# Documentation for the Global Subnational Infant Mortality Rates, Version 2.01

**February 2021**

Center for International Earth Science Information Network (CIESIN), Columbia University

## Abstract

This document outlines the basic methodology and data sets used to construct the Global Subnational Infant Mortality Rates (IMR), Version 2.01, along with use cases, limitations, and use constraints. Version 2.01 of SEDAC's Global Subnational Infant Mortality Rates data set compiles IMR data for 234 countries and territories, 143 of which include subnational units. The data are benchmarked to the year 2015 (Version 1 was benchmarked to the year 2000), and are drawn from national offices, Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS), and other sources from 2006 to 2014. Version 2.01 includes crude estimates of births and infant deaths, which could be aggregated or disaggregated to different geographies to calculate infant mortality rates at different scales or resolutions, where births are the rate denominator and infant deaths are the rate numerator. Boundary inputs are derived primarily from the Gridded Population of the World, Version 4 (GPWv4) data collection. National and subnational data are mapped to grid cells at a spatial resolution of 30 arc-seconds (~1 km) (Version 1 has a spatial resolution of 1/4 degree, ~28 km at the equator) allowing for easy integration with demographic, environmental, and other spatial data.

**Data set citation:** Center for International Earth Science Information Network (CIESIN), Columbia University. 2021. Global Subnational Infant Mortality Rates, Version 2.01. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/0gdn-6y33. Accessed DAY MONTH YEAR.

**Suggested citation for this document:** Center for International Earth Science Information Network (CIESIN), Columbia University. 2021. Documentation for the Global Subnational Infant Mortality Rates, Version 2.01. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/g739-5620. Accessed DAY MONTH YEAR.

We appreciate feedback regarding this data set, such as suggestions, discovery of errors, difficulties in using the data, and format preferences. Please contact:

NASA Socioeconomic Data and Applications Center (SEDAC)
Center for International Earth Science Information Network (CIESIN)
Columbia University
Phone: 1 (845) 365-8920
Email: ciesin.info@ciesin.columbia.edu

## Contents



## I. Introduction

The Global Subnational Infant Mortality Rates, Version 2.01 data set includes infant mortality rate data for the lowest administrative units available for each country as of June 2017. The Infant Mortality Rate (IMR) for a region or country (defined as the number of children who die before their first birthday for every 1,000 live births) is of interest to a wide user community in interdisciplinary studies of health, development, sustainability, and the environment. Subnational IMR estimates derived from vital statistics and other sources are frequently used as a proxy for indicators such as poverty and wellbeing since alternative measures, such as Gross Domestic Product (GDP) or population living on less than one U.S. dollar per day, can be difficult to obtain at subnational levels for many countries (Dasgupta, 1993). IMR also has a number of advantages over other metrics. First, its measurement, unlike small area estimates of poverty or income, is highly standardized. Second, when compared with average income metrics, IMRs are less likely to be influenced by the kind of skewed wealth distribution that might make otherwise poor areas appear well-off because a few high income people live there. Third, the data are available for 90% or more of the population in medium and low-income countries (Balk et al., 2006).

This data set compiles IMR data for 234 countries and territories, 143 of which include subnational units, and includes estimates of births and infant deaths to facilitate the aggregation or disaggregation of infant mortality rates at different geographies. The data are benchmarked to the year 2015, whereas Version 1 of the data set was benchmarked to the year 2000 (CIESIN, 2005). Metadata are included describing uncertainties related to

temporal and spatial scale adjustment, small island state (SIS) status, and conflict regions. Data are drawn from national offices, Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS), and other sources from 2006 to 2014. Boundary inputs are derived primarily from the Gridded Population of the World, Version 4 (GPWv4) data collection. Assigning both national and subnational data to grid cells at a spatial resolution of 30 arc-seconds (~1 km) allows for integration with demographic, environmental, and other spatial data.

## II. Data and Methodology

### Input data

IMR data has been collected for 234 countries and territories, of which 91 include only national units, while 143 include subnational units, representing an improvement of 78 additional countries with subnational data compared to the Version 1. Distribution of countries by level of administrative unit used and total number of units for each level is displayed in Table 1. Data acquisition included collecting IMR, live births, and infant deaths for the most recent year available. The highest administrative level (subnational unit) available with an IMR as of June 2017 is included in the gridded data product.

*Table 1: Summary of administrative level, resolution, and number of subnational units (SNU)*

| Administrative Level | Count of Highest Resolution SNU** | Sum of Total Number of SNUs** |
|---|---|---|
| 0 | 91 | 91 |
| 1 | 113 | 1863 |
| 2 | 22 | 3513 |
| 3 | 7 | 1439 |
| 4 | 1 | 163 |
| **Grand Total** | **234** | **7069** |

Table 2 shows source information for each country, including the number of reporting units. Subnational data were drawn from national offices (82 countries), DHS (41 countries), MICS (17 countries), and other sources (3 countries). National office data were sourced from either, national Human Development Reports, National Statistical Offices (NSO), or Ministry of Health repositories. Subnational data ranges from 2008 to 2014.

