
Supplemental Material: Chapter 7 (Metabolic Effects) Integrated Science Assessment for Particulate Matter

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Contents

- Table S7-1. Corresponding effect estimates for Figure 7-10
- Table S7-2. Corresponding effect estimates for Figure 7-11
- Table S7-3. Corresponding effect estimates for Figure 7-12
- Table S7-4. Summary of Studies Examining the Concentration-Response Relationship for Long-term Exposure to PM_{2.5} and Metabolic Effects

Supplemental Tables for Chapter 7 (Metabolic Effects)

Table S7-1. Corresponding effect estimates for Figure 7-10

Study	Cohort	Years	Mean (ug/m ³)	Relative Risk (95 % CI)
†Park et al. (2015)	MESA Air-6 Sites, U.S.	2000	17	1.11 (0.75, 1.61)
†Puett et al. (2011)	NHS and HPFU, U.S.	1976/86-2009	18.3 and 17.5	1.04 (0.95, 1.13)
†Coogan et al. (2016)	BWHS-56 Metro Areas, U.S.	1999-2008	13.9	0.98 (0.83, 1.16)
†Chen et al. (2013)	Ontario, Canada	2001-2006	1.7	1.05 (1.01, 1.10)
†Hansen et al. (2016)	Danish Nurses Cohort	1990-2013	18.1	1.18 (1.03, 1.38)
†Weinmayr et al. (2015)	HNR Study, Germany	2002-2003	16.8	1.18 (0.78, 1.74)

† Studies published since the 2009 PM Integrated Science Assessment.

BWHS = Black Women's Health Study; CI = confidence interval; HNR = Heinz Nixdorf Recall study; HPFU = Health Professionals Follow-up Study; MESA = Multiethnic Study of Atherosclerosis; NHS = Nurses' Health Study; RR = relative risk.
Associations are presented per 5 µg/m³ increase in pollutant concentration.

Table S7-2. Corresponding effect estimates for Figure 7-11

Study	Cohort	Pollutant	Correlation	Relative Risk (95% CI)
†Puett et al. (2011)	HPFU Study	PM _{2.5}	NR	1.04 (0.95, 1.13)
		+ PM _{10-2.5}		1.00 (0.91, 1.10)
†Hansen et al. (2016)	Danish Nurses Cohort	PM _{2.5}	NR	1.28 (0.88, 1.85)
		+ PM ₁₀		1.07 (0.71, 1.61)
†Coogan et al. (2012)	BWHS	PM _{2.5}	NR	1.28 (0.88, 1.85)
		+ NO _x		1.07 (0.71, 1.61)
†Hansen et al. (2016)	Danish Nurses Cohort	PM _{2.5}	NR	1.18 (1.03, 1.38)
		+ NO ₂		1.22 (0.98, 1.51)

†Studies published since the 2009 PM Integrated Science Assessment.

BWHS = Black Women's Health Study; HPFU = Health Professionals Follow-up Study; CI = confidence interval; NO₂ = nitrogen dioxide; NO_x = Oxides of Nitrogen; NR = Not Reported.

Associations are presented per 5 µg/m³ increase in pollutant concentration.

Table S7-3. Corresponding effect estimates for Figure 7-12

Study	Cohort	Notes	Years	Mean ($\mu\text{g}/\text{m}^3$)	Relative Risk (95% CI)
Brook et al. (2013)	CanCHEC		1991-2001	8.7	1.23 (1.18, 1.28)
Crouse et al. (2015)	CanCHEC		1991-2006	8.9	1.15 (1.11, 1.19)
Crouse et al. (2016)	CanCHEC		1991-20063	8.9	1.14 (1.11, 1.17)
Jerrett et al. (2016)	ACS		1982-2004	11.4	1.06 (1.00, 1.13)
Turner et al. (2016)	ACS		1982-2004	12.6	1.07 (1.01, 1.13)
Pope et al. (2014)	ACS		1982-2004	12.6	1.06 (1.01, 1.12)
Crouse et al. (2015)	CanCHEC	Circ+Diabetes	1991-2006	8.9	1.04 (1.03, 1.05)
Pinault et al. (2016)	CCHS	Circ+Diabetes	2000-2011	6.3	1.11 (1.05, 1.17)
Weichenthal et al. (2016)	CanCHEC	Cardiometabolic	2001-2008	9.81	1.04 (0.98, 1.08)

[†]Studies published since the 2009 PM Integrated Science Assessment.

ACS = American Cancer Society; CanCHEC = Canadian Census Health and the Environment Cohort; CI = confidence interval; Circ = Circulatory, CCHS = Canadian Community Health Survey.

Table S7-4. Summary of Studies Examining the Concentration-Response Relationships for Long-term Exposure to PM_{2.5} and Metabolic Effects

Study Location – Cohort (Table/Figure from Reference)	Outcome	Exposure PM _{2.5} Mean (Range) in $\mu\text{g}/\text{m}^3$	Statistical Analysis Summary
Chen et al. (2013) Ontario, Canada (Figure S2)	Type 2 Diabetes	6-yr avg at postal code centroid, Satellite derived AOD Mean 10.6 (range: 2.6-19.1)	Natural cubic splines with 2 degrees of freedom. AIC to assess relative goodness of fit. Adjusted HRs estimated by comparing to a reference category of 2.6 $\mu\text{g}/\text{m}^3$. No evidence of departure from linearity.
Hansen et al. (2016) Danish Nurse Cohort, Denmark (Figure 2)	Type 2 Diabetes	5-yr avg at residence, dispersion model Mean 18.1	Restricted cubic spline and log likelihood test No evidence of deviation from linearity. HRs become less precise at approximately 20 $\mu\text{g}/\text{m}^3$.
Wallwork et al. (2017) NAS, greater Boston	Abdominal Obesity High FBG	Mean: 10.5 Range: 4.2-13.6	LOESS or visual assessment of linearity for continuous variables.

(Figure 2)	Low HDL cholesterol Hypertension Hyper-triglyceridemia Metabolic Syndrome		No major departures from linearity apparent. HRs remained significant and strengthened in sensitivity analysis restricted to 1-year avg PM2.5 levels < 12 µg/m ³
†Thiering et al. (2013) Munich, Wesel and South Germany GINIplus and LISApplus	HOMA IR	Annual avg at residence, LUR	GAM models that allowed the use of smooth functions for covariates and exposures to assess linearity No evidence of departure from linearity
†Wolf et al. (2016) Augsburg and 2 adjacent rural counties, Germany	HOMA IR	Mean (SD) 13.5 and 13.6 (0.8-0.9)	Restricted cubic spline with 3 degrees of freedom. Deviation from linearity observed so exposure concentration was log-transformed

†Studies published since the 2009 PM Integrated Science Assessment.

AIC = Akaike information criterion; AOD = Aerosol Optical Density; FBG = fasting blood glucose; GAM = generalized additive model; GINIplus = German Infant Study on the Influence of Nutrition Intervention plus Environmental and Genetic Influences on Allergy Development; LOESS = locally weighted scatterplot smoothing; HOMA IR = Homeostatic model assessment of Insulin Resistance; HDL = high density lipoprotein; HR = hazard ratio; LISApplus = Influence of LifeStyle Factors on the Development of the Immune System and Allergies in East and West Germany plus the Influence of Traffic Emissions and Genetics, LUR = land use regression; NAS = Normative Aging Study

Note: An important consideration is whether the C-R function is linear across the full concentration range that is encountered, or if there are concentration ranges where there are departures from linearity. Generally, the results of these analyses support a linear or log-linear relationship for metabolic effects examined.

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