World Health Organization

WHO standard methodology to estimate SDG 2.2.3 indicator on anaemia prevalence in women 15-49 years, by pregnancy status | 2000-2023

Background document

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Contents

Acknowledgments

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WHO gratefully acknowledges the financial contribution of the Gates Foundation, the United States Centers for Disease Control and Prevention (CDC) (up to January 2025) towards updating the WHO Micronutrients Database and the preparation and publication of these estimates.

Estimates, input data and analysis are available at: https://www.who.int/data/gho/

For further information about the estimates and methods, or to obtain computer codes, please contact nfsdata@who.int

1. Introduction

The World Health Organization (WHO) Department of Nutrition and Food Safety (NFS) is currently updating country, regional and global estimates of the SDG 2.2.3 indicator on the prevalence of anaemia in women aged 15-49 years, to include up to the year 2023. The underlying methodology used to generate these estimates is the same as the first employed for the estimates published in 2011[1,2,3,4] with enhancements on how data using capillary puncture and HemoCue® 301 are treated, based on available data and emerging evidence. The new anaemia estimates will be published in May 2025 through the United Nations (UN) Sustainable Development Goals (SDG) mechanisms, as well as WHO global reports and the Global Health Observatory. They will be used to track the progress in achieving the global nutrition target on anaemia, namely, a 50% reduction of anaemia in women of reproductive age by 2030. The estimates will also feed into the WHO Global Nutrition Targets Tracking Tool[5] to update countries' status and trends.

We estimated trends between 2000 and 2023 in the distributions of blood haemoglobin for women aged 15-49 years, separately by pregnancy status, in 197 countries and territories. Our analysis included five steps:

1. Identifying data sources on haemoglobin and anaemia;
2. Assessing data sources for inclusion;
3. Accessing and extracting necessary data and metadata;
4. Adjusting haemoglobin for altitude; and
5. Applying a statistical model to estimate trends in blood haemoglobin distributions accompanied by uncertainty intervals, for women 15-49 years, by pregnancy status.

The fitted distributions in Step 5 allowed coherent and consistent estimation of haemoglobin means and prevalences of total anaemia. We defined total anaemia based on WHO thresholds of haemoglobin published in 1989[6]: < 110 g/L for pregnant women, and <120 g/L for non-pregnant women. The most recent cut-offs and adjustments to define anaemia in individuals and populations published in 2024[7] were not used in this round. However, work is ongoing to update the anaemia database based on these criteria with the aim of reporting further updates in the next round.

Based on the latest evidence, the use of venous blood was recommended as the gold standard for measuring haemoglobin concentrations due to its high accuracy.[6] However, thus far, national survey data based on venous blood are limited compared to capillary blood. For the current exercise, we accounted for possible higher error in haemoglobin measurements using capillary blood by taking only the mean haemoglobin concentrations because means are not affected by higher measurement errors. We used all available summary statistics or individual-level data if assessment was done using venous blood. We also allowed for suspected biased measurements by measurement method when using HemoCue® 301. These enhancements were applied considering the emerging evidence on measurement errors in haemoglobin that can influence the accuracy and precision of estimates.[8,9,10]

2. Data identification, access and inclusion

Our data search and access strategy were designed to obtain as many sources as possible while ensuring their representativeness of the national population or covered at least three areas within a country. The distribution of blood haemoglobin concentration in a population is commonly summarized as a percentage below a threshold, or a prevalence of anaemia. Mean haemoglobin and its standard deviation may also be reported. Anaemia thresholds typically vary by age, sex, and pregnancy status. Studies may also use different haemoglobin thresholds to define anaemia, and may report multiple anaemia severities, such as mild, moderate and severe anaemia.

We accessed data in two forms: 1) anonymised individual-level haemoglobin data when available, and 2) summary statistics, including mean haemoglobin and anaemia prevalences below specific thresholds. We used anaemia prevalences with any definition in our statistical model described in Section 4, which accounts for the specific thresholds used to define anaemia when using the data.

We *included* data sources if:

- blood haemoglobin was measured;
- the study reported anaemia and/or mean haemoglobin for women 15-49 years of age;
- a probabilistic sampling method with a defined sampling frame was used and data were representative of at least three areas within a country;
- the haemoglobin measurement method, including device and model if a HemoCue® was used after 2006, was reported;
- data were collected in or after 1995;
- data were from 194 Member States or 3 territories: Puerto Rico; Taiwan, China; State of Palestine; and
- standard, validated data collection techniques and laboratory methodologies were used.

