SDG indicator metadata

(Harmonized metadata template - format version 1.1)

0. Indicator information (SDG_INDICATOR_INFO)

0.a. Goal (SDG_GOAL)

Goal 3: Ensure healthy lives and promote well-being for all at all ages

0.b. Target (SDG_TARGET)

Target 3.9: By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination

0.c. Indicator (SDG_INDICATOR)

Indicator 3.9.1: Mortality rate attributed to household and ambient air pollution

0.d. Series (SDG_SERIES_DESCR)

SH_AAP_ASMORT - Age-standardized mortality rate attributed to ambient air pollution [3.9.1]

SH_HAP_ASMORT - Age-standardized mortality rate attributed to household air pollution [3.9.1]

SH_STA_ASAIRP - Age-standardized mortality rate attributed to household and ambient air pollution [3.9.1]

0.e. Metadata update (META_LAST_UPDATE)

2023-12-15

0.f. Related indicators (SDG_RELATED_INDICATORS)

11.6.2: Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)

7.1.2: Proportion of population with primary reliance on clean fuels and technology

0.g. International organisations(s) responsible for global monitoring (SDG_CUSTODIAN_AGENCIES)

World Health Organization (WHO)

1. Data reporter (CONTACT)

1.a. Organisation (CONTACT_ORGANISATION)

World Health Organization (WHO)

2. Definition, concepts, and classifications (IND_DEF_CON_CLASS)

2.a. Definition and concepts (STAT_CONC_DEF)

Definition:
The mortality rate attributable to the joint effects of household and ambient air pollution can be expressed as: crude death rate or age-standardized death rate. Crude rates are calculated by dividing the brut number of deaths by the total population (or indicated if a different population group is used, e.g. children under 5 years), while the age-standardized rates adjust for differences in the age distribution of the population by applying the observed age-specific mortality rates for each population to a standard population.

Evidence from epidemiological studies have shown that exposure to air pollution is linked, among others, to the important underlying causes of death taken into account in this estimate:

- Acute lower respiratory infections (estimated in all age groups; ICD-10: J09-J22, P23, U04);
- Cerebrovascular diseases (stroke) in adults (estimated above 25 years; ICD-10: I60-I69);
- Ischaemic heart diseases (IHD) in adults (estimated above 25 years; ICD-10: I20-I25);
- Chronic obstructive pulmonary disease (COPD) in adults (estimated above 25 years; ICD-10: J40-J44); and
- Lung cancer in adults (estimated above 25 years; ICD-10: C33-C34).

Concepts:
The mortality resulting from the exposure to ambient (outdoor) air pollution and household (indoor) air pollution from polluting fuels used for cooking and/or heating was assessed. Ambient air pollution results from emissions from industrial activity, households, cars and trucks which are complex mixtures of air pollutants, many of which are harmful to health. Of all these pollutants, fine particulate matter has the greatest effect on human health. By polluting fuels is understood kerosene, wood, coal, animal dung, charcoal, and crop wastes.

2.b. Unit of measure (UNIT_MEASURE)

Deaths per 100,000 population

2.c. Classifications (CLASS_SYSTEM)

Not applicable

3. Data source type and data collection method (SRC_TYPE_COLL_METHOD)

3.a. Data sources (SOURCE_TYPE)

A. Exposure:

- Household air pollution: Indicator 7.1.2 was used as exposure indicator Ambient air pollution: Annual mean concentration of particulate matter of less than 2.5 µm was used as exposure indicator for ambient air pollution. The data is modelled according to methods described for Indicator 11.6.2.

B. Exposure-response function:
The integrated exposure-response functions (IER) developed for the Global Burden of Disease (GBD) project 2010 and 2013 (Burnett et al, 2014 and Forouzanfar et al, 2015) were used. These IERs were updated using the most recent epidemiological evidence identified through a systematic search of studies on particulate matter and mortality, for the five outcomes of interest.
The exposure-response function captures the magnitude of the death risks due to the exposure to air pollution by integrating epidemiological evidence from four sources of PM: ambient air pollution, household air pollution, active smoking, and second-hand smoking; and excluding the possible effects of other risk factors on the outcomes of interest. Due that, it is possible to assess the attributable burden due to household and ambient air pollution using the same IERs.
The IER has recently been included and is available for download in the AirQ+ software tool for health risk assessment of air pollution, version 2.2 (released in March the 14th, 2023).

