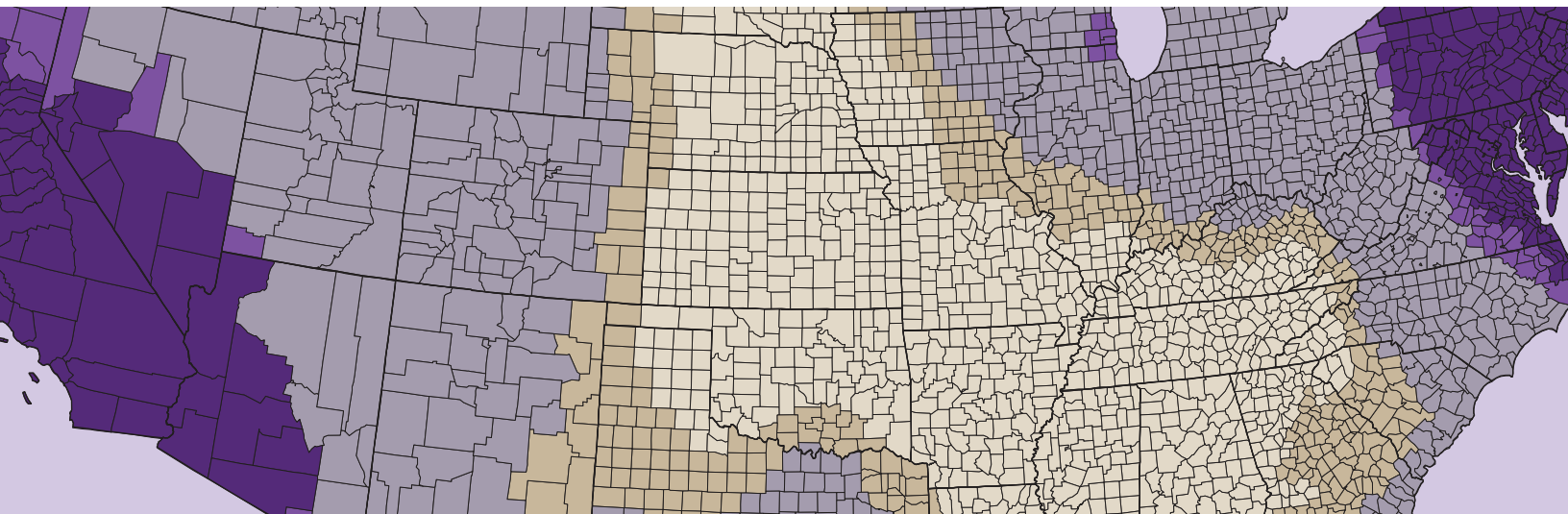


County-Level Analysis of U.S. Licensed Psychologists and Health Indicators

American Psychological Association
Center for Workforce Studies

Luona Lin, Karen Stamm and Peggy Christidis
March 2016



AMERICAN
PSYCHOLOGICAL
ASSOCIATION



CWS CENTER FOR
WORKFORCE
STUDIES
AMERICAN PSYCHOLOGICAL ASSOCIATION

Recommended citation: American Psychological Association. (2016). *County-Level Analysis of U.S. Licensed Psychologists and Health Indicators*. Washington, DC: Author.

This report describes research and analysis conducted by staff members of the American Psychological Association's Center for Workforce Studies. It does not constitute official policy of the American Psychological Association.

The authors thank Howard Kurtzman and Jaime Diaz-Granados for valuable input on previous drafts of this report.

The American Psychological Association's Center for Workforce Studies is responsible for the collection, analysis and dissemination of information relevant to the psychology workforce and education system. Through the use of surveys, federal statistics and data mining, the Center gathers information about the profession of psychology, including its scientific and educational communities, practitioners, and psychologists working in the public interest.

For questions regarding this report, please contact the APA Center for Workforce Studies at cws@apa.org or 1-800-374-2721 (extension 5980)

Table of Contents

Executive Summary	1
Introduction	2
1. Licensed Psychologists by County	3
2. Licensed Psychologists and County-Level Health Indicators	9
Conclusion	14
Appendix A. Terms and Definitions	15
Appendix B. Data and Methodology.....	17
Appendix C. County-Level Maps on Population Health Indicators.....	26
References	30

