THE GLOBAL PREVALENCE OF ANAEMIA IN 2011

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CONTENTS

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SCOPE AND PURPOSE

This document describes estimates of the prevalence of anaemia for the year 2011 in preschool-age children (6–59 months) and women of reproductive age (15–49 years), by pregnancy status, and by regions of the United Nations and World Health Organization (WHO), as well as by country. This report is based on analyses previously published *(1)* to estimate trends (from 1995 to 2011) in the distribution of blood haemoglobin concentrations and the prevalence of anaemia in these same population groups.

This document may serve as a resource for estimating the baseline prevalence of anaemia in women of reproductive age, in working towards achieving the second global nutrition target 2025, a 50% reduction of anaemia in women of reproductive age *(2)*, as outlined in the *Comprehensive implementation plan on maternal, infant and young child nutrition* and endorsed by the Sixty-fifth World Health Assembly, in resolution WHA65.6*(3)* .

BACKGROUND

Anaemia, defined as a low blood haemoglobin concentration, has been shown to be a public health problem that affects low-, middle- and high-income countries and has significant adverse health consequences, as well as adverse impacts on social and economic development *(1, 4–6)*. Although the most reliable indicator of anaemia at the population level is blood haemoglobin concentration, measurements of this concentration alone do not determine the *cause* of anaemia. Anaemia may result from a number of causes, with the most significant contributor being iron deficiency.[1] Approximately 50% of cases of anaemia are considered to be due to iron deficiency, but the proportion probably varies among population groups and in different areas, according to the local conditions *(1, 7, 8)*. Other causes of anaemia include other micronutrient deficiencies (e.g. folate, riboflavin, vitamins A and B_{12}), acute and chronic infections (e.g. malaria, cancer, tuberculosis and HIV), and inherited or acquired disorders that affect haemoglobin synthesis, red blood cell production or red blood cell survival (e.g. haemoglobinopathies) *(9, 10)*.

Anaemia resulting from iron deficiency adversely affects cognitive and motor development, causes fatigue and low productivity *(8, 9, 11)* and, when it occurs in pregnancy, may be associated with low birth weight and increased risk of maternal and perinatal mortality *(12, 13)*. In developing regions, maternal and neonatal mortality were responsible for 3.0 million deaths in 2013 and are important contributors to overall global mortality *(14, 15)*. It has been further estimated that 90 000 deaths in both sexes and all age groups are due to iron deficiency anaemia alone *(16)*. Any strategy implemented to prevent or treat anaemia should be tailored to local conditions, taking into account the specific etiology and prevalence of anaemia in a given setting and population group.

METHODS

The study design, data sources and statistical modelling methods on which this report is based have been presented in detail elsewhere *(1)*. The methods were designed to assess trends in the distribution of blood haemoglobin concentrations between 1995 and 2011, using a statistical model (described

[1] *Iron deficiency anaemia and anaemia are often used synonymously and the prevalence of anaemia has often been used as a proxy for iron deficiency anaemia. However, it is important to realize that not all anaemia is caused by iron deficiency.*

below in "Application of a statistical model to estimate trends in the distribution of blood haemoglobin concentrations and their uncertainties"); however, only the estimates from 2011 are presented here. Briefly, the analysis included three steps, described under the subheadings that follow.

Identification of data sources for blood haemoglobin concentration and anaemia through a systematic review; accessing and extracting data; and systematically assessing the population representativeness of data

A PubMed search was carried out for relevant search terms related to anaemia, haemoglobin and iron status, searching for studies published after 1 January 1990. In addition to indexed articles, many reports of national and international agencies were identified and accessed through requests to each corresponding organization.

Data that were representative of the population level, or representative of at least three regions within the country, were included. Data mainly came from the Micronutrients Database of the WHO Vitamin and Mineral Information System (VMNIS), which summarizes data on the micronutrient status of populations, collected from the scientific literature and through collaborators, including WHO regional and country offices, United Nations organizations, ministries of health, research and academic institutions, and nongovernmental organizations. In some cases, anonymized individual-level data were obtained from multi-country surveys, including demographic and health surveys, multiple indicator cluster surveys, reproductive health surveys and malaria indicator surveys. Data sources were included if:

- blood haemoglobin concentration was measured;
- the study reported anaemia or mean blood haemoglobin concentration for preschool-age children or women of reproductive age;
- a probabilistic sampling method was used;
- the sample size was at least 100;
- data were collected after 1990;
- data were from the 190 countries designated for the original analysis.

