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Black Carbon Effects on Public Health

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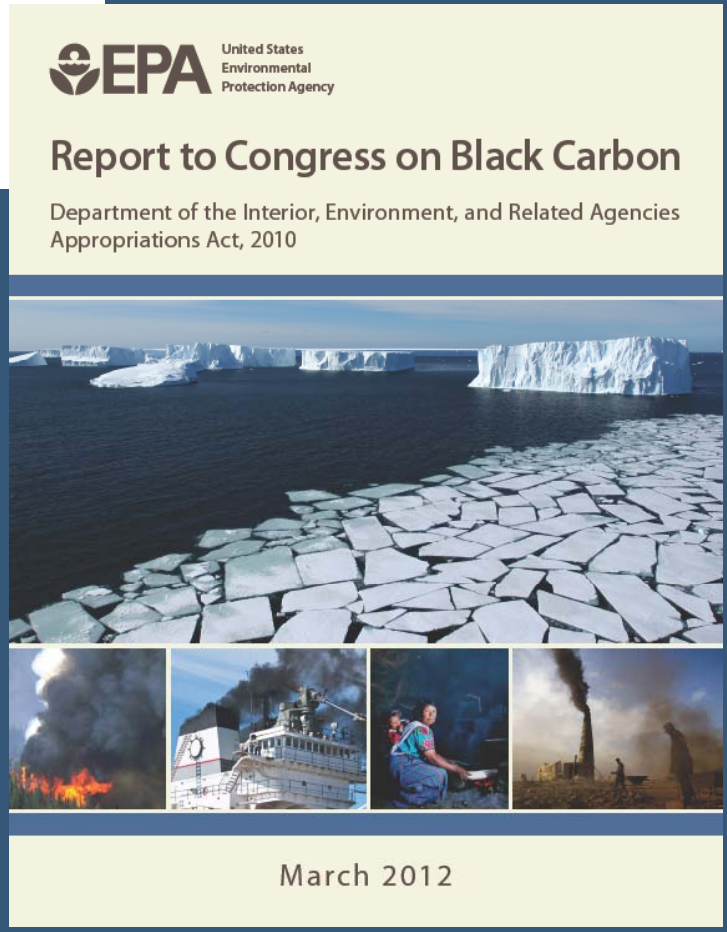
Report to Congress on Black Carbon

Chapter 3

Black Carbon Effects on Public Health and the Environment



PM ISA – December 2009

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Table 2-1. Summary of causal determinations for short-term exposure to $PM_{2.5}$.

Size Fraction	Outcome	Causality Determination

Table 2-2. Summary of causal determinations for long-term exposure to $PM_{2.5}$.

Size Fraction	Outcome	Causality Determination
$PM_{2.5}$	Cardiovascular Effects	Causal
	Respiratory Effects	Likely to be causal
	Mortality	Causal
	Reproductive and Developmental	Suggestive
	Cancer, Mutagenicity, and Genotoxicity	Suggestive

In epidemiologic studies, short-term exposure to $PM_{2.5}$ is associated with a broad range of respiratory and cardiovascular effects, as well as mortality.

Overall, the results indicate that many constituents of PM can be linked with differing health effects and the evidence is not yet sufficient to allow differentiation of those constituents or sources that are more closely related to specific health outcomes.

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Scoping out the Chapter for the RTC

- BC/EC (Not BS)
- Sources: ambient, indoor (not occupational)
- Disciplines – Epi
  - –Not much Tox (mostly Carbon Black)
  - –Not much CHE (didn't include diesel exhaust studies)
- Health Effects – Focus on CVD, Resp (including mortality).
  - –Very little evidence on anything else (Repro, Cancer, CNS)

Observational Studies of Health Effects Associated with Ambient BC

- Associations with monitored BC/EC concentrations
- Associations with modeled BC (LUR)
- Associations with indicators of BC concentrations
  - Traffic/Near-road environment
- Source Apportionment Studies

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Key Health Effects Associated with BC

