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### **Supplemental Material**

#### **Global Estimate of Lung Cancer Mortality Attributable to Residential Radon**

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#### **References**

**Table S1 – References for Reported National Residential Radon Exposures**

| <b>Country</b> | <b>RnArithMn<sup>a</sup></b><br>(Bq/m <sup>3</sup> ) | <b>RnGeoMn<sup>b</sup></b><br>(Bq/m <sup>3</sup> ) | <b>RnGeoSD<sup>c</sup></b> | <b>Reference</b>             |
|----------------|--|--|----------------------------|------------------------------|
| Albania        | 101  |  |                            | (Tushe et al. 2016)          |
| Algeria        | 30   |  |                            | (Cherouati and Djeffal 1988) |
| Argentina      | 37   |  |                            | (Canoba et al. 2002)         |
| Armenia        | 104  |  | 1.3                        | (UNSCEAR 2006)               |
| Australia      | 11.6   | 8.7  | 2.1                        | (Langroo et al. 1990)        |
| Austria        | 99   | 61   |                            | (Friedmann 2005)             |
| Belarus        | 31.8   |  |                            | (UNSCEAR 2006)               |
| Belgium        | 48   | 38   | 2                          | (UNSCEAR 2006)               |
| Brazil         | 41   |  |                            | (Veiga et al. 2007)          |
| Bulgaria       |  | 80   | 2.1                        | (Ivanova et al. 2013)        |
| Canada         |  | 41.9   | 2.8                        | (Chen et al. 2012)           |
| Chile          | 25   |  | 1.8                        | (Stuardo 1996)               |
| China          | 43.8   | 34.4   |                            | (UNSCEAR 2006)               |
| Croatia        | 68   | 50   | 2.3                        | (Radolić et al. 2006)        |
| Cuba           | 7.7  | 5.2  | 3.3                        | (UNSCEAR 2006)               |
| Cyprus         | 7  | 7  | 2.6                        | (UNSCEAR 2006)               |
| Czech Republic | 118  | 94.4   | 1.84                       | (UNSCEAR 2006)               |
| Denmark        | 59   | 39   | 2.2                        | (UNSCEAR 2006)               |
| Ecuador        | 94.3   |  |                            | (Canoba et al. 2002)         |
| Egypt          | 9  |  |                            | (UNSCEAR 2006)               |
| Estonia        | 60   |  |                            | (Pahapill et al. 2003)       |
| Finland        | 120  | 84   | 2.1                        | (UNSCEAR 2006)               |
| France         | 63   |  | 2.0                        | (Billon et al. 2005)         |
| Germany        | 49   | 37   | 2.2                        | (Haucke 2010)                |
| Greece         | 55   | 44   | 2.4                        | (Nikolopoulos et al. 2005)   |

