Annex

METHODS USED TO ESTIMATE REGIONAL TRENDS

The data used to analyse the levels and trends reported here have been accumulated over several iterations and decades, including for earlier UNSCN reports on the world nutrition situation,[1] and for an extensive update and analysis in 2004 supported by the Micronutrient Initiative and UNICEF (see Mason, Rivers & Helwig, 2005). These compilations drew most of their data from WHO's databases, and from Demographic and Health Surveys (DHS)[2], UNICEF (State of the World's Children[3], ChildInfo[4]) and similar sources. For the present update, starting in 2008, new outcome data were sought and introduced primarily from WHO's current databases, adding to the existing files; other sources are given under the respective deficiencies. Almost all the outcome data used here are in WHOSIS,[5] the WHO online database. The data used for interpolation (independent variables) are described later in this Annex. The country groups are those used by the UN, the same as in the fifth report on the world nutrition situation (SCN, 2004), and are given in Table A3. The focus here is on developing countries and regions. Europe and north America have not been included. For Oceania, repeated data were available only for Papua New Guinea, and regional estimates are not included except for underweight and stunting.[6]

The main objective is to assess trends. Estimates of average prevalence levels are published periodically by WHO: for anaemia, (WHO, 2008), vitamin A deficiency (WHO, 2009) and iodine deficiency (WHO, 2004). These are generally given as averages by period (e.g. 1993-2005 for anaemia and 1995-2005 for vitamin A deficiency), although point estimates were given for iodine deficiency disorders for 1993 and 2003. Trends are analysed to a lesser extent than levels. As discussed in Chapter 2, hardly any substantial differences are seen when comparing the prevalence level estimates presented in this report with WHO's estimates by country group (region or subregion) and time. In any event, the main purpose here is to estimate and comment on trends rather than levels.

Three methods are used to assess trends, as follows.

Method 1. Repeated national surveys at different times are compared, when these are considered to have comparable samples in terms of national coverage, and when biological groups (e.g. age groups, pregnancy) are similar. In commenting (in the last column of the tables reporting results from repeated national surveys), a difference of 2 percentage points between surveys is used as a guide for likely significant change. This stems from a difference of the prevalence estimates likely to be about two standard errors given usual sample sizes (e.g. 2000). Rates of change are also estimated as percentage points per year, by subtracting the earlier from the later prevalence and dividing by the number of years; thus a negative rate means improvement.[7]

Method 2. Available survey results can be aggregated by region and averaged, to give a first view of possible regional trends. Such estimates are limited since the same countries may not appear in each time period. The datapoints might be regarded as a sample for that period and region, and the averages are thus not population-weighted. This method is used here for micronutrients, as a check on other findings – it would be a reason for concern if the direction of change from the first and third methods by region was substantially different from the crude averages. In practice, as seen here, all three methods almost always show changes in the same direction. This method also provides a convenient display of the numbers of surveys available by region and time period.

Method 3. Regression models are used to estimate trends and levels with a similar approach for vitamin A deficiency, anaemia, and underweight and stunting (for some purposes).[8] Iodine deficiency disorders are different (because the main predictor is use of iodized salt) and details are given below in the corresponding methods section.

1 http://www.unscn.org/en/publications/index.php#RWNS
2 http://www.measuredhs.com/
3 http://www.unicef.org/sowc/
4 http://www.childinfo.org/index.html
5 http://www.who.int/whosis/
6 Papua New Guinea is included for country level data in certain Annex tables.
7 This use of percentage points per year in estimating changes is an alternative to using percentage changes – e.g. 2.7% per year needed to halve prevalences in the period 1990-2015 to meet MDG goals. It is preferred here, and in other similar reports, for several reasons, including being much easier to calculate by inspection and hence lends itself to policy discussions; because expected rates are known (e.g. 0.5 ppts/yr is average for underweight); it stresses the larger reduction required in high prevalence countries.
8 Country-year estimates derived from interpolation models were used to identify outliers in the survey estimates of underweight, and check the likelihood of results used in estimating trends, e.g. as in table 20.

This modelling approach is necessary as the majority of country-years do not have an estimate – for example, for the 107 countries included for 1990-2007, there are 1926 possible country-years, but for underweight (for which there is the most data) there are only about 410 survey data points, i.e. 20%, so 80% are missing. The procedure in principle (for details see Mason, Rivers & Helwig, 2005, pp. 65-74) is to establish associations of outcome prevalence estimates (a case being a country-year estimate) with independent variables (potential predictors of missing data) that are available for all countries and years; the values of these are matched by time (e.g. a survey result for country X in 1999 is matched with the GNI for that country for 1999). In the survey result database (in Statistical Package for Social Sciences: SPSS) regression models are then developed to provide the best fit, including regional dummy variables, and interactions where needed (not usually). Outliers are identified by extreme values, by highly inconsistent results (e.g. ranging from 20% to 80% over a few years), and by examining residuals from near-final models to flag unlikely cases for further examination. The criteria for deciding which variables should be included in the final models (especially regional dummies) depended on the significance of coefficients (as usual) but also on consideration of reducing the spread of residuals (e.g. by their standard deviation). Year (of survey) was always tested, and in no case remained signi-ficant in the final model (i.e. changes in outcome variables through time are absorbed in the changes through time of the independent variables, e.g. GNI).[9] This allows the models to show a response to changing external factors, rather than forcing a direction of change based on year.

Once the model is established for each deficiency, the relevant independent variables are looked up for the reference years (2000, 2005, 2007 here) for each country, and the algorithm from the regression equation used, in Excel, to predict the prevalence for each country for the reference year. Population data (by country, for the relevant age or biological group and year) are entered and the number affected (e.g. number of children underweight) calculated (prevalence/100)* population). This is summed for the subregions and regions, and divided by the population for that region or subregion (also summed). Dividing these two gives the population-weighted subregional or regional prevalence. Extending estimates back to 1990, where applicable, was done as described for vitamin A deficiency, see below.

VITAMIN A DEFICIENCY[10]

Data compilation

Xerophthalmia prevalence was calculated as the sum of the prevalences of night-blindness (XN) and Bitot spots (X1B). Data exist for multiple biological groups, and in extracting the data the age ranges for which prevalences were given were recorded. For xerophthalmia, the commonest groups were described as ages 6 to 72 months, 24 to 72 months, and 0 to 72 months. Age groupings were aggregated into 0 to 72 months and no age adjustments were made. Most data for xerophthalmia were reported as the prevalence of night-blindness. Where both night-blindness and Bitot spots were recorded, prevalence of xerophthalmia was determined by XN + X1B. In most cases only XN or X1B was available. In line with previous estimates in the database, for cases with only night-blindness (XN) results, xerophthalmia was determined as XN * 1.5; where only Bitot spots (X1B) prevalence was reported, xerophthalmia was determined as X1B * 2.

Only national data were used for xerophthalmia prevalences. Although sub-national results were available, it was uncertain as to whether projecting sub-national results onto the national population was applicable. Seven new national data points were found and added to the data available from the previous report (Mason, Rivers & Helwig, 2005).

Vitamin A deficiency was reported in terms of serum retinol (SR), with prevalences defined as serum retinol levels below 0.7 µmol/l, or 20 µg/dl ("low serum retinol"). The most common age ranges were 6 to 60 months and 12 to 60 months. The age groups were aggregated to analyse all data falling within 0 to 72 months. No age adjustments were made. Thus the results from any subgroup within the set of children aged 0 to 72 months old were treated as the same biological group. For example, if one survey assessed vitamin A deficiency in children 12 to 72 months of age, it was treated as comparable, for the purposes of analysis, to that for children aged 0 to 59 months.

