

Environmental Factors as Determinants of Health in New Jersey, USA

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Abstract

There is a well-documented association between socioeconomic factors and community health. While environmental conditions are considered in most public health evaluations, they have the least weighted values of all the metrics measured. The U.S. state of New Jersey has a very robust, long-standing environmental protection program combined with some of the highest educational attainment, employment, and income levels in the country. These conditions may have re-positioned or re-prioritized those societal factors that traditionally dominate health outcomes, placing greater emphasis on environmental factors. This paper seeks to evaluate whether in New Jersey at the county level the long-established connection between health status and environmental quality conditions needs to be re-defined. Because of its high per capita income, well-educated population, and strong industrial and service sector employment base, New Jersey residents are fairly healthy, and New Jersey is generally placed within the top ten healthiest places to live in the United States. Thus, this state is well positioned to assess the relative importance that releases to air, water, and soil may play in determining health outcomes. This is due to the state's long history of significant pollution of its air, water, and soil coupled with a strong, effective regulatory program that slowly is achieving meaningful improvements to environmental quality.

Five data sets related to discharges to the air, water, or soil were compiled and tested separately against two New Jersey specific community health indices. The health surveys include the New Jersey Hospital Association's 2019 report on social gaps and their impact on health (CHART) and the nationwide America's Health Rankings (UHF). A Pearson's product moment correlation coefficient was used to compare each state's health ranking – both CHART and UHF - with the independent variable, environmental exposure data sets. The analysis found that there are no meaningful correlations between the environmental exposure data sets and the CHART or UHF county health rankings. This suggests that environmental factors may be over-weighted given the level of state and federal regulatory protection programs already in place within New Jersey. Policy makers should now consider two shifts in public health strategy: encouraging economic growth in areas with underperforming health

outcomes so as to maximize those determinants that do most impact positive outcomes (insurance, income, etc.) coupled with aggressive enforcement of existing environmental regulations to protect communities from the possible consequences of that expanded development.

Keywords: health outcomes, ranking, socioeconomic status, environment, correlation

1. Introduction

Numerous studies have confirmed the association between certain societal factors and public health outcomes (Braveman & Gottlieb, 2014; Tabb et al., 2018; Tobin-Tyler, 2018). Within the cited studies, and across almost all other models reviewed, the influence of five dominant societal factors: poverty (income), education, employment, social support, and community safety have dominated most understandings of the why and how of community health. Table 1 provides a brief, non-comprehensive summary of weighting factors researchers have assigned to societal factors and public health outcomes. While environmental conditions such as potential exposure to air and water pollution, housing, and transit or commuting times are considered in some way in most studies, they typically have the least weighted values (affect) of all the metrics measured.

Table 1. Typical Health Determinant Societal Factors

Societal Factor	Weight %
Health Behavior	32
Clinical Care	15
Social & Economic Factors	47
Physical Environment	6
(Park et. al, 2015)	
Health Behaviors	30
Clinical Care	20
Social & Economic Factors	40
Physical Environment	10
(Remington et al., 2015)	
Medical Care	20
Social & Economic Factors	70
Environment	10
(Tobin-Tyler, 2018)	

The U.S. state of New Jersey, the most densely populated state in the United States, has a very robust, long-standing environmental protection program combined with some of the

highest educational attainment, employment, and income levels in the country. The comparatively high standard of living enjoyed by New Jersey residents, combined with its aggressive environmental programs, may have re-positioned or re-prioritized those societal factors that traditionally dominate health outcomes (Table 1), perhaps placing greater emphasis on environmental factors. This paper seeks to evaluate whether in New Jersey, at the county level, the modest, long-established connection between health status and environmental quality conditions needs to be re-defined. In other words, are environmental conditions playing a more prominent role in determining health outcomes within the context of a well-educated, economically upscale population?

2. A Garden State (New Jersey) Primer

New Jersey is in the mid-Atlantic Region of the United States (Figure 1). It had a 2019 estimated population of 8.97 million residents crammed into an area of approximately 8,700 square miles (22,500 square kilometers). Sandwiched between the major metropolitan areas of New York City and Philadelphia, New Jersey is the ninth most populated state while ranking 47th in total land area. It is the most densely populated place in the United States at 1,030 people per square mile (2.6 square kilometers). Ninety percent of the residents live in areas meeting the definition of urban.



