## Online supplements

Contents list:

Table S1. Patient information of all STEMI (N=189,410) and non-STEMI (N=262,933) events in MINAP 2003-2009.

| Patient characteristic | Response | STEMI events | | Non-STEMI events | |
|---|---|---|---|---|---|
| | | No. | %[a] | No. | %[a] |
| Sex | Male | 131226 | 69.3 | 161691 | 61.5 |
| | Female | 57360 | 30.3 | 100626 | 38.3 |
| Age | < 70 years | 107878 | 57.0 | 97091 | 36.9 |
| | 70+ years | 78753 | 41.6 | 158750 | 60.4 |
| Patient status | Alive | 137596 | 72.6 | 161041 | 61.2 |
| | Dead | 45475 | 24.0 | 95590 | 36.4 |
| Smoking status | Non-smoker | 35772 | 18.9 | 59837 | 22.8 |
| | Ex/current smoker | 111346 | 58.8 | 141352 | 53.8 |
| Previous MI | No | 137072 | 72.4 | 160689 | 61.1 |
| | Yes | 27228 | 14.4 | 79198 | 30.1 |
| Previous angina | No | 130643 | 69.0 | 142527 | 54.2 |
| | Yes | 30847 | 16.3 | 94426 | 35.9 |
| Previous lipids | No | 109993 | 58.1 | 151828 | 57.7 |
| | Yes | 45025 | 23.8 | 77651 | 29.5 |
| Previous hypertension | No | 93595 | 49.4 | 113495 | 43.2 |
| | Yes | 68981 | 36.4 | 124711 | 47.4 |
| Presence of peripheral vascular disease | No | 150031 | 79.2 | 212690 | 80.9 |
| | Yes | 5279 | 2.8 | 14018 | 5.3 |
| History of cerebrovascular disease | No | 147111 | 77.7 | 204865 | 77.9 |
| | Yes | 9439 | 5.0 | 24851 | 9.5 |
| Asthma or COPD | No | 135437 | 71.5 | 186348 | 70.9 |
| | Yes | 18878 | 10.0 | 39145 | 14.9 |
| Chronic renal failure | No | 153642 | 81.1 | 215106 | 81.8 |
| | Yes | 3694 | 2.0 | 15035 | 5.7 |
| Congestive cardiac failure | No | 153011 | 80.8 | 208825 | 79.4 |
| | Yes | 4310 | 2.3 | 21516 | 8.2 |
| Previous percutaneous coronary intervention | No | 148977 | 78.7 | 211058 | 80.3 |
| | Yes | 8985 | 4.7 | 20278 | 7.7 |
| Previous coronary artery bypass grafting | No | 154157 | 81.4 | 214754 | 81.7 |
| | Yes | 4339 | 2.3 | 17916 | 6.8 |
| Diabetes | No | 141976 | 75.0 | 185115 | 70.4 |
| | Yes | 22599 | 11.9 | 54620 | 20.8 |
| Angiotensin converting enzyme inhibitor in regular use before admission | No | 75638 | 39.9 | 92972 | 35.4 |
| | Yes | 31805 | 16.8 | 69993 | 26.6 |
| Betablocker in regular use before admission | No | 79949 | 42.2 | 105791 | 40.2 |
| | Yes | 27570 | 14.6 | 57256 | 21.8 |
| Statin in regular use before admission | No | 72129 | 38.1 | 81568 | 31.0 |
| | Yes | 37477 | 19.8 | 84271 | 32.1 |
| Clopidogrel in regular use before admission | No | 73856 | 39.0 | 103232 | 39.3 |
| | Yes | 15556 | 8.2 | 29331 | 11.2 |
| Aspirin/anti-platelet in regular use before admission | No or started now | 144525 | 76.3 | 159265 | 60.6 |
| | Yes | 28694 | 15.1 | 80907 | 30.8 |

COPD, chronic obstructive pulmonary disease; MINAP, myocardial ischaemia national audit project; STEMI, ST-elevation myocardial infarction.
[a] % of all events, which does not add to 100 where missing responses were present

Table S2. Percentage change (Δ%) in risk of CVD emergency hospital admissions for a 10th-90th percentile range change in pollutant (in 2003-2008) at lags 0-4days. Models included the presented pollutant effects, matched with lunar month and adjusted for day of week [a] and temperature (lag0-1, 2-7, 8-14). Stratified by sex and age group. Data source: HES database 2003-2008.