9 Except iodine deficiency disorders, see below.

10 Based on the work of Bibi Al-Ibrahim, MPH.

New low SR data entered since 2005 were national data only. Low SR prevalences greater than 70% were not used for developing the model. A total of 21 new datapoints for low SR were added for developing the model, for a total of 104 data points.

Database description

The vitamin A database is available as an SPSS file containing the results of vitamin A surveys and a set of independent variables. Cases are defined by country-year, with each case containing one survey result; thus for example xerophthalmia and serum retinol survey results from the same survey would be in the same row (case); if from different surveys or different age groups from the same survey (the more usual situation) each result is entered as a different case. Results for children aged 0 to 72 months were added to the previous database of the previous report. A code for national and sub-national data is included.

Each case has regional codes and indicators used in interpolation models as independent variables, including infant mortality rates, female literacy rates, and measles immunization coverage. The values for these independent variables were entered for the year of the vitamin A deficiency survey with which they were included; e.g. if the vitamin A deficiency result was for 1994, then the independent variables were for that year. Where the exact year was not reported, a linear interpolation for the independent variable was made from the nearest years reported.

Regional dummy variables,[11] to represent different country groups, were created taking the value 1 if the country is in that region, otherwise 0; from previous experience, India and China were treated as regions in some analyses. Interaction terms between independent variables were created by multiplying the two interacting variables, for use in the regression analysis.

Analytical methods

Repeated national surveys

National surveys in the same country at different times were compared where these existed, as the first method of examining trends. After including new data, there were 12 cases with national equivalent repeated surveys for xerophthalmia and 13 cases for vitamin A deficiency assessed as low serum retinol.

Unadjusted averages by region and time period

The unadjusted average was calculated by computing an unweighted mean for all the prevalence datapoints for a particular region and time. The time periods used to calculate the means were before 1990, 1990-1994 (centered on 1992), 1995-1999 (centered on 1997), 2000-2004 (centered on 2002), and 2005 and later. The regions are the same as those used throughout this report, shown in Table A3. For xerophthalmia, only national results were included. For low serum retinol, both national and sub-national results were included, to raise the number of surveys.

Interpolations of prevalences by country to reference years

Regression models were developed for both xerophthalmia and low serum retinol, however only the low serum retinol results are used in this report – in line with the shift from clinical to biochemical assessment (which is also a reason that there are few recent xerophthalmia results).

The final model used was:

Prevalence of low serum retinol = 22.049 + 0.192 (IMR) - 0.168 (Femlit) + 8.500 (DAfr) + 28.591 (DIndia) + 23.350 (DOther) + 8.282 (DSEAsia) where IMR is infant mortality rate, Femlit is % women literate, and DAfr, DIndia, DOther and DSEAsia are regional dummy variables; more details are given below in the section on independent variables. In the regression, n=105, adjusted $R^2 = 0.480$, and $p<0.05$ for all coefficients except those for DSEAsia and DOther, where $p<0.1$. Seven cases were excluded as outliers: six with prevalences >70; and one (Jamaica 1997, at 58.8%) as having outlying high residuals. Both national (n=63) and sub-national (n=42) cases were included.

This equation allowed prevalences to be predicted for each country and reference year based on the values for the independent variables included in the regression model, for the reference years (2000, 2005 and 2007). The subregional and regional averages were then estimated, for these years, by calculating the numbers of children with low serum retinol in the population less than 5 years old; then summing these numbers for subregions and regions; summing the total populations less than 5 years old; and dividing the numbers with low serum retinol by the total population. This procedure allowed flexible re-aggregation by different subregions and regions.

Estimating trends 1990-2007

Subregional and regional estimates for 2000, 2005 and 2007, calculated as described in the previous paragraphs, were linked to estimates for 1990 and 1995 in order to calculate longer-term trends, and relate these to analogies to the MDG goals for underweight. This was done based on the estimates made previously, for 1990-2000, as given by

11 For definitions see independent variables section.

Mason, Rivers & Helwig (2005, Table 7); these used models similar to those described here. Both estimates included 2000, and minor differences in prevalence estimates by subregion – typically around 1 percentage point – resulted from some differences in coefficients and in the series of independent variables (which are regularly updated, and were updated during the five years since the previous calculations). The two trends, 1990-2000 and 2000-2007, were joined based on the new 2000 estimate, by adjusting the 1990 and 1995 estimates by the difference between the two 2000 result sets, by subregion. For example, if the previous estimates for 1995 and 2000 were 32% and 30%, and the new estimate for 2000 was 29%, then the 1995 estimate would be adjusted to 31%; and similarly for 1990. The trend estimate was thus not affected. The purpose of adjusting the level was to avoid a discontinuity.

Trend estimates are then expressed in percentage points per year, e.g. (prevalence in 2007 – prevalence in 1990)/17. For comparison with analogous MDG goals, of halving the prevalence from 1990 to 2015, the required rate was calculated as (prevalence in 1990/2)/25 in percentage points per year.

Comparison with WHO data

The prevalence levels calculated here are in line with WHO's estimates, for example comparing these data for 2000 with WHO data for 1995-2005, considering the slightly different regional groupings, as seen in Table A4.

IODINE DEFICIENCY DISORDERS[12]

Data compilation

Outcome variables

Two measures of iodine deficiency were studied: goitre prevalence and urinary iodine (the main indicator being prevalence of urinary iodine < 100 µg/l). The database used for the present analysis built on that used and described by Mason, Rivers & Helwig (2005). Updated data on iodine deficiency were extracted from the WHO global database on iodine deficiency, part of the Vitamin and Mineral Nutrition Information System (VMNIS).[13] Information on the data sources and inclusion criteria for the data-base on iodine deficiency[14] is summarized below.

For the WHO global database on iodine deficiency, survey reports and publications reporting on goitre and/or urinary iodine are requested or collected from: ministries of health, through WHO regional and country offices; national research and academic institutions; nongovernmental organizations; organizations of the United Nations system; regular searches of online databases, such as PubMed, Medline, Ovid, and Embase; WHO regional databases (African Index Medicus, Index Medicus for the WHO Eastern Mediterranean Region, Latin American and Caribbean Center on Health Sciences Information, Pan American Health Organization Library Institutional Memory Database, Index Medicus for South-East Asia Region). Survey data are extracted and included in the WHO database only from complete original survey reports and publications that provide details of the sampling methods. Data from all administrative levels and all population groups cited are included. Studies included must have a population-based sample frame and must use standard measuring techniques for urinary iodine and total goiter prevalence.

To be included in the WHO database, a survey must report on at least one of the following criteria:

- Goitre prevalence investigated by palpation and classified according to WHO recommendations.
- *Grade 1:* A goitre that is palpable but not visible when the neck is in the normal position, even when the thyroid is not visibly enlarged. Thyroid nodules in a thyroid, which is otherwise not enlarged, fall into this category.
- *Grade 2:* A swelling in the neck that is clearly visible when the neck is in a normal position and is consistent with an enlarged thyroid when the neck is palpated.

  A thyroid gland will be considered goitrous when each lateral lobe has a volume greater than the terminal phalanx of the thumbs of the subject being examined.

  Only total goitre prevalence data measuring goitre by palpation are includ ed. Until recently, no international reference values for thyroid size in iodine-replete populations measured by ultrasonography were available. Thus results from surveys using this technique have not yet been included.

- Urinary iodine reported by at least one of the following categories:
- Distribution: the percentage of the population falling within the categories < 20 µg/l, 20-49 µg/l, 50-99 µg/l, 100-299 µg/l, > 300 µg/l.
- Prevalence: the percentage of the population falling below the cut-off level of 100 µg/l.
- Median and/or mean (µg/l, µg/g creatinine or µg/24h).