We performed an additional screening if a facility-based sampling scheme was used to exclude data where these would not be representative of the general population. The threshold for inclusion was 80% affiliation of the target population at the facility. For women sampled from obstetric care providers, data were included if the coverage of at least one antenatal care (ANC) visit was greater than 80%. We included these data if women were selected from patient records (versus from those attending the clinic). For school-based sampling of adolescents, the completion rate of lower secondary school for girls was required to be greater than 80%.

We *excluded* data if migrants comprised more than 40% of the population in the country, and the data source only covered nationals. This potentially affected data from Kuwait, Qatar, United Arab Emirates, and Singapore. We excluded subnational data sources if the subnational area was selected on a variable causally related to anaemia prevalence, e.g., malaria endemicity. We manually identified and removed duplicated data accessed from more than one source. Our last dataset update was performed on 17 September 2024.

2.1 Individual-level data

We obtained anonymised individual-level data of women aged 15 to 49 years from health-examination surveys and household surveys with haemoglobin measurements. In this update, we included individual level data only when haemoglobin concentrations were assessed using venous blood. We extracted the following variables from each observation: age, sex, haemoglobin concentration, pregnancy status, urban or rural residence, altitude (if available), and survey sample weight, stratum, and primary sampling unit.

Haemoglobin concentrations recorded in survey datasets that were considered biologically implausible were excluded; i.e., haemoglobin measurements that were less than 25 g/L or greater than 200 g/L. Finally, we adjusted all haemoglobin data for altitude, as described in Section 3.

2.2 Data accessed as summary statistics

As part of the Vitamin and Mineral Nutrition Information System (VMNIS)[11], WHO maintains a Micronutrients Database which contains mean haemoglobin concentrations, anaemia prevalence and assessment methods. Data are identified through periodic MEDLINE searches and an international network of collaborators who provide data sources not reported in routine databases. To include recent data, a search on bibliographic databases[i] was performed. The search was limited to humans, and the following search terms were used:

(((national) AND (survey)) OR ((population) AND (prevalence))) AND ((iron status) OR (iron deficiency) OR (anemia) OR (anaemia) OR (hemoglobin) OR (haemoglobin) OR (low iron level) OR (transferrin receptor) OR (ferritin) OR (insufficient iron))

Studies are included in the WHO Micronutrients Database if they had a defined population-based sampling frame, and used a probabilistic sampling procedure. For inclusion of anaemia data into the estimates, we accessed and further screened these summary data using our exclusion criteria. Consistent with our inclusion and exclusion criteria, we *excluded* summarized data sources if:

- data were collected prior to 1995;
- we had access to the same data as individual-level records;
- non-random sampling methods were used, or sampling methods were not adequately described;
- a facility-based surveillance method was used in a country where facility utilization was lower than 80% (as described above);
- they were representative of only one or two first administrative units, or only urban or rural areas;
- we were unable to determine whether the data were adjusted for altitude and the data were collected in a high-altitude country;
- data for women aged 15-49 years were combined with data for children under 10 years of age without reporting summary statistics in smaller age bands;
- haemoglobin was assessed using capillary blood and mean haemoglobin concentration was not reported;
- method of analysis, including device and model if the method was HemoCue® and data were collected after 2006, was not reported; or
- the study did not have data on haemoglobin concentration or anaemia prevalence in women aged 15-49 years.

In some cases, the sample size was not reported in the WHO Micronutrients Database. In that case, we conservatively assumed a sample size of 100.

2.3 Accounting for complex survey design

As described in Section 4, the statistical model used individual-level data when available and used summary statistics when individual data was not available to estimate the full distribution of blood haemoglobin concentration by country and year.

All the individual-level data in the analysis came from surveys that used complex survey designs. Specifically, in designing a representative survey, the target populations were usually divided into strata based on geographical regions within the country, whether place of residence was rural or urban, and/or the socio-economic characteristics of the place of residence; within each stratum, a number of clusters were randomly selected. Clusters may be villages, administrative units, or census units. Households or participants were then randomly sampled within each cluster. Because

[i] Bibliographic databases used to identify anaemia data sources: MEDLINE, EMBASE, Web of Science, CINAHL, AGRICOLA, IBECS, SCIELO, LILACS, AIM (AFRO), IMEMR (EMRO), PAHO, WHOLIS, WPRIM (WPRO), IMSEAR, Native Health Research Database.

the total population may differ among strata and clusters, individuals or households in smaller units have a higher probability of being selected than those in larger units. To account for the differences in probability of being sampled, each observation is assigned a sample weight. These weights are calculated to make the survey data representative of the total population.