Figure 1. New Jersey's location relative to other Mid-Atlantic U.S. states

New Jerseyans generally are well educated with 90 percent having graduated high school (ranking 29th nationwide) and 40 percent of adults holding at least a bachelor's degree (the sixth best rate in the country). As a result, residents of the Garden State enjoy some of the greatest annual per capita wages in the United States at \$70,800, the fifth highest in the country. Offsetting this hard-earned largess is the cost of living. New Jersey is the eighth most expensive place to live in the United States, with costs driven largely by property and other taxes, as well as the price of housing, insurance, and transportation.

Table 2 lists those industries contributing to New Jersey's relative economic prosperity, thanks to employers and manufacturers drawn to the state due to its easy access to the large

markets of New York and Pennsylvania; New Jersey is within a day's drive of 40 percent of the U.S. population. Contributing to this economic attraction is New Jersey's educated work force, and extensive (although aging) transportation infrastructure, including mature and integrated rail, road, water, and air systems.

Table 2. Major New Jersey Industry Sectors (2019) [source: NJ Department of Labor & Workforce Development]

No.	Sector	Employment (% of private sector workers)	Total Wages (\$ billions) (% of state private sector wages)
1	Biopharmaceutical & Life Sciences	76,430 (2.2)	12.4 (5.3)
2	Transportation, Distribution & Logistics	414,610 (11.8)	30.4 (13)
3	Financial Services	220,500 (6.3)	28.6 (12.2)
4	Retail Trade	447,280 (12.7)	16.2 (6.9)
5	Manufacturing	250,000 (7.0)	20.0 (8.5)
6	Health Care	487,580 (13.9)	29.8 (12.7)
7	Technology	183,350 (4.1)	24.5 (10.4)
8	Construction & Energy	159,460 (4.6)	Not Available
9	Leisure & Hospitality	391,520 (11.2)	10.3 (4.4)

Politically, New Jersey is a home rule state which means that municipalities, towns, cities, or regional agencies, such as county governments, are granted by state constitution or related statute a wide degree of autonomy. This is conditioned on the non-state based governing body or agency accepting and abiding by state and federal constitutional authority when appropriate. New Jersey has taken this concept to the extreme with 21 distinct county governments and 565 individual municipalities (Figure 2). Each major governing body has its own law enforcement agency, schools, judicial systems, and tax code, with services seldom shared and often overlapping.



Figure 2. New Jersey Counties

In comparison, Florida, a state over seven times larger than New Jersey with twice the population, has 410 municipalities or equivalent local governing bodies. Florida is ranked 43 among the U.S. states in effective state level tax burden, New Jersey is in the top ten.

3. New Jersey’s Health Status

Because of its high per capita income, well-educated population, and strong industrial and service sector employment base, New Jersey residents are fairly healthy. Table 3 compares seven health metrics to those of the United States as a whole.

Table 3. Selected Health Metrics Comparison (2018-2019) [source: Centers for Disease Control and Prevention]

No.	Metric	New Jersey	United States
1	Adult Obesity (% population)	27.7	42.4
2	Infant Mortality (per 100,000 births)	3.9	5.7
3	Life Expectancy (years)	80.4	78.8
4	Cancer Mortality (per 100,000)	136.5	158.3
5	Diabetes Mortality (per 100,000)	28	30
6	Respiratory Disease Mortality	26.3	47.8
7	Health Insurance Coverage (% population)	92.6	91.1

While not a definitive summary of New Jersey’s health status, these metrics tend to support

the findings of various health ranking studies by non-governmental actors that place New Jersey within the top ten healthiest places to live in the United States (Stebbins & Sauter, 2019; United Health Foundation, 2019).

4. New Jersey's Environment

Primary responsibility for enforcement of federal and state environmental statutes within New Jersey falls to the Department of Environmental Protection (NJDEP). Founded on April 22, 1970, America's first Earth Day, NJDEP has grown into a complex bureaucracy of almost 2,900 employees with an annual (2020) budget of over \$240 million. For comparison, the Virginia Department of Environmental Quality, a state with roughly the same population but almost five times the land area of New Jersey, had a 2020 budget of \$180 million and operates with a staff of about 800. Manufacturing in New Jersey in 2015 as a percentage of gross domestic product was 8.5 percent, for Virginia it was 9.4 percent.