12 Based on the work of Katie Robinette, MPH

13 http://www.who.int/vmnis/iodine/data/database/countries/en/index.html (accessed 15 September 2008).

14 http://www.who.int/vmnis/iodine/data/sources/iodine_data_sources/en/index.html (accessed 6 February 2009).

Household consumption of iodized salt
Updated data on the percentage of households consuming adequately iodized salt at the country level from 2000-2007 were extracted from the UNICEF global database on iodized salt consumption.[15] Country-level data were compiled for this database from several population-based surveys, including those administered by the Multiple Indicator Cluster Survey (MICS) programme, by Demographic and Health Surveys (DHS), by UNICEF, or by a country's ministry of health.

Selection criteria for outcome data
Age group: data for school-aged children (aged 6-12 years) were included in the analysis for each country-year case when available. If not available, data for other age groups were included in the analysis in the following order of priority: closest age group of children, adults (including pregnant women), general population, preschool-age children (WHO, 2004).

National versus sub-national: data were included for analysis only if they were nationally representative. Iodine deficiency indicator: country-year cases were included if there was a value for either total goiter rate, prevalence of low urinary iodine (<100 µg/l), and mean or median of urinary iodine.

Household consumption of iodized salt
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To increase the number of cases with a value for household consumption of iodized salt, values for household iodine were extrapolated for those cases without a value in that specific year, based on methods described by WHO (2004). A country-year case was given the closest value for household iodine measured within 4 years of the survey. If there was more than one value before and after the case within 4 years before or after the survey, these values were averaged.

Updating database
New data on iodine deficiency indicators and on household consumption of iodized salt were added to the 159 country-year cases in the iodine deficiency dataset described by Mason, Rivers & Helwig (2005). Cases were added to the dataset, and information on the related survey was recorded, including survey year, survey administrator, sample size, and whether it was national or sub-national. Iodine deficiency indicators, including total goitre rate, percentage of the population with low urinary iodine, and median urinary iodine, were included as available for each case. The percentage of households with adequate consumption was recorded, as well as relevant information on the data, including iodine cut-off points. Although the most recent cases were the most helpful in providing an update on iodization status, data from before 2005 were also added to the data set if not already present.

The previous analysis used only total goitre rate as the indicator for iodine deficiencies, because it was the most historically available and therefore better for comparisons over time. However, surveys are now changing from total goiter rate to urinary iodine measures (prevalence of low urinary iodine, mean and median urinary) as indicators for iodine deficiency disorders. Consequently, upon searching through the WHO global database on iodine deficiency, the majority of the more recent surveys provided data on urinary iodine, and fewer surveys included data on total goitre rate. In total there were 197 datapoints for total goitre rate, and 91 for low urinary iodine prevalence.

Endogenous (pre-iodization) total goiter rate
The calculation of goitre prevalence depended on estimates of the pre-iodization prevalence of goitre ("endemic goitre rate"). Values for endogenous total goitre rate were taken from previous estimates, derived from research linking en-dogenous goitre prevalences to soil characteristics (from FAO data) and other factors (Mason, Rivers & Helwig, 2005, pp. 70-72), and then imputing endogenous rates from these characteristics to fill in missing data. The two regression equations used (n = 46 and n = 53 countries) showed highly significant associations, with adjusted R^2 of 0.65 and 0.46. A listing of estimated endogenous total goitre rates by country is given in Table A5. These values were not needed in the final models for urinary iodine.

Calculating prevalence of low urinary iodine from median urinary iodine
Values for median urinary iodine were converted to prevalence of low urinary iodine with an equation based on WHO

15 http://www.childinfo.org/idd_profiles.php (accessed 6 February 2009).
16 http://www.childinfo.org/idd_profiles.php (accessed 6 February 2009).

methods. According to WHO (2004, p. 16): "If the proportion of population with UI values below 100 µg/l was not presented, it was computed from median UI, using the simple linear regression equation based on the data points presented in Figure 2.2: % UI <100 µg/l = 86.3 – 0.324* Median".

A regression was run on the prevalence of low urinary iodine with median urinary iodine in our database, resulting in an equation very similar to that above and specific to the data included in this analysis:
*% urinary iodine <100 µg/l = 83.156 – 0.296*median*

This equation was used to estimate the prevalence of low urinary iodine for countries that only had values for median urinary iodine. A variable was added to denote whether the value for the prevalence of low urinary iodine was derived from the equation or as reported. One estimate for the prevalence of low urinary iodine came out negative because the value for median urinary iodine was so high. This case was recorded as having a zero prevalence of low urinary iodine. Adding 13 estimates of the prevalence of low urinary iodine to the spreadsheet, derived by using the formula, made a total of n = 89 cases that have values for the prevalence of low urinary iodine (and n = 73 with values for median urinary iodine).

Regression models
The model for total goiter rate used here was as follows: *TGR = 16.616 – (0.113 * hhiod) + (0.321 * endtgr) – (2.707 * lnyrsiod)* where TGR = goitre prevalence (%), hhiod = % households with iodized salt (p = 0.004), endtgr = estimate or pre-iodization (endogenous) total goitre prevalence (p = 0.000), and lnyrsiod is the natural logarithm of (years since iodization started) (p=0.026). Cases where iodization had not started, i.e. hhiod=0 or yrsiod=0, were excluded. This model had n = 83, and adjusted R^2 = 0.256. As can be seen, in this case the time was important, and including the period since iodization started (as a logarithm) found to give the best fit.

The key to this model working is the estimate of pre-iodization (or endogenous) goiter prevalence, which is a value calculated for each country based on a series of characteristics, developed in previous work (Mason, Rivers & Helwig, 2005, pp. 17-20 and 86-95). These values were only previously provided as ranges, so are included here in Table A5.

Using these factors, estimates were calculated for countries, in Excel, inserting values for 1995-2000 and 2001-2007 for household iodine, endogenous total goitre rate, and years from start of iodization, centred on 1998 and 2004. Household iodine data were extracted from UNICEF (2009, p. 125). (Data refer to the most recent year available during the 2000-2007 period.) To estimate numbers of people affected, population data for 2005 were used (see independent variables section).

The model for low urinary iodine was as follows: *UI = 73.911 – (0.380*hhiod) – (11.224*DAmer) – (4.895*lnyriod)* where UI = prevalence of urinary iodine < 100 µg/l, hhiod = % households with iodized salt (p = 0.000), DAmer = regional dummy for Americas (p = 0.077) and lnyrsiod is the natural logarithm of (years since iodization started) (p = 0.066). The model had n = 68, and adjusted R^2 = 0.46.

Using these factors, prevalences of low urinary iodine were estimated for periods centred on 1998 and 2004, as described above for total goiter rate.

ANAEMIA[17]

Data compilation

This analysis of anaemia includes the data used in the previous report (Mason, Rivers & Helwig, 2005), supplemented by additional data from various sources. New data since the previous report were primarily found through Demographic and Health Surveys (DHS) and the WHO anaemia database[18]. The WHO anaemia database is a repository of anaemia data from multiple organizations, including Helen Keller International, UNICEF, national research and academic institutions, and ministries of health. DHS data were specifically queried from STATcompiler,[19] an online tool for searching across indicators using DHS data. Prevalence of anaemia is found under the Maternal and Child Nutrition category in STATcompiler. In each survey used from DHS and the WHO anaemia database, the sample size was at least 100. In addition, only surveys that were nationally representative were included in the analysis.