|                   |       |      |      |                                      |
|-------------------|-------|------|------|--------------------------------------|
| Hungary           |       | 62   | 2.07 | (Hámori et al. 2006)                 |
| Iceland           | 10    |      |      | (UNSCEAR 2006)                       |
| India             | 57    | 42   | 2.2  | (UNSCEAR 2006)                       |
| Indonesia         | 35.1  | 35.1 | 1.2  | (UNSCEAR 2006)                       |
| Iran              | 82    |      |      | (UNSCEAR 2006)                       |
| Ireland           | 77    | 51   | 2.4  | (Dowdall et al. 2017)                |
| Israel            | 31    |      |      | (Epstein et al. 2014)                |
| Italy             | 70    | 52   | 2.1  | (Bohicchio et al. 1999)              |
| Japan             | 13.7  | 10.4 | 2    | (Suzuki et al. 2010)                 |
| Kazakstan         | 15    |      |      | (UNSCEAR 2006)                       |
| Kuwait            | 32.8  | 26.5 | 1.9  | (Al-Azmi et al. 2008)                |
| Lithuania         | 55    | 36.5 |      | (UNSCEAR 2006)                       |
| Luxembourg        | 110   | 70   | 2    | (UNSCEAR 2006)                       |
| Malaysia          | 14    |      |      | (UNSCEAR 2006)                       |
| Mexico            | 84    | 82.1 | 1.25 | (Espinosa and Gammage 2011)          |
| Montenegro        | 105   | 49.6 | 3.2  | (Vukotic et al. 2008)                |
| Netherlands       | 15.6  | 12.2 |      | (Smetsers et al. 2016)               |
| New Zealand       | 21.5  | 19.5 |      | (UNSCEAR 2006)                       |
| Norway            | 74.5  | 38   | 3.19 | (Stigum et al. 2003)                 |
| Pakistan          | 70    |      |      | (Faheem et al. 2008)                 |
| Paraguay          | 28    |      |      | (UNSCEAR 2006)                       |
| Peru              | 32.29 |      |      | (Canoba et al. 2002)                 |
| Philippines       | 23    | 22   | 1.13 | (UNSCEAR 2006)                       |
| Poland            | 165   | 133  | 1.91 | (Kozak et al. 2011; Przylibski 2015) |
| Portugal          | 62    | 45   | 2.2  | (Faisca et al. 1992)                 |
| Republic of Korea | 62    | 49   | 2    | (Kim et al. 2011)                    |
| Romania           | 126   | 84   | 2.5  | (Cosma et al. 2013)                  |
| Russian           | 48    |      |      | (Yarmoshenko et al. 2015)            |

|                      |      |      |     |                               |
|----------------------|------|------|-----|-------------------------------|
| Federation           |      |      |     |                               |
| Saudi Arabia         | 22   |      |     | (Abu-Jarad et al. 2003)       |
| Slovakia             |      | 48   | 3.3 | (Vicanova et al. 1998)        |
| Slovenia             | 87   | 60   | 2.2 | (Križman et al. 1996)         |
| Spain                | 80.3 | 52.9 | 2.5 | (Sainz-Fernandez et al. 2014) |
| Sweden               | 90   |      |     | (Axelsson et al. 2015)        |
| Switzerland          | 71   | 51   |     | (Menzler et al. 2008)         |
| Syrian Arab Republic | 44   |      |     | (Othman et al. 1996)          |
| Thailand             | 23   | 16   | 1.2 | (UNSCEAR 2006)                |
| Tunisia              | 45.5 |      |     | (El May et al. 2008)          |
| Turkey               | 81   | 57   | 2.3 | (Celebi et al. 2015)          |
| UK                   | 20   | 14   | 3.2 | (UNSCEAR 2006)                |
| USA                  | 46   | 25   | 3.1 | (Marcinowski et al. 1994)     |
| Venezuela            | 52.5 |      |     | (Canoba et al. 2002)          |

Notes: a) RnArithMn - arithmetic mean of national radon distribution, b) RnGeoMn - geometric mean of national radon distribution, c) RnGeoSD - geometric standard deviation of national radon distribution.