Table of Figures

Figure 1. Number of Licensed Psychologists by County, 2012-2015	3
Figure 2. Number of Licensed Psychologists per 100,000 Population, 2012-2015	4
Figure 3. Hot Spot Analysis on the Number of Licensed Psychologists, 2012-2015	6
Figure 4. Distribution of Licensed Psychologists in the State of New York, 2012-2015.....	7
Figure 5. Number of Licensed Psychologists in Relation to Groups of Population, 2012-2015.....	8
Figure 6. County-Level Health Indicators: Reported Poor or Fair Health, Poor Mental Health Days, and Poor Physical Health Days, 2006-2012	10
Figure 7. Number of Licensed Psychologists and Behavioral Health Indicators: Smoking, Obese, and Physical Inactivity, 2006-2012.....	11
Figure 8. Census Regions and Divisions of the United States.....	15
Figure 9. County-Level Health Indicators: Smoking, Obese, and Physical Inactivity, 2006-2012.....	26
Figure 10. County-Level Health Indicators: Excessive Drinking, Diabetes, and Teen Births, 2006-2012	27
Figure 11. Number of Licensed Psychologists and Behavioral Health Indicators: Poor or Fair Health Days, Diabetes, and Excessive Drinking, 2006-2012	28
Figure 12. Number of Licensed Psychologists and Behavioral Health Indicators: Teen Births, 2006-2012	29

Table of Tables

Table 1. Number and Concentration of Licensed Psychologists by Census Region and Division, 2012-2015	5
Table 2. Health Indicators by Geographic Region and Division, 2006-2012.....	12
Table 3. Number of Records of Licensed Psychologists by State, 2012-2015	18
Table 4. Regression Results: County-Level Licensed Psychologists with Health Indicators.....	20
Table 5. Regression Results: County-Level Licensed Psychologists with Health Indicators, Standardized Coefficients.....	23

Executive Summary

Based on data from state licensing boards of 50 states and the District of Columbia in 2012-2015, this report presents a county-level analysis of the distribution of licensed psychologists in the United States. It also examines the relationship between the distribution and population health outcomes. Major findings include:

Higher concentrations of psychologists were found in the Northeast and along the Pacific coast areas. The concentrations of licensed psychologists in the South and the Midwest areas were significantly lower.

Higher concentrations of licensed psychologists were generally located in urban areas. Counties with higher rural population were associated with both lower numbers and lower concentrations of licensed psychologists.

Counties with higher concentrations of licensed psychologists were comparably healthier, with lower mean numbers of poor mental and physical health days per month, and smaller percentages of the population reporting smoking, excessive drinking, obesity, physical inactivity, or diabetes.

Lower concentrations of licensed psychologists were found in the South. The South Region, where both the number and the concentration of licensed psychologists were significantly lower compared to other areas in the nation, also had significantly worse outcomes on most health indicators.

Introduction

The purpose of this report is to provide an overview of the distribution of licensed psychologists in the United States at the county level and to understand how this distribution relates to population characteristics and health outcomes.

In this report, licensed psychologists were defined as active, doctoral-level licensed psychologists. Data for licensed psychologists in 2012-2015 were obtained from state licensing boards from the 50 states and the District of Columbia. Where data from multiple years were available, the most recent state licensing board list from each state was used.¹ The data on health indicators used in this report were obtained from the Robert Wood Johnson Foundation's 2015 County Health Rankings, which combined county-level health indicators from a number of federal data sources, such as the Behavioral Risk Factor Surveillance System and Center for Disease Control and Prevention.

