Rwanda

Demographic and Health Survey

2019–20

Supplemental Report for Micronutrients

Republic of Rwanda

Rwanda Demographic and Health Survey 2019–20

Supplemental Report for Micronutrients

National Institute of Statistics of Rwanda
Kigali, Rwanda

Ministry of Health
Kigali, Rwanda

The DHS Program
ICF
Rockville, Maryland, USA

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The 2019–20 Rwanda Demographic and Health Survey (2019–20 RDHS) was implemented by the National Institute of Statistics of Rwanda (NISR) in collaboration with the Ministry of Health (MoH). The funding for the 2019–20 RDHS was provided by the Government of Rwanda, the United States Agency for International Development (USAID), the United Nations Children's Fund (UNICEF), the United Nations Population Fund (UNFPA), Enabel (Belgian Development Agency), the United Nations Entity for Gender Equality and the Empowerment of Women (UN Women), and the Centers for Disease Control and Prevention (CDC). ICF provided technical assistance through The DHS Program, a USAID-funded project that provides support and technical assistance in the implementation of population and health surveys in countries worldwide. We acknowledge the technical and financial support of the Centers for Disease Control and Prevention's International Micronutrient Malnutrition Prevention and Control Team (IMMPaCt) to the 2019-2020 Rwanda Demographic and Health Survey Supplemental Report for Micronutrients (December 2023). The findings and conclusions in this report are those of the authors and do not represent the official position of the Centers for Disease Control and Prevention.

Additional information about the 2019–20 RDHS may be obtained from the National Institute of Statistics of Rwanda, 6139 Kigali, Rwanda; telephone: +250 788 383 103; email: info@statistics.gov.rw; website: www.statistics.gov.rw.

Information about The DHS Program may be obtained from ICF, 530 Gaither Road, Suite 500, Rockville, MD 20850, USA; telephone: +1-301-407-6500; fax: +1-301-407-6501; email: info@DHSprogram.com; internet: www.DHSprogram.com.

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FOREWORD

The Government of Rwanda conducted the 2019–20 Rwanda Demographic and Health Survey (RDHS) to collect up-to-date information for monitoring progress on health care programs and policies in Rwanda, including the First National Strategy for Transformation (NST1 2017–2024) and the Sustainable Development Goals (SDGs).

The 2019–20 RDHS is a follow-up to the previous five RDHS surveys. Each survey provides data on the background characteristics of respondents and demographic and health indicators. The target groups in these surveys were women age 15–49 and men age 15–59 who were randomly selected from households across the country. Information about children age 5 and under also was collected, including the height and weight of the children.

The 2019–20 RDHS was implemented by the National Institute of Statistics of Rwanda (NISR) in partnership with the Ministry of Health (MoH). The Rwanda Biomedical Center (RBC), and in particular the HIV, Malaria, and National Reference Laboratory (NRL) Divisions, collaborated on several aspects of the survey, especially the biomarkers. ICF International provided technical assistance in the implementation of the survey.

Funding for the 2019–20 RDHS was provided by the Government of Rwanda, the United States Agency for International Development (USAID), One United Nations (One UN), the U.S. Centers for Disease Control and Prevention (CDC), the United Nations Children's Fund (UNICEF), the United Nations Population Fund (UNFPA), Enabel, and the United Nations Entity for Gender Equality and the Empowerment of Women (UN Women).

The results of the 2019–20 RDHS show substantial improvements in some indicators and slight declines in others. This report is therefore an important tool that addresses health concerns and informs policymakers and other stakeholders of priority areas for intervention, future planning, and resource allocation.

The report provides only a snapshot, however, and it is our sincere hope that researchers will deepen the level of understanding of the topics covered in the survey by undertaking further analysis of the survey data sets. Last but not least, we urge all stakeholders, both individuals and organizations, to play an active role in using this valuable information to contribute to a better quality of life for the Rwandan population.

MINISTRY OF HEALTH

Dr. NGAMIJE M. Daniel
Minister of Health

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This report has been prepared with the participation of a large number of individuals and organizations. We would like to express our gratitude to all of them.

First, we sincerely acknowledge the men and women who generously agreed to respond to all questions they were asked. The response rate was high.

We also present our sincere thanks to the Ministry of Local Government and to local government authorities for their assistance and contributions to the smooth implementation of the survey.

We would like to express our sincere appreciation to the Ministry of Health for close collaboration with the National Institute of Statistics of Rwanda (NISR) during preparation and implementation of the survey. The orientation and directives given by the steering committee members are appreciated.

We also express our gratitude to many international organizations for their vital financial assistance. Contributions from the United States Agency for International Development (USAID), the One United Nations (ONE UN), the Centers for Disease Control and Prevention (CDC), the United Nations Children's Fund (UNICEF), the United Nations Population Fund (UNFPA), Enabel, and the United Nations Entity for Gender Equality and the Empowerment of Women (UNWOMEN) were of immense importance to the effective accomplishment of the survey.

We express our profound gratitude to the team from ICF International, and in particular to Dr. Rathavuth Hong and his colleagues. Their technical assistance contributed to the success of the survey.

We thank the technical staff from the Ministry of Health (MOH), RBC-IHDPC, and NISR, for their unfailing participation in all activities of the survey, which were coordinated by NDAKIZE R. Michel and his assistants, in particular MUKANYONGA, Apolline (who has retired) for her valuable contribution to the last five RDHSs. We congratulate the supervisors, cartographers, listers, team leaders, interviewers, and biomarkers technicians for their valuable efforts, and also the drivers who were able to overcome the fatigue and other challenges inherent in this type of operation. We also thank the Information and Communication Technology team, led by HARERIMAMA, Massoud, for its contribution to the completion of the survey.

We appreciate the valuable support provided by administrative and financial departments of the NISR. Their interventions allowed this RDHS to be carried out smoothly and under good conditions.

Thank you,

MURANGWA Yusuf,
Director General of NISR

INTRODUCTION AND SURVEY METHODOLOGY 1

The 2019–20 Rwanda Demographic and Health Survey (RDHS) is the sixth Demographic and Health Survey (DHS) conducted in Rwanda, following those implemented in 1992, 2000, 2005, 2010, and 2014–15. The National Institute of Statistics of Rwanda (NISR), in collaboration with the Ministry of Health (MOH), implemented the survey. Data collection took place from November 9, 2019, to July 20, 2020. The data collection was interrupted for more than 2 months, from March 21 to June 7, 2020, due to the nationwide lockdown for the coronavirus (COVID-19) pandemic. Funding for the 2019–20 RDHS was provided by the Government of Rwanda, the United States Agency for International Development (USAID), One United Nations (One UN), the Centers for Disease Control and Prevention (CDC), the United Nations Children's Fund (UNICEF), the United Nations Population Fund (UNFPA), the United Nations Entity for Gender Equality and the Empowerment of Women (UN Women), and Enabel. ICF provided technical assistance through The DHS Program, which assists countries in the collection of data to monitor and evaluate population, health, and nutrition programs.

1.1 Survey Objectives

The primary objective of the 2019–20 RDHS is to provide up-to-date estimates of basic demographic and health indicators, including estimates of micronutrient indicators. As part of the survey, blood samples were collected to measure biomarkers of inflammation, anemia, iron, vitamin A, and vitamin B12 status in children age 6–59 months and in women age 15–49. In addition, women were tested for folate (blood sample) and iodine status (urine sample). Anthropometry and malaria infection data were also collected for children age 6–59 months and women age 15–49.

The information collected through the micronutrient component is intended to assist policymakers and program managers in evaluating and designing programs and strategies for preventing and treating micronutrient deficiencies in the Rwandan population.

Micronutrients are vitamins and minerals that are essential to human health. Micronutrient deficiencies develop over time and may or may not lead to clinically observable symptoms in those affected. Sustained micronutrient deficiencies can lead to adverse health outcomes, impairing physical, cognitive, and mental development. Anemia can be caused by a lack of consumption of foods that supply sufficient vitamins and minerals, as well as by infections and genetic abnormalities. Strategies to prevent or address the nutritional causes of anemia include agricultural approaches such as biofortification, food-based approaches that can be complemented with food fortification, and, for specific life stages and population groups, direct micronutrient supplementation (USAID 2019). Strategies that address other causes of anemia are also essential, such as mitigation of inflammation and infections and improvements in water, sanitation, and education.

1.2 Sample Design

For the sample design of the 2019–20 RDHS, see the final report.

In all selected clusters, half of the households (13 of 26) were selected for the male survey. All men age 15–59 who were either permanent residents of the selected households or visitors who stayed in the household the night before the survey were eligible to be interviewed. The subsample households for the male survey were also the subsample for standard biomarkers (height and weight measurements, anemia testing, and malaria testing) for women age 15–49 and children less than age 5 (with anthropometry only for children under age 6 months) and for HIV testing among women age 15–49 and men age 15–59.

Seven of the 13 households in the subsample not selected for the male survey were the subsample for micronutrients. Venous blood samples were collected for micronutrient testing among children age 6–59 months and women age 15–49. In the micronutrient subsample, height and weight measurements, anemia testing, and malaria testing (rapid test only) for children and women were also performed. Urine samples were collected among women.

1.3 Questionnaires

Five questionnaires were used for the 2019–20 RDHS: the Household Questionnaire, the Woman's Questionnaire, the Man's Questionnaire, the Biomarker Questionnaires, and the Fieldworker Questionnaire. The Biomarker Questionnaires included two parts: one for standard biomarkers and another for micronutrients (see Section 1.2). Details on these questionnaires can be found in the 2019–20 RDHS final report.

Tablet computers with the computer-assisted personal interviewing (CAPI) data collection system (mobile version of CSPro) were used for data collection. See the final report for more details.

1.4 Anthropometry, Anemia, Malaria, HIV, and Micronutrient Testing

In the half of the households selected for the male survey, the 2019–20 RDHS implemented anthropometry measurements, anemia testing, and malaria testing for children and women and HIV testing for adults.

1.4.1 Anthropometry, Anemia, and Malaria

Anthropometry, anemia, and malaria data and results appear in the final report.

1.4.2 HIV Testing

HIV testing data and results were published in a separate supplemental report.

1.4.3 Micronutrient Testing

Venous blood samples for biomarker testing were collected via antecubital venipuncture from children age 6–59 months and women age 15–49. Each field team included biomarker technicians who carried out both capillary blood collection for standard biomarkers and venous blood collection for micronutrients. The technicians also collected urine samples from women age 15–49 as well as anthropometric measurements from children age 6–59 months and women age 15–49. They processed blood specimens to prepare the samples for laboratory testing. The technicians requested informed consent from respondents and from parents or guardians of children age 6–59 months before the blood and urine samples were collected.

Transmittal sheets were used to track the blood and urine samples from the field to the laboratory, ensuring that samples collected in the field were monitored until they reached the laboratory. These forms were also used to monitor the conditions that the samples were stored in throughout the transport process. Barcode labels were affixed to the samples, and duplicate barcode labels were attached to the Micronutrient Biomarker Questionnaire and the transmittal sheet. Phlebotomists performed antecubital venipuncture and collected a total of up to 15 ml of venous blood samples into 5-ml evacuated tubes containing K2-EDTA anticoagulant and 10-ml tubes containing clot-activating agents and serum separating gel. Drops of blood from the anticoagulated blood tubes were used to perform anemia and malaria testing in the household. Blood tubes were carried in cold boxes with frozen gel packs to maintain temperatures between 0 and 10 °C. Later the same day, an improvised field lab with a centrifuge was set up to prepare whole blood lysates for red blood cell folate testing, recover plasma from the remaining anticoagulated blood, and prepare up to five serum aliquots from the coagulated blood tubes. Serum and plasma specimen cryovials were then frozen at −15 to −20 °C using a portable freezer. At the end of work in each cluster (up to 4 days after specimen collection), frozen blood specimens were transferred to an intermediate regional lab for frozen storage at −20 °C for about 3–4 days before samples could be transported to the main laboratory for storage at −80 °C until shipping.

Anemia testing using venous blood. Anemia testing was performed using anticoagulated blood specimens collected from children age 6–59 months and women age 15–49. Blood was taken from the tube of whole blood using a disposable pipette, dropped onto a small piece of wax film, and then collected immediately in a microcuvette and tested. Hemoglobin testing was carried out on-site using a battery-operated portable HemoCue® 201+ device. Results were provided verbally and in writing to those being tested and were recorded in the Micronutrient Biomarker Questionnaire. Parents or guardians of children with a hemoglobin level below 8 g/dl were provided with a referral and instructed to take the child to a health facility for follow-up care. Likewise, adults were referred for follow-up care if their hemoglobin levels were below 8 g/dl.

Malaria testing with venous blood using a rapid diagnostic test (RDT). Another drop of blood, taken from the same anticoagulated blood tube used for anemia testing, was tested immediately using the Rwanda-approved SD Bioline Malaria Ag P.f (HRP-II)™ RDT. This qualitative test detects the histidine-rich protein II antigen of *Plasmodium falciparum* in human whole blood. The *P. falciparum* parasite, transmitted by the *Anopheles* mosquito, is the major cause of malaria in Rwanda. The diagnostic test includes a disposable sample applicator that comes in a standard package. A tiny volume of blood was captured on the applicator and placed in the well of the testing device from the same blood placed on wax film for the purposes of hemoglobin testing. All technicians were trained to perform the RDT in the field in accordance with the manufacturers' instructions. RDT results were available in 15 minutes and recorded as either positive or negative, with faint test lines considered positive. As with the anemia testing, the RDT results were provided to the respondent (or, in the case of children, the child's parent or guardian) verbally and in written form and were recorded on the questionnaire.

A nurse provided a referral for women who tested positive for malaria. Children who tested positive for malaria according to the RDT and who had been treated with artemisinin-based combination therapy (ACT) within 2 weeks before the day of the interview were referred to a health facility if they continued to have a fever 2 days after the last dose of ACT. In addition, children who tested positive according to the RDT and met at least one of two criteria—a hemoglobin level below 8 g/dl or symptoms indicative of severe malaria—were considered to have severe malaria and were referred to a health facility for immediate treatment. Children who tested positive for uncomplicated malaria were offered a full course of medication according to the standard treatment guidelines in Rwanda. Age-appropriate doses of ACT were provided, along with instructions on how to administer the medicine to the child.

Urine specimen collection and processing. Urine samples were taken from all women age 15–49, regardless of current pregnancy status. The samples were collected in 50-ml bottles and then transferred into two screw-capped vials (2 ml each). Subsequently, the samples were transferred to an intermediate regional lab until they could be transported to the main laboratory and stored refrigerated or frozen at −20 °C until shipping or assay testing. Urine samples were a single, untimed collection taken during the technician's visit to the household.

Anthropometry. Weight measurements were taken using SECA scales with a digital display (model number SECA 878U). Height and length were measured with a ShorrBoard® measuring board. Children younger than age 24 months were measured lying down (recumbent length), while older children and adults were measured standing (height).

To assess the precision of measurements, one child per cluster was randomly selected to be measured a second time. The DHS Program defines a difference of less than 1 centimeter between the two height measurements as an acceptable level of precision. Children with a *z* score of less than −3 or more than 3 for height-for-age, weight-for-height, or weight-for-age were flagged and measured a second time. The remeasurement of flagged cases was performed to ensure accurate reporting of height and weight measurements.

Micronutrient status. Below is a list of micronutrient biomarkers measured in the micronutrient component, including information on the biomarkers selected and eligible respondents.

Micronutrient or micronutrient-related biomarkers	Eligible respondents	Specimen type
Anemia (hemoglobin)	Children and women	Venous whole blood collected with K2-EDTA anticoagulant
Anthropometry	Children and women	
P. falciparum malaria (RDT)	Children and women	Venous whole blood collected with K2-EDTA anticoagulant
Vitamin B12 (plasma B12)	Children and women	Plasma prepared from K2-EDTA anticoagulated venous blood
Vitamin A (serum retinol)	Children and women	Serum prepared from coagulated venous blood
Vitamin A (retinol binding protein; RBP)	Children and women	Serum prepared from coagulated venous blood
Iron (serum ferritin)	Children and women	Serum prepared from coagulated venous blood
Iron (soluble transferrin receptor; sTfR)	Children and women	Serum prepared from coagulated venous blood
Iodine (urinary iodine concentration)	Women	Urine
Iodized salt (quantitative iodate)	Household samples	
Inflammation (serum alpha-1-acid glycoprotein and C-reactive protein)	Children and women	Serum prepared from coagulated venous blood
Red blood cell folate	Women	Whole blood hemolysate prepared from K2-EDTA anticoagulated venous blood
Serum folate	Women	Serum prepared from coagulated venous blood

Results of the micronutrient testing were not provided to participants because the micronutrient testing was laboratory based. Results of the anemia and malaria testing were provided to participants.

1.5 Pretest and Training of Field Staff

More details on survey implementation can be found in the final report.

1.5.1 Pretest

A pretest was conducted from July 29 through August 14, 2019, when 25 candidates (15 women and 10 men) participated in questionnaire training. Additionally, 10 biomarker health technicians participated in separate biomarker training conducted in parallel.

The biomarker training included orientation on collecting height and weight data; testing for anemia, malaria, and HIV (RDT and dried blood spot [DBS] collection); venous blood collection; and processing blood specimens to prepare them for micronutrient laboratory testing.

1.5.2 Training of Field Staff

The main training for the 2019–20 Rwanda DHS started on September 30 and ended on November 1, 2019. A total of 160 participants from all over the country were invited to take part in the training.

A variety of different learning tools were used in the training. The training was divided into questionnaire training, CAPI training, biomarker training (including venous blood collection and processing), and field practice. The biomarker technicians included at least one phlebotomist and one nurse for each fieldwork team.

The field coordinators were trained in the use of the Biomarker Checklist to ensure quality in terms of HIV testing and collection of biomarker data.

1.6 Fieldwork

Data collection was carried out by 17 field teams. Each team was provided a four-wheel-drive truck with a driver. All biomarker specimens were transferred to the NISR office every 3–4 days by 10 supervisors from NISR and the National Reference Laboratory (NRL) who also coordinated and supervised fieldwork activities. The fieldwork for the 2019–20 RDHS was carried out under close supervision starting on November 9, 2019. It was completed on July 20, 2020.

1.7 Data Processing

Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia (BRINDA) methodological approach. Ferritin and soluble transferrin (sTfR) levels (both measures of iron status) increase in response to inflammation. Retinol and retinol-binding protein (RBP) levels (both measures of vitamin A status) decrease in response to inflammation. To account for this, the BRINDA regression correction approach uses a linear regression to adjust for inflammation based on C-reactive protein (CRP) and/or alpha-1-acid glycoprotein (AGP). Ferritin is adjusted for CRP and AGP concentrations among children and women, sTfR is adjusted for AGP only among children and women, and retinol and RBP are adjusted for CRP and AGP among children only (Larson et al. 2018; Luo et al. 2023; Namaste et al. 2020; Raiten et al. 2011). The BRINDA inflammation adjustment R package was used to calculate the adjustments (BRINDA 2022). A total of 32.7% of CRP values among children, 34.4% of CRP values among nonpregnant women, and 12.1% of CRP values among pregnant women were below the limit of detection (<0.05) and these values were replaced with 0.04 in analyses. A total of 1.4% of RBP values among children, 5.4% of RBP values among nonpregnant women, and 2.4% of RBP values among pregnant women were above the limit of detection (>4.0) and these values were replaced with 4.1 in analyses. A total of 0.8% of sTfR values among children, 0.9% of sTfR values among nonpregnant women, and 2.0% of sTfR values among pregnant women were above the limit of detection (>40.0) and these values were replaced with 40.1 in analyses.

1.8 Coverage and Completeness

The overall response rates for the survey are provided in **Table 1.1**. **Tables 1.2**, **1.3**, and **1.4** present data on the coverage of testing and completeness of reporting for the micronutrient component of the survey.

1.9 Reading Tables

For further information on reading and understanding tables, see the final report.

List of Tables

Table 1.1 Results of the household and individual interviews

Number of households, number of interviews, and response rates, according to residence (unweighted), Rwanda DHS 2019–20

	Residence		
Result	Urban	Rural	Total
Household interviews			
Households selected	2,913	10,092	13,005
Households occupied	2,892	10,059	12,951
Households interviewed	2,892	10,057	12,949
Household response rate[1]	100.0	100.0	100.0
Interviews with women age 15–49			
Number of eligible women	3,564	11,111	14,675
Number of eligible women interviewed	3,551	11,083	14,634
Eligible women response rate[2]	99.6	99.7	99.7
Household interviews in men's subsample			
Households selected	1,456	5,047	6,503
Households occupied	1,441	5,031	6,472
Households interviewed	1,441	5,030	6,471
Household response rate in subsample[1]	100.0	100.0	100.0
Interviews with men age 15–59			
Number of eligible men	1,514	5,030	6,544
Number of eligible men interviewed	1,504	5,009	6,513
Eligible men response rate[2]	99.3	99.6	99.5
Household interviews in micronutrient subsample			
Households selected	784	2,717	3,501
Households occupied	784	2,708	3,492
Households interviewed	784	2,707	3,491
Household response rate in subsample[1]	100.0	100.0	100.0

[1] Households interviewed/households occupied
[2] Respondents interviewed/eligible respondents

Table 1.2 Coverage of testing for anemia, malaria, and micronutrient biomarkers in children

Percentage of eligible children age 6–59 months who were tested for anemia, malaria, and micronutrient biomarkers using venous blood and percentage who were tested for anemia using capillary blood, according to background characteristics (unweighted), Rwanda DHS 2019–20

	Percentage tested for:[1]		Percentage tested for:[2]						
Background characteristic	Anemia	Number of children	Anemia	Malaria with RDT	Ferritin	Retinol	Retinol-binding protein	Soluble transferrin receptor	Number of children
Age in months									
6–11	99.5	420	85.5	85.1	85.1	85.1	85.1	85.1	249
12–23	99.8	802	90.9	91.5	91.3	90.9	91.3	91.3	461
24–35	99.6	844	87.8	89.4	87.6	87.2	87.6	87.6	499
36–47	99.9	809	91.9	92.7	91.9	91.7	91.9	91.9	494
48–59	100.0	810	90.1	90.5	90.3	90.3	90.3	90.3	473
Sex									
Male	99.7	1,861	89.4	90.1	89.7	89.4	89.7	89.7	1,089
Female	99.9	1,824	89.8	90.6	89.6	89.4	89.6	89.6	1,087
Mother's interview status									
Interviewed	99.8	3,428	89.3	90.1	89.4	89.1	89.4	89.4	2,035
Not interviewed but in household	95.0	20	92.3	92.3	92.3	92.3	92.3	92.3	13
Not interviewed and not in the household[3]	100.0	237	93.8	93.8	93.8	93.8	93.8	93.8	128
Residence									
Urban	99.2	781	86.3	86.3	86.9	86.9	86.9	86.9	474
Rural	99.9	2,904	90.5	91.5	90.4	90.1	90.4	90.4	1,702
Province									
City of Kigali	99.5	415	92.0	92.0	92.4	92.4	92.4	92.4	238
South	99.8	855	92.8	92.8	93.0	92.8	93.0	93.0	514
West	99.8	911	88.8	90.8	88.6	88.2	88.6	88.6	552
North	100.0	592	91.3	93.1	91.0	90.4	91.0	91.0	334
East	99.8	912	85.3	85.1	85.5	85.5	85.5	85.5	538
Mother's education[4]									
No education	100.0	410	90.7	92.0	91.2	90.7	91.2	91.2	226
Primary	99.9	2,232	91.0	92.0	90.9	90.6	90.9	90.9	1,317
Secondary	99.8	640	84.8	84.8	84.8	84.8	84.8	84.8	396
More than secondary	97.0	166	83.5	83.5	84.4	84.4	84.4	84.4	109
Wealth quintile									
Lowest	100.0	872	92.8	92.4	93.0	92.4	93.0	93.0	527
Second	100.0	763	88.5	90.0	88.2	88.2	88.2	88.2	399
Middle	99.9	691	91.1	92.5	91.1	90.8	91.1	91.1	425
Fourth	99.9	684	90.9	92.4	90.9	90.7	90.9	90.9	408
Highest	99.1	675	83.9	83.9	84.2	84.2	84.2	84.2	417
Total	99.8	3,685	89.6	90.3	89.7	89.4	89.7	89.7	2,176

RDT = rapid diagnostic test (SD Bioline Malaria Ag P.f)
[1] Tested using capillary blood
[2] Tested using venous blood
[3] Includes children whose mothers are deceased
[4] For women who are not interviewed, information is taken from the Household Questionnaire. Excludes children whose mothers are not listed in the Household Questionnaire.