- Cardiovascular
  - –Changes in blood pressure and heart rate variability
  - –Cardiac Arrhythmia
  - –Hospital Admissions and Emergency Dept Visits
  - –Endothelial Dysfunction
- Respiratory
  - –Airways Inflammation
  - –Decreased Lung Function
  - –Hospital Admissions and Emergency Dept Visits
- Mortality

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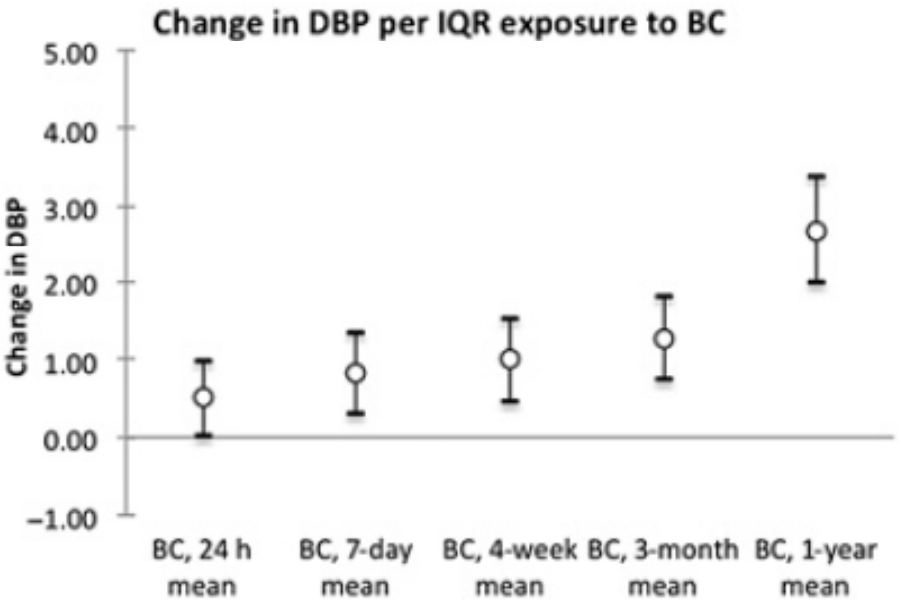
BC Effects on Blood Pressure



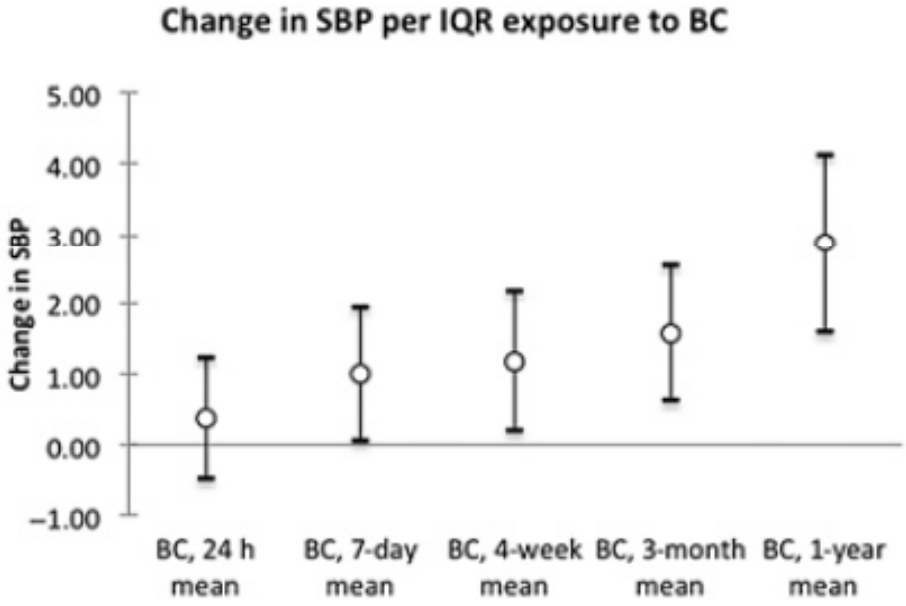


Figure 1 Estimated change in blood pressure associated with an IQR increase in black carbon (BC) exposure. DBP, Diastolic blood pressure; SBP, systolic blood pressure.