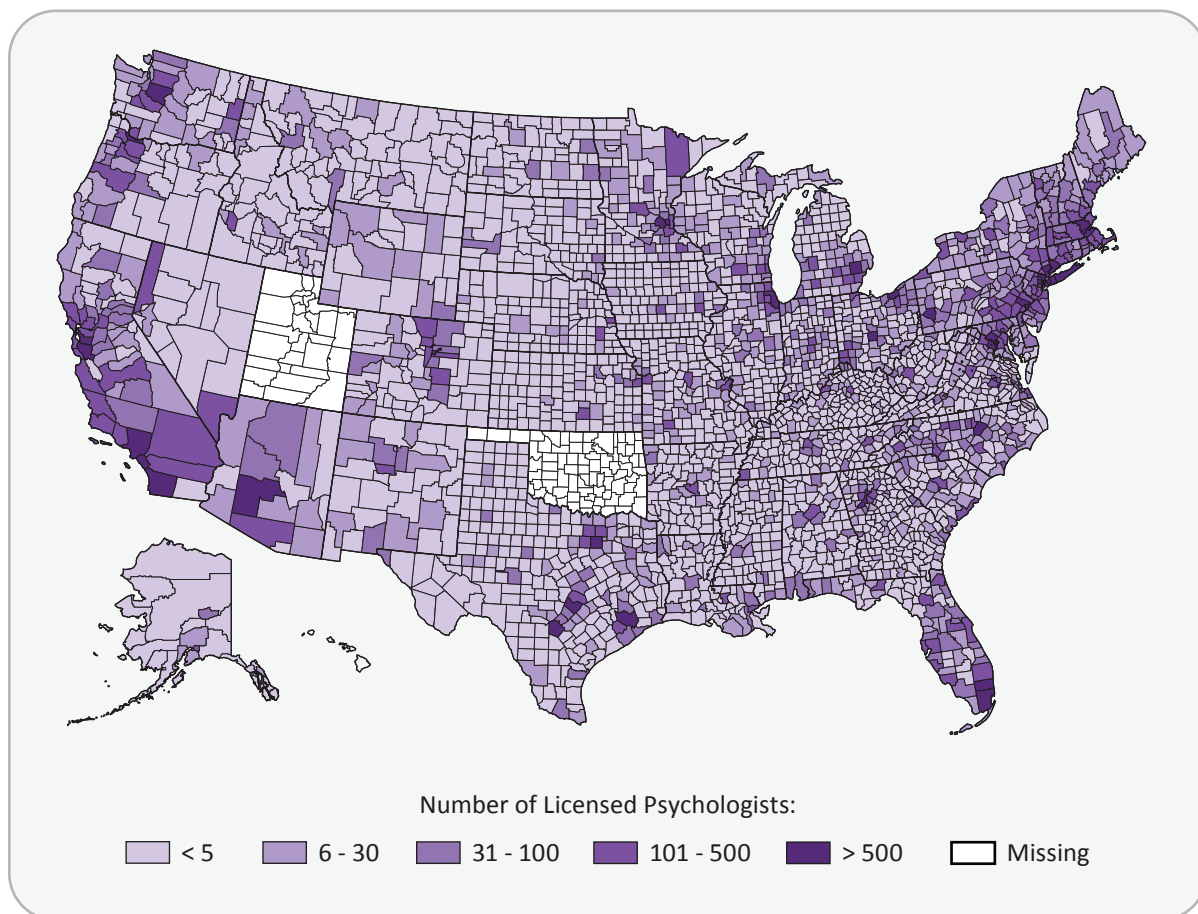
Section 1 of this report analyzes the numbers of licensed psychologists by county, as well as their overall geographic distribution. Section 2 links county-level data on licensed psychologists with health indicators and examines relationships using regression analysis. Strengths and limitations of the methodology of this report are discussed in the Conclusion. Appendix A contains documentation of terms and definitions included in this report, Appendix B presents the data and methodology of the report, and Appendix C includes additional figures on county-level licensed psychologists and health indicators.

1. See detailed documentation on source of data for licensed psychologists in Appendix B.

1. Licensed Psychologists by County

According to the 2012-2015 State Licensing Board lists, there were approximately 106,000 licensed psychologists in the United States.² Figure 1 displays the distribution of these licensed psychologists by county. Approximately 34.5 percent of the counties in the nation had no records of licensed psychologists and were treated as zeroes. 66.4 percent of counties had no more than five psychologists, and 74.6 percent of counties had no more than ten psychologists. Larger numbers of psychologists were found in the Northeast and along the Pacific coast, while relatively smaller numbers were found in the South.