Table 1.3 Coverage of testing for anemia, malaria, and micronutrient biomarkers in women

Percentage of eligible women age 15–49 who were tested for anemia, malaria, and micronutrient biomarkers using venous blood and percentage who were tested for anemia using capillary blood, according to background characteristics (unweighted), Rwanda DHS 2019–20

	Percentage tested for:[1]		Percentage tested for:[2]						
Background characteristic	Anemia	Number of women	Anemia	Malaria with RDT	Ferritin	Retinol	Retinol-binding protein	Soluble transferrin receptor	Number of women
Age									
15–19	99.8	1,674	99.6	99.4	99.4	99.3	99.4	99.4	899
20–29	99.7	2,166	99.4	99.4	99.3	99.0	99.3	99.3	1,255
30–39	99.8	2,101	99.3	99.2	99.2	99.1	99.2	99.2	1,137
40–49	99.6	1,378	100.0	100.0	100.0	100.0	100.0	100.0	713
Maternity status									
Pregnant	99.8	414	99.6	99.6	99.6	99.6	99.6	99.6	248
Not pregnant[3]	99.7	6,905	99.5	99.4	99.4	99.3	99.4	99.4	3,756
Residence									
Urban	99.0	1,795	98.7	98.7	98.7	98.4	98.7	98.7	975
Rural	100.0	5,524	99.8	99.7	99.7	99.6	99.7	99.7	3,029
Province									
City of Kigali	99.4	947	99.3	99.4	99.4	99.3	99.4	99.4	539
South	99.8	1,744	99.8	99.7	99.5	99.4	99.5	99.5	939
West	99.8	1,677	99.9	99.7	99.9	99.9	99.9	99.9	887
North	99.8	1,134	99.2	99.2	99.0	98.9	99.0	99.0	621
East	99.8	1,817	99.2	99.2	99.2	99.0	99.2	99.2	1,018
Education									
No education	99.7	703	99.7	99.4	99.7	99.4	99.7	99.7	356
Primary	99.8	4,233	99.9	99.8	99.8	99.7	99.8	99.8	2,338
Secondary	99.8	2,042	99.2	99.1	99.0	98.8	99.0	99.0	1,124
More than secondary	98.2	341	96.2	96.8	96.8	96.8	96.8	96.8	186
Wealth quintile									
Lowest	100.0	1,335	100.0	100.0	100.0	100.0	100.0	100.0	813
Second	99.9	1,394	99.9	99.7	99.9	99.7	99.9	99.9	712
Middle	99.9	1,354	100.0	99.9	99.6	99.5	99.6	99.6	787
Fourth	100.0	1,478	99.7	99.7	99.7	99.7	99.7	99.7	753
Highest	99.0	1,758	98.2	98.2	98.2	97.9	98.2	98.2	939
Total	99.7	7,319	99.5	99.5	99.4	99.3	99.4	99.4	4,004

RDT = rapid diagnostic test (SD Bioline Malaria Ag P.f)
[1] Tested using capillary blood
[2] Tested using venous blood
[3] Includes women who do not know if they are pregnant

Table 1.4 Coverage of testing for urinary iodine in women

Percentage of eligible women age 15–49 who were tested for urinary iodine, according to background characteristics (unweighted), Rwanda DHS 2019–20

Background characteristic	Percentage tested for: Urinary iodine	Number of women
Age		
15–19	99.4	899
20–29	99.2	1,255
30–39	99.0	1,137
40–49	100.0	713
Maternity status		
Pregnant	99.6	248
Not pregnant[1]	99.3	3,756
Residence		
Urban	98.7	975
Rural	99.6	3,029
Province		
City of Kigali	99.4	539
South	99.5	939
West	99.5	887
North	99.0	621
East	99.2	1,018
Education		
No education	99.7	356
Primary	99.7	2,338
Secondary	99.0	1,124
More than secondary	96.8	186
Wealth quintile		
Lowest	99.8	813
Second	99.9	712
Middle	99.5	787
Fourth	99.7	753
Highest	98.2	939
Total	99.4	4,004

[1] Includes women who do not know if they are pregnant

INFLAMMATION STATUS 2

Inflammation is the body's response to acute, chronic, or subclinical infections, trauma, and disease (Raiten et al. 2011). Prolonged anemia, referred to as "anemia of inflammation" or "anemia of chronic disease," is the result of iron being unavailable for hemoglobin production (sequestered in cells) although iron is present in the bone marrow (Weiss and Goodnough 2005). C-reactive protein (CRP) and alpha-1-acid glycoprotein (AGP) are acute phase proteins released by the liver in response to inflammation and are commonly used to measure inflammation (CDC 2020). CRP concentrations rise and fall quickly, while AGP concentrations rise slowly and remain elevated longer; thus, together these biomarkers capture acute and chronic inflammation. CRP and AGP were measured to assess the prevalence of acute and chronic inflammation. CRP and AGP concentrations were also used to aid in the interpretation of iron and vitamin A biomarkers (see Section 1.7).

Acute inflammation in children and women

Percentage of children age 6–59 months or women with a CRP level of higher than 5 milligrams per liter.

Sample: Children age 6–59 months, nonpregnant women age 15–49, and pregnant women age 15–49

Chronic inflammation in children and women

Percentage of children age 6–59 months or women with an AGP level of higher than 1 gram per liter.

Sample: Children age 6–59 months, nonpregnant women age 15–49, and pregnant women age 15–49

Any inflammation in children and women

Percentage of children age 6–59 months or women with a CRP level of higher than 5 milligrams per liter or an AGP level of higher than 1 gram per liter.

Sample: Children age 6–59 months, nonpregnant women age 15–49, and pregnant women age 15–49

2.1 Inflammation Status of Children

Table 2.1 shows that 14% of children age 6–59 months have an elevated CRP (acute inflammatory status), 31% have an elevated AGP (chronic inflammation), and 34% have elevations in both markers (any inflammation). **Table 2.1** also presents information on differences according to background characteristics.

2.2 Inflammation Status of Women

Eleven percent of women age 15–49 have an elevated CRP (acute inflammatory status), 15% have an elevated AGP (chronic inflammation), and 20% have elevations in both markers (any inflammation) (**Table 2.2**). Differences according to background characteristics are presented in **Table 2.2**.

Table 2.3 shows that 19% of pregnant women have an elevated CRP (acute inflammatory status), 6% have an elevated AGP (chronic inflammation), and 21% have elevations in both markers (any inflammation).

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Table 2.1 Inflammation status of children: Micronutrient subsample

Median (IQR) concentration of C-reactive protein (CRP) and alpha-1-acid glycoprotein (AGP) and percentage of children age 6–59 months in the micronutrient subsample classified as having elevated CRP, elevated AGP, and any inflammation, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	CRP (mg/L)			Percentage with elevated CRP	AGP (g/L)			Percentage with elevated AGP	Percentage with any inflammation (CRP >5 mg/L or AGP >1 g/L)	Number of children age 6–59 months
	Median	Q1	Q3	(>5 mg/L)	Median	Q1	Q3	(>1 g/L)		
Age in months										
6–11	0.52	0.04	3.29	21.1	0.88	0.71	1.13	35.9	41.1	214
12–23	0.53	0.04	2.45	13.7	0.82	0.67	1.06	29.0	31.7	442
24–35	0.27	0.04	1.50	13.4	0.87	0.67	1.10	31.5	34.2	449
36–47	0.31	0.04	1.81	14.4	0.85	0.72	1.11	33.3	36.4	453
48–59	0.14	0.04	1.21	12.2	0.80	0.65	1.02	26.5	29.7	437
6–23	0.53	0.04	2.57	16.1	0.84	0.68	1.09	31.2	34.8	656
24–59	0.23	0.04	1.50	13.4	0.83	0.68	1.08	30.5	33.5	1,339
Sex										
Male	0.27	0.04	1.81	13.9	0.84	0.68	1.07	30.9	33.9	987
Female	0.36	0.04	1.91	14.6	0.84	0.67	1.09	30.6	33.9	1,008
Malaria RDT[1]										
Positive	(2.72)	(0.37)	(16.64)	(45.0)	(1.12)	(0.87)	(1.49)	(55.2)	(58.0)	35
Negative	0.30	0.04	1.77	13.7	0.83	0.68	1.07	30.2	33.4	1,957
Missing	*	*	*	*	*	*	*	*	*	3
Anemia status[2]										
Anemic (hemoglobin <11 g/dl)	0.58	0.04	3.64	21.0	0.89	0.71	1.14	35.8	39.2	443
Not anemic (hemoglobin ≥11 g/dl)	0.26	0.04	1.55	12.3	0.83	0.67	1.06	29.3	32.4	1,552
Residence										
Urban	0.32	0.04	1.69	13.1	0.80	0.66	0.99	23.6	28.0	355
Rural	0.31	0.04	1.93	14.5	0.85	0.68	1.10	32.3	35.2	1,640
Province										
City of Kigali	0.24	0.04	1.76	12.9	0.79	0.65	0.99	22.7	26.3	267
South	0.35	0.04	2.31	15.8	0.86	0.68	1.10	31.7	35.5	429
West	0.35	0.04	2.06	15.8	0.89	0.73	1.14	34.9	37.9	466
North	0.24	0.04	1.59	15.0	0.88	0.70	1.13	35.5	37.3	306
East	0.36	0.04	1.61	11.9	0.82	0.64	1.03	27.6	30.9	527
Mother's education[3]										
No education	0.28	0.04	1.89	14.8	0.83	0.72	1.08	31.8	34.1	210
Primary	0.33	0.04	1.95	14.0	0.85	0.68	1.11	32.2	35.2	1,218
Secondary	0.37	0.04	1.81	15.2	0.80	0.65	1.00	24.5	29.6	360
More than secondary	0.29	0.04	1.39	10.6	0.79	0.65	1.09	33.1	34.5	88
Wealth quintile										
Lowest	0.47	0.04	2.69	17.3	0.89	0.72	1.13	35.2	39.6	475
Second	0.51	0.04	1.99	16.3	0.89	0.73	1.15	35.9	38.8	365
Middle	0.24	0.04	1.69	11.7	0.83	0.66	1.07	30.0	31.5	399
Fourth	0.24	0.04	1.59	14.6	0.81	0.65	1.05	27.8	30.8	383
Highest	0.24	0.04	1.50	10.9	0.78	0.64	1.00	23.9	27.7	373
Total	0.31	0.04	1.87	14.3	0.84	0.68	1.08	30.7	33.9	1,995

Note: Inflammation is based on CRP, AGP, or both and cutoffs defined in WHO 2020. CRP is measured in milligrams per liter (mg/L) and AGP in grams per liter (g/L). Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] The SD Bioline Malaria Ag P.f rapid diagnostic test (RDT) was used to test for malaria.
[2] The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device.
[3] For women who are not interviewed, information is taken from the Household Questionnaire. Excludes children whose mothers are not listed in the Household Questionnaire.

Table 2.2 Inflammation status of nonpregnant women: Micronutrient subsample

Median (IQR) concentration of C-reactive protein (CRP) and alpha-1-acid glycoprotein (AGP) and percentage of nonpregnant women age 15–49 in the micronutrient subsample classified as having elevated CRP, elevated AGP, and any inflammation, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	CRP (mg/L) Median	CRP (mg/L) Q1	CRP (mg/L) Q3	Percentage with elevated CRP (>5 mg/L)	AGP (g/L) Median	AGP (g/L) Q1	AGP (g/L) Q3	Percentage with elevated AGP (>1 g/L)	Percentage with any inflammation (CRP >5 mg/L or AGP >1 g/L)	Number of non-pregnant women[1]
Age										
15–19	0.11	0.04	0.79	7.7	0.75	0.63	0.92	16.0	18.2	883
20–29	0.27	0.04	1.35	11.5	0.73	0.61	0.88	15.0	19.8	1,139
30–39	0.32	0.04	1.48	11.2	0.73	0.60	0.90	15.2	20.2	1,047
40–49	0.40	0.04	1.69	11.1	0.74	0.60	0.89	15.7	21.6	687
Malaria RDT[2]										
Positive	4.36	0.21	10.06	43.7	0.97	0.74	1.17	47.0	61.5	61
Negative	0.25	0.04	1.26	9.9	0.73	0.61	0.90	14.9	19.1	3,692
Other	*	*	*	*	*	*	*	*	*	3
Anemia status[3]										
Anemic (hemoglobin <12 g/dl)	0.56	0.04	3.02	19.8	0.79	0.64	1.01	26.7	32.7	387
Not anemic (hemoglobin ≥12 g/dl)	0.23	0.04	1.18	9.4	0.73	0.61	0.89	14.1	18.4	3,368
Residence										
Urban	0.43	0.04	2.05	15.3	0.74	0.61	0.90	14.0	22.6	747
Rural	0.22	0.04	1.14	9.3	0.73	0.61	0.90	15.8	19.2	3,009
Province										
City of Kigali	0.48	0.04	2.21	15.6	0.74	0.61	0.90	13.6	23.5	578
South	0.26	0.04	1.39	11.7	0.76	0.63	0.95	19.6	23.3	768
West	0.12	0.04	0.96	8.0	0.73	0.61	0.90	16.4	19.0	793
North	0.17	0.04	0.92	7.1	0.73	0.60	0.89	13.1	15.1	564
East	0.32	0.04	1.38	10.4	0.73	0.60	0.88	13.8	18.4	1,052
Education										
No education	0.26	0.04	1.29	10.3	0.75	0.62	0.91	16.5	20.5	324
Primary	0.25	0.04	1.24	10.0	0.73	0.61	0.90	16.1	20.1	2,215
Secondary	0.23	0.04	1.24	10.2	0.74	0.61	0.88	13.3	18.1	1,061
More than secondary	1.03	0.15	3.00	18.6	0.77	0.63	0.95	18.1	26.7	155
Wealth quintile										
Lowest	0.16	0.04	0.88	10.0	0.75	0.61	0.93	19.2	21.6	748
Second	0.15	0.04	1.02	8.8	0.74	0.62	0.92	17.4	21.1	677
Middle	0.20	0.04	1.00	8.7	0.71	0.59	0.89	14.9	18.1	734
Fourth	0.35	0.04	1.40	10.7	0.73	0.60	0.86	11.0	16.3	732
Highest	0.46	0.04	2.03	13.5	0.76	0.61	0.89	14.7	21.8	865
Total	0.26	0.04	1.32	10.5	0.74	0.61	0.90	15.4	19.8	3,755

Note: Inflammation is based on CRP, AGP, or both and cutoffs defined in WHO 2020. CRP is measured in milligrams per liter (mg/L) and AGP in grams per liter (g/L). An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] Includes women who do not know if they are pregnant
[2] The SD Bioline Malaria Ag P.f rapid diagnostic test (RDT) was used to test for malaria.
[3] The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device.

Table 2.3 Inflammation status of pregnant women: Micronutrient subsample

Median (IQR) concentration of C-reactive protein (CRP) and alpha-1-acid glycoprotein (AGP) and percentage of pregnant women age 15–49 in the micronutrient subsample classified as having elevated CRP, elevated AGP, and any inflammation, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	CRP (mg/L)			Percentage with elevated CRP (>5 mg/L)	AGP (g/L)			Percentage with elevated AGP (>1 g/L)	Percentage with any inflammation (CRP >5 mg/L or AGP >1 g/L)	Number of pregnant women
	Median	Q1	Q3		Median	Q1	Q3			
Age										
15–19	*	*	*	*	*	*	*	*	*	16
20–29	1.57	0.31	3.79	16.8	0.60	0.49	0.77	5.2	18.5	117
30–39	1.28	0.32	4.37	21.9	0.59	0.48	0.81	8.2	25.1	103
40–49	*	*	*	*	*	*	*	*	*	12
Malaria RDT[1]										
Negative	1.41	0.28	3.73	18.5	0.60	0.49	0.78	6.3	20.6	247
Anemia status[2]										
Anemic (hemoglobin <11 g/dl)	(1.59)	(0.05)	(4.56)	(24.9)	(0.59)	(0.49)	(0.77)	(6.2)	(26.9)	44
Not anemic (hemoglobin ≥11 g/dl)	1.40	0.32	3.21	17.1	0.60	0.49	0.78	6.3	19.3	204
Residence										
Urban	0.93	0.10	3.79	20.2	0.65	0.50	0.81	8.0	24.3	48
Rural	1.52	0.30	3.61	18.1	0.60	0.48	0.75	5.8	19.8	200
Province										
City of Kigali	(0.89)	(0.20)	(3.79)	(24.6)	(0.77)	(0.54)	(0.86)	(12.4)	(30.9)	31
South	1.42	0.12	4.31	18.3	0.60	0.47	0.77	5.9	19.9	59
West	1.18	0.35	3.09	13.8	0.59	0.47	0.69	3.1	13.8	51
North	(1.59)	(0.77)	(2.97)	(13.8)	(0.55)	(0.49)	(0.73)	(2.6)	(16.4)	38
East	1.55	0.30	4.07	21.9	0.64	0.50	0.80	8.2	24.1	69
Education										
No education	(1.55)	(0.77)	(2.65)	(15.3)	(0.59)	(0.50)	(0.80)	(4.2)	(15.3)	28
Primary	1.07	0.20	3.79	18.4	0.59	0.48	0.75	7.4	20.8	142
Secondary	1.55	0.25	3.53	13.3	0.64	0.50	0.79	3.1	13.3	60
More than secondary	*	*	*	*	*	*	*	*	*	18
Wealth quintile										
Lowest	(0.95)	(0.32)	(2.48)	(22.4)	(0.56)	(0.45)	(0.72)	(3.7)	(22.4)	40
Second	2.17	0.75	4.07	13.2	0.56	0.47	0.69	3.7	15.1	53
Middle	0.89	0.17	3.04	18.2	0.60	0.51	0.81	10.9	20.8	57
Fourth	(1.55)	(0.30)	(4.87)	(23.4)	(0.71)	(0.55)	(0.86)	(6.4)	(23.4)	44
Highest	1.32	0.08	3.73	17.1	0.61	0.49	0.80	5.6	22.4	54
Total	1.41	0.28	3.73	18.5	0.60	0.49	0.78	6.3	20.6	247

Note: Inflammation is based on CRP, AGP, or both and cutoffs defined in WHO 2020. CRP is measured in milligrams per liter (mg/L) and AGP in grams per liter (g/L). Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] The SD Bioline Malaria Ag P.f rapid diagnostic test (RDT) was used to test for malaria.
[2] The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device.

ANEMIA, IRON STATUS, AND IRON DEFICIENCY ANEMIA 3

Anemia is a condition characterized by insufficient hemoglobin, a protein responsible for transporting oxygen in the blood (Chaparro and Suchdev 2019). In children, anemia can impair cognitive development and is associated with long-term health consequences. When anemia is severe, it can cause death (Chaparro and Suchdev 2019). Anemia in adults can cause fatigue, lethargy, reduced physical productivity, and poor work performance (Chaparro and Suchdev 2019). Anemia is a major concern among pregnant women because it can lead to increased maternal mortality and poor birth outcomes (Haider et al. 2013). Iron deficiency is the main nutritional cause of anemia, but the condition also results from deficiencies in other micronutrients, such as vitamin B12, folate, and vitamin A, along with non-nutritional causes, including malaria, other infections, and hemoglobinopathies (Chaparro and Suchdev 2019).

Iron is a micronutrient that plays an important role in numerous biological systems. Iron deficiency is one of the primary causes of anemia. Iron is critical for cognitive development, and iron deficiency during the first 2 years of life can cause long-lasting neural, developmental, and behavioral effects.

The micronutrient component included an assessment of the prevalence of anemia, iron deficiency anemia, and iron deficiency. Anemia was assessed based on low hemoglobin concentrations. Hemoglobin levels are influenced by altitude and smoking status and are adjusted accordingly (WHO 2011). Ferritin was the primary biomarker used to assess iron status. Low levels of ferritin indicate insufficient iron reserves and the beginning stages of iron deficiency. When iron levels are inadequate to support red blood cell production, this is classified as iron deficiency anemia. Ferritin, in combination with hemoglobin, was used to differentiate anemia with and without iron deficiency. A secondary measure used to assess iron status was soluble transferrin receptor (sTfR) levels. The production of sTfR increases in response to the cellular demand for iron and is a measure of low tissue iron stores. Inflammation adjustments were made to ferritin and sTfR because these biomarkers are directly or indirectly influenced by inflammation (see Section 1.7).

3.1 Anemia, Iron Status, and Iron Deficiency Anemia among Children

Anemia in children

Anemia status	Hemoglobin level in grams/deciliter*
Anemic	<11.0
– Mildly anemic	10.0–10.9
– Moderately anemic	7.0–9.9
– Severely anemic	<7.0
Not anemic	≥11.0

* Hemoglobin levels are adjusted for altitude in enumeration areas above 1,000 meters using formulas in CDC 1998 and cutoffs defined in WHO 2017.

Sample: Children age 6–59 months

Iron deficiency in children

Percentage of children age 6–59 months with a ferritin level of less than 12 micrograms per liter.*

* Ferritin levels are adjusted for inflammation using the regression correction approach.

Sample: Children age 6–59 months

Low tissue iron stores in children

Percentage of children age 6–59 months with a soluble transferrin receptor level of less than 8.3 milligrams per liter.*

* Soluble transferrin receptor levels are adjusted for inflammation using the regression correction approach.

Sample: Children age 6–59 months

The results in **Table 3.1** show that 22% of children have any anemia, with 15% having mild anemia, 7% having moderate anemia, and less than 1% having severe anemia.

Table 3.2 presents data on the prevalence of iron deficiency and iron deficiency anemia. Eight percent of children have ferritin levels of less than 12 micrograms per liter (iron deficiency), and 4% have iron deficiency anemia.

Differences in anemia prevalence, iron deficiency, and iron deficiency anemia according to background characteristics are presented in **Tables 3.1** and **3.2**.

Data on iron deficiency and iron deficiency anemia unadjusted for inflammation are provided in Appendix A, **Table A.1**. Information on low tissue iron stores (based on sTfR) is provided in Appendix A, **Table A.4**.

3.2 Anemia, Iron Status, and Iron Deficiency Anemia among Women

Anemia in nonpregnant women

Anemia status	Hemoglobin level in grams/ deciliter*
Anemic	<12.0
– Mildly anemic	11.0–11.9
– Moderately anemic	8.0–10.9
– Severely anemic	<8.0
Not anemic	≥12.0

* Hemoglobin levels are adjusted for cigarette smoking and for altitude in enumeration areas above 1,000 meters.

Sample: Nonpregnant women age 15–49

Anemia in pregnant women

Anemia status	Hemoglobin level in grams/ deciliter*
Anemic	<11.0
– Mildly anemic	10.0–10.9
– Moderately anemic	7.0–9.9
– Severely anemic	<7.0
Not anemic	≥11.0

* Hemoglobin levels are adjusted for cigarette smoking and for altitude in enumeration areas above 1,000 meters.

Sample: Pregnant women age 15–49

Iron deficiency in women

Percentage of women with a ferritin level of less than 15 micrograms per liter.*

* Ferritin levels are adjusted for inflammation using the regression correction approach.

Sample: Nonpregnant women age 15–49 and pregnant women age 15–49

Low tissue iron stores in women

Percentage of women with a soluble transferrin receptor level of less than 8.3 milligrams per liter.*

* Soluble transferrin receptor levels are adjusted for inflammation using the regression correction approach.

Sample: Nonpregnant women age 15–49 and pregnant women age 15–49

Nonpregnant women: The results in **Table 3.3** show that 10% of women age 15–49 have some degree of anemia. Seven percent are mildly anemic, 3% are moderately anemic, and less than 1% are severely anemic.

Nine percent of nonpregnant women have ferritin levels of less than 15 micrograms per liter (iron deficiency), and 3% have iron deficiency anemia (**Table 3.4**).

Tables 3.3 and **3.4** also present differences by background characteristics in anemia prevalence, iron deficiency, and iron deficiency anemia among nonpregnant women.

Data on iron deficiency and iron deficiency anemia among nonpregnant women unadjusted for inflammation are provided in Appendix A, **Table A.2**, and information on low tissue iron stores (based on sTfR) is provided in Appendix A, **Table A.5**.

Pregnant women: Overall, 18% of women age 15–49 have some degree of anemia. Nine percent are mildly anemic, 9% are moderately anemic, and less than 1% are severely anemic (**Table 3.5**).

Table 3.6 shows that 15% of pregnant women have ferritin levels of less than 12 micrograms per liter (iron deficiency) and 4% have iron deficiency anemia.

Data on iron deficiency and iron deficiency anemia among nonpregnant women unadjusted for inflammation are provided in Appendix A, **Table A.3**, and information on low tissue iron stores (based on sTfR) is provided in Appendix A, **Table A.6**.