An implication of the sampling method is that the so-called effective sample size of the survey (ESS) is different from its actual sample size. This occurs primarily because the sampled individuals are from clusters that are representative but do not cover the entire country, and hence contain less information than they would, had they been a true random sample of the population.

To reflect the true availability of the information in each survey and in the individual level data that it provided to the statistical model, we estimated ESS based on the "*estat effects*" command of the Stata version 17 svy suite of commands.[ii] This command generates the design effect (DEFF), which is the ratio between the (usually smaller) ESS and the real sample size, e.g. a survey with 1000 subjects with a DEFF of 2.0 has an ESS of 500. The DEFF may differ by summary statistic metrics (mean vs. prevalence below 100 g/L vs. prevalence below 120 g/L) depending on how these indicators, and the metrics, are distributed across the strata and clusters. For each survey, we calculated the DEFF as the median of those from a range of metrics, specifically, mean haemoglobin concentration and prevalence below 90, 100, 110, 120, 130 g/L. ESS was then calculated as sample size divided by DEFF.

In our statistical model, we accounted for the difference between the real and effective sample sizes and for the difference in weights for each observation by scaling the weights across all observations in a study to sum to the ESS. These scaled weights were then used to weight the likelihood contributions from each individual. In addition, surveys may over- or under-sample pregnant women relative to their proportion in the population. To account for this, in the statistical model for women, we scaled the weights for each individual such that the sum of the weights for pregnant women was equal to the total ESS for the study multiplied by the proportion of pregnant women in the study; we did the same for non-pregnant women. This ensured that the sum of weights across all women was equal to the ESS for the study and that the relative weighting of pregnant and non-pregnant women reflected the number of women in each category in the study.

Data sources providing only summary statistics were predominantly from surveys that used complex survey designs, but sample sizes recorded for these data sources are actual sample sizes and not the effective sample sizes. To ensure that the sample sizes used for these sources in the statistical modelling also reflected the complex survey design, we estimated ESS for each study as the actual sample size multiplied by an estimate of the DEFF. Calculating the DEFF requires individual-level data, which by definition is not available for these data sources. We used the median DEFF from all surveys with individual-level data. We then used the estimated ESS for each study in deriving the joint normal likelihood for the summary statistics from each study.

[ii] StataCorp, 2019.

3. Methods for adjusting haemoglobin for altitude

Haemoglobin needs are greater for people living at high altitudes due to the lower concentration of oxygen in the atmosphere.[4] When altitude measurements corresponding to individual-level observations were available, we adjusted haemoglobin concentrations using a formula developed by the US Centers for Disease Control and Prevention in 1989:[12,13]

$$Hb_{adjusted} = Hb_{unadjusted} + 0.32 \times (altitude \times 0.0033) - 0.22 \times (altitude \times 0.0033)^2$$

where haemoglobin is measured in g/L and altitude is measured in meters above sea level (m.a.s.l.).

The adjustment is only applied to individuals living at altitudes over 1000 m.a.s.l. We were unable to obtain altitude information for individual subjects for some surveys with individual record data. In those cases, when the proportion of population living at altitudes above 1500 m.a.s.l. (an altitude at which there is 3 g/L effect on haemoglobin concentration) was less than 5% of total population (hereafter termed low-altitude countries), we included the source.

For data available only as summary statistics, we determined whether the data were from a low- or high- altitude country. If data were from a low-altitude country, we used the data regardless of adjustment for altitude. We used previously developed regression equations to correct unadjusted summary statistics from high-altitude countries.[4]

We accounted for uncertainty of this step by calculating the standard regression prediction variance, which accounts for both uncertainty in estimating the regression relationship and variability of individual values around the regression line. This variability from the effect of predicting adjusted country-level metrics was then included in the statistical modelling as an added variance in the likelihood for each summary statistic from these sources.