Schwartz et al. 2012, OEM 69

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BC Effects on Hospital Admissions

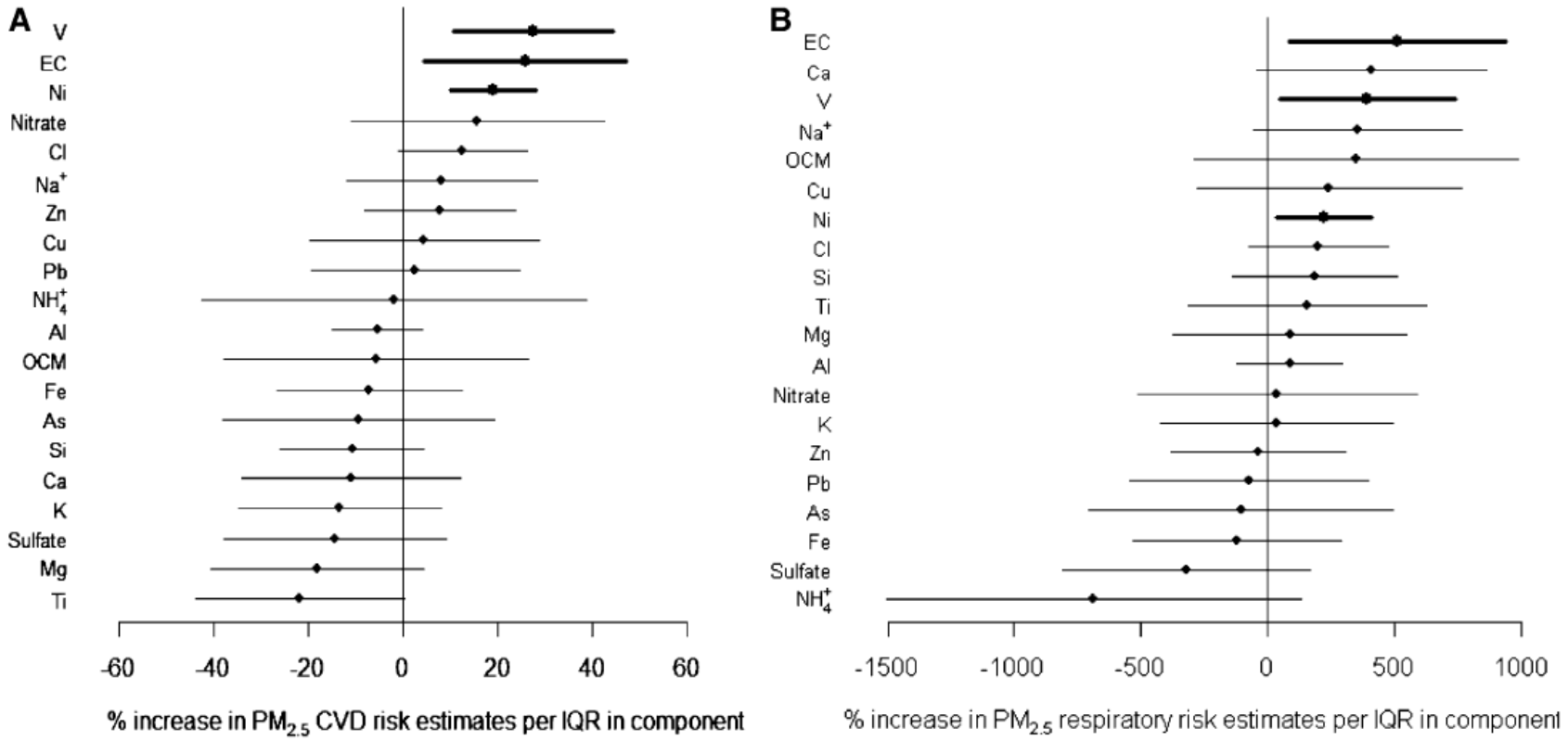

Figure 3. Percent increase in health effects estimates for particulate matter with aerodynamic diameter 2.5 μm or less ($PM_{2.5}$) lag 0 and risk of cardiovascular hospitalizations (*A*) and respiratory hospitalizations (*B*) per IQR increase in the fraction of $PM_{2.5}$ total mass for each component. The *points* reflect the central estimate and the *horizontal line* represents the 95% posterior interval. Statistically significant associations are shown in bold. CVD = cardiovascular disease; EC = elemental carbon; IQR = interquartile range; OCM = organ carbon matter.