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Table 3.1 Anemia in children: Micronutrient subsample

Median (IQR) concentration and percentage of children age 6–59 months in the micronutrient subsample classified as having anemia, according to background characteristics, Rwanda DHS 2019–20

	Hemoglobin (g/dl)			Anemia status by hemoglobin level				
Background characteristic	Median	Q1	Q3	Any (<11.0 g/dl)	Mild (10.0–10.9 g/dl)	Moderate (7.0–9.9 g/dl)	Severe (<7.0 g/dl)	Number of children age 6–59 months
Age in months								
6–11	10.7	10.1	11.5	52.3	31.3	21.0	0.0	215
12–23	11.5	10.7	12.2	30.8	22.8	7.5	0.5	445
24–35	11.8	11.1	12.5	17.4	11.2	6.2	0.0	450
36–47	12.0	11.3	12.6	13.9	10.7	3.2	0.0	454
48–59	12.1	11.5	12.8	12.1	9.5	2.7	0.0	437
6–23	11.3	10.5	12.0	37.8	25.6	11.9	0.3	659
24–59	12.0	11.3	12.6	14.5	10.5	4.0	0.0	1,341
Sex								
Male	11.7	10.9	12.4	25.3	17.7	7.4	0.1	987
Female	11.8	11.1	12.5	19.1	13.2	5.9	0.1	1,013
Malaria RDT[1]								
Positive	(10.4)	(9.5)	(11.2)	(69.9)	(33.8)	(33.4)	(2.6)	35
Negative	11.8	11.1	12.5	21.3	15.1	6.1	0.1	1,963
Missing	*	*	*	*	*	*	*	3
Mother's interview status								
Interviewed	11.8	11.0	12.5	22.3	15.7	6.4	0.1	1,870
Not interviewed but in household	*	*	*	*	*	*	*	11
Not interviewed and not in the household[2]	11.8	11.1	12.4	19.8	10.5	9.3	0.0	119
Nutrition supplements in last week[3,4]								
Yes	11.7	10.8	12.3	26.9	19.2	7.5	0.2	319
No	11.8	11.1	12.5	21.3	14.7	6.4	0.1	1,681
Don't know/missing	*	*	*	*	*	*	*	0
Ongera intungamubiri in last week[4,5,6,7]								
Yes	11.6	10.8	12.2	26.6	15.9	10.4	0.4	178
No	11.5	10.7	12.3	30.1	20.9	9.0	0.2	886
Deworming medication in last 6 months[4,6,8,9]								
Yes	11.9	11.1	12.5	18.0	13.3	4.6	0.1	1,547
No	11.2	10.4	12.1	43.0	27.6	15.0	0.3	321
Don't know	*	*	*	*	*	*	*	2
Residence								
Urban	11.9	11.0	12.6	22.0	16.4	5.5	0.2	355
Rural	11.7	11.0	12.4	22.2	15.3	6.9	0.1	1,645
Province								
City of Kigali	11.9	11.0	12.7	24.6	17.8	6.8	0.0	267
South	11.6	10.8	12.2	26.1	16.9	9.1	0.2	429
West	11.8	11.1	12.5	21.7	15.6	6.1	0.0	470
North	11.8	11.1	12.5	22.4	15.2	7.0	0.3	307
East	11.9	11.1	12.5	18.0	13.1	4.8	0.1	527
Mother's education[10]								
No education	11.6	11.0	12.3	23.8	16.5	7.0	0.3	210
Primary	11.8	11.0	12.4	22.5	16.2	6.2	0.1	1,223
Secondary	11.8	11.0	12.5	22.1	14.1	7.9	0.0	360
More than secondary	12.2	11.5	12.9	17.0	14.0	3.1	0.0	88
Wealth quintile								
Lowest	11.7	11.0	12.3	25.0	15.6	9.0	0.3	476
Second	11.6	11.0	12.3	24.1	16.8	7.2	0.0	366
Middle	11.8	11.1	12.5	19.4	14.9	4.3	0.2	400
Fourth	11.8	11.0	12.5	22.5	16.4	6.2	0.0	386
Highest	12.0	11.2	12.7	19.4	13.5	5.9	0.0	373

Continued…

Table 3.1—*Continued*

Background characteristic	Hemoglobin (g/dl)			Anemia status by hemoglobin level				
	Median	Q1	Q3	Any (<11.0 g/dl)	Mild (10.0–10.9 g/dl)	Moderate (7.0–9.9 g/dl)	Severe (<7.0 g/dl)	Number of children age 6–59 months
Total	11.8	11.0	12.5	22.2	15.4	6.6	0.1	2,001

Note: Table is based on children who stayed in the household on the night before the interview and who were tested for anemia. The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] The SD Bioline Malaria Ag P.f rapid diagnostic test (RDT) was used to test for malaria.
[2] Includes children whose mothers are deceased
[3] Nootritoto, Shisha Kibondo, Sosoma fortified, or CSB+
[4] Based on mother's recall
[5] Local name for multiple micronutrient powders
[6] Excludes children whose mothers were not interviewed
[7] Restricted to children age 6–23 months
[8] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.
[9] Restricted to children age 12–59 months
[10] For women who are not interviewed, information is taken from the Household Questionnaire. Excludes children whose mothers are not listed in the Household Questionnaire.

Table 3.2 Iron deficiency and iron deficiency anemia in children: Micronutrient subsample

Median (IQR) concentration of inflammation-adjusted ferritin and percentage of children age 6–59 months in the micronutrient subsample classified as having inflammation-adjusted iron deficiency and iron deficiency anemia, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Adjusted ferritin (µg/L)			Percentage with adjusted iron deficiency (ferritin <12 µg/L)	Percentage with adjusted iron deficiency anemia (ferritin <12 µg/L and hemoglobin <11 g/dl)	Number of children age 6–59 months
	Median	Q1	Q3			
Age in months						
6–11	32.2	15.2	57.6	19.2	14.0	214
12–23	32.8	19.6	54.2	11.6	8.5	442
24–35	37.7	26.6	52.0	6.3	2.1	449
36–47	41.9	28.0	60.7	5.0	1.0	453
48–59	46.8	33.0	63.8	4.5	0.7	437
6–23	32.5	18.6	55.2	14.0	10.3	656
24–59	41.8	28.9	59.6	5.3	1.3	1,339
Sex						
Male	37.7	23.9	56.7	9.8	5.2	987
Female	40.8	26.4	60.3	6.6	3.3	1,008
Malaria RDT[1]						
Positive	(70.3)	(45.4)	(93.0)	(5.7)	(5.7)	35
Negative	38.7	25.1	57.2	8.2	4.2	1,957
Missing	*	*	*	*	*	3
Mother's interview status						
Interviewed	38.4	24.8	57.6	8.5	4.5	1,864
Not interviewed but in household	*	*	*	*	*	11
Not interviewed and not in the household[2]	45.7	32.8	63.8	4.0	0.0	119
Nutrition supplements in last week[3,4]						
Yes	37.4	22.6	55.3	10.5	6.2	319
No	39.5	25.7	58.8	7.7	3.9	1,675
Don't know/missing	*	*	*	*	*	0
Ongera intungamubiri in last week[4,5,6,7]						
Yes	37.1	25.8	56.0	5.5	4.7	178
No	34.2	20.1	53.2	12.5	7.8	882
Deworming medication in last 6 months[4,6,8,9]						
Yes	39.0	25.8	57.1	7.4	3.5	1,543
No	35.5	18.8	62.1	13.6	9.2	320
Don't know	*	*	*	*	*	2
Residence						
Urban	32.7	18.8	50.0	13.7	6.4	355
Rural	40.7	26.5	60.4	7.0	3.8	1,640
Province						
City of Kigali	32.8	19.0	53.9	12.0	5.4	267
South	38.6	25.8	58.6	6.4	3.1	429
West	43.9	29.8	66.3	5.6	3.6	466
North	40.8	28.1	55.7	5.8	3.4	306
East	37.1	22.8	55.8	11.3	5.6	527
Mother's education[10]						
No education	44.0	29.8	66.4	5.3	3.7	210
Primary	39.4	26.1	58.3	6.4	3.3	1,218
Secondary	34.6	18.5	50.6	15.0	8.6	360
More than secondary	34.9	17.3	54.1	17.5	6.2	88
Wealth quintile						
Lowest	42.6	29.6	60.4	4.7	3.0	475
Second	41.3	25.9	62.4	7.8	4.3	365
Middle	41.6	28.7	60.9	5.3	1.9	399
Fourth	35.7	23.1	55.4	9.3	5.1	383
Highest	32.0	18.7	52.0	14.9	7.4	373

Continued…

Table 3.2—*Continued*

Background characteristic	Adjusted ferritin (µg/L) Median	Q1	Q3	Percentage with adjusted iron deficiency (ferritin <12 µg/L)	Percentage with adjusted iron deficiency anemia (ferritin <12 µg/L and hemoglobin <11 g/dl)	Number of children age 6–59 months
Total	39.1	25.4	58.3	8.2	4.2	1,995

Note: Ferritin and prevalence of iron deficiency, based on ferritin levels, are adjusted for inflammation using the regression correction approach and cutoff defined in WHO 2020. The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Ferritin is measured in micrograms per liter (µg/L). Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] The SD Bioline Malaria Ag P.f rapid diagnostic test (RDT) was used to test for malaria.
[2] Includes children whose mothers are deceased
[3] Nootritoto, Shisha Kibondo, Sosoma fortified, or CSB+
[4] Based on mother's recall
[5] Local name for multiple micronutrient powders
[6] Excludes children whose mothers were not interviewed
[7] Restricted to children age 6–23 months
[8] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.
[9] Restricted to children age 12–59 months
[10] For women who are not interviewed, information is taken from the Household Questionnaire. Excludes children whose mothers are not listed in the Household Questionnaire.

Table 3.3 Anemia in nonpregnant women: Micronutrient subsample

Median (IQR) concentration and percentage of nonpregnant women age 15–49 in the micronutrient subsample classified as having anemia, according to background characteristics, Rwanda DHS 2019–20

	Hemoglobin (g/dl)			Anemia status by hemoglobin level				
Background characteristic	Median	Q1	Q3	Any (<12.0 g/dl)	Mild (11.0–11.9 g/dl)	Moderate (8.0–10.9 g/dl)	Severe (<8.0 g/dl)	Number of non-pregnant women[1]
Age								
15–19	13.4	12.6	13.9	10.2	6.8	3.1	0.2	884
20–29	13.4	12.6	14.1	10.3	6.7	3.3	0.4	1,140
30–39	13.6	12.8	14.2	8.6	5.5	2.5	0.5	1,048
40–49	13.4	12.6	14.1	13.1	8.3	4.4	0.5	687
Number of children ever born								
0	13.4	12.6	14.0	10.0	6.7	2.9	0.4	1,393
1–3	13.5	12.7	14.2	10.1	6.4	3.4	0.3	1,405
4+	13.4	12.7	14.1	11.1	7.0	3.5	0.6	961
Contraceptive use								
IUD/injectables/implants/pills	13.6	12.8	14.3	7.5	4.8	2.4	0.3	1,237
Other contraception	13.4	12.7	14.0	8.4	6.5	1.9	0.0	292
No	13.4	12.5	14.0	12.1	7.7	3.9	0.5	2,230
Breastfeeding status								
Breastfeeding	13.4	12.6	14.1	11.2	7.1	3.9	0.2	988
Not breastfeeding	13.5	12.7	14.1	10.0	6.5	3.0	0.5	2,771
Malaria RDT[2]								
Positive	12.1	11.2	13.3	48.4	28.8	16.6	3.0	61
Negative	13.5	12.7	14.1	9.7	6.3	3.0	0.4	3,695
Other	*	*	*	*	*	*	*	3
Nutrition supplements in last week[3]								
Yes	13.5	12.6	14.1	9.2	6.4	2.3	0.4	355
No	13.4	12.7	14.1	10.4	6.7	3.3	0.4	3,403
Missing	*	*	*	*	*	*	*	1
Residence								
Urban	13.5	12.7	14.1	11.7	5.6	5.3	0.7	747
Rural	13.4	12.7	14.1	10.0	6.9	2.7	0.3	3,011
Province								
City of Kigali	13.5	12.6	14.1	13.5	6.9	6.3	0.3	578
South	13.4	12.7	14.2	11.1	7.5	3.2	0.4	771
West	13.3	12.5	13.9	12.1	8.9	2.9	0.4	793
North	13.4	12.6	13.9	8.1	5.9	2.0	0.2	565
East	13.7	12.9	14.3	7.8	4.7	2.5	0.6	1,052
Education								
No education	13.3	12.5	14.1	12.9	10.3	2.1	0.6	324
Primary	13.4	12.6	14.1	10.5	6.7	3.3	0.5	2,217
Secondary	13.5	12.7	14.1	8.4	5.6	2.6	0.2	1,063
More than secondary	13.5	12.7	14.1	14.8	6.0	8.9	0.0	155
Wealth quintile								
Lowest	13.3	12.5	14.0	13.6	8.8	4.1	0.6	748
Second	13.3	12.5	14.0	8.7	6.6	2.2	0.0	677
Middle	13.4	12.7	14.0	8.3	5.9	2.2	0.2	736
Fourth	13.6	12.8	14.2	10.0	6.3	3.4	0.2	732
Highest	13.5	12.7	14.1	10.7	5.9	4.0	0.7	866
Total	13.4	12.7	14.1	10.3	6.7	3.2	0.4	3,759

Note: The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] Includes women who do not know if they are pregnant
[2] The SD Bioline Malaria Ag P.f rapid diagnostic test (RDT) was used to test for malaria.
[3] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+

Table 3.4 Iron deficiency and iron deficiency anemia in nonpregnant women: Micronutrient subsample

Median (IQR) concentration of inflammation-adjusted ferritin and percentage of nonpregnant women age 15–49 in the micronutrient subsample classified as having inflammation-adjusted iron deficiency and iron deficiency anemia, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Adjusted ferritin (µg/L) Median	Q1	Q3	Percentage with adjusted iron deficiency (ferritin <15 µg/L)	Percentage with adjusted iron deficiency anemia (ferritin <15 µg/L and hemoglobin <12 g/dl)	Number of nonpregnant women[1]
Age						
15–19	44.4	30.0	64.9	8.9	2.7	883
20–29	47.6	28.4	72.2	10.3	2.8	1,139
30–39	54.1	32.0	79.6	8.2	2.6	1,047
40–49	51.8	33.1	81.6	6.4	2.2	687
Number of children ever born						
0	43.5	26.9	63.4	11.2	3.0	1,393
1–3	51.9	30.6	76.1	8.4	3.0	1,401
4+	56.4	36.0	85.0	5.3	1.5	961
Contraceptive use						
IUD/injectables/implants/pills	57.7	37.1	83.9	5.1	1.5	1,236
Other contraception	45.8	29.1	67.0	8.4	2.0	291
No	45.0	27.6	68.6	10.6	3.3	2,228
Breastfeeding status						
Breastfeeding	56.0	35.6	80.2	5.1	1.6	984
Not breastfeeding	47.1	28.9	71.3	9.9	3.0	2,771
Malaria RDT[2]						
Positive	66.4	40.2	104.3	5.0	3.4	61
Negative	48.7	30.5	73.4	8.7	2.6	3,692
Other	*	*	*	*	*	3
Nutrition supplements in last week[3]						
Yes	44.6	26.3	65.8	12.2	2.2	354
No	49.8	31.0	74.8	8.3	2.7	3,400
Missing	*	*	*	*	*	1
Deworming medication in the last 6 months[4]						
Yes	48.9	30.8	71.1	7.5	0.7	368
No	48.9	30.6	74.4	8.8	2.8	3,387
Residence						
Urban	36.8	16.9	59.6	21.2	6.8	747
Rural	52.8	34.0	76.9	5.5	1.6	3,009
Province						
City of Kigali	35.8	16.8	55.0	22.5	6.7	578
South	50.1	32.4	76.3	6.4	1.7	768
West	57.2	36.8	82.3	4.5	1.8	793
North	58.6	40.6	83.6	1.8	0.7	564
East	45.6	28.2	66.4	9.5	2.6	1,052
Education						
No education	60.0	42.0	88.0	3.0	0.7	324
Primary	52.9	33.7	77.8	6.3	1.8	2,215
Secondary	41.2	25.3	62.9	12.4	3.8	1,061
More than secondary	30.4	12.8	54.5	28.2	9.6	155
Wealth quintile						
Lowest	59.2	40.3	83.8	4.4	1.5	748
Second	56.9	38.9	83.1	3.6	0.4	677
Middle	51.6	35.9	72.9	3.6	1.1	734
Fourth	45.6	27.1	68.8	10.3	3.5	732
Highest	35.5	18.0	58.6	19.1	5.8	865
Total	48.9	30.6	73.7	8.7	2.6	3,755

Note: Ferritin and prevalence of iron deficiency, based on ferritin levels, are adjusted for inflammation using the regression correction approach and cutoff defined in WHO 2020. The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Ferritin is measured in micrograms per liter (µg/L). An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] Includes women who do not know if they are pregnant
[2] The SD Bioline Malaria Ag P.f rapid diagnostic test (RDT) was used to test for malaria.
[3] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+
[4] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.

Table 3.5 Anemia in pregnant women: Micronutrient subsample

Median (IQR) concentration and percentage of pregnant women age 15–49 in the micronutrient subsample classified as having anemia, according to background characteristics, Rwanda DHS 2019–20

	Hemoglobin (g/dl)			Anemia status by hemoglobin level				
Background characteristic	Median	Q1	Q3	Any (<11.0 g/dl)	Mild (10.0–10.9 g/dl)	Moderate (7.0–9.9 g/dl)	Severe (<7.0 g/dl)	Number of pregnant women
Age								
15–19	*	*	*	*	*	*	*	16
20–29	12.2	11.3	12.9	14.6	7.8	6.8	0.0	117
30–39	12.1	11.2	12.9	18.6	10.0	7.8	0.9	103
40–49	*	*	*	*	*	*	*	12
Number of children ever born								
0	12.0	11.0	12.8	19.7	8.1	11.6	0.0	66
1–3	12.2	11.3	13.0	14.3	8.6	5.1	0.6	145
4+	(12.0)	(10.8)	(12.7)	(26.6)	(10.2)	(16.4)	(0.0)	37
Malaria RDT[1]								
Positive	na	na	na	na	na	na	na	0
Negative	12.1	11.2	12.9	17.6	8.7	8.6	0.4	247
Nutrition supplements in last week[2]								
Yes	(11.9)	(11.1)	(12.6)	(16.8)	(6.4)	(10.4)	(0.0)	28
No	12.1	11.3	12.9	17.7	9.0	8.3	0.4	220
Residence								
Urban	11.8	10.8	12.6	26.1	7.3	18.8	0.0	48
Rural	12.2	11.3	12.9	15.6	9.0	6.1	0.4	200
Province								
City of Kigali	(12.0)	(10.7)	(12.5)	(26.7)	(15.9)	(10.8)	(0.0)	31
South	12.1	11.2	13.0	18.0	9.6	6.9	1.5	59
West	12.0	11.2	12.7	19.0	4.5	14.5	0.0	51
North	(12.3)	(11.1)	(12.8)	(16.7)	(11.4)	(5.2)	(0.0)	38
East	12.3	11.4	13.0	12.6	6.2	6.4	0.0	69
Education								
No education	(11.6)	(11.0)	(12.4)	(23.9)	(10.2)	(13.7)	(0.0)	28
Primary	12.2	11.3	12.9	16.3	9.7	5.9	0.6	142
Secondary	12.1	11.6	13.0	17.3	5.3	12.0	0.0	60
More than secondary	*	*	*	*	*	*	*	18
Wealth quintile								
Lowest	(12.0)	(11.3)	(12.6)	(16.7)	(9.5)	(7.1)	(0.0)	40
Second	12.1	11.1	12.5	16.4	10.8	5.5	0.0	53
Middle	12.3	11.5	12.9	13.3	5.1	6.7	1.6	57
Fourth	(12.5)	(11.8)	(13.1)	(12.1)	(10.2)	(1.9)	(0.0)	44
Highest	11.8	10.7	12.7	28.5	8.6	19.9	0.0	54
Total	12.1	11.2	12.9	17.6	8.7	8.6	0.4	247

Note: The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
na = not applicable
[1] The SD Bioline Malaria Ag P.f rapid diagnostic test (RDT) was used to test for malaria.
[2] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+

Table 3.6 Iron deficiency and iron deficiency anemia in pregnant women: Micronutrient subsample

Median (IQR) concentration of inflammation-adjusted ferritin and percentage of pregnant women age 15–49 in the micronutrient subsample classified as having inflammation-adjusted iron deficiency and iron deficiency anemia, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Adjusted ferritin (µg/L)			Percentage with adjusted iron deficiency (ferritin <15 µg/L)	Percentage with adjusted iron deficiency anemia (ferritin <15 µg/L and hemoglobin <11 g/dl)	Number of pregnant women
	Median	Q1	Q3			
Age						
15–19	*	*	*	*	*	16
20–29	33.3	20.3	57.4	19.0	4.5	117
30–39	41.6	21.9	65.2	12.1	3.7	103
40–49	*	*	*	*	*	12
Number of children ever born						
0	38.3	15.5	54.8	24.2	2.7	66
1–3	37.3	21.9	62.2	13.9	5.0	145
4+	(49.1)	(33.1)	(73.4)	(2.8)	(0.0)	37
Malaria RDT[1]						
Positive	na	na	na	na	na	0
Negative	38.9	20.7	61.6	15.0	3.7	247
Nutrition supplements in last week[2]						
Yes	(31.3)	(20.3)	(64.0)	(18.2)	(6.8)	28
No	39.5	22.1	59.4	14.6	3.3	220
Deworming medication in the last 6 months[3]						
Yes	(39.5)	(22.1)	(52.6)	(12.2)	(2.6)	44
No	38.6	20.6	62.2	15.6	3.9	203
Residence						
Urban	31.1	18.2	49.2	20.5	8.2	48
Rural	40.7	22.4	62.0	13.7	2.6	200
Province						
City of Kigali	(41.6)	(20.5)	(52.6)	(17.5)	(8.4)	31
South	36.9	18.1	61.6	17.1	3.6	59
West	41.8	24.5	59.4	5.7	2.2	51
North	(47.5)	(28.6)	(95.7)	(9.2)	(2.8)	38
East	32.2	17.4	57.8	22.1	3.1	69
Education						
No education	(50.0)	(37.3)	(73.7)	(3.8)	(0.0)	28
Primary	38.3	20.6	62.2	13.8	2.9	142
Secondary	43.6	18.2	56.9	21.6	5.2	60
More than secondary	*	*	*	*	*	18
Wealth quintile						
Lowest	(47.8)	(31.5)	(81.6)	(9.8)	(2.3)	40
Second	37.3	26.4	54.3	14.3	2.0	53
Middle	46.2	20.6	62.0	10.1	0.0	57
Fourth	(31.9)	(15.7)	(61.6)	(24.3)	(7.3)	44
Highest	32.1	19.9	54.8	17.2	7.3	54
Total	38.9	20.7	61.6	15.0	3.7	247

Note: Ferritin and prevalence of iron deficiency, based on ferritin levels, are adjusted for inflammation using the regression correction approach and cutoff defined in WHO 2020. The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Ferritin is measured in micrograms per liter (µg/L). Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
na = not applicable
[1] The SD Bioline Malaria Ag P.f rapid diagnostic test (RDT) was used to test for malaria.
[2] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+
[3] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.

VITAMIN A STATUS 4

Vitamin A is a micronutrient that supports the immune system and plays an important role in maintaining the epithelial tissue in the body. Severe vitamin A deficiency can cause eye damage, increase the severity of infections such as those causing measles, and slow recovery from illness.

The prevalence of vitamin A deficiency was assessed by measuring serum retinol in the micronutrient component of the 2019–20 RDHS. Vitamin A is stored in the liver, and when liver stores are depleted retinol is reduced. Because retinol levels decline only when liver reserves become extremely low, retinol is a measure of the later stages of vitamin A deficiency (Tanumihardjo 2011). A secondary measure used to assess vitamin A status was retinol-binding protein (RBP), which transports retinol in the blood. Inflammation adjustments were made to serum retinol and RBP for children because these biomarkers are influenced by inflammation (see Section 1.7).

4.1 Vitamin A Status of Children

Vitamin A deficiency in children

Percentage of children age 6–59 months with a serum retinol level of less than 0.7 micromoles per liter.*

* Serum retinol levels are adjusted for inflammation using the regression correction approach.

Sample: Children age 6–59 months

Table 4.1 shows that, overall, 7% of children age 6–59 months suffer from vitamin A deficiency. **Table 4.1** also presents information on differences in vitamin A deficiency among children according to background characteristics.

Data on vitamin A deficiency unadjusted for inflammation are provided in Appendix A, **Table A.10**. RBP is considered to be a proxy indicator for serum retinol. In this survey, the molar relationship between serum retinol and RBP was found not to be close enough to a 1:1 ratio to establish a cutoff for RBP that is equivalent to the cutoff for serum retinol. Data are presented on the distribution of RBP (Appendix A, **Table A.7**), but information on the prevalence of low RBP levels is not presented.

4.2 Vitamin A Status of Women

Vitamin A status of women

Vitamin A status	Serum retinol level in micromoles/liter*
Vitamin A insufficiency	<1.05
Vitamin A deficiency	<0.7

* Serum retinol levels are unadjusted for inflammation.

Sample: Nonpregnant women age 15–49 and pregnant women age 15–49

Nonpregnant women: The results in **Table 4.2** show that only 2% of nonpregnant women age 15–49 suffer from vitamin A deficiency. However, 13% have vitamin A insufficiency.

Table 4.2 also presents data on differences in vitamin A deficiency and vitamin A insufficiency among nonpregnant women according to background characteristics.

Pregnant women: Overall, 8% of pregnant women age 15–49 suffer from vitamin A deficiency, and 28% suffer from vitamin A insufficiency (**Table 4.3**).

