

**Major Epidemiologic Studies of PM<sub>2.5</sub> and Total Mortality in California**

<http://scientificintegrityinstitute.org/PM25RRs092410.pdf>

**Relative risk of death from all causes (RR and 95% CI) associated with increase of 10 µg/m<sup>3</sup> in PM<sub>2.5</sub>**

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McDonnell 2000	CA AHSMOG Cohort (N~3,800 [1,347 M + 2,422 F]; Adventists in 9 airsheds, used to estimate PM <sub>2.5</sub> )	RR ~ 1.03 (0.95 – 1.12) during 1976-1992
Krewski 2000 (from Krewski 2010)	CA CPS II Cohort (N=40,408 [18,000 M + 22,408 F]; 4 MSAs; 1979-1983 PM <sub>2.5</sub> ; 44 covariates)	RR = 0.872 (0.805-0.944) during 1982-1989
Enstrom 2005	CA CPS I Cohort (N=35,783 [15,573 M + 20,210 F]; 11 counties; 1979-1983 PM <sub>2.5</sub> )	RR = 1.039 (1.010-1.069) during 1973-1982 RR = 0.997 (0.978-1.016) during 1983-2002
Enstrom 2006	CA CPS I Cohort (N=35,783 [15,573 M + 20,210 F]; 11 counties; 1979-1983 & 1999-2001 PM <sub>2.5</sub> )	RR = 1.061 (1.017-1.106) during 1973-1982 RR = 0.995 (0.968-1.024) during 1983-2002
Zeger 2008	“West” portion of MCAPS Cohort (3.1 M [1.5 M M + 1.6 M F]; Medicare enrollees in CA+OR+WA; 2000-2005 PM <sub>2.5</sub> )	RR = 0.989 (0.970-1.008) during 2000-2005
Jerrett 2010	CA CPS II Cohort (N~95,000 [42,000 M + 53,000 F]; ~50 counties; 1999-2000 PM <sub>2.5</sub> )	RR ~ 0.994 (0.965-1.025) during 1982-2000
Krewski 2010	CA CPS II Cohort (N=40,408; 4 MSAs; 1979-1983 PM <sub>2.5</sub> ) 44 covariates (N=50,930; 7 MSAs; 1999-2000 PM <sub>2.5</sub> )	RR = 0.960 (0.920-1.002) during 1982-2000 RR = 0.968 (0.916-1.022) during 1982-2000
Ostro 2010	CA Teachers Cohort (N~45,000 [45,000 F]; 2002-2007 PM <sub>2.5</sub> )	RR ~ 1.8 (1.6 – 2.0) during 2002-2007

**Epidemiologic Study of PM<sub>2.5</sub> and Total Mortality in United States Relied Upon by CARB and US EPA as of 2010**  
**Relative risk of death from all causes (RR and 95% CI) associated with increase of 10 µg/m<sup>3</sup> in PM<sub>2.5</sub>**

Krewski 2009	CPS II Cohort (N=342,521; 58 MSAs; 1979-1983 PM <sub>2.5</sub> ) 44 covariates (N=488,370; 116 MSAs; 1999-2000 PM <sub>2.5</sub> )	RR = 1.028 (1.014-1.043) during 1982-2000 RR = 1.036 (1.017-1.054) during 1982-2000
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FJC	Requirement to establish causal epidemiologic relationship	RR >= 2.0
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Federal Judiciary Center “Reference Manual on Scientific Evidence, 2<sup>nd</sup> Edition”

[http://www.fjc.gov/public/pdf.nsf/lookup/sciman06.pdf/\\$file/sciman06.pdf](http://www.fjc.gov/public/pdf.nsf/lookup/sciman06.pdf/$file/sciman06.pdf)

Reference Guide on Epidemiology

[http://www.fjc.gov/public/pdf.nsf/lookup/6.epide.pdf/\\$File/6.epide.pdf](http://www.fjc.gov/public/pdf.nsf/lookup/6.epide.pdf/$File/6.epide.pdf)