| Outcome | Pollutant | All | | | By sex | | | | | By age group | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Male | | Female | | *P* | <70 years old | | 70+ years old | | *P* |
| | | N. of events | Δ% | (95%CI) | Δ% | (95%CI) | Δ% | (95%CI) | | Δ% | (95%CI) | Δ% | (95%CI) | |
| CVD | CO | 2,315,102 | -0.6 | (-1.3, 0.0) | -0.7 | (-1.5, 0.1) | 0.6 | (-0.3, 1.5) | 0.19 | -1.5 | (-2.4, -0.5) | 0.0 | (-0.8, 0.8) | 0.02 |
| | $NO_2$ | 2,634,065 | 1.7 | (0.9, 2.6) | 1.7 | (0.6, 2.9) | 1.7 | (0.5, 2.9) | 0.03 | 0.2 | (-1.0, 1.4) | 2.9 | (1.8, 4.0) | <0.01 |
| | $O_3$ | 2,663,067 | -1.4 | (-2.1, -0.6) | -1.9 | (-2.8, -0.9) | -0.8 | (-1.9, 0.2) | 0.28 | -1.5 | (-2.5, -0.4) | -1.3 | (-2.2, -0.4) | <0.01 |
| | $PM_{10}$ | 2,422,697 | -1.4 | (-1.9, -0.9) | -1.5 | (-2.2, -0.8) | -1.3 | (-2.1, -0.6) | 0.70 | -1.9 | (-2.7, -1.1) | -1.1 | (-1.8, -0.4) | 0.17 |
| | $PM_{2.5}$ | 706,957 | -1.7 | (-2.7, -0.8) | -2.0 | (-3.2, -0.7) | -1.5 | (-2.8, -0.1) | 0.05 | 2.2 | (-3.5, -0.8) | -1.4 | (-2.7, -0.2) | 0.64 |
| | $SO_2$ | 2,499,129 | -0.3 | (-1.0, 0.3) | -0.6 | (-1.4, 0.3) | 0.0 | (-0.9, 0.9) | 0.50 | 1.2 | (-2.2, -0.3) | 0.4 | (-0.5, 1.2) | 0.03 |
| Non-MI | CO | 1,978,859 | -0.5 | (-1.2, 0.2) | -0.9 | (-1.8, 0.0) | 0.0 | (-1.0, 0.9) | 0.13 | -1.5 | (-2.5, -0.5) | 0.2 | (-0.7, 1.1) | 0.03 |
| | $NO_2$ | 2,253,105 | 2.0 | (1.1, 2.9) | 1.6 | (0.4, 2.8) | 2.5 | (1.2, 3.8) | 0.02 | 0.5 | (-0.8, 1.9) | 3.2 | (2.0, 4.3) | 0.02 |
| | $O_3$ | 2,277,016 | -1.5 | (-2.3, -0.7) | -1.6 | (-2.7, -0.5) | -1.4 | (-2.5, -0.3) | 0.49 | -1.5 | (-2.6, -0.3) | -1.5 | (-2.5, -0.5) | <0.01 |
| | $PM_{10}$ | 2,072,273 | -1.4 | (-2.0, -0.8) | -1.6 | (-2.4, -0.8) | -1.2 | (-2.0, -0.4) | 0.71 | -1.9 | (-2.7, -1.0) | -1.1 | (-1.8, -0.3) | 0.35 |
| | $PM_{2.5}$ | 614,630 | -1.7 | (-2.8, -0.7) | -2.2 | (-3.5, -0.8) | -1.2 | (-2.6, 0.2) | 0.10 | -2.1 | (-3.6, -0.6) | -1.4 | (-2.7, -0.1) | 0.65 |
| | $SO_2$ | 2,137,313 | -0.4 | (-1.1, 0.3) | -0.8 | (-1.7, 0.2) | 0.1 | (-0.9, 1.1) | 0.22 | -1.3 | (-2.3, -0.2) | 0.3 | (-0.6, 1.2) | 0.06 |
| Stroke | CO | 368,081 | -1.4 | (-2.9, 0.2) | -0.1 | (-2.2, 2.1) | -2.5 | (-4.5, -0.5) | 0.20 | -4.8 | (-7.4, -2.3) | 0.2 | (-1.6, 2.0) | 0.01 |
| | $NO_2$ | 421,340 | 0.2 | (-1.8, 2.3) | 0.9 | (-1.9, 3.7) | -0.4 | (-3.0, 2.4) | 0.16 | -3.1 | (-6.4, 0.3) | 1.8 | (-0.6, 4.2) | <0.01 |
| | $O_3$ | 426,940 | 0.8 | (-1.0, 2.7) | 2.0 | (-0.5, 4.5) | -0.2 | (-2.5, 2.2) | 0.25 | -1.5 | (-4.4, 1.6) | 1.8 | (-0.3, 4.0) | 0.10 |
| | $PM_{10}$ | 385,412 | -1.5 | (-2.8, -0.2) | -1.0 | (-2.8, 0.9) | -2.0 | (-3.7, -0.2) | 0.79 | -2.8 | (-5.0, -0.6) | -0.9 | (-2.5, 0.6) | 0.10 |
| | $PM_{2.5}$ | 114,924 | -3.1 | (-5.4, -0.7) | -2.7 | (-5.8, 0.5) | -3.4 | (-6.4, -0.3) | 0.26 | -4.4 | (-8.1, -0.5) | -2.5 | (-5.1, 0.2) | 0.71 |
| | $SO_2$ | 397,873 | -0.8 | ( -2.3, 0.8) | -0.6 | (-2.8, 1.7) | -1.0 | (-3.1, 1.2) | 0.96 | -2.2 | (-4.9, 0.5) | -0.1 | ( -2, 1.8) | 0.13 |
| IHD [b] | CO | 786,938 | -1.0 | (-2.0, 0.1) | -0.3 | (-1.6, 1.0) | -2.0 | (-3.6, -0.4) | 0.37 | -1.4 | (-2.8, 0.1) | -0.6 | (-2.0, 0.8) | 0.01 |
| | $NO_2$ | 887,432 | 0.8 | (-0.6, 2.2) | 1.5 | (-0.2, 3.3) | -0.4 | (-2.5, 1.8) | 0.20 | -1.3 | (-3.1, 0.7) | 2.7 | (0.8, 4.7) | 0.09 |
| | $O_3$ | 898,275 | -1.8 | (-3.1, -0.6) | -2.7 | (-4.2, -1.1) | -0.6 | (-2.4, 1.3) | 0.12 | -0.9 | (-2.6, 0.8) | -2.6 | (-4.2, -1.0) | 0.04 |
| | $PM_{10}$ | 820,198 | -1.7 | (-2.6, -0.8) | -1.2 | (-2.3, 0.0) | -2.5 | (-3.8, -1.1) | 0.65 | -2.4 | (-3.6, -1.1) | -1.1 | (-2.3, 0.2) | 0.02 |
| | $PM_{2.5}$ | 234,692 | -2.3 | (-3.9, -0.7) | -2.0 | (-4.0, 0.0) | -2.8 | (-5.2, -0.3) | 0.84 | -1.8 | (-4.0, 0.4) | -2.8 | (-4.9, -0.6) | 0.41 |
| | $SO_2$ | 845,927 | -0.4 | (-1.5, 0.6) | -0.6 | (-1.9, 0.8) | -0.2 | (-1.9, 1.4) | 0.38 | -1.2 | (-2.7, 0.3) | 0.3 | (-1.1, 1.8) | 0.71 |
| MI | CO | 336,243 | -1.2 | (-2.8, 0.4) | 0.2 | (-1.7, 2.2) | -3.7 | (-6.1, -1.2) | 0.01 | -1.3 | (-3.6, 1.1) | -1.2 | (-3.2, 0.9) | 0.40 |
| | $NO_2$ | 380,960 | 0.4 | (-1.7, 2.6) | 2.1 | (-0.6, 4.8) | -2.4 | (-5.6, 0.9) | 0.32 | -2.1 | (-5.1, 1.0) | 2.4 | (-0.4, 5.3) | 0.13 |
| | $O_3$ | 386,051 | -0.8 | (-2.7, 1.2) | -2.7 | (-5.0, -0.4) | 2.5 | (-0.5, 5.5) | 0.06 | -1.4 | (-4.1, 1.3) | -0.4 | (-2.8, 2.1) | 0.87 |
| | $PM_{10}$ | 350,424 | -1.3 | (-2.7, 0.0) | -1.0 | (-2.7, 0.7) | -2.0 | (-4.1, 0.2) | 0.93 | -2.0 | (-4.0, 0.0) | -0.8 | (-2.6, 1.0) | 0.30 |
| | $PM_{2.5}$ | 92,327 | -1.7 | (-4.3, 0.9) | -1.3 | (-4.4, 1.9) | -2.6 | (-6.5, 1.5) | 0.26 | -2.3 | (-5.9, 1.4) | -1.3 | (-4.6, 2.1) | 0.58 |
| | $SO_2$ | 361,816 | 0.3 | (-1.4, 1.9) | 0.2 | (-1.8, 2.3) | 0.3 | (-2.3, 3.0) | 0.73 | -1.0 | (-3.4, 1.5) | 1.2 | (-0.9, 3.4) | 0.55 |
| Chronic IHD | CO | 72,529 | 0.8 | (-2.6, 4.2) | 0.3 | (-3.6, 4.5) | 1.6 | (-3.9, 7.5) | 0.89 | -2.0 | (-6.3, 2.5) | 4.1 | (-0.8, 9.2) | 0.25 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $NO_2$ | 81,169 | 2.3 | (-2.1, 6.9) | 1.3 | (-3.8, 6.8) | 4.3 | (-3, 12.1) | 0.70 | -2.2 | (-7.6, 3.6) | 8.0 | (1.5, 15.0) | 0.06 |
| | $O_3$ | 81,206 | -2.8 | (-6.9, 1.4) | -2.6 | (-7.3, 2.3) | -3.2 | (-9.4, 3.5) | 0.49 | -1.8 | (-7.0, 3.6) | -4.0 | (-9.3, 1.7) | 0.43 |
| | $PM_{10}$ | 76,402 | -1.5 | (-4.4, 1.6) | -4.2 | (-7.6, -0.6) | 4.0 | (-1.0, 9.3) | 0.02 | -4.1 | (-7.8, -0.2) | 1.7 | (-2.6, 6.2) | 0.27 |
| | $PM_{2.5}$ | 30,441 | -3.1 | (-7.5, 1.4) | -4.0 | (-9.0, 1.4) | -1.4 | (-8.6, 6.2) | 0.76 | -2.0 | (-7.6, 4.0) | -4.6 | (-10.5, 1.8) | 0.72 |
| | $SO_2$ | 77,536 | 0.5 | (-3.1, 4.3) | -1.3 | (-5.7, 3.2) | 4.0 | (-2.1, 10.5) | 0.26 | -1.3 | (-6.1, 3.7) | 2.6 | (-2.7, 8.2) | 0.50 |
| Arrythmias [c] | CO | 305,027 | -0.6 | (-2.3, 1.1) | -0.2 | (-2.5, 2.2) | -1.0 | (-3.3, 1.3) | 0.12 | -0.7 | (-3.1, 1.8) | -0.6 | (-2.8, 1.7) | 0.49 |
| | $NO_2$ | 349,238 | 2.9 | (0.6, 5.2) | 2.1 | (-1.0, 5.2) | 3.6 | (0.5, 6.8) | <0.01 | 1.8 | (-1.4, 5.1) | 3.7 | (0.7, 6.8) | 0.39 |
| | $O_3$ | 352,775 | -1.7 | (-3.8, 0.3) | -2.4 | (-5.0, 0.3) | -1.1 | (-3.7, 1.6) | 0.02 | -1.2 | (-3.9, 1.6) | -2.2 | (-4.7, 0.4) | 0.46 |
| | $PM_{10}$ | 319,992 | -1.4 | (-2.8, 0.1) | -1.7 | (-3.6, 0.4) | -1.1 | (-3.0, 0.9) | 0.84 | -0.3 | (-2.4, 1.8) | -2.2 | (-4.1, -0.3) | 0.16 |
| | $PM_{2.5}$ | 93,302 | -2.1 | (-4.7, 0.5) | -4.0 | (-7.4, -0.5) | -0.2 | (-3.7, 3.4) | 0.04 | -3.1 | (-6.6, 0.6) | -1.3 | (-4.6, 2.1) | 0.77 |
| | $SO_2$ | 329,941 | 0.2 | (-1.6, 2.0) | 0.7 | (-1.8, 3.2) | -0.2 | (-2.6, 2.2) | 0.62 | 1.3 | (-1.3, 3.9) | -0.7 | (-3.0, 1.7) | 0.40 |
| Atrial Fibrillation | CO | 249,702 | -0.4 | (-2.3, 1.5) | 0.3 | (-2.3, 2.9) | -1.1 | (-3.6, 1.5) | 0.11 | -0.1 | (-2.9, 2.8) | -0.7 | (-3.0, 1.8) | 0.79 |
| | $NO_2$ | 285,898 | 2.8 | (0.3, 5.4) | 2.8 | (-0.7, 6.3) | 2.8 | (-0.5, 6.3) | 0.02 | 1.2 | (-2.5, 5.0) | 3.9 | (0.7, 7.2) | 0.30 |
| | $O_3$ | 288,617 | -1.8 | (-4.0, 0.5) | -3.2 | (-6.0, -0.2) | -0.5 | (-3.3, 2.5) | 0.05 | -0.8 | (-3.9, 2.5) | -2.5 | (-5.2, 0.3) | 0.19 |
| | $PM_{10}$ | 262,106 | -1.9 | (-3.5, -0.3) | -2.6 | (-4.8, -0.4) | -1.3 | (-3.5, 0.9) | 0.67 | -1.4 | (-3.7, 1.0) | -2.3 | (-4.3, -0.3) | 0.31 |
| | $PM_{2.5}$ | 76,548 | -2.7 | (-5.6, 0.1) | -4.8 | (-8.5, -0.9) | -0.8 | (-4.6, 3.1) | 0.04 | -4.4 | (-8.4, -0.2) | -1.6 | (-5.1, 2.0) | 0.45 |
| | $SO_2$ | 269,880 | 0.3 | (-1.7, 2.2) | 0.7 | (-2.0, 3.5) | -0.2 | (-2.8, 2.5) | 0.68 | 1.7 | (-1.3, 4.7) | -0.7 | (-3.2, 1.8) | 0.32 |
| AVCD | CO | 38,325 | -0.4 | (-5.1, 4.6) | -0.2 | (-6.2, 6.2) | -0.6 | (-7.6, 6.9) | 0.92 | 3.4 | (-5.5, 13.3) | -1.7 | (-7.1, 3.9) | 0.33 |
| | $NO_2$ | 43,973 | 4.0 | (-2.3, 10.7) | 0.9 | (-6.8, 9.2) | 8.7 | (-1, 19.2) | 0.58 | -1.8 | (-12.5, 10.2) | 6.2 | (-1.2, 14.1) | 0.78 |
| | $O_3$ | 44,445 | 0.5 | (-6.1, 5.4) | -0.9 | (-7.7, 6.3) | 0.0 | (-7.8, 8.4) | 0.65 | -0.1 | (-9.6, 10.5) | -0.7 | (-6.9, 5.9) | 0.91 |
| | $PM_{10}$ | 40,083 | 0.9 | (-3.2, 5.3) | -1.1 | (-6.2, 4.3) | 3.9 | (-2.4, 10.5) | 0.86 | -1.1 | (-8.4, 6.9) | 1.6 | (-3.1, 6.6) | 0.49 |
| | $PM_{2.5}$ | 13,646 | 1.3 | (-5.5, 8.7) | -4.4 | (-12.4, 4.3) | 10.1 | (-0.5, 22) | 0.24 | 5.6 | (-7.0, 19.8) | -0.2 | (-7.8, 8.0) | 0.29 |
| | $SO_2$ | 41,405 | -2.2 | (-7.1, 3.0) | -3.6 | (-9.8, 3.0) | -0.2 | (-7.7, 8.0) | 0.25 | 1.3 | (-7.8, 11.3) | -3.6 | (-9.3, 2.4) | 0.09 |
| Pulmonary embolism | CO | 70,168 | -5.0 | (- 8.3, - 1.6) | -7.0 | (-11.6, -2.1) | -3.4 | (-7.8, 1.2) | 0.76 | -8.5 | (-12.7, -4.2) | -0.6 | (-5.5, 4.6) | 0.03 |
| | $NO_2$ | 81,525 | -3.5 | (- 7.9, 1.1) | -5.3 | (-11.3, 1.2) | -2.0 | (-7.7, 4.1) | 0.86 | -7.4 | (-12.8, -1.6) | 1.6 | (-4.9, 8.7) | <0.01 |
| | $O_3$ | 82,231 | -1.3 | (- 5.5, 3.0) | -0.8 | (-6.4, 5.1) | -1.7 | (-6.9, 3.7) | 0.29 | 2.4 | (-2.9, 8.1) | -5.8 | (-11.2, -0.1) | 0.09 |
| | $PM_{10}$ | 74,092 | -6.3 | (- 9.1, - 3.3) | -8.1 | (-12.1, -4.0) | -4.7 | (-8.5, -0.7) | 0.79 | -8.1 | (-11.7, -4.3) | -3.9 | (-8.1, 0.5) | 0.05 |
| | $PM_{2.5}$ | 22,391 | -6.5 | (-11.4, - 1.3) | -3.2 | (-10.2, 4.3) | -9.3 | (-15.4, -2.6) | 0.69 | -13 | (-18.9, -6.8) | 2.2 | (-5.3, 10.2) | 0.01 |
| | $SO_2$ | 76,730 | -5.0 | (- 8.6, - 1.4) | -7.0 | (-12, -1.8) | -3.4 | (-8.1, 1.6) | 0.49 | -9.1 | (-13.4, -4.5) | 0.6 | (-4.9, 6.4) | 0.03 |
| Heart failure | CO | 272,763 | 0.2 | (- 1.5, 2.0) | -1.1 | (-3.4, 1.4) | 1.5 | (-0.9, 4.0) | 0.14 | 2 | (-1.8, 5.9) | -0.2 | (-2.1, 1.8) | 0.47 |
| | $NO_2$ | 308,543 | 4.4 | ( 2.0, 6.8) | 4.5 | (1.2, 7.9) | 4.2 | (1.0, 7.6) | 0.04 | 5.9 | (0.8, 11.2) | 4.0 | (1.4, 6.7) | 0.23 |
| | $O_3$ | 312,332 | -0.9 | (- 3.0, 1.3) | -0.7 | (-3.5, 2.2) | -1.0 | (-3.8, 1.9) | 0.81 | -1.1 | (-5.3, 3.3) | -0.8 | (-3.1, 1.6) | 0.27 |
| | $PM_{10}$ | 284,550 | -0.2 | (- 1.7, 1.4) | -0.7 | (-2.8, 1.4) | 0.4 | (-1.6, 2.6) | 0.57 | 0.7 | (-2.6, 4.0) | -0.3 | (-2.0, 1.3) | 0.71 |
| | $PM_{2.5}$ | 82,879 | 0.8 | (- 2.0, 3.6) | -0.8 | (-4.4, 3.0) | 2.3 | (-1.4, 6.2) | 0.74 | 3 | (-2.7, 9.1) | 0.2 | (-2.8, 3.3) | 0.30 |
| | $SO_2$ | 293,763 | 0.6 | (- 1.2, 2.5) | -0.3 | (-2.8, 2.2) | 1.5 | (-1.0, 4.1) | 0.10 | -1.9 | (-5.7, 2.1) | 1.2 | (-0.8, 3.3) | 0.18 |

