

**ATTRIBUTABLE CHANGE IN NUMBER OF HOUSEHOLDS
RELYING ON BIOMASS FUELS OR COAL AS THE MAIN SOURCE
OF HEATING AND COOKING**

GENERAL CONSIDERATIONS

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| <i>Issues</i> | Respiratory diseases |
| <i>Type of indicator</i> | Action |
| <i>Rationale</i> | <p>Children spend a large proportion of their time indoors, either at home or at school. Levels of air pollution in the indoor environment are therefore important determinants of exposure to air pollutants, and thus of children's health. Short periods of high level exposures are known to be implicated in acute respiratory responses (e.g. reduced lung function, wheezing, asthma attacks). Sensitization to air pollution at an early age may also increase long-term susceptibility to air pollution and contribute to risks of chronic health effects in later life.</p> <p>Much of the pollution found indoors derives from outdoor sources; indoor concentrations thus depend in part on outdoor concentrations, and much of this derives from indoor combustion sources. Combustion of biomass fuels in unvented (or poorly vented) stoves and fires for cooking and heating often represents the most important indoor source (together with smoking). Pollutants emitted include particles, carbon monoxide, sulphur dioxide, nitrogen dioxide and volatile organic compounds (of which a number are known or suspected carcinogens). In poorly vented environments, particles and carbon monoxide are often found at especially high levels and pose particular health threats. Potential health effects include acute respiratory infection, chronic pulmonary disease, cancer, tuberculosis, reduced birthweight and eye-damage.</p> <p>Actions to reduce exposures from indoor combustion sources may take many forms. Depending on circumstances, they might include local initiatives to set up woodland schemes (in order to substitute firewood for dung), help to make available improved stoves and heating appliances, changes in taxation policies on domestic fuels or installation of electricity or gas supplies. If successful, these schemes should result in the reduction of the number of households reliant on highly polluting combustion sources, and thus in the number of children exposed.</p> |
| <i>Issues in indicator design</i> | <p>As with other measures of action, this indicator should ideally be focused on monitoring the degree of success of the actions, rather than simply the action itself. For this reason, the preferred indicator is not one that reports on the existence or extent of policies to reduce exposures to indoor air pollution, but instead measures changes in exposures as a result of these policies. If the relevant information were available, this could be based on monitoring of air pollution in the indoor environment. Such data are, however, generally lacking. In practice, they may also be difficult to interpret because of the many other factors that contribute to indoor air pollution. In most cases, therefore, the effectiveness of actions targeted at indoor combustion sources are best computed in terms of changes in the character of those sources. The specific sources involved may vary, depending on the scope and purpose of the action (e.g. whether it is aimed at all biomass sources, or only at dung or wood). In general terms, however, the indicator can be designed to measure changes in the number or percentage of children exposed to the combustion sources of interest. The indicator may be developed either to monitor changes in the extent of exposure over time, as a result of the introduction of the policies, or to compare areas in which action has been taken with those in which it has not. In both these cases, however,</p> |

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| | interpretation can be difficult, because changes may be confounded by other events or other differences between the study areas. Ideally, therefore, the indicator should be measured by comparing rates of change in an 'intervention area' (before and after the intervention) with those in a matched 'control area' (a similar areas in which the intervention has not been carried out). |
| SPECIFICATION | |
| <i>Definition</i> | Attributable change in the percentage (or number) of children aged 0-4 years living in households using coal, wood or dung as the main source of heating and cooking fuel. |
| <i>Terms and concepts</i> | <p>Household: a single dwelling unit (e.g. a house or apartment) intended for permanent residence.</p> <p>Use of coal, wood or dung as the main source of cooking or heating: the reliance on coal (or lignite), wood or dung as the primary cooking or heating fuel in the home.</p> <p>Attributable change: the percentage (or number) of fewer or additional children potentially exposed (i.e. living in households using coal, wood or dung as the main source of heating and cooking fuel) as a direct or indirect consequence of the intervention.</p> |
| <i>Data needs</i> | Number of children aged 0-4 years by type of fuel usage in the home before and after policy intervention in both the intervention area and a matched control area. |
| <i>Data sources, availability and quality</i> | <p>Data on number of households using coal, wood or dung as the main source of cooking and heating fuel may be available from census statistics or household surveys, and in these cases are liable to be broadly reliable. In many cases, however, data will need to be collected via household surveys. Surveys should ideally be held immediately before and some time after the intervention, in order to ensure that any long term effects and adjustments are taken into account. Where different areas are to be compared, it is important to find matched areas that were as similar as possible before intervention, and to ensure that – apart from the intervention itself – they otherwise remain similar thereafter.</p> <p>Data on the total number of children by age and household should be available through national census statistics, though care is needed in relation to the definition of a 'household' (e.g. how collective dwellings are classified). Alternatively, they can be obtained for a sample of households as part of the household survey.</p> |
| <i>Level of spatial aggregation</i> | Community or administrative district |
| <i>Averaging period</i> | Annual or longer term |
| <i>Computation</i> | <p>The indicator can be computed as the percentage difference in the rates of change between the intervention and control areas, as follows:</p> $100 * \{[(C_{bio}/C_{tot})_t - (C_{bio}/C_{tot})_b]_i / n_i\} - \{[(C_{bio}/C_{tot})_t - (C_{bio}/C_{tot})_b]_c\} / n_c$ <p>where: C_{bio} is the number of children living in households using coal, wood or dung as the main source of cooking/heating fuel;</p> <p>C_{tot} is the total number of children aged 0-4 years</p> <p>t = current year and b = baseline (pre-intervention) year</p> <p>i = intervention area; c = control area</p> <p>n = number of years between current and baseline surveys</p> |