C. Background health burden: The total number of deaths by country, disease, sex and age group have been developed by the World Health Organization's (WHO 2019b) Global Health Estimates (GHE).

3.b. Data collection method (COLL_METHOD)

A. Exposure:
- Household air pollution: As reported for Indicator 7.1.2
- Ambient air pollution: As reported for Indicator 11.6.2.

B. Exposure-response function:
Modelled by the WHO Air Quality and Health Unit with input from epidemiological studies on particulate matter and mortality, collected through a systematic search.

C. Background health burden: collected from the WHO Global Health Estimates (GHE).

3.c. Data collection calendar (FREQ_COLL)

Not applicable

3.d. Data release calendar (REL_CAL_POLICY)

Not applicable

3.e. Data providers (DATA_SOURCE)

WHO Global Health Estimates
Global Burden of Disease project
WHO as a custodial agency of the SDG 11.6.2
WHO as a custodial agency of the SDG 7.1.2

3.f. Data compilers (COMPILING_ORG)

World Health Organization (WHO)

3.g. Institutional mandate (INST_MANDATE)

Not applicable

4. Other methodological considerations (OTHER_METHOD)

4.a. Rationale (RATIONALE)

As part of a broader project to assess major risk factors to health, the mortality resulting from exposure to ambient (outdoor) air pollution and household (indoor) air pollution from polluting fuel use for cooking was assessed. Ambient air pollution results from emissions from industrial activity, households, cars and trucks which are complex mixtures of air pollutants, many of which are harmful to health. Of all of these pollutants, fine particulate matter has the greatest effect on human health. By polluting fuels is understood as wood, coal, animal dung, charcoal, and crop wastes, as well as kerosene.

Air pollution is the biggest environmental risk to health. The majority of the burden is borne by the populations in low and middle-income countries.

4.b. Comment and limitations (REC_USE_LIM)

An approximation of the combined effects of risk factors (i.e., ambient and household air pollution) is possible if independence and little correlation between risk factors with impacts on the same diseases can be assumed (Ezzati et al, 2003). In the case of air pollution, however, there are some limitations to estimate the joint effects: limited knowledge on the distribution of the population exposed to both household and ambient air pollution, correlation of exposures at individual level as household air pollution is a contributor to ambient air pollution, and non-linear interactions (Lim et al, 2012; Smith et al, 2014). In several regions, however, household air pollution remains mainly a rural issue, while ambient air pollution is predominantly an urban problem. Also, in some continents, many countries are relatively unaffected by household air pollution, while ambient air pollution is a major concern. If assuming independence and little correlation, a rough estimate of the total impact can be calculated, which is less than the sum of the impact of the two risk factors.
On the other hand, as the IER function integrates epidemiological evidence from four sources of PM (i.e., ambient air pollution, household air pollution, active smoking and second-hand smoking), some assumptions are assumed. Specifically, the relative risk at any concentration is independent of the source of PM2.5, and only dependent on the magnitude of the total exposure from all sources together (Burnett et al, 2020).

4.c. Method of computation (DATA_COMP)

Attributable mortality is calculated by first combining information on the increased (or relative) risk of a disease resulting from exposure, with information on how widespread the exposure is in the population (e.g. the annual mean concentration of particulate matter to which the population is exposed, proportion of population relying primarily on polluting fuels for cooking).

This allows calculation of the 'population attributable fraction' (PAF), which is the fraction of disease seen in a given population that can be attributed to the exposure (e.g in that case of both the annual mean concentration of particulate matter and exposure to polluting fuels for cooking).

