**Supplemental Material:**

**Degrees and Dollars – Health Costs Associated with Suboptimal Ambient Temperature Exposure**

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# Air Pollution as Potential Confounder

## Data and Method

This study investigates Ozone (O3) and Particulate Matter with radius smaller or equal than 2.5 μm (PM2.5) for potential confounding effects by air pollutants (AP) in the risk assessment model of temperature and population health. Current literature has not fully agreed on the statistical significance of such effects. Therefore, this study conducts sensitivity analysis to see how the inclusion of AP data may affect the results. Lin et al. (2009) and Christenson et al. (2016) included air pollutants in their analyses as air pollutants theoretically qualify as confounders. O3 and PM2.5 are risk factors for mortality and morbidity, are associated with temperature, and are not in the causal pathway between temperature and population health. The risk assessment model in Lavigne et al. (2014) considers O3 but not PM2.5 as a confounder based on model diagnostics. Medina-Ramón and Schwartz (2007) and Michelozzi et al. (2009) did not include O3 since it did not lead to substantial changes in risk assessment results.

In this study, the AP related sensitivity analysis is restricted to a nine-year period between 2005 and 2013 due to data availability. The historical records of AP were originally available for 2000-2013. However, O3 was measured only during summer months prior to 2005, leading to severe issue of missing data between 2000 and 2004. In the remaining O3 time series, 2006 and 2009 did not have records for October. As O3 is highly seasonal, we randomly sampled October O3 from October of other years during which data is available. The time series of PM2.5 has less than three missing data points that are not close to each other. This study assumes the PM2.5 level on these days are identical to that on their previous days, respectively. The public health data used in the sensitivity analysis was truncated for the time horizon established by the air pollutants data. Age-stratification is not considered in this sensitivity analysis. Models that adjust for same day (lag=0) O3 and PM2.5 using a natural cubic spline given 3 degrees of freedom are compared to the baseline model, the final model used in the main text of this study. Three criteria are subsequently used to evaluate the comparison: (1) the shape and confidence interval of exposure-response function (by observation); (2) the p-value of O3 and PM2.5 variables in the regression models; and (3) the corresponding attributable risk point estimations.

The following sections show the results regarding the three criteria stated above. Our results suggest that it is justifiable to exclude AP from the risk assessment model in this study as doing so does not lead to substantial changes in health burden estimates.

## Results

### The Exposure Response Functions



MORT – mortality; EDV – emergency department visits; EDHSP – emergency hospitalizations; MORB – emergency department visits and emergency hospitalizations. This plot compares the exposure response function when adjust for AP to their respective baseline models. There is no significant change in their shapes or ranges of hazardous (i.e. statistically significant) temperature exposure levels.

### Model Diagnostics

|  |  |  |
| --- | --- | --- |
| **Health Outcome** | **Model** | **p-value** |
| **ns(AP, 3) 1** | **ns(AP, 3) 2** | **ns(AP, 3) 3** |
| **MORT** |  | **Baseline** | - | - | - |
| **O3** | 0.99 | 0.16 | 0.75 |
| **PM2.5** | 0.93 | 0.56 | 0.87 |
| **EDV** |  | **Baseline** | - | - | - |
| **O3** | 0.53 | 0.83 | 0.81 |
| **PM2.5** | **<0.01** | **0.01** | 0.64 |
| **EDHSP** |  | **Baseline** | - | - | - |
| **O3** | **<0.01** | 0.18 | 0.64 |
| **PM2.5** | **<0.01** | 0.20 | 0.76 |
| **Morb** |  | **Baseline** | - | - | - |
| **O3** | 0.11 | 0.79 | 0.97 |
| **PM2.5** | **<0.01** | **0.01** | 0.67 |

MORT – mortality; EDV – emergency department visits; EDHSP – emergency hospitalizations; MORB – emergency department visits and emergency hospitalizations. This table shows the p-value of the air pollutants when included in the baseline model. The p-values smaller than 0.05 are marked by bold fonts. PM2.5 is significant for all morbidity outcomes (EDV, EDHSP, MORB). O3 is only significant for EDHSP.