4. Bayesian hierarchical mixture model

Our aim was to estimate the complete distributions of blood haemoglobin for every country and year, which would then allow for calculating any relevant summary statistic. This approach allows making coherent inference on mean haemoglobin and on the prevalence of anaemia at all levels of severity.

To inform this update, we performed an exploratory analysis by using indicator variables for equipment types and fitted the model using the dataset from the 2019 update.[14] We obtained fitted coefficients of the indicator variables, which estimated a 3-6 g/L difference between HemoCue® 301 and 201+/B measurements. Hence, we decided to fit the model with an indicator variable to account for the suspected bias in HemoCue® 301 measurements and to provide more accurate trend information in the specific countries that used 301.

We accounted for possible higher measurement error in haemoglobin in capillary blood by using only the mean haemoglobin concentrations as means are less by measurement errors. We used all available summary statistics or individual-level data when assessment was done using venous blood. We also allowed for biased measurements by measurement method when using HemoCue® 301. To do so, we included an indicator variable in the model which took the value of 1 when HemoCue® 301 was used, with laboratory methods, HemoCue® 201+, or HemoCue® B as the reference methods (value of 0). We then predicted anaemia prevalence with the indicator variables set to zero, which adjusts for the estimated bias in HemoCue® 301 measurements.[9,10]

The statistical methods are described in detail in a previous publication.[15] In brief, we used a Bayesian hierarchical mixture model, which uses all available data to make estimates for each country-year. In the hierarchical model, estimates for each country-year were informed by data from that country-year itself, if available, and by data from other years for the same

country and from other countries, particularly from those in the same region with data during similar time periods. The hierarchical model informed the results to a greater degree where data are non-existent or weakly informative (i.e., have large uncertainty), and to a lesser degree in data-rich countries and regions. We modelled trends over time as a linear trend plus a smooth nonlinear trend, at the country, regional, and global levels. The estimates are also informed by covariates that help predict haemoglobin levels, including socio-demographic index[16], meat supply (kcal/capita)[iii], and probit of overweight prevalence[17]. The model included a variance term that accounted for unobserved design factors (sample design, season, haemoglobin measurement method, etc.) that lead to additional variability in the data beyond that expected due to sample size. Finally, the model accounted for the fact that subnational data and data that do not exactly cover the age ranges of interest may have larger variation than national data and data that exactly cover the age ranges of interest, respectively. We fitted the model to data from 1995 to 2023 to mitigate boundary effects but report results between 2000 and 2023, given data scarcity between 1995 and 1999.

The mixture model uses a mixture (a weighted-average) of multiple normal ("bell-shaped") densities to estimate the full haemoglobin distributions, which may themselves be skewed. For adult women, we used two five-component mixtures, one for pregnant women and another for non-pregnant women. This approach uses all data sources – those that separate pregnant and non-pregnant women, those in which pregnant and non-pregnant women are reported together, and those in which only one group was measured – to make separate estimates by pregnancy status. The differences in haemoglobin distributions between pregnant and non-pregnant women were allowed to vary by country and year. In years and countries where separate data by pregnancy status were lacking, the difference was informed based on other sources, especially those in the same region with data in similar time periods.

[iii] Derived from FAO food balance sheets.

The model is specified as follows, with g an indicator differentiating pregnant and non-pregnant
strata within a study:

$$f_{gi}(z) = \sum_{m=1}^{M+1} w_{mgi}\,\mathcal{N}\left(z \mid \theta_m, \sigma_m^2\right)$$

$$w_{mgi} = \begin{cases} \Phi(\alpha_{mgi}) \prod_{u=1}^{m-1}(1-\Phi(\alpha_{ugi})) & \text{if } m \le M \\ \prod_{u=1}^{M}(1-\Phi(\alpha_{mgi})) & \text{if } m = M+1 \end{cases}$$

$$\alpha_{mgi} = \delta^c_{mj[i]} + (\varphi\delta^c)_{mj[i]}t_i + u_{mj[i]t_i} + \beta_m x_i + a_{mi} + b_{mi} + I_{gi}(\gamma^c_m$$