AVCD, atrio-ventricular conduction disorders; HES, hospital episode statistics; IHD, ischaemic heart disease; MI, myocardial infarction.
*P* value by 2-sided Wald test for overall interaction terms
[a] For all CVD and non-MI admissions, day of week is matched as well as lunar month because of limitation in computing memory.
[b] including MI and chronic IHD
[c] excluding conduction disorders and bradycardias, including atrial fibrillation

Table S3. Percentage change (Δ%) in risk of CVD mortality for a 10th-90th percentile change in pollutant (in 2003-2006) at lags 0-4days. Stratified by sex and age group. Data source: ONS mortality registry.

| Outcome | Pollut-ant | All | | | By sex | | | | | By age group | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N. of events | Δ% | (95%CI) | Male Δ% | Male (95%CI) | Female Δ% | Female (95%CI) | *P* | <70 years old Δ% | <70 years old (95%CI) | 70+ years old Δ% | 70+ years old (95%CI) | *P* |
| CVD | CO | 624,839 | -0.5 | (-1.8, 0.9) | -0.3 | (-2.2, 1.7) | -0.7 | (-2.5, 1.2) | 0.07 | -2.3 | (-5.3, 0.8) | -0.1 | (-1.6, 1.4) | 0.69 |
| | $NO_2$ | 683,381 | -0.5 | (-2.1, 1.1) | 0.1 | (-2.1, 2.4) | -1.1 | (-3.2, 1.1) | 0.53 | -1.6 | (-5.1, 2) | -0.3 | (-2, 1.5) | 0.01 |
| | $O_3$ | 692,886 | 1.1 | (-0.4, 2.6) | -0.2 | (-2.1, 1.7) | 2.3 | (0.4, 4.2) | 0.04 | -1.2 | (-4.1, 1.9) | 1.6 | (0, 3.2) | 0.02 |
| | $PM_{10}$ | 633,383 | -0.8 | (-1.8, 0.2) | -0.8 | (-2.2, 0.6) | -0.7 | (-2.1, 0.6) | 0.02 | -0.9 | (-3.1, 1.4) | -0.8 | (-1.9, 0.3) | 0.02 |
| | $PM_{2.5}$ | 158,287 | 1.4 | (-0.4, 3.3) | -1.0 | (-3.5, 1.5) | 3.7 | (1.3, 6.3) | 0.05 | -1.7 | (-5.5, 2.3) | 2.1 | (0.1, 4.2) | 0.11 |
| | $SO_2$ | 660,409 | -0.2 | (-1.4, 1.1) | 0.1 | (-1.7, 1.9) | -0.4 | (-2.1, 1.4) | 0.81 | -1.6 | (-4.4, 1.3) | 0.2 | (-1.2, 1.6) | 0.70 |
| Non-MI | CO | 624,839 | 0 | (-1.6, 1.5) | 0.2 | (-2, 2.4) | -0.2 | (-2.2, 1.9) | 0.07 | -1.7 | (-5.2, 1.9) | 0.3 | (-1.4, 2) | 0.93 |
| | $NO_2$ | 683,381 | -0.4 | (-2.2, 1.4) | 0.3 | (-2.2, 2.9) | -1.0 | (-3.3, 1.4) | 0.80 | -2.8 | (-6.7, 1.4) | 0.1 | (-1.9, 2.1) | 0.27 |
| | $O_3$ | 692,886 | 1.0 | (-0.7, 2.6) | 0 | (-2.2, 2.2) | 1.8 | (-0.2, 3.9) | 0.09 | -2.1 | (-5.4, 1.4) | 1.6 | (-0.2, 3.3) | 0.02 |
| | $PM_{10}$ | 633,383 | -0.5 | (-1.6, 0.7) | -0.6 | (-2.2, 1.1) | -0.4 | (-1.9, 1.1) | 0.04 | -1.6 | (-4.2, 1) | -0.2 | (-1.5, 1) | 0.03 |
| | $PM_{2.5}$ | 158,287 | 1.5 | (-0.5, 3.6) | -0.9 | (-3.6, 2) | 3.6 | (0.9, 6.4) | 0.09 | -1.1 | (-5.5, 3.5) | 2.1 | (-0.1, 4.3) | 0.29 |
| | $SO_2$ | 660,409 | -0.6 | (-2.0, 0.8) | -0.7 | (-2.8, 1.4) | -0.5 | (-2.4, 1.4) | 0.56 | -3.3 | (-6.5, 0.1) | -0.1 | (-1.6, 1.5) | 0.36 |
| Stroke | CO | 173,406 | 0.6 | (-2.0, 3.3) | 0.3 | (-3.7, 4.5) | 0.8 | (-2.5, 4.1) | 0.18 | 0.6 | (-6.4, 8.2) | 0.6 | (-2.2, 3.4) | 0.41 |
| | $NO_2$ | 189,521 | 2.0 | (-1.1, 5.2) | 3.0 | (-1.8, 7.9) | 1.4 | (-2.4, 5.4) | 0.26 | -1.7 | (-9.6, 6.9) | 2.4 | (-0.8, 5.8) | 0.14 |
| | $O_3$ | 192,584 | 0.1 | (-2.6, 2.9) | 0.3 | (-3.6, 4.4) | 0 | (-3.2, 3.4) | 0.83 | -2.7 | (-9.4, 4.5) | 0.6 | (-2.3, 3.5) | 0.39 |
| | $PM_{10}$ | 183,037 | -0.5 | (-2.4, 1.4) | -1.1 | (-4, 1.9) | -0.2 | (-2.6, 2.2) | 0.04 | -1.5 | (-6.5, 3.9) | -0.4 | (-2.4, 1.7) | 0.82 |
| | $PM_{2.5}$ | 42,458 | 2.8 | (-0.8, 6.5) | 1.8 | (-3.5, 7.4) | 3.4 | (-1, 7.9) | 0.87 | 6.7 | (-2.7, 17) | 2.3 | (-1.5, 6.2) | 0.13 |
| | $SO_2$ | 183,037 | 0.1 | (-2.3, 2.6) | -1.9 | (-5.5, 1.9) | 1.4 | (-1.7, 4.5) | 0.16 | -2.8 | (-9.2, 4.2) | 0.5 | (-2.1, 3.1) | 0.61 |
| IHD [a] | CO | 301,937 | -0.9 | (-2.8, 1.1) | -1.1 | (-3.6, 1.5) | -0.6 | (-3.4, 2.3) | 0.22 | -2.7 | (-6.6, 1.3) | -0.4 | (-2.5, 1.9) | 0.59 |
| | $NO_2$ | 329,033 | -0.7 | (-3.0, 1.6) | -0.8 | (-3.8, 2.2) | -0.6 | (-3.9, 2.8) | 0.31 | -1.1 | (-5.7, 3.6) | -0.7 | (-3.2, 1.9) | 0.02 |
| | $O_3$ | 333,324 | 2.0 | (-0.1, 4.1) | 0.8 | (-1.8, 3.5) | 3.4 | (0.5, 6.4) | 0.04 | 1.0 | (-3, 5.1) | 2.3 | (0, 4.7) | 0.09 |
| | $PM_{10}$ | 306,554 | -0.9 | (-2.3, 0.5) | -0.6 | (-2.4, 1.3) | -1.3 | (-3.3, 0.8) | 0.08 | -0.3 | (-3.1, 2.7) | -1.1 | (-2.7, 0.5) | 0.05 |
| | $PM_{2.5}$ | 73,748 | 2.1 | (-0.7, 4.8) | -0.8 | (-4.2, 2.6) | 5.8 | (1.9, 9.9) | 0.02 | -2.6 | (-7.7, 2.8) | 3.2 | (0.2, 6.3) | 0.07 |
| | $SO_2$ | 318,383 | 1.5 | (-0.3, 3.4) | 2.4 | (0, 4.9) | 0.4 | (-2.3, 3.1) | 0.22 | 0.8 | (-3, 4.6) | 1.7 | (-0.3, 3.8) | 0.83 |
| MI | CO | 127,779 | -2.2 | (-5.1, 0.8) | -1.8 | (-5.6, 2.1) | -2.6 | (-6.9, 1.8) | 0.67 | -4.2 | (-9.8, 1.9) | -1.6 | (-4.9, 1.8) | 0.84 |
| | $NO_2$ | 138,049 | -1.1 | (-4.6, 2.5) | -0.8 | (-5.3, 3.9) | -1.4 | (-6.4, 3.8) | 0.44 | 1.7 | (-5.3, 9.1) | -1.9 | (-5.7, 2.1) | 0.03 |
| | $O_3$ | 139,710 | 1.7 | (-1.6, 5.0) | -0.4 | (-4.3, 3.7) | 4.3 | (-0.2, 9.1) | 0.06 | 1.8 | (-4.2, 8.2) | 1.7 | (-1.8, 5.4) | 0.07 |
| | $PM_{10}$ | 130,030 | -1.9 | (-4.1, 0.2) | -1.6 | (-4.4, 1.2) | -2.4 | (-5.4, 0.8) | 0.12 | 1.3 | (-3, 5.9) | -2.9 | (-5.3, -0.5) | 0.21 |
| | $PM_{2.5}$ | 29,508 | 1.1 | (-3.2, 5.5) | -1.2 | (-6.4, 4.3) | 3.9 | (-2.1, 10.4) | 0.26 | -3.2 | (-10.9, 5.2) | 2.1 | (-2.6, 7) | 0.48 |
| | $SO_2$ | 134,319 | 1.5 | (-1.2, 4.4) | 2.6 | (-1.1, 6.4) | 0.1 | (-3.9, 4.3) | 0.07 | 3.0 | (-2.6, 8.9) | 1.1 | (-2, 4.3) | 0.71 |
| Chronic IHD | CO | 172,705 | -0.1 | (-2.7, 2.6) | -0.9 | (-4.2, 2.6) | 0.9 | (-2.9, 4.8) | 0.25 | -1.8 | (-7, 3.7) | 0.4 | (-2.5, 3.4) | 0.82 |
| | $NO_2$ | 189,408 | -0.6 | (-3.6, 2.5) | -0.9 | (-4.8, 3.1) | -0.3 | (-4.6, 4.2) | 0.67 | -3.5 | (-9.4, 2.8) | 0 | (-3.3, 3.5) | 0.40 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $O_3$ | 192,013 | 2.3 | (-0.5, 5.1) | 1.8 | (-1.7, 5.3) | 2.9 | (-0.9, 6.9) | 0.06 | 0.3 | (-4.9, 5.8) | 2.8 | (-0.2, 6) | 0.34 |
| | $PM_{10}$ | 175,061 | -0.2 | (-2.1, 1.8) | 0.2 | (-2.3, 2.8) | -0.6 | (-3.3, 2.2) | 0.39 | -1.6 | (-5.4, 2.4) | 0.2 | (-2, 2.3) | 0.08 |
| | $PM_{2.5}$ | 43,928 | 2.6 | (-0.9, 6.3) | -0.7 | (-5, 3.9) | 6.9 | (1.8, 12.2) | 0.01 | -2.1 | (-8.7, 4.9) | 3.8 | (-0.1, 7.9) | 0.06 |
| | $SO_2$ | 182,550 | 1.6 | (-0.6, 4.1) | 2.4 | (-0.9, 5.7) | 0.6 | (-2.9, 4.3) | 0.64 | -1.1 | (-6.1, 4.2) | 2.3 | (-0.5, 5.1) | 0.63 |
| Arrhythmias [b] | CO | 9,757 | -0.5 | (-11.0, 11.3) | 4.1 | (-14.2, 26.4) | -2.7 | (-14.7, 11) | 0.22 | -58.9 | (-76, -29.6) | 3.1 | (-8, 15.6) | <0.01 |
| | $NO_2$ | 10,631 | -0.9 | (-13.0, 13.0) | 7.4 | (-14.2, 34.4) | -4.3 | (-17.8, 11.5) | 0.54 | -65.7 | (-81.4, -36.6) | 3.3 | (-9.6, 18) | <0.01 |
| | $O_3$ | 10,837 | -7.9 | (-18.0, 3.4) | 0.1 | (-16.9, 20.6) | -11.2 | (-22.2, 1.3) | 0.53 | -28.9 | (-56.7, 16.9) | -6.7 | (-17, 4.9) | 0.31 |
| | $PM_{10}$ | 9,914 | 6.3 | (-1.9, 15.2) | 10.4 | (-3.7, 26.5) | 4.6 | (-4.9, 14.9) | 0.94 | -20.8 | (-45.3, 14.7) | 7.7 | (-0.7, 16.9) | 0.50 |
| | $PM_{2.5}$ | 2,248 | 21.0 | (3.9, 40.8) | 24.8 | (-2.4, 59.6) | 18.9 | (-0.3, 41.9) | 0.62 | -50.2 | (-77.2, 8.9) | 24.6 | (6.8, 45.3) | 0.15 |
| | $SO_2$ | 10,301 | 1.5 | (-8.4, 12.6) | 0.2 | (-16.9, 20.8) | 1.7 | (-9.9, 14.9) | 0.28 | 0.4 | (-37.2, 60.5) | 1.4 | (-8.8, 12.7) | 0.98 |
| Atrial Fibrillation | CO | 9,660 | -0.7 | (-11.3, 11.1) | 3.9 | (-14.5, 26.2) | -2.9 | (-15, 10.8) | 0.27 | -62.4 | (-78.5, -34) | 3.1 | (-8.1, 15.6) | <0.01 |
| | $NO_2$ | 10,526 | -1.3 | (-13.5, 12.5) | 6.4 | (-15.1, 33.3) | -4.5 | (-18.1, 11.3) | 0.51 | -67.3 | (-82.6, -38.6) | 2.8 | (-10, 17.5) | <0.01 |
| | $O_3$ | 10,731 | -7.9 | (-18.0, 3.5) | 1.3 | (-16, 22.2) | -11.6 | (-22.6, 0.9) | 0.50 | -33.5 | (-60.1, 10.9) | -6.6 | (-17, 5.1) | 0.35 |
| | $PM_{10}$ | 9,821 | 6.5 | (-1.8, 15.4) | 10.1 | (-4.1, 26.4) | 4.9 | (-4.6, 15.3) | 0.92 | -28.1 | (-51.2, 5.7) | 8.2 | (-0.3, 17.5) | 0.27 |
| | $PM_{2.5}$ | 2,230 | 21.0 | (3.9, 41.0) | 25.3 | (-2.2, 60.5) | 18.8 | (-0.5, 41.8) | 0.55 | -49.1 | (-77.1, 12.9) | 24.5 | (6.7, 45.3) | 0.20 |
| | $SO_2$ | 10,198 | 1.0 | (-9.0, 12.1) | -1.4 | (-18.4, 19.2) | 10.1 | (-2.5, 24.4) | 0.28 | -7.0 | (-43.1, 51.9) | 1.1 | (-9.1, 12.4) | 0.99 |
| Pulmonary embolism | CO | 10,404 | -3.4 | (-13.3, 7.6) | 7.6 | (-8.8, 26.9) | -10 | (-21.4, 3.2) | 0.48 | -17.0 | (-33.6, 3.9) | 1.0 | (-10.4, 13.9) | 0.39 |
| | $NO_2$ | 11,385 | 4.0 | (-8.5, 18.2) | 8.6 | (-10.8, 32.1) | 1.3 | (-13.6, 18.6) | 0.96 | -5.4 | (-27, 22.6) | 6.8 | (-7.4, 23.1) | 0.26 |
| | $O_3$ | 11,577 | -7.0 | (-16.8, 4.1) | -14.6 | (-27.4, 0.6) | -1.8 | (-14.2, 12.3) | 0.31 | -6.6 | (-24.2, 15.1) | -7.3 | (-18.1, 4.8) | 0.62 |
| | $PM_{10}$ | 10,372 | 0.5 | (-7.2, 8.9) | -1.1 | (-12.6, 11.9) | 1.4 | (-8.1, 12) | 0.52 | -2.7 | (-17.1, 14.3) | 1.5 | (-7.1, 10.9) | 0.92 |
| | $PM_{2.5}$ | 2,401 | 20.2 | (3.5, 39.7) | 15.3 | (-8.1, 44.6) | 23.3 | (2.9, 47.8) | 0.98 | 7.3 | (-20.3, 44.3) | 23.8 | (5, 45.8) | 0.74 |
| | $SO_2$ | 10,948 | -0.3 | (-9.9, 10.4) | -4.2 | (-18.1, 12) | 2.2 | (-10.2, 16.3) | 0.49 | -5.9 | (-23.7, 16) | 1.1 | (-9.8, 13.3) | 0.33 |
| Heart failure | CO | 31,105 | 2.4 | (-3.6, 8.9) | 4.1 | (-5.3, 14.4) | 1.4 | (-6.1, 9.3) | 0.25 | -7.0 | (-27.4, 19) | 2.9 | (-3.3, 9.6) | 0.62 |
| | $NO_2$ | 33,733 | -2.6 | (-9.3, 4.6) | -2.6 | (-12.8, 8.8) | -2.6 | (-10.7, 6.3) | 0.23 | -4.0 | (-27, 26.3) | -2.4 | (-9.2, 5) | 0.90 |
| | $O_3$ | 34,404 | 3.4 | (-3.1, 10.3) | -1.3 | (-10.3, 8.6) | 6.3 | (-1.6, 14.8) | 0.03 | 11.4 | (-12.2, 41.2) | 3.0 | (-3.6, 10) | 0.53 |
| | $PM_{10}$ | 31,412 | 0 | (-4.4, 4.6) | 0.3 | (-6.5, 7.5) | -0.2 | (-5.6, 5.5) | 0.90 | -7.7 | (-22.6, 10.2) | 0.5 | (-4, 5.3) | 0.23 |
| | $PM_{2.5}$ | 8,871 | -3.2 | (-10.5, 4.6) | -0.6 | (-11.4, 11.7) | -5.0 | (-13.6, 4.5) | 0.55 | 10.2 | (-16.1, 44.6) | -3.9 | (-11.2, 4.1) | 0.54 |
| | $SO_2$ | 32,792 | -3.4 | (-8.8, 2.2) | -4.0 | (-12.4, 5.1) | -3.1 | (-9.8, 4) | 0.34 | -13.9 | (-31.9, 8.9) | -2.6 | (-8.1, 3.3) | 0.22 |