### Attributable Risk Comparison

|  |  |  |  |
| --- | --- | --- | --- |
| **Health Outcome** | **Model** | **Attributable Cases****(AC)** | **Attributable Fraction****(AF, %)** |
|  |
| **Mort** | **Baseline** | 13,478 | 8.34 |
| **O3** | 12,846 | 7.95 |
| **PM2.5** | 13,249 | 8.20 |
| **EDV** | **Baseline** | 267,248 | 4.53 |
| **O3** | 267,561 | 4.54 |
| **PM2.5** | 267,206 | 4.53 |
| **EDHSP** | **Baseline** | 40,446 | 3.09 |
| **O3** | 37,736 | 2.89 |
| **PM2.5** | 42,710 | 3.27 |
| **Morb** | **Baseline** | 302,441 | 4.20 |
| **O3** | 302,957 | 4.19 |
| **PM2.5** | 303,280 | 4.21 |

MORT – mortality; EDV – emergency department visits; EDHSP – emergency hospitalizations; MORB – emergency department visits and emergency hospitalizations. This table shows the attributable fractions (AF) and attributable cases (AC) as a result of including AP in the baseline model. Mort indicates mortality. Relatively larger changes are observed for EDHSP although the percentage changes are still smaller than 10%.

# Deriving the Exposure Response Function – Model Specifications

The description of the risk assessment model can be found in the main text. This section only focuses on parameter selection. Originally, a large number of parameter combinations were tested by switching the center knots of the exposure response relationship to 50th and 25th percentiles; the maximum lag considered to 14, 21, and 35 days; the degree of freedom given to the long-term trend during each year to 6-10; and by including air pollution (O3 and PM2.5). The combination of parameter with that optimizes q-AIC (Quasi-Akaike’s Information Criterion) and residual partial autocorrelation was selected.

# Annual Attributable Risk Estimation

|  |  |  |  |
| --- | --- | --- | --- |
|  | Mort | EDV | EDHSP |
|  | Senior | Youth | Adult | Senior | Youth | Adult | Senior |
| 1998 | 1188 | - | - | - | - | - | - |
| 1999 | 1,536 | - | - | - | - | - | - |
| 2000 | 1,445 | - | - | - | - | - | - |
| 2001 | 1,525 | - | - | - | - | - | - |
| 2002 | 1,507 | - | - | - | - | - | - |
| 2003 | 1,389 | - | - | - | - | - | - |
| 2004 | 1,359 | - | - | - | - | - | - |
| 2005 | 1,416 | 15,640 | 8,515 | 1,915 | 1,392 | 2,322 | 3,221 |
| 2006 | 1,327 | 17,352 | 9,929 | 2,472 | 1,578 | 2,549 | 3,579 |
| 2007 | 1,346 | 18,894 | 8,932 | 2,159 | 1,677 | 2,699 | 3,681 |
| 2008 | 1,527 | 20,197 | 10,793 | 2,648 | 1,707 | 3,015 | 4,096 |
| 2009 | 1,444 | 19,099 | 10,350 | 2,546 | 1,672 | 2,775 | 3,621 |
| 2010 | 1,445 | 17,817 | 9,983 | 2,388 | 1,451 | 2,691 | 3,516 |
| 2011 | 1,654 | 21,783 | 12,137 | 3,026 | 1,567 | 2,982 | 3,909 |
| 2012 | 1,353 | 16,110 | 9,807 | 2,924 | 1,245 | 2,247 | 3,174 |
| 2013 | 1,729 | 22,230 | 13,074 | 3,614 | 1,554 | 3,079 | 4,142 |
| 2014 | 1,721 | 23,033 | 13,641 | 3,436 | 1,605 | 3,027 | 3,972 |
| Total | 24,911 | 192,155 | 107,161 | 27,128 | 15,448 | 27,386 | 36,911 |

This table shows the results of the “Year-to-Year Variations for Cost Estimation” under the “Data and Methods” Section. Year-to-year variations are assessed because many cost estimation parameters changes on an annual basis.

# Cost Estimation Parameters

## Adjusting Value of Statistical Life

### Methods

In a U.S. Department of Transportation Memorandum titled “Guidance on Treatment of the Economic Value of a Statistical Life (VSL) in the U.S. Department of Transportation Analyses - 2015 Adjustment”, the following equation was used to approximate VSL values in years other than when it was originally estimated (Thomson and Monje 2015):

$$VSL\_{year}=VSL\_{base}×\frac{CPI\_{year}}{CPI\_{base}}×\left(\frac{RI\_{year}}{RI\_{base}}\right)^{η}$$