Applying this fraction to the total burden of disease (e.g. cardiopulmonary disease expressed as deaths), gives the total number of deaths that results from exposure to that particular risk factor (in the example given above, to ambient and household air pollution).

To estimate the combined effects of risk factors, a joint population attributable fraction is calculated, as described in Ezzati et al (2003).

The mortality associated with household and ambient air pollution was estimated based on the calculation of the joint population attributable fractions assuming independently distributed exposures and independent hazards as described in (Ezzati et al, 2003).

The joint population attributable fraction (PAF) were calculated using the following formula:

$$PAF = 1 - PRODUCT\ (1 - PAFi)$$

Where PAFi is PAF of individual risk factors.

The PAF for ambient air pollution and the PAF for household air pollution were assessed separately, based on the Comparative Risk Assessment (Ezzati et al, 2002) and expert groups for the Global Burden of Disease (GBD) 2010 study (Lim et al, 2012; Smith et al, 2014).

For exposure to ambient air pollution, annual mean estimates of particulate matter of a diameter of less than 2.5 um (PM25) were modelled as described in (Shaddick et al, 2018; Shaddick et al, 2021)), or for Indicator 11.6.2.

For exposure to household air pollution, the proportion of population with primary reliance on polluting fuels use for cooking was modelled (see Indicator 7.1.2 [polluting fuels use=1-clean fuels use]). Details on the model are published in (Bonjour et al, 2013).

The integrated exposure-response functions (IER) developed for the GBD 2010 and 2013 (Burnett et al, 2014 and Forouzanfar et al, 2015) were used. These IERs were updated using the most recent epidemiological evidence identified through a systematic search of studies on particulate matter and mortality for the five outcomes of interest.

The percentage of the population exposed to a specific risk factor (here ambient air pollution, i.e. PM2.5) was provided by country and by increment of 1 µg/m3; relative risks were calculated for each PM2.5 increment, based on the IER. The counterfactual concentration was selected to be between 2.4 and 5.9 µg/m^3, as described elsewhere (Cohen et al, 2017). The country population attributable fraction for ALRI, COPD, IHD, stroke and lung cancer were calculated using the following formula:

$$PAF = SUM(Pi(RR - 1)/(SUM(RR - 1) + 1)$$

Where i is the level of PM2.5 in ug/m^3, and Pi is the percentage of the population exposed to that level of air pollution, and RR is the relative risk.

The calculations for household air pollution are similar and are explained in detail elsewhere (WHO 2014a).

4.d. Validation (DATA_VALIDATION)

Not applicable

4.e. Adjustments (ADJUSTMENT)

Not applicable

4.f. Treatment of missing values (i) at country level and (ii) at regional level (IMPUTATION)

- **At country level**
  Countries with no data are reported as blank.

- **At regional and global levels**
  Countries with no data are not considered to estimate the regional and global averages.

4.g. Regional aggregations (REG_AGG)

Number of deaths by country are summed and divided by the population of countries included in the region (regional aggregates) or by the total population (global aggregates).

4.h. Methods and guidance available to countries for the compilation of the data at the national level (DOC_METHOD)

Not applicable

4.i. Quality management (QUALITY_MGMNT)

Not applicable

4.j Quality assurance (QUALITY_ASSURE)

Not applicable

4.k Quality assessment (QUALITY_ASSMNT)

Not applicable

5. Data availability and disaggregation (COVERAGE)

Data availability:
Data is available by country, sex, disease and age.

Disaggregation:
The data is available by country, by sex, by disease, and by age.

6. Comparability / deviation from international standards (COMPARABILITY)

Sources of discrepancies:
Underlying differences between country produced and internationally estimated data may due to :
- Different exposure data (annual mean concentration of particulate matter of less than 2.5 µm of diameter, proportion of population using clean fuels and technology for cooking)
- Different exposure-risk estimates
- Different underlying mortality data

7. References and Documentation (OTHER_DOC)

URL:

https://www.who.int/data/gho/data/themes/air-pollution
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