RBP is considered to be a proxy indicator for serum retinol. In this survey, the molar relationship between serum retinol and RBP was found not to be close enough to a 1:1 ratio to establish a cutoff for RBP that is equivalent to the cutoff for serum retinol. Data are presented on the distribution of RBP (Appendix A, **Table A.8** for nonpregnant women, **Table A.9** for pregnant women), but information on the prevalence of low RBP levels is not presented.

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Table 4.1 Vitamin A deficiency in children: Micronutrient subsample

Median (IQR) concentration of inflammation-adjusted serum retinol and percentage of children age 6–59 months in the micronutrient subsample classified as having inflammation-adjusted vitamin A deficiency, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Adjusted serum retinol (µmol/L)			Percentage with adjusted vitamin A deficiency (serum retinol <0.7 µmol/L)	Number of children age 6–59 months
	Median	Q1	Q3		
Age in months					
6–11	1.3	1.0	1.6	6.5	214
12–23	1.2	1.0	1.5	6.5	441
24–35	1.2	1.0	1.5	4.2	448
36–47	1.1	0.9	1.4	7.0	452
48–59	1.2	0.9	1.5	9.9	437
6–23	1.2	1.0	1.5	6.5	655
24–59	1.2	0.9	1.5	7.0	1,336
Sex					
Male	1.1	0.9	1.5	6.3	984
Female	1.2	1.0	1.5	7.4	1,006
Malaria RDT[1]					
Positive	1.1	0.8	1.4	13.6	35
Negative	1.2	1.0	1.5	6.7	1,953
Missing	1.0	0.9	1.0	0.0	3
Anemia status[2]					
Anemic (hemoglobin <11 g/dl)	1.1	0.9	1.5	9.1	441
Not anemic (hemoglobin ≥11 g/dl)	1.2	1.0	1.5	6.2	1,550
Mother's interview status					
Interviewed	1.2	1.0	1.5	7.1	1,860
Not interviewed but in household	1.2	1.0	1.4	8.0	11
Not interviewed and not in the household[3]	1.2	1.0	1.4	2.2	119
Nutrition supplements in last week[4,5]					
Yes	1.2	1.0	1.4	6.4	318
No	1.2	1.0	1.5	6.9	1,672
Ongera intungamubiri in last week[5,6,7,8]					
Yes	1.3	1.0	1.6	3.1	177
No	1.2	1.0	1.5	6.3	879
Deworming medication in last 6 months[5,7,9,10]					
Yes	1.2	1.0	1.5	7.2	1,538
No	1.2	0.9	1.5	6.9	320
Don't know	1.5	1.5	1.5	0.0	2
Vitamin A supplements in the last 6 months					
Yes	1.2	1.0	1.5	6.9	1,610
No	1.2	0.9	1.5	8.9	250
Residence					
Urban	1.2	0.9	1.5	8.3	355
Rural	1.2	1.0	1.5	6.5	1,636
Province					
City of Kigali	1.2	0.9	1.6	6.3	267
South	1.2	1.0	1.5	6.1	428
West	1.2	1.0	1.5	9.2	464
North	1.1	1.0	1.4	5.5	304
East	1.1	0.9	1.4	6.4	527
Mother's education[11]					
No education	1.2	0.9	1.4	6.5	209
Primary	1.2	0.9	1.5	7.9	1,215
Secondary	1.2	1.0	1.5	5.5	360
More than secondary	1.3	1.0	1.5	4.4	88
Wealth quintile					
Lowest	1.2	0.9	1.5	7.9	473
Second	1.2	0.9	1.5	5.5	365
Middle	1.2	1.0	1.4	6.4	398
Fourth	1.2	0.9	1.5	10.1	383
Highest	1.2	1.0	1.5	4.0	373

Continued…

Table 4.1—*Continued*

Background characteristic	Adjusted serum retinol (µmol/L) Median	Q1	Q3	Percentage with adjusted vitamin A deficiency (serum retinol <0.7 µmol/L)	Number of children age 6–59 months
Total	1.2	1.0	1.5	6.9	1,991

Note: Serum retinol and prevalence of vitamin A deficiency, based on serum retinol levels, are adjusted for inflammation using the regression correction approach in Larson 2018 and cutoff defined in WHO 2011. Serum retinol is measured in micromoles per liter (µmol/L).
IQR = interquartile range
Q = quartile
[1] The SD Bioline Malaria Ag P.f rapid diagnostic test (RDT) was used to test for malaria.
[2] The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device.
[3] Includes children whose mothers are deceased
[4] Nootritoto, Shisha Kibondo, Sosoma fortified, or CSB+
[5] Based on mother's recall
[6] Local name for multiple micronutrient powders
[7] Excludes children whose mothers were not interviewed
[8] Restricted to children age 6–23 months
[9] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.
[10] Restricted to children age 12–59 months
[11] For women who are not interviewed, information is taken from the Household Questionnaire. Excludes children whose mothers are not listed in the Household Questionnaire.

Table 4.2 Vitamin A deficiency in nonpregnant women: Micronutrient subsample

Median (IQR) concentration of unadjusted serum retinol and percentage of nonpregnant women age 15–49 in the micronutrient subsample classified as having unadjusted vitamin A deficiency, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Unadjusted serum retinol (µmol/L)			Percentage with unadjusted vitamin A deficiency (serum retinol <0.7 µmol/L)	Percentage with unadjusted vitamin A insufficiency (serum retinol <1.05 µmol/L)	Number of non-pregnant women[1]
	Median	Q1	Q3			
Age						
15–19	1.4	1.2	1.7	2.6	14.5	882
20–29	1.5	1.2	1.8	2.2	12.4	1,136
30–39	1.6	1.3	2.0	2.4	12.6	1,046
40–49	1.6	1.3	2.0	2.5	9.8	687
Number of children ever born						
0	1.4	1.2	1.7	2.5	14.5	1,390
1–3	1.5	1.3	1.9	2.4	11.3	1,400
4+	1.6	1.3	2.0	2.2	11.2	960
Breastfeeding status						
Breastfeeding	1.6	1.3	2.0	2.0	10.4	984
Not breastfeeding	1.5	1.2	1.9	2.5	13.2	2,766
Malaria RDT[2]						
Positive	1.3	1.0	1.5	8.6	28.5	61
Negative	1.5	1.2	1.9	2.3	12.2	3,687
Other	*	*	*	*	*	3
Anemia status[3]						
Anemic (hemoglobin <12 g/dl)	1.4	1.1	1.7	5.4	22.8	385
Not anemic (hemoglobin ≥12 g/dl)	1.5	1.3	1.9	2.0	11.3	3,365
Nutrition supplements in last week[4]						
Yes	1.5	1.2	1.8	2.8	14.2	352
No	1.5	1.2	1.9	2.3	12.3	3,397
Missing	*	*	*	*	*	1
Deworming medication in the last 6 months[5]						
Yes	1.5	1.2	1.9	3.0	15.5	368
No	1.5	1.2	1.9	2.3	12.1	3,382
Residence						
Urban	1.5	1.2	1.8	2.9	16.1	744
Rural	1.5	1.3	1.9	2.2	11.5	3,007
Province						
City of Kigali	1.4	1.2	1.7	1.7	16.0	577
South	1.6	1.3	1.9	2.3	9.3	767
West	1.6	1.2	1.9	3.1	13.8	793
North	1.6	1.3	2.0	2.5	8.0	563
East	1.5	1.2	1.9	2.2	14.2	1,050
Education						
No education	1.6	1.3	1.9	3.8	12.6	323
Primary	1.5	1.3	1.9	2.4	11.8	2,213
Secondary	1.5	1.2	1.8	1.9	14.2	1,059
More than secondary	1.5	1.2	1.9	1.3	9.7	155
Wealth quintile						
Lowest	1.6	1.3	1.9	3.6	11.0	748
Second	1.6	1.3	1.9	1.9	10.8	676
Middle	1.5	1.2	1.9	2.1	13.6	733
Fourth	1.5	1.2	1.9	2.4	14.1	732
Highest	1.5	1.2	1.8	1.9	12.7	862
Total	1.5	1.2	1.9	2.4	12.5	3,750

Note: Serum retinol and prevalence of vitamin A deficiency, based on serum retinol levels, are unadjusted for inflammation and cutoffs defined in WHO 2011 and WHO 2020. Serum retinol is measured in micromoles per liter (µmol/L). An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] Includes women who do not know if they are pregnant
[2] The SD Bioline Malaria Ag P.f rapid diagnostic test (RDT) was used to test for malaria.
[3] The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device.
[4] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+
[5] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.

Table 4.3 Vitamin A deficiency in pregnant women: Micronutrient subsample

Median (IQR) concentration of unadjusted serum retinol and percentage of pregnant women age 15–49 in the micronutrient subsample classified as having unadjusted vitamin A deficiency, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Unadjusted serum retinol (µmol/L)			Percentage with unadjusted vitamin A deficiency (serum retinol <0.7 µmol/L)	Percentage with unadjusted vitamin A insufficiency (serum retinol <1.05 µmol/L)	Number of pregnant women
	Median	Q1	Q3			
Age						
15–19	*	*	*	*	*	16
20–29	1.3	1.0	1.5	9.4	27.3	117
30–39	1.2	1.0	1.5	8.8	30.1	103
40–49	*	*	*	*	*	12
Number of children ever born						
0	1.4	1.1	1.5	5.7	23.8	66
1–3	1.3	1.0	1.6	9.5	29.3	145
4+	(1.2)	(1.0)	(1.4)	(9.3)	(29.3)	37
Malaria RDT[1]						
Positive	na	na	na	na	na	0
Negative	1.3	1.0	1.5	8.4	27.9	247
Anemia status[2]						
Anemic (hemoglobin <11 g/dl)	(1.2)	(0.9)	(1.4)	(12.5)	(38.8)	44
Not anemic (hemoglobin ≥11 g/dl)	1.3	1.0	1.6	7.6	25.5	204
Nutrition supplements in last week[3]						
Yes	(1.3)	(0.9)	(1.6)	(14.2)	(32.0)	28
No	1.3	1.0	1.5	7.7	27.3	220
Deworming medication in the last 6 months[4]						
Yes	(1.4)	(0.9)	(1.5)	(13.8)	(34.1)	44
No	1.3	1.0	1.5	7.3	26.5	203
Residence						
Urban	1.3	0.9	1.6	13.9	29.9	48
Rural	1.3	1.0	1.5	7.1	27.4	200
Province						
City of Kigali	(1.2)	(0.8)	(1.6)	(13.2)	(34.2)	31
South	1.3	1.1	1.6	7.8	21.7	59
West	1.4	1.1	1.7	6.3	22.6	51
North	(1.3)	(1.0)	(1.6)	(10.6)	(25.8)	38
East	1.2	1.0	1.4	7.3	35.3	69
Education						
No education	(1.3)	(1.1)	(1.5)	(3.8)	(23.2)	28
Primary	1.3	1.0	1.6	9.3	26.3	142
Secondary	1.2	0.9	1.5	7.8	35.9	60
More than secondary	*	*	*	*	*	18
Wealth quintile						
Lowest	(1.2)	(1.0)	(1.7)	(4.1)	(37.9)	40
Second	1.3	1.0	1.4	12.2	31.3	53
Middle	1.3	1.0	1.6	12.8	28.0	57
Fourth	(1.2)	(1.0)	(1.5)	(3.5)	(26.8)	44
Highest	1.3	1.1	1.6	7.3	17.9	54
Total	1.3	1.0	1.5	8.4	27.9	247

Note: Serum retinol and prevalence of vitamin A deficiency, based on serum retinol levels, are unadjusted for inflammation and cutoffs defined in WHO 2011 and WHO 2020. Serum retinol is measured in micromoles per liter (µmol/L). Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] The SD Bioline Malaria Ag P.f rapid diagnostic test (RDT) was used to test for malaria.
[2] The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device.
[3] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+
[4] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.

VITAMIN B12 STATUS 5

Vitamin B12 and folate are water-soluble vitamins that share some common functions. Both vitamins are critical for DNA synthesis, development of the central nervous system, and production of healthy red blood cells. B12 is required for the development, myelination, and function of the central nervous system (Langan and Goodbred 2017). In pregnant and breastfeeding women, vitamin B12 deficiency can cause neural tube defects, developmental delays, failure to thrive, and anemia in offspring. Folate is vital for proper brain and spinal cord formation in the developing fetus, and folate deficiency in pregnant women is strongly associated with neural tube defects (Avagliano et al. 2019).

The prevalence of vitamin B12 deficiency was assessed by measuring serum vitamin B12 in the micronutrient component of the 2019–20 RDHS. Serum vitamin B12 is a long-term measure of vitamin B12 status and assesses the amount of vitamin B12 circulating in the blood.

The prevalence of folate deficiency was assessed by measuring serum folate and red blood cell folate in the micronutrient component of the 2019–20 RDHS. Serum folate is a short-term measure of folate intake and assesses the amount of folate circulating in the blood. Red blood cell folate is a long-term measure of folate status and is well correlated with liver folate stores.

Vitamin B12 status of children and women

B12 status	Serum B12 in picograms per milliliter
Risk of B12 insufficiency	<300
B12 deficiency	<203

Sample: Children age 6–59 months, nonpregnant women age 15–49, and pregnant women age 15–49

5.1 Vitamin B12 Status of Children

The results of the 2019–20 RDHS show that 16% of Rwandan children age 6–59 months suffer from vitamin B12 deficiency (serum B12 below 203 pg/ml). Moreover, 40% of children are at risk of vitamin B12 deficiency or vitamin B12 insufficiency (serum B12 below 300 pg/ml) (**Table 5.1**)

Data on differences in vitamin B12 deficiency and insufficiency by background characteristics are presented in **Table 5.1**.

5.2 Vitamin B12 Status of Women

Table 5.2 presents results regarding vitamin B12 deficiency and vitamin B12 insufficiency among nonpregnant women. Overall, 24% of nonpregnant women suffer from vitamin B12 deficiency, and one in every two nonpregnant women (50%) are at risk of vitamin B12 deficiency or insufficiency.

Vitamin B12 deficiency and vitamin B12 insufficiency are more pronounced among pregnant women than among nonpregnant women. Forty-four percent of pregnant women suffer from vitamin B12 deficiency and 72% are at risk of vitamin B12 deficiency or insufficiency (**Table 5.3**).

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Table 5.1 B12 deficiency in children: Micronutrient subsample

Median (IQR) concentration of serum B12 and percentage of children age 6–59 months in the micronutrient subsample classified as having B12 deficiency, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Serum B12 (pg/ml) Median	Q1	Q3	Percentage with B12 deficiency (serum B12 <203 pg/ml)	Percentage with risk of B12 deficiency (serum B12 <300 pg/ml)[1]	Number of children age 6–59 months
Age in months						
6–11	309	217	443	23.1	47.9	213
12–23	300	213	425	20.8	49.9	442
24–35	344	237	479	16.3	40.8	448
36–47	379	253	501	11.9	34.0	451
48–59	389	273	517	10.3	31.6	437
6–23	304	214	428	21.6	49.3	655
24–59	372	255	501	12.8	35.5	1,336
Sex						
Male	345	237	466	15.6	41.1	984
Female	347	243	492	15.9	38.9	1,007
Anemia status[2]						
Anemic (hemoglobin <11 g/dl)	337	231	483	18.5	44.0	443
Not anemic (hemoglobin ≥11 g/dl)	348	244	483	14.9	38.9	1,549
Mother's interview status						
Interviewed	342	239	476	15.7	40.6	1,861
Not interviewed but in household	*	*	*	*	*	11
Not interviewed and not in the household[3]	413	271	524	14.4	30.5	119
Nutrition supplements in last week[4]						
Yes	375	249	506	15.3	35.5	319
No	340	237	474	15.8	40.9	1,672
Ongera intungamubiri in last week[4,5,6,7]						
Yes	304	220	418	18.8	47.3	177
No	319	225	449	19.4	46.1	881
Residence						
Urban	361	239	483	15.8	36.0	354
Rural	342	239	482	15.7	40.9	1,637
Province						
City of Kigali	357	251	483	14.7	36.4	267
South	369	260	521	13.4	34.0	429
West	374	247	498	15.1	36.5	466
North	301	210	416	21.2	50.0	304
East	331	235	466	15.5	44.2	525
Mother's education[8]						
No education	333	218	478	18.8	45.3	210
Primary	341	243	472	15.7	40.6	1,217
Secondary	334	239	466	16.7	40.9	357
More than secondary	424	277	543	6.8	28.6	88
Wealth quintile						
Lowest	320	232	471	16.5	46.0	475
Second	334	226	461	17.3	44.4	363
Middle	339	237	474	17.4	40.3	399
Fourth	374	267	507	13.3	31.9	382
Highest	379	257	517	13.9	36.1	372
Total	345	239	483	15.7	40.0	1,992

Note: Serum B12 cutoffs are defined in WHO 2020. Serum B12 is measured in picograms per milliliter (pg/ml). An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] Including children with serum B12 <203 pg/ml
[2] The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device.
[3] Includes children whose mothers are deceased
[4] Nootritoto, Shisha Kibondo, Sosoma fortified, or CSB+
[5] Based on mother's recall
[6] Local name for multiple micronutrient powders
[7] Excludes children whose mothers were not interviewed
[8] For women who are not interviewed, information is taken from the Household Questionnaire. Excludes children whose mothers are not listed in the Household Questionnaire.

Table 5.2 B12 deficiency in nonpregnant women: Micronutrient subsample

Median (IQR) concentration of serum B12 and percentage of nonpregnant women age 15–49 in the micronutrient subsample classified as having B12 deficiency, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Serum B12 (pg/ml) Median	Q1	Q3	Percentage with B12 deficiency (serum B12 <203 pg/ml)	Percentage with risk of B12 deficiency (serum B12 <300 pg/ml)[1]	Number of nonpregnant women[2]
Age						
15–19	299	208	413	23.9	50.1	881
20–29	296	208	413	23.4	50.2	1,139
30–39	303	210	428	23.1	48.6	1,047
40–49	289	200	432	25.4	52.8	687
Breastfeeding status						
Breastfeeding	290	201	404	25.4	52.8	984
Not breastfeeding	302	210	425	23.2	49.3	2,770
Anemia status[3]						
Anemic (hemoglobin <12 g/dl)	306	226	416	18.0	47.6	387
Not anemic (hemoglobin ≥12 g/dl)	298	204	420	24.5	50.5	3,366
Don't know/missing	*	*	*	*	*	1
Nutrition supplements in last week[4]						
Yes	304	215	418	20.8	49.7	352
No	299	206	419	24.1	50.2	3,401
Missing	*	*	*	*	*	1
Residence						
Urban	322	221	438	20.1	44.5	745
Rural	294	203	416	24.7	51.6	3,009
Province						
City of Kigali	328	235	436	18.7	44.5	577
South	320	227	421	18.0	44.9	768
West	320	214	485	22.6	46.3	793
North	267	194	370	29.6	57.2	564
East	273	190	389	28.6	56.3	1,052
Education						
No education	300	203	433	24.7	49.8	324
Primary	293	201	415	25.2	51.7	2,215
Secondary	305	220	419	21.6	48.4	1,059
More than secondary	339	226	459	17.1	41.9	156
Wealth quintile						
Lowest	275	200	399	26.0	56.0	748
Second	281	195	415	28.4	54.3	677
Middle	292	204	405	24.3	51.7	734
Fourth	308	210	429	23.5	47.2	732
Highest	328	227	459	18.0	43.3	864
Total	299	207	419	23.8	50.2	3,754

Note: Serum B12 cutoffs are defined in WHO 2020. Serum B12 is measured in picograms per milliliter (pg/ml). An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] Including women with serum B12 <203 pg/ml
[2] Includes women who do not know if they are pregnant
[3] The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device.
[4] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+

Table 5.3 B12 deficiency in pregnant women: Micronutrient subsample

Median (IQR) concentration of serum B12 and percentage of pregnant women age 15–49 in the micronutrient subsample classified as having B12 deficiency, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Serum B12 (pg/ml)			Percentage with B12 deficiency (serum B12 <203 pg/ml)	Percentage with risk of B12 deficiency (serum B12 <300 pg/ml)[1]	Number of pregnant women
	Median	Q1	Q3			
Age						
15–19	*	*	*	*	*	16
20–29	208	134	290	47.7	75.4	117
30–39	249	168	333	38.7	68.4	103
40–49	*	*	*	*	*	12
Anemia status[2]						
Anemic (hemoglobin <11 g/dl)	(234)	(152)	(308)	(39.9)	(71.6)	44
Not anemic (hemoglobin ≥11 g/dl)	221	142	325	44.3	72.0	204
Nutrition supplements in last week[3]						
Yes	(193)	(133)	(281)	(52.6)	(81.4)	28
No	226	150	326	42.4	70.8	220
Residence						
Urban	218	145	284	46.4	76.6	48
Rural	228	149	326	42.8	70.8	200
Province						
City of Kigali	(191)	(148)	(281)	(51.2)	(77.1)	31
South	256	168	325	38.3	66.0	59
West	262	194	371	26.9	63.0	51
North	(190)	(126)	(361)	(50.0)	(68.8)	38
East	196	110	286	53.3	83.1	69
Education						
No education	(161)	(119)	(269)	(65.1)	(83.3)	28
Primary	236	168	326	39.1	68.6	142
Secondary	220	141	337	39.9	72.5	60
More than secondary	*	*	*	*	*	18
Wealth quintile						
Lowest	(225)	(128)	(303)	(43.3)	(72.9)	40
Second	192	141	308	55.6	74.7	53
Middle	258	168	352	35.3	63.0	57
Fourth	(208)	(138)	(290)	(47.8)	(77.0)	44
Highest	241	171	303	37.0	73.9	54
Total	221	148	319	43.5	71.9	247

Note: Serum B12 cutoffs are defined in WHO 2020. Serum B12 is measured in picograms per milliliter (pg/ml). Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] Including women with serum B12 <203 pg/ml
[2] The prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device.
[3] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+

IODINE STATUS AND IODIZED SALT 6

Iodine is a micronutrient that plays an important role in thyroid function, which is critical for reproductive function, growth, and development. Iodine deficiency is related to adverse pregnancy outcomes including spontaneous abortion, fetal brain damage and congenital malformation, stillbirth, and perinatal death (Niwattisaiwong et al. 2017). Sufficient iodine prevents goiter, brain damage, and other thyroid-related health problems (WHO 2014b). It is recommended that household salt be fortified with iodine.

6.1 Iodine Status of Women

In the micronutrient component of the 2019–20 RDHS, urinary iodine concentration was measured in single-spot urine samples rather than 24-hour samples. Urinary iodine is a measure of recent iodine intake. Due to diurnal variations in iodine excretion, individual iodine status is not provided; rather, the results represent the status in the entire sample population (CDC et al. 2020).

Iodine insufficiency in women

Population	Median urinary iodine concentration in micrograms/liter (µg/L)
Nonpregnant women age 15–49	Less than 100: iodine insufficiency 100–199: adequate iodine nutrition 200–299: above requirements
Pregnant women age 15–49	Less than 150: iodine insufficiency 150–249: adequate iodine nutrition 250–499: above requirements
Breastfeeding women age 15-49	Less than 100: iodine insufficiency Greater than 100: adequate iodine nutrition

Sample: Nonpregnant and pregnant women age 15–49 whose urine was tested for iodine

Iodine insufficiency is measured at the population level rather than the individual level through comparing the median urinary iodine concentration for the population with the established cutoff (CDC 2020, WHO 2013). The survey results showed that median urine iodine levels are 253.9 µg/L among nonpregnant women (**Table 6.1**) and 242.4 µg/L among pregnant women (**Table 6.2**). Median concentrations of urinary iodine are 241.7 µg/L among nonpregnant women who are breastfeeding, 257.6 µg/L among nonpregnant women who are not breastfeeding, and 242.4 µg/L among pregnant women (**Tables 6.1** and **6.2**). These median concentrations are all above the thresholds. Therefore, these women are not considered to have iodine insufficiency.

6.2 Iodization Status of Household Salt

Fifty grams of salt were collected from seven households per cluster (the micronutrient sample households), and households were provided replacement salt. The individual household salt samples were stored in airtight (hard plastic) primary packaging with secondary packaging (paper or plastic bag) to prevent cross-contamination. The samples were sorted by whether they were crude crystal salt or refined powder salt. Salt samples from each cluster were mixed together by their respective types: crude crystal or refined powder. The samples were tested using quantitative titration with sodium thiosulfate to determine the concentration of iodine.

Household salt iodization (quantitative)

Iodine level	Iodine in milligrams/ kilogram
No iodine	<5
Inadequate iodine	5–14.9
Adequate iodine	15–40
Excess iodine	>40

Sample: Clusters in which crude crystal salt was tested for iodine content and clusters in which refined powder salt was tested for iodine content

As seen in **Table 6.3**, 56% of eligible households provided crude crystal salt samples, 42% provided refined powder salt samples, and 2% did not have salt.

Table 6.4 shows that 377 of the 500 sampled clusters (75%) had crude crystal salt tested and 454 (91%) had refined powder salt tested. Nearly one in every two crude crystal samples (47%) had adequate iodine (15–40 mg/kg); 51% had excess iodine (more than 40 mg/kg), and 2% had inadequate iodine (5–14.9 mg/kg). Sixty percent of refined powder samples had excess iodine and 38% had adequate iodine.