where CPI is the Consumer Price Index, RI is Real Income, which refers to individual income after adjusting for inflation, and $η$ is the income elasticity based on which societal Willingness to Pay (WTP) increase with Real Income. $VSL\_{base}$ in the main analysis is from an EPA meta-analysis (U.S. EPA 1997) although various other, updated VSL estimates are also used to check the results. It is not yet certain how VSL changes by age groups (U.S. EPA Office of Air and Radiation 2011). The VSL for elderly, for instance, have been shown to be both lower and higher than population average (Aldy and Viscusi 2007; Hammitt 2007; Johansson 2006). In this study, VSL does not vary by age. The BenMAP (Environmental benefits Mapping and Analysis Program - Community Edition) uses an $η$ with central estimate of 0.4 for Premature Mortality (RTI International 2015). This value is adopted by our study since we believe a Statistical Life is a normal good - an increase in income will lead to a rise in demand. However, we are also aware that some recent studies have provided drastic different estimations for $η$. For instance, Kniesner et al. (2010) has shown income elasticity ranging from 2.24 at low incomes to 1.23 at high incomes. With values greater than 1, studies like this have shown that statistical life could be considered a luxury good.

 Using the parameters discussed, the following sections estimate the VSL in the context of this study, and then provide the mortality costs estimates based on EPA as well as updated VSL values.

### Consumer Price Index

|  |  |
| --- | --- |
| Year | CPI |
| 1990 | 127 |
| 1991 | 130.4 |
| 1992 | 135 |
| 1993 | 139.2 |
| 1994 | 143.6 |
| 1995 | 147 |
| 1996 | 151.9 |
| 1997 | 155.4 |
| 1998 | 158.3 |
| 1999 | 163.3 |
| 2000 | 170.1 |
| 2001 | 176.5 |
| 2002 | 179.6 |
| 2003 | 182.7 |
| 2004 | 187.9 |
| 2005 | 193.1 |
| 2006 | 196.2 |
| 2007 | 201.247 |
| 2008 | 208.958 |
| 2009 | 207.889 |
| 2010 | 211.728 |
| 2011 | 219.339 |
| 2012 | 224.459 |
| 2013 | 228.811 |
| 2014 | 232.013 |
| 2015 | 230.567 |
| 2016 | 234.145 |

The Consumer Price Index (CPI) for all urban consumers is used in this study to capture inflation. Data is obtained through the U.S. Department of Labor, Bureau of Labor Statistics (U.S. Bureau of Labor Statistics 2017). This data is specific to the Minneapolis-St. Paul MN-WI Combined Statistical Area for all items. The reference period (during which CPI = 100) is 1982-84.

### Income-Based Willing to Pay Adjustments

|  |  |  |  |
| --- | --- | --- | --- |
| Year | Low | Center | High |
| 1997 | 1.009685 | 1.049381 | 1.128201 |
| 1998 | 1.012248 | 1.062778 | 1.1647 |
| 1999 | 1.01501 | 1.077372 | 1.205346 |
| 2000 | 1.017342 | 1.089828 | 1.240791 |
| 2001 | 1.017327 | 1.089745 | 1.240554 |
| 2002 | 1.018005 | 1.09339 | 1.251059 |
| 2003 | 1.01954 | 1.101673 | 1.275164 |
| 2004 | 1.021781 | 1.113866 | 1.311246 |
| 2005 | 1.023681 | 1.124291 | 1.342672 |
| 2006 | 1.025017 | 1.131672 | 1.36525 |
| 2007 | 1.025666 | 1.135277 | 1.376378 |
| 2008 | 1.024676 | 1.129785 | 1.359452 |
| 2009 | 1.021716 | 1.113508 | 1.310176 |
| 2010 | 1.023051 | 1.120826 | 1.332167 |
| 2011 | 1.023712 | 1.124463 | 1.343195 |
| 2012 | 1.024862 | 1.130815 | 1.362613 |
| 2013 | 1.025588 | 1.134841 | 1.375031 |
| 2014 | 1.026868 | 1.141967 | 1.397211 |

The Income-Based Willingness to Pay (WTP) Adjustments is obtained from the Environmental Benefits Mapping and Analysis Program - Community Edition (BenMAP - CE) user’s manual (p.113) (RTI International 2015). The values in this table is calculated as the following:

$$\left(\frac{RI\_{year}}{RI\_{1990}}\right)^{η}$$

where Real Income (RI) essentially is income after taking into consideration inflation on purchasing power. The reference period (when Income-based WTP adjustments = 1) is 1990. The low, center, high estimations are a result of different income elasticity ($η$) approximations of 0.08, 0.4, 1 although in this study we fix $η at 0.4$.