Three biological groups are most commonly used to assess the prevalence of anaemia in a population. These are: pregnant women; non-pregnant women of reproductive age (15-49 years); and children less than 5 years of age. In some cases, children less than 5 years of age were categorized as 0-5 years old; in other cases, the age range was indicated as 6-60 months. The criteria for anaemia vary by biological group. For pregnant women and children, the cut-off point is 11 grams per decilitre (g/dl) of haemoglobin concentra-

17 Based on the work of Amit Wadhwa, MPH.
18 http://www.who.int/vmnis/anaemia/data/en/index.html
19 From Measure/DHS: http://www.statcompiler.com

tion in the blood. For non-pregnant women, the cut-off point is 12 g/dl. Only surveys using these definitions of anaemia were included in the analysis.

Some available survey data from both DHS and the WHO anaemia database also reported anaemia prevalence in other biological groups, such as adolescents and adult males. However, these groups are not frequently assessed, creating too small of a set of data for analysis.

Database description

The anaemia dataset was created with case definition as a country-year. Each country-year case can have prevalence values for each of the three biological groups – pregnant women, non-pregnant women, and 0-5 year old children. The dataset contained a total of 675 cases. (The database built up from previous work included sub-national surveys, thus a filter variable was created to select only national surveys.) For pregnant women, n = 228; for non-pregnant women, n = 191; and for children less than 5 years old, n = 129.

Analytical methods

Repeated national surveys

Analysis was conducted on countries where results from repeated national level surveys were available. A total of 40 countries had repeated national surveys allowing for analysis of trends in non-pregnant women. For pregnant women, 43 countries had repeated national surveys, while the number of countries with repeated national surveys for children less than 5 years old was 30. In analysing the trend over years, differences of two percentage points were considered likely to be significant.

Unadjusted averages by region and time period

Regions were grouped into: Africa, Asia, and Latin America & Caribbean. Time periods were defined as: before 1990; 1990-1994; 1995-1999; 2000-2004; and 2005 or after. Each biological group was analysed separately. It should be noted that even with the large geographical groupings used, child datapoints before 1990 and in the period 1990-1994 were limited in number.

Survey results from countries having prevalence data in a given time period were averaged by region as one method for tracking regional trends. This method is fairly crude, as countries represented in one time period are not necessarily represented in subsequent or previous periods. The average calculation is not weighted. Weighting by population combined with inconsistent country reporting over time periods would make interpretation increasingly complex.

Interpolations of prevalences by country to reference years

Regression models for prevalence of anaemia were developed for each biological group to allow for prediction of values for the years of interest: 2000, 2005 and 2007. As a starting point, the same regression model from the previous report was tested, with variables added and removed to improve the model with newly added data points. Changes in reporting of some independent variables used in the previous analysis required the substitution of equivalent indicators. Specifically, grams of meat consumed per day was used as an indicator (instead of using percentage of calories from meat). Also, gross national product (GNP) per capita was replaced by gross national income GNI per capita (and log GNP per capita was replaced by log GNI per capita).

In some cases, independent variables were not available for each country-year combination. In each of these cases, a best guess was made by interpolating values from years for which data were available or by estimating a value based upon values for neighbouring countries with similar conditions.

Interactions between logical candidates were again tested, and those found to be significant were included in the final models. In the case of anaemia, the only model that had a significant interaction term was in the non-pregnant women model. In this model, the interaction between grams of meat consumed and GNI per capita was found to be significant. In addition, regional variables were tested in each model, and those holding significance were included in the final model, as described below.

After rigorous models were found to predict anaemia prevalence in each biological group, the required independent variables and country-year cases were added to an Excel worksheet. Columns were added with data for the independent variables required per model. Population data were also added as a weighting factor for calculating regional averages.

The regression model yielded a constant value and coefficients for each independent variable to predict prevalence of anaemia. The regression model for each biological group is given below.

Regression model for anaemia in pregnant women (15-49 years)

ANAEMIA = 89.165 + (-0.0746 * grams of meat consumed per day) + (13.956 * regional variable for India) + (-14.372* log GNI per capita) + (-17.335 * regional variable for China)

In the regression, n = 188, adjusted R^2 = 0.261, and for the coefficients: grams of meat consumed per day, p = 0.040; regional variable for India, p = 0.014; log GNI per capita, p = 0.000; regional variable for China, p = 0.004.

Regression model for anaemia in non-pregnant women (15-49 years)

ANAEMIA = 45.166 + (-0.124 * grams of meat consumed per day) + (19.152 * regional variable for India) + (-0.00121 * GNI per capita) + (0.000008972 * interaction of meat and GNI per capita) + (7.684 * regional variable for south Asia) + (5.224 * regional variable for sub-Saharan Africa)

In the regression, n = 157, adjusted R^2 = 0.308, and for the coefficients: grams of meat consumed per day, $p<0.05$; regional variable for India, $p<0.05$; GNI per capita, $p<0.05$; interaction of meat and GNI per capita, $p<0.05$; regional variable for South Asia, $p<0.05$; regional variable for sub-Saharan Africa, $p<0.05$.

Regression model for anaemia in children (0-5 years)

ANAEMIA = 98.303 + (-15.582 * log GNI) + (-0.190% female literacy) + (25.834* regional dummy variable for India) + (-23.238* regional dummy variable for China) + (18.838* regional dummy variable for south America) + (18.258* regional dummy variable for sub-Saharan Africa).

In the regression, n = 112, adjusted R2 = 0.553, and for the coefficients: log GNI, p = 0.000; female literacy (%), p = 0.001; regional dummy variable for India, p = 0.010; regional dummy variable for China, p = 0.019; regional dummy variable for south America, p = 0.000; regional dummy variable for sub-Saharan Africa, p = 0.000.

UNDERWEIGHT AND STUNTING[20]

Data compilation

The results given in Tables 21 and 23 were based on data compiled by WHO as follows. Cross-sectional data on the prevalence of underweight and stunting were obtained from national nutrition surveys included in the WHO global database on child growth and malnutrition.[21] A total of 608 surveys were available with underweight prevalence and 576 with stunting prevalence data. For 22 countries, national survey data were available from only one survey, 29 countries had two surveys, and the remaining countries had three or more surveys. Around two fifths of the data included is based on surveys conducted in the period 2000-2008. The earliest survey dates back to 1966 (from Nicaragua), while the most recent surveys were conducted in 2008 (Bhutan, Cambodia, Chile, Egypt, Mauritania and Viet Nam). All surveys included boys and girls, and the age groups ranged from birth to 5 years.

Database description

The database used for all estimates except those shown in Tables 21 and 23 was set up with each country survey result as a case; there were 419 valid cases for underweight. Data for selected countries were plotted to show time trends in Figure 11. Stunting prevalences were included in the database, for which there were 236 valid cases.

Analytical methods

Repeated national surveys

The method used to compare repeated national surveys is straightforward and similar to that used for micronutrients. A country was included when more than one national prevalence estimate was available for that country, and the latest survey was in the 2000s. The difference between two consecutive estimates was calculated and divided by the number of years between the datapoints, to give the change in percentage points per year for the period between the two surveys. For more than two surveys, the rate was calculated for each interval. Using the same calculation as for vitamin A deficiency, but estimating the sample sizes as likely to be around 2000, a difference of 2 percentage points between surveys was considered likely to be significant; less than this was noted as static. This assessment was made regardless of the number of years between surveys.