**Table S2 – National Male and Female Adult Smoking Prevalence**

| <b>Country</b>        | <b>Male Smoking Prevalence (%)<br/>Mean ± SD</b> | <b>Female Smoking Prevalence (%)<br/>Mean ± SD</b> |
|-----------------------|--|--|
| <b>Albania</b>        | 52 ± 6.3   | 8.2 ± 1.3  |
| <b>Algeria</b>        | 28 ± 6.1   | 2.0 ± 0.2  |
| <b>Argentina</b>      | 32 ± 3.1   | 21 ± 2.1   |
| <b>Armenia</b>        | 55 ± 5.1   | 1.7 ± 0.2  |
| <b>Australia</b>      | 18 ± 1.8   | 15 ± 1.4   |
| <b>Austria</b>        | 37 ± 5.8   | 36 ± 6.2   |
| <b>Belarus</b>        | 49 ± 5.1   | 11 ± 1.2   |
| <b>Belgium</b>        | 28 ± 4.9   | 21 ± 4.2   |
| <b>Brazil</b>         | 21 ± 2.4   | 12 ± 1.5   |
| <b>Bulgaria</b>       | 45 ± 5.1   | 30 ± 4.0   |
| <b>Canada</b>         | 20 ± 1.7   | 14 ± 1.3   |
| <b>Chile</b>          | 42 ± 6.1   | 37 ± 5.1   |
| <b>China</b>          | 49 ± 5.0   | 2.0 ± 0.2  |
| <b>Croatia</b>        | 39 ± 5.1   | 32 ± 4.0   |
| <b>Cuba</b>           | 53 ± 15.4  | 20 ± 6.2   |
| <b>Cyprus</b>         | 41 ± 6.5   | 18 ± 4.0   |
| <b>Czech Republic</b> | 38 ± 4.0   | 29 ± 3.1   |
| <b>Denmark</b>        | 21 ± 2.3   | 19 ± 2.1   |
| <b>Ecuador</b>        | 15 ± 3.2   | 3.6 ± 0.9  |
| <b>Egypt</b>          | 46 ± 5.5   | 0.4 ± 0.1  |
| <b>Estonia</b>        | 44 ± 4.4   | 25 ± 2.7   |
| <b>Finland</b>        | 25 ± 2.3   | 20 ± 1.9   |
| <b>France</b>         | 31 ± 4.4   | 26 ± 3.6   |
| <b>Germany</b>        | 34 ± 3.4   | 29 ± 2.7   |

|                      |          |           |
|----------------------|----------|-----------|
| <b>Greece</b>        | 54 ± 8.3 | 34 ± 7.1  |
| <b>Hungary</b>       | 35 ± 4.1 | 27 ± 3.4  |
| <b>Iceland</b>       | 19 ± 3.3 | 17 ± 2.5  |
| <b>India</b>         | 23 ± 2.6 | 2.4 ± 0.3 |
| <b>Indonesia</b>     | 72 ± 8.1 | 4.0 ± 0.4 |
| <b>Iran</b>          | 23 ± 2.8 | 1.1 ± 0.2 |
| <b>Ireland</b>       | 24 ± 3.2 | 24 ± 3.2  |
| <b>Israel</b>        | 42 ± 7.0 | 20 ± 3.4  |
| <b>Italy</b>         | 29 ± 2.4 | 20 ± 1.7  |
| <b>Japan</b>         | 36 ± 3.9 | 11 ± 1.3  |
| <b>Kazakstan</b>     | 46 ± 5.7 | 9.7 ± 1.4 |
| <b>Kuwait</b>        | 35 ± 4.1 | 4.0 ± 0.8 |
| <b>Lithuania</b>     | 41 ± 5.0 | 22 ± 2.7  |
| <b>Luxembourg</b>    | 27 ± 3.5 | 22 ± 3.1  |
| <b>Malaysia</b>      | 45 ± 7.2 | 1.6 ± 0.3 |
| <b>Mexico</b>        | 23 ± 2.2 | 7.6 ± 0.8 |
| <b>Montenegro</b>    | 42 ± 5.3 | 26 ± 3.4  |
| <b>Netherlands</b>   | 28 ± 2.8 | 25 ± 2.4  |
| <b>New Zealand</b>   | 21 ± 2.1 | 19 ± 1.9  |
| <b>Norway</b>        | 26 ± 2.2 | 25 ± 2.3  |
| <b>Pakistan</b>      | 41 ± 5.7 | 3.6 ± 0.6 |
| <b>Paraguay</b>      | 31 ± 5.1 | 9.0 ± 1.6 |
| <b>Peru</b>          | 21 ± 0.6 | 6.5 ± 0.8 |
| <b>Philippines</b>   | 46 ± 4.3 | 9.2 ± 1.0 |
| <b>Poland</b>        | 35 ± 3.7 | 26 ± 2.8  |
| <b>Portugal</b>      | 32 ± 4.2 | 14 ± 2.5  |
| <b>Rep. of Korea</b> | 52 ± 8.5 | 4.4 ± 1.0 |
| <b>Romania</b>       | 40 ± 4.3 | 23 ± 2.5  |
| <b>Russian Fed.</b>  | 60 ± 5.9 | 23 ± 2.5  |
| <b>Saudi Arabia</b>  | 26 ± 3.5 | 3.0 ± 0.8 |