Table 6.4 also provides information on differences in the iodine quantities of crude crystal salt and refined powder salt according to background characteristics.

List of Tables

Table 6.1 Urinary iodine concentrations in nonpregnant women: Micronutrient subsample

Median (IQR) urinary iodine concentrations among nonpregnant women age 15–49 in the micronutrient subsample, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Urinary iodine (µg/L)			Number of non-pregnant women[1]
	Median	Q1	Q3	
Age				
15–19	261.4	149.2	411.2	883
20–29	261.8	147.1	395.1	1,138
30–39	247.0	129.5	403.6	1,046
40–49	243.5	124.7	399.8	687
Breastfeeding status				
Breastfeeding	241.7	124.7	380.5	984
Not breastfeeding	257.6	143.5	412.8	2,770
Residence				
Urban	283.3	159.3	438.6	747
Rural	247.7	132.9	391.6	3,006
Province				
City of Kigali	307.7	174.8	470.7	579
South	246.7	136.7	396.9	768
West	203.9	107.9	353.4	791
North	241.7	130.7	368.2	564
East	280.8	156.0	429.6	1,052
Education				
No education	246.8	132.9	400.5	324
Primary	252.0	132.6	406.3	2,213
Secondary	256.1	151.4	392.5	1,061
More than secondary	260.7	154.5	404.0	156
Wealth quintile				
Lowest	253.5	144.0	414.1	747
Second	239.2	119.7	374.5	677
Middle	255.5	137.9	413.1	733
Fourth	249.2	134.5	392.0	732
Highest	263.3	154.5	427.1	866
Total	253.9	137.9	400.4	3,754

Note: Urinary iodine is in micrograms per liter (µg/L).
IQR = interquartile range
Q = quartile
[1] Includes women who do not know if they are pregnant

Table 6.2 Urinary iodine concentrations in pregnant women: Micronutrient subsample

Median (IQR) urinary iodine concentrations among pregnant women age 15–49 in the micronutrient subsample, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Urinary iodine (µg/L)			Number of pregnant women
	Median	Q1	Q3	
Age				
15–19	*	*	*	16
20–29	248.0	118.2	332.6	117
30–39	243.0	152.9	384.8	103
40–49	*	*	*	12
Residence				
Urban	265.6	137.9	547.1	48
Rural	239.8	122.3	359.2	200
Province				
City of Kigali	(265.6)	(133.3)	(673.7)	31
South	299.7	161.8	423.4	59
West	218.5	124.4	328.9	51
North	(166.3)	(92.3)	(256.8)	38
East	262.2	122.3	379.9	69
Education				
No education	(260.4)	(180.3)	(391.9)	28
Primary	233.2	122.3	365.5	142
Secondary	243.0	110.3	412.7	60
More than secondary	*	*	*	18
Wealth quintile				
Lowest	(292.3)	(180.3)	(391.5)	40
Second	215.4	122.0	322.6	53
Middle	243.9	119.9	367.3	57
Fourth	(242.4)	(115.8)	(412.7)	44
Highest	232.8	137.6	423.4	54
Total	242.4	124.4	379.9	247

Note: Urinary iodine is in micrograms per liter (µg/L). Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile

Table 6.3 Salt samples

Among all micronutrient subsample households, percentage with crude crystal salt, percentage with refined powder salt, and percentage with no salt in the household, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Among all households, percentage:				Total	Number of households
	With crude crystal collected	With refined powder salt collected	With no salt in the household	Other		
Residence						
Urban	57.9	40.2	1.8	0.1	100.0	637
Rural	56.0	42.1	1.9	0.0	100.0	2,850
Province						
City of Kigali	64.1	34.3	1.5	0.0	100.0	490
South	62.8	36.0	1.0	0.1	100.0	810
West	48.8	48.3	2.9	0.0	100.0	741
North	62.4	35.5	2.1	0.0	100.0	542
East	48.9	49.2	1.9	0.0	100.0	904
Wealth quintile						
Lowest	53.0	44.4	2.6	0.0	100.0	792
Second	59.3	38.5	2.2	0.0	100.0	679
Middle	55.8	42.6	1.6	0.0	100.0	655
Fourth	56.1	42.2	1.7	0.0	100.0	681
Highest	58.1	40.6	1.2	0.1	100.0	680
Total	56.3	41.7	1.9	0.0	100.0	3,487

Table 6.4 Quantitative salt iodine testing (unweighted)

Among clusters with salt tested in the micronutrient subsample, percentage with different levels of iodized salt and median iodine content, according to background characteristics, Rwanda DHS 2019–20

	Among clusters in which crude crystal salt was tested:							Among clusters in which refined powder salt was tested:						
Background characteristic	Percentage with no iodine (<5 mg/kg)	Percentage with inade-quate iodine (5–14.9 mg/kg)	Percentage with adequate iodine (15–40 mg/kg)	Percentage with excess iodine (>40 mg/kg)	Median iodine content (mg/kg)[1]	Total	Number of clusters	Percentage with no iodine (<5 mg/kg)	Percentage with inade-quate iodine (5–14.9 mg/kg)	Percentage with adequate iodine (15–40 mg/kg)	Percentage with excess iodine (>40 mg/kg)	Median iodine content (mg/kg)[1]	Total	Number of clusters
Residence														
Urban	0.0	2.3	41.9	55.8	40.4	100.0	86	0.0	4.1	35.7	60.2	42.4	100.0	98
Rural	0.3	1.7	48.8	49.1	39.2	100.0	291	0.3	1.1	38.8	59.8	41.3	100.0	356
Province														
City of Kigali	(0.0)	(2.1)	(44.7)	(53.2)	40.3	100.0	47	0.0	1.8	38.6	59.6	41.3	100.0	57
South	0.0	1.0	48.0	51.0	40.3	100.0	102	0.0	1.7	40.2	58.1	41.3	100.0	117
West	1.2	2.4	46.3	50.0	39.8	100.0	82	0.0	3.8	36.5	59.6	41.3	100.0	104
North	0.0	3.5	43.9	52.6	40.3	100.0	57	0.0	1.4	37.5	61.1	41.5	100.0	72
East	0.0	1.1	50.6	48.3	38.3	100.0	89	1.0	0.0	37.5	61.5	42.4	100.0	104
Wealth quintile														
Lowest	0.0	2.4	54.8	42.9	37.1	100.0	84	0.0	2.1	41.2	56.7	41.0	100.0	97
Second	0.0	1.4	51.4	47.1	39.1	100.0	70	0.0	0.0	36.9	63.1	42.4	100.0	84
Middle	1.6	1.6	41.9	54.8	40.3	100.0	62	0.0	2.8	44.4	52.8	40.3	100.0	72
Fourth	0.0	2.4	43.9	53.7	40.3	100.0	82	1.0	1.0	35.3	62.7	41.6	100.0	102
Highest	0.0	1.3	43.0	55.7	40.3	100.0	79	0.0	3.0	34.3	62.6	42.4	100.0	99
Total	0.3	1.9	47.2	50.7	40.0	100.0	377	0.2	1.8	38.1	59.9	41.5	100.0	454

Note: Iodized salt cutoffs are defined in UNICEF 2018. Figures in parentheses are based on 25–49 unweighted cases.
[1] Medians are based only on salt samples with >5 mg/kg of iodine.

NUTRITIONAL STATUS 7

7.1 Nutritional Status of Children

Anthropometry is commonly used to measure a child's nutritional status. Anthropometric measurements are used to report on child growth indicators. The distribution of height and weight among children under age 5 was compared with the WHO Child Growth Standards reference population (WHO 2006). The distribution of a well-nourished population will be similar to the reference population, while the distribution of a poorly nourished population will not. The indices height-for-age, weight-for-height, and weight-for-age can be expressed in standard deviation units (*z* scores) from the median of the reference population. Values that are greater than two standard deviations below the median of the WHO Child Growth Standards are used to define malnutrition.

Stunting, or low height-for-age, is a measure of growth faltering. Stunting is a marker of the deficient growth environment to which children have been exposed and reflects the overall well-being of a population (Perumal et al. 2018). Suboptimal nutrition can contribute to stunting, while other causes include recurrent infection, chronic diseases, and more; many of the causes of stunting are complex and unknown (WHO 2014a).

Wasting, or low weight-for-height, is a measure of acute undernutrition. It represents the failure to receive adequate nutrition in the period immediately before the survey. Wasting may result from inadequate food intake or from a recent episode of illness or infection causing weight loss.

Underweight, or low weight-for-age, is a composite index of weight-for-height and height-for-age. It reflects children who are stunted, wasted, or both.

Overweight, or high weight-for-height, results from an imbalance between energy consumed (too much) and energy expended (too little).

Stunting (assessed via height-for-age)

Height-for-age is a measure of growth faltering. Children whose height-for-age *z* score is below minus two standard deviations (−2 SD) from the median of the reference population are considered short for their age (stunted). Children whose *z* score is below minus three standard deviations (−3 SD) from the median are considered severely stunted.

Sample: Children under age 5

Wasting (assessed via weight-for-height)

The weight-for-height index measures body mass in relation to body height or length and describes acute undernutrition. Children whose weight-for-height *z* score is below minus two standard deviations (−2 SD) from the median of the reference population are considered thin (wasted). Children whose *z* score is below minus three standard deviations (−3 SD) from the median are considered severely wasted.

Sample: Children under age 5

Underweight (assessed via weight-for-age)

Weight-for-age is a composite index of height-for-age and weight-for-height that takes into account both wasting and stunting. Children whose weight-for-age *z* score is below minus two standard deviations (−2 SD) from the median of the reference population are classified as underweight. Children whose *z* score is below minus three standard deviations (−3 SD) from the median are considered severely underweight.

Sample: Children under age 5

Overweight (assessed via weight-for-height)

Children whose weight-for-height *z* score is more than two standard deviations (+2 SD) above the median of the reference population are considered overweight.

Sample: Children under age 5

The means of the *z* scores for height-for-age, weight-for-height, and weight-for-age are also calculated as summary statistics that represent the nutritional status of children in a population. The mean scores describe the nutritional status of the entire population of children without the use of a cutoff point. A mean *z* score of less than 0 (a negative mean value for stunting, wasting, or underweight) suggests a downward shift in the entire sample population's nutritional status relative to the reference population. The farther away the mean *z* scores are from 0, the higher the prevalence of malnutrition.

Child Growth Measures of Malnutrition

Anthropometry measurements were collected in two subsamples: in 15 of 30 households per cluster selected for the male survey (standard biomarkers) and in seven of the 15 households that were not selected for the male survey (micronutrients). Nutritional status results for 4,160 children from 15 households per cluster were presented in the 2019–20 RDHS final report. The nutritional status data from the micronutrient subsample of 2,257 children are presented here. Anthropometry data in the final report have been available to the public since September 2021. Appendix C of the final report includes data quality tables related to anthropometry measurement.

Table 7.1 shows that 35% of children under age 5 are stunted (too short for their age), and 9% are severely stunted. One percent are wasted (too thin for their height), and less than 1% are severely wasted. Eight percent of children are underweight (too thin for their age), with 1% being severely underweight. Six percent of children are overweight. At the national level, the nutritional status results among children from this subsample are identical to the results from the larger sample presented in the final report. **Table 7.1** also presents nutritional status patterns according to background characteristics.

7.2 WOMEN'S NUTRITIONAL STATUS

Chronic energy deficiency is caused by eating too little or having an unbalanced diet that lacks adequate nutrients. Women of reproductive age (age 15–49) are especially vulnerable to chronic energy deficiency and malnutrition due to low dietary intakes, inequitable distribution of food within the household, improper food storage and preparation, dietary taboos, infectious diseases, and inadequate care practices. Chronic energy deficiency leads to low productivity among adults and greater morbidity and mortality (WHO 1995). In addition, undernutrition among women is a major risk factor for adverse birth outcomes. Overweight and obesity have adverse health outcomes as well. Overweight and obesity are major risk factors for several chronic diseases, including diabetes, cardiovascular diseases, and cancer.

Body mass index (BMI) is the ratio of weight relative to height squared; it is used to measure nutritional status among adults age 15–49. BMI values are independent of age and sex. Adult women age 15–49 whose height is less than 145 centimeters are classified as being of short stature.

Body mass index (BMI)

BMI is calculated by dividing weight in kilograms by height in meters squared (kg/m^2).

Adult status	BMI
Too thin for height	Less than 18.5
Normal	Between 18.5 and 24.9
Overweight	Between 25.0 and 29.9
Obese	Greater than or equal to 30.0

Sample: Women age 15–49 who are not pregnant and who have not had a birth in the 2 months before the survey

Short stature

Percentage of women age 15–49 with height under 145 cm.

Sample: Women age 15–49

As with children, the sample of women in this chapter were from the same subsample of households of children. Nutritional status for women calculate from the standard biomarker subsample are available in the final report. Also, Appendix C of the final report includes data quality tables related to anthropometry measurement.

The results in **Table 7.2** show that 68% of women have a normal BMI, while 6% are thin and 26% are overweight or obese; the mean BMI among women is 23.3. Three percent of women are of short stature. At the national level, the nutritional status among women from this subsample are identical to those from the larger sample, which can be found in the final report.

List of Tables

Table 7.1 Nutritional status of children: Micronutrient subsample

Percentage of children under age 5 classified as malnourished according to three anthropometric indices of nutritional status: height-for-age, weight-for-height, and weight-for-age, according to background characteristics, Rwanda DHS 2019–20

	Height-for-age[1]				Weight-for-height					Weight-for-age				
Background characteristic	Percent-age below −3 SD	Percent-age below −2 SD[2]	Mean z score (SD)	Number of children	Percent-age below −3 SD	Percent-age below −2 SD[2]	Percent-age above +2 SD	Mean z score (SD)	Number of children	Percent-age below −3 SD	Percent-age below −2 SD[2]	Percent-age above +2 SD	Mean z score (SD)	Number of children
Age in months														
<6	1.4	16.0	−0.8	215	1.0	3.1	9.6	0.6	214	2.9	9.0	1.7	−0.2	215
6–8	0.9	14.5	−0.9	107	0.0	0.9	8.0	0.4	107	0.9	6.6	2.4	−0.3	107
9–11	7.7	29.4	−1.4	115	0.6	3.3	7.7	0.2	116	2.0	12.8	2.6	−0.6	116
12–17	6.8	31.1	−1.4	240	0.3	2.0	4.0	0.2	240	1.5	7.1	1.9	−0.5	240
18–23	18.6	47.5	−1.9	218	0.3	0.3	7.6	0.4	218	0.9	6.7	2.8	−0.7	218
24–35	9.5	41.4	−1.7	459	0.5	1.6	4.8	0.4	459	0.4	7.7	0.7	−0.6	459
36–47	11.2	40.1	−1.7	460	0.0	0.0	5.5	0.5	460	0.4	8.0	0.3	−0.7	460
48–59	7.8	32.1	−1.5	440	0.0	0.7	3.0	0.4	441	0.7	7.7	0.3	−0.7	441
0–23	7.8	29.3	−1.3	896	0.5	1.9	7.2	0.4	896	1.7	8.1	2.2	−0.5	897
24–59	9.5	37.9	−1.6	1,359	0.2	0.8	4.5	0.4	1,360	0.5	7.8	0.4	−0.7	1,360
Sex														
Male	11.2	37.6	−1.6	1,121	0.2	1.2	6.2	0.5	1,121	1.1	8.3	1.4	−0.6	1,121
Female	6.5	31.4	−1.4	1,134	0.4	1.3	4.9	0.3	1,135	0.8	7.6	0.9	−0.6	1,135
Birth interval in months[3]														
First birth[4]	6.0	30.3	−1.4	543	0.3	0.9	5.5	0.4	543	0.5	6.9	1.5	−0.5	543
<24	6.3	29.3	−1.5	225	0.0	0.8	5.6	0.4	225	2.6	6.7	1.2	−0.5	225
24–47	11.5	40.4	−1.7	785	0.5	0.9	5.9	0.4	785	1.1	8.1	1.3	−0.7	786
48+	7.6	32.0	−1.4	571	0.3	2.0	5.4	0.4	571	0.6	8.8	0.6	−0.6	571
Size at birth[3]														
Very small	(15.2)	(41.1)	1.7	48	(1.4)	(2.9)	(2.5)	0.1	48	(0.0)	(19.3)	(0.0)	1.1	48
Small	10.5	47.2	−1.9	345	0.8	2.3	2.2	0.0	346	2.0	15.0	0.5	−1.1	346
Average or larger	7.7	31.4	−1.4	1,721	0.2	0.9	6.4	0.5	1,720	0.8	5.9	1.4	−0.4	1,721
Missing	*	*	*	10	*	*	*	*	10	*	*	*	*	10
Mother's interview status														
Interviewed	8.5	34.3	−1.5	2,125	0.3	1.2	5.6	0.4	2,125	1.0	7.8	1.2	−0.6	2,126
Not interviewed but in household	*	*	*	11	*	*	*	*	11	*	*	*	*	11
Not interviewed and not in the household[5]	14.6	37.6	−1.7	119	0.0	0.7	4.6	0.4	119	0.0	9.7	0.8	−0.7	119
Mother's age at birth[3]														
<20	7.6	34.0	−1.5	107	0.6	2.5	4.7	0.4	107	0.9	9.3	0.5	−0.6	107
20–34	8.3	34.2	−1.5	1,560	0.3	1.1	6.4	0.4	1,561	0.8	6.8	1.2	−0.5	1,561
35–49	9.2	34.9	−1.6	457	0.2	1.0	3.3	0.2	456	1.7	11.1	1.1	−0.7	457
Mother's nutritional status[6]														
Thin (BMI <18.5)	12.3	32.4	−1.5	75	0.5	3.8	3.8	−0.2	75	1.4	17.7	1.2	−1.0	75
Normal (BMI 18.5–24.9)	10.2	39.5	−1.7	1,254	0.2	0.8	4.4	0.3	1,253	0.8	9.1	0.7	−0.7	1,254
Overweight/ obese (BMI ≥25)	4.8	24.6	−1.1	555	0.3	0.9	7.9	0.6	555	0.2	3.2	2.3	−0.2	555
Residence														
Urban	3.9	19.1	−1.0	410	0.8	2.2	7.6	0.4	410	0.3	4.7	4.0	−0.2	410
Rural	10.0	37.9	−1.6	1,846	0.2	1.0	5.1	0.4	1,846	1.1	8.7	0.5	−0.6	1,847
Province														
City of Kigali	1.8	19.3	−0.9	302	0.5	1.8	8.3	0.4	302	0.0	3.8	4.3	−0.2	302
South	8.3	36.9	−1.5	482	0.4	1.1	4.7	0.2	483	1.1	12.5	0.9	−0.7	483
West	15.9	42.2	−1.8	531	0.3	0.9	4.7	0.5	531	1.2	9.1	0.6	−0.7	531
North	11.9	41.3	−1.8	335	0.0	0.0	6.3	0.6	334	0.6	4.7	0.6	−0.6	335
East	4.9	29.6	−1.4	606	0.3	2.0	5.1	0.4	606	1.4	7.2	0.6	−0.5	606
Mother's education[7]														
No education	16.4	39.4	−1.9	235	0.0	1.2	3.5	0.3	235	3.1	11.1	0.4	−0.9	235
Primary	9.2	39.3	−1.6	1,374	0.4	1.3	4.5	0.4	1,373	0.9	9.0	0.5	−0.7	1,374
Secondary	4.1	22.4	−1.1	420	0.1	0.2	8.6	0.5	420	0.6	3.6	1.9	−0.3	420
More than secondary	0.9	5.9	−0.2	108	1.3	4.4	13.0	0.7	108	0.0	2.7	8.8	0.4	108

Continued…

Table 7.1—*Continued*

Background characteristic	Height-for-age[1] Percentage below −3 SD	Height-for-age[1] Percentage below −2 SD[2]	Height-for-age[1] Mean z score (SD)	Height-for-age[1] Number of children	Weight-for-height Percentage below −3 SD	Weight-for-height Percentage below −2 SD[2]	Weight-for-height Percentage above +2 SD	Weight-for-height Mean z score (SD)	Weight-for-height Number of children	Weight-for-age Percentage below −3 SD	Weight-for-age Percentage below −2 SD[2]	Weight-for-age Percentage above +2 SD	Weight-for-age Mean z score (SD)	Weight-for-age Number of children
Wealth quintile														
Lowest	13.8	46.3	−1.9	541	0.2	1.6	4.7	0.3	542	1.8	12.1	0.7	−0.8	542
Second	15.7	42.6	−1.8	404	0.0	0.7	2.6	0.3	404	1.0	12.2	0.3	−0.8	404
Middle	7.2	35.8	−1.6	445	0.3	0.7	5.1	0.5	444	0.5	5.6	0.4	−0.6	445
Fourth	4.9	29.8	−1.4	427	0.4	1.5	6.0	0.4	427	1.4	6.9	0.8	−0.5	427
Highest	2.0	15.6	−0.8	439	0.5	1.5	9.3	0.5	439	0.1	2.3	3.5	−0.1	439
Total	8.9	34.5	−1.5	2,256	0.3	1.2	5.5	0.4	2,256	1.0	7.9	1.1	−0.6	2,257

Note: Each of the indices is expressed in standard deviation units (SD) from the median of the WHO Child Growth Standards. Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
[1] Recumbent length is measured for children under age 2; standing height is measured for all other children.
[2] Includes children who are below −3 standard deviations (SD) from the WHO Child Growth Standards population median
[3] Excludes children whose mothers were not interviewed
[4] First-born twins (triplets, etc.) are counted as first births because they do not have a previous birth interval.
[5] Includes children whose mothers are deceased
[6] Excludes children whose mothers were not weighed and measured, children whose mothers were not interviewed, and children whose mothers are pregnant or gave birth within the preceding 2 months. Mother's nutritional status in terms of BMI (body mass index) is presented in Table 7.2.
[7] For women who are not interviewed, information is taken from the Household Questionnaire. Excludes children whose mothers are not listed in the Household Questionnaire.