Analysis by subregion and region

The subregional and regional analyses, and the results given in Tables 21 and 23, were provided by WHO Department of Nutrition for Health and Development. The data file was constructed with the following variables: region; subregion; country; survey year; sample size; prevalence <-2 standard deviation (SD) below the weight-for-age median; prevalence <-2SD below the height-for-age median; and population of children younger than 5 years of age during the survey year. To obtain comparable prevalences across countries, surveys with available raw data (344 out of 608 for underweight) were analysed following a standard format using the WHO Child Growth Standards. For the other 264 surveys (43.3%) for which raw data were not available, a conversion method was applied to transfer underweight prevalences based on the National Center for Health Statistics reference to prevalences based on the WHO standards (Yang & de Onis, 2008). The steps followed to check for quality control and analyse the surveys in a standard way have been described elsewhere (de Onis & Blössner, 2003). Linear mixed-effects modeling was used to estimate prevalence rates and numbers of affected children by region from 1990 to 2007. This method has been used in previous trend analyses (de Onis et al., 2004[a]) and described in detail elsewhere (de Onis et al., 2004[b]).

20 Based in part on the work of Emily Cercone, MPH.
21 http://www.who.int/nutgrowthdb/en/ (accessed 23 June 2010).

Countries were grouped into regions and subregions following the UN classification system (as used elsewhere in this report), which includes territories according to their geographical distribution. The numbers of affected children aged less than 5 years were estimated using data from the 2008 revision of World population prospects (UN Population Division, see data sources).

"The method used to derive these regional and global estimates has some limitations. Like any trend analysis, it relies on the data available and no country has survey data for every year. Also, depending on where and when surveys were conducted, this may have biased our trend estimates. The method furthermore does not control for uncertainty in each survey's prevalence estimate nor for different age ranges in the survey data used. With reference to the latter, it is important to note that the vast majority of data points, however, cover the age group 0-5 years with a few – mainly earlier surveys – that cover a smaller range. Despite these limitations, the 95% CIs should accommodate most of the uncertainty around the presented estimates. All efforts will be made to continue improving the method applied."[22]
The linear mixed effect models used to derive the estimates in Table 21, according to the logit transformation ln ((1-P) /P) = A + B (year), where "p" is the prevalence expressed as a proportion and "year" the calendar year , yield the results given in Table A1.

Analysis by country-year: interpolations
Underweight prevalences were also interpolated for each country for 2000, 2005 and 2007. While these results were not used in the regional and subregional estimates (Table 21), they acted as a check for plausibility of the country survey data. Briefly, this method was as follows. The results of 419 national surveys from 106 developing countries, carried out between 1975 and 2007, were used for this report, building on the previous data compilations (Mason, Rivers & Helwig, 2005; Mason et al., 2001) used for earlier ACC/UNSCN reports (ACC/SCN, 1993). A number of independent variables were used to develop a regression model, an update of that described by Mason, Rivers & Helwig (2005, p. 22). Underweight prevalence in children aged 0-59 months was the outcome indicator. This analysis made use of the new WHO Child Growth Standards, converting from NCHS-based results as needed using the method of Yang & de Onis (2008).

22 Statement provided by WHO, February 2010.

Table A1.
Linear mixed effect model parameters (on log-odds) used to derive Table 21 estimates

UN region and subregions	Coefficient (log odds B)	t-test degrees of freedom	t-test p-values
Africa(a)	-0.01056	97	0.1054(b)
Eastern	-0.01056	97	0.1054(b)
Middle	-0.01960	97	0.1272(b)
Northern	-0.01794	97	0.0654(b)
Southern	0.00825	97	0.4884(b)
Western	-0.00851	97	0.2361(b)
Asia(a)			
Eastern	-0.07881	156	<0.0001
South-central	-0.04289	156	<0.0001
South-eastern	-0.03973	156	<0.0001
Western	-0.03911	156	<0.0001
Latin America & Caribbean(a)			
Caribbean	-0.04452	108	<0.0001
Central America	-0.04868	108	<0.0001
South America	-0.03989	108	<0.0001

a Models were run by region to estimate subregional trends; prevalence estimates for regions and aggregated levels were derived using subregional prevalence estimates weighted by populations (de Onis et al., 2003).
b Non-significant p-values, reflecting stagnation.

The final model was as follows:
*ln ((1-P)/P) = -0.508 + (0.00988 * FemSecF) + (0.00504 * UrbPopF) + (0.00642 * PedFinJ) + (-0.00205 * IMRF) + (0.263 * lnLAGGNI) + (-1.262 * dSAsia) + (-1.694 * dSAmeri) + (0.260 * intSMgnF) + (-0.757 * dSEAsia) + (0.657 * dNewInd)*
where P = prevalence of underweight (%), n = 411, and adjusted R^2 = 0.790. For all coefficients, $p<0.05$. The independent variables are defined below. This model was then used, like the models for vitamin A deficiency and anaemia, by entering values of the independent variables by country-year.

Stunting and underweight
Regression results for three regions (Africa, Asia, central and south America & Caribbean) together (Figure 10 a-c): Stunting = 20.502 + (0.894 * uwt) – 5.495 (dummy for Asia) – 14.261 (dummy for SC Amer/Caribb) + 1.036 (interaction: dummy for SC Amer/Caribb * uwt) where n = 232, adjusted R2 = 0.764, and all coefficients are significant, p = 0.000; interaction for Asia NS when in model.

Regression results for three subregions (Caribbean, central America, south America) together (Figure 10 d): Stunting = 11.261 + (1.710 * uwt) – 10.894 (dummy for Caribbean) + 1.378 (dummy for C Amer) where n = 59 and adjusted R^2 = 0.806. The coefficients for underweight (uwt) and dummy for Caribbean are significant, p = 0.000; the coefficient for dummy for central America is not significant; interaction for Caribbean NS when in model.

LOW BIRTH WEIGHT[23]

Repeated national surveys

Data compilation
National estimates from the same country at different times were compared when data were available for the period between 1997 and 2007. Since the majority of births occur outside health facilities in most developing countries, birth weight data from health services and routine national reporting systems tend to underestimate the incidence of low birth weight. Thus, the majority of data points presented here were collected from nationally representative household surveys: Multiple Indicator Cluster Surveys (MICS), Demographic and Health Surveys (DHS), and the reproductive health surveys supported by the Centers for Disease Control and Prevention.

Low birth weight is considered to be the proportion of infants born in a certain period who weighed less than 2500 g at birth. One limitation of this data is that, on average, in national surveys nearly half (48%) of infants are not weighed at birth (Blanc & Wardlaw, 2005). To reduce bias in nationally representative surveys, UNICEF/WHO have adopted different adjustment procedures depending upon the data available: when possible, reported birth weights are adjusted for underreporting and heaping at 2500 g. An analysis of 114 MICS and DHS surveys found an average increase of 24% once adjustments were made for relative birth size and heaping at 2500 g; in cases where data files are not available for further analysis, estimates are adjusted for underreporting and for maternal assessment of relative birth size, where possible. Otherwise, an average adjustment of 24% is applied to published data (UNICEF/WHO, 2004).

A total of 120 datapoints on incidence[24] of low birth weight in the period 1997-2007 were retrieved from the UNICEF global database on low birth weight[25] and the UNICEF/WHO (2004) report. Of these, 95 datapoints had been adjusted by UNICEF/WHO using the method described above, except where shown as indicated in Table 24. Five datapoint pairs were compared using routine data for: Argentina, Mexico, Panama, Malaysia, and Mauritius. An additional four datapoints were compiled from DHS reports and adjusted upwards by 24%, following the UNICEF method described above. These four datapoints were included to allow for additional comparisons. Eight pairs of estimates (as indicated in the footnotes to Table 24) should be interpreted with caution because they were derived using different methods.