*Table 2: Countries with IMR Data*

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| Europe | ANR | Andorra | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| Asia | AFG | Afghanistan | 1 | 34 | 2011-2015 | DHS | 2006-2015 | DHS | Acquired | UN IGME 2017 |
| Africa | AGO | Angola | 1 | 18 | 2011-2015 | DHS | 2006-2015/16 | DHS | Acquired | UN IGME 2017 |
| Europe | ALB | Albania | 1 | 3 | 2014 | DHS | 1999-2008 | DHS | Acquired | UN IGME 2017 |
| Asia | ARE | United Arab Emirates | 0 | 1 | 2011 | National | n/a | n/a | Acquired | UN IGME 2017 |
| S. America | ARG | Argentina | 2 | 525 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Asia | ARM | Armenia | 1 | 11 | 2014 | National | 2013 | National | Acquired | UN IGME 2017 |
| Oceania | ASM | American Samoa | 0 | 1 | 2014 | CIA | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| N. America | ATG | Antigua and Barbuda | 0 | 1 | 2007 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Australia | AUS | Australia | 1 | 9 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Europe | AUT | Austria | 1 | 9 | 2014 | National | 2013 | National | Calculated by CIESIN | UN IGME 2017 |
| Asia | AZE | Azerbaijan | 2 | 74 | 2014 | National | 2013 | National | Acquired | UN IGME 2017 |
| Africa | BDI | Burundi | 1 | 5 | 2006-2011 | DHS | 2001-2011 | DHS | Acquired | UN IGME 2017 |
| Europe | BEL | Belgium | 2 | 11 | 2013 | National | 2013 | National | Acquired (admin0 and admin1); Calculated | UN IGME 2017 |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | by CIESIN (admin2) | |
| Africa | BEN | Benin | 1 | 12 | 2010-2014 | MICS | 2010-2014 | MICS | Acquired | UN IGME 2017 |
| N. America | BES | Bonaire, Sint Eustatius, Saba | 0 | 1 | 2009 | PAHO | n/a | n/a | Acquired | n/a |
| Africa | BFA | Burkina Faso | 1 | 13 | 2006-2010 | DHS | 2001-2010 | DHS | Acquired | UN IGME 2017 |
| Asia | BGD | Bangladesh | 2 | 64 | 2014 | National | admin1: 2014, admin2: 2012 | National | Acquired | UN IGME 2017 |
| Europe | BGR | Bulgaria | 3 | 28 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Asia | BHR | Bahrain | 0 | 1 | 2013 | National | n/a | n/a | Acquired | UN IGME 2017 |
| N. America | BHS | Bahamas | 0 | 1 | 2013 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | BIH | Bosnia and Herzegovina. | 3 | 142 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| N. America | BLM | Saint-Barthelemy | 0 | 1 | 2014 | Other | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Europe | BLR | Belarus | 3 | 155 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| N. America | BLZ | Belize | 1 | 6 | 2011-2015 | MICS | 2009 | National | Acquired | UN IGME 2017 |
| N. America | BMU | Bermuda | 0 | 1 | 2014 | National | n/a | n/a | Calculated by CIESIN | U.S. Census Bureau International Data Base |
| S. America | BOL | Bolivia | 1 | 9 | 2008 | National | 2008 | National | Acquired | UN IGME 2017 |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| S. America | BRA | Brazil | 3 | 557 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| N. America | BRB | Barbados | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| Asia | BRN | Brunei Darussalam | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Asia | BTN | Bhutan | 1 | 20 | 2012 | National | 2012 and 2005 | National | Acquired | UN IGME 2017 |
| Africa | BWA | Botswana | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Africa | CAF | Central African Republic | 1 | 16 | 2010 | MICS | 2010 | MICS | Acquired | UN IGME 2017 |
| N. America | CAN | Canada | 1 | 13 | 2012 | National | 2012 | National | Acquired | UN IGME 2017 |
| Europe | CHE | Switzerland | 1 | 26 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| S. America | CHL | Chile | 2 | 347 | 2013 | National | 2013 | National | Acquired | UN IGME 2017 |
| Asia | CHN | China | 1 | 31 | 2012 | National | 11/2009-10/2010 | National | Calculated by CIESIN | UN IGME 2017 |
| Africa | CIV | Côte d'Ivoire | 1 | 11 | 2007-2012 | DHS | 2002-2012 | DHS | Acquired | UN IGME 2017 |
| Africa | CMR | Cameroon | 1 | 12 | 2009-2014 | MICS | 2005-2014 | MICS | Acquired | UN IGME 2017 |
| Africa | COD | Democratic Republic of the Congo | 1 | 11 | 2009-2013 | DHS | 2003-2013 | DHS | Acquired | UN IGME 2017 |
| Africa | COG | Congo (Brazzaville) | 1 | 12 | 2010-2014/2015 | MICS | 2002-2011 | DHS | Acquired | UN IGME 2017 |
| Oceania | COK | Cook Islands | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| S. America | COL | Colombia | 1 | 33 | 2005-2010 | DHS | 2000-2010 | DHS | Acquired | UN IGME 2017 |
| Africa | COM | Comoros | 1 | 3 | 2008-2012 | DHS | 2003-2012 | DHS | Acquired | UN IGME 2017 |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| Africa | CPV | Cape Verde | 1 | 22 | 2013 | National | 2011 | National | Acquired (admin0); Calculated by CIESIN (admin1) | UN IGME 2017 |
| N. America | CRI | Costa Rica | 2 | 81 | 2014 | National | 2013 | National | Acquired | UN IGME 2017 |
| N. America | CUB | Cuba | 1 | 16 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| N. America | CUW | Curacao | 0 | 1 | 2014 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| N. America | CYM | Cayman Islands | 0 | 1 | 2014 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Asia | CYP | Cyprus | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | CZE | Czech Republic | 2 | 77 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Europe | DEU | Germany | 1 | 16 | 2013 | National | 2013 | National | Acquired | UN IGME 2017 |
| Africa | DJI | Djibouti | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| N. America | DMA | Dominica | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | DNK | Denmark | 1 | 5 | 2014 | National | 2014 | National | Calculated by CIESIN | UN IGME 2017 |
| N. America | DOM | Dominican Republic | 1 | 10 | 2009-2014 | MICS | 2009-2014 | MICS | Acquired | UN IGME 2017 |
| Africa | DZA | Algeria | 1 | 48 | 2014 | National | 2013 | National | Acquired | UN IGME 2017 |
| S. America | ECU | Ecuador | 2 | 24 | 2013 | National | 2012 | National | Acquired | UN IGME 2017 |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| Africa | EGY | Egypt | 1 | 27 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Africa | ERI | Eritrea | 1 | 6 | 2010 | National | 2010 | National | Acquired | UN IGME 2017 |
| Africa | ESH | Western Sahara | 0 | 1 | 2014 | CIA | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Africa | ESP | Spain | 2 | 52 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Europe | EST | Estonia | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Africa | ETH | Ethiopia | 1 | 11 | 2006-2011 | DHS | 2001-2011 | DHS | Acquired | UN IGME 2017 |
| Europe | FIN | Finland | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Oceania | FJI | Fiji | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | FRA | France | 2 | 96 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Europe | FRO | Faroe Islands | 0 | 1 | 2014 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Oceania | FSM | Micronesia (Fed. States of) | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| Africa | GAB | Gabon | 1 | 10 | 2007-2012 | DHS | 2002-2012 | DHS | Acquired | UN IGME 2017 |
| Europe | GBR | United Kingdom of Great Britain and Northern Ireland | 3 | 405 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Asia | GEO | Georgia | 1 | 12 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| Europe | GGY | Guernsey | 0 | 1 | 2010-2012 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Africa | GHA | Ghana | 1 | 10 | 2010-2014 | DHS | 2005-2014 | DHS | Acquired | UN IGME 2017 |
| Europe | GIB | Gibraltar | 0 | 1 | 2014 | CIA | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Africa | GIN | Guinea | 1 | 8 | 2007-2012 | DHS | 2002-2012 | DHS | Acquired | UN IGME 2017 |
| N. America | GLP | Guadeloupe | 0 | 1 | 2014 | National | n/a | n/a | Acquired | n/a |
| Africa | GMB | Gambia | 1 | 8 | 2009-2013 | DHS | 2003-2013 | DHS | Acquired | UN IGME 2017 |
| Africa | GNB | Guinea-Bissau | 1 | 9 | 2010-2014 | MICS | 2010-2014 | MICS | Acquired | UN IGME 2017 |
| Africa | GNQ | Equatorial Guinea | 1 | 2 | 2007-2011 | DHS | 2001-2011 | DHS | Acquired | UN IGME 2017 |
| Asia | GRC | Greece | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| N. America | GRD | Grenada | 0 | 1 | 2010 | National | n/a | n/a | Acquired | UN IGME 2017 |
| N. America | GRL | Greenland | 0 | 1 | 2013 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| N. America | GTM | Guatemala | 1 | 22 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| S. America | GUF | French Guiana | 0 | 1 | 2014 | National | n/a | n/a | Acquired | n/a |
| Oceania | GUM | Guam | 0 | 1 | 2014 | National | n/a | n/a | Acquired | U.S. Census Bureau |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | International Data Base |
| S. America | GUY | Guyana | 0 | 1 | 2010-2014 | MICS | n/a | n/a | Acquired | UN IGME 2017 |
| Asia | HKG | China Hong Kong Special Administrative Region (SAR) | 0 | 1 | 2014 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| N. America | HND | Honduras | 1 | 18 | 2014 | National | 2002-2012 | DHS | Acquired | UN IGME 2017 |
| Europe | HRV | Republic of Croatia | 1 | 21 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| N. America | HTI | Haiti | 1 | 11 | 2007-2012 | DHS | 2002-2012 | DHS | Acquired | UN IGME 2017 |
| Europe | HUN | Hungary | 2 | 20 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Asia | IDN | Indonesia | 1 | 33 | 2008-2012 | DHS | 2003-2012 | DHS | Acquired | UN IGME 2017 |
| Europe | IMN | Isle of Man | 0 | 1 | 2014 | CIA | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Asia | IND | India | 1 | 37 | 2013 | National | 2013 | National | Acquired | UN IGME 2017 |
| Europe | IRL | Ireland | 2 | 34 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Asia | IRN | Iran | 1 | 26 | 2014 | UN | 1996 | UN | Acquired | UN IGME 2017 |
| Asia | IRQ | Iraq | 1 | 18 | 2014 | National | 2006-2011 | MICS | Acquired | UN IGME 2017 |
| Europe | ISL | Iceland | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Africa | ISR | Israel | 2 | 16 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Europe | ITA | Italy | 3 | 110 | 2013 | National | 2013 | National | Acquired | UN IGME 2017 |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| N. America | JAM | Jamaica | 0 | 1 | 2001-2011 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | JEY | Jersey | 0 | 1 | 2010-2012 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Asia | JOR | Jordan | 1 | 12 | 2008-2012 | DHS | 2003-2012 | DHS | Acquired | UN IGME 2017 |
| Asia | JPN | Japan | 2 | 1714 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Asia | KAZ | Kazakhstan | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Africa | KEN | Kenya | 1 | 8 | 2010-2014 | DHS | 2005-2014 | DHS | Acquired | UN IGME 2017 |
| Asia | KGZ | Kyrgyzstan | 1 | 9 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Asia | KHM | Cambodia | 1 | 19 | 2010-2014 | DHS | 2003-2014 | DHS | Acquired | UN IGME 2017 |
