Radon Testing Disparities: District of Columbia

Radon and Radon Testing in District of Columbia

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American Lung Association

1 Introduction: Radon

The U.S. Environmental Protection Agency (EPA) estimates that radon exposure is responsible for 21,000 lung cancer deaths each year in the United States (U.S.) [1]. Radon is the leading cause of lung cancer among individuals who have never smoked and the second leading cause of lung cancer overall in the U.S.

The EPA recommends that all homes be tested for radon and mitigated if the radon concentration is 4 picocuries per liter (pCi/L) or higher. Because protracted radon exposure at concentrations less than 4 pCi/L also poses a risk, the EPA also recommends homeowners consider reducing the radon concentrations for homes measuring between 2 pCi/L and 4 pCi/L [2].

> Even though some counties exhibit relatively lower radon averages, it is important that all homes be tested since radon concentrations greatly exceeding the EPA's Radon Action Level have been reported in homes and other buildings in many of these "lower" radon counties.

Indoor radon concentrations vary substantially, both within and between counties, in the U.S. The primary cause of the geographic variation in radon is the geologic radon source strength and soil permeability within a geographic area. Some of the secondary causes of geographic radon variation include differences in home construction, HVAC type, and occupant behavior (e.g., opening windows) [3]. The rate of residential radon testing also varies widely within and between U.S. counties.

This report is one of a set of state-by-state reports that attempts to provide a basic summary of U.S. publicly available radon testing data, provided by the Centers for Disease Control and Prevention (CDC), to illustrate the testing rate in U.S. counties, the average radon concentration reported, and a combined "Radon Testing Disparity" measure developed by the American Lung Association to highlight areas with both higher radon concentrations and lower testing rates within each state.

There is clearly no singular way to prioritize these multifaceted aspects of radon testing, but we hope the Testing Disparity presented here provides a meaningful summary for policymakers, and the public alike. In addition, publicly available data on radon testing are often sparse, with some areas reporting few to no radon tests during the period over which data are available. To provide meaningful maps, we apply a smoothing model to borrow strength from neighboring counties within the same state. As radon levels can vary widely at finer geographic scales, we denote counties which had no data, or those which had fewer than 10 tests during the data availability period.

The study period for District of Columbia was from 2008-2017.

2 Using This Document

Public health professionals may be interested in mean radon levels, testing rates, or a combined measure that highlights relatively fewer tests and also higher radon levels gives a summary. In all cases, caution is required in interpreting the results due to the issues highlighted in Section 4. In addition, the District of Colombia does not have counties over which the distribution of these quantities can be compared, so it may be of interest to compare to other state reports.

3 Quick Facts: Radon in District of Columbia

- District of Columbia has an estimated 322,793 total homes with 2,126 tests during the study period.
- Overall, District of Columbia has an estimated mean radon level of 1.9 pCi/L.

4 Technical Notes

Data on radon tests and mean concentrations was obtained from the CDC National Public Health Environmental Tracking Network via the Tracking API [4, 5]. Census data for housing-unit adjusted comparisons were obtained from the U.S. census via the `tidycensus` package for R version 4.1.2 [6, 7]. Full code and tabular versions of the data are available at GitHub.

Radon data were collected from 2008-2017 for the measures: Mean pre-mitigation radon level in tested buildings and Number of pre-mitigation radon tests by radon level over 10 years. Data was accessed on 2022-07-29.

In general, data used were those as reported by testing laboratories voluntarily participating in the CDC's radon data collection and mapping effort. Where laboratory data were unavailable, data as reported by states to CDC were used for this analysis.

The selected Testing Disparity metric is $R * log_{10}(\frac{H}{N})$ where R is the mean radon level, H is the number of housing units, and N is the number of Radon tests, adjusted to reflect the expected number of tests per 10 year period. The lower the testing rate, $\frac{N}{H}$, and the higher the mean radon level, the higher this metric will be, suggesting that increased attention to testing could be valuable in such counties. However, radon testing in other counties, even those at the bottom of the scale, remains much in need. The values shown in the plots are scaled so that the lowest value of the Testing Disparity metric in the U.S. is 0 and the largest value is 100, with values above 25% of the national maximum capped at 100 to prevent outliers from dominating the scale. This approach can help highlight areas which may benefit more from attention to testing than others, but there are substantial limitations, and policy should not be based on this document in isolation. In addition to the presence of unaccounted-for small-scale variability within states, comparisons between states may be affected by differential data availability. In addition, the Testing Disparity metric presented here describes one of many possible prioritization schemes for trading off radon levels and testing rates. Alternative approaches may strike a different balance between these two measures, or prioritize high or low population areas. Direct interpretation of the units presented here is also limited, and is intended to support relative comparisons within each respective state.