### VSL Results

|  |  |
| --- | --- |
|  | **VSL Estimates (million 2016 USD)** |
| Year | A | B | C | D | E | F | G | H | I | J | K |
| 1998 | 9.41 | 7.17 | 7.23 | 12.89 | 9.89 | 9.91 | 8.41 | 9.77 | 8.04 | 5.18 | 12.94 |
| 1999 | 9.53 | 7.27 | 7.33 | 13.06 | 10.03 | 10.05 | 8.52 | 9.90 | 8.15 | 5.25 | 13.12 |
| 2000 | 9.64 | 7.35 | 7.42 | 13.21 | 10.14 | 10.16 | 8.62 | 10.02 | 8.25 | 5.31 | 13.27 |
| 2001 | 9.64 | 7.35 | 7.42 | 13.21 | 10.14 | 10.16 | 8.62 | 10.02 | 8.25 | 5.31 | 13.27 |
| 2002 | 9.68 | 7.38 | 7.44 | 13.26 | 10.18 | 10.20 | 8.65 | 10.05 | 8.27 | 5.32 | 13.31 |
| 2003 | 9.75 | 7.43 | 7.50 | 13.36 | 10.26 | 10.27 | 8.71 | 10.13 | 8.34 | 5.36 | 13.41 |
| 2004 | 9.86 | 7.52 | 7.58 | 13.51 | 10.37 | 10.39 | 8.81 | 10.24 | 8.43 | 5.42 | 13.56 |
| 2005 | 9.95 | 7.59 | 7.65 | 13.63 | 10.47 | 10.48 | 8.89 | 10.33 | 8.51 | 5.47 | 13.69 |
| 2006 | 10.01 | 7.64 | 7.70 | 13.72 | 10.53 | 10.55 | 8.95 | 10.40 | 8.56 | 5.51 | 13.78 |
| 2007 | 10.05 | 7.66 | 7.73 | 13.77 | 10.57 | 10.59 | 8.98 | 10.43 | 8.59 | 5.53 | 13.82 |
| 2008 | 10.00 | 7.62 | 7.69 | 13.70 | 10.52 | 10.53 | 8.94 | 10.38 | 8.55 | 5.50 | 13.75 |
| 2009 | 9.85 | 7.51 | 7.58 | 13.50 | 10.37 | 10.38 | 8.81 | 10.23 | 8.43 | 5.42 | 13.56 |
| 2010 | 9.92 | 7.56 | 7.63 | 13.59 | 10.43 | 10.45 | 8.87 | 10.30 | 8.48 | 5.46 | 13.64 |
| 2011 | 9.95 | 7.59 | 7.65 | 13.63 | 10.47 | 10.49 | 8.90 | 10.33 | 8.51 | 5.48 | 13.69 |
| 2012 | 10.01 | 7.63 | 7.70 | 13.71 | 10.53 | 10.54 | 8.95 | 10.39 | 8.56 | 5.51 | 13.77 |
| 2013 | 10.04 | 7.66 | 7.72 | 13.76 | 10.56 | 10.58 | 8.98 | 10.43 | 8.59 | 5.53 | 13.81 |
| 2014 | 10.11 | 7.71 | 7.77 | 13.85 | 10.63 | 10.65 | 9.03 | 10.50 | 8.64 | 5.56 | 13.90 |

Literature included: A-U.S. EPA (1997); B-Viscusi (2004); C-Kniesner and Viscusi (2005); D-(Evans and Smith 2008); E-Viscusi and Hersch (2008); F-Evans and Schaur (2010); G-Hersch and Viscusi (2010); H-Kniesner et al. (2010); I-Scotton and Taylor (2011); J-Kniesner et al. (2012); K-Kniesner et al. (2012).

### Total Mortality Cost Estimates (Sensitivity Analysis)

|  |  |
| --- | --- |
|  | Total Mortality Costs Estimates (billion 2016 USD) |
| Exposure Type | A | B | C | D | E | F | G | H | I | J | K |
| Extreme Cold Only | **2.01** | 1.53 | 1.54 | 2.75 | 2.11 | 2.11 | 1.80 | 2.09 | 1.71 | 1.10 | 2.76 |
| Moderate to Extreme Cold | **8.11** | 6.19 | 6.24 | 11.12 | 8.54 | 8.56 | 7.26 | 8.43 | 6.94 | 4.47 | 11.17 |
| Extreme Heat Only | **0.67** | 0.51 | 0.51 | 0.91 | 0.70 | 0.70 | 0.59 | 0.69 | 0.57 | 0.37 | 0.91 |
| Moderate to Extreme Heat | **1.17** | 0.89 | 0.90 | 1.60 | 1.23 | 1.23 | 1.04 | 1.21 | 1.00 | 0.64 | 1.61 |