| Oceania | KIR | Kiribati | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| N. America | KNA | Saint Kitts and Nevis | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| Asia | KOR | Republic of Korea | 1 | 17 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Europe | KOS | Kosovo | 1 | 37 | 2014 | National | 2014 | National | Calculated by CIESIN | U.S. Census Bureau International Data Base |
| Asia | KWT | Kuwait | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Asia | LAO | Lao People's Democratic Republic | 1 | 17 | 2012 | MICS/DHS | 2007-2011 | MICS/DHS | Acquired | UN IGME 2017 |
| Asia | LBN | Lebanon | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| Africa | LBR | Liberia | 1 | 5 | 2008-2012 | DHS | 2003-2012 | DHS | Acquired | UN IGME 2017 |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| Africa | LBY | Libyan Arab Jamahiriya | 1 | 22 | 2010 | National | 2010 | National | Calculated by CIESIN | UN IGME 2017 |
| N. America | LCA | Saint Lucia | 0 | 1 | 2012 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | LIE | Liechtenstein | 0 | 1 | 2014 | CIA | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Asia | LKA | Sri Lanka | 1 | 25 | 2010 | National | 2010 | National | Acquired | UN IGME 2017 |
| Africa | LSO | Lesotho | 1 | 10 | 2009-2014 | DHS | 2004-2014 | DHS | Acquired | UN IGME 2017 |
| Europe | LTU | Lithuania | 1 | 10 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Europe | LUX | Luxemburg | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | LVA | Latvia | 1 | 6 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Asia | MAC | China Macao Special Administrative Region (SAR) | 0 | 1 | 2014 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| N. America | MAF | Saint Martin | 0 | 1 | 2014 | Other | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Africa | MAR | Morocco | 0 | 1 | 2011 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | MCO | Monaco | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | MDA | Republic of Moldova | 2 | 35 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Africa | MDG | Madagascar | 1 | 22 | 2012-2013 | National | 1998-99 to 2008-09 | DHS | Acquired | UN IGME 2017 |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| Asia | MDV | Maldives | 1 | 3 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| N. America | MEX | Mexico | 1 | 32 | 2014 | National | 2014 | National | Calculated by CIESIN | UN IGME 2017 |
| Oceania | MHL | Marshall Islands | 0 | 1 | 2011 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | MKD | Republic of Macedonia | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Africa | MLI | Mali | 1 | 9 | 2008-2013 | DHS | 2004-2013 | DHS | Acquired | UN IGME 2017 |
| Europe | MLT | Malta | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Asia | MMR | Myanmar | 1 | 15 | 2010 to 2015-2016 | National | 2005 to 2015-2016 | National | Acquired | UN IGME 2017 |
| Europe | MNE | Montenegro | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Asia | MNG | Mongolia | 2 | 22 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Oceania | MNP | Northern Mariana Islands | 0 | 1 | 2002 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Africa | MOZ | Mozambique | 1 | 11 | 2006-2011 | DHS | 2001-2011 | DHS | Acquired | UN IGME 2017 |
| Africa | MRT | Mauritania | 1 | 12 | 2007-2011 | MICS | 2007-2011 | MICS | Acquired | UN IGME 2017 |
| N. America | MSR | Montserrat | 0 | 1 | 2014 | CIA | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| N. America | MTQ | Martinique | 0 | 1 | 2014 | National | n/a | n/a | Acquired | n/a |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| Africa | MUS | Mauritius (excluding Agalega and St Brandon) | 1 | 10 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Africa | MWI | Malawi | 2 | 30 | 2014 | National | 2009-2014 (admin1) and 2004-2014 (admin2) | MICS | Acquired | UN IGME 2017 |
| Asia | MYS | Malaysia | 1 | 16 | 2012 | National | 2012 | National | Acquired | UN IGME 2017 |
| Africa | MYT | Mayotte | 0 | 1 | 2014 | National | n/a | n/a | Acquired | n/a |
| Africa | NAM | Namibia | 1 | 13 | 2008-2012 | DHS | 2003-2012 | DHS | Acquired | UN IGME 2017 |
| Oceania | NCL | New Caledonia | 0 | 1 | 2012 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Africa | NER | Niger | 1 | 8 | 2008-2012 | DHS | 2003-2012 | DHS | Acquired | UN IGME 2017 |
| Africa | NGA | Nigeria | 1 | 6 | 2009-2013 | DHS | 2004-2013 | DHS | Acquired | UN IGME 2017 |
| N. America | NIC | Nicaragua | 1 | 17 | 2011-2012 | National | 2011-2012 | National | Acquired | UN IGME 2017 |
| Oceania | NIU | Niue | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | NLD | Netherlands | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | NOR | Norway | 1 | 19 | 2014 | National | 2006-2010 | National | Acquired | UN IGME 2017 |
| Asia | NPL | Nepal | 1 | 15 | 2009 -2014 | MICS | 2009 -2014 | MICS | Acquired | UN IGME 2017 |
| Oceania | NRU | Nauru | 0 | 1 | 2011-2013 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Oceania | NZL | New Zealand | 1 | 20 | 2014 | National | 2012 | National | Acquired | UN IGME 2017 |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| Asia | OMN | Oman | 1 | 11 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Asia | PAK | Pakistan | 1 | 6 | 2008-2012 | DHS | 2003-2012 | DHS | Acquired | UN IGME 2017 |
| N. America | PAN | Panama | 1 | 13 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| S. America | PER | Peru | 1 | 25 | 2013 | National | 2011 | National | Acquired | UN IGME 2017 |
| Asia | PHL | Philippines | 1 | 17 | 2009-2013 | DHS | 2004-2013 | DHS | Acquired | UN IGME 2017 |
| Oceania | PLW | Palau | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| Asia | PNG | Papua New Guinea | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | POL | Poland | 1 | 16 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| N. America | PRI | Puerto Rico | 1 | 78 | 2014 | National | 2014 | National | Acquired | U.S. Census Bureau International Data Base |
| Asia | PRK | Democratic People's Republic of Korea | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| Africa | PRT | Portugal | 1 | 7 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| S. America | PRY | Paraguay | 1 | 18 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Asia | PSE | Occupied Palestinian Territory | 1 | 2 | 2010-2014 | MICS | 2010-2014 | MICS | Acquired | UN IGME 2017 |
| Oceania | PYF | French Polynesia | 0 | 1 | 2014 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Asia | QAT | Qatar | 1 | 7 | 2013 | National | 2013 | National | Acquired | UN IGME 2017 |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| Africa | REU | Réunion | 0 | 1 | 2014 | National | n/a | n/a | Acquired | n/a |
| Europe | ROU | Romania | 3 | 42 | 2012 | National | 2012 | National | Acquired | UN IGME 2017 |
| Europe | RUS | Russian Federation | 1 | 80 | 2014 | National | 2013 | National | Acquired | UN IGME 2017 |
| Africa | RWA | Rwanda | 1 | 5 | 2010-2014 | DHS | 2005-2014 | DHS | Acquired | UN IGME 2017 |
| Asia | SAU | Saudi Arabia | 0 | 1 | 2013 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Africa | SDN | Sudan | 1 | 18 | 2010-2014 | MICS | 2010-2014 | MICS | Acquired | UN IGME 2017 |
| Africa | SEN | Senegal | 1 | 14 | 2013 | National | 2013 | National | Acquired | UN IGME 2017 |
| Asia | SGP | Singapore | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Africa | SHN | Saint Helena | 0 | 1 | 2013 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Oceania | SLB | Solomon Islands | 1 | 10 | 2009 | National | 2009 | National | Acquired | UN IGME 2017 |
| Africa | SLE | Sierra Leone | 2 | 14 | 2009-2013 | DHS | 2004-2013 | DHS | Acquired | UN IGME 2017 |
| N. America | SLV | El Salvador | 1 | 14 | 2010-2014 | MICS | 2010-2014 | MICS | Acquired | UN IGME 2017 |
| Europe | SMR | San Marino | 0 | 1 | 2010-2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Africa | SOM | Somalia | 1 | 18 | 2001-2006 | MICS | 2006-2011 | MICS | Acquired | UN IGME 2017 |
| N. America | SPM | Saint Pierre and Miquelon | 0 | 1 | 2014 | CIA | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Europe | SRB | Republic of Serbia | 4 | 163 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| Africa | SSD | Republic of South Sudan | 1 | 10 | 2006 | National | 2005-2010 | National | Acquired | UN IGME 2017 |
| Africa | STP | Sao Tome and Principe | 1 | 4 | 2011-2014 | MICS | 2005-2014 | MICS | Acquired | UN IGME 2017 |
| S. America | SUR | Suriname | 0 | 1 | 2012 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Europe | SVK | Slovakia | 2 | 85 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Europe | SVN | Slovenia | 1 | 12 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Europe | SWE | Sweden | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Africa | SWZ | Swaziland | 1 | 4 | 2009-2014 | MICS | 2009-2014 | MICS | Acquired | UN IGME 2017 |
| N. America | SXM | Sint Maaerten | 0 | 1 | 2013 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Africa | SYC | Seychelles | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Asia | SYR | Syrian Arab Republic | 1 | 14 | 2014 | UN | 2008 | UN | Acquired | UN IGME 2017 |
| N. America | TCA | Turks and Caicos Islands | 0 | 1 | 2013 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Africa | TCD | Chad | 1 | 21 | 2010-2014 | DHS | 2005-2014 | DHS | Acquired | UN IGME 2017 |
| Africa | TGO | Togo | 1 | 6 | 2009-2013 | DHS | 2004-2013 | DHS | Acquired | UN IGME 2017 |
| Asia | THA | Thailand | 2 | 76 | 2012 | National | 2011 | UN | Acquired | UN IGME 2017 |
| Asia | TJK | Tajikistan | 1 | 5 | 2008-2012 | DHS | 2003-2012 | DHS | Acquired | UN IGME 2017 |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| Asia | TKM | Turkmenistan | 0 | 1 | 2012 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Asia | TLS | Timor-Leste | 1 | 13 | 2005- 2009 | DHS | 2000-2009 | DHS | Acquired | UN IGME 2017 |
| Oceania | TON | Tonga | 0 | 1 | 2011 | National | n/a | n/a | Acquired | UN IGME 2017 |
| N. America | TTO | Trinidad and Tobago | 0 | 1 | 2008 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Africa | TUN | Tunisia | 0 | 1 | 2014 | National | n/a | n/a | Acquired | UN IGME 2017 |
| Asia | TUR | Turkey | 1 | 81 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Oceania | TUV | Tuvalu | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| Asia | TWN | Taiwan | 0 | 1 | 2014 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Africa | TZA | United Republic of Tanzania | 1 | 9 | 2010/11-2015/16 | DHS | 2005/06-2015/16 | DHS | Acquired | UN IGME 2017 |
| Africa | UGA | Uganda | 1 | 10 | 2012-2016 | DHS | 2002-2011 | DHS | Acquired | UN IGME 2017 |
| Europe | UKR | Ukraine | 1 | 27 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| S. America | URY | Uruguay | 1 | 19 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| N. America | USA | United States of America | 1 | 51 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Asia | UZB | Uzbekistan | 0 | 1 | 2014 | UN | n/a | n/a | Acquired | UN IGME 2017 |
| N. America | VCT | Saint Vincent and the Grenadines | 0 | 1 | 2013 | National | n/a | n/a | Acquired | UN IGME 2017 |
| S. America | VEN | Venezuela | 1 | 25 | 2012 | National | 2012 | National | Acquired | UN IGME 2017 |