IHD, ischaemic heart disease; MI, myocardial infarction; ONS, office of national statistics.
*P* value by 2-sided Wald test for overall interaction terms
Results of atrio-venticular conduction disorders are not shown due to the limited number of events.
[a] including MI and chronic IHD
[b] excluding conduction disorders and bradycardias, including atrial fibrillation

Table S4 Within-stratum correlation between pollutants: [a] HES analysis and [b] mortality analysis

[a] HES analysis

| | CO | $NO_2$ | $O_3$ | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ |
|---|---|---|---|---|---|---|
| CO | 1.0000 | - | - | - | - | - |
| $NO_2$ | 0.6450 | 1.0000 | - | - | - | - |
| $O_3$ | -0.2973 | -0.3489 | 1.0000 | - | - | - |
| $PM_{10}$ | 0.4802 | 0.5445 | 0.0302 | 1.0000 | - | - |
| $PM_{2.5}$ | 0.4752 | 0.5299 | -0.0960 | 0.8611 | 1.0000 | - |
| $SO_2$ | 0.3035 | 0.4554 | -0.0849 | 0.4356 | 0.4078 | 1.0000 |

[b] mortality analysis

| | CO | $NO_2$ | $O_3$ | $PM_{10}$ | $PM_{2.5}$ | $SO_2$ |
|---|---|---|---|---|---|---|
| CO | 1.0000 | - | - | - | - | - |
| $NO_2$ | 0.6580 | 1.0000 | - | - | - | - |
| $O_3$ | -0.3024 | -0.3290 | 1.0000 | - | - | - |
| $PM_{10}$ | 0.4791 | 0.5474 | 0.0146 | 1.0000 | - | - |
| $PM_{2.5}$ | 0.4754 | 0.5416 | -0.0450 | 0.8715 | 1.0000 | - |
| $SO_2$ | 0.2910 | 0.4633 | -0.0853 | 0.4432 | 0.4333 | 1.0000 |

Figure S1. AURN monitoring sites for air pollution (red points, except roadside and curbside) and BADC sites for temperature (blue points) in 2003-2009. Gray dots show MINAP patient's residential addresses.

