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Supplemental Material

Estimates of the Global Burden of Ambient PM_{2.5}, Ozone, and NO₂ on Asthma Incidence and Emergency Room Visits

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Table S1. Description of meta-analyses identified during literature review.

Figure S1. Regional average fraction of asthmatics visiting emergency room in last year, according to combinations of World Health Organization regions and World Bank income categorizations. Estimates were calculated from country-specific survey data shown in Table 1. Low = low income; LM = low-middle income; UM = upper middle income; High = high income.

Figure S2. Demographic inputs to the health impact function. (a) Gridded population (all ages) in 2015; (b) Country-specific asthma prevalence rate (per 100,000 people) in 2015; (c) Frequency and cumulative distribution of locations (of 54 countries and Hong Kong) with fraction of asthmatics visiting emergency room in last year; (d) as for (c) but mapped, with countries lacking survey data assigned regional average rates.

Figure S3. Ozone and NO₂ concentrations from different sources. (a) Standard deviation of annual average of 8-hour daily maximum ozone concentrations (ppb) in 2010 among the five HTAP chemical transport models. (b) Ratio of annual average 24-hr average NO₂ concentrations to annual average of 1-2pm NO₂ concentrations in 2010 simulated with the GMI-Replay model at 2°x2.5° resolution. (c) Difference between annual average NO₂ concentration (ppb) in 2015 derived from two different satellite column NO₂ products (OMI/Aura – DOMINO).

Figure S4. Sensitivity of estimated pollution-attributable asthma ERVs to different RR estimates, for all ages and children. Confidence intervals (95%) reflect error in the RR estimate only.

Figure S5. Number of asthma emergency room visits and new asthma cases in each region in 2015 among all ages (left) and children ages 0-17 years (right).

Figure S6. Percent of global and regional asthma ERVs for all ages in 2015 that are attributable to anthropogenic ozone (top) and PM_{2.5} (bottom), using RR central estimates from three epidemiological meta-analyses.

Figure S7. Country-specific asthma ERVs per 100,000 people in 2015 attributable to PM_{2.5}- and ozone. Panels (a-c) show results using total concentrations and RR estimates from Orellano et al. (2017), Zhang et al. (2016), and Zheng et al. (2015), respectively. Panels (d-f) show results using anthropogenic concentrations and the same RR estimates. Circle size indicates country population size. Dotted line indicates 1:1 line.

Figure S8. Percent of global and regional asthma incidence among children in 2015 that are attributable to anthropogenic PM_{2.5} (top) and NO₂ (bottom), using RR central estimates from three epidemiological meta-analyses. Regions are defined by World Health Organization regions.

Figure S9. Asthma incidence among children aged 0-17 years attributable to PM_{2.5}, using central RR estimates from Anderson et al. (2013) (a) Total concentrations, number of cases; (b) total concentrations, fraction of national asthma incidence; (c) anthropogenic concentrations, number of cases; (d) anthropogenic concentrations, fraction of national asthma incidence.