Details on the selection of data sources are available as web appendices for the original publication *(1,17);* however, this document only presents data for 185 Member States of WHO (see Annexes 1 and 3).

Adjustment of data on blood haemoglobin concentrations for altitude and smoking

Total and severe anaemia were defined according to WHO thresholds for blood haemoglobin concentration for individuals living at sea level *(18).* High altitude and smoking both increase haemoglobin concentration *(18)*, so, where applicable, data that had been adjusted for altitude and smoking status were used whenever possible. Biologically implausible haemoglobin values (<25 g/L or >200 g/L) were excluded.

Application of a statistical model to estimate trends in the distribution of blood haemoglobin concentrations and their uncertainties

A Bayesian hierarchical mixture model *(1)* was used to estimate trends in the distribution of blood haemoglobin concentrations for children and for women of reproductive age by pregnancy status. Briefly, the model calculates estimates for each country and year, informed by data from that country and year themselves, if available, and by data from other years in the same country and in other countries with data for similar time periods, especially countries in the same region. The model borrows data to a greater extent when data are non-existent or weakly informative, and to a lesser degree for data-rich countries and regions. The resulting estimates are also informed by covariates that help predict blood haemoglobin concentrations (e.g. maternal education, prevalence of sickle-cell disorders, mean weight-for-age *z*-score for children). The uncertainty ranges (credibility intervals)[1] reflect the major sources of

[1] *As a Bayesian statistical model was used, 95% credibility intervals were calculated. These are analogous to confidence intervals, which are used in frequentist statistics.*

uncertainty, including sampling error, non-sampling error due to issues in sample design/measurement, and uncertainty from making estimates for countries and years without data. All analyses were done separately for children and women of reproductive age. Estimates were made for: preschool-age children (6–59 months),[1] women of reproductive age (15–49 years), and pregnant women (15–49 years) and non-pregnant women (15–49 years) separately. Data from male and female children were pooled.

The time frame for the estimates presented in the original analyses *(1)* was 1995–2011. The complete population distributions of blood haemoglobin concentrations for every country and year were estimated, which allowed calculation of the relevant summary statistics. For example, from the population distributions, the mean population blood haemoglobin concentration and the total number of individuals affected by, and the population prevalence of, severe anaemia for each country and year were calculated. Distributions for regions were calculated as population-weighted averages of the constituent countries. The prevalence of haemoglobin values below the WHO-recommended population-specific haemoglobin threshold concentration in blood was used to classify countries by the level of significance of the public health problem *(18)*. Although esimates for each year (1995 to 2011) have been generated, the current report only presents estimates for the year 2011.

An additional analysis was carried out to estimate the prevalence of anaemia that may be attributed to iron deficiency. In this analysis, the attribution of iron deficiency to the prevalence of anaemia was calculated as the population that would not be anaemic if iron supplements were given. Meta-analyses of the effect of iron supplementation on mean blood haemoglobin concentration in children aged 0–59 months and pregnant women and non-pregnant women aged 12–50 years were used to estimate the percentage of anaemia that could be eliminated by increased iron intake *(19–21)*.

RESULTS

Population coverage

The analysis performed *(1)* included 257 surveys conducted between 1990 and 2012, of which 232 (90%) were nationally representative sources. Two-hundred and five sources (80%) had data on women and 224 (87%) had data on children. Of the 194 WHO Member States, estimates of the prevalence of anaemia were not made for nine countries because covariate data were not available. Of the remaining 185 countries, 95 (51%) and 101 (55%) had at least one data source for children and women, respectively, covering 82–85% of the global population of children and women. Data were most sparse in the WHO European Region. In contrast, all countries in the WHO South-East Asia Region had at least one data source, as did 78% of countries in the African Region.

Data for non-pregnant women and pregnant women were summed and weighted by the prevalence of pregnancy, to generate one value for all women of reproductive age. Although data for non-pregnant women and all women of reproductive age are very similar, they are shown for all three groups of women separately in the tables. The population covered by survey data at the regional and global level was calculated by summing the population (number of children and women) in countries with survey data and dividing by the total population in all countries in that region or globally. The proportion of the population covered by surveys, by WHO region, was over 90% in the African, South-East Asia and Western Pacific Regions and was lowest (18–23%) in the European Region (see Table 1). Annex 2 presents the results by United Nations region.

