children and PW, IFA and vitamin A

intake, and use of RDTs, microscopy, and antimalarials. However, the metrics and the denominators used to describe these risk factors and interventions vary, from all facility attendees to those who were tested. These differences do not allow for calculation of comparable prevalence. Data from different sectors can be repurposed to monitor anemia burden and program coverage. Additionally, data altogether lacking on the prevalence of helminth infestation in WRA and PW, micronutrient status in PW, delayed cord clamping, and genetic disorders.

9. **Continue to strengthen governance and coordination:** The flow of information between the regional and district health personnel remains strong. This could be expanded to an interregional level, with review meetings between the leaders of the four regions, if that is not already being done. However, there are tradeoffs to allocation of resources from the government. If there is a choice to be made to spend public resources on these sharing meetings or program implementation, there should be steps taken to ensure that program funding is protected and external sources of funds should be sought to facilitate these meetings.
10. **Leverage donor funding:** Donor-driven programming can be implemented within the structure of government policies and priorities. The GHS and other agencies of the Government of Ghana can engage donor support by identifying their preferred priorities that could use the aid of donors.
11. **Advocate for additional government funding:** With a strong human resource component in the health system of northern Ghana, there is a case to be made to the policymakers at the national level to increase health sector funding for the four regions of northern Ghana to build infrastructure and capacity for anemia and nutrition programs.
12. **Design and conduct a comprehensive national survey:** An assessment of anemia and its causes should ideally come from a single national survey that is representative of the regions and collects data of the prevalence of anemia and its causes—infections, nonspecific inflammation, genetic disorders, and micronutrient deficiencies—to allow for a comprehensive overview of the drivers of anemia in Ghana. Measuring the prevalence of all the causes of anemia in the same survey allows us to ascertain the proportion contribution of various causes to the anemia prevalence, using statistical methods like the population attributable fractions (Yimgang et al. 2021). This would be critical to then prioritizing the interventions to use to reduce anemia in the various subnational areas, targeted to the main cause of anemia in a specified area.

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Annex 1. List of Key Informants

The key informants who we contacted are listed below.

Key Informants Contacted for Information on the Anemia Landscape in Northern Ghana

Region	District*	Job Title	Anemia Program Area
Northern	Gushegu	Municipal Nutrition officer	Nutrition: platforms for delivering anemia interventions and control programs, supportive supervision, monitoring, and intervention, use of data on anemia
	Kariga	District Biomedical Scientist	Diagnosis
		Deputy Northern Regional Nutrition Officer	Governance and coordination
North East	Mampurugu Mogduri	District Health Information Officer	Monitoring and evaluation, supportive supervision, platforms for delivering anemia interventions and control programs, use of anemia data, and how often records are updated
	Mampurugu Mogduri	District Laboratory Technician	Diagnosis
	East Mampurisi	District Laboratory Technician	Diagnosis
		Regional Nutrition Officer	Platforms for delivering anemia interventions and control programs, monitoring and evaluation, supportive supervision, monitoring and evaluation, funding and challenges, commodities supply and associated problems
Upper West	Nadowle Kaleo	District Information Officer	How often anemia data are updated, use of data on anemia

Region	District*	Job Title	Anemia Program Area
	Nadowle Kaleo	District Nutrition Officer	Platforms for delivering anemia intervention and control programs, monitoring and evaluation, supportive supervision, funding and associated challenges
	Defiama Bussia Issa	Nutrition Officer	Nutrition: platforms for delivering anemia interventions and control programs, supportive supervision, monitoring and evaluation, funding and associated challenges
Upper East	Bawku Municipal	Public Health Officer	Platforms for delivering anemia interventions and control programs, supportive supervision, monitoring and evaluation, funding and associated challenges.
	Tempane District	District Nutrition Officer	Platforms for delivering anemia interventions and control programs, supportive supervision, monitoring and evaluation, funding and associated challenges

* Only for district-level key informants.

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March 2023

USAID Advancing Nutrition is the Agency's flagship multi-sectoral nutrition project, addressing the root causes of malnutrition to save lives and enhance long-term health and development.

This report is made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of JSI Research & Training Institute, Inc. (JSI), and do not necessarily reflect the views of USAID or the United States government.