5 State Rankings

Table 1: State-level summary data. Note: Hawaii and Mississippi are excluded due to lack of data.

State	Rank	Weighted Average Smoothed Testing Disparity	Estimated Mean Radon Level	Housing Units	Radon Tests (10 years)	Radon Tests per 1,000 Housing Units
South Dakota	1	41.6	8.5	401,862	6,275	15.6
Montana	2	31.7	6.7	519,935	9,893	19.0
North Dakota	3	31.5	6.9	380,173	6,607	17.4
Ohio	4	28.9	6.5	5,232,869	98,840	18.9
Pennsylvania	5	27.0	7.3	5,732,628	203,045	35.4
Maine	6	25.9	5.6	750,939	11,825	15.7
Kentucky	7	25.6	5.4	2,006,358	28,793	14.4
Indiana	8	24.9	5.0	2,921,032	43,148	14.8
Alaska	9	23.7	3.3	319,854	830	2.6
New Mexico	10	23.1	3.5	948,473	3,721	3.9
Idaho	11	23.1	5.4	751,105	12,961	17.3
Wisconsin	12	22.9	5.7	2,725,296	68,104	25.0
New Hampshire	13	22.6	5.5	642,315	15,608	24.3
Texas	14	22.5	2.8	11,283,353	4,615	0.4
Wyoming	15	22.4	5.6	280,291	7,638	27.3
Utah	16	22.0	5.3	1,133,521	28,342	25.0
Iowa	17	21.4	7.1	1,418,626	95,245	67.1
Colorado	18	20.8	5.8	2,464,164	96,367	39.1
West Virginia	19	20.7	3.9	894,956	10,061	11.2
Tennessee	20	19.8	3.9	3,028,213	31,066	10.3
Nebraska	21	19.3	6.0	851,227	42,782	50.3
Arkansas	22	19.3	2.4	1,389,129	668	0.5
Missouri	23	18.2	4.0	2,819,383	58,525	20.8
Illinois	24	17.8	4.1	5,388,066	108,909	20.2
Oklahoma	25	17.3	2.1	1,749,464	814	0.5
Arizona	26	17.1	2.4	3,075,981	3,589	1.2
Virginia	27	16.9	3.4	3,562,143	53,199	14.9
Connecticut	28	16.6	3.8	1,524,992	25,572	16.8
Minnesota	29	14.9	4.7	2,477,753	130,912	52.8
Alabama	30	14.4	2.3	2,284,847	12,569	5.5
Georgia	31	14.3	2.6	4,378,391	30,152	6.9
Washington	32	14.1	2.2	3,195,004	8,201	2.6
California	33	13.9	1.8	14,366,336	9,415	0.7
New York	34	13.9	2.6	8,404,381	97,145	11.6
Maryland	35	13.8	3.2	2,470,316	47,941	19.4
Florida	36	13.5	2.1	9,673,682	53,794	5.6
Oregon	37	13.4	2.8	1,808,465	23,951	13.2
Vermont	38	13.1	3.4	339,439	10,600	31.2
Michigan	39	12.1	3.1	4,629,611	114,407	24.7
Nevada	40	11.0	2.1	1,285,684	10,930	8.5
District of Columbia	41	9.8	1.9	322,793	2,126	6.6
North Carolina	42	9.7	2.2	4,747,943	73,139	15.4
Delaware	43	9.0	2.2	443,781	12,214	27.5
Kansas	44	8.6	4.1	1,288,401	88,584	68.8
Louisiana	45	8.5	1.0	2,089,777	499	0.2
Rhode Island	46	8.4	3.4	470,168	37,874	80.6
Massachusetts	47	8.4	3.2	2,928,732	234,152	79.9
South Carolina	48	8.2	1.7	2,351,286	26,481	11.3
New Jersey	49	2.1	1.8	3,641,812	1,234,094	338.9

6 Disclaimer

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References

[1] U.S. Environmental Protection Agency. *EPA assessment of risks from radon in homes*. 2003. URL: https://www.epa.gov/sites/production/files/2015-05/documents/402-r-03-003.pdf.

[2] U.S. Environmental Protection Agency. *A citizen's guide to radon: the guide to protecting yourself and your family from radon*. 2003. URL: https://www.epa.gov/sites/default/files/2016-12/documents/2016_a_citizens_guide_to_radon.pdf.