| Continent | ISO3 | Country | Highest Resolution SNU** | Total Number of SNUs** | National IMR (Year) | National IMR* | Sub-national IMR (Year) | Sub-national IMR* | Method of Calculation | Source of Adjustment |
|---|---|---|---|---|---|---|---|---|---|---|
| N. America | VGB | British Virgin Islands | 0 | 1 | 2014 | CIA | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| N. America | VIR | United States Virgin Islands | 0 | 1 | 2014 | National | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Asia | VNM | Viet Nam | 2 | 63 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Oceania | VUT | Vanuatu | 0 | 1 | 2013 | DHS | n/a | n/a | Acquired | UN IGME 2017 |
| Oceania | WLF | Wallis and Futuna Islands | 0 | 1 | 2014 | CIA | n/a | n/a | Acquired | U.S. Census Bureau International Data Base |
| Oceania | WSM | Samoa | 1 | 4 | 2014 | National | 2014 | National | Acquired | UN IGME 2017 |
| Asia | YEM | Yemen | 1 | 21 | 2009-2013 | DHS | 2004-2013 | DHS | Acquired | UN IGME 2017 |
| Africa | ZAF | South Africa | 2 | 53 | 2011 | National | 2011 | National | Acquired | UN IGME 2017 |
| Africa | ZMB | Zambia | 1 | 10 | 2009-2013 | DHS | 2004-2013 | DHS | Acquired | UN IGME 2017 |
| Africa | ZWE | Zimbabwe | 1 | 10 | 2010-2014 | MICS | 2010-2014 | MICS | Acquired | UN IGME 2017 |

