

Appendix A. Global Health Data Exchange data sources and YLD calculation summary

The Global Health Data Exchange (GHDX), which inputs data from multiple sources to estimate anemia prevalence was the data source for years lived with disability (YLD) estimates (<http://ghdx.healthdata.org>). Although the databases used in the GBD project are not publicly accessible, many of the input data sets are publicly available such as the Demographic Health Surveys (DHS), the Malaria Indicator Surveys (MIS), and various national surveys like the United States National Health and Nutrition Examination Survey (NHANES). The GHDX also incorporates data from the WHO Vitamin and Mineral Nutrition Information System (VMNIS) Micronutrients Database, which is a micronutrient database that systematically retrieves and summarizes data on vitamin and mineral status of populations. The VMNIS contains national or first administrative level data, but not individual-level information.

The YLD estimate from anemia is a product of the prevalence of anemia, categorized as mild, moderate, or severe, and the corresponding disability weights for mild, moderate, and severe anemia. Anemia is not considered a cause of death in GBD analyses, and therefore cannot contribute to the years of life lost (YLL) estimation. Overarching Disability Adjusted Life Years (DALYs) are the sum of YLD and YLL.

Table S1. Covariates of interest for hemoglobin interpretation within the BRINDA database ^a

Country, survey year	Hemoglobin adjusted for		Hemocue® model	Inflammatory proteins measured	
	Altitude	Smoking		CRP	AGP
Afghanistan, 2013	Yes	No	Unknown	Yes	Yes
Azerbaijan, 2013	Yes	Yes ^c	201 ^b	Yes	Yes
Bangladesh, 2010	No	No	201	Yes	Yes
Bangladesh, 2012	No	No	Unknown	Yes	Yes
Cambodia, 2014	No	Yes	301	Yes	Yes
Cameroon, 2009	No	No	201 ^b	Yes	Yes
Colombia, 2010	Yes	Yes	Hb-B	Yes	No
Côte d'Ivoire, 2007	No	No	201 ^b	Yes	Yes
Ecuador, 2012	Yes	Yes	Unknown	Yes	No
Georgia, 2009	Yes	Yes	Unknown	Yes	No
Kenya, 2007	No	No	Hb-B	Yes	Yes
Kenya, 2010	No	No	301	Yes	Yes
Laos, 2006	Yes	No	Hb-B	Yes	Yes
Liberia	No	No	201 ^b	Yes	Yes
Malawi, 2016	Yes	Yes ^c	301 ^b	Yes	Yes
Mexico, 2006	Yes	Yes	Unknown	Yes	No
Mexico, 2012	Yes	Yes	Unknown	Yes	No
Nicaragua, 2005	No	No	Hb-B	No	Yes
Pakistan, 2011	No	No	201	Yes	Yes
Papua New Guinea, 2005	Yes	Yes	201	Yes	Yes
Philippines, 2011	No	No	201	Yes	Yes
United Kingdom, 2014	No	Yes	Unknown	Yes	No
United States, 2006	No	Yes	201 ^b	Yes	No
Vietnam, 2010	No	No	301	Yes	No

- a. Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia (BRINDA); C-reactive protein (CRP); alpha-1-acid glycoprotein (AGP).
- b. Represents venous blood collection for anemia, otherwise finger prick collection.
- c. All respondents in Azerbaijan reported no smoking; only one respondent in Malawi reported smoking.

Table S2. Prevalence of any anemia, moderate or severe anemia, inflammation, iron deficiency, and iron deficiency anemia, alongside the proportion of individuals with concomitant anemia and iron deficiency or malaria among preschool children within the BRINDA dataset, including estimates of iron unadjusted or adjusted for inflammation using two approaches ^a

