



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
National Center for Environmental Assessment
Office of Air Quality Planning and Standards
Research Triangle Park, NC 27711

MEMORANDUM

SUBJECT: Particulate Matter Air Quality Data Requested from Epidemiologic Study Authors

FROM: Lindsay Wichers Stanek, National Center for Environmental Assessment
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TO: PM NAAQS Review Dockets (EPA-HQ-ORD-2007-0517 and EPA-HQ-OAR-2007-0492)

DATE: July 22, 2010

This memorandum provides information regarding the distribution of air quality data from U.S.- and Canadian-based epidemiologic studies evaluated in the Integrated Science Assessment (ISA) for particulate matter (PM), which supports the current review of the PM National Ambient Air Quality Standards (NAAQS). Additional descriptive statistics beyond those reported in the published studies provide evidence for the concentrations at which health effects are observed and aid the Office of Air Quality Planning and Standards (OAQPS) in developing the Health Risk Assessment and Policy Assessment documents.

NCEA and OAQPS collaborated to request additional descriptive statistics from the authors of U.S.- and Canadian-based epidemiologic studies of short-term exposures to PM_{2.5} and PM_{10-2.5}, as well as long-term exposure to PM_{2.5}. Additional descriptive statistics were requested for studies with the following characteristics: multi-city and single-city studies evaluating mortality and/or morbidity effects associated with short-term exposure to PM_{2.5} and/or PM_{10-2.5} concentrations, and studies evaluating mortality and morbidity effects associated with long-term exposure to PM_{2.5} concentrations.

On May 2, 2009 and October 20, 2009, emails were sent to study authors requesting the below information:

For multi-city studies evaluating mortality and/or morbidity effects associated with short-term PM_{2.5} and/or PM_{10-2.5} concentrations, the following were requested: 1) mean; 95th, 96th, 97th, 98th, 99th percentile values; and minimum and maximum values (each as the average across modeled cities- e.g., the average of the 98th percentile values across the cities evaluated); 2) if applicable, differentiate the above air quality information by specific years and regions (as defined in the study); 3) identify the air quality monitors used if they were not specified in the published study; and, 4) for PM_{10-2.5} studies, provide the above information for PM₁₀ if available (this phrase was added for the October email).

For single-city studies evaluating mortality and morbidity effects associated with short-term PM_{2.5} ambient concentrations, the information requested for multi-city studies were also requested for the one city evaluated.

For studies evaluating mortality and morbidity effects associated with long-term PM_{2.5} ambient concentrations, the following were requested: 1) mean of the ambient PM_{2.5} mean concentrations across cities reported in the study for the time period evaluated in the study; and, 2) if applicable, differentiate the above information by individual years, season (as defined in the study) and region (as defined in the study).

It was noted that authors could alternatively provide air quality data sets. Follow-up correspondence occurred periodically via telephone and/or email between May 2, 2009 and December 11, 2009. The email correspondence received from study authors has been incorporated into the ORD docket for this PM NAAQS review (EPA-HQ-ORD-2007-0517) and the attachment contains the document title, document ID numbers, and date posted for these materials contained in the docket.

In response to the above request, study authors provided EPA with either the requested concentrations across all study years or the air quality data for each individual year included in the study. When study authors only provided air quality data for each individual year included in the study EPA scientists calculated the corresponding descriptive statistics for the entire study period. If no additional data were received from study authors, then statistics reported in the published studies were not replicated in this memorandum. Data provided for the previous PM Criteria Documents or Staff Papers have also not been replicated in this memorandum.

Tables 1-3 included in this memorandum provide the descriptive statistics for each study and are organized by size fraction and study period (short-term and long-term PM_{2.5} exposure and short-term PM_{10-2.5} exposure). The short-term PM_{2.5} and PM_{10-2.5} exposure tables (Tables 1 and 3) summarize the mean and upper percentile concentrations (95th-99th, maximum). When available, the overall data and the averages calculated from yearly data were included in Table 3 for PM_{10-2.5}. The long-term PM_{2.5} exposure table (Table 2) summarizes mean concentrations. Studies within the tables are organized alphabetical according to the principal investigator and include a hyperlink to NCEA's Health and Environmental Research Online (HERO) database at <http://epa.gov/hero>, which contains scientific literature used by the EPA in developing ISAs.