|                    |          |           |
|--------------------|----------|-----------|
| <b>Slovakia</b>    | 41 ± 8.0 | 18 ± 4.3  |
| <b>Slovenia</b>    | 24 ± 2.9 | 19 ± 2.3  |
| <b>Spain</b>       | 34 ± 3.5 | 28 ± 2.9  |
| <b>Sweden</b>      | 22 ± 2.0 | 23 ± 2.0  |
| <b>Switzerland</b> | 28 ± 2.6 | 21 ± 1.8  |
| <b>Syria</b>       | 48 ± 6.9 | 18 ± 2.6  |
| <b>Thailand</b>    | 42 ± 3.6 | 2.4 ± 0.2 |
| <b>Tunisia</b>     | 52 ± 6.1 | 11 ± 0.2  |
| <b>Turkey</b>      | 43 ± 4.1 | 14 ± 1.4  |
| <b>UK</b>          | 22 ± 2.4 | 20 ± 2.4  |
| <b>USA</b>         | 21 ± 1.9 | 16 ± 1.5  |
| <b>Venezuela</b>   | 28 ± 4.7 | 16 ± 2.5  |

Note: The source of this data was the WHO Global Health Observatory for 2012

**Table S3 - Radon Population Attributable Risk (PAR) of Lung Cancer Mortality, estimated from extending the pooled residential studies to model lifetime exposure**

| Country        | Radon <sup>a</sup><br>GM (GSD)<br>(Bq/m <sup>3</sup> ) | PAR (%)<br>Krewski <sup>b</sup><br>Mean (95% CI) | PAR (%)<br>Darby <sup>c</sup><br>Mean (95% CI) |
|----------------|--|--|--|
| <b>median</b>  | <b>38</b>  | <b>10.4</b>                                      | <b>8.4</b>                                     |
| Albania        | 75 (2.2)   | 18.0 (0, 33.7)                                   | 14.3 (3.2, 23.5)                               |
| Algeria        | 22 (2.2)   | 6.4 (0, 13.1)                                    | 4.8 (1.0, 8.3)                                 |
| Argentina      | 27 (2.2)   | 7.7 (0, 15.6)                                    | 5.8 (1.2, 10.1)                                |
| Armenia        | 101 (1.3)  | 22.5 (0, 40.7)                                   | 18.2 (4.3, 29.3)                               |
| Australia      | 8.7 (2.1)  | 2.6 (0, 5.6)                                     | 1.9 (0.4, 3.5)                                 |
| Austria        | 61 (4.8)   | 15.3 (0, 29.3)                                   | 12.0 (2.6, 20.0)                               |
| Belarus        | 23 (2.2)   | 6.7 (0, 13.8)                                    | 5.0 (1.0, 8.8)                                 |
| Belgium        | 38 (2.0)   | 10.3 (0, 20.6)                                   | 7.9 (1.7, 13.5)                                |
| Brazil         | 30 (2.2)   | 8.4 (0, 17.1)                                    | 6.4 (1.3, 11.1)                                |
| Bulgaria       | 80 (2.1)   | 18.9 (0, 35.2)                                   | 15.1 (3.4, 24.7)                               |
| Canada         | 42 (2.8)   | 11.2 (0, 22.2)                                   | 8.6 (1.8, 14.7)                                |
| Chile          | 21 (1.8)   | 6.1 (0, 12.5)                                    | 4.5 (0.9, 8.0)                                 |
| China          | 34 (3.6)   | 9.5 (0, 19.1)                                    | 7.2 (1.5, 12.4)                                |
| Croatia        | 50 (2.3)   | 13.0 (0, 25.4)                                   | 10.1 (2.2, 17.0)                               |
| Cuba           | 5.2 (3.3)  | 1.6 (0, 3.4)                                     | 1.2 (0.2, 2.1)                                 |
| Cyprus         | 7 (2.6)  | 2.1 (0, 4.6)                                     | 1.6 (0.3, 2.8)                                 |
| Czech Republic | 94 (1.8)   | 21.4 (0, 39.0)                                   | 17.3 (4.0, 27.9)                               |
| Denmark        | 39 (2.2)   | 10.5 (0, 20.9)                                   | 8.1 (1.7, 13.8)                                |
| Ecuador        | 70 (2.2)   | 17.1 (0, 32.3)                                   | 13.5 (3.0, 22.4)                               |
| Egypt          | 6.6 (2.2)  | 2.0 (0, 4.3)                                     | 1.5 (0.3, 2.6)                                 |
| Estonia        | 44 (2.2)   | 11.8 (0, 23.2)                                   | 9.1 (1.9, 15.4)                                |
| Finland        | 84 (2.1)   | 19.6 (0, 36.3)                                   | 15.7 (3.6, 25.6)                               |