The rationale behind New Jersey's strong environmental regulatory infrastructure are two factors. New Jersey has a long history of air, water, and land contamination, bequeathed to it from the petrochemical industry that today remains a major employer and still is a significant part of its economy. One oft cited metric is that New Jersey contains the most uncontrolled hazardous waste disposal sites (i.e., CERCLA Superfund) of any state in the nation – 113 – as compared to Virginia's 31.

Corroborating this toxic legacy is the NJDEP's Known Contaminated Site List (KCSL) which catalogs over 15,000 current places across the state where a discharge to soil or ground water is known or suspected to have occurred. Site investigations are ongoing or in some stage of completion at these locations which include numerous leaks from underground residential heating oil tanks. When coupled with the highest population density in the nation, and New Jersey's heavy reliance on ground water for potable and industrial/commercial uses – especially in southern New Jersey where almost 25 percent of water usage is from ground water sources – makes these resources especially vulnerable. New Jersey's decision makers long have recognized this and vested extraordinary land use and pollution control regulatory authority with NJDEP.

NJDEP, with support and funding from U.S. EPA and a relatively newly woke private sector, has been chipping away at this toxic legacy. As of January 2021, NJDEP has overseen the remediation of over 8,000 contaminated properties. In addition, approximately 95 percent of the almost 35,000 river miles in the state meet Clean Water Act goals of being fishable or swimmable with 11,000 river miles qualifying for special protected status as sources of drinking water or supporting outstanding ecological resources.

In 2019 New Jersey's air exceeded the Clean Air Act's Air National Ambient Air Quality Standards (NAAQS) Air Quality Index (AQI) only 14 times (days). Twelve of the exceedance days were because of ozone, and one each for nitrogen dioxide and fine particulate matter (PM_{2.5}). Monitoring data in New Jersey show a steady decline in overall PM_{2.5} levels, which are now in compliance with NAAQS. Nitrogen dioxide (NO₂) is a reactive gas emitted primarily from motor vehicles. New Jersey has an extensive record of compliance with the

NAAQS for NO₂. New Jersey sporadically reports sulfur dioxide (SO₂) concentrations in excess of NAAQS. These are attributable to a coal-burning facility across the Delaware River in Pennsylvania. After this plant ceased operations under a court-mediated settlement agreement, SO₂ levels in New Jersey again meet this NAAQS standard.

U.S. EPA's Toxics Release Inventory (TRI) tracks the management of over 650 toxic chemicals that pose a threat to human health and the environment. Certain industry sectors that manufacture, process, or otherwise use these chemicals in amounts above established levels must report how each chemical is managed through recycling, energy recovery, treatment, and releases to the environment. In 2008, New Jersey based industries and businesses released over 94 million pounds of TRI managed chemicals to the environment. By 2019, this amount had decreased to slightly more than 14 million pounds, an almost seven-fold improvement. However, in 2020 New Jersey still ranks ninth in the country (by weight) of TRI-regulated chemicals discharged to the environment.

The above data describe a state that has made significant progress in improving environmental quality related to the management and cleanup of oil and hazardous waste discharges to air, soil, and water; but these results also indicate that much remains to be done. Nevertheless, several non-governmental surveys or assessments rank New Jersey fairly high in "green" indices. These include the very dated 2007 Forbes America's Greenest States survey where New Jersey is ranked seventh (Forbes, 2007), the more recent 2016 Wallet Hub Greenest States survey in which New Jersey places 16th (Kiernan, 2019), and a thoughtfully developed eco-efficiency index proposed by Frost (2017) ranking New Jersey seventh. This dichotomy of findings likely is related to the emphasis placed in ranking indices weighting related to energy use (renewables), greenhouse gas emissions, and urban land use; categories in which New Jersey has a well-established track record (NJDEP, 2021).