Analytical methods
For each country listed in Table 24, the difference between the earlier and the later estimates was calculated and divided by the number of years between the data points to give the rate of change between surveys (in percentage points per year). Absolute differences (i.e. irrespective of interval) of either one or two percentage points were noted as indicating improvement, no change, or deterioration between the observations. The number of countries "improving," "deteriorating," or with "no change" were summed by region (Table 25).

Database description
The low-birth-weight database is available as an SPSS file containing the results of household surveys and independent variables. Cases are defined by country-year, with each case

23 Based on the work of Lisa Saldanha, MPH.

24 The UNICEF/WHO (2004, p. 4) report states: "The incidence of low birth weight in a population is defined as the percentage of live births that weigh less than 2,500 g out of the total of live births during the same time period." One reviewer noted that the correct term should be point prevalence rather than incidence, however the UNICEF/WHO terminology is kept here.

25 http://www.childinfo.org/low_birthweight_profiles.php

representing one survey result. The data source and method of adjustment is included in the database for each case.

Associations between trends in low birth weight, and prevalences of underweight children and low body mass index (BMI) in women.

Data compilation

The regional averages used come from different sources. The low-birth-weight estimates for the 1980s and 1990s were derived from a WHO report on low birth weight (WHO, 1992), as used in the Second report on the world nutrition situation (ACC/SCN, 1992). The regional estimates of low birth weight for the 2000s were derived from UNICEF/WHO estimates (UNICEF/WHO, 2004, p. 8, Table 2). For underweight, results were taken from calculations provided elsewhere in the present report, using WHO growth standards. These were made compatible with 1980s estimates from the Second report on the world nutrition situation by comparing 1990 estimates calculated for the sixth and second reports. The data from the second report were adjusted to WHO standards using the WHO algorithm, as described in the section on underweight and stunting.

For women with low BMI, unweighted regional estimates for the 1980s were taken from the Second report on the world nutrition situation (ACC/SCN, 1992). For the 2000s, national estimates of prevalence of females aged 15-49 years with BMI less than or equal to 18.5 were taken from the WHO global database on BMI.[26] Of the 86 cases, 4 included a broader age range (India, Pakistan, South Africa, and Viet Nam). An additional 24 BMI estimates were compiled from DHS surveys.[27]

Analytical methods

The data were plotted over time to examine regional trends in low birth weight, underweight children and underweight women. The most problematic low BMI estimate is for south-east Asia in 2000, with only three country estimates available from the WHO database. To compensate for this lack of data, additional prevalences of chronic energy deficiency were also looked up from FAO's country profiles[28] and national publications (Philippines FNRI, 2001); the mean (often from sub-national surveys) was approximately 20%, similar to the mean derived from WHO data. The datapoint was plotted at 20%.

Median age at marriage and low birth weight

Data compilation

The analysis of the relationship between age at marriage and low birth weight uses the same SPSS database as for the other analyses. A total of 88 datapoints were available, with each case representing one national survey result for low birth weight and the associated independent variables for that year (GNI, BMI, and enrolment of girls in secondary education). Cases were included from Asia, Africa, and Latin America & Caribbean. Data on median age at marriage (medmarr) were collected from DHS data for women aged 20-49 years for the period 1992 to 2006 These were matched to the years for which low-birth-weight estimates were available (plus or minus 5 years, based on the assumption that median age at marriage changes slowly). Methods of compiling the other variables are as follows: GNI (ln_GNI08): logarithm of GNI per capita for the year of each survey data point, calculated using gross national income converted to current USD (2008) using the Atlas method and divided by midyear population for each country: World Bank (Accessed on 23 June 2010 from http://ddp-ext.worldbank.org/ext/DDPQQ/member.do?method=getMembers&userid=1&queryId=135). BMI (ln_BMI): logarithm of BMI, compiled as described above on page 60.

Gross secondary school enrolment ratio for females (femsecf): UNICEF (Table generated from http://www.unicef.org/statistics/index_step1.php).

Analytical methods

Bivariate associations of low birth weight with median age at marriage were examined by scatterplot and regression within regions, as shown in Figure 14. In controlling for potential confounders, not all cases with low birth weight and marriage age could be matched with the control variables (GNI, BMI and education), thus the number of cases dropped from a total of 111 to 90.

SOURCES FOR INDEPENDENT VARIABLES

The methods for identifying independent variables and including them in the regression and prediction models for vitamin A deficiency, iodine deficiency disorders, anaemia, and underweight and stunting, for 1990, 1995 and 2000, have been previously described (Mason, Rivers & Helwig, 2005, pp. 7-24), and in most cases these were updated with more recent data. New data for the 2005 and 2007 estimates were primarily obtained from the UN Population Division,[29] an online database that includes country-level data from population-based surveys such as the Multiple

26 http://apps.who.int/bmi/index.jsp (accessed 23 June 2010).
27 http://www.statcompiler.com/index.cfm (accessed 23 June 2010).
28 http://www.fao.org/ag/agn/nutrition/profiles_by_country_en.stm (accessed 23 June 2010).
29 http://data.un.org/Browse.aspx?d=PopDiv and http://data.un.org/Default.aspx

Indicator Cluster Survey (MICS) and Demographic and Health Surveys (DHS), as well as data collected by national governments and UN agencies. These data are compiled by the UN data system for domains of interest (i.e. education, health, etc.) as well as MDG indicators. Additional data were downloaded from the World Bank, UNICEF and FAO: more details on the specific independent variables used for each outcome are listed at the end of this Annex, with sources for each.

To develop the regression models, the independent variables used for each outcome were matched to each country-year for which there were prevalence data. In cases where values for these independent variables were unavailable, data were usually interpolated between two years. For example, a value of 18 for the infant mortality rate for Belize 2002 was interpolated from the available data of 15 in 2005 and 20 in 2000 (as 20 - ((20 - 15)/5)*2). In some cases, where no data were available for years before and after the required year for interpolation, data were estimated as a value from the closest year (usually within two years, unless indicated otherwise). For example, the underweight database contained a survey prevalence estimate for 1989 for Uganda, but no data were available on female secondary schooling for that year. However, there were such data for 1988, so the 1988 value was used.

Regional dummy variables were created to represent different country groups (or countries, in the cases of China and India), taking the value 1 if the country was in that region, otherwise 0. Interaction terms between independent variables (usually with the regional dummies) were created by multiplying the two interacting variables, for use in the regression analysis. These were investigated in developing the regression models, and were included where significant ($p<0.1$). It should be noted that the regional specifications did not always exactly match the UN regions for which results were finally calculated and presented. This was generally either when earlier models were built upon for the new estimates, or when dummy variables for China and India alone were needed. These models are included in the respective methods sections.

Following the same methods, independent variables were compiled for base years 2000, 2005 and 2007, and (using Excel) used to calculate outcome estimates from the algorithms from the regression models. As above, in cases where values for these independent variables were unavailable for the base year, a linear interpolation was made from the nearest years reported. The algorithms used in Excel were the same as the final regression models, inserting independent variable values for 2000, 2005 and 2007. The datasets are available to researchers (at: www.tulane.edu/~internut).

Further details on the sources used to derive the independent variables are given below. Unless otherwise stated, data were accessed in March 2009.

Vitamin A deficiency

- Infant (0-1 years of age) mortality per 1000 live births (imrf): UN Statistics Division.

- Female (women aged 15 years and older) literacy (femlitf): UN Statistics Division (Table entitled "Gender info 2007: adult literacy rate" generated from: http://data.un.org/Data.aspx?q=adult+literacy&d=GenderStat&f=inID%3a49%3btimeID%3a35%2c38%2c41%2c42&c=1,2,3,4,5,6&s=_crEngNameOrderBy:asc&v=1).