|               |           |                |                  |
|---------------|-----------|----------------|------------------|
| France        | 50 (2.0)  | 13.0 (0, 25.3) | 10.0 (2.2, 17.0) |
| Germany       | 37 (2.2)  | 10.0 (0, 20.1) | 7.7 (1.6, 13.2)  |
| Greece        | 44 (2.4)  | 11.7 (0, 23.1) | 9.0 (1.9, 15.3)  |
| Hungary       | 62 (2.1)  | 15.5 (0, 29.7) | 12.2 (2.7, 20.3) |
| Iceland       | 7.3 (2.2) | 2.2 (0, 4.8)   | 1.6 (0.3, 2.9)   |
| India         | 42 (2.2)  | 11.2 (0, 22.3) | 8.6 (1.8, 14.7)  |
| Indonesia     | 35 (1.2)  | 9.6 (0, 19.3)  | 7.3 (1.5, 12.6)  |
| Iran          | 61 (2.2)  | 15.3 (0, 29.4) | 12.0 (2.6, 20.1) |
| Ireland       | 51 (2.4)  | 13.2 (0, 25.7) | 10.3 (2.2, 17.3) |
| Israel        | 23 (2.2)  | 6.5 (0, 13.5)  | 4.9 (1.0, 8.6)   |
| Italy         | 52 (2.1)  | 13.5 (0, 26.2) | 10.4 (2.3, 17.6) |
| Japan         | 10 (2.0)  | 3.1 (0, 6.6)   | 2.3 (0.5, 4.1)   |
| Kazakstan     | 11 (2.2)  | 3.3 (0, 7.0)   | 2.4 (0.5, 4.3)   |
| Kuwait        | 27 (6.7)  | 7.5 (0, 15.4)  | 5.7 (1.2, 9.9)   |
| Lithuania     | 37 (4.1)  | 9.9 (0, 19.9)  | 7.6 (1.6, 13.0)  |
| Luxembourg    | 70 (2.0)  | 17.1 (0, 32.3) | 13.5 (3.0, 22.4) |
| Malaysia      | 10 (2.2)  | 3.1 (0, 6.5)   | 2.3 (0.5, 4.0)   |
| Mexico        | 82 (1.3)  | 19.3 (0, 35.8) | 15.4 (3.5, 25.2) |
| Montenegro    | 50 (3.2)  | 13.0 (0, 25.3) | 10.0 (2.2, 17.0) |
| Netherlands   | 12 (2.5)  | 3.6 (0, 7.7)   | 2.7 (0.5, 4.8)   |
| New Zealand   | 20 (2.3)  | 5.6 (0, 11.7)  | 4.2 (0.9, 7.4)   |
| Norway        | 38 (3.2)  | 10.3 (0, 20.5) | 7.9 (1.7, 13.5)  |
| Pakistan      | 52 (2.2)  | 13.4 (0, 26.0) | 10.4 (2.2, 17.5) |
| Paraguay      | 21 (2.2)  | 5.9 (0, 12.3)  | 4.5 (0.9, 7.8)   |
| Peru          | 24 (2.2)  | 6.8 (0, 13.9)  | 5.1 (1.0, 8.9)   |
| Philippines   | 22 (1.1)  | 6.3 (0, 13.0)  | 4.7 (1.0, 8.3)   |
| Poland        | 133 (1.9) | 27.3 (0, 47.5) | 22.6 (5.6, 35.4) |
| Portugal      | 45 (2.2)  | 11.9 (0, 23.5) | 9.2 (2.0, 15.6)  |
| Rep. of Korea | 49 (2.0)  | 12.8 (0, 25.0) | 9.9 (2.1, 16.7)  |
| Romania       | 84 (2.5)  | 19.7 (0, 36.4) | 15.7 (3.6, 25.7) |