The proportion of the population and number of individuals with anaemia

The 2011 estimates suggest anaemia affects around 800 million children and women (see Table 2).

[1] *Estimates were made for children aged 6–59 months because few household surveys measure anaemia in children under 6 months of age. However, the estimate was applied to the entire population of children aged less than 5 years; thus, the number of children affected is for the age range 0–59 months.*

Globally, the mean blood haemoglobin concentration was 111 g/L (95% credibility interval[1] [CI]: 110–113) in children, 126 g/L (95% CI: 124–128) in non-pregnant women, and 114 g/L (95% CI: 112–116) in pregnant women (see Table 2), indicating that, on average, all population groups were above the threshold for mild anaemia (110 g/L for children and pregnant women and 120 g/L for non-pregnant women). In 2011, the highest prevalence of anaemia was in children (42.6%, 95% CI: 37–47), and the lowest prevalence was in non-pregnant women (29.0%, 95% CI: 23.9–34.8). In addition, the global prevalence of anaemia for pregnant women was 38.2% (95% CI: 33.5–42.6) and for all women of reproductive age was 29.4% (95% CI: 24.5–35.0). Severe anaemia is associated with substantially worse mortality and cognitive and functional outcomes; in 2011, its prevalence in children and women ranged from 0.9% to 1.5%. Haemoglobin concentrations in pregnant women were lower than in non-pregnant women. However, as the threshold for defining anaemia is lower for pregnant women, the prevalences of anaemia in pregnant and non-pregnant women were only about nine percentage points apart. These prevalences translate to 273.2 million (95% CI: 241.8–303.7) children, 496.3 million (95% CI: 409.3–595.1) non-pregnant women, and 32.4 million (95% CI: 28.4–36.2) pregnant women, giving a total of 528.7 million (95% CI: 440.3–629.4) women of reproductive age with anaemia worldwide in 2011. Of these, 9.6 million (95% CI: 6.9–14.4) children, 19.4 million (95% CI: 12.7–29.4) non-pregnant women and 0.8 million (95% CI: 0.5–1.1) pregnant women had severe anaemia, giving a total of 20.2 million (95% CI: 13.3–30.5) women of reproductive age.

Mean blood haemoglobin concentrations and prevalences of anaemia varied substantially across regions and countries. In 2011, the WHO South-East Asia, Eastern Mediterranean and African Regions had the lowest mean blood haemoglobin concentrations and the highest prevalences of anaemia across population groups (see Table 2). Children in these three regions had a mean blood haemoglobin concentration between 104 and 109 g/L (i.e. below the threshold for mild anaemia), with more than half of children in the South-East Asia and African Regions (53.8% or more) classified as having anaemia; severe anaemia was highest in the African Region, with 3.6% of children affected. While women in these regions had higher blood haemoglobin levels than children, the mean blood haemoglobin concentration was also lowest for all women in the same three regions. The prevalence of anaemia was 37.7% to 41.5% for non-pregnant women and 38.9% to 48.7% for pregnant women in these regions. The countries with the lowest blood haemoglobin levels and highest prevalences of anaemia were in the WHO African Region (see Annex 3); this reflects the high prevalence of factors affecting anaemia in this region, such as malaria, sickle cell and thalassaemias. Children in the African Region represented the highest *proportion* of individuals affected with anaemia, at 62.3% (95% CI: 59.6–64.8), while the greatest *number* of children and women with anaemia resided in the South-East Asia Region, including 96.7 million (95% CI: 71.7–115.0) children and 202.0 million (95% CI: 141.8–254.3) women of reproductive age (see Table 2) in 2011. The Eastern Mediterranean Region had the next highest anaemia burden for children, accounting for 35.7 million (95% CI: 29.7–41.9) children with anaemia, and the Western Pacific Region had the next highest anaemia burden for women, accounting for 96.2 million (95% CI: 53.5–175.3) women with anaemia in 2011.

Classification of countries by degree of public health significance of anaemia, based on blood haemoglobin concentration