Table 7.2 Nutritional status of women: Micronutrient subsample

Among women age 15–49, percentage with height under 145 cm, mean body mass index (BMI), and percentage with specific BMI levels, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Height: Percentage below 145 cm	Height: Number of women	Body mass index[1]: Mean body mass index (BMI)	18.5–24.9 (total normal)	<18.5 (total thin)	17.0–18.4 (mildly thin)	<17 (moderately and severely thin)	≥25.0 (total overweight or obese)	25.0–29.9 (overweight)	≥30.0 (obese)	Number of women
Age											
15–19	6.2	899	22.1	73.3	11.3	7.4	3.9	15.3	14.4	1.0	881
20–29	2.5	1,259	23.2	70.7	4.2	3.8	0.4	25.1	20.0	5.1	1,113
30–39	2.7	1,153	24.1	64.5	3.8	2.9	0.9	31.7	22.2	9.5	1,020
40–49	1.4	699	23.7	59.6	7.6	5.7	1.9	32.8	21.9	10.9	686
Residence											
Urban	1.2	800	25.2	47.8	5.2	4.5	0.7	46.9	32.3	14.6	739
Rural	3.7	3,211	22.8	72.5	6.7	4.8	1.9	20.8	16.5	4.4	2,961
Province											
City of Kigali	1.3	611	24.8	51.0	5.9	5.2	0.8	43.1	29.4	13.7	571
South	3.3	830	22.6	71.2	8.8	6.9	1.9	19.9	16.6	3.3	758
West	3.4	845	23.0	71.4	6.3	4.7	1.6	22.3	17.2	5.1	779
North	3.7	605	23.2	70.7	4.8	3.5	1.3	24.5	19.3	5.3	560
East	3.6	1,120	23.2	69.4	5.8	3.7	2.2	24.8	18.5	6.3	1,032
Education											
No education	3.5	351	22.5	71.6	9.6	7.8	1.8	18.8	14.4	4.4	320
Primary	3.9	2,357	23.1	70.5	6.1	4.6	1.6	23.3	18.2	5.1	2,177
Secondary	2.0	1,127	23.5	64.9	6.1	4.4	1.7	28.9	21.8	7.1	1,053
More than secondary	0.0	176	26.8	33.8	5.4	3.2	2.2	60.8	35.5	25.2	150
Wealth quintile											
Lowest	5.1	788	22.0	78.3	8.5	6.7	1.8	13.2	11.9	1.4	735
Second	4.7	730	22.2	78.9	7.3	4.5	2.8	13.8	11.5	2.3	668
Middle	3.2	792	22.8	71.3	7.2	5.4	1.8	21.5	18.5	3.0	723
Fourth	2.0	776	23.8	64.8	5.2	4.3	0.8	30.1	22.3	7.8	718
Highest	1.4	926	25.2	48.6	4.3	3.1	1.2	47.0	31.3	15.7	856
Total	3.2	4,011	23.3	67.6	6.4	4.8	1.7	26.0	19.6	6.4	3,700

Note: Body mass index (BMI) is expressed as the ratio of weight in kilograms to the square of height in meters (kg/m^2).
[1] Excludes pregnant women and women with a birth in the preceding 2 months

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ADDITIONAL TABLES — Appendix A

Table A.1 Iron deficiency and iron deficiency anemia, not adjusted for inflammation, in children: Micronutrient subsample

Median (IQR) concentration of ferritin, not adjusted for inflammation, and percentage of children age 6–59 months in the micronutrient subsample classified as having iron deficiency and iron deficiency anemia, not adjusted for inflammation, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Unadjusted ferritin (µg/L)			Percentage with unadjusted iron deficiency (ferritin <12 µg/L)	Percentage with unadjusted iron deficiency anemia (ferritin <12 µg/L and hemoglobin <11 g/dl)	Number of children age 6–59 months
	Median	Q1	Q3			
Age in months						
6–11	41.0	19.4	71.7	12.1	10.7	214
12–23	40.2	24.8	67.4	7.4	5.2	442
24–35	48.5	33.1	67.2	4.2	1.4	449
36–47	52.5	36.0	77.5	3.3	0.7	453
48–59	56.8	39.4	78.5	3.7	0.7	437
6–23	40.2	22.7	68.8	8.9	7.0	656
24–59	52.8	35.8	74.1	3.7	0.9	1,339
Sex						
Male	48.4	28.8	70.3	6.5	3.6	987
Female	52.0	32.4	74.7	4.4	2.3	1,008
Malaria RDT[1]						
Positive	(116.1)	(69.2)	(162.4)	(0.0)	(0.0)	35
Negative	49.5	30.5	71.9	5.5	2.9	1,957
Missing	*	*	*	*	*	3
Mother's interview status						
Interviewed	49.0	30.4	71.9	5.8	3.1	1,864
Not interviewed but in household	*	*	*	*	*	11
Not interviewed and not in the household[2]	60.5	37.7	78.5	0.8	0.0	119
Nutrition supplements in last week[3,4]						
Yes	48.0	28.5	73.6	8.1	4.8	319
No	50.2	31.0	72.9	4.9	2.6	1,675
Don't know/missing	*	*	*	*	*	0
Ongera intungamubiri in last week[4,5,6,7]						
Yes	48.5	32.7	71.5	4.7	3.9	178
No	41.7	24.8	66.9	7.8	5.1	882
Deworming medication in last 6 months[4,6,8,9]						
Yes	49.5	32.4	71.7	4.9	2.3	1,543
No	44.9	23.2	76.0	9.5	6.8	320
Don't know	*	*	*	*	*	2
Residence						
Urban	40.0	22.8	59.6	10.7	5.0	355
Rural	52.1	32.9	75.7	4.3	2.5	1,640
Province						
City of Kigali	39.7	21.4	64.4	10.0	4.0	267
South	50.2	32.5	73.5	4.0	2.0	429
West	57.3	37.7	80.9	3.6	2.9	466
North	52.9	36.2	73.1	3.7	2.4	306
East	45.2	26.7	68.0	6.9	3.4	527
Mother's education[10]						
No education	53.7	35.9	81.9	2.3	1.1	210
Primary	50.5	32.4	73.8	4.4	2.4	1,218
Secondary	41.9	22.1	62.7	10.1	6.0	360
More than secondary	44.1	20.7	64.4	15.6	6.2	88
Wealth quintile						
Lowest	54.5	37.0	78.3	2.2	1.3	475
Second	51.4	33.4	78.8	4.1	2.0	365
Middle	52.9	34.5	75.1	4.2	1.6	399
Fourth	44.9	25.6	67.6	5.9	4.0	383
Highest	40.8	21.4	61.5	11.8	6.1	373

Continued…

Table A.1—*Continued*

Background characteristic	Unadjusted ferritin (µg/L) Median	Q1	Q3	Percentage with unadjusted iron deficiency (ferritin <12 µg/L)	Percentage with unadjusted iron deficiency anemia (ferritin <12 µg/L and hemoglobin <11 g/dl)	Number of children age 6–59 months
Total	49.8	30.6	72.9	5.4	2.9	1,995

Note: Ferritin and prevalence of iron deficiency, based on ferritin levels, are unadjusted for inflammation and cutoff defined in WHO 2020. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Prevalence of anemia, based on hemoglobin levels, is adjusted for altitude using formulas in CDC 1998 and cutoffs defined in WHO 2017. Ferritin is measured in micrograms per liter (µg/L). Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] Tested for malaria using a rapid diagnostic test (RDT) (SD Bioline Malaria Ag P.f/Pan)
[2] Includes children whose mothers are deceased
[3] Nootritoto, Shisha Kibondo, Sosoma fortified, or CSB+
[4] Based on mother's recall
[5] Local name for multiple micronutrient powders
[6] Excludes children whose mothers were not interviewed
[7] Restricted to children age 6–23 months
[8] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.
[9] Restricted to children age 12–59 months
[10] For women who are not interviewed, information is taken from the Household Questionnaire. Excludes children whose mothers are not listed in the Household Questionnaire.

Table A.2 Iron deficiency and iron deficiency anemia, not adjusted for inflammation, in nonpregnant women: Micronutrient subsample

Median (IQR) concentration of ferritin, not adjusted for inflammation, and percentage of nonpregnant women age 15–49 in the micronutrient subsample classified as having iron deficiency and iron deficiency anemia, not adjusted for inflammation, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Unadjusted ferritin (µg/L)			Percentage with unadjusted iron deficiency (ferritin <15 µg/L)	Percentage with unadjusted iron deficiency anemia (ferritin <15 µg/L and hemoglobin <12 g/dl)	Number of nonpregnant women[1]
	Median	Q1	Q3			
Age						
15–19	54.4	34.9	81.6	6.2	2.3	883
20–29	57.1	32.7	86.8	9.2	2.5	1,139
30–39	62.9	38.2	97.8	6.9	2.2	1,047
40–49	63.5	40.6	98.2	5.5	1.9	687
Number of children ever born						
0	52.9	31.3	77.8	9.0	2.6	1,393
1–3	60.8	36.0	93.1	7.2	2.6	1,401
4+	67.7	42.8	104.7	4.5	1.2	961
Contraceptive use						
IUD/injectables/implants/pills	69.2	44.3	102.1	4.0	1.0	1,236
Other contraception	55.2	33.0	85.0	8.1	2.0	291
No	55.2	32.7	84.5	8.8	3.0	2,228
Breastfeeding status						
Breastfeeding	68.4	43.7	98.9	3.6	1.0	984
Not breastfeeding	56.4	33.7	87.1	8.4	2.7	2,771
Malaria RDT[2]						
Positive	97.4	50.4	150.4	5.0	3.4	61
Negative	58.8	35.8	90.0	7.2	2.2	3,692
Other	*	*	*	*	*	3
Nutrition supplements in last week[3]						
Yes	54.6	31.7	82.9	8.6	1.3	354
No	59.6	36.3	91.4	7.0	2.3	3,400
Missing	*	*	*	*	*	1
Deworming medication in the last 6 months[4]						
Yes	60.0	34.8	90.8	6.0	0.5	368
No	58.9	36.0	90.7	7.3	2.4	3,387
Residence						
Urban	44.0	20.7	71.9	18.2	5.9	747
Rural	62.9	40.0	93.9	4.4	1.3	3,009
Province						
City of Kigali	41.2	20.4	69.0	18.9	5.6	578
South	63.0	39.0	95.8	4.6	1.4	768
West	68.8	45.4	101.1	4.3	1.8	793
North	70.6	49.7	100.9	1.4	0.7	564
East	54.2	32.6	81.4	7.8	2.1	1,052
Education						
No education	74.8	49.4	107.4	2.4	0.4	324
Primary	62.7	39.7	96.0	5.1	1.7	2,215
Secondary	51.2	29.2	75.9	10.5	3.1	1,061
More than secondary	36.6	16.6	68.9	23.3	8.3	155
Wealth quintile						
Lowest	71.4	47.9	103.6	2.9	1.2	748
Second	69.7	47.0	98.6	2.9	0.4	677
Middle	61.2	42.8	93.6	2.9	1.1	734
Fourth	55.4	31.9	85.6	9.3	2.8	732
Highest	42.9	21.6	70.3	16.0	5.0	865
Total	59.0	36.0	90.7	7.2	2.2	3,755

Note: Ferritin and prevalence of iron deficiency, based on ferritin levels, are unadjusted for inflammation and cutoff defined in WHO 2020. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017. Ferritin is measured in micrograms per liter (µg/L). An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] Includes women who do not know if they are pregnant
[2] Tested for malaria using a rapid diagnostic test (RDT) (SD Bioline Malaria Ag P.f/Pan)
[3] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+
[4] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.

Table A.3 Iron deficiency and iron deficiency anemia, not adjusted for inflammation, in pregnant women: Micronutrient subsample

Median (IQR) concentration of ferritin, not adjusted for inflammation, and percentage of pregnant women age 15–49 in the micronutrient subsample classified as having iron deficiency and iron deficiency anemia, not adjusted for inflammation, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Unadjusted ferritin (µg/L)			Percentage with unadjusted iron deficiency (ferritin <15 µg/L)	Percentage with unadjusted iron deficiency anemia (ferritin <15 µg/L and hemoglobin <11 g/dl)	Number of pregnant women
	Median	Q1	Q3			
Age						
15–19	*	*	*	*	*	16
20–29	39.4	22.9	62.9	14.5	2.8	117
30–39	47.5	24.5	75.1	11.1	3.7	103
40–49	*	*	*	*	*	12
Number of children ever born						
0	44.9	17.9	60.5	17.7	2.7	66
1–3	40.7	23.9	74.6	12.6	3.7	145
4+	(55.0)	(39.0)	(78.9)	(2.8)	(0.0)	37
Contraceptive use						
No	45.9	23.3	70.3	12.5	2.9	247
Breastfeeding status						
Breastfeeding	*	*	*	*	*	8
Not breastfeeding	46.2	24.5	70.3	12.4	3.0	239
Malaria RDT[1]						
Positive	na	na	na	na	na	0
Negative	45.9	23.3	70.3	12.5	2.9	247
Nutrition supplements in last week[2]						
Yes	(39.3)	(21.1)	(83.3)	(14.2)	(6.8)	28
No	45.9	25.6	70.3	12.3	2.4	220
Deworming medication in the last 6 months[3]						
Yes	(46.3)	(22.9)	(60.5)	(7.4)	(0.2)	44
No	44.9	23.3	74.6	13.6	3.5	203
Residence						
Urban	38.0	18.1	60.5	20.5	8.2	48
Rural	46.6	25.8	74.6	10.5	1.6	200
Province						
City of Kigali	(46.5)	(20.7)	(60.5)	(17.5)	(8.4)	31
South	45.9	18.6	63.4	15.3	3.6	59
West	41.6	26.0	70.3	5.7	2.2	51
North	(47.5)	(31.2)	(110.2)	(3.9)	(0.0)	38
East	34.0	18.8	75.1	17.5	1.8	69
Education						
No education	(53.7)	(40.3)	(86.1)	(3.8)	(0.0)	28
Primary	41.0	23.3	77.0	11.0	2.2	142
Secondary	49.9	18.7	62.8	18.0	3.4	60
More than secondary	*	*	*	*	*	18
Wealth quintile						
Lowest	(52.0)	(32.0)	(90.3)	(7.5)	(0.0)	40
Second	38.3	29.6	57.8	10.5	0.0	53
Middle	47.3	23.3	78.9	6.1	0.0	57
Fourth	(35.2)	(16.8)	(63.4)	(21.9)	(7.3)	44
Highest	43.9	19.8	62.3	17.2	7.3	54
Total	45.9	23.3	70.3	12.5	2.9	247

Note: Ferritin and prevalence of iron deficiency, based on ferritin levels, are unadjusted for inflammation and cutoff defined in WHO 2020. Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017. Ferritin is measured in micrograms per liter (µg/L). Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
na = not applicable
[1] Tested for malaria using a rapid diagnostic test (RDT) (SD Bioline Malaria Ag P.f/Pan)
[2] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+
[3] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.

Table A.4 Low tissue iron stores in children: Micronutrient subsample

Median (IQR) concentration of soluble transferrin receptor (sTfR), unadjusted and adjusted for AGP, and percentage of children age 6–59 months in the micronutrient subsample classified as having low tissue iron stores, unadjusted and adjusted for AGP, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Unadjusted sTfR (mg/L)			Adjusted sTfR (mg/L)			Percentage with unadjusted low tissue iron stores (sTfR >8.3 mg/L)	Percentage with adjusted low tissue iron stores (sTfR >8.3 mg/L)	Number of children age 6–59 months
	Median	Q1	Q3	Median	Q1	Q3			
Age in months									
6–11	8.1	6.1	12.1	6.6	5.2	9.4	45.3	35.3	214
12–23	6.8	5.6	9.1	6.0	4.9	8.0	30.9	23.1	442
24–35	6.5	5.5	8.3	5.8	4.9	7.1	24.8	14.6	449
36–47	6.5	5.5	8.1	5.6	4.9	7.0	22.6	13.6	453
48–59	6.2	5.4	7.4	5.6	4.8	6.5	14.5	7.3	437
6–23	7.1	5.7	9.8	6.2	4.9	8.6	35.6	27.0	656
24–59	6.4	5.5	7.8	5.7	4.8	6.8	20.7	11.9	1,339
Sex									
Male	6.7	5.6	8.4	5.9	4.9	7.3	26.5	17.6	987
Female	6.6	5.5	8.2	5.7	4.8	7.1	24.7	16.1	1,008
Malaria RDT[1]									
Positive	(7.7)	(5.7)	(15.5)	(5.7)	(5.1)	(11.4)	(43.4)	(31.3)	35
Negative	6.6	5.5	8.4	5.8	4.9	7.2	25.2	16.6	1,957
Missing	*	*	*	*	*	*	*	*	3
Anemia status[2]									
Anemic (hemoglobin <11 g/dl)	7.2	5.8	10.4	6.2	5.0	8.8	36.8	28.9	443
Not anemic (hemoglobin ≥11 g/dl)	6.5	5.5	8.0	5.7	4.8	6.9	22.4	13.4	1,552
Mother's interview status									
Interviewed	6.6	5.5	8.4	5.8	4.9	7.2	25.7	17.2	1,864
Not interviewed but in household	*	*	*	*	*	*	*	*	11
Not interviewed and not in the household[3]	6.8	5.8	8.2	5.9	5.0	7.3	23.7	12.0	119
Nutrition supplements in last week[4,5]									
Yes	6.6	5.7	8.8	6.0	4.9	7.4	28.6	20.0	319
No	6.6	5.5	8.3	5.8	4.9	7.2	25.0	16.3	1,675
Don't know/missing	*	*	*	*	*	*	*	*	0
Ongera intungamubiri in last week[4,5,6,7]									
Yes	6.5	5.3	8.1	5.8	4.6	7.2	23.9	18.9	178
No	6.9	5.6	9.3	6.0	5.0	8.1	33.0	23.1	882
Deworming medication in last 6 months[5,7,9,10]									
Yes	6.5	5.5	8.1	5.7	4.8	7.0	23.1	14.4	1,543
No	7.1	5.7	10.3	6.2	5.0	8.9	37.6	30.4	320
Don't know	*	*	*	*	*	*	*	*	2
Residence									
Urban	6.6	5.5	8.6	6.0	4.9	7.4	27.0	17.9	355
Rural	6.6	5.6	8.4	5.7	4.9	7.2	25.3	16.6	1,640
Province									
City of Kigali	6.6	5.3	8.7	5.9	4.8	7.9	28.3	19.7	267
South	6.6	5.6	8.4	5.8	4.9	7.3	25.3	16.6	429
West	6.7	5.5	8.4	5.6	4.9	7.2	25.4	17.0	466
North	6.6	5.6	8.3	5.7	4.9	6.9	24.9	14.8	306
East	6.5	5.5	8.3	5.8	4.8	7.2	25.0	16.7	527
Mother's education[11]									
No education	6.3	5.2	7.9	5.4	4.6	7.0	21.4	13.1	210
Primary	6.5	5.5	8.2	5.7	4.8	7.0	24.5	17.0	1,218
Secondary	6.9	5.7	8.8	6.2	5.1	7.7	30.9	19.8	360
More than secondary	6.7	5.5	9.2	5.9	4.9	7.7	31.7	18.9	88
Wealth quintile									
Lowest	6.5	5.5	8.1	5.5	4.7	7.1	22.6	14.5	475
Second	6.7	5.7	8.7	5.8	4.9	7.4	28.1	18.2	365
Middle	6.4	5.4	7.7	5.6	4.8	6.8	21.8	13.3	399
Fourth	6.7	5.5	8.7	5.9	5.0	7.7	28.0	20.0	383
Highest	6.7	5.6	8.6	6.0	5.1	7.6	28.5	19.2	373

Continued…

Table A.4—*Continued*

Background characteristic	Unadjusted sTfR (mg/L)			Adjusted sTfR (mg/L)			Percentage with unadjusted low tissue iron stores (sTfR >8.3 mg/L)	Percentage with adjusted low tissue iron stores (sTfR >8.3 mg/L)	Number of children age 6–59 months
	Median	Q1	Q3	Median	Q1	Q3			
Total	6.6	5.5	8.4	5.8	4.9	7.2	25.6	16.9	1,995

Note: sTfR and low iron stores, based on sTfR levels, are adjusted for inflammation using the regression correction approach in Luo 2023 and the cutoff defined by assay in Erhardt 2004. sTfR is measured in milligrams per liter (mg/L). Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
AGP = alpha-1-acid glycoprotein
Q = quartile
[1] Tested for malaria using a rapid diagnostic test (RDT) (SD Bioline Malaria Ag P.f/Pan)
[2] Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Prevalence of anemia, based on hemoglobin levels, is adjusted for altitude using formulas in CDC 1998 and cutoffs defined in WHO 2017.
[3] Includes children whose mothers are deceased
[4] Nootritoto, Shisha Kibondo, Sosoma fortified, or CSB+
[5] Based on mother's recall
[6] Local name for multiple micronutrient powders
[7] Excludes children whose mothers were not interviewed
[8] Restricted to children age 6–23 months
[9] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.
[10] Restricted to children age 12–59 months
[11] For women who are not interviewed, information is taken from the Household Questionnaire. Excludes children whose mothers are not listed in the Household Questionnaire.

Table A.5 Low tissue iron stores in nonpregnant women: Micronutrient subsample

Median (IQR) concentration of soluble transferrin receptor (sTfR), unadjusted and adjusted for AGP, and percentage of nonpregnant women age 15–49 classified as having low tissue iron stores, unadjusted and adjusted for AGP, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Unadjusted sTfR (mg/L) Median	Unadjusted sTfR (mg/L) Q1	Unadjusted sTfR (mg/L) Q3	Adjusted sTfR (mg/L) Median	Adjusted sTfR (mg/L) Q1	Adjusted sTfR (mg/L) Q3	Percentage with unadjusted low tissue iron stores (sTfR >8.3 mg/L)	Percentage with adjusted low tissue iron stores (sTfR >8.3 mg/L)	Number of non-pregnant women[1]
Age									
15–19	5.7	4.8	7.1	5.1	4.2	6.2	15.4	9.4	883
20–29	5.6	4.6	7.0	5.0	4.2	6.2	16.4	11.7	1,139
30–39	5.4	4.5	6.9	4.8	4.1	5.9	13.1	8.4	1,047
40–49	5.6	4.6	7.1	5.0	4.0	6.2	15.7	10.7	687
Number of children ever born									
0	5.7	4.8	7.1	5.1	4.2	6.3	16.5	11.1	1,393
1–3	5.5	4.6	7.0	4.9	4.1	6.0	14.6	10.0	1,401
4+	5.4	4.5	6.9	4.8	4.0	5.9	13.8	8.5	961
Contraceptive use									
IUD/injectables/implants/pills	5.4	4.5	6.7	4.7	4.0	5.8	12.4	7.6	1,236
Other contraception	5.7	4.8	7.2	5.2	4.3	6.2	14.9	8.3	291
No	5.7	4.7	7.1	5.1	4.2	6.3	16.6	11.6	2,228
Breastfeeding status									
Breastfeeding	5.6	4.6	6.9	4.8	4.1	5.9	13.9	8.2	984
Not breastfeeding	5.6	4.7	7.0	5.0	4.1	6.2	15.5	10.7	2,771
Malaria RDT[2]									
Positive	7.2	5.6	10.2	6.3	4.8	8.6	41.3	25.5	61
Negative	5.5	4.6	7.0	4.9	4.1	6.1	14.7	9.8	3,692
Other	*	*	*	*	*	*	*	*	3
Anemia status[3]									
Anemic (hemoglobin <12 g/dl)	6.5	5.0	11.1	5.7	4.3	9.7	41.7	33.3	387
Not anemic (hemoglobin ≥12 g/dl)	5.5	4.6	6.9	4.9	4.1	6.0	12.0	7.4	3,368
Nutrition supplements in last week[4]									
Yes	5.7	4.7	7.2	5.1	4.2	6.2	14.5	8.7	354
No	5.6	4.6	7.0	4.9	4.1	6.1	15.2	10.2	3,400
Missing	*	*	*	*	*	*	*	*	1
Deworming medication in the last 6 months[5]									
Yes	5.7	4.8	7.0	5.0	4.3	6.1	15.2	9.0	368
No	5.6	4.6	7.0	4.9	4.1	6.1	15.1	10.2	3,387
Residence									
Urban	5.7	4.7	7.5	5.1	4.2	6.6	20.5	15.9	747
Rural	5.5	4.6	6.9	4.9	4.1	6.0	13.8	8.6	3,009
Province									
City of Kigali	5.9	4.8	7.7	5.2	4.3	7.0	21.3	16.2	578
South	5.7	4.9	7.4	5.1	4.2	6.3	19.0	12.9	768
West	5.4	4.6	6.6	4.8	4.1	5.8	11.2	6.1	793
North	5.0	4.3	6.1	4.5	3.8	5.4	5.0	2.3	564
East	5.7	4.7	7.2	5.1	4.2	6.3	17.2	11.8	1,052
Education									
No education	5.5	4.6	7.1	4.9	4.0	6.3	17.2	12.4	324
Primary	5.5	4.6	6.9	4.9	4.1	6.0	14.0	9.1	2,215
Secondary	5.7	4.7	7.1	5.0	4.2	6.3	15.7	10.3	1,061
More than secondary	5.9	4.9	7.9	5.1	4.3	7.0	22.8	17.6	155
Wealth quintile									
Lowest	5.5	4.6	6.9	4.9	4.1	6.0	16.1	9.8	748
Second	5.5	4.6	7.0	4.9	4.1	6.1	13.5	8.4	677
Middle	5.5	4.6	6.9	4.9	4.1	5.9	11.6	7.6	734
Fourth	5.6	4.7	7.0	5.0	4.2	6.2	16.2	10.4	732
Highest	5.7	4.7	7.2	5.0	4.1	6.3	17.6	13.4	865

Continued…

Table A.5—*Continued*

Background characteristic	Unadjusted sTfR (mg/L)			Adjusted sTfR (mg/L)			Percentage with unadjusted low tissue iron stores (sTfR >8.3 mg/L)	Percentage with adjusted low tissue iron stores (sTfR >8.3 mg/L)	Number of non-pregnant women[1]
	Median	Q1	Q3	Median	Q1	Q3			
Total	5.6	4.6	7.0	5.0	4.1	6.1	15.1	10.1	3,755

Note: sTfR and low iron stores, based on sTfR levels, are adjusted for inflammation using the regression correction approach in Luo 2023 and the cutoff defined by assay in Erhardt 2004. sTfR is measured in milligrams per liter (mg/L). An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
AGP = alpha-1-acid glycoprotein
Q = quartile
[1] Includes women who do not know if they are pregnant
[2] Tested for malaria using a rapid diagnostic test (RDT) (SD Bioline Malaria Ag P.f/Pan)
[3] Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017.
[4] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+
[5] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.

