Critical Issues in Combining Disparate Sources of Information to Estimate the Global Burden of Disease Attributable to Ambient Fine Particulate Matter Exposure

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The Global Burden of Disease Study 2010

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Summary

Background Quantification of the disease burden caused by different risk factors informs prevention by providing an account of health loss different from that provided by a disease-by-disease analysis. Complete revision of global disease burden caused by risk factors has been done since a comparative risk assessment in 2000, and no previous analysis has assessed changes in burden attributable to risk factors over time.

Methods We estimated deaths and disability-adjusted life years (DALYs) per year from 1990 to 2010 for 21 regions, and relative risks per unit of exposure by systematically reviewing and synthesising published and unpublished data. We used these estimates, together with estimates of cause-specific deaths and DALYs from the Global Burden of Disease Study 2010, to calculate the burden attributable to each risk factor considered in the model for 2010, and to compare the estimated minimum-risk exposure. We incorporated uncertainty in disease burden, relative risks, and exposures into our estimates of attributable burden.

Findings In 2010, the three leading risk factors for global disease burden were high blood pressure (7.0% [55% uncertainty interval 6.2–7.7] of global DALYs), tobacco smoking including second-hand smoke (6.0% [5–7.7]), and alcohol use (5.3% [5.0–5.9]). In 1990, the leading risks were childhood underweight (7.9% [6.9–8.9]), household air pollution from solid fuels (HAP; 7.9% [5.8–8.3]), and tobacco smoking including second-hand smoke (6.5% [5.4–7.4]). Dietary risk factors and physical inactivity collectively accounted for 39.9% (95% UI 39.1–40.6) of global DALYs in 2010, with the most prominent dietary risks being diets low in fruits and vegetables. Seven risks that primarily affect children communicable diseases, including unimproved water and sanitation and childhood micronutrient deficiencies, fell in rank between 1990 and 2010, with unimproved water
2005 population-weighted regional estimated average PM$_{2.5}$

Distributions of selected regional 2005 estimated PM$_{2.5}$ by urban and rural areas
Needed: a risk model for PM$_{2.5}$ exposure over the entire global range
Comparison of Ambient Air Pollution Linear (red) and IER (blue) Risk Models for IHD Mortality

Relative Risk vs. PM2.5 (ug/m3)

- Old Standard
- New Standard
Top 15 Global Risk Factors in 2010

Percent of Global DALYs, 2010

- Dietary risks
- High blood pressure
- Smoking
- Household air pollution
- Alcohol use
- High body-mass index
- High fasting plasma glucose
- Childhood underweight
- Ambient PM pollution
- Physical inactivity
- Occupational risks
- Iron deficiency
- Suboptimal breastfeeding
- High total cholesterol
- Drug use

% DALYs attributable to risk factors

- War & disaster
- Intentional injuries
- Unintentional injuries
- Transport injuries
- Other non-communicable
- Musculoskeletal disorders
- Diabetes/urogen/blood/endo
- Mental & behavioral disorders
- Neurological disorders
- Digestive diseases
- Cirrhosis
- Chronic respiratory diseases
- Cardio & circulatory diseases
- Cancer
- Other communicable
- Nutritional deficiencies
- Neonatal disorders
- Maternal disorders
- NTD & malaria
- Diarrhea/LRI/other infectious
- HIV/AIDS & tuberculosis
Themes

• Criteria:
  – GBD considers an appropriate treatment of “imperfect” data better is than no data

• Problem Characteristics
  – No data on risk at high ambient concentrations
  – Needed to incorporate ‘indirect’ information from disparate combustion sources

• Strengths
  – Something is better than nothing
  – Estimate risk for sources with no direct information (HAPs and CV mortality)

• Limitations
  – Many (as yet) untested assumptions

• Research Needs
  – Conduct cohort studies in highly polluted environments (Asia)