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| <i>Units of measurement</i> | Percentage change |
| <i>Worked example</i> | <p>Assume that, for the intervention area, the baseline (pre-intervention) survey shows that 380 children from a sample of 1400 live in homes relying on coal, wood or dung as the main fuel source for cooking and heating, whilst the current (post-intervention) survey, five years later shows that 270 from a sample of 1300 children now live in homes relying on coal, wood or dung as the main fuel source for cooking and heating. Assume, also, that for the matched control area, the pre-intervention survey showed that 450 children from a sample of 1600 lived in homes relying on coal, wood or dung as the main fuel source for cooking and heating, while the post-intervention survey, seven years later) showed that 420 from a sample of 1620 children live in homes relying on coal, wood or dung as the main fuel source for cooking and heating. The value of the indicator is thus:</p> $100 * \left[\left(\frac{270}{1300} - \frac{380}{1400} \right) / 5 \right] - \left[\left(\frac{420}{1620} - \frac{450}{1600} \right) / 7 \right]$ $= 100 * \left[(0.207 - 0.271) / 5 \right] - \left[(0.259 - 0.281) / 7 \right]$ $= 100 * (-0.012 - -0.003) = -0.9 \text{ (i.e. a 0.9\% per year reduction in potential exposure attributable to the intervention)}$ |
| <i>Interpretation</i> | <p>This indicator provides a general measure of changes in potential exposure to air pollutants from indoor heating and cooking sources as a result of policy or other actions. A positive value indicates that the proportion of children potentially exposed has increased; a negative value indicates a reduction in potential exposure (and thus a reduced risk of respiratory illness).</p> <p>The extent to which these changes can be truly attributable to the intervention does, of course, need to be interpreted with caution. Many other events may contribute to the measured change, and if these are acting differentially between the intervention and control area they can seriously bias the indicator. Careful selection of the control area is essential to minimize this risk.</p> |
| <i>Variations and alternatives</i> | <p>As described above, this indicator requires before and after surveys in both the intervention area and a matched control area. For various reasons this may not be possible: because of cost, because the intervention is taking place everywhere (thereby leaving no suitable control areas), or because suitable baseline surveys were not undertaken before the intervention started. In these cases, a weaker version of the indicator can sometimes be computed, for example simply by comparing the proportions of children living in homes relying on coal, wood or dung as the main fuel source for cooking and heating before and after intervention in the one area; or by comparing these proportions between intervention and control areas only at one moment in time, after intervention. Inevitably, however, the indicator is more difficult to interpret in these situations, because it becomes impossible to adjust for confounding by other factors, and thus to assess the amount of change actually attributable to the intervention.</p> <p>Many other variations on this indicator are possible, to reflect local circumstances. Different fuel sources or different heating and cooking facilities might be selected, for example, as a basis for the indicator (e.g. 'open fires or unvented gas cookers and heaters' may be more appropriate in more developed areas of the world).</p> <p>Similar indicators can also be designed to include other sources of indoor air pollution, such as asbestos-containing materials, radon-bearing rocks or cements, or homes in which adults smoke.</p> |
| <i>Examples</i> | None known |
| <i>Useful references</i> | Albalak, R., Frisancho, A.R. and Keeler, G.J. 1999 Domestic biomass fuel combustion and chronic bronchitis in two rural Bolivian villages. <i>Thorax</i> 54, |

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