Bell et al. 2009, Am J Respir Crit Care Med 179

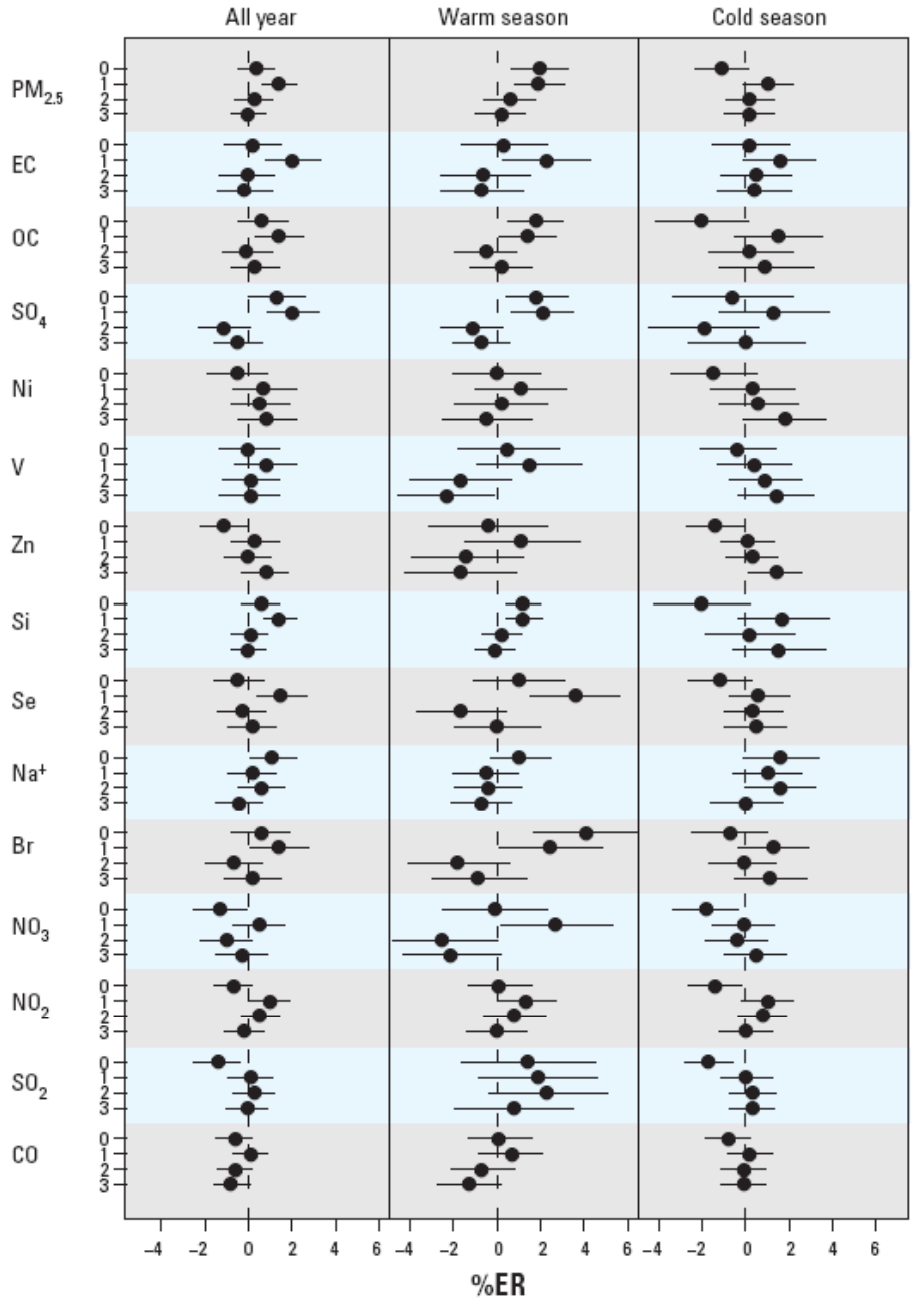

Figure 3. %ER for CVD mortality per IQR increase in air pollutant, adjusted for temporal trend, day-of-week, same-day, and delayed temperature effects.