|              |          |                |                  |
|--------------|----------|----------------|------------------|
| Russian Fed. | 35 (2.2) | 9.7 (0, 19.5)  | 7.4 (1.6, 12.7)  |
| Saudi Arabia | 16 (2.2) | 4.7 (0, 9.9)   | 3.5 (0.7, 6.2)   |
| Slovakia     | 48 (3.3) | 12.6 (0, 24.6) | 9.7 (2.1, 16.5)  |
| Slovenia     | 60 (2.2) | 15.1 (0, 29.0) | 11.8 (2.6, 19.8) |
| Spain        | 53 (2.5) | 13.7 (0, 26.5) | 10.6 (2.3, 17.9) |
| Sweden       | 67 (2.2) | 16.4 (0, 31.2) | 13.0 (2.9, 21.5) |
| Switzerland  | 51 (4.2) | 13.2 (0, 25.7) | 10.3 (2.2, 17.3) |
| Syria        | 33 (2.2) | 9.0 (0, 18.1)  | 6.8 (1.4, 11.8)  |
| Thailand     | 16 (1.2) | 4.7 (0, 9.8)   | 3.5 (0.7, 6.2)   |
| Tunisia      | 34 (2.2) | 9.3 (0, 18.7)  | 7.1 (1.5, 12.2)  |
| Turkey       | 57 (2.3) | 14.5 (0, 28.0) | 11.3 (2.5, 19.0) |
| UK           | 14 (3.2) | 4.1 (0, 8.7)   | 3.1 (0.6, 5.4)   |
| USA          | 25 (3.1) | 7.1 (0, 14.5)  | 5.4 (1.1, 9.3)   |
| Venezuela    | 39 (2.2) | 10.5 (0, 20.9) | 8.0 (1.7, 13.7)  |

Notes: a) The sources of the national radon geometric means (GM) and geometric standard deviations (GSD) are described in Table S1; b) the mean and 95% confidence intervals of the population attributable risk (PAR) of lung cancer mortality from radon, converted to percentage, estimated by extending the pooled North American residential radon studies of excess risk ratio after restricting the analysis to individuals having measurements for at least 20 of the 25 years of radon exposure (Krewski et al. 2006); c) the mean and 95% confidence intervals of the population attributable risk (PAR) of lung cancer mortality from radon, converted to percentage, estimated by extending the pooled European residential radon studies of excess risk ratio after adjusting the limited measurements of residential radon for random uncertainties (Darby et al. 2006).

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