Details on the model specifications and features are provided elsewhere[15].Briefly, equation 2 describes a finite mixture of M + 1 normal (*N*) distributions (or mixture components), where the weights (ω) on the constituent normal distributions vary across studies. We specified a probit stick-breaking model for the ω's in equation 3. This transformation uses the standard normal cumulative distribution function (Φ) to transform α's that range between - ∞ and ∞ to ω's that range between 0 and 1. Specifically, the α's determine the relative weights assigned to each cluster in the following manner: starting with a 'stick' of length one, Φ ($\alpha 1gi$) is the proportion of the stick that we break off and assign to ω_{1gi}; Φ (α_{2gi}) is the proportion of the remaining stick of length (1—ω_{1gi}) that we break off and allocate to ω_{2i}; and so on. Larger values of α_{mgi} thus correspond to higher weights on the mth mixture component for stratum *g* in study *i*. The probit stick-breaking transformation therefore allows placing a flexible model on the α's, while ensuring that the ω's still add to one, in such a way that large mass in one part of the haemoglobin distribution is balanced by smaller mass in others parts, and vice versa, through exchanges among the constituent mixture components.

In equation 4, α_{mgi} is defined to leverage all available information in making estimates for each country-year-stratum. $\delta_{cmj[i]}$ is a country-by-component interaction term, determining the baseline weight placed on each of the M + 1 normal distributions in country *j*. $(\varphi\delta^c)_{mj[i]}$ is a country- and component-specific linear time

effect, determining the linear parts of country j's time trend. Letting T = 29 be the total number of analysis years (1995, 1996,… , 2023), the *T*-vector $u_{mj[i]}$ captures smooth nonlinear change over time in country *j* and mixture component *m*. b_m is the effect of time-varying country-level covariates *x* (described above) in mixture component *m*. The *a*'s are study-specific random effects, and the *b*'s capture the extra variance of studies that included women under age 15 or over age 50.

This indicator multiples a country- and component-specific term, $\gamma^c_{mj[i]}$, that quantifies the overall difference between pregnant and non-pregnant women, a linear time effect for the pregnant/non-pregnant difference, $(\varphi\gamma^c)_{mj[i]}$, and study-specific errors, c_{mi}, in the difference. The difference in haemoglobin between pregnant and non-pregnant women was modelled as linear for simplicity and because there are insufficient data to reliably estimate more complex trends in difference.

The hierarchical prior distributions for the country-specific terms and specifications of the study-specific error terms are described in detail in Stevens et al.[2], with the additional terms introduced here, $\gamma^c_{mj[i]}$, $(\varphi\gamma^c)_{mj[i]}$ and c_{mi}, treated analogously to δ^c_{mj}, $(\varphi\delta^c)_{mj}$ and α_{mi}, respectively.

For data accessed as summary statistics for which pregnant and non-pregnant women are not distinguished, we took the mixture densities for pregnant and for non-pregnant women and combined them into a (2*M* + 2) -component mixture, weighting by the proportion of pregnant women estimated for that country-year, as described earlier.

The uncertainties of our estimates incorporated sampling error in each data source; non-sampling error of national data, e.g. because of issues in sample design and measurement; additional error associated with subnational data; uncertainty due to altitude adjustments; and uncertainty due to making estimates by country and year when data were missing altogether, when only summary statistics (vs. individual-level data) were available, or when data were not available separately by pregnancy status.

We fitted the Bayesian model using the Markov chain Monte Carlo (MCMC) algorithm and obtained 3,600 samples from the parameters' posterior, in turn used to obtain 3,600 posterior samples of the population haemoglobin distributions for each country-year. With each of the 3,600 sampled distributions we calculated the population haemoglobin mean and total and severe anaemia prevalences for each country-year. All reported uncertainty intervals represent the 2.5th-97.5th percentiles of these 3,600 draws.

5. Comparison with other studies

The results presented here represent an update of previous WHO estimates for women 15-49 years for 1995-2011[18], 1995-2017[19] and 2000-2019[3] At the global level, the estimates presented here are similar to previous WHO estimates, Differences in estimates at the country or region level can be attributed to inclusion of recently published haemoglobin data, and enhancements on how data using capillary puncture and HemoCue® 301 are treated, based on available data and emerging evidence. The current estimates included 412 data sources spanning 1995-2023, while the estimates for 1995-2019 analysed 408 data sources, that included anaemia in women, spanning 1990-2019. In this round, we used the same covariates but used updated data. We used mean haemoglobin concentrations from capillary blood assessments to minimize the impact of measurement errors. For venous blood assessments, we used all available data. The model included an indicator variable for HemoCue® 301, with other methods as references. This adjustment helped predict anaemia prevalence more accurately.[9,10]

