EXPOSURE TO HOUSEHOLD AIR POLLUTION

Indicator Phrasing

English: number or % of people exposed in their homes to [specify the pollutant] level above [specify: national / WHO] guidelines

French: nombre ou % de personnes exposées dans leur foyer à un niveau de [précisez le polluant] supérieur aux directives [précisez : nationales / de l'OMS]

Portuguese: número ou % de pessoas expostas em suas casas a [especificar o poluente] a um nível acima das diretrizes [especificar: nacionais / OMS]

Czech: počet nebo % lidí vystavených ve svých domovech vyšším hodnotám [upřesněte znečišťující látku], než doporučují [upřesněte: národní / WHO] standardy

What is its purpose?

The indicator measures the proportion (or number) of people exposed to above-threshold levels of dangerous air pollutants (such as PM2.5 and CO) in their homes. In the context of lower-income countries, these are mostly caused by burning of solid or organic fuel for cooking and heating. In such contexts, household air pollution is among the main causes of poor health and mortality.

How to Collect and Analyse the Required Data

Determine the indicator's value by using the following methodology:

1) **Specify the pollutant, including its threshold**

Define the exact pollutant that you intend to measure and the relevant threshold. The **thresholds** for the main indoor air pollutants are usually set by the national authorities; alternatively, you can use WHO recommendations (see below). The thresholds are usually expressed as 24-hour averages, e.g. 25 µg/m3 of PM2.5 per 24-hour average.

2) **Decide on the monitoring technology**

The choice of sensors depends on which pollutant you want to measure and which sensors you are able to use (considering their availability, price, ease-of-use). See an overview of sensors in this article, though also check more recent products, as the market for low-cost air quality monitors is evolving rapidly. If your team has limited experience with using sensors, contract a relevant specialist, such as an expert from a company / state authority or a freelance consultant, to support you with the data collection and analysis process (alternatively, you can sub-contract the entire data collection and analysis process).

3) **Define the installation and data collection process**

In collaboration with a competent specialist, define the installation and data collection process, including:

- how many sensors will be used

- who will calibrate them (this must be done by a specialized company)

- where will they be placed (for example, when monitoring household levels of PM2.5, one sensor is usually placed in the kitchen, and the second is hung on the neck of the main cook. Ensure that you follow recognized best practices, as an incorrect position of the sensors (e.g. too close / too far from a cook stove) is likely to provide biased data

- how long will they be deployed (e.g. for 24 or 48 hours)

- which quality assurance measures need to be followed and by whom

This step is very important and needs to be done in collaboration with an experienced specialist, following guidelines provided by the sensor company.

4) **Determine the sampling and sample size**

First, determine the required number of households participating in the measurements. Considering the time and financial requirements of measuring household air pollution, you might want to use a representative sample with a higher margin of error (e.g. 7.5 instead of 5 percentage points), so that you can use a smaller sample size, making the data collection workload more manageable.

Next, to select participating households, use three-stage cluster sampling, ensuring randomization at the following levels:

- first, randomly select a relevant number of districts (or any similar administrative units)

- then, randomly select a relevant number of villages within these districts

- as the last step, randomly select the participating households

5) Make sure that the selected **households understand and fully agree with the monitoring process** and that the selected household member (usually women) **will be present at home** for the duration of the measurement (e.g. 48 hours). If not, proceed to the next randomly selected household.

6) **Collect the required data** using the monitoring process defined under point 3.

7) To **calculate the indicator's value**:

- count the number of participating households with household air pollution exceeding relevant thresholds

- divide the result by the total number of participating households

- multiply the result by 100 to convert it to a percentage

Disaggregate by

Disaggregate the data by gender, the type and location of cooking / heating devices used by the households.

Important Comments

1) Before starting, **assess the most common sources of air pollution** in the areas where you plan to conduct measurements. For example, the occasional burning of waste or seasonal burning can greatly affect your results. In some countries, people sometimes also purposely create a lot of smoke to ward off insects from the animal stables, which skews the results.

2) Ensure that the participating staff **provides clear instructions** to each person carrying the sensor, such as what to do when taking a shower, when sleeping etc. Also, keep in mind that you are making someone intimately aware of a risk s/he faces. Give those **ethical implications** some careful consideration. Consider awarding those respondents with a discount (e.g. voucher) for a technology that improves their air quality (however, do not inform them about any incentives before the test is fully completed, as this might influence the way in which they behave during the test).

3) Measuring household air pollution **requires technical expertise, specialized equipment and time**. Therefore, only use this indicator if you are able to ensure all these pre-conditions. If you need to purchase new equipment, you will need thousands of EUR (at least), even if you go for low-cost options (see overviews attached below) and use a smaller sample of participants. Therefore, ensure that the data collection is properly budgeted and, if required, contract relevant specialists to help you with the entire process (including the possibility of using their equipment).

4) In many countries, **the levels of household air pollution are prone to seasonal variations** – for example, the monthly average PM2.5 concentration being lower in the rainy season and higher in dry season. Therefore, ensure that the baseline and endline measurements take place in the same (or comparable) part of a year.

5) Most studies monitoring household air pollution in the kitchens (i.e. place where the pollution is likely to be the highest) tend to **place the sensor**:

- on the wall (or a stand) approximately 100 cm from the centre of the combustion zone of the cooking stove (measured as the shortest, horizontal line - parallel to the floor)

- approx. 150 cm above the floor, reflecting the approximate breathing zone of a standing woman

- at least 150 cm away (horizontally) from doors and windows, where possible (source: 1, 2, 3)

6) **Pollutants which are most commonly measured in household areas** include, amongst others:

- **PM2.5**: Particulate matter (PM) is a complex mixture of extremely small particles and liquid droplets, including soil or dust particles, metals, acids and organic chemicals. They are emitted from cooking, fires, cars, industries, etc. PM2.5 has a size of 2.5 µm or smaller and can be easily inhaled, lodging deep in the lungs and causing serious health effects.

- **CO**: Carbon monoxide is a colourless, odourless, tasteless and highly toxic gas produced from incomplete oxidation of carbon in combustion (when burning kerosene, charcoal, wood, coal, natural gas and other fuels). Exposure to high levels of CO can lead to poisoning and death.

Access Additional Guidance

- WHO (2014) WHO guidelines for indoor air quality - household fuel combustion

- WHO (2010) WHO guidelines for indoor air quality - selected pollutants

- WHO (2005) WHO Air quality guidelines for PM, ozone, nitrogen dioxide and sulfur dioxide

- Gold Standard (2017) Methodology to Estimate and Verify Averted Mortality and Disability

- EC (0) Measuring air pollution with low-cost sensors

- EC (2019) Review of sensors for air quality