* DHS = Demographic Health Survey; MICS = Multiple Indicator Cluster Surveys; UN = Various United Nations programs; CIA = Central Intelligence Agency; PAHO = Pan American Health Organization; National = various sources from national Human Development Reports, National Statistical Offices, or Ministries of Health
** SNU = Subnational Unit

Spatial boundaries were obtained from the same IMR data source when possible or otherwise supplemented with input boundaries from the Gridded Population of the World, Version 4 (GPWv4): Population Count (CIESIN, 2016a) shown in Table 3. For the seven countries and territories where no IMR data has been collected, boundaries are coded as No Data (-9999). Water features were also obtained from the Gridded Population of the World, Version 4 (GPWv4): Land and Water Area (CIESIN, 2016b), and coded as No Population or Uninhabited areas (-7777).

Using GPWv4 boundaries improves interoperability (in the sense (i.e., interchanging and making use of information)) between IMR and the various GPWv4 data such as population counts and density, and basic demographic characteristics (age and sex variables) (CIESIN, 2017d).

*Table 3: Sources of boundary data*

| Boundary Source | Number of Countries |
|---|---|
| GPWv4 | 192* |
| DHS | 42 |
| GADM | 6 |
| IGBE | 1 |
| **Grand Total** | **241** |

***** Includes 7 countries and territories that do not have IMR data (Åland Islands, British Indian Ocean Territory, Falkland Islands (Malvinas), French Southern Territories, Heard and McDonald Islands, South Georgia and the South Sandwich Islands, Svalbard and Jan Mayen Islands)

## Methods

### 1. IMR grid

The infant mortality rates were either “Acquired” or “Calculated by CIESIN”. “Acquired” means that IMRs were collected from vital registration data, surveys, models, or other estimates. “Calculated by CIESIN” indicates that the rates were estimated using reported live births and infant deaths data. IMRs were calculated by taking the number of infant deaths, dividing them by the number of live births, and multiplying the result by 1,000.

$$IMR = (\text{deaths of infants less 1 year old} / \text{live births}) * 1000$$

Out of all *national* IMRs in the database, 90 countries use “Acquired” data. Only one (Bermuda) uses estimates “Calculated by CIESIN”. Out of all *subnational* IMRs, 135 countries use “Acquired” data, and eight use estimations “Calculated by CIESIN” (Table 2). The highest available subnational resolution of IMR was included in the final gridded product.