The descriptive statistics in the following tables were used within the ISA to supplement the published data provided in each study. These statistics were primarily used to summarize the air quality distribution across which PM-related health effects were observed in the summary figures presented in Chapter 2 of the ISA. In addition, the 98th percentiles were incorporated into some of the summary tables in Chapter 6 of the ISA to better characterize the upper percentiles of the air quality distribution. The mean concentrations provided by study authors were included in some of the summary tables in Chapters 6 and 7 of the ISA, if the published study did not report a mean concentration. In some instances, the descriptive statistics, either provided by study authors or calculated by EPA scientists using the air quality data sets provided by study authors, were found to vary slightly from those reported in the published studies. However, the difference between the two concentrations was not substantial.

Table 1. Statistics for 24-hour PM_{2.5} Concentrations from Short-term Exposure Health Studies in µg/m³

Study	Location	Author-Provided Mean	Study Mean	95%	96%	97%	98%	99%	Max
Adamkiewicz et al. (2004, 087925)	Steubenville, OH	19.7	19.7	43.6	43.8	46.1	48.4	50.3	50.7
Adar et al., (2007, 001458)	St. Louis, MO	10.1	NP	19.9	21.3	22.2	22.4	23.0	23.2
Auchincloss et al., (2008, 156234)	6 U.S. cities	16.6	16.8	26.3	27.2	29.1	30.6	34.7	47.9
Bell et al., (2008, 156266)	202 U.S. counties	12.9	NP	27.8	29.3	31.3	34.2	38.8	66.4
Burnett et al., (2004, 086247)	12 Canadian cities	12.2 ^a	12.8 ^b	30.0 ^a	31.8 ^a	34.3 ^a	38.1 ^a	45.5 ^a	85.6 ^a
Diez Roux et al., (2006, 156400)	6 U.S. cities	16.6	NP	26.3	27.2	29.1	30.6	34.7	47.9
Dubowsky et al., (2006, 088750)	St. Louis, MO	16.0	16	25.4	25.8	27.9	27.9	27.9	27.9
Ebelt et al., (2005, 056907)	Vancouver, Canada	11.3	11.4	17.3	18.1	19.8	23.0	25.9	28.7
Franklin et al., (2007, 091257)	27 U.S. communities	15.6	15.8 ^c	35.5	37.8	41.0	45.8	54.7	239.0
Franklin et al., (2008, 097426)	25 U.S. communities	14.8	15.4 ^c	33.1	35.4	38.4	43.0	50.9	239.2
Gent et al., (2003, 052885)	4 cities in southern New England	13.1	13.1	30.7	32.4	32.7	33.2	37.6	44.2
Gent et al., (2009, 180399)	New Haven, CT	16.6	17.0	33.7	35.8	38.6	40.9	46.3	83.4
Goldberg et al., (2003, 035202)	Montreal, Quebec	17.4	17.4	39.5	44.3	46.5	53.0	59.0	72.0
Goldberg et al., (2006, 088641)	Montreal, Quebec	17.4	17.4	39.5	44.3	46.5	53.0	59.0	72.0
Ito et al., (2007, 156594)	New York, NY	15.1	15.1	32.0	34.0	36.0	39.0	43.0	81.0
Klemm et al., (2004, 056585)	Atlanta, GA	19.6	19.6	34.5	35.4	37.3	38.9	41.8	48.0
Lisabeth et al., (2008, 155939)	Corpus Christi, TX	NP	NP	17.0	17.6	19.3	23.6	27.8	41.9
Liu et al., (2009, 192003)	Windsor, Ontario	7.1	NP	14.5	19.0	19.0	19.0	20.5	20.5
Luttmann-Gibson et al., (2006, 089794)	Steubenville, OH	19.7	19.7	43.6	43.8	46.1	48.4	50.3	50.7
Mar et al., (2004, 057309)	Spokane, WA	NP	9.8 ^c	19.7	20.6	23.0	25.8	28.9	34.8
McCormack et al., (2009, 199833)	Baltimore, MD	12.4	NP	24.9	26.0	28.7	32.0	34.1	45.2
Metzger et al., (2004, 044222)	Atlanta, GA	19.7 ^c	NP	35.6 ^c	36.5 ^c	38.4 ^c	39.8 ^c	42.0 ^a	47.8 ^c
O'Neill et al., (2007, 156006)	6 U.S. cities	16.6	16.5	26.3	27.2	29.1	30.6	34.7	47.9