BC Effects on CVD Mortality

Ito et al. 2011, EHP 119:4

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BC Effects on CVD Mortality

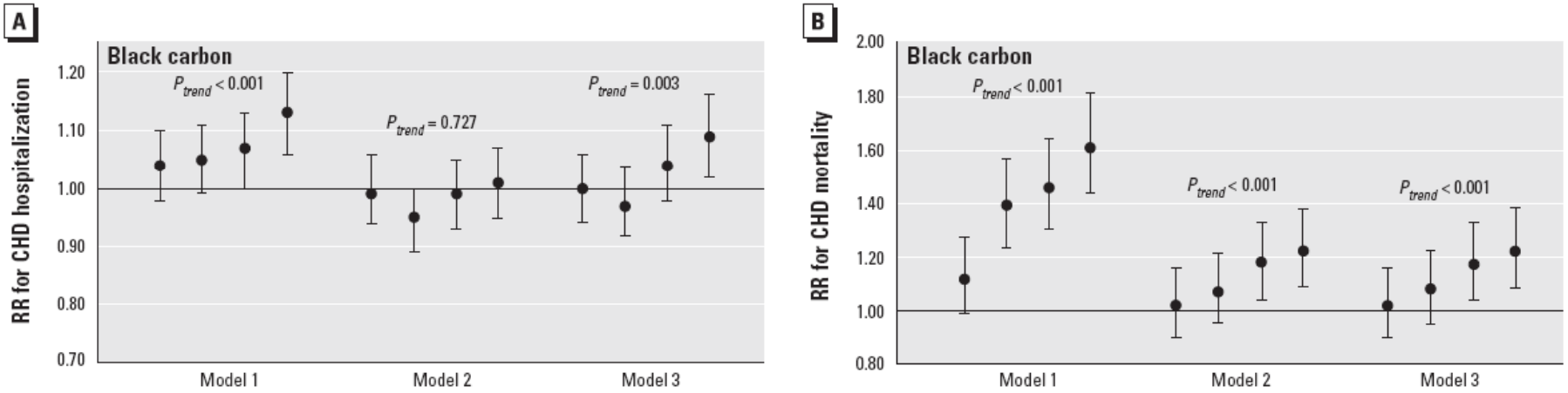

Figure 1. RRs and 95% CIs of CHD hospitalization (*A*) and mortality (*B*) for quintiles of black carbon, $PM_{2.5}$, NO_2 and NO. Quintile 1 (lowest) was the reference category. From left to right, each error bar represents RR and 95% CI of CHD hospitalization (*A*) or mortality (*B*) for quintiles 2–5, respectively, compared with quintile 1. p_{trend} indicates linear trend across quintile groups. Model 1, bivariable analysis; model 2, adjusted for age, sex, preexisting comorbidity, and neighborhood SES; model 3, additionally adjusted for copollutants ($PM_{2.5}$ and NO_2 for black carbon, black carbon and NO_2 for $PM_{2.5}$, black carbon and $PM_{2.5}$ for NO_2 and NO).

Gan et al. 2011, EHP 119:4

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Putting it all together….