WHO classification	Country, survey yr	n	Any anemia, %	Moderate or severe anemia, % ^b	Elevated CRP or AGP, % ^c	Iron deficiency (unadjusted), % ^d	Iron deficiency (ferritin <30µg/L), % ^e	BRINDA inflammation adjusted iron deficiency, % ^f	Iron deficiency anemia (ferritin <30µg/L), % ^g	BRINDA inflammation adjusted iron deficiency anemia, % ^h	Iron deficiency (ferritin <30µg/L) among those with anemia, % ⁱ	BRINDA inflammation adjusted iron deficiency among those with anemia, % ^j	Plasmodium falciparum parasitemia among those with anemia, % ^k
Severe	Bangladesh, 2010	1,492	83.5	48.6	35.7	8	17.7	16.0	16.7	15.1	20.0	18.1	--
	Kenya, 2010	845	71.7	52.2	61.8	19.2	32.3	53.7	25.6	39.9	35.8	55.9	40.9
	Côte d'Ivoire, 2007	768	71.0	48.0	67.5	11.8	24.1	39.0	17.8	29.6	25.0	41.5	28.8
	Kenya, 2007	934	65.7	35.8	65.5	38.8	61.3	72.5	44.6	50.9	66.6	76.0	23.1
	Pakistan, 2011	4,099	63.0	39.4	35.5	47.1	57.9	45.1	41.3	33.4	66.3	53.5	--
	Liberia, 2011	1,444	59.3	28.6	59.1	20.5	37.0	51.0	25.2	32.2	42.3	54.1	37.6
	Cambodia, 2014	455	55.6	25.6	38.5	4.5	6.3	5.3	5.3	4.4	9.9	8.2	--
	Cameroon, 2009	787	54.1	30.0	48.1	14.8	23.6	34.1	17.6	22.5	32.3	41.4	40.7
	PNG, 2005	454	48.0	25.0	57.2	--	--	--	--	--	--	--	--
	Afghanistan, 2013	703	43.7	23.6	24.8	21.4	28.9	23.7	13.7	10.7	33.9	30.3	--
Philippines, 2011	1,777	41.8	16.6	26.0	26.2	34.2	34.9	21.8	21.6	52.1	51.5	--	
Laos, 2006	488	40.7	19.0	43.8	16.4	27.6	25.6	14.9	15.5	36.7	38.0	--	
Moderate	Bangladesh, 2012	568	33.1	5.4	29.5	10.2	15.4	13.7	10.2	8.4	31.3	25.9	--
	Malawi, 2016	1,140	31.6	13.2	56.9	10.9	25.4	21.8	10.2	9.3	33.3	30.4	48.1
	Azerbaijan, 2013	1,076	24.6	8.4	30.9	13.9	18.9	22.3	8.2	8.8	34.2	37.5	--
	Ecuador, 2012	2,020	24.7	8.2	12.5	10.1	12.9	49.0	7.9	16.2	31.8	65.7	--
	Georgia, 2009	2,200	22.8	10.0	24.7	0.3	0.9	0.3	0.4	0.05	1.9	0.2	--
Mexico, 2006	5,264	20.7	9.7	10.8	22.8	26.9	33.9	6.6	8.8	32.1	42.8	--	

	Nicaragua, 2005	1,156	20.0	5.3	26.9	33.2	44.8	24.0	8.4	5.2	63.3	39.3	--
Mild	Mexico, 2012	6,338	16.8	6.9	12.0	13.4	16.4	18.1	3.8	4.0	22.9	23.9	--
	Colombia, 2010	5,955	13.2	8.3	18.8	10.1	17.1	13.5	3.3	2.5	25.3	18.9	--
	Vietnam, 2010	395	7.1	1.8	12.4	14.3	17.5	18.8	3.2	3.2	42.9	42.9	--
Normal	US, 2006	1,529	1.9	0.4	5.9	10.6	11.5	13.3	1.2	1.2	57.0	57.0	--

- a. Values represent weighted percent, taking into account cluster, strata, weight. '--' means no data. Prevalences greater than 20% colored dark gray, and 10-20% colored light gray for comparison, throughout. C-reactive protein (CRP); alpha-1-acid glycoprotein (AGP); Papua New Guinea (PNG); United States (US)
- b. Moderate or severe anemia was defined as altitude adjusted hemoglobin < 100 g/L. Not all surveys measured altitude (see Table S1 for details).
- c. Elevated inflammatory proteins was defined as CRP > 5 mg/L or AGP > 1 g/L. Not all surveys measured both inflammatory proteins (see Table S1 for details).
- d. Iron deficiency defined using serum ferritin <12µg/L for all individuals.
- e. Iron deficiency defined using serum ferritin <30µg/L for individuals with CRP > 5 mg/L or AGP > 1 g/L, else serum ferritin <12µg/L.
- f. Inflammation-adjusted iron deficiency was defined as serum ferritin <12µg/L after regression correction for inflammation according to the Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia project.
- g. Iron deficiency anemia (ferritin <30µg/L) was defined as hemoglobin < 110 g/L and serum ferritin < 30 µg/L for individuals with CRP > 5 mg/L or AGP > 1 g/L, else serum ferritin < 12 µg/L.
- h. BRINDA inflammation adjusted iron deficiency anemia was defined as hemoglobin < 110 g/L and BRINDA inflammation-adjusted serum ferritin < 12 µg/L.
- i. Iron deficiency defined using serum ferritin <30µg/L for individuals with CRP > 5 mg/L or AGP > 1 g/L, else serum ferritin <12µg/L, restricted to individuals with anemia.
- j. BRINDA inflammation-adjusted serum ferritin < 12 µg/L restricted to individuals with anemia
- k. Recent malaria restricted to individuals with anemia was defined based on results from rapid diagnostic test kits or microscopy. Malaria was assessed using microscopy in Kenya and Cote d'Ivoire, and rapid diagnostic test kits in Malawi, Liberia, and Cameroon.