[3] N. Barros, D.J. Steck, and William R. Field. *Utility of short-term basement screening radon measurements to predict year-long residential radon concentrations of upper floors*. 2016.

[4] Centers for Disease Control and Prevention. *National Environmental Public Health Tracking Network*. URL: https://ephtracking.cdc.gov/.

[5] Michael A McGeehin, Judith R Qualters, and Amanda Sue Niskar. "National environmental public health tracking program: bridging the information gap". In: *Environmental Health Perspectives* 112.14 (2004), pp. 1409–1413.

[6] R Core Team. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing. Vienna, Austria, 2021. URL: https://www.R-project.org/.

[7] Kyle Walker and Matt Herman. *tidycensus: Load US Census Boundary and Attribute Data as tidyverse and sf-Ready Data Frames*. R package version 1.1. 2021. URL: https://walker-data.com/tidycensus/.

[8] Jeroen Ooms. *jsonlite: A Simple and Robust JSON Parser and Generator for R*. R package version 1.7.2. 2020. URL: https://CRAN.R-project.org/package=jsonlite.

[9] Yihui Xie. *knitr: A General-Purpose Package for Dynamic Report Generation in R*. R package version 1.33. 2021. URL: https://yihui.org/knitr/.

[10] Perry de Valpine et al. *nimble: MCMC, Particle Filtering, and Programmable Hierarchical Modeling*. R package version 0.12.1. 2021. URL: https://CRAN.R-project.org/package=nimble.

[11] Roger Bivand. *spdep: Spatial Dependence: Weighting Schemes, Statistics*. R package version 1.2-1. 2022. URL: https://CRAN.R-project.org/package=spdep.

[12] Hadley Wickham. *tidyverse: Easily Install and Load the Tidyverse*. R package version 1.3.1. 2021. URL: https://CRAN.R-project.org/package=tidyverse.

[13] Kyle Walker. *tigris: Load Census TIGER/Line Shapefiles*. R package version 1.6. 2022. URL: https://github.com/walkerke/tigris.

[14] Martijn Tennekes. *tmaptools: Thematic Map Tools*. R package version 3.1-1. 2021. URL: https://github.com/mtennekes/tmaptools.

[15] Simon Garnier. *viridis: Colorblind-Friendly Color Maps for R*. R package version 0.6.2. 2021. URL: https://CRAN.R-project.org/package=viridis.

[16] Jeroen Ooms. "The jsonlite Package: A Practical and Consistent Mapping Between JSON Data and R Objects". In: *arXiv:1403.2805 [stat.CO]* (2014). URL: https://arxiv.org/abs/1403.2805.

[17] Yihui Xie. *Dynamic Documents with R and knitr*. 2nd. ISBN 978-1498716963. Boca Raton, Florida: Chapman and Hall/CRC, 2015. URL: https://yihui.org/knitr/.

[18] Yihui Xie. "knitr: A Comprehensive Tool for Reproducible Research in R". In: *Implementing Reproducible Computational Research*. Ed. by Victoria Stodden, Friedrich Leisch, and Roger D. Peng. ISBN 978-1466561595. Chapman and Hall/CRC, 2014. URL: http://www.crcpress.com/product/isbn/9781466561595.

[19] Perry de Valpine et al. "Programming with models: writing statistical algorithms for general model structures with NIMBLE". In: *Journal of Computational and Graphical Statistics* 26 (2 2017), pp. 403–413. DOI: 10.1080/10618600.2016.1172487.

[20] Perry de Valpine et al. *NIMBLE: MCMC, Particle Filtering, and Programmable Hierarchical Modeling*. Version 0.12.1. R package version 0.12.1. 2021. DOI: 10.5281/zenodo.1211190. URL: https://cran.r-project.org/package=nimble.

[21] Perry de Valpine et al. *NIMBLE User Manual*. Version 0.12.1. R package manual version 0.12.1. 2021. DOI: 10.5281/zenodo.1211190. URL: https://r-nimble.org.

[22] Roger Bivand and David W. S. Wong. "Comparing implementations of global and local indicators of spatial association". In: *TEST* 27.3 (2018), pp. 716–748. URL: https://doi.org/10.1007/s11749-018-0599-x.

[23] Roger S. Bivand, Edzer Pebesma, and Virgilio Gomez-Rubio. *Applied spatial data analysis with R, Second edition*. Springer, NY, 2013. URL: https://asdar-book.org/.

[24] Hadley Wickham et al. "Welcome to the tidyverse". In: *Journal of Open Source Software* 4.43 (2019), p. 1686. DOI: 10.21105/joss.01686.