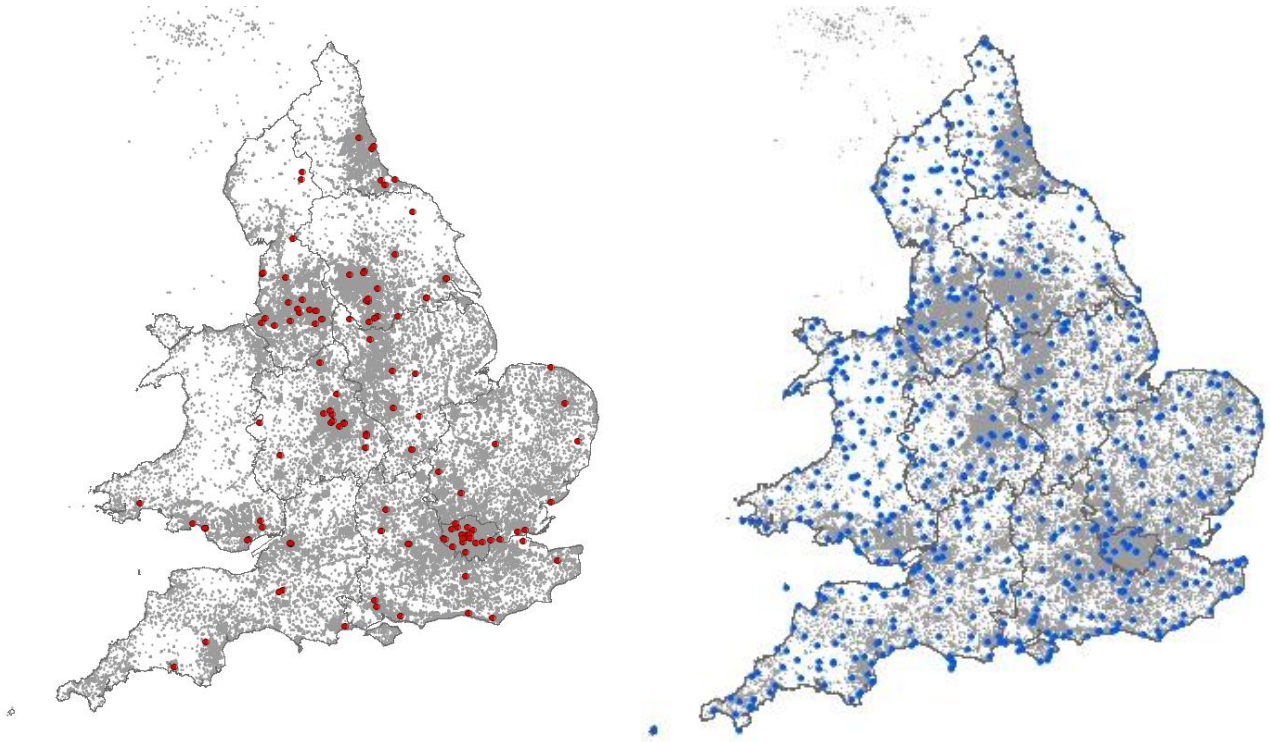
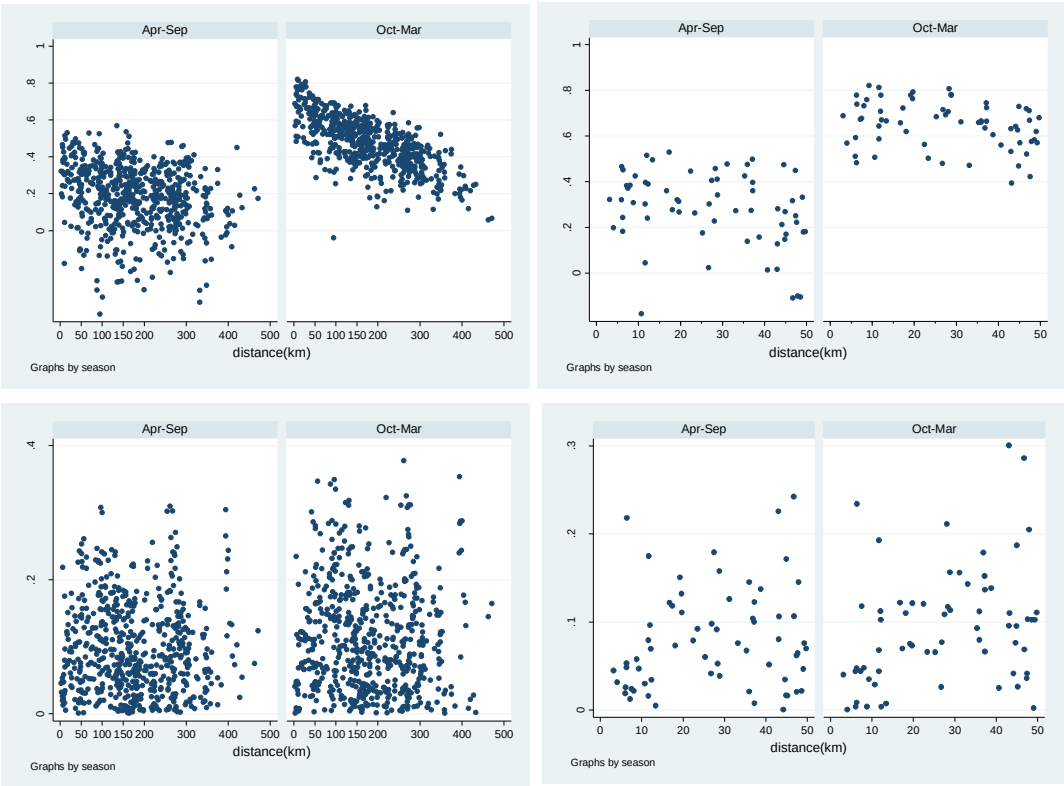
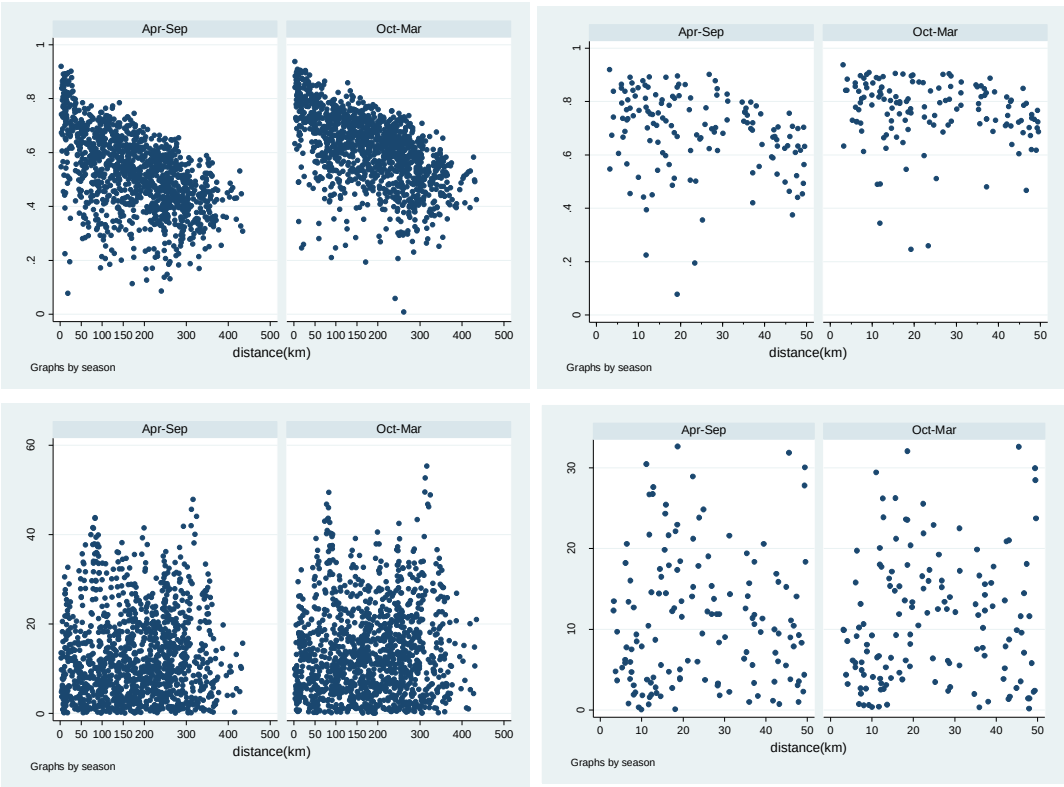


Figure S2. Correlations and mean differences of daily pollution and temperature values by distance. Points represent agreement between all possible combinations of 2 monitors. Figures show agreement separately by season (April-September and October-March) and by distances (within 500km and then just within 50km). $PM_{2.5}$ is not shown due to small number of monitoring stations.