- Regional dummy variables: Africa (dafr), India (dindia), Newly Independent States (dother), and South-East Asia (dseasia) (see table A3 for country and subregions).

Iodine deficiency disorders

- Percentage of households consuming adequately iodized salt (hhiod): UNICEF global database on iodized salt consumption (Table generated on 6 February 2009 from: http://www.childinfo.org/idd_profiles.php).

- Endogenous total goitre rates and years since iodization started are given by Mason, Rivers & Helwig (2005, pp. 17-21 and 86-95), and reproduced here in Table A5 for ease of reference.

Anaemia (children less than 5 years of age)

- Logarithm of GNI per capita as described above but not lagged (floggni): World Bank.

- Female (women aged 15 years and older) literacy (mergefem): UN Statistics Division.

- Regional dummy variables for India (fdindia), China (fdchina), South America (fdsamer), and sub-Saharan Africa (fdssa) (see table A3 for country and subregions).

Anaemia (non-pregnant women)

- Average meat consumption (g/person per day) (mtcopy): FAO data on consumption (http://faostat.fao.org/site/610/DesktopDefault.aspx?PageID=610).
- GNI per capita as described above but not logged (final_GN): World Bank.
- Regional dummy variables for India (fdindia), south Asia (fdsasia), and sub-Saharan Africa (fdssa) (see table A3 for country and subregions).
- Interaction term for grams of meat in diet and GNI per capita (fimtgni) (see table A3 for country and subregions).

Anaemia (pregnant women)

- Average grams of meat in diet, as described above (mtcopy): FAO data on consumption.
- Logarithm of GNI per capita as described above (floggni): World Bank.
- Regional dummy variables for India (fdindia), and China (fdchina) (see table A3 for country and subregions).

Underweight and stunting

- Gross secondary school enrolment ratio for females (femsecf): UNICEF (Table generated from http://www.unicef.org/statistics/index_step1.php).
- Percentage of the population living in urban areas (urbpopf): UNICEF (Tables generated from http://www.unicef.org/statistics/index_step1.php and http://www.unicef.org/statistics/index_step1.php).
- Infant (0-1 years of age) mortality per 1000 live births (imrf): UN Statistics Division (Table generated from http://data.un.org/Data.aspx?q=infant+mortality&d=CDB&f=srID%3a1230).
- Logarithm of GNI per capita for the year prior to each survey data point (lnlaggni), calculated using gross national income converted to current USD (2008) using the Atlas method and divided by midyear population for each country: World Bank (Accessed from http://ddp-ext.worldbank.org/ext/DDPQQ/member.do?method=getMembers&userid=1&queryId=135).
- Regional dummy variables: south Asia (dsasia), south America (dsameri), south-east Asia (dseasia), Newly Independent States (dnewind) (Former Soviet Union, now included in south central and west Asia).
- Interaction term for south America and the lagged logarithm of GNI per capita (intsmgnf).

Table A2.
Comparison of anaemia prevalence according to WHO (2008) and UNSCN (2000)

Anaemia	Non-pregnant women		Pregnant women		Children	
	UNSCN 2000	WHO 1993-2005	UNSCN 2000	WHO 1993-2005	UNSCN 2000	WHO 1993-2005
Africa	43.6	44.4	50.3	55.8	64.6	64.6
Asia	42.1 (36*)	33.0	45.6	41.6	46.4	47.7
Latin America and the Caribbean South America/Caribbean	25.5	23.5	28.4	31.1	39.7	39.5

* Setting India = 52% and China = 20%
Source: WHO, 2008, table A2.2, p 18.

Table A3. Country regions and subregions

Region	Country	Region	Country	Region	Country
Africa		**Asia**		**South America & Caribbean**	
East Africa	Kenya	East Asia	China	Caribbean	Cuba
	Madagascar		Mongolia		Dominican Republic
	Malawi	South central Asia	Afghanistan		Haiti
	Mauritius		Bangladesh		Jamaica
	Mozambique		Bhutan		Trinidad and Tobago
	Rwanda		India	Central America	Belize
	Somalia		Iran (Islamic Rep. of)		Costa Rica
	Uganda		Kazakhstan		El Salvador
	United Rep. of Tanzania		Kyrgyzstan		Guatemala
	Zambia		Nepal		Honduras
	Zimbabwe		Pakistan		Mexico
Central Africa	Angola		Sri Lanka		Nicaragua
	Cameroon		Tajikistan		Panama
	Central African Republic		Turkmenistan	South America	Bolivia (Plurin. State of)
	Chad		Uzbekistan		Brazil
	Congo	Southeast Asia	Cambodia		Chile
	Dem. Rep. of the Congo		Indonesia		Colombia
	Gabon		Lao People's Dem. Rep.		Ecuador
North Africa	Algeria		Malaysia		Guyana
	Egypt		Myanmar		Paraguay
	Libyan Arab Jamahiriya		Papua New Guinea		Peru
	Morocco		Philippines		Uruguay
	Sudan		Thailand		Venezuela (Boliv. Rep. of)
	Tunisia		Viet Nam		
Southern Africa	Botswana	West Asia	Armenia		
	Lesotho		Azerbaijan		
	Namibia		Georgia		
	South Africa		Iraq		
	Swaziland		Jordan		
West Africa	Benin		Kuwait		
	Burkina Faso		Lebanon		
	Côte d'Ivoire		Saudi Arabia		
	Gambia		Syrian Arab Republic		
	Ghana		Turkey		
	Guinea		United Arab Emirates		
	Guinea-Bissau		Yemen		
	Liberia				
	Mali				
	Mauritania				
	Niger				
	Nigeria				
	Senegal				
	Sierra Leone				
	Togo				

Table A4.
Comparison between UNSCN and WHO estimates for vitamin A deficiency in preschool children

UNSCN 2000		WHO 1995–2005	
Africa	39.5	WHO African Region	44.4
Asia	33.8	WHO Region of the Americas	15.6
South America & Caribbean	13.5	WHO South-East Asia Region	49.9
		WHO Eastern Mediterranean Region	20.4
		WHO Western Pacific Region	12.9

Source: WHO (2009, Table 11).

Table A5. Endogenous goitre prevalence estimates, with predicted prevalences of goitre (total goitre rate) and low urinary iodine, by country[30]

Region	Country	Estimate of endogenous (pre-iodization) total goitre rate	Predicted prevalence of total goitre rate in 1998	Predicted prevalence of total goitre rate in 2004	Predicted prevalence of low urinary iodine in 2004	Predicted prevalence of low urinary iodine in 2007
East Africa	Burundi	42.3	15.9	12.1	34.0	24.1
	Eritrea	19.1	11.8	9.4	40.1	37.9
	Ethiopia	29.5	32.3	21.9	85.2	62.9
	Kenya	32.8	6.8	7.2	19.6	22.1
	Madagascar	17.2	12.0	8.0	42.8	35.2
	Malawi	36.7	17.0	16.0	43.1	42.7
	Mauritius	28.1	31.9	31.9	85.2	85.2
	Mozambique	34.1	16.2	14.9	42.5	41.7
	Rwanda	41.8	14.0	13.1	28.3	27.9
	Somalia	12.3	26.7	26.7	84.8	84.8
	Uganda	38.8	16.4	11.4	38.9	25.3
	United Republic of Tanzania	34.7	16.4	16.9	40.4	46.8
	Zambia	50.6	17.8	17.4	30.9	32.5
	Zimbabwe	49.1	19.6	15.8	36.7	28.1
North Africa	Algeria	39.5	13.3	15.2	28.8	37.8
	Egypt	35.9	12.7	11.9	31.2	31.0
	Libyan Arab Jamahiriya	41.5	14.1	12.6	29.5	26.8
	Morocco	34.0	22.2	19.2	60.6	55.2
	Sudan	36.4	25.3	22.2	68.5	62.8
	Tunisia	28.2	5.6	5.1	20.4	19.8

Table continued on next page.