5. Data Sets

New Jersey is uniquely positioned to assess the relative importance that releases to the environment may play on a microscale (county) level in determining health outcomes. This is due to the state's long history of significant pollution of its air, water, and soil coupled with a strong, effective regulatory program that slowly is achieving meaningful improvements to environmental quality. This progress is being made despite a robust petrochemical and pharmaceutical industry that continues to place New Jersey in the upper tier of states with the most discharges of hazardous chemicals and enormous greenfield development pressure on its remaining open spaces (Lathrop & Hasse, 2020). These competing environmental dynamics operate within the context of a populace having a set of favorable health determinant characteristics including high per capita incomes, low unemployment, and almost universal insurance coverage.

To assess the degree, if any, of possible connection between New Jersey's current state of environmental quality and its health status (on the county level) five data sets were compiled and tested separately against two New Jersey specific community health indices. The selected data sets (independent variables) are described in Table 4 and are related to physical discharges to the environment and, presumably, represent some degree of population

exposure or uptake risk. The health surveys (dependent variables) include the New Jersey Hospital Association's 2019 report on social gaps and their impact on health (CHART, 2019) and the nationwide America's Health Rankings (United Health Foundation, 2019).

Table 4. Environmental Exposure Data Sets

No.	Data Set	Description	Source
1	KCS	Number of Known Contaminated Sites per county resident. Includes sites with one or more active cases or remedial action permits where contamination has been confirmed.	https://www13.state.nj.us/DataMiner , (NJDEP, March 28, 2020)
2	Title V	Number of Clean Air Act regulated Title V facilities for every 100,000 county residents. Title V facilities are stationary sources emitting more than 10 tons of pollutants per year.	https://www13.state.nj.us/DataMiner , (NJDEP, March 28, 2020)
3	NJPDES	Number of New Jersey Pollution Discharge Emission System permits per county resident. These are facilities discharging pollutants into surface water or ground water.	https://www13.state.nj.us/DataMiner , (NJDEP, March 28, 2020)
4	Superfund	Number of Superfund sites for every 100,000 county residents. These are places where uncontrolled releases of contaminants to soil and ground water require extended cleanup actions.	https://www.epa.gov/superfund/ (NJDEP, March 28, 2021)
5	TRI	Total discharges (in pounds) to land, air, and water, per 10,000 county residents, of chemical regulated under EPA's Toxic Release Inventory.	https://www.epa.gov/toxics (NJDEP, March 28, 2021)

The CHART report used 20 measures of health from publicly available data sets to develop a weighted health status or vulnerability score for each community (zip code) within New Jersey. The higher the rank, the worse the community's health status. Of the 20 metrics analyzed, no measures of environmental quality – discharges to air, water, or soil – were included. For the purposes of this paper, zip code data were re-combined by county and an average health status score calculated (Table 5). Data are presented on a per capita basis for these metrics to adjust for population differences among more rural and more urbanized counties.

Table 5. New Jersey County Health Rankings

No.	County	New Jersey Hospital Association (CHART, 2019)		America's Health Rankings (UHF, 2019)	
		Mean Score	Rank	z-Score	Rank
1	Atlantic	398.5	20	1.10	19
2	Bergen	199.3	4	-1.04	3
3	Burlington	285.5	11	0.07	13
4	Camden	386.0	19	0.96	18
5	Cape May	301.9	13	0.61	17
6	Cumberland	439.4	21	1.81	21
7	Essex	292.7	12	0.60	16
8	Gloucester	317.1	14	0.34	15
9	Hudson	367.8	17	-0.07	11
10	Hunterdon	106.7	1	-1.33	1
11	Mercer	278.4	10	-0.10	10
12	Middlesex	260.7	6	-0.61	6
13	Monmouth	206.0	5	-0.38	7
14	Morris	166.9	3	-1.32	2
15	Ocean	347.2	16	-0.19	9
16	Passaic	343.5	15	0.27	14
17	Salem	381.3	18	1.19	20
18	Somerset	137.0	2	-0.97	4
19	Sussex	268.4	8	-0.63	5
20	Union	273.9	9	-0.32	8
21	Warren	261.0	7	0.02	12

United Health Foundation's America's Health Rankings Annual Report is the longest running state-by-state analysis of the nation's health. It examines 54 socioeconomic and health factors sorted into five categories: Social & Economic (30 percent); Physical Environment (10 percent); Clinical Care (15 percent); Behaviors (20 percent); and Health Outcomes (25 percent). Percent weights assigned to each category are indicated in the parenthesis and the statistical analysis used to calculate the ranking is described in the UHF report. Air pollution is the only environmental quality indicator included in the analysis. Data are compiled on a county level and the lower the z-score, the better the health status (Table 5). In general, the county standings are fairly consistent between the two survey indices.