Study	Location	Author-Provided Mean	Study Mean	95%	96%	97%	98%	99%	Max
Ostro et al., (2006, 087991)	9 CA counties	19.9	19.4 ^c	53.0	56.9	62.0	68.2	82.0	160.0
Ostro et al., (2007, 091354)	9 CA counties	18.4	19.3	47.7	51.3	56.2	61.2	70.1	116.1
Ostro et al., (2008, 097971)	9 CA counties	18.4	19.3	47.7	51.3	56.2	61.2	70.1	116.1
Ostro et al., (2009, 191971)	6 CA counties	19.7	19.4	48.5	53.2	57.6	61.3	69.0	96.2
Park et al., (2005, 057331)	Boston, MA	10.9	11.4	23.9	25.9	27.4	30.6	34.6	73.0
Park et al., (2008, 156845)	Boston, MA	11.8	12.0	24.9	26.5	28.2	30.8	36.3	73.0
Peel et al., (2005, 056305)	Atlanta, GA	19.7 ^c	19.2	35.6 ^c	36.5 ^c	38.4 ^c	39.8 ^c	42.0 ^c	47.8 ^c
Pope et al., (2008, 191969)	3 metropolitan areas in Utah	NP	11.1 ^c	31.2 ^c	34.1 ^c	38.6 ^c	44.5 ^c	54.6 ^c	118 ^c
Rabinovitch et al., (2004, 096753)	Denver, CO	10.6 ^c	10.8	22.3 ^c	23.2 ^c	25.9 ^c	29.3 ^c	31.7 ^c	43.1 ^c
Rabinovitch et al (2006, 088031)	Denver, CO	7.4 ^{c, d}	7.4 ^{c, d}	13.4 ^{c, d}	14.3 ^{c, d}	14.6 ^{c, d}	17.2 ^{c, d}	21.9 ^{c, d}	22.1 ^{c, d}
Rich et al., (2004, 055631)	Vancouver, Canada	8.2	8.2	16.3	19.1	20.0	21.3	29.7	140.3
Rich et al., (2008, 156910)	2 monitoring sites in NJ	13.4	NP	31.1	33.1	34.8	37.6	41.5	61.4
Rosenthal et al., (2008, 156925)	Indianapolis, IN	NP	NP	30.6 ^{a, c}	NP	NP	36.0 ^{a, c}	41.3 ^{a, c}	NP
Sarnat et al., (2006, 090489)	Steubenville, OH	19.7	19.6	43.6	43.8	46.1	48.4	50.3	50.7
Schreuder et al., (2006, 097959)	Spokane, WA	10.8	10.6	25.1	26.1	27.5	29.6	32.8	45.8
Slaughter et al., (2005, 073854)	Spokane, WA	10.8	NP	25.1	26.1	27.5	29.6	32.8	45.8
Symons et al., (2006, 091258)	Baltimore, MD	16.5	16.0	36.6	39.8	45.2	50.1	55.8	69.3
Tolbert et al., (2007, 090316)	Atlanta, GA	17.1	17.1	33.3	34.3	35.9	38.7	40.7	65.8
Villeneuve et al., (2006, 090191)	Edmonton, Canada	NP	8.5	19.0	19.2	21.0	24.0	30.2	103.0
Wilson et al., (2007, 091141)	Edmonton, Canada	13.0	NP	27.0	27.8	28.9	31.6	33.4	41.0
Zanobetti and Schwartz (2009, 188462)	112 U.S. cities	13.2	13.3 ^c	28.2	29.7	31.6	34.3	38.6	57.4
Zhang et al., (2009, 191970)	Contiguous U.S.	13.9 ^c	13.9	29.3 ^c	31.6 ^c	33.9 ^c	37.6 ^c	40.5 ^c	77.1 ^c

NP=not provided

^a FRM data reported; TEOM data available

^b Population-weighted

^c Calculated from seasonal averages, yearly averages, and/or averages over multiple locations

^d TEOM data reported; FRM data available

Table 2. Statistics for 24-hour PM_{2.5} Concentrations from Long-term Exposure Health Studies in µg/m³

Study	Location	Author-provided Mean	Study Mean
Allen et al., (2009, 156209)	5 U.S. cities	16.1	15.8
Bell et al., (2007, 091059)	13 counties in MA and CT	12.0	11.9
Chen et al. (2005, 087942)	Southern California	23.7 ^a	29.0
Diez Roux et al., (2008, 156401)	6 U.S. cities	18.7	21.7
Laden et al., (2006, 087605)	6 U.S. cities	16.4 ^a	NP
Meng et al., (2007, 093275)	LA and San Diego Counties	19.1	NP
Miller et al., (2007, 090130)	36 U.S. metropolitan areas	12.9	13.5
O'Neill et al., (2007, 156006)	6 U.S. cities	18.7	16.5
Rich et al., (2009, 180122)	20 monitoring sites in NJ	13.7	13.8 ^b