Table S3. Prevalence of any anemia, moderate or severe anemia, inflammation, iron deficiency, and iron deficiency anemia, alongside the proportion of individuals with concomitant anemia and iron deficiency or malaria among non-pregnant women of reproductive age within the BRINDA dataset, including estimates of iron unadjusted or adjusted using the BRINDA approach ^a

WHO classificatio	Country, survey yr	n	Any anemia,%	Moderate or severe anemia, % ^b	Elevated CRP or AGP, % ^c	Iron deficiency (unadjusted), % ^d	BRINDA inflammation adjusted iron deficiency, % ^e	Iron deficiency anemia (unadjusted iron), % ^f	BRINDA inflammation adjusted iron deficiency anemia, % ^g	Iron deficiency (unadjusted) among those with anemia, % ^h	BRINDA inflammation adjusted iron deficiency among those with anemia, % ⁱ	Plasmodium falciparum parasitemia among those with anemia, % ^j
Severe	Pakistan, 2011	10,787	50.4	29.5	26.0	36.4	42.5	24.0	27.1	47.8	54.1	--
	Côte d'Ivoire, 2007	850	49.9	25.7	33.5	13.5	22.7	9.4	15.3	18.8	30.4	5.6
	Cambodia, 2014	447	45.4	21.0	38.9	2.2	3.5	1.7	2.9	3.9	6.6	--
	Azerbaijan, 2013	2,713	38.1	19.2	34.4	30.8	42.7	22.7	26.3	59.6	69.0	--
Moderate	Cameroon, 2009	775	36.3	17.0	20.4	13.0	19.5	9.6	13.3	26.9	37.1	18.6
	Laos, 2006	823	36.0	18.4	13.9	22.8	26.3	14.5	15.9	40.3	44.1	--
	PNG, 2005	760	35.1	18.1	24.8	--	--	--	--	--	--	--
	Afghanistan, 2013	1,308	34.7	16.7	20.3	26.2	30.7	14.2	16.6	36.6	42.8	--
	Liberia, 2011	1,971	33.2	11.5	18.4	17.9	29.1	10.1	14.9	30.3	44.7	19.7
	Bangladesh, 2012	1,033	26.0	8.4	16.8	7.5	9.3	4.7	5.2	18.1	20.0	--
	Georgia, 2009	1,711	23.3	9.3	29.3	1.3	1.8	0.7	0.9	3.1	3.6	--
	Malawi, 2016	789	22.7	7.3	13.1	11.4	15.0	6.2	8.0	27.9	36.2	22.5
Mild	Ecuador, 2012	8,118	14.5	5.2	17.4	14.8	37.4	7.9	11.1	54.4	76.4	--
	Mexico, 2006	3,050	13.9	5.3	24.2	26.9	34.5	7.7	8.8	55.0	63.3	--
	Mexico, 2012	4,174	12.9	5.4	20.9	27.8	43.7	8.3	9.8	61.6	72.8	--
	Vietnam, 2010	1,491	11.4	3.2	6.6	13.1	18.0	5.2	5.8	45.3	50.6	--
	United Kingdom, 2014	937	10.9	1.9	16.7	18.7	29.7	5.1	5.7	46.0	51.2	--
	Colombia, 2010	9,678	8.0	4.9	22.0	23.0	25.6	4.4	4.5	57.1	59.4	--

	US, 2006	3,226	6.7	2.7	25.6	13.1	20.7	4.4	5.1	66.5	77.6	--
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- a. Values represent weighted percent, taking into account cluster, strata, weight. ‘--’ means no data. Prevalences greater than 20% colored dark gray, and 10-20% colored light gray for comparison, throughout. C-reactive protein (CRP); alpha-1-acid glycoprotein (AGP); Papua New Guinea (PNG); United States (US)
- b. Moderate or severe anemia was defined as altitude and smoking adjusted hemoglobin < 110 g/L. Not all surveys measured smoking and altitude (see Table S1 for details).
- c. Elevated inflammatory proteins was defined as CRP > 5 mg/L or AGP > 1 g/L. Not all surveys measured both inflammatory proteins (see Table S1 for details).
- d. Unadjusted iron deficiency was defined as serum ferritin < 15µg/L.
- e. Inflammation-adjusted iron deficiency was defined as serum ferritin <15µg/L after regression correction for inflammation according to the Biomarkers Reflecting Inflammation and Nutritional Determinants of Anemia project.
- f. Iron deficiency anemia (unadjusted iron) was defined as hemoglobin < 120 g/L and serum ferritin < 15 µg/L.
- g. BRINDA inflammation adjusted iron deficiency anemia was defined as hemoglobin < 120 g/L and inflammation-adjusted serum ferritin < 15 µg/L.
- h. Serum ferritin < 15 µg/L restricted to individuals with anemia.
- i. Inflammation-adjusted serum ferritin < 15 µg/L restricted to individuals with anemia.
- j. Recent malaria restricted to individuals with anemia was defined based on results from rapid diagnostic test kits or microscopy. Malaria was assessed using microscopy in Cote d’Ivoire, and rapid diagnostic test kits in Malawi, Liberia, and Cameroon.