6. Data Analysis

Summary statistics consisting of mean, median, mode (when appropriate), standard deviation, variance, etc. were calculated for each environmental exposure data set – the independent variables (Table 6). As might be expected when dealing with county-scale (micro) environmental metrics, these statistics largely describe data sets that are fairly well grouped, with few outliers. Standard deviations and standard errors generally are low with tight (low) 95 percent confidence intervals. Skewness and kurtosis ranges indicate most data sets are normally distributed. The one exception being TRI, which can be considered reflective of the degree of county development or industrialization, with the more rural, somewhat less urbanized western or southern New Jersey counties have fewer TRI regulated facilities than those in the central and eastern counties.

Table 6. Data Set Summary

County	CHART, 2019	UHF, 2019	KCS	Title V	NJPDES	Superfund	TRI
Atlantic	20	19	3.90	2.3	15	3.4	4.2
Bergen	4	3	3.46	1.5	14	1.1	182.0
Burlington	11	13	2.94	1.8	24	3.1	211.3
Camden	19	18	3.40	2.8	8	1.8	13.1
Cape May	13	17	3.28	4.3	37	1.1	0.1
Cumberland	21	21	3.32	10.0	28	3.3	155.2
Essex	12	16	3.79	2.0	8	0.8	688.4
Gloucester	14	15	2.97	7.5	23	2.4	12750.1
Hudson	17	11	3.63	1.9	7	0.7	206.3
Hunterdon	1	1	4.18	4.8	38	3.2	507.2
Mercer	10	10	3.04	3.8	18	0.0	61.6
Middlesex	6	6	2.73	5.7	10	2.2	2455.5
Monmouth	5	7	3.48	1.6	14	1.8	52.4

County	CHART, 2019	UHF, 2019	KCS	Title V	NJPDES	Superfund	TRI
Morris	3	2	3.64	1.6	19	2.4	463.1
Ocean	16	9	1.80	1.8	21	2.0	24.5
Passaic	15	14	3.04	1.0	9	0.6	228.5
Salem	18	20	3.86	16.0	36	1.6	8651.9
Somerset	2	4	3.00	2.7	18	2.4	217.5
Sussex	8	5	4.77	1.4	32	1.4	3.0
Union	9	8	3.52	4.0	9	0.4	1028.7
Warren	7	12	3.51	5.7	29	0.9	500.9
Mean	---	---	3.4	4.0	19.9	1.7	1352.6
Standard Error	---	---	0.1	0.78	2.2	0.2	702.9
Standard Deviation	---	---	0.6	3.58	10.2	1.0	3221.3
Confidence Interval (95%)	---	---	0.3	1.6	4.7	0.46	1466.3
Kurtosis	---	---	2.3	5.7	-1.0	-1.0	8.9
Skewness	---	---	-0.3	2.2	0.5	0.1	3.1

A Pearson's product moment correlation coefficient (r) was used to compare each state's health ranking – both CHART and UHF - with the independent variable, environmental exposure data sets (Table 7). This statistic is a dimensionless index that ranges from -1 to 1 inclusive and reflects the extent of a linear relationship between two data sets. It can be described as the covariance of the two variables divided by the product of their standard deviations where +1 is total positive correlation, 0 is no correlation, and -1 is total negative correlation.

Like many commonly used statistics, the Pearson's product moment is not particularly robust (Wilcox, 2005), so its value can be misleading if outliers are present. However, inspection of scatterplots between X 's (county health ranking) and Y 's (environmental exposure data sets)

did not point to a situation where lack of robustness might be an issue. That is, outliers generally were not observed or present in the independent or dependent variable data sets.