NP=not provided

^a Calculated from seasonal averages, yearly averages and/or averages over multiple locations

^b Calculated over three pregnancy trimesters

Table 3. Statistics for 24-hour PM_{10-2.5} Concentrations from Short-term Exposure Health Studies in µg/m³

Study	Location	Author-provided Mean	Study Mean	95%	96%	97%	98%	99%	Max
Burnett et al., (2004, 086247)	12 Canadian cities	11.0	11.4 ^a	26.9	29.0	31.5	35.0	40.5	150.9
Klemm et al., (2004, 056585) Calculated from yearly averages	Atlanta, GA	9.7	NP	18.2	18.8	19.8	20.8	22.4	34.2
Overall		9.7	9.7	16.8	17.4	18.0	18.6	20.2	25.2
Mar et al., (2004, 057309)	Spokane, WA	NP	10.8 ^b	23.6	24.9	26.8	32.2	40.6	50.9
Metzger et al., (2004, 044222) Calculated from yearly averages	Atlanta, GA	9.7	NP	18.9	19.5	20.2	20.9	22.6	34.2
Overall		9.7	NP	18.8	19.4	20.1	21.0	22.7	34.2
Peel et al., (2005, 056305) Calculated from yearly averages	Atlanta, GA	9.7	NP	18.9	19.5	20.2	20.9	22.6	34.2
Overall		9.7	9.7	18.8	19.4	20.1	21.0	22.7	34.2

Study	Location	Author-provided Mean	Study Mean	95%	96%	97%	98%	99%	Max
Peng et al., (2008, 156850)	108 U.S. counties	12.3	NP	26.5	28.3	30.9	34.7	41.9	81.3
Tolbert et al., (2007, 090316) Calculated from yearly averages	Atlanta, GA	9.1	NP	17.9	18.6	19.5	21.0	23.4	50.3
Overall		9.0	9.0	18.8	19.6	20.8	21.9	23.8	50.3
Zanobetti & Schwartz (2009, 188462)	47 U.S. cities	11.8	11.6 ^c	31.1	33.3	35.9	40.2	47.2	88.3

NP=not provided

^a Population-weighted

^b Calculated from PM₁₀ and PM_{2.5} concentrations

^c Calculated from seasonal averages, yearly averages and/or averages over multiple locations