## References

Author & Year	Home Institution	Underlying Study Cohort	Primary Funding
McDonnell 2000	Loma Linda U, CA	California Adventist Health Study of Smog (AHSMOG)	CARB and US EPA
1) McDonnell WF; Nishino-Ishikawa N; Petersen FF; Chen LH; Abbey DE (2000). Relationships of mortality with the fine and coarse fractions of long-term ambient PM10 concentrations in nonsmokers. <i>J Expo Sci Environ Epidemiol</i> 2000;10:427-436. EPA ISA No 010319 Peer-Reviewed Journal ( <a href="http://scientificintegrityinstitute.org/JEAAA090100.pdf">http://scientificintegrityinstitute.org/JEAAA090100.pdf</a> )			
Krewski 2000	U Ottawa, CN	1982 ACS Cancer Prevention Study (CPS II)	Assume HEI
1) Unpublished August 31, 2010 letter from Krewski to HEI with California-specific results from Table 33 in Krewski 2009 ( <a href="http://www.arb.ca.gov/research/health/pm-mort/HEI_Correspondence.pdf">http://www.arb.ca.gov/research/health/pm-mort/HEI_Correspondence.pdf</a> )			
2) "Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality: HEI Special Report. July 2000" ( <a href="http://pubs.healtheffects.org/view.php?id=6">http://pubs.healtheffects.org/view.php?id=6</a> ). Figure 21 on page 197 of Part II: Sensitivity Analyses ( <a href="http://pubs.healtheffects.org/getfile.php?u=275">http://pubs.healtheffects.org/getfile.php?u=275</a> ).			
3) Enstrom JE (2006). Response to "A Critique of 'Fine Particulate Air Pollution and Total Mortality Among Elderly Californians, 1973-2002'" by Bert Brunekreef, PhD, and Gerard Hoek, PhD, <i>Inhal Toxicol</i> 2006;18:509-514 ( <a href="http://scientificintegrityinstitute.org/IT060106.pdf">http://scientificintegrityinstitute.org/IT060106.pdf</a> )			
Enstrom 2005	UCLA, CA	1959 California Cancer Prevention Study (CA CPS I)	EPRI
Enstrom JE (2005). Fine particulate air pollution and total mortality among elderly Californians, 1973-2002. <i>Inhal Toxicol</i> 2005;17:803-816. EPA ISA No. 087356 Peer Reviewed Journal ( <a href="http://www.arb.ca.gov/planning/gmerp/dec1plan/gmerp_comments/enstrom.pdf">http://www.arb.ca.gov/planning/gmerp/dec1plan/gmerp_comments/enstrom.pdf</a> ) and ( <a href="http://scientificintegrityinstitute.org/IT121505.pdf">http://scientificintegrityinstitute.org/IT121505.pdf</a> )			
Enstrom 2006	UCLA, CA	1959 California Cancer Prevention Study (CA CPS I)	EPRI
Enstrom JE (2006). Response to "A Critique of 'Fine Particulate Air Pollution and Total Mortality Among Elderly Californians, 1973-2002'" by Bert Brunekreef, PhD, and Gerard Hoek, PhD', <i>Inhal Toxicol</i> 2006;18:509-514			

<http://scientificintegrityinstitute.org/IT060106.pdf>

Zeger 2008                      Johns Hopkins U, MD    2000 US Medicare Cohort (MCAPS)                      EPA and NIEHS  
Zeger SL, Dominici F, McDermott A, Samet JM (2008). Mortality in the Medicare Population and Chronic Exposure to Fine Particulate Air Pollution in Urban Centers (2000-2005). *Environ Health Perspect* 2008;116:1614-1619  
(<http://ehp03.niehs.nih.gov/article/info:doi/10.1289/ehp.11449>)

Jerrett 2010                      UC Berkeley, CA            1982 ACS Cancer Prevention Study (CPS II)                      CARB  
Unpublished February 26, 2010 CARB presentation (<http://scientificintegrityinstitute.org/carbjerrett022610.pdf>)

Krewski 2010                      U Ottawa, CN                      1982 ACS Cancer Prevention Study (CPS II)                      Assume HEI  
1) Unpublished August 31, 2010 letter from Krewski to HEI with California-specific results from Krewski 2009  
([http://www.arb.ca.gov/research/health/pm-mort/HEI\\_Correspondence.pdf](http://www.arb.ca.gov/research/health/pm-mort/HEI_Correspondence.pdf))

Ostro 2010                      Cal EPA OEHHA            1995 California Teachers Cohort                      CARB and NCI  
Ostro B, Lipsett M, Reynolds P, Goldberg D, Hertz A, Garcia C, Henderson KD, Bernstein L (2010). Long-Term Exposure to Constituents of Fine Particulate Air Pollution and Mortality: Results from the California Teachers Study. *Environ Health Perspect* 2010;118:363-369 (<http://ehp03.niehs.nih.gov/article/info:doi/10.1289/ehp.0901181>)

Krewski 2009                      U Ottawa, CN                      1982 ACS Cancer Prevention Study (CPS II)                      HEI,NIEHS,CARB,US EPA  
Krewski D, Jerrett M, Burnett RT, Ma R, Hughes E, Shi Y, Turner MC, Pope CA III, Thurston G, Calle EE, Thun MJ. Extended Analysis of the American Cancer Society Study of Particulate Air Pollution and Mortality. HEI Research Report 140. May 2009  
(<http://pubs.healtheffects.org/view.php?id=315>)

April 21, 2010 Enstrom Comments to CARB on PM2.5 and Mortality in CA:  
([http://www.arb.ca.gov/lists/offroad09/25-carb\\_enstrom\\_comments\\_on\\_pm2.5\\_mortality\\_in\\_ca\\_042110.pdf](http://www.arb.ca.gov/lists/offroad09/25-carb_enstrom_comments_on_pm2.5_mortality_in_ca_042110.pdf))