Table 7. New Jersey County Health Rankings and Environmental Exposure Data Sets

Pearson Correlations	CHART, 2019	UHF, 2019	KCS	Title V	NJPDES	Superfund	TRI
CHART, 2019	1.00	---	---	---	---	---	---
UHF, 2019	0.89	1.00	--	--	--	--	--
KCS	-0.14	-0.06	1.00	--	--	--	--
Title V	0.31	0.46	0.07	1.00	--	--	--
NJPDES	-0.08	0.05	0.25	0.51	1.00	--	--
Superfund	0.04	0.04	-0.01	0.16	0.33	1.00	--
TRI	0.19	0.27	-0.06	0.65	0.23	0.10	1.00

Based on the Pearson r values in Table 7, there is a strong correlation between the CHART and UHF county health ranking systems. This is not surprising as they generally use the same set of metrics to evaluate health status. This association does support the use of average county scores compiled from the CHART zip code/municipality data.

Within the environmental data exposure sets, there is a good correlation (0.65) between the number of Title V facilities and those sites discharging TRI regulated compounds to the environment. There is a lower, but still consequential correlation (0.51), between Title V operations and those businesses maintaining NJPDES discharge permits to surface water or ground water. These relationships appear to be reasonable as many types of industrial and manufacturing activities tend to require multi-media (air and water) regulation of their wastes and waste management (disposal) practices.

There are no meaningful correlations between the environmental exposure data sets and the CHART county health rankings. The same holds true for Pearson r values between the environmental exposure data sets and UHF county health rankings, except for a possible connection (0.46) with the number of Title V facilities.

7. Discussion

The protection of public health is one of the highest obligations of government. To achieve the most benefit from scarce public resources, the health policies and programs implemented by political decision makers need to be based on data that are reliably predicting favorable

wellness outcomes. The rudimentary statistical analysis presented here suggests that a re-thinking of environmental policy is worth considering. There apparently is very little connection between New Jersey county public health ranking and the presence or absence of facilities associated with discharges to the physical environment (soil, water, air). Other socioeconomic factors such as access to health insurance, per capita income, and educational attainment dominant health outcomes and these factors are appropriately recognized and prioritized in the UHF and CHART schemas. So, the original objective of the analysis presented here – evaluating whether environmental factors are appropriately weighted for assessing health rankings at the county level in New Jersey – has been achieved; they are. In fact, environmental factors may be over-weighted given the level of regulatory protection programs in place for the Garden State.

Early environmental indices (Berger et al., 1987; Hamilton, 1988; Hall & Kerr, 1991) were more inclined to include or to prioritize releases of hazardous or noxious compounds to the water or air in their ranking methodologies. As regulatory requirements became stricter, driving implementation of mitigative measures, albeit at differing paces and varying success rates, the role such discharges might have played in health outcomes began to diminish. New Jersey has some of the most comprehensive and demanding environmental regulations in the United States and the correlations presented here suggest that county level health rankings are not significantly influenced by discharges to the environment. While more rigorous analyses are needed to confirm the findings presented here, if there is little to no connection between environmental discharges to air and water and health outcomes, then policy makers should consider two shifts in public health policy: encouraging economic growth in areas with underperforming health outcomes coupled with aggressive enforcement of existing environmental regulations.

The UHF and CHART indices clearly indicate that at the county level in New Jersey, better health is strongly correlated with increasing socioeconomic status. This means access to employment, insurance, and education likely are the key factors in resident population wellness, not whether there is a Superfund site in the neighborhood or if ozone levels exceed NAAQS standards for a few days. Economic growth – bringing jobs to the community, and not just high tech or service sector positions – should be the focus of policy makers. Even economic development that may have significant environmental challenges, such as heavy manufacturing, should be encouraged. Banning or discouraging industries or businesses that may have a reputation (deserved or undeserved) as polluting, in the name of a vague “environmental justice” goal, actually does not serve any community, disadvantaged or not. Given New Jersey’s strong environmental infrastructure and with appropriate, consistent, and well-funded regulatory oversight, these types of operations can be safely integrated into the community and bring with them improving health outcomes for all.