Literature included: A-U.S. EPA (1997); B-Viscusi (2004); C-Kniesner and Viscusi (2005); D-Evans and Smith (2008); E-Viscusi and Hersch (2008); F-Evans and Schaur (2010); G-Hersch and Viscusi (2010); H-Kniesner et al. (2010); I-Scotton and Taylor (2011); J-Kniesner et al. (2012); K-Kniesner et al. (2012). Total mortality costs estimates discussed in the main text are marked by bold fonts.

## Age-based & Year-Specific Daily Production Value

### Method

The daily production value is based on Grosse et al. (2009) titled “Economic Productivity by Age and Sex *2007 Estimates for the United States*”. In their study, DPV is the sum of daily market compensation (from working at a job) and household service daily value (e.g. household management). Here, we convert DPV for other years using the following equation:

$$\begin{matrix}DPV\_{year}\left(\$2016\right)&=DPV\_{2007}\left(\$2007\right)×\frac{CPI\_{year}}{CPI\_{2007}}×\frac{CPI\_{2016}}{CPI\_{year}}\\ &= DPV\_{2007}\left(\$2007\right)×\frac{CPI\_{2016}}{CPI\_{2007}}\end{matrix}$$

This section continues to use the CPI values identified above from the U.S. Bureau of Labor Statistics (U.S. Bureau of Labor Statistics 2017). The term “$year” represents the USD value during that corresponding year.

### DPV by Age Groups

|  |  |  |  |
| --- | --- | --- | --- |
| **Age** | **Proportion of Total Population** | **DPV ($2007)** | **Weighted DPV ($2007)** |
| 0-4 | 7.3 | 0 | 8.74 |
| 5-9 | 5.4 | 0 |
| 10-14 | 4.9 | 0 |
| 15-19 | 7 | 30.73 |
| 20-24 | 9.7 | 90.19 | 175.78 |
| 25-29 | 9.1 | 152.69 |
| 30-34 | 9.1 | 190.86 |
| 35-39 | 7.95 | 209.24 |
| 40-44 | 7.95 | 212.71 |
| 45-49 | 7.05 | 211.71 |
| 50-54 | 7.05 | 205.86 |
| 55-59 | 5.4 | 175.8 |
| 60-64 | 3.7 | 142.82 |
| 65-69 | 1.95 | 79.39 | 57.12 |
| 70-74 | 1.95 | 63.89 |
| 75-79 | 1.5 | 50.83 |
| 80-84 | 1.5 | 41.91 |
| 85+ | 1.6 | 41.91 |

 The Weighted DPV ($2007) is calculated as the following:

$$DPV\_{ag}=\sum\_{i\in ag}^{}\frac{p\_{i}}{p\_{ag}}\*DPV\_{i}$$

where $DPV\_{ag}$ is the weighted DPV of a given age group (*ag*), *i* is a 5-year age range that belongs to *ag*, $p\_{i}$ is the proportion of age range *i* in the total population, $p\_{ag}$ is the proportion of *ag* in the total population, and $DPV\_{i}$ is the DPV of age range *i*. The term “$year” represents the USD value during that corresponding year.

# Minimum Effect Temperature

|  |  |
| --- | --- |
|  | **MET** |
| Age Group | MORT °F (%ile) | EDV°F (%ile) | EDHSP°F (%ile) |
| 0-19 | --- | 71 (62.46) | 84 (89.13) |
| 20-64 | --- | 73 (63.75) | 70 (61.99) |
| 65+ | 85 (90.39) | 75 (66.98) | 70 (61.99) |
| All | 84 (89.13) | 72 (63.09) | 71 (62.46) |

MET is the most comfortable temperature for human body regarding different population health outcomes (MORT, EDV, EDHSP) and different age strata (0-19 yo, 20-64 yo, 65+ yo, and all). Specific to MORT, MET is commonly seen in literature as minimum mortality temperature (MMT). This study uses MET to indicate that such most comfortable temperatures are relevant for both mortality and morbidity outcomes.