The IMR input data comes from different sources and spans from 2006 to 2014 varying by country and subnational unit. Because of this, rates were adjusted for year and source to be

consistent with the United Nations (UN) Inter-Agency Group for Child Mortality Estimation (UN IGME, 2017) national estimates for the year 2015. This data source does not include all the countries included in the Version 2.01 data set, thus adjustment values for countries not included in the UN IGME 2017 report were imputed using data from the U.S. Census Bureau International Database[1]. Five countries were not included in either source, therefore they were only adjusted by year. Coded values are included for those data not imputed (0), imputed (1), and year adjustment only (2).

The adjustment approach follows the method used in Version 1 of the infant mortality data set (Storeygard et al., 2008:216):

> The IMR value $r_{c,y,s,x}$ for country *c*, year *y* from source *s*, at scale *x* (0 = national; 1 = subnational) were scaled to *y* = 2015 national rates from UN IGME (denoted *s* = 0), where UN IGME includes observed and imputed values, while values for five countries represent only an adjustment for year *y*.

$$r_{c,2015,0,1} = (r_{c,y,s,1} * r_{c,2015,0,0}) / r_{c,y,s,0}$$

Given the formula above, the adjustment cannot be applied to the Cook Islands, which has a reported IMR value of 0 and an adjustment rate of 6.9. The reported national IMR of 0 is used un-adjusted.

Topology was applied such that there are no gaps or overlaps between country or subnational unit boundaries. The data were then gridded to a spatial resolution of 30 arc-seconds, which is about 1 kilometer at the equator. The final gridded product represents the estimated IMR at the highest subnational resolution available for the year 2015.

Coded values are included for No Data (-9999), and for No Population or Uninhabited areas including Bodies of Water (-7777).

## 2. Crude estimation of births and infant deaths grids

The Global Subnational Infant Mortality Rates, v2.01 (2015) data set includes crude estimates of births and infant deaths, which allows for aggregation or disaggregation to different geographies in order to calculate infant mortality rates at different scales or resolutions, where births are the rate denominator and infant deaths are the rate numerator. There are 3 different approaches for estimating births, which are explained in section A, and 3 corresponding approaches for estimating infant deaths, which are explained in section B.

### A) Estimation of births

**(A.1)** The Global Subnational Infant Mortality Rates, v1 (2000) estimated subnational births by applying national Crude Birth Rates (CBRs) from the UN population division to a detailed

[1] U.S. Census Bureau. *International Programs. International Data Base*. Revised: December 22, 2017. Version: Data:17.0810 Code:12.0321

population grid from the Gridded Population of the World, Version 3 (GPWv3) (Storeygard et al., 2008). The same method was used here to produce the resulting file, which is **povmap-global-subnational-infant-mortality-rates-v2-01_cbr15-alloc**.

The CBR is the number of births in a time interval (usually one year) divided by the population in the same year, for a country or any other spatial unit. National CBRs are from the United Nations Department of Economic and Social Affairs (UN DESA) World Population Prospects 2017 revision (UN DESA, 2017a). The CBRs were joined to the Gridded Population of the World, Version 4 (GPWv4): National Identifier Grid, Revision 10 (CIESIN, 2017b) to create a lookup table including country ID and country CBR. This was then applied to the Gridded Population of the World, Version 4 (GPWv4): Population Count Adjusted to Match 2015 Revision of UN WPP Country Totals, Revision 10 (CIESIN, 2017c), to obtain estimates of the numbers of births in 2015 for each grid cell.

For Version 2.01 of the IMR, two other approaches were used for the creation of alternative births grids, as described in (A.2) and (A.3).

**(A.2)** Births are estimated using gridded data from Gridded Population of the World, Version 4 (GPWv4): Basic Demographic Characteristics, Revision 10 (CIESIN, 2017a), to produce the resulting file which is **povmap-global-subnational-infant-mortality-rates-v2-01_pop0-2015.**

Rectangular distribution[2] was applied to the grid of 0-4 year old population counts to obtain crude estimates of population age 0 in each grid cell. The estimates of population age 0 were then converted to proportions of the total population in 2010. These proportions were then applied to the 2015 total GPWv4 Population Count Adjusted to Match 2015 Revision of UN WPP Country Totals v4.10 (CIESIN, 2017c) to obtain crude estimates of population age 0 in 2015 (under the assumption that the structure of the population remained stable between 2010 and 2015).

**(A.3)** In a third approach, the national total number of births in 2015 (obtained from UN World Population Prospects 2017 (UN DESA, 2017a), UN Demographic Yearbook 2017 (UN DESA, 2017b), and the U.S. Census Bureau International Database, depending on availability by country) were allocated according to the subnational distribution of the population age group 0-4 using Gridded Population of the World, Version 4 (GPWv4): Basic Demographic Characteristics, Revision 10 (CIESIN, 2017a). The resulting file is **povmap-global-subnational-infant-mortality-rates-v2-01_birth15-alloc.**

The table with the 2015 number of births by country was joined to the Gridded Population of the World, Version 4 (GPWv4): National Identifier Grid, Revision 10 (CIESIN, 2017b) to create a

[2] "Rectangular distribution assumes that all the smaller groups (e.g., 1-year age group) have identical shares of the larger group (e.g., 5-year age group). The numbers in each of the smaller groups can be computed by dividing the population of the larger group by the number of subdivisions desired" (Smith, S., J. Tayman and D. Swanson. 2013. *A Practitioner's Guide to State and Local Population Projections*. New York, Springer. Pp. 280)

lookup table (similar to the method used in A.1). The proportion of a country's population age 0-4 in each grid cell in 2015 was estimated as:

*[(Pop 0-4 in the cell) / (Sum of the country's pop 0-4)]*

This grid was then multiplied by the lookup table containing the country's total number of births to obtain crude estimates of the 2015 births in each grid cell.