Figure 1. Number of Licensed Psychologists by County, 2012-2015

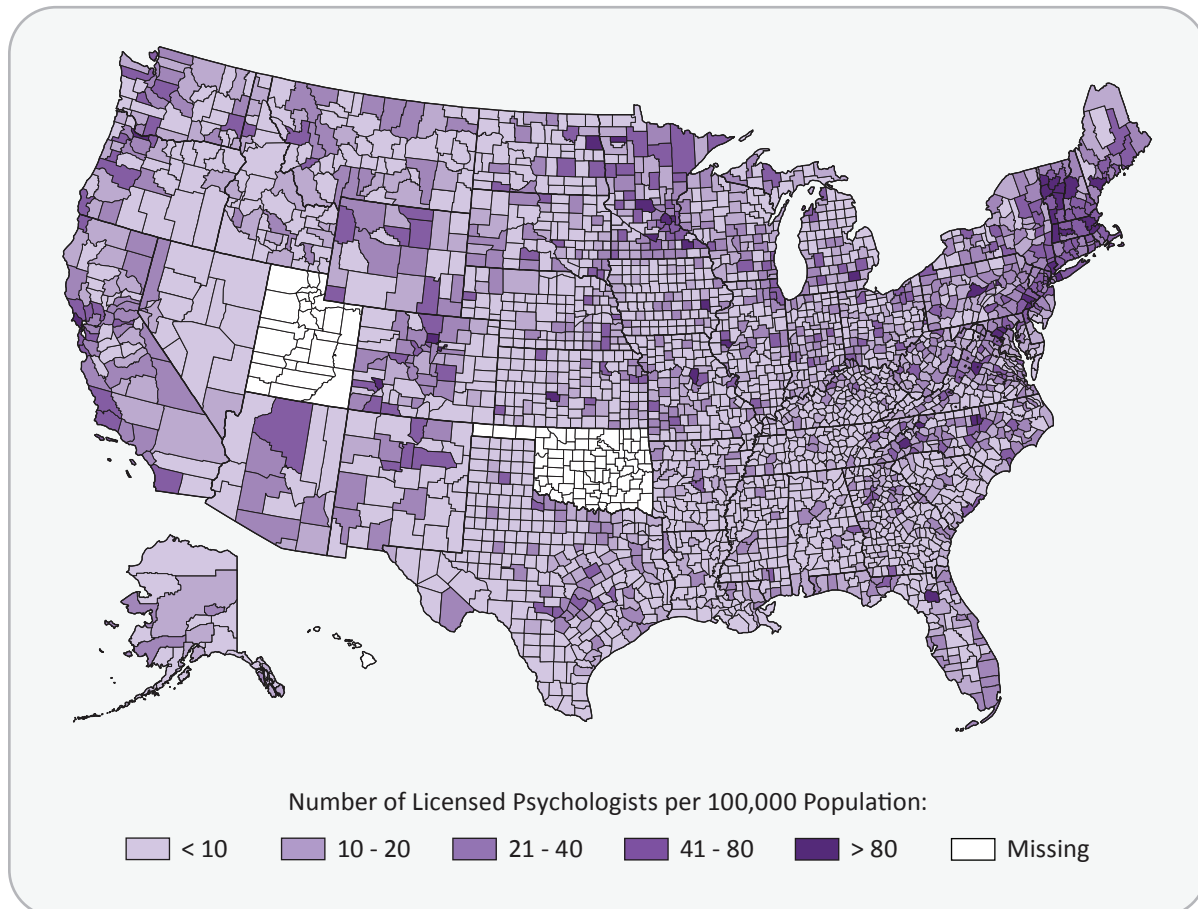


Source: American Psychological Association, 2012-2015 State Licensing Board Lists; U.S. Census Bureau, 2014 County Cartographic Boundary Shape files.

2. The total number of licensed psychologists was based on all records from state licensing boards in 50 states and the District of Columbia. County-level analysis was based on records with zip codes in 3,078 out of 3,192 counties in the nation. Due to large proportions of missing zip codes, no records in Hawaii, Oklahoma, and Utah (comprising the remaining 114 counties) were included. Numbers of records for all states were summarized in Appendix B.

Figure 2 displays the concentration of licensed psychologists (i.e., the number of licensed psychologists per 100,000 population in the county) across the nation. The pattern is very similar to Figure 1, with higher concentrations of licensed psychologists in the Northeast and lower concentrations in the South. Table 1 lists the numbers and concentrations of licensed psychologists by Census Regions and Divisions.³

Figure 2. Number of Licensed Psychologists per 100,000 Population, 2012-2015



Source: American Psychological Association, 2012-2015 State Licensing Board Lists; U.S. Census Bureau, 2014 Population Estimate and 2014 County Cartographic Boundary Shape files.

3. This report divides the United States into four geographic Regions and nine geographic Divisions as defined by the U.S. Census Bureau. See detailed documentation in Appendix A.

Table 1. Number and Concentration of Licensed Psychologists by Census Region and Division, 2012-2015

Region/Division	Number of Licensed Psychologists per County (Mean)	Concentration of Licensed Psychologists per County (Mean)
Northeast Region	131.2 (+)	36.6 (+)
New England Division	130.1 (+)	51.1 (+)
Middle Atlantic Division	131.7 (+)	29.7 (+)
Midwest Region	20.1 (-)	12.9 (-)
East North Central Division	27.1	12.4 (-)
West North Central Division	14.6 (-)	13.2
South Region	21.5 (-)	11.8 (-)
South Atlantic Division	32.1	18.1 (+)
East South Central Division	8.8 (-)	6.3 (-)
West South Central division	17.2 (-)	13.8 (-)
West Region	53.4 (+)	7.3 (+)
Mountain Division	21.6	15.2
Pacific Division	103.7 (+)	19.7 (+)
United States	33.5	14.7

Source: American Psychological Association, 2012-2015 State Licensing Board Lists; U.S. Census Bureau, 2014 Population Estimate.