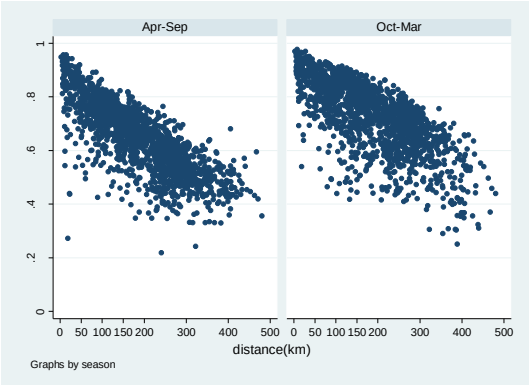
CO (daily mean, mg/m$^3$): 35 sites

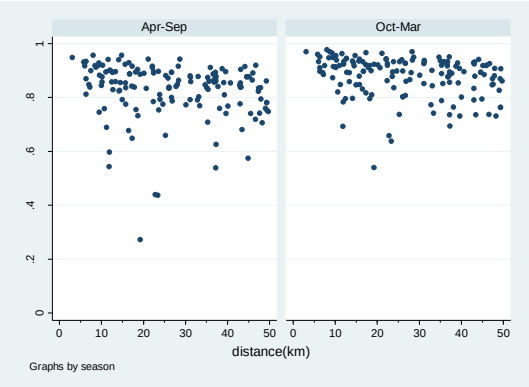


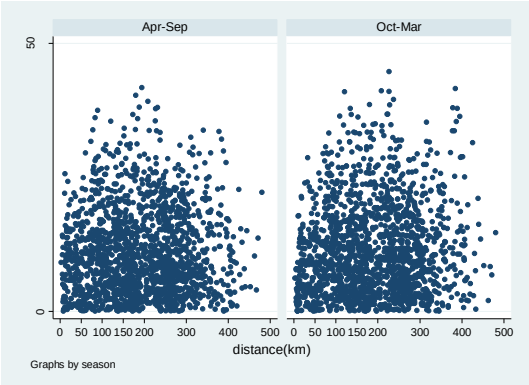

$NO_2$ (daily mean, mg/m$^3$): 50 sites

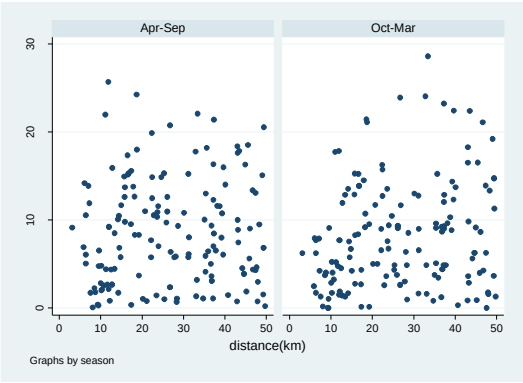


## O3 (daily mean, mg/m3): 60 sites

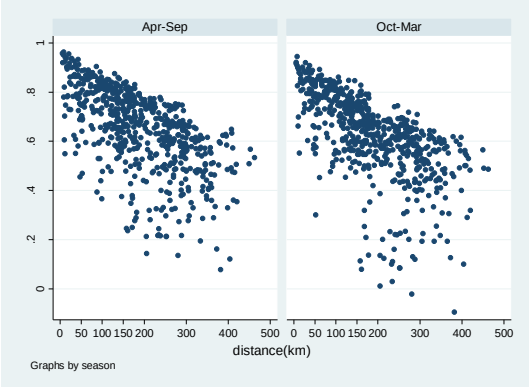


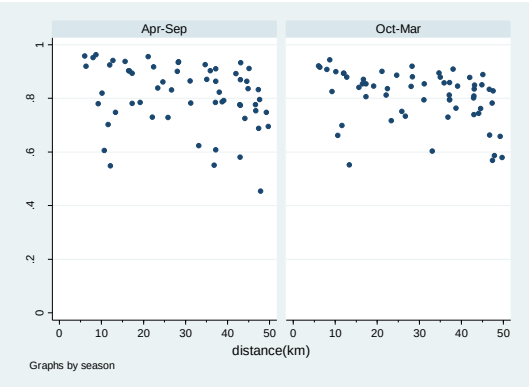


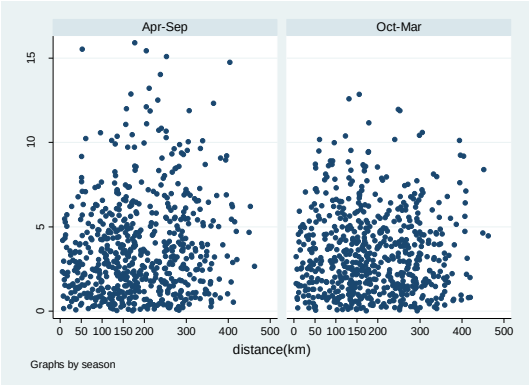


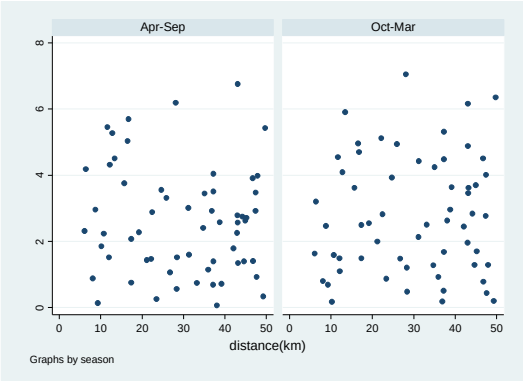


## PM$_{10}$ (daily mean, μg/m$^3$): 36 sites

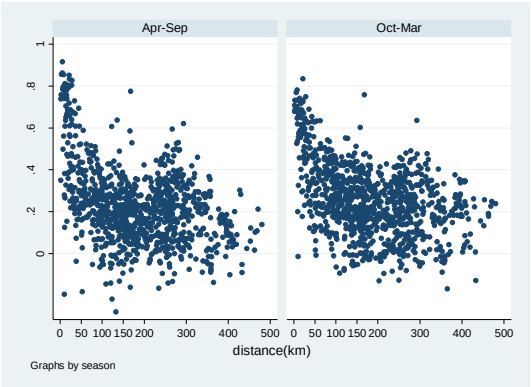


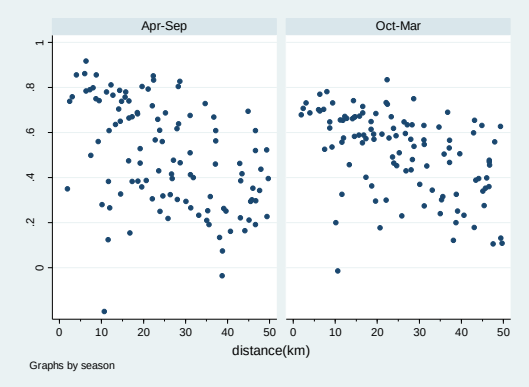


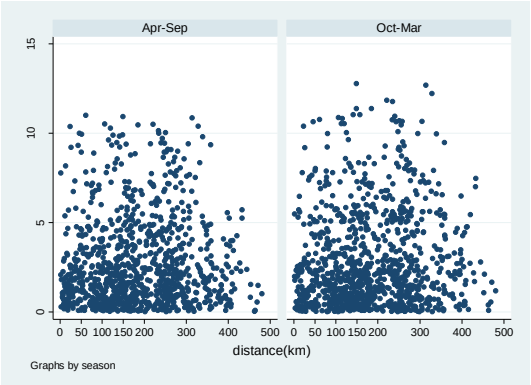


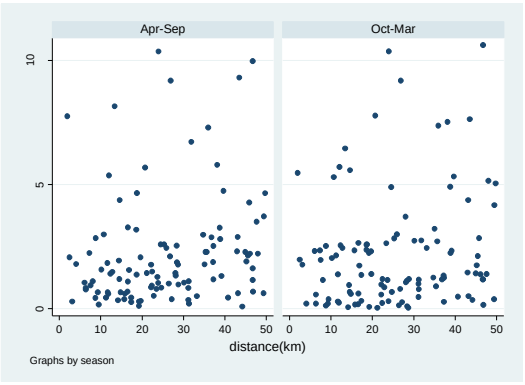


## $SO_2$ (daily mean, $mg/m^3$): 45 sites

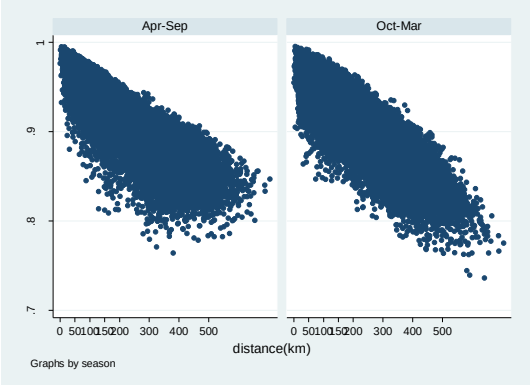


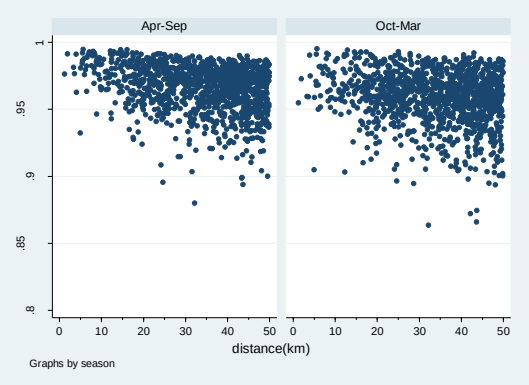


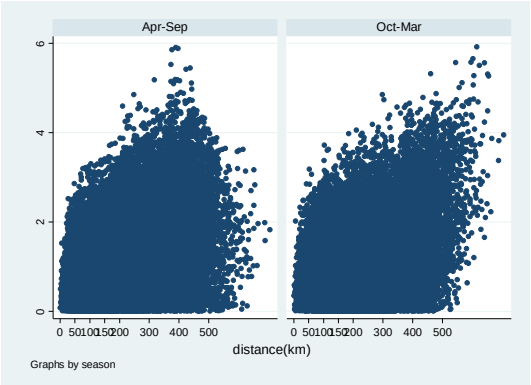




## Temperature (daily mean, degrees C): 254 sites







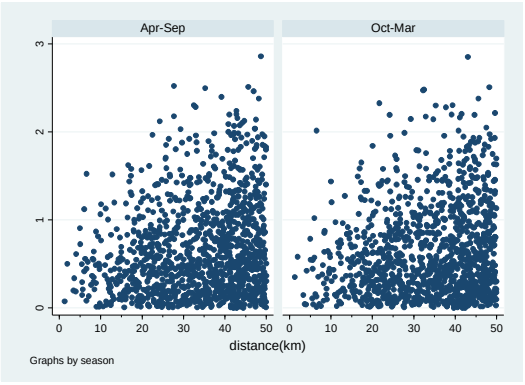
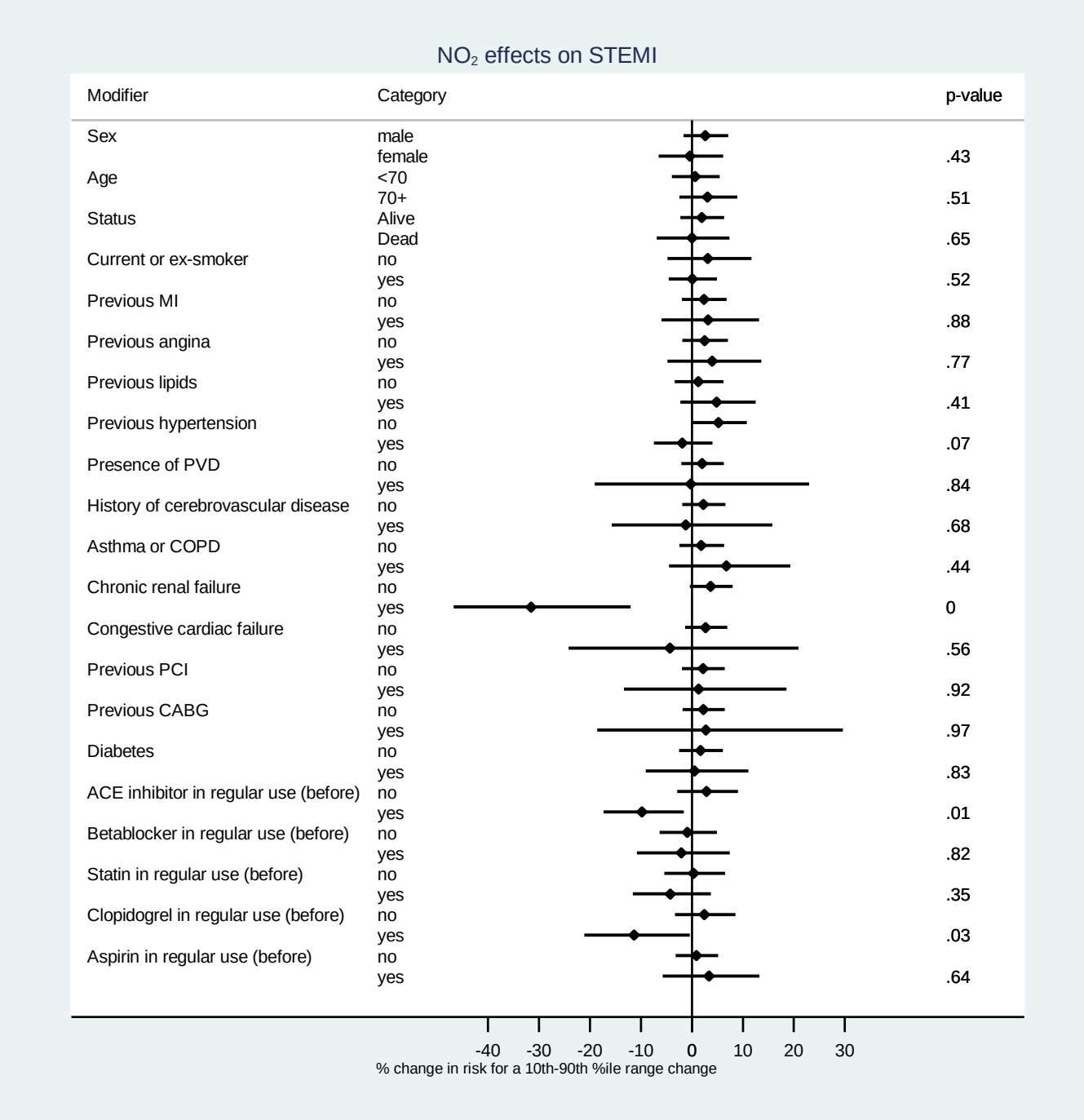