**B) Estimation of infant deaths**
Once the births per grid cell were estimated, the next step was the estimation of infant deaths. For the three methods described in (A), infant deaths were calculated by multiplying the subnational IMRs to the birth estimates. The resulting files are as follows:
**(B.1). povmap-global-subnational-infant-mortality-rates-v2-01_infd-cbr**
**(B.2). povmap-global-subnational-infant-mortality-rates-v2-01_infd-pop0**
**(B.3). povmap-global-subnational-infant-mortality-rates-v2-01_infd-birth**

## III. Data Set Description(s)

**Data set description**:
The Global Subnational Infant Mortality Rates, Version 2.01 consists of estimates of infant mortality rates, births, and infant deaths for the year 2015. The data product is a set of grids (raster data) of IMR rates, births and infant deaths at 30-arc seconds (~1 km) resolution.
The IMR grid is the same data as the Version 2.0 distributed in 2018. In Version 2.01, three births and three infant death grids have been included for methods A, B, and C. The nominal resolution of the vector input layers to produce the IMR grid varies from country to country, the highest administrative level used is defined in the **povmap-global-subnational-infant-mortality-rates-v2-01-adm-used-geotiff.zip** data file. The IMR data are also available as administrative level 1 information (administrative level 0 when level 1 is not available) in the **povmap-global-subnational-infant-mortality-rates-v2-01-adm1-gdb.zip** data file. All of the data is documented in a data dictionary with sources of information, in the **povmap-global-subnational-infant-mortality-rates-v2-01-xlsx.zip.**

**Data set web page:**
SEDAC URL: https://sedac.ciesin.columbia.edu/data/set/povmap-global-subnational-infant-mortality-rates-v2-01

Permanent URL: https://doi.org/10.7927/0gdn-6y33

**Data set format:**
The data are available as global grids in GeoTIFF format, vector feature class in an Esri Geodatabase (GDB), and Microsoft Excel (XLSX) format as downloadable zip files. The downloadables are compressed zip files containing: 1) GeoTIFF, GDB, or XLSX and 2) PDF documentation:

- Global Subnational Gridded IMR 2015; 30 arc-second (~1 km) resolution in GeoTIFF format
- Global Subnational Gridded Births 2015; 30 arc-second (~1 km) resolution in GeoTIFF format
- Global Subnational Gridded Infant Deaths 2015; 30 arc-second (~1 km) resolution in GeoTIFF format
- Global Administrative Level Used in the IMR 2015 Grid; 30 arc-second (~1 km) resolution in GeoTIFF format
- Global IMR 2015 Data with Administrative Level 1 Information (Administrative Level 0 when Level 1 not available); Vector data as feature classes in Esri Geodatabase (GDB) format
- Global Subnational IMR 2015 Data with Sources and Data Dictionary; Tabular data in XLSX format

**Data set downloads:**
povmap-global-subnational-infant-mortality-rates-v2-01-geotiff.zip
povmap-global-subnational-infant-mortality-rates-v2-01-births-geotiff.zip
povmap-global-subnational-infant-mortality-rates-v2-01-infantdeaths-geotiff.zip
povmap-global-subnational-infant-mortality-rates-v2-01-adm-used-geotiff.zip
povmap-global-subnational-infant-mortality-rates-v2-01-adm1-gdb.zip
povmap-global-subnational-infant-mortality-rates-v2-01-xlsx.zip

## IV. How to Use the Data

The raster data in GeoTIFF format and the vector data in geodatabase format, as well as in web map services, can be used directly in mapping and geospatial analysis.

## V. Potential Use Cases

The Global Subnational Infant Mortality Rates, Version 2.01 has many potential applications for the study of the geographic distribution of infant mortality within countries, as well as a proxy for the analysis of poverty and living conditions in general, particularly in conjunction with environmental or other geographical factors. It could also be a valuable input into other new or existing data sets. As Storeygard et al. (2008:209) notes, “While national data show a similar pattern for infant deaths, with half concentrated in the same six countries, spatially explicit subnational data would permit further quantification of spatial concentration and identify geographical ‘hotspots’ or clusters of mortality, some of which would be expected to cut across national boundaries”.

Version 1 has a large number of citations demonstrating applications of the data; search the SEDAC citations database (https://sedac.ciesin.columbia.edu/citations-db) by filtering on SEDAC Data Collections "povmap".

## VI. Limitations

The Global Subnational Infant Mortality Rates, Version 2.01 data set has a few limitations. The quality of IMR data varies globally in terms of defining and reporting live births and infant deaths, as well as methods of calculating rates. Sampling errors, data omission, and misreporting are common examples of how the input data may be skewed (Storeygard et al., 2008).

Some sources are unclear as to whether births are reported as stillborn and live births, or live births alone. Also, methods of calculation of the infant mortality rates differ between sources, and from the approach "Calculated by CIESIN" where the rates were not available directly from the source.

DHS and MICS survey-based data may have sampling errors and bias related to the survey design, sample size, and temporal range, as both report IMRs for five (national) or ten (subnational) year periods.

## VII. Acknowledgments

Funding for the development and dissemination of this data set was provided under the U.S. National Aeronautics and Space Administration (NASA) contract 80GSFC18C0111 for the continued operation of the Socioeconomic Data and Applications Center (SEDAC), which is operated by the Center for International Earth Science Information Network (CIESIN) of Columbia University.

## VIII. Disclaimer

CIESIN follows procedures designed to ensure that data disseminated by CIESIN are of reasonable quality. If, despite these procedures, users encounter apparent errors or misstatements in the data, they should contact SEDAC User Services at ciesin.info@ciesin.columbia.edu. Neither CIESIN nor NASA verifies or guarantees the accuracy, reliability, or completeness of any data provided. CIESIN provides this data without warranty of any kind whatsoever, either expressed or implied. CIESIN shall not be liable for incidental, consequential, or special damages arising out of the use of any data provided by CIESIN.

## IX. Use Constraints



## X. Recommended Citation(s)

### Data set(s):

Center for International Earth Science Information Network (CIESIN), Columbia University. 2021. Global Subnational Infant Mortality Rates, Version 2.01. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/0gdn-6y33. Accessed DAY MONTH YEAR.

### Scientific publication:

Mendeloff, D., S. B. Adamo, M. A. Levy, and A. de Sherbinin. 2019. Global Subnational Distribution of Infant Mortality Rates. Paper presented at the 2019 Annual Meeting of the Population Association of America, Austin, TX.

## XI. Source Code

No source code is available for this data set.