6. Strengths and limitations

The strengths of this study include our extensive data search and rigorous criteria for inclusion of sources; intensive search for completed analytical methodologies (type of blood source and equipment and brand) for each included data source, consistent analysis by for women by pregnancy status; estimating trends by country and region; estimating the full population distributions of haemoglobin, which is consistent with epidemiological evidence on the harms of low blood haemoglobin; and systematic estimation and reporting of uncertainty. The main limitation of our analysis is that despite the extensive data search and access, there were gaps in data availability and analytical methods reporting such as type of blood source used and equipment and model. As a result, the estimates may not capture the full variation across countries and regions, tending to "shrink" towards global means when data are sparse. This may have especially affected the estimates in high-income and upper-middle-income countries, where anaemia prevalence is low and typically addressed in a clinical setting. Nevertheless, this study benefited from an active consultation with WHO member states, which resulted in identification and inclusion of many data sources and analytical methods. We aimed to address concerns in factors associated with the measurement of blood haemoglobin in household survey that could have a substantial effect on the estimated prevalence of anaemia such as different type of blood sample (e.g. venous or capillary blood), and analytical methods for measuring blood haemoglobin in household surveys. Further research is needed to determine additional factors associated with survey design, implementation or haemoglobin measurement are responsible for any systematic differences among data sources, so that global models can account for the relevant factors.

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Checklist of information that should be included in new reports of global health estimates

Item #	Checklist item	Reported on page #
Objectives and funding		
1	Define the indicator(s), populations (including age, sex, and geographic entities), and time period(s) for which estimates were made.	Section 1, page 1
2	List the funding sources for the work.	Acknowledgments
Data Inputs		
For all data inputs from multiple sources that are synthesized as part of the study:		
3	Describe how the data were identified and how the data were accessed.	Section 2, page 2
4	Specify the inclusion and exclusion criteria. Identify all ad-hoc exclusions.	Section 2, page 3
5	Provide information on all included data sources and their main characteristics. For each data source used, report reference information or contact name/institution, population represented, data collection method, year(s) of data collection, sex and age range, diagnostic criteria or measurement method, and sample size, as relevant.	WHO Global Health Observatory and WHO anaemia estimates page
6	Identify and describe any categories of input data that have potentially important biases (e.g., based on characteristics listed in item 5).	Section 3, page 5
For data inputs that contribute to the analysis but were not synthesized as part of the study:		
7	Describe and give sources for any other data inputs.	Sections 2-4, page 2-.7
For all data inputs:		
8	Provide all data inputs in a file format from which data can be efficiently extracted (e.g., a spreadsheet rather than a PDF), including all relevant meta-data listed in item 5. For any data inputs that cannot be shared because of ethical or legal reasons, such as third-party ownership, provide a contact name or the name of the institution that retains the right to the data.	WHO Global Health Observatory and WHO anaemia estimates page
Data analysis		
9	Provide a conceptual overview of the data analysis method. A diagram may be helpful.	Section 4, page 5-7
10	Provide a detailed description of all steps of the analysis, including mathematical formulae. This description should cover, as relevant, data cleaning, data pre-processing, data adjustments and weighting of data sources, and mathematical or statistical model(s).	Section 4, page 5-7
11	Describe how candidate models were evaluated and how the final model(s) were selected.	Section 4, page 5-7
12	Provide the results of an evaluation of model performance, if done, as well as the results of any relevant sensitivity analysis.	Section 4, page 5-7
13	Describe methods for calculating uncertainty of the estimates. State which sources of uncertainty were, and were not, accounted for in the uncertainty analysis.	Section 4, page 5-7
14	State how analytic or statistical source code used to generate estimates can be accessed.	Acknowledgments

Results and Discussion		
15	Provide published estimates in a file format from which data can be efficiently extracted.	WHO Global Health Observatory
16	Report a quantitative measure of the uncertainty of the estimates (e.g. uncertainty intervals).	WHO Global Health Observatory
17	Interpret results in light of existing evidence. If updating a previous set of estimates, describe the reasons for changes in estimates.	Section 5, page 7
18	Discuss limitations of the estimates. Include a discussion of any modelling assumptions or data limitations that affect interpretation of the estimates.	Section 6, page 8

This checklist should be used in conjunction with the GATHER statement and Explanation and Elaboration document, found on gather-statement.org