Table A.6 Low tissue iron stores in pregnant women: Micronutrient subsample

Median (IQR) concentration of soluble transferrin receptor (sTfR), unadjusted and adjusted for AGP, and percentage of pregnant women age 15–49 classified as having low tissue iron stores, unadjusted and adjusted for AGP, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Unadjusted sTfR (mg/L)			Adjusted sTfR (mg/L)			Percentage with unadjusted low tissue iron stores (sTfR >8.3 mg/L)	Percentage with adjusted low tissue iron stores (sTfR >8.3 mg/L)	Number of pregnant women
	Median	Q1	Q3	Median	Q1	Q3			
Age									
15–19	*	*	*	*	*	*	*	*	16
20–29	5.3	4.4	6.6	5.0	4.1	6.1	15.7	11.6	117
30–39	5.4	4.4	7.0	4.8	4.2	6.3	14.3	11.9	103
40–49	*	*	*	*	*	*	*	*	12
Number of children ever born									
0	5.3	4.5	6.7	5.1	4.1	6.1	15.0	11.9	66
1–3	5.2	4.3	6.6	4.8	4.0	6.0	12.0	9.0	145
4+	(5.6)	(4.6)	(6.7)	(4.9)	(4.4)	(6.3)	(15.5)	(13.1)	37
Malaria RDT[2]									
Positive	na	na	na	na	na	na	na	na	0
Negative	5.3	4.4	6.7	4.8	4.1	6.1	13.3	10.4	247
Anemia status[2]									
Anemic (hemoglobin <11 g/dl)	(7.0)	(5.1)	(9.5)	(6.1)	(4.8)	(8.4)	(28.5)	(26.4)	44
Not anemic (hemoglobin ≥11 g/dl)	5.1	4.4	6.3	4.7	4.0	5.8	10.1	7.0	204
Nutrition supplements in last week[3]									
Yes	(5.9)	(4.5)	(6.8)	(5.6)	(4.1)	(6.1)	(15.9)	(15.9)	28
No	5.2	4.4	6.7	4.8	4.1	6.1	13.0	9.7	220
Deworming medication in the last 6 months[4]									
Yes	(5.5)	(4.1)	(7.0)	(4.8)	(3.9)	(6.3)	(13.6)	(11.6)	44
No	5.3	4.4	6.6	4.9	4.1	6.1	13.3	10.1	203
Residence									
Urban	5.7	4.5	7.3	5.3	3.9	7.0	21.0	17.4	48
Rural	5.2	4.4	6.5	4.8	4.1	6.0	11.5	8.7	200
Province									
City of Kigali	(5.4)	(4.1)	(6.2)	(4.8)	(3.9)	(5.7)	(16.7)	(11.1)	31
South	6.0	4.7	7.5	5.6	4.6	7.0	22.6	16.2	59
West	5.0	4.4	6.7	4.7	4.1	5.8	10.6	10.6	51
North	(4.7)	(4.1)	(5.6)	(4.6)	(3.8)	(5.1)	(2.3)	(0.0)	38
East	5.6	4.5	6.8	5.1	4.2	6.7	11.9	10.6	69
Education									
No education	(4.6)	(3.6)	(6.7)	(4.2)	(3.5)	(6.4)	(16.2)	(6.9)	28
Primary	5.4	4.4	6.7	5.0	4.2	6.2	12.0	9.5	142
Secondary	5.3	4.5	6.2	4.8	4.1	5.7	12.2	10.2	60
More than secondary	*	*	*	*	*	*	*	*	18
Wealth quintile									
Lowest	(4.6)	(4.0)	(6.5)	(4.6)	(3.8)	(6.2)	(18.6)	(14.4)	40
Second	5.1	4.2	6.6	4.8	3.9	6.0	5.2	1.9	53
Middle	5.1	4.5	6.3	4.8	4.2	5.7	6.9	6.9	57
Fourth	(5.6)	(4.8)	(7.7)	(5.1)	(4.3)	(7.0)	(19.8)	(15.3)	44
Highest	5.6	4.7	7.0	5.2	4.1	6.4	19.0	15.6	54
Total	5.3	4.4	6.7	4.8	4.1	6.1	13.3	10.4	247

Note: sTfR and low iron stores, based on sTfR levels, are adjusted for inflammation using the regression correction approach in Luo 2023 and the cutoff defined by assay in Erhardt 2004. sTfR is measured in milligrams per liter (mg/L). Figures in parentheses are based on 25–49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
AGP = alpha-1-acid glycoprotein
Q = quartile
na = not applicable
[1] Tested for malaria using a rapid diagnostic test (RDT) (SD Bioline Malaria Ag P.f/Pan)
[2] Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017.
[3] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+
[4] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.

Table A.7 Retinol-binding protein in children: Micronutrient subsample

Median (IQR) concentration of retinol-binding protein (RBP), unadjusted and adjusted for inflammation in children age 6–59 months in the micronutrient subsample according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Unadjusted RBP (µmol/L)			Adjusted RBP (µmol/L)			Number of children age 6–59 months
	Median	Q1	Q3	Median	Q1	Q3	
Age in months							
6–11	1.1	0.8	1.5	1.2	0.9	1.6	214
12–23	1.0	0.8	1.4	1.1	0.9	1.5	442
24–35	1.0	0.8	1.3	1.1	0.8	1.4	449
36–47	1.0	0.8	1.2	1.1	0.9	1.4	453
48–59	1.0	0.8	1.3	1.1	0.8	1.4	437
6–23	1.0	0.8	1.4	1.2	0.9	1.5	656
24–59	1.0	0.8	1.3	1.1	0.9	1.4	1,339
Sex							
Male	0.9	0.8	1.3	1.0	0.8	1.4	987
Female	1.0	0.8	1.3	1.1	0.9	1.5	1,008
Malaria RDT[1]							
Positive	(0.9)	(0.7)	(1.2)	(1.1)	(0.8)	(1.5)	35
Negative	1.0	0.8	1.3	1.1	0.9	1.4	1,957
Missing	*	*	*	*	*	*	3
Anemia status[2]							
Anemic (hemoglobin <11 g/dl)	0.9	0.7	1.3	1.1	0.8	1.5	443
Not anemic (hemoglobin ≥ 11 g/dl)	1.0	0.8	1.3	1.1	0.9	1.4	1,552
Mother's interview status							
Interviewed	1.0	0.8	1.3	1.1	0.9	1.4	1,864
Not interviewed but in household	*	*	*	*	*	*	11
Not interviewed and not in the household[3]	1.0	0.8	1.4	1.1	0.9	1.5	119
Nutrition supplements in last week[4,5]							
Yes	1.0	0.8	1.4	1.1	0.9	1.5	319
No	1.0	0.8	1.3	1.1	0.9	1.4	1,675
Don't know/missing	*	*	*	*	*	*	0
Ongera intungamubiri in last week[4,5,6,7]							
Yes	1.0	0.8	1.4	1.1	0.9	1.5	178
No	1.0	0.8	1.4	1.1	0.9	1.5	882
Deworming medication in last 6 months[5,7,9,10]							
Yes	1.0	0.8	1.3	1.1	0.9	1.4	1,543
No	1.1	0.8	1.5	1.2	0.9	1.6	320
Don't know	*	*	*	*	*	*	2
Vitamin A supplements in last 6 months[11]							
Yes	1.0	0.8	1.3	1.1	0.9	1.4	1,614
No	1.1	0.8	1.4	1.2	0.9	1.5	250
Residence							
Urban	1.0	0.8	1.3	1.1	0.9	1.4	355
Rural	1.0	0.8	1.3	1.1	0.9	1.4	1,640
Province							
City of Kigali	1.0	0.8	1.4	1.1	0.8	1.5	267
South	1.0	0.8	1.3	1.1	0.9	1.5	429
West	1.0	0.8	1.3	1.1	0.9	1.4	466
North	0.9	0.8	1.2	1.0	0.9	1.3	306
East	1.0	0.8	1.3	1.1	0.9	1.4	527
Mother's education[12]							
No education	1.0	0.8	1.2	1.0	0.9	1.4	210
Primary	1.0	0.8	1.3	1.1	0.9	1.4	1,218
Secondary	1.0	0.8	1.3	1.1	0.9	1.4	360
More than secondary	1.0	0.9	1.5	1.1	1.0	1.5	88
Wealth quintile							
Lowest	1.0	0.8	1.3	1.1	0.9	1.4	475
Second	1.0	0.8	1.3	1.1	0.9	1.5	365
Middle	1.0	0.8	1.3	1.1	0.9	1.4	399
Fourth	1.0	0.8	1.3	1.1	0.8	1.4	383
Highest	1.0	0.8	1.3	1.1	0.9	1.4	373

Continued…

Table A.7—*Continued*

Background characteristic	Unadjusted RBP (µmol/L)			Adjusted RBP (µmol/L)			Number of children age 6–59 months
	Median	Q1	Q3	Median	Q1	Q3	
Total	1.0	0.8	1.3	1.1	0.9	1.4	1,995

Note: Retinol-binding protein is sometimes used as a proxy for circulating retinol. Retinol-binding protein is unadjusted and adjusted for inflammation using the regression correction approach in Larson 2018. The Kendall's Tau coefficient of correlation between RBP and retinol is less than 0.60. Due to the poor correlation of RBP with retinol, only RBP distributions are presented; the prevalence of low RBP is not presented. Retinol-binding protein is measured in micromoles per liter (µmol/L). Figures in parentheses are based on 25-49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] Tested for malaria using a rapid diagnostic test (RDT) (SD Bioline Malaria Ag P.f/Pan)
[2] Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Prevalence of anemia, based on hemoglobin levels, is adjusted for altitude using formulas in CDC 1998 and cutoffs defined in WHO 2017.
[3] Includes children whose mothers are deceased
[4] Nootritoto, Shisha Kibondo, Sosoma fortified, or CSB+
[5] Based on mother's recall
[6] Local name for multiple micronutrient powders
[7] Excludes children whose mothers were not interviewed
[8] Restricted to children age 6–23 months
[9] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.
[10] Restricted to children age 12–59 months
[11] Based on both mother's recall and the vaccination card (where available)
[12] For women who are not interviewed, information is taken from the Household Questionnaire. Excludes children whose mothers are not listed in the Household Questionnaire.

Table A.8 Retinol-binding protein in nonpregnant women: Micronutrient subsample

Median (IQR) concentration of unadjusted retinol-binding protein (RBP) for nonpregnant women age 15–49 in the micronutrient subsample, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Unadjusted RBP (µmol/L)			Number of non-pregnant women[1]
	Median	Q1	Q3	
Age				
15–19	1.5	1.1	2.0	883
20–29	1.5	1.1	2.2	1,139
30–39	1.6	1.1	2.3	1,047
40–49	1.7	1.2	2.6	687
Number of children ever born				
0	1.5	1.1	2.0	1,393
1–3	1.6	1.1	2.2	1,401
4+	1.7	1.3	2.6	961
Breastfeeding status				
Breastfeeding	1.7	1.2	2.4	984
Not breastfeeding	1.5	1.1	2.2	2,771
Malaria RDT[2]				
Positive	1.2	0.9	1.6	61
Negative	1.6	1.1	2.2	3,692
Other	*	*	*	3
Anemia status[3]				
Anemic (hemoglobin <12 g/dl)	1.3	1.0	1.8	387
Not anemic (hemoglobin ≥12 g/dl)	1.6	1.2	2.3	3,368
Nutrition supplements in last week[4]				
Yes	1.6	1.1	2.3	354
No	1.6	1.1	2.2	3,400
Missing	*	*	*	1
Deworming medication in the last 6 months[5]				
Yes	1.6	1.2	2.3	368
No	1.6	1.1	2.2	3,387
Residence				
Urban	1.4	1.0	2.0	747
Rural	1.6	1.2	2.3	3,009
Province				
City of Kigali	1.3	1.0	1.8	578
South	1.6	1.2	2.2	768
West	1.7	1.3	2.5	793
North	1.9	1.4	2.5	564
East	1.4	1.0	2.1	1,052
Education				
No education	1.8	1.2	2.5	324
Primary	1.6	1.2	2.3	2,215
Secondary	1.5	1.1	2.1	1,061
More than secondary	1.4	1.0	2.3	155
Wealth quintile				
Lowest	1.6	1.2	2.3	748
Second	1.7	1.3	2.3	677
Middle	1.7	1.2	2.4	734
Fourth	1.5	1.1	2.1	732
Highest	1.4	1.1	2.1	865
Total	1.6	1.1	2.2	3,755

Note: Retinol-binding protein is sometimes used as a proxy for circulating retinol. Retinol-binding protein is unadjusted for inflammation. The Kendall’s Tau coefficient of correlation between RBP and retinol is less than 0.60. Due to the poor correlation of RBP with retinol, only RBP distributions are presented; the prevalence of low RBP is not presented. Retinol-binding protein is measured in micromoles per liter (µmol/L). An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] Includes women who do not know if they are pregnant
[2] Tested for malaria using a rapid diagnostic test (RDT) (SD Bioline Malaria Ag P.f/Pan)
[3] Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017.
[4] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+
[5] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.

Table A.9 Retinol-binding protein in pregnant women: Micronutrient subsample

Median (IQR) concentration of unadjusted retinol-binding protein (RBP) for pregnant women age 15–49 in the micronutrient subsample, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Unadjusted RBP (µmol/L)			Number of pregnant women
	Median	Q1	Q3	
Age				
15–19	*	*	*	16
20–29	1.5	1.1	2.1	117
30–39	1.4	1.0	2.0	103
40–49	*	*	*	12
Number of children ever born				
0	1.3	1.0	2.1	66
1–3	1.5	1.1	2.0	145
4+	(1.4)	(1.1)	(1.9)	37
Breastfeeding status				
Breastfeeding	*	*	*	8
Not breastfeeding	1.4	1.0	2.0	239
Malaria RDT[1]				
Positive	na	na	na	0
Negative	1.4	1.0	2.0	247
Anemia status[2]				
Anemic (hemoglobin <11 g/dl)	(1.2)	(0.9)	(1.6)	44
Not anemic (hemoglobin ≥11 g/dl)	1.5	1.1	2.1	204
Nutrition supplements in last week[3]				
Yes	(1.3)	(1.0)	(2.3)	28
No	1.4	1.0	2.0	220
Deworming medication in the last 6 months[4]				
Yes	(1.2)	(1.0)	(1.9)	44
No	1.5	1.1	2.1	203
Residence				
Urban	1.4	1.0	2.1	48
Rural	1.4	1.1	2.0	200
Province				
City of Kigali	(1.3)	(0.9)	(2.1)	31
South	1.5	1.2	2.0	59
West	1.5	1.1	2.1	51
North	(1.3)	(1.0)	(2.1)	38
East	1.3	1.0	1.8	69
Education				
No education	(1.3)	(1.1)	(2.0)	28
Primary	1.4	1.1	1.9	142
Secondary	1.3	1.0	2.1	60
More than secondary	*	*	*	18
Wealth quintile				
Lowest	(1.5)	(1.1)	(1.9)	40
Second	1.4	1.0	1.8	53
Middle	1.5	1.0	2.0	57
Fourth	(1.6)	(1.1)	(2.1)	44
Highest	1.3	1.0	2.3	54
Total	1.4	1.0	2.0	247

Note: Retinol-binding protein is sometimes used as a proxy for circulating retinol. Retinol-binding protein is unadjusted for inflammation. The Kendall's Tau coefficient of correlation between RBP and retinol is less than 0.60. Due to the poor correlation of RBP with retinol, only RBP distributions are presented; the prevalence of low RBP is not presented. Retinol-binding protein is measured in micromoles per liter (µmol/L). Figures in parentheses are based on 25-49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
na = not applicable
[1] Tested for malaria using a rapid diagnostic test (RDT) (SD Bioline Malaria Ag P.f/Pan)
[2] Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Prevalence of anemia, based on hemoglobin levels, is adjusted for altitude and for cigarette smoking, if known, using formulas in CDC 1998 and cutoffs defined in WHO 2017.
[3] Nootrimama, Shisha Kibondo, Sosoma fortified, or CSB+
[4] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.

Table A.10 Vitamin A deficiency in children, not adjusted for inflammation: Micronutrient subsample

Median (IQR) concentration of serum retinol, not adjusted for inflammation, and percentage of children age 6–59 months in the micronutrient subsample classified as having vitamin A deficiency, not adjusted for inflammation, according to background characteristics, Rwanda DHS 2019–20

Background characteristic	Unadjusted serum retinol (μmol/L) Median	Q1	Q3	Percentage with unadjusted vitamin A deficiency (serum retinol <0.7 μmol/L)	Number of children age 6–59 months
Age in months					
6–11	1.1	0.9	1.5	10.8	214
12–23	1.1	0.9	1.4	11.2	441
24–35	1.1	0.9	1.4	7.9	448
36–47	1.1	0.8	1.3	11.7	452
48–59	1.1	0.9	1.3	13.8	437
6–23	1.1	0.9	1.4	11.1	655
24–59	1.1	0.9	1.3	11.1	1,336
Sex					
Male	1.1	0.8	1.4	11.5	984
Female	1.1	0.9	1.4	10.7	1,006
Malaria RDT[1]					
Positive	(0.9)	(0.7)	(1.2)	(24.9)	35
Negative	1.1	0.9	1.4	10.9	1,953
Missing	*	*	*	*	3
Anemia status[2]					
Anemic (hemoglobin <11 g/dl)	1.0	0.8	1.3	14.7	441
Not anemic (hemoglobin ≥11 g/dl)	1.1	0.9	1.4	10.1	1,550
Mother's interview status					
Interviewed	1.1	0.9	1.4	11.3	1,860
Not interviewed but in household	*	*	*	*	11
Not interviewed and not in the household[3]	1.1	0.9	1.3	8.6	119
Nutrition supplements in last week[4,5]					
Yes	1.1	0.9	1.3	10.3	318
No	1.1	0.9	1.4	11.3	1,672
Don't know/missing	*	*	*	*	0
Ongera intungamubiri in last week[4,5,6,7]					
Yes	1.1	0.9	1.4	7.9	177
No	1.1	0.9	1.4	10.6	879
Deworming medication in last 6 months[5,7,9,10]					
Yes	1.1	0.9	1.4	11.1	1,538
No	1.1	0.8	1.4	12.1	320
Don't know	*	*	*	*	2
Vitamin A supplements in last 6 months[11]					
Yes	1.1	0.9	1.4	11.0	1,610
No	1.1	0.8	1.4	13.0	250
Residence					
Urban	1.1	0.8	1.4	12.1	355
Rural	1.1	0.9	1.4	10.9	1,636
Province					
City of Kigali	1.1	0.9	1.4	9.7	267
South	1.1	0.9	1.4	9.9	428
West	1.1	0.8	1.4	14.6	464
North	1.1	0.8	1.3	9.4	304
East	1.1	0.8	1.3	10.6	527
Mother's education[12]					
No education	1.1	0.9	1.3	10.9	209
Primary	1.1	0.9	1.4	12.4	1,215
Secondary	1.1	0.9	1.4	8.3	360
More than secondary	1.2	0.9	1.4	9.0	88
Wealth quintile					
Lowest	1.1	0.8	1.3	12.1	473
Second	1.1	0.8	1.4	11.4	365
Middle	1.1	0.9	1.3	10.3	398
Fourth	1.1	0.8	1.4	15.0	383
Highest	1.1	0.9	1.4	6.5	373

Continued…

Table A.10—*Continued*

Background characteristic	Unadjusted serum retinol (µmol/L)			Percentage with unadjusted vitamin A deficiency (serum retinol <0.7 µmol/L)	Number of children age 6–59 months
	Median	Q1	Q3		
Total	1.1	0.9	1.4	11.1	1,991

Note: Serum retinol and prevalence of vitamin A deficiency, based on serum retinol levels, are unadjusted for inflammation and cutoff defined in WHO 2011. Serum retinol is measured in micromoles per liter (µmol/L). Figures in parentheses are based on 25-49 unweighted cases. An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.
IQR = interquartile range
Q = quartile
[1] Tested for malaria using a rapid diagnostic test (RDT) (SD Bioline Malaria Ag P.f/Pan)
[2] Hemoglobin is measured (with venous blood) in grams per deciliter (g/dl) using the HemoCue 201+ device. Prevalence of anemia, based on hemoglobin levels, is adjusted for altitude using formulas in CDC 1998 and cutoffs defined in WHO 2017.
[3] Includes children whose mothers are deceased
[4] Nootritoto, Shisha Kibondo, Sosoma fortified, or CSB+
[5] Based on mother's recall
[6] Local name for multiple micronutrient powders
[7] Excludes children whose mothers were not interviewed
[8] Restricted to children age 6–23 months
[9] Deworming for intestinal parasites is commonly done for helminths and schistosomiasis.
[10] Restricted to children age 12–59 months
[11] Based on both mother's recall and the vaccination card (where available)
[12] For women who are not interviewed, information is taken from the Household Questionnaire. Excludes children whose mothers are not listed in the Household Questionnaire.

SAMPLING ERRORS

Appendix B

Table B.1 Sampling errors for selected indicators for the micronutrient survey, Rwanda DHS 2019–20

Variable	Estimate	Base population
NON-PREGNANT WOMEN		
Prevalence of any anemia	Proportion	Non-pregnant women 15–49 tested
Prevalence of severe anemia	Proportion	Non-pregnant women 15–49 tested
Prevalence of iron deficiency (based on adjusted ferritin)[1]	Proportion	Non-pregnant women 15–49 tested
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	Proportion	Non-pregnant women 15–49 tested
Prevalence of vitamin A deficiency (based on adjusted retinol)	Proportion	Non-pregnant women 15–49 tested
Prevalence of inflammation (based on CRP and AGP)	Proportion	Non-pregnant women 15–49 tested
Prevalence of B12 deficiency	Proportion	Non-pregnant women 15–49 tested
Urinary iodine	Median	Non-pregnant women 15–49 tested
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	Proportion	Non-pregnant women 15–49 tested
Body Mass Index (BMI) <18.5	Proportion	Non-pregnant women 15–49 who are measured
Body Mass Index (BMI) ≥25	Proportion	Non-pregnant women 15–49 who are measured
PREGNANT WOMEN		
Prevalence of anemia	Proportion	Pregnant women 15–49 tested
Prevalence of severe anemia	Proportion	Pregnant women 15–49 tested
Prevalence of iron deficiency (based on adjusted ferritin)[1]	Proportion	Pregnant women 15–49 tested
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	Proportion	Pregnant women 15–49 tested
Prevalence of vitamin A deficiency (based on unadjusted retinol)	Proportion	Pregnant women 15–49 tested
Prevalence of inflammation (based on CRP and AGP)	Proportion	Pregnant women 15–49 tested
Prevalence of B12 deficiency	Proportion	Pregnant women 15–49 tested
Urinary iodine	Median	Pregnant women 15–49 tested
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	Proportion	Pregnant women 15–49 tested
CHILDREN		
Prevalence of anemia	Proportion	Children under 5 who are tested
Prevalence of severe anemia	Proportion	Children under 5 who are tested
Prevalence of iron deficiency (based on adjusted ferritin)[1]	Proportion	Children under 5 who are tested
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	Proportion	Children under 5 who are tested
Prevalence of vitamin A deficiency (based on adjusted retinol)	Proportion	Children under 5 who are tested
Prevalence of inflammation (based on CRP and AGP)	Proportion	Children under 5 who are tested
Prevalence of B12 deficiency	Proportion	Children under 5 who are tested
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	Proportion	Children under 5 who are tested
Height-for-age (-2SD)	Proportion	Children under 5 who are measured
Weight-for-height (-2SD)	Proportion	Children under 5 who are measured
Weight-for-age (-2SD)	Proportion	Children under 5 who are measured

[1] Adjusted ferritin is adjusted for CRP and AGP using the regression approach defined in WHO, 2020. Retinol is adjusted for children but not women using the regression approach defined in Larson, 2018. Soluble transferrin receptor is adjusted for AGP using the regression correction approach defined in Luo, 2023.