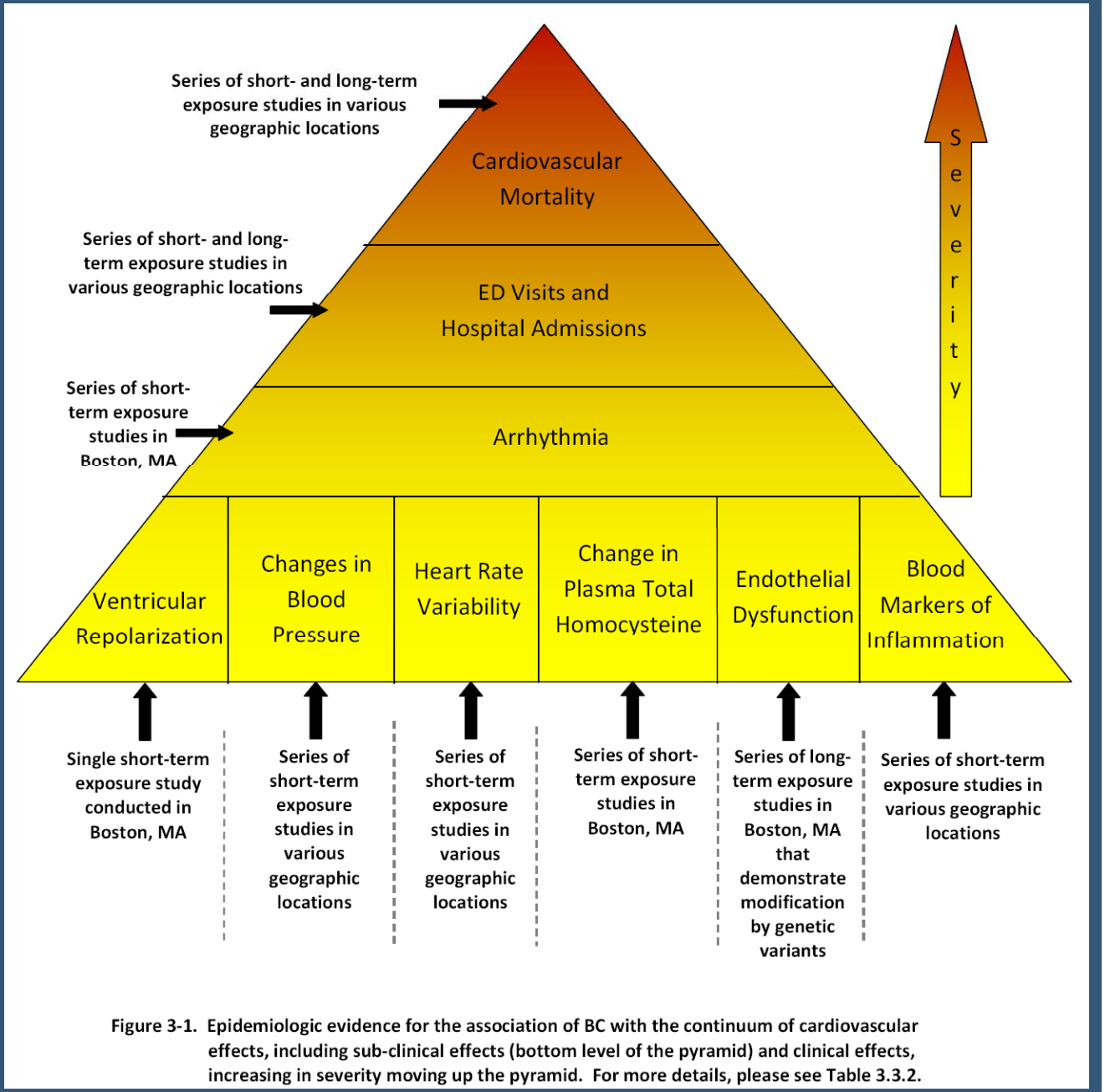

Figure 3-1. Epidemiologic evidence for the association of BC with the continuum of cardiovascular effects, including sub-clinical effects (bottom level of the pyramid) and clinical effects, increasing in severity moving up the pyramid. For more details, please see Table 3.3.2.

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Conclusions

- Health effects associated with BC are consistent with those associated with PM2.5
- Most consistent evidence is for cardiovascular effects
  - Mostly short-term exposures, limited data for health effects of long-term exposures to PM constituents, including BC
- Still difficult to differentiate health effects of various constituents of PM2.5; EPA assumes many constituents are associated with health effects

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Uncertainties

- Majority of BC health studies conducted in greater Boston, MA areas
  - Spatial variability of BC within Boston area?
  - Representative of effects in other geographic areas?
- HEI report on traffic found most consistent associations with respiratory effects, with less consistent evidence for cardiovascular effects

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Thanks

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