References

- Berger, M. C., Blomquist, G. C., & Waldner, W. (1987). A Revealed-Preference Ranking of Quality of Life for Metropolitan Areas. *Social Science Quarterly*, 68(4), 761-778.
- Braveman, P., & Gottlieb, L. (2014). The Social Determinants of Health: it’s time to consider

the causes of the causes. *Public Health Reports, Jann-Feb; 129* (Suppl 2), 19-31. <https://doi.org/10.1177/00333549141291S206>

Centers for Disease Control and Prevention, (2021). Disability & Health Data System: New Jersey: <https://www.cdc.gov/ncbddd/disabilityandhealth/impacts/new-jersey.html>.

CHART: Center for Health Analytics, Research, & Transformation, (November 2019). New Jersey's Most Vulnerable Communities: A zip code analysis of social gaps and their impact on health. New Jersey Hospital Association. <https://www.njha.com/chart>. February 9, 2021.

Forbes, M. (October 17, 2007). America's Greenest States. <https://www.forbes.com>. March 20, 2021.

Frost, R. (February 8, 2017). How Green is Your State? Constructing a modern state environmental index. Center for Local, State, and Urban Policy, Gerald Ford School of Public Policy, University of Michigan. <https://www.researchgate.net>. April 18, 2021.

Hall, B., & Kerr, M. L. (1991). The 1991-1992 Green Index: A state-by-state guide to the nation's environmental health. Island Press, New York.

Hamilton, H. R. (1988). Identification and Ranking of Environmental Impacts Associated with the United States Interstate Highway System. *Transportation Research Record, 1166*, 1-8.

Hood, C. M., Gennuso, K. P., Swain, G. R. C., & B. B. (2016). County Health Rankings: Relationships between determinant factors and health outcomes. *American Journal of Preventive Medicine, 50*(2), 129-135. <https://doi.org/10.1016/j.amepre.2015.08.024>

Kiernan, J. S. (2019). Greenest States. <https://www.wallethub.com> March 27, 2021.

Lathrop, R. G., & Hasse, J. E. (2020). Changing Landscapes in the Garden State: Land use change in New Jersey 1986 through 2015. Rutgers University. <https://doi.org/10.7282/t3-x1yc-dh86>

New Jersey Department of Labor & Workforce Development, (2021). Labor Market Information, <https://www.nj.gov/labor/>

NJDEP: New Jersey Department of Environmental Protection, (2020). Data Miner, Open Public Records Act, <https://www13.state.nj.us/DataMiner>

NJDEP: New Jersey Department of Environmental Protection, (2021). Climate Resilience for New Jersey. <https://www.nj.gov/dep/climatechange>. April 9, 2021

Park, H. J., Rouba, A. M., Jovaag, A., Gennuso, K. P., & Catlin, B. B. (2015). Relative contributions of a set of health factors to selected health outcomes. *American Journal of Preventive Medicine, 49*(6), 961-969. <https://doi.org/10.1016/j.amepre.2015.07.016>

Remington, P. L., Catlin, B. B., & Gennuso, K. P. (2015). The County Health Rankings: Rationale and methods. *Population Health Metrics, 13*(11). <https://doi.org/10.1186/s12963-015-0044-2>

Stebbins, S. S., & Michael, B. (November 7, 2019). Where does your state rank? These are some of the best and worst states to live in: Analysis. USA Today <https://www.usatoday.com/story/money/2019>

Tabb, L. P., & McClure, L. A. (2018). Quick, Harrison, Purtle, Jonathan, and Diez Roux, Ana V., (2018). Assessing the spatial heterogeneity in overall health across the United States using spatial regression methods: The contribution of health factors and county-level demographics. *Health & Place*, 51, 68-77. <https://doi.org/10.1016/j.healthplace.2018.02.012>

Tobin-Tyler, E. (2018). Health Justice in the Age of Alternative Facts and Tax Cuts: Value-based care, Medicaid reform, and the social determinants of health. *Saint Louis Journal of Health Law & Policy*, 12(1), Article 5. <https://scholarship.law.slu.edu/jhlp> January 5, 2021

UHF: United Health Foundation, (December 2019). America's Health Rankings. <https://www.americashealthrankings.org>. January 5, 2021.

Wilcox, R. R. (2005). Introduction to robust hypothesis testing. Academic Press, New York.

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