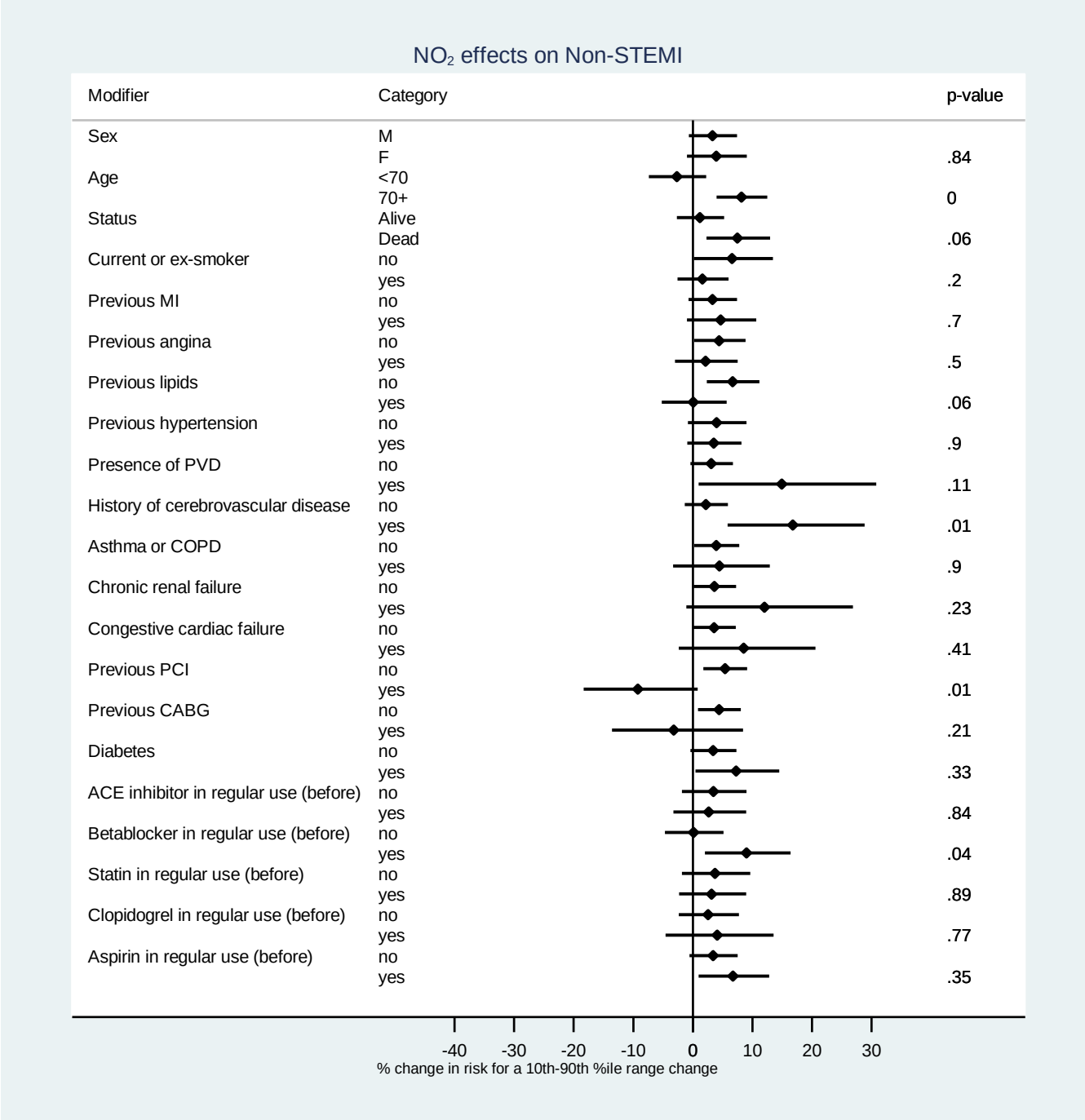
Figure S3. Effects of $NO_2$ at lags 0-4days on [a] STEMI and [b] non-STEMI diagnosis by risk factors. Column on extreme right shows *P* value from interactions model.

[a]




ACE, angiotensio converting enzyme; PVD, peripheral vascular disease; PCI, percutaneous coronary intervention; CABG, coronary artery bypass graft;

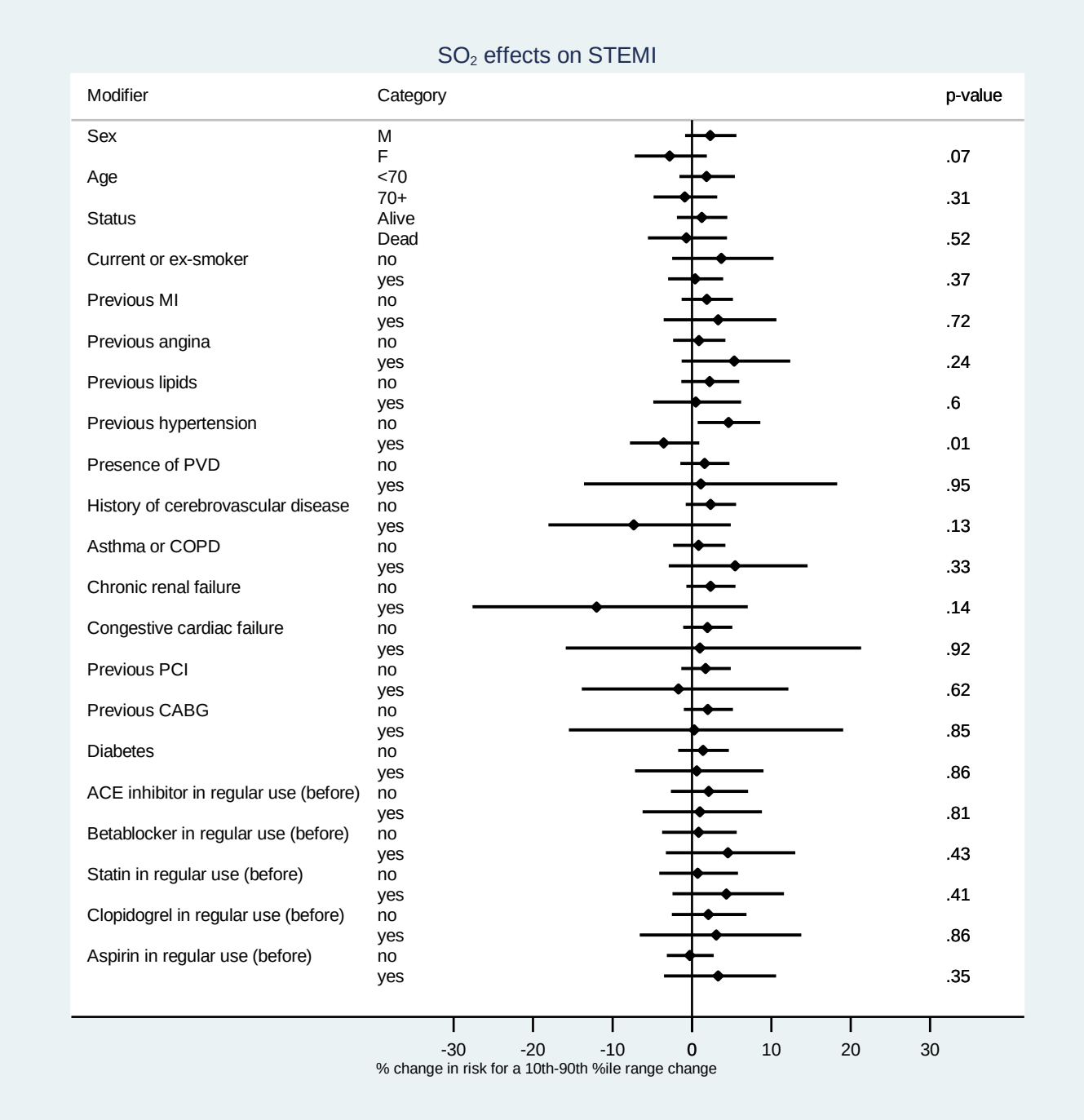
[b]




ACE, angiotensio converting enzyme; PVD, peripheral vascular disease; PCI, percutaneous coronary intervention; CABG, coronary artery bypass graft;

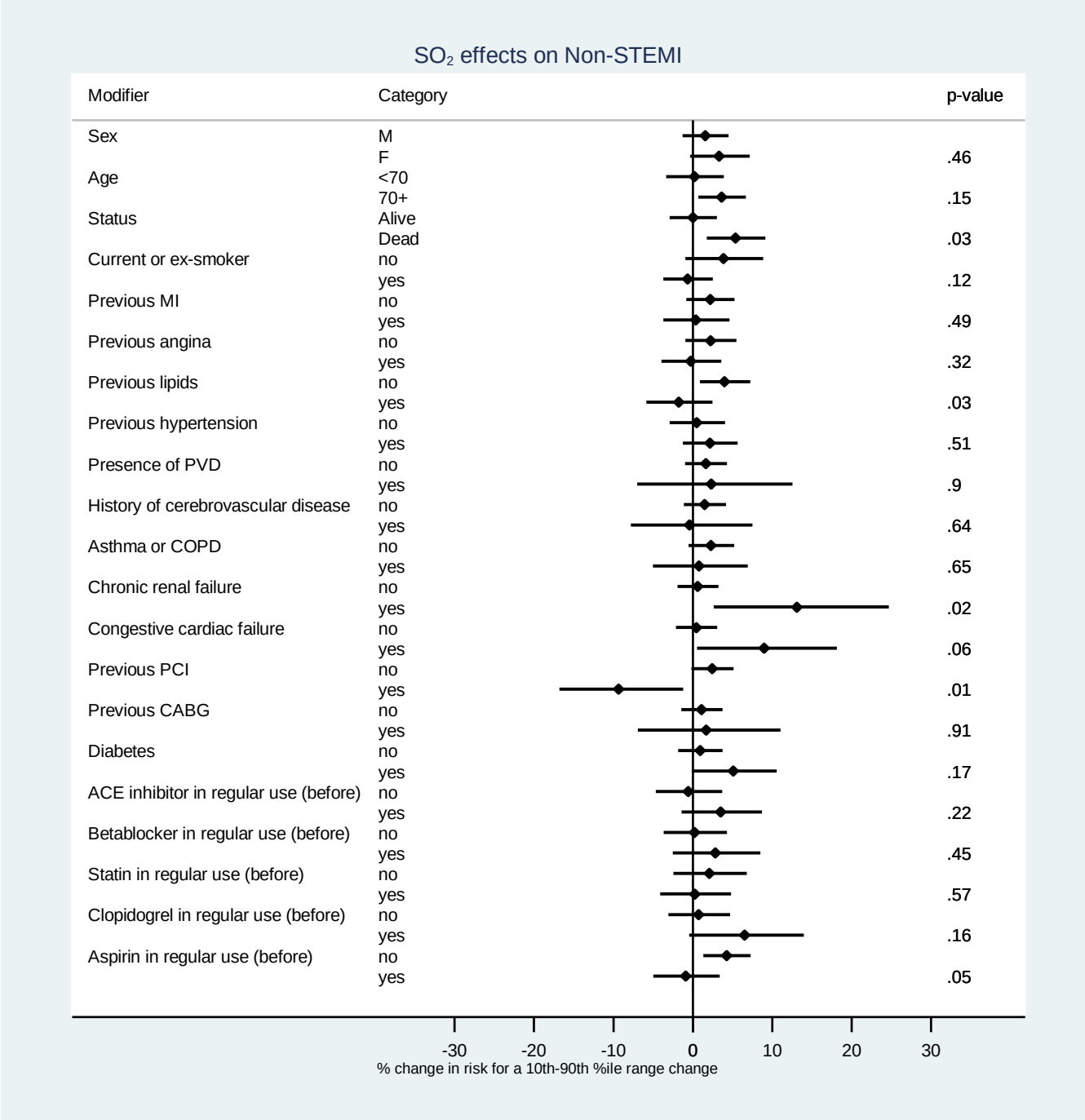
Figure S4. Effects of $SO_2$ at lags 0-4days on [a] STEMI and [b] non-STEMI diagnosis by risk factors. Column on extreme right shows *P* value from interactions model.