Table B.2 Sampling errors: Total sample, Rwanda DHS 2019–20, Micronutrient Subsample

Variable	Value (R)	Standard error (SE)	Number of cases: Un-weighted (N)	Number of cases: Weighted (WN)	Design effect (DEFT)	Relative error (SE/R)	Confidence interval: R-2SE	Confidence interval: R+2SE
NON-PREGNANT WOMEN								
Prevalence of any anemia	0.103	0.006	3,756	3,778	1.294	0.062	0.090	0.115
Prevalence of severe anemia	0.004	0.001	3756	3,778	0.989	0.256	0.002	0.006
Prevalence of iron deficiency (based on adjusted ferritin)	0.086	0.006	3,734	3,760	1.235	0.066	0.075	0.098
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.026	0.003	3,733	3,759	1.161	0.116	0.020	0.032
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.024	0.003	3,729	3,755	1.287	0.135	0.017	0.030
Prevalence of inflammation (based on CRP and AGP)	0.198	0.008	3,734	3,760	1.171	0.039	0.183	0.214
Prevalence of B12 deficiency	0.238	0.010	3,733	3,758	1.393	0.041	0.219	0.257
Urinary iodine	253.8	5.8	3,733	3,760	1.444	0.023	242.3	265.4
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.101	0.006	3,734	3,760	1.277	0.063	0.088	0.113
Body Mass Index (BMI) <18.5	0.064	0.004	3,683	3,700	1.097	0.069	0.055	0.073
Body Mass Index (BMI) ≥25	0.260	0.009	3,683	3,700	1.272	0.035	0.242	0.279
PREGNANT WOMEN								
Prevalence of any anemia	0.175	0.025	248	248	1.044	0.144	0.125	0.226
Prevalence of severe anemia	0.004	0.004	248	248	0.944	1.002	0.000	0.011
Prevalence of iron deficiency (based on adjusted ferritin)	0.150	0.026	247	248	1.122	0.171	0.099	0.201
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.037	0.011	247	248	0.909	0.297	0.015	0.058
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.084	0.019	247	248	1.063	0.223	0.047	0.122
Prevalence of inflammation (based on CRP and AGP)	0.206	0.028	247	248	1.084	0.136	0.150	0.262
Prevalence of B12 deficiency	0.435	0.033	247	248	1.039	0.075	0.369	0.501
Urinary iodine	242.2	13.9	247	248	1.103	0.058	214.3	270.1
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.104	0.020	247	248	1.047	0.196	0.063	0.145
CHLDREN								
Prevalence of any anemia	0.222	0.011	1,950	2,001	1.141	0.049	0.200	0.244
Prevalence of severe anemia	0.001	0.001	1,950	2,001	0.887	0.586	0.000	0.002
Prevalence of iron deficiency (based on adjusted ferritin)	0.082	0.007	1,951	2,000	1.203	0.091	0.067	0.097
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.042	0.006	1,946	1,995	1.402	0.151	0.030	0.055
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.068	0.008	1,946	1,996	1.397	0.117	0.052	0.084
Prevalence of inflammation (based on CRP and AGP)	0.339	0.013	1,951	2,000	1.246	0.039	0.312	0.366
Prevalence of B12 deficiency	0.157	0.010	1,943	1,992	1.242	0.065	0.137	0.178
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.168	0.010	1,951	2,000	1.137	0.057	0.149	0.187
Height-for-age (-2SD)	0.345	0.012	2,198	2,256	1.114	0.034	0.321	0.369
Weight-for-height (-2SD)	0.012	0.002	2,199	2,256	1.017	0.199	0.007	0.017
Weight-for-age (-2SD)	0.079	0.007	2,200	2,257	1.128	0.086	0.066	0.093

Table B.3 Sampling errors: Urban sample, Rwanda DHS 2019–20, Micronutrient Subsample

Variable	Value (R)	Standard error (SE)	Number of cases: Un-weighted (N)	Number of cases: Weighted (WN)	Design effect (DEFT)	Relative error (SE/R)	Confidence interval: R-2SE	Confidence interval: R+2SE
NON-PREGNANT WOMEN								
Prevalence of any anemia	0.115	0.017	918	758	1.567	0.143	0.082	0.148
Prevalence of severe anemia	0.007	0.003	918	758	1.139	0.441	0.001	0.014
Prevalence of iron deficiency (based on adjusted ferritin)	0.212	0.018	905	748	1.323	0.085	0.176	0.248
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.068	0.011	904	747	1.363	0.168	0.045	0.091
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.029	0.009	902	745	1.580	0.303	0.012	0.047
Prevalence of inflammation (based on CRP and AGP)	0.226	0.020	905	748	1.415	0.087	0.186	0.265
Prevalence of B12 deficiency	0.201	0.018	904	746	1.317	0.087	0.166	0.236
Urinary iodine	283.3	14.6	905	748	1.656	0.052	254.0	312.5
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.159	0.017	905	748	1.430	0.109	0.124	0.194
Body Mass Index (BMI) <18.5	0.052	0.008	897	739	1.111	0.158	0.036	0.069
Body Mass Index (BMI) ≥25	0.469	0.022	897	739	1.301	0.046	0.426	0.513
PREGNANT WOMEN								
Prevalence of any anemia	0.261	0.074	57	48	1.249	0.282	0.114	0.408
Prevalence of severe anemia	0.000	0.000	57	48	na	na	0.000	0.000
Prevalence of iron deficiency (based on adjusted ferritin)	0.205	0.057	57	48	1.065	0.281	0.090	0.319
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.082	0.030	57	48	0.815	0.364	0.022	0.141
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.139	0.057	57	48	1.223	0.408	0.026	0.253
Prevalence of inflammation (based on CRP and AGP)	0.243	0.068	57	48	1.181	0.279	0.107	0.379
Prevalence of B12 deficiency	0.464	0.067	57	48	1.009	0.145	0.330	0.598
Urinary iodine	256.6	47.2	57	48	1.353	0.184	162.2	351.0
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.175	0.056	57	48	1.101	0.320	0.063	0.287
CHLDREN								
Prevalence of any anemia	0.220	0.028	409	355	1.382	0.127	0.164	0.276
Prevalence of severe anemia	0.002	0.002	409	355	0.944	1.006	0.000	0.006
Prevalence of iron deficiency (based on adjusted ferritin)	0.138	0.021	412	358	1.205	0.149	0.097	0.179
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.064	0.017	409	355	1.388	0.264	0.030	0.097
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.083	0.022	412	358	1.626	0.267	0.039	0.127
Prevalence of inflammation (based on CRP and AGP)	0.280	0.029	412	358	1.304	0.103	0.222	0.337
Prevalence of B12 deficiency	0.158	0.025	408	354	1.366	0.156	0.109	0.207
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.178	0.022	412	358	1.186	0.126	0.133	0.222
Height-for-age (-2SD)	0.191	0.025	473	410	1.322	0.128	0.142	0.240
Weight-for-height (-2SD)	0.022	0.008	474	410	1.199	0.355	0.006	0.038
Weight-for-age (-2SD)	0.047	0.011	474	410	1.153	0.232	0.025	0.068

Table B.4 Sampling errors: Rural sample, Rwanda DHS 2019–20, Micronutrient Subsample

Variable	Value (R)	Standard error (SE)	Number of cases: Un-weighted (N)	Number of cases: Weighted (WN)	Design effect (DEFT)	Relative error (SE/R)	Confidence interval: R-2SE	Confidence interval: R+2SE
NON-PREGNANT WOMEN								
Prevalence of any anemia	0.099	0.007	2,838	3,019	1.219	0.069	0.086	0.113
Prevalence of severe anemia	0.003	0.001	2,838	3,019	0.937	0.314	0.001	0.005
Prevalence of iron deficiency (based on adjusted ferritin)	0.055	0.005	2,829	3,012	1.189	0.092	0.045	0.066
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.016	0.002	2,829	3,012	1.031	0.153	0.011	0.021
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.022	0.003	2,827	3,010	1.202	0.150	0.016	0.029
Prevalence of inflammation (based on CRP and AGP)	0.192	0.008	2,829	3,012	1.105	0.043	0.175	0.208
Prevalence of B12 deficiency	0.247	0.011	2,829	3,012	1.388	0.046	0.225	0.270
Urinary iodine	248.0	6.1	2,828	3,012	1.372	0.025	235.8	260.1
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.086	0.006	2,829	3,012	1.221	0.075	0.073	0.099
Body Mass Index (BMI) <18.5	0.067	0.005	2,786	2,961	1.082	0.077	0.057	0.077
Body Mass Index (BMI) ≥25	0.208	0.010	2,786	2,961	1.309	0.048	0.188	0.228
PREGNANT WOMEN								
Prevalence of any anemia	0.155	0.025	191	200	0.959	0.162	0.105	0.205
Prevalence of severe anemia	0.004	0.004	191	200	0.923	1.002	0.000	0.013
Prevalence of iron deficiency (based on adjusted ferritin)	0.137	0.029	190	200	1.153	0.211	0.079	0.194
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.026	0.012	190	200	1.005	0.450	0.003	0.049
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.071	0.019	190	200	1.016	0.267	0.033	0.109
Prevalence of inflammation (based on CRP and AGP)	0.197	0.031	190	200	1.058	0.155	0.136	0.259
Prevalence of B12 deficiency	0.428	0.037	190	200	1.039	0.087	0.353	0.503
Urinary iodine	238.8	18.0	190	200	0.997	0.075	202.9	274.8
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.087	0.021	190	200	1.044	0.246	0.044	0.130
CHLDREN								
Prevalence of any anemia	0.222	0.012	1,541	1,645	1.088	0.053	0.198	0.246
Prevalence of severe anemia	0.001	0.001	1,541	1,645	0.879	0.720	0.000	0.002
Prevalence of iron deficiency (based on adjusted ferritin)	0.069	0.008	1,539	1,642	1.229	0.115	0.054	0.085
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.038	0.007	1,537	1,640	1.415	0.182	0.024	0.052
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.065	0.008	1,534	1,638	1.339	0.130	0.048	0.082
Prevalence of inflammation (based on CRP and AGP)	0.352	0.015	1,539	1,642	1.236	0.043	0.322	0.382
Prevalence of B12 deficiency	0.157	0.011	1,535	1,637	1.213	0.072	0.135	0.180
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.166	0.011	1,539	1,642	1.122	0.064	0.145	0.187
Height-for-age (-2SD)	0.379	0.014	1,725	1,846	1.106	0.036	0.352	0.406
Weight-for-height (-2SD)	0.010	0.002	1,725	1,846	0.961	0.241	0.005	0.015
Weight-for-age (-2SD)	0.087	0.008	1,726	1,847	1.108	0.091	0.071	0.102

Table B.5 Sampling errors: Kigali sample, Rwanda DHS 2019–20, Micronutrient Subsample

Variable	Value (R)	Standard error (SE)	Number of cases: Un-weighted (N)	Number of cases: Weighted (WN)	Design effect (DEFT)	Relative error (SE/R)	Confidence interval: R-2SE	Confidence interval: R+2SE
NON-PREGNANT WOMEN								
Prevalence of any anemia	0.134	0.020	513	582	1.358	0.152	0.093	0.175
Prevalence of severe anemia	0.003	0.003	513	582	1.145	1.010	0.000	0.008
Prevalence of iron deficiency (based on adjusted ferritin)	0.225	0.022	510	578	1.208	0.100	0.180	0.269
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.068	0.014	509	578	1.249	0.206	0.040	0.095
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.017	0.006	509	577	1.113	0.374	0.004	0.030
Prevalence of inflammation (based on CRP and AGP)	0.235	0.024	510	578	1.287	0.103	0.186	0.283
Prevalence of B12 deficiency	0.187	0.020	509	576	1.164	0.108	0.147	0.227
Urinary iodine	306.8	14.3	510	578	1.346	0.047	278.2	335.4
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.162	0.020	510	578	1.207	0.122	0.122	0.201
Body Mass Index (BMI) <18.5	0.059	0.011	504	571	1.068	0.190	0.037	0.082
Body Mass Index (BMI) ≥25	0.431	0.024	504	571	1.068	0.055	0.384	0.478
PREGNANT WOMEN								
Prevalence of any anemia	0.267	0.106	26	31	1.189	0.397	0.055	0.479
Prevalence of severe anemia	0.000	0.000	26	31	na	na	0.000	0.000
Prevalence of iron deficiency (based on adjusted ferritin)	0.174	0.081	26	31	1.062	0.463	0.013	0.336
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.084	0.046	26	31	0.832	0.547	0.000	0.175
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.132	0.077	26	31	1.137	0.587	0.000	0.287
Prevalence of inflammation (based on CRP and AGP)	0.310	0.089	26	31	0.968	0.289	0.131	0.488
Prevalence of B12 deficiency	0.512	0.092	26	31	0.923	0.180	0.328	0.696
Urinary iodine	265.7	113.2	26	31	1.155	0.426	39.3	492.0
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.112	0.067	26	31	1.065	0.603	0.000	0.246
CHLDREN								
Prevalence of any anemia	0.246	0.039	219	267	1.330	0.157	0.169	0.324
Prevalence of severe anemia	0.000	0.000	219	267	na	na	0.000	0.000
Prevalence of iron deficiency (based on adjusted ferritin)	0.120	0.024	220	269	1.092	0.200	0.072	0.168
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.054	0.020	219	267	1.315	0.373	0.014	0.095
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.063	0.024	220	269	1.437	0.376	0.016	0.110
Prevalence of inflammation (based on CRP and AGP)	0.261	0.033	220	269	1.099	0.125	0.196	0.327
Prevalence of B12 deficiency	0.147	0.025	219	267	1.058	0.173	0.096	0.197
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.196	0.031	220	269	1.149	0.157	0.134	0.257
Height-for-age (-2SD)	0.193	0.034	248	302	1.301	0.174	0.126	0.261
Weight-for-height (-2SD)	0.018	0.008	248	302	0.972	0.445	0.002	0.034
Weight-for-age (-2SD)	0.038	0.013	248	302	1.094	0.340	0.012	0.064

Table B.6 Sampling errors: South sample, Rwanda DHS 2019–20, Micronutrient Subsample

Variable	Value (R)	Standard error (SE)	Number of cases: Un-weighted (N)	Number of cases: Weighted (WN)	Design effect (DEFT)	Relative error (SE/R)	Confidence interval: R-2SE	Confidence interval: R+2SE
NON-PREGNANT WOMEN								
Prevalence of any anemia	0.111	0.013	869	771	1.177	0.113	0.086	0.136
Prevalence of severe anemia	0.004	0.002	869	771	1.049	0.580	0.000	0.008
Prevalence of iron deficiency (based on adjusted ferritin)	0.064	0.009	864	770	1.120	0.146	0.045	0.083
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.017	0.005	864	770	1.180	0.304	0.007	0.028
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.023	0.005	863	768	1.068	0.237	0.012	0.034
Prevalence of inflammation (based on CRP and AGP)	0.233	0.016	864	770	1.095	0.068	0.202	0.265
Prevalence of B12 deficiency	0.180	0.018	864	770	1.376	0.100	0.144	0.216
Urinary iodine	246.6	9.5	865	771	1.468	0.039	227.6	265.7
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.129	0.014	864	770	1.185	0.105	0.102	0.156
Body Mass Index (BMI) <18.5	0.088	0.011	854	758	1.144	0.126	0.066	0.111
Body Mass Index (BMI) ≥25	0.199	0.016	854	758	1.170	0.080	0.167	0.231
PREGNANT WOMEN								
Prevalence of any anemia	0.180	0.039	70	59	0.854	0.219	0.101	0.259
Prevalence of severe anemia	0.015	0.015	70	59	1.033	1.006	0.000	0.045
Prevalence of iron deficiency (based on adjusted ferritin)	0.171	0.047	70	59	1.037	0.275	0.077	0.265
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.036	0.014	70	59	0.607	0.374	0.009	0.064
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.078	0.032	70	59	0.986	0.409	0.014	0.141
Prevalence of inflammation (based on CRP and AGP)	0.199	0.048	70	59	1.004	0.243	0.102	0.295
Prevalence of B12 deficiency	0.383	0.054	70	59	0.925	0.141	0.275	0.491
Urinary iodine	281.0	42.0	70	59	0.990	0.149	197.1	365.0
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.162	0.044	70	59	0.995	0.272	0.074	0.250
CHLDREN								
Prevalence of any anemia	0.261	0.024	477	429	1.158	0.092	0.213	0.310
Prevalence of severe anemia	0.002	0.002	477	429	0.862	1.008	0.000	0.005
Prevalence of iron deficiency (based on adjusted ferritin)	0.065	0.011	478	429	0.930	0.161	0.044	0.086
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.031	0.008	477	429	0.940	0.239	0.016	0.047
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.061	0.012	477	429	1.064	0.191	0.038	0.084
Prevalence of inflammation (based on CRP and AGP)	0.354	0.024	478	429	1.099	0.068	0.306	0.402
Prevalence of B12 deficiency	0.134	0.018	477	429	1.182	0.138	0.097	0.171
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.166	0.017	478	429	0.992	0.102	0.132	0.199
Height-for-age (-2SD)	0.369	0.026	532	482	1.212	0.071	0.317	0.421
Weight-for-height (-2SD)	0.011	0.005	534	483	1.050	0.424	0.002	0.020
Weight-for-age (-2SD)	0.125	0.016	534	483	1.079	0.125	0.094	0.156

Table B.7 Sampling errors: West sample, Rwanda DHS 2019–20, Micronutrient Subsample

Variable	Value (R)	Standard error (SE)	Number of cases: Un-weighted (N)	Number of cases: Weighted (WN)	Design effect (DEFT)	Relative error (SE/R)	Confidence interval: R-2SE	Confidence interval: R+2SE
NON-PREGNANT WOMEN								
Prevalence of any anemia	0.121	0.015	835	794	1.306	0.122	0.092	0.151
Prevalence of severe anemia	0.004	0.002	835	794	1.004	0.568	0.000	0.008
Prevalence of iron deficiency (based on adjusted ferritin)	0.045	0.008	834	794	1.096	0.174	0.029	0.061
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.018	0.004	834	794	0.943	0.238	0.010	0.027
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.031	0.008	834	794	1.248	0.241	0.016	0.046
Prevalence of inflammation (based on CRP and AGP)	0.190	0.016	834	794	1.149	0.082	0.159	0.222
Prevalence of B12 deficiency	0.226	0.020	834	794	1.370	0.088	0.186	0.266
Urinary iodine	203.0	11.7	831	792	1.517	0.057	179.6	226.3
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.061	0.011	834	794	1.271	0.172	0.040	0.082
Body Mass Index (BMI) <18.5	0.063	0.010	819	779	1.124	0.151	0.044	0.082
Body Mass Index (BMI) ≥25	0.223	0.020	819	779	1.350	0.088	0.183	0.262
PREGNANT WOMEN								
Prevalence of any anemia	0.190	0.048	52	51	0.875	0.252	0.094	0.286
Prevalence of severe anemia	0.000	0.000	52	51	na	na	0.000	0.000
Prevalence of iron deficiency (based on adjusted ferritin)	0.057	0.031	52	51	0.957	0.544	0.000	0.119
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.022	0.022	52	51	1.054	0.976	0.000	0.066
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.063	0.034	52	51	0.995	0.537	0.000	0.131
Prevalence of inflammation (based on CRP and AGP)	0.138	0.052	52	51	1.080	0.379	0.033	0.243
Prevalence of B12 deficiency	0.269	0.058	52	51	0.935	0.215	0.153	0.385
Urinary iodine	212.3	22.1	52	51	1.131	0.104	168.2	256.4
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.106	0.047	52	51	1.093	0.444	0.012	0.201
CHLDREN								
Prevalence of any anemia	0.217	0.019	490	470	0.982	0.087	0.180	0.255
Prevalence of severe anemia	0.000	0.000	490	470	na	na	0.000	0.000
Prevalence of iron deficiency (based on adjusted ferritin)	0.056	0.011	489	467	1.023	0.191	0.034	0.077
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.036	0.009	487	466	1.107	0.260	0.017	0.055
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.092	0.024	487	466	1.825	0.261	0.044	0.140
Prevalence of inflammation (based on CRP and AGP)	0.381	0.030	489	467	1.361	0.079	0.321	0.441
Prevalence of B12 deficiency	0.151	0.021	487	466	1.314	0.142	0.108	0.194
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.170	0.019	489	467	1.143	0.114	0.131	0.209
Height-for-age (-2SD)	0.422	0.027	557	531	1.175	0.064	0.369	0.476
Weight-for-height (-2SD)	0.009	0.004	557	531	1.083	0.485	0.000	0.017
Weight-for-age (-2SD)	0.091	0.016	557	531	1.261	0.181	0.058	0.123

Table B.8 Sampling errors: North sample, Rwanda DHS 2019–20, Micronutrient Subsample

Variable	Value (R)	Standard error (SE)	Number of cases: Un-weighted (N)	Number of cases: Weighted (WN)	Design effect (DEFT)	Relative error (SE/R)	Confidence interval: R-2SE	Confidence interval: R+2SE
NON-PREGNANT WOMEN								
Prevalence of severe anemia	0.002	0.002	584	570	0.976	1.004	0.000	0.005
Prevalence of iron deficiency (based on adjusted ferritin)	0.018	0.005	578	565	0.984	0.304	0.007	0.029
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.007	0.003	578	565	0.987	0.507	0.000	0.013
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.025	0.010	577	564	1.604	0.421	0.004	0.045
Prevalence of inflammation (based on CRP and AGP)	0.151	0.014	578	565	0.940	0.093	0.123	0.179
Prevalence of B12 deficiency	0.296	0.026	578	565	1.362	0.087	0.244	0.348
Urinary iodine	241.6	9.6	578	565	1.307	0.040	222.4	260.8
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.023	0.007	578	565	1.184	0.323	0.008	0.038
Body Mass Index (BMI) <18.5	0.048	0.009	574	560	0.988	0.184	0.030	0.066
Body Mass Index (BMI) ≥25	0.245	0.020	574	560	1.138	0.083	0.204	0.286
PREGNANT WOMEN								
Prevalence of any anemia	0.167	0.063	37	38	1.022	0.381	0.040	0.294
Prevalence of severe anemia	0.000	0.000	37	38	na	na	0.000	0.000
Prevalence of iron deficiency (based on adjusted ferritin)	0.092	0.044	37	38	0.910	0.474	0.005	0.180
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.028	0.027	37	38	1.001	0.991	0.000	0.082
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.107	0.052	37	38	1.018	0.492	0.002	0.211
Prevalence of inflammation (based on CRP and AGP)	0.164	0.074	37	38	1.188	0.449	0.017	0.312
Prevalence of B12 deficiency	0.500	0.097	37	38	1.156	0.194	0.307	0.694
Urinary iodine	157.9	33.4	37	38	1.130	0.211	91.1	224.6
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.000	0.000	37	38	na	na	0.000	0.000
CHLDREN								
Prevalence of any anemia	0.224	0.028	305	307	1.148	0.124	0.168	0.280
Prevalence of severe anemia	0.003	0.003	305	307	0.978	1.002	0.000	0.009
Prevalence of iron deficiency (based on adjusted ferritin)	0.058	0.015	304	306	1.092	0.254	0.028	0.087
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.034	0.011	304	306	1.078	0.328	0.012	0.057
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.055	0.015	302	304	1.140	0.272	0.025	0.085
Prevalence of inflammation (based on CRP and AGP)	0.373	0.032	304	306	1.146	0.085	0.310	0.437
Prevalence of B12 deficiency	0.212	0.034	302	304	1.427	0.159	0.145	0.280
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.148	0.026	304	306	1.277	0.176	0.096	0.200
Height-for-age (-2SD)	0.413	0.028	336	335	1.009	0.067	0.358	0.468
Weight-for-height (-2SD)	0.000	0.000	335	334	na	na	0.000	0.000
Weight-for-age (-2SD)	0.047	0.013	336	335	1.040	0.270	0.021	0.072

Table B.9 Sampling errors: East sample, Rwanda DHS 2019–20, Micronutrient Subsample

Variable	Value (R)	Standard error (SE)	Number of cases: Un-weighted (N)	Number of cases: Weighted (WN)	Design effect (DEFT)	Relative error (SE/R)	Confidence interval: R-2SE	Confidence interval: R+2SE
NON-PREGNANT WOMEN								
Prevalence of any anemia	0.077	0.012	955	1,060	1.359	0.152	0.054	0.101
Prevalence of severe anemia	0.006	0.002	955	1,060	0.894	0.364	0.002	0.011
Prevalence of iron deficiency (based on adjusted ferritin)	0.095	0.012	948	1,052	1.297	0.130	0.070	0.120
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.026	0.006	948	1,052	1.059	0.209	0.015	0.037
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.022	0.006	946	1,050	1.321	0.289	0.009	0.034
Prevalence of inflammation (based on CRP and AGP)	0.184	0.015	948	1,052	1.209	0.083	0.154	0.215
Prevalence of B12 deficiency	0.286	0.022	948	1,052	1.496	0.077	0.242	0.330
Urinary iodine	280.6	11.8	949	1,054	1.494	0.042	257.1	304.2
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.118	0.014	948	1,052	1.350	0.120	0.090	0.146
Body Mass Index (BMI) <18.5	0.058	0.008	932	1,032	1.104	0.145	0.041	0.075
Body Mass Index (BMI) ≥25	0.248	0.020	932	1,032	1.439	0.082	0.207	0.288
PREGNANT WOMEN								
Prevalence of any anemia	0.125	0.046	63	70	1.091	0.368	0.033	0.216
Prevalence of severe anemia	0.000	0.000	63	70	na	na	0.000	0.000
Prevalence of iron deficiency (based on adjusted ferritin)	0.221	0.065	62	69	1.220	0.295	0.091	0.351
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.031	0.023	62	69	1.016	0.727	0.000	0.076
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.073	0.035	62	69	1.046	0.479	0.003	0.142
Prevalence of inflammation (based on CRP and AGP)	0.241	0.060	62	69	1.100	0.251	0.120	0.361
Prevalence of B12 deficiency	0.533	0.071	62	69	1.110	0.133	0.391	0.675
Urinary iodine	260.8	29.1	62	69	1.047	0.111	202.7	318.9
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.106	0.042	62	69	1.074	0.399	0.022	0.191
CHLDREN								
Prevalence of any anemia	0.180	0.020	459	527	1.148	0.113	0.139	0.220
Prevalence of severe anemia	0.001	0.001	459	527	0.805	1.004	0.000	0.004
Prevalence of iron deficiency (based on adjusted ferritin)	0.113	0.019	460	528	1.320	0.173	0.074	0.152
Prevalence of iron deficiency anemia (based on hemoglobin and adjusted ferritin)	0.056	0.018	459	527	1.650	0.318	0.020	0.091
Prevalence of vitamin A deficiency (based on adjusted retinol)	0.064	0.012	460	528	1.087	0.195	0.039	0.088
Prevalence of inflammation (based on CRP and AGP)	0.309	0.029	460	528	1.324	0.093	0.251	0.366
Prevalence of B12 deficiency	0.155	0.019	458	525	1.123	0.123	0.117	0.193
Prevalence of low tissue iron stores (based on adjusted soluble transferrin receptor)	0.166	0.019	460	528	1.098	0.115	0.128	0.205
Height-for-age (-2SD)	0.296	0.022	525	606	1.058	0.074	0.252	0.340
Weight-for-height (-2SD)	0.020	0.006	525	606	0.960	0.312	0.007	0.032
Weight-for-age (-2SD)	0.072	0.013	525	606	1.081	0.181	0.046	0.098