30 Estimates done by Peter Horjus, MPH.

(table A5 continued from previous page). Endogenous goitre prevalence estimates, with predicted prevalences of goitre (total goitre rate) and low urinary iodine, by country

Region	Country	Estimate of endogenous (pre-iodization) total goitre rate	Predicted prevalence of total goitre rate in 1998	Predicted prevalence of total goitre rate in 2004	Predicted prevalence of low urinary iodine in 2004	Predicted prevalence of low urinary iodine in 2007
Central Africa	Angola	37.3	33.7	19.7	81.4	51.8
	Cameroon	32.1	12.3	14.4	32.8	42.7
	Central African Republic	54.2	19.3	20.2	32.1	38.2
	Chad	51.4	22.1	20.0	44.2	40.5
	Congo	37.2	24.6	25.6	51.0	54.0
	Democratic Rep. of the Congo	46.2	27.1	16.8	66.0	34.8
	Gabon	31.4	32.8	18.8	84.8	53.4
Southern Africa	Botswana	38.5	19.4	13.8	51.9	35.0
	Lesotho	52.8	20.0	16.3	36.6	26.8
	Namibia	38.6	18.6	15.6	44.7	38.7
	South Africa	29.5	10.1	9.5	34.0	33.1
	Swaziland	12.2	13.8	5.2	57.2	32.2
West Africa	Benin	21.4	9.3	10.3	34.4	40.5
	Burkina Faso	36.6	23.9	18.9	61.8	50.8
	Côte d'Ivoire	22.7	10.7	8.1	35.2	30.7
	Gambia	20.6	28.4	20.5	81.8	67.9
	Ghana	21.7	17.4	14.0	57.9	51.0
	Guinea	25.2	20.5	13.6	59.9	45.0
	Guinea-Bissau	17.0	28.2	18.2	84.8	66.7
	Liberia	17.6	22.3	18.4	73.9	66.7
	Mali	47.6	29.0	17.3	67.1	33.7
	Mauritania	20.9	29.2	19.3	84.0	66.4
	Niger	47.4	22.7	21.0	46.2	46.3
	Nigeria	38.6	12.0	10.7	25.9	23.8
	Senegal	30.8	23.6	16.2	67.1	48.2
	Sierra Leone	18.4	20.3	13.7	56.7	50.0
	Togo	22.2	12.5	14.9	40.8	53.7
East Asia	China	33.5	13.3	10.5	32.5	26.9
	Mongolia	29.4	16.5	11.0	44.7	32.2

Table continued on next page.

(table A5 continued from previous page). Endogenous goitre prevalence estimates, with predicted prevalences of goitre (total goitre rate) and low urinary iodine, by country

Region	Country	Estimate of endogenous (pre-iodization) total goitre rate	Predicted prevalence of total goitre rate in 1998	Predicted prevalence of total goitre rate in 2004	Predicted prevalence of low urinary iodine in 2004	Predicted prevalence of low urinary iodine in 2007
South central Asia	Afghanistan	49.4	38.6	35.6	84.8	74.5
	Bangladesh	40.9	20.6	14.3	47.6	31.2
	Bhutan	58.2	19.1	16.4	30.2	23.0
	India	47.2	17.1	18.1	35.1	40.4
	Iran (Islamic Republic of)	36.9	13.0	10.5	29.4	24.1
	Kazakhstan	24.9	24.9	10.4	65.0	32.2
	Kyrgyzstan	25.7	28.0	12.5	74.9	38.2
	Nepal	60.8	21.4	19.8	37.7	33.5
	Pakistan	47.5	27.8	24.3	63.3	57.3
	Sri Lanka	24.2	16.1	7.8	50.7	27.4
	Tajikistan	34.1	31.5	18.6	77.6	49.6
	Turkmenistan	20.6	29.5	11.5	85.2	37.5
	Uzbekistan	28.6	30.1	16.0	78.7	47.0
South east Asia	Cambodia	19.4	28.3	10.2	82.5	38.3
	Indonesia	16.2	7.6	5.5	37.0	31.8
	Lao People's Democratic Rep.	32.6	12.6	12.3	31.0	34.1
	Malaysia	21.4	12.2	10.6	44.7	42.0
	Myanmar	25.0	15.4	12.2	45.8	40.9
	Papua New Guinea	20.0	14.4	11.4	49.5	44.2
	Philippines	16.1	15.2	9.9	59.4	44.6
	Thailand	24.7	12.7	11.7	43.6	42.5
	Viet Nam	17.6	7.9	5.2	32.2	26.8
West Asia	Armenia	28.6	24.1	11.1	58.6	30.3
	Azerbaijan	17.9	22.5	12.5	64.7	46.6
	Georgia	21.6	20.0	9.9	52.1	34.1
	Iraq	37.1	23.6	19.1	63.3	52.0
	Jordan	30.9	13.9	10.9	34.4	30.3
	Kuwait	38.1	21.3	17.5	51.5	44.7
	Lebanon	27.8	10.3	8.4	30.2	26.8
	Saudi Arabia	32.1	18.3	15.3	49.5	44.2
	Syrian Arab Republic	42.1	22.6	15.2	53.3	33.1
	United Arab Emirates	19.9	23.6	13.6	66.2	48.1
	Yemen	20.4	16.9	14.1	55.7	52.3

Table continued on next page.

(table A5 continued from previous page). Endogenous goitre prevalence estimates, with predicted prevalences of goitre (total goitre rate) and low urinary iodine, by country

Region	Country	Estimate of endogenous (pre-iodization) total goitre rate	Predicted prevalence of total goitre rate in 1998	Predicted prevalence of total goitre rate in 2004	Predicted prevalence of low urinary iodine in 2004	Predicted prevalence of low urinary iodine in 2007
Caribbean	Cuba	7.9	25.4	5.4	74.0	22.5
	Dominican Republic	11.2	15.0	11.8	51.0	44.2
	Haiti	11.2	19.1	14.6	58.9	52.0
	Jamaica	11.2	-0.1	-0.7	8.4	7.4
	Trinidad and Tobago	11.2	23.3	13.3	63.3	45.3
Central America	Belize	24.6	20.6	10.6	39.8	21.7
	Costa Rica	20.6	3.2	3.2	9.5	10.5
	El Salvador	19.3	4.7	7.1	14.0	23.6
	Guatemala	22.7	13.1	12.4	34.5	34.9
	Honduras	24.5	6.5	5.9	16.2	15.2
	Mexico	28.0	11.7	9.3	20.4	17.4
	Nicaragua	19.4	5.0	3.0	15.3	9.9
	Panama	19.4	3.1	2.5	10.3	9.3
South America	Argentina	43.6	13.7	12.6	16.3	14.3
	Bolivia (Plurinational State of)	45.4	11.9	11.4	11.8	11.2
	Brazil	46.6	12.2	12.4	11.0	12.6
	Chile	25.9	19.9	9.2	36.0	16.8
	Colombia	30.7	11.2	9.3	19.0	15.6
	Ecuador	30.5	8.1	7.1	12.1	10.4
	Guyana	18.0	18.5	8.4	39.8	21.7
	Paraguay	46.1	17.2	14.0	22.4	14.8
	Peru	32.4	7.5	7.1	11.0	10.8
	Ursuguay	27.5	9.6	8.1	18.3	15.6
	Venezuela (Bolivarian Republic of)	30.2	12.4	9.9	21.7	17.2

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