[a]




ACE, angiotensio converting enzyme; PVD, peripheral vascular disease; PCI, percutaneous coronary intervention; CABG, coronary artery bypass graft;

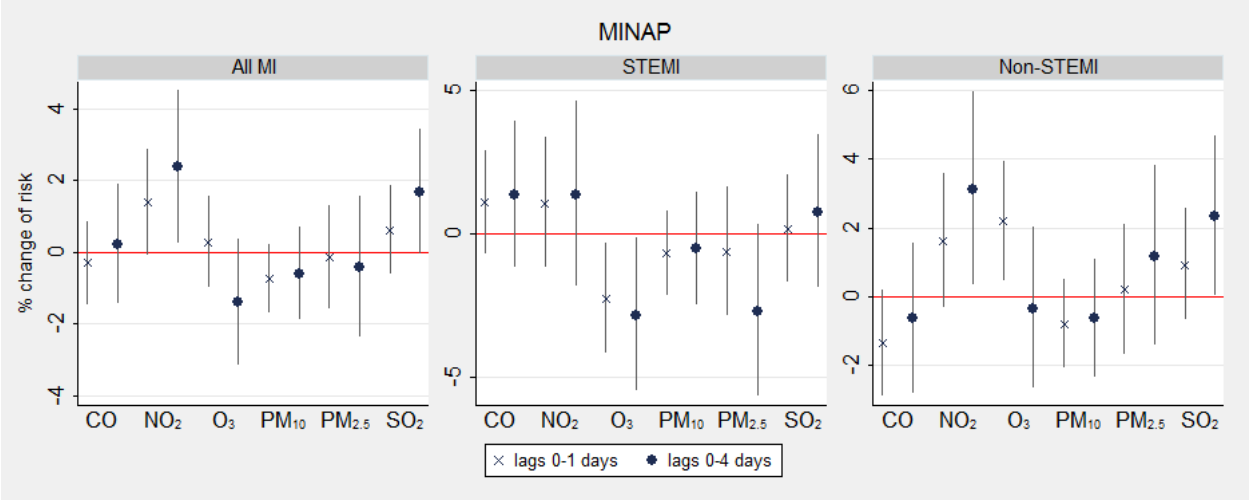
[b]



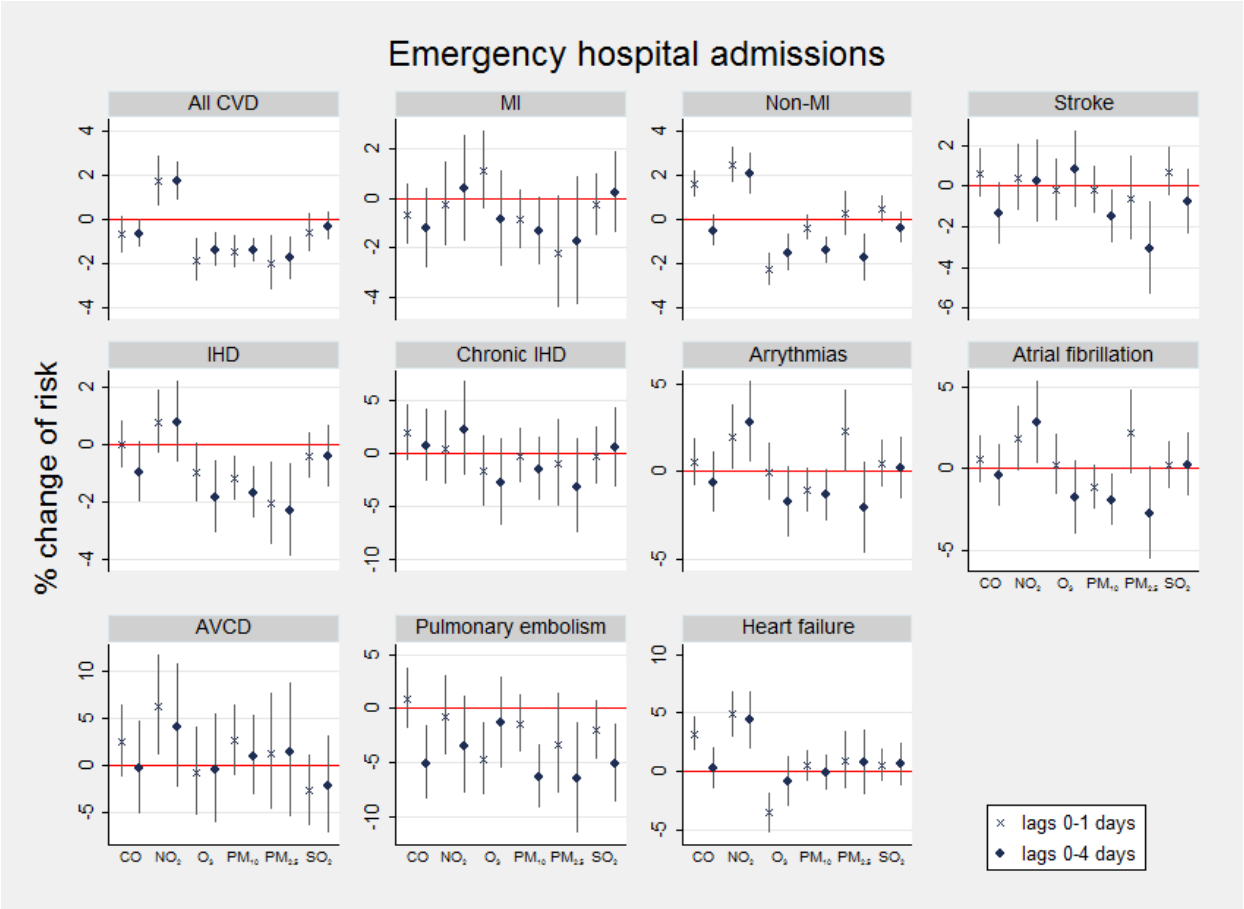

ACE, angiotensio converting enzyme; PVD, peripheral vascular disease; PCI, percutaneous coronary intervention; CABG, coronary artery bypass graft;

Figure S5. Percentage change (95%CI) in risk of cardiovascular events for a 10th-90th percentile range change in pollutant at lags 0-1 days and lags 0-4 days. 10th-90th percentile ranges in pollutant vary in databases: [a] MINAP 2003-2009, [b] HES 2003-2008, and [c] ONS mortality 2003-2006. AVCD, MI, and IHD represent Atrio-venticular conduction disorder, myocardial infarction, and ischaemic heart disease respectively.

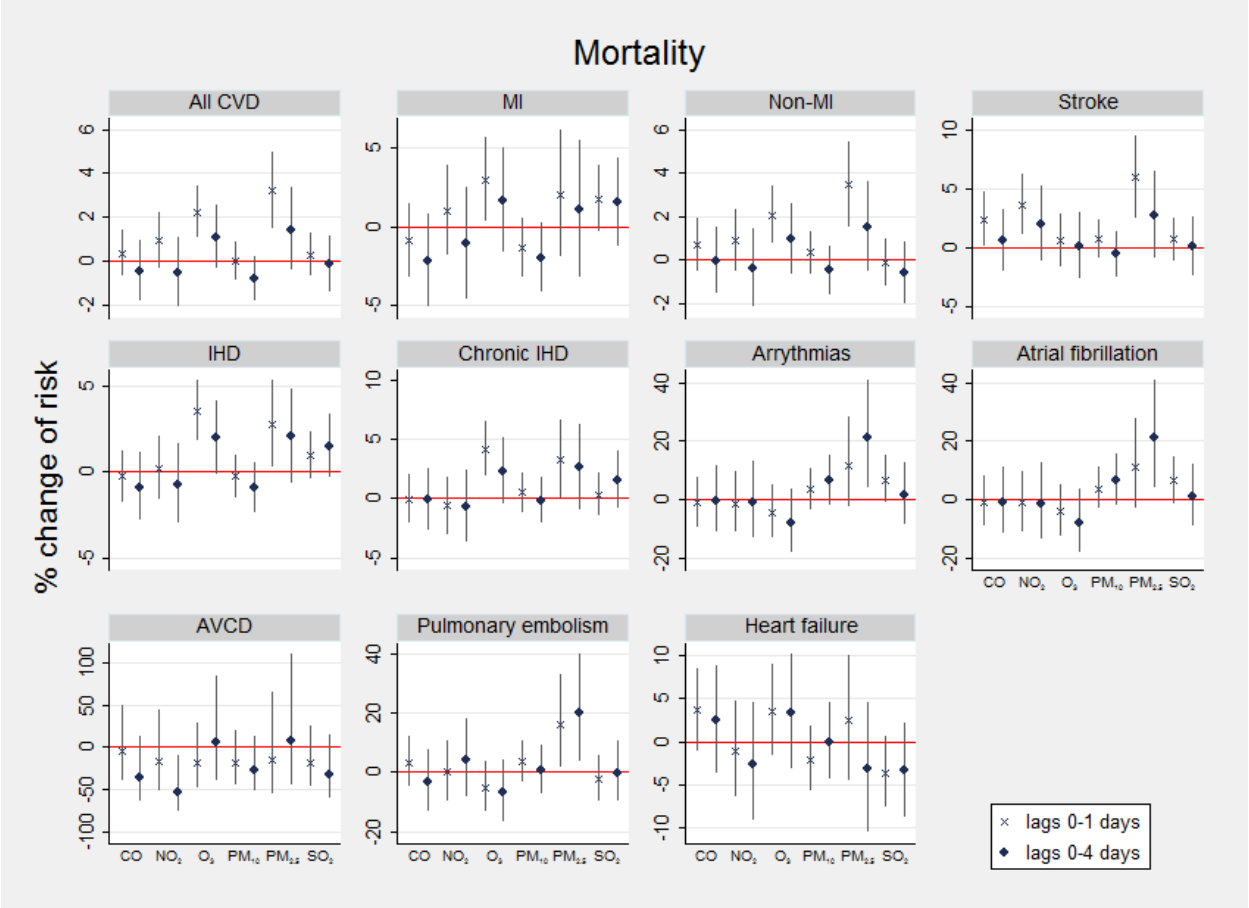
[a]




[b]



[c]


Mortality
All CVD
MI
Non-MI
Stroke
IHD
Chronic IHD
Arrythmias
Atrial fibrillation
AVCD
Pulmonary embolism
Heart failure
% change of risk
CO
NO2
O3
PM10
PM2.5
SO2
lags 0-1 days
lags 0-4 days