Attachment

DOCUMENT TITLE	DOCUMENT ID	DATE POSTED
Email to authors of recent U.S. and Canadian epidemiological studies	EPA-HQ-ORD-2007-0517-0050	05/21/2009
Email to authors of recent U.S. and Canadian epidemiological studies evaluating health effects associated with exposure to particulate matter (PM) from Beth Hassett-Sipple on October 20, 2009	EPA-HQ-ORD-2007-0517-0104	01/15/2010
Email to Jason Sacks, USEPA - June 1, 2009	EPA-HQ-ORD-2007-0517-0064	8/26/2009
Zanobetti Data: Descriptive PM2.5 in 112 Cities (By Region)	EPA-HQ-ORD-2007-0517-0064.1	08/26/2009
Zanobetti Data: Descriptive PM2.5 in 112 Cities (Overall)	EPA-HQ-ORD-2007-0517-0064.2	08/26/2009
Zanobetti Data: Descriptive PM-Coarse in 47 Cities (By Region)	EPA-HQ-ORD-2007-0517-0064.3	08/26/2009
Zanobetti Data: Descriptive PM-Coarse in 47 Cities (Overall)	EPA-HQ-ORD-2007-0517-0064.4	08/26/2009
Zanobetti Data: List Cities and Counties	EPA-HQ-ORD-2007-0517-0064.5	8/26/2009
Email regarding Bell Quality Data Response to Request	EPA-HQ-ORD-2007-0517-0087	01/13/2010
Email to Rebecca Yang, Student Services Contractor, USEPA from Zu-Ming Zhang on 12/02/2009	EPA-HQ-ORD-2007-0517-0088	01/13/2010
Email to Rebecca Yang, Student Services Contractor, USEPA from Synnove F. Knutsen, Professor and Chair, Loma Linda University on 12/01/2009	EPA-HQ-ORD-2007-0517-0089	01/13/2010
Email to Rebecca Yang from Lindsay Stanek on 11/30/2009	EPA-HQ-ORD-2007-0517-0090	01/13/2010
Email to Rebecca Yang, USEPA from Karen Fung on 12/01/2009	EPA-HQ-ORD-2007-0517-0091	01/13/2010
Email to Rebecca Yang, USEPA from Tim Larson, University of Washington on November 27, 2009	EPA-HQ-ORD-2007-0517-0092	01/13/2010
Email to Beth Hassett-Sipple, USEPA from Tim Larson, University of Washington on May 19, 2009	EPA-HQ-ORD-2007-0517-0093	01/13/2010
Email to Beth Hassett-Sipple, USEPA from Elizabeth Sheppard, University of Washington on July 20, 2009	EPA-HQ-ORD-2007-0517-0094	01/13/2010
Email to Lindsay Stanek and Beth Hassett-Sipple, USEPA from Steven Dutton, USEPA on November 18, 2009	EPA-HQ-ORD-2007-0517-0095	01/13/2010
Email to Beth Hassett-Sipple, USEPA from Ying-Ying Meng, UCLA Center for Health Policy Research on November 16, 2009	EPA-HQ-ORD-2007-0517-0096	01/13/2010
Email to Rebecca Yang, USEPA from J. Morel Symons, E.I. Du Pont de Nemours and Company on November 10, 2009	EPA-HQ-ORD-2007-0517-0097	01/13/2010
Email to Rebecca Yang, USEPA from Lynda Lisabeth, University of Michigan on November 09, 2009	EPA-HQ-ORD-2007-0517-0098	01/14/2010
Email to Paul Villeneuve, Health Canada from Li Chen, Health Canada on October 29, 2009	EPA-HQ-ORD-2007-0517-0099	01/14/2010
Email to Rebecca Yang, USEPA from Paul Villeneuve, Health Studies on November 03, 2009	EPA-HQ-ORD-2007-0517-0100	01/14/2010
Email to Rebecca Yang, USEPA from Arden Pope, Brigham Young University on October 30, 2009	EPA-HQ-ORD-2007-0517-0101	01/14/2010
Email to Rebecca Yang, USEPA from Lyndsey Darrow, Emory University on October 30, 2009	EPA-HQ-ORD-2007-0517-0102	01/14/2010
Email to Frank Rosenthal, Purdue University from Beth Hassett-Sipple, USEPA on October 29, 2009	EPA-HQ-ORD-2007-0517-0103	01/15/2010
Email to Beth Hassett-Sipple, USEPA from Karin Yeatts, University of North Carolina on June 15, 2009	EPA-HQ-ORD-2007-0517-0105	01/15/2010
Email to George O'Connor, Boston University School of	EPA-HQ-ORD-2007-0517-0106	01/20/2010

Medicine from Beth Hassett-Sipple, USEPA on October 20, 2009		
Email to Rebecca Yang, Student Services Contractor, USEPA from Michael Brauer, Director, School of Environmental Health, The University of British Columbia on December 8, 2009	EPA-HQ-ORD-2007-0517-0107	01/20/2010
Email to Beth Hassett-Sipple, USEPA/RTP from Bart Ostro, Chief, Air Pollution Epidemiology Section, Office of Environmental Health Hazard Assessment (OEHHA) on July 21, 2009	EPA-HQ-ORD-2007-0517-109	02/04/2010
Email to Beth Hassett-Sipple, USEPA/RTP from Rick Burnett on July 21, 2009	EPA-HQ-ORD-2007-0517-110	02/12/2010
Email to Rebecca Yang, USEPA/RTP from Meridith Franklin on October 28, 2009	EPA-HQ-ORD-2007-0517-111	02/12/2010
Email to Beth Hassett-Sipple, USEPA/RTP from Janneane F. Gent, Research Scientist, Yale University on October 21, 2009	EPA-HQ-ORD-2007-0517-112	02/12/2010
Email to Beth Hassett-Sipple, USEPA/RTP from Cynthia Curl, MWSA Air Project Manager, University of Washington on August 10, 2009	EPA-HQ-ORD-2007-0517-113	02/12/2010
Email to Beth Hassett-Sipple, USEPA/RTP from Greg Diette on June 25, 2009	EPA-HQ-ORD-2007-0517-114	02/12/2010
Email to Paul Villeneuve from Li Chen on October 29, 2009	EPA-HQ-ORD-2007-0517-115	02/12/2010
Email to USEPA: Beth Hassett-Sipple, Lindsay Stanek, Rebecca Yang, and Pradeep Rajan from Lyndsey Darrow, Paige Tolbert, Emory University on October 21, 2009	EPA-HQ-ORD-2007-0517-116	02/12/2010
Email from Francine Laden, Harvard School of Public Health, to Beth Hassett-Sipple, USEPA on May 21, 2009	EPA-HQ-OAR-2007-0492-0122	7/15/10