## XII. References

Balk, D., G. D. Deane, M. A. Levy, A. Storeygard, and S. Ahamed. 2006. The Biophysical Determinants of Global Poverty: Insights from an Analysis of Spatially Explicit Data. Paper presented at the *2006 Annual Meeting of the Population Association of America*, Los Angeles, CA, 30 March - 1 April 2006.

Center for International Earth Science Information Network (CIESIN), Columbia University. 2005. Poverty Mapping Project: Global Subnational Infant Mortality Rates. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/H4PZ56R2.

Center for International Earth Science Information Network (CIESIN), Columbia University. 2016a. Gridded Population of the World, Version 4 (GPWv4): Population Count. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/H4X63JVC.

Center for International Earth Science Information Network (CIESIN), Columbia University. 2016b. Gridded Population of the World, Version 4 (GPWv4): Land and Water Area. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/H45M63M9.

Center for International Earth Science Information Network (CIESIN), Columbia University. 2017a. Gridded Population of the World, Version 4 (GPWv4): Basic Demographic Characteristics, Revision 10. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/H45H7D7F.

Center for International Earth Science Information Network (CIESIN), Columbia University. 2017b. Gridded Population of the World, Version 4 (GPWv4): National Identifier Grid, Revision 10. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/H4T72FDB.

Center for International Earth Science Information Network (CIESIN), Columbia University. 2017c. Gridded Population of the World, Version 4 (GPWv4): Population Count Adjusted to Match 2015 Revision of UN WPP Country Totals, Revision 10. Palisades, NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/H4JQ0XZW.

Center for International Earth Science Information Network (CIESIN), Columbia University. 2017d. Documentation for the Gridded Population of the World, Version 4 (GPWv4), Revision 10 Data Sets. Palisades NY: NASA Socioeconomic Data and Applications Center (SEDAC). https://doi.org/10.7927/H4B56GPT.

Dasgupta, P. 1993. *An Inquiry into Well-Being and Destitution*. Clarendon Press, Oxford.

Smith, S., J. Tayman and D. Swanson. 2013. *A Practitioner's Guide to State and Local Population Projections*. New York, Springer. Pp. 280.

Storeygard, A., D. Balk, M. A. Levy, and G. Deane. 2008. The Global Distribution of Infant Mortality: A Subnational Spatial View. *Population, Space and Place* 14:209–229. https://doi.org/10.1002/psp.484.

United Nations Department of Economic and Social Affairs (UN DESA). 2017a. *World Population Prospects 2017 revision*. https://www.un.org/development/desa/publications/world-population-prospects-the-2017-revision.html.

United Nations Department of Economic and Social Affairs (UN DESA). 2017b. *2017 Demographic Yearbook*. https://unstats.un.org/unsd/demographic-social/products/dyb/dyb_2017/.

UN IGME. 2017. *Levels and Trends in Child Mortality Report 2017. Estimates Developed by the United Nations Inter-Agency Group for Child Mortality Estimation*. Accessed 1 August 2018. https://www.unicef.org/publications/files/Child_Mortality_Report_2017.pdf.

U.S. Census Bureau. *International Programs. International Data Base*. Revised: December 22, 2017. Version: Data:17.0810 Code:12.0321.

## XIII. Documentation Copyright and License



## Appendix 1. Data Revision History

The IMR grid Version 2.0 distributed in 2018 did not change. We are including three births and three infant death grids in this Version 2.01, to allow for aggregation to different geographies to calculate infant mortality rates at different scales or resolutions.

## Appendix 2. Contributing Authors & Documentation Revision History

| Revision Date | ORCID | Contributors | Revisions |
|---|---|---|---|
| December 14, 2018 | 0000-0002-8875-4864 | D. Mendeloff, A. de Sherbinin, S. Adamo | This document is the 1st instance of documentation. |
| February 15, 2021 | | D. Mendeloff, S. Adamo, A-L. White | The 2nd instance of documentation includes the addition of the methodology for developing the births and infant deaths grids, as well as description of the data set and data set downloads. |

## Appendix 3. Mali: Data Imputation for the Northern Regions 2012-2013

Mali's regions of Timbuktu, Kidal, Gao and part of Mopti were not included in the 2012-13 DHS due to the ongoing conflict. The steps followed to complete subnational IMRs for Mali are described below:

1) Two additional Malian DHS reports were used: DHS 2006 and DHS 2001. The reason for including the 2001 report is that IMR for Kidal was not reported in 2006 because of the small numbers. The table below lists the IMR by region in the three DHS reports:

*Table 4: Crude calculation of missing IMRs for northern Mali*

| Region | 2001 | 2006 | 2012/2013 | Difference 2001-2006 | % Change 2001-2006 |
|---|---|---|---|---|---|
| Bamako | 44.1 | 66 | 42 | | |
| **Gao** | 141.8 | 68 | **40** | -73.8 | -52.05 |
| Kayes | 124.6 | 105 | 60 | | |
| **Kidal** | 141.8 | 97 | **57** | | -31.59 |
| Koulikoro | 120.8 | 114 | 61 | | |
| **Mopti** | 156.3 | 108 | **62** | | |
| Ségou | 118.6 | 131 | 64 | | |
| Sikasso | 126.4 | 132 | 76 | | |
| **Timbuktu** | 141.8 | 126 | **73** | -15.8 | -11.14 |

2) Mopti: three *cercles* (Douentza, Ténenkou and Youwarou) were not included in the 2012/13 DHS. The decision was to apply the IMR of the rest of the region to these three *cercles*.

3) Timbuktu and Gao: 2012/13 IMR was calculated by applying the percent change in national IMR between the 2006 and 2012/13 (as reported in the country's DHS reports) to the IMR in 2006 (table 5).

*Table 5: Percent change in national IMR, Mali*

| Survey / year | IMR year | IMR value |
|---|---|---|
| DHS 2006 | IMR 2001-2006 | 96 |
| DHS 2012/2013 | IMR 4-years | 56 |
| Difference | | -40 |
| Percent change | | -41.67% |

4) Kidal: The starting point was to calculate the IMR in 2006. In the 2001 DHS, Kidal, Timbuktu and Gao were reported together. Because of this, Kidal 2006 was calculated applying the average % change of Tombouctou and Gao to Kidal's 2001 IMR (see Table 4). The 2012/13 IMR was calculated using the procedure described above for Gao and Timbuktu (table 5).