# Data used to generate Figure 2 and Figure 3 in Main Text

## 6.1 Attributable Fraction and Attributable Cases Estimates given Moderate to Extreme Exposures

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Moderate-Extreme Cold ExposureHI\_max < 30th %ile | Moderate-Extreme Heat ExposureHI\_max > 70th %ile |
| Health Outcome | Age Group | AF[95% eCI] | AC[95% eCI] | AF[95% eCI] | AC[95% eCI] |
| Mort(1998-2014) | 0-19 |  |  |  |  |
| 20-64 |
| 65+ | **6.19****[3.17, 9.02]** | **13,991****[7,197, 20,158]** | **0.89****[0.38, 1.40]** | **2,016****[863, 3,193]** |
| EDV(2005-2014) | 0-19 | **7.03****[5.89, 8.10]** | **137,622****[115,749, 157,331]** | **1.2****[0.44, 1.92]** | **23,478****[8751, 37,860]** |
| 20-64 | **1.77****[0.97, 2.57]** | **70,464****[37,961, 102,260]** | 0.32[-0.14, 0.79] | 12,733[-5,415, 31,057] |
| 65+ | **2.21****[0.62, 3.76]** | **15,921****[4,741, 26,936]** | 0.27[-0.41, 0.94] | 1,943[-3,075, 6,827] |
| EDHSP(2005-2014) | 0-19 | **6.63****[2.48, 10.27]** | **9,242****[3,666, 14,339]** | **0.78****[0.14, 1.39]** | **1,089****[194, 1,929]** |
| 20-64 | **2.57****[1.25, 3.94]** | **18504****[8,727, 27,641]** | 0.56[-0.46, 1.53] | 4,026[-3,036, 10,829] |
| 65+ | **4.13****[2.68, 5.52]** | **24,252****[15,750, 32,327]** | 0.87[-0.11, 1.84] | 5,091[-802, 10,993] |

## Attributable Fraction and Attributable Cases Estimates given Extreme Exposures

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | Extreme Cold ExposureHI\_max < 5%ile | Extreme Heat ExposureHI\_max > 95%ile |
| Health Outcome | Age Group | AF[95% eCI] | AC[95% eCI] | AF[95% eCI] | AC[95% eCI] |
| Mort(1998-2014) | 0-19 |  |  |  |  |
| 20-64 |
| 65+ | **1.53****[0.89, 2.12]** | **3,444****[2,040, 4,792]** | **0.51****[0.20, 0.79]** | **1,144****[466, 1,812]** |
| EDV(2005-2014) | 0-19 | **1.9****[1.63, 2.17]** | **37,208****[31,734, 42,494]** | **0.62****[0.39, 0.84]** | **12,079****[7,512, 16,420]** |
| 20-64 | **0.31****[0.12, 0.50]** | **12,376****[4,895, 20,169]** | 0.14[-0.01, 0.29] | 5,602[-496, 11,759] |
| 65+ | 0.06[-0.33, 0.43] | 426[-2,354, 3,075] | 0.06[-0.2, 0.33] | 440[-1,553, 2,414] |
| EDHSP(2005-2014) | 0-19 | **1.79****[0.88, 2.64]** | **2,488****[1,225, 3680]** | **0.47****[0.07, 0.85]** | **657****[102, 1,189]** |
| 20-64 | **0.61****[0.29, 0.93]** | **4,372****[1,992, 6,732]** | 0.21[-0.07, 0.48] | 1,495[-653, 3,478] |
| 65+ | **0.76****[0.39, 1.11]** | **4,445****[2,319, 6,509]** | 0.23[-0.08, 0.52] | 1402[-353, 3,128] |

# Cost Estimation Supplemental Results

|  |  |  |  |
| --- | --- | --- | --- |
| Statistical Features | Cold ExposureMorbidity Costs Proportion (%) | Heat ExposureMorbidity Costs Proportion (%) | All Temperature ExposureMorbidity Costs Proportion(%) |
| Mean |  | 1.03 | 0.37 | 1.13 |
| Minimum |  | 0.56 | 0.16 | 0.65 |
| Maximum |  | 2.42 | 1.00 | 2.35 |

Costs proportion is calculated by dividing the costs attributable to morbidity outcomes by the costs attributable to both mortality and morbidity outcomes. Cold exposure is defined as the temperature range between the minimum daily maximum heat index (HImax) and the minimum effect temperature (MET, specific to health outcome and age group); heat exposure is defined as the temperature range between the MET and the maximum HImax. All temperature exposure includes the entire temperature range.

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