Note: Concentrations of licensed psychologists are presented by the number of licensed psychologists per 100,000 population.

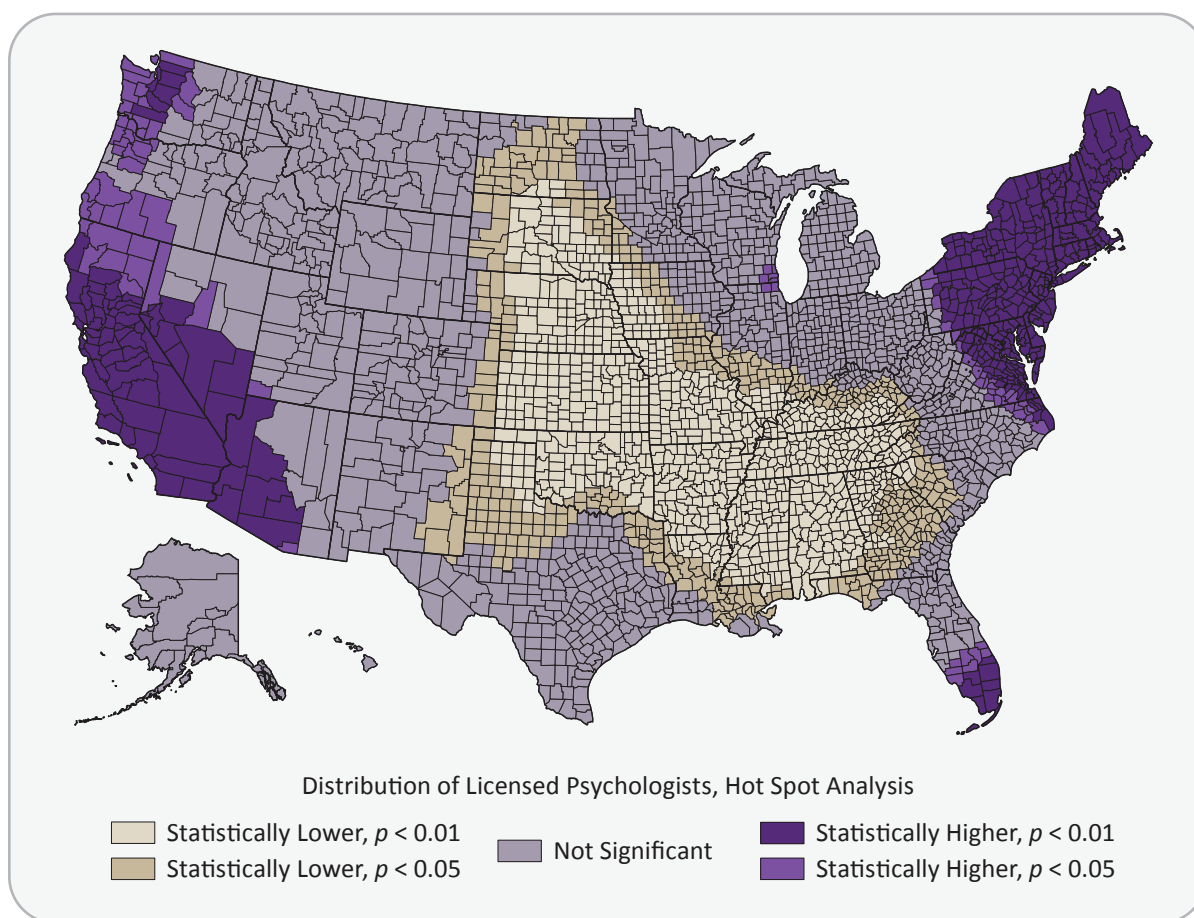
(+) Statistically higher than all other areas in the nation (based on independent samples t test)

(-) Statistically lower than all other areas in the nation (based on independent samples t test)

Figure 3 presents a hot spot analysis⁴ of the distribution of licensed psychologists in the country. Hot spot analysis uses geographic inferential statistics to identify areas with statistically higher or lower numbers of licensed psychologists. Figure 3 identifies “hot spots” of licensed psychologists in the Northeast, most of California, and around the cities of Miami and Seattle. By comparison, a large “cold spot” of licensed psychologists stretched from the South to the center of the nation.

4. Hot spot analysis identifies statistically significant spatial clusters of high values (hot spots) and low values (cold spots). See detailed documentation on hot spot analysis in Appendix B.

Figure 3. Hot Spot Analysis on the Number of Licensed Psychologists, 2012-2015



Source: American Psychological Association, 2012-2015 State Licensing Board Lists; U.S. Census Bureau, 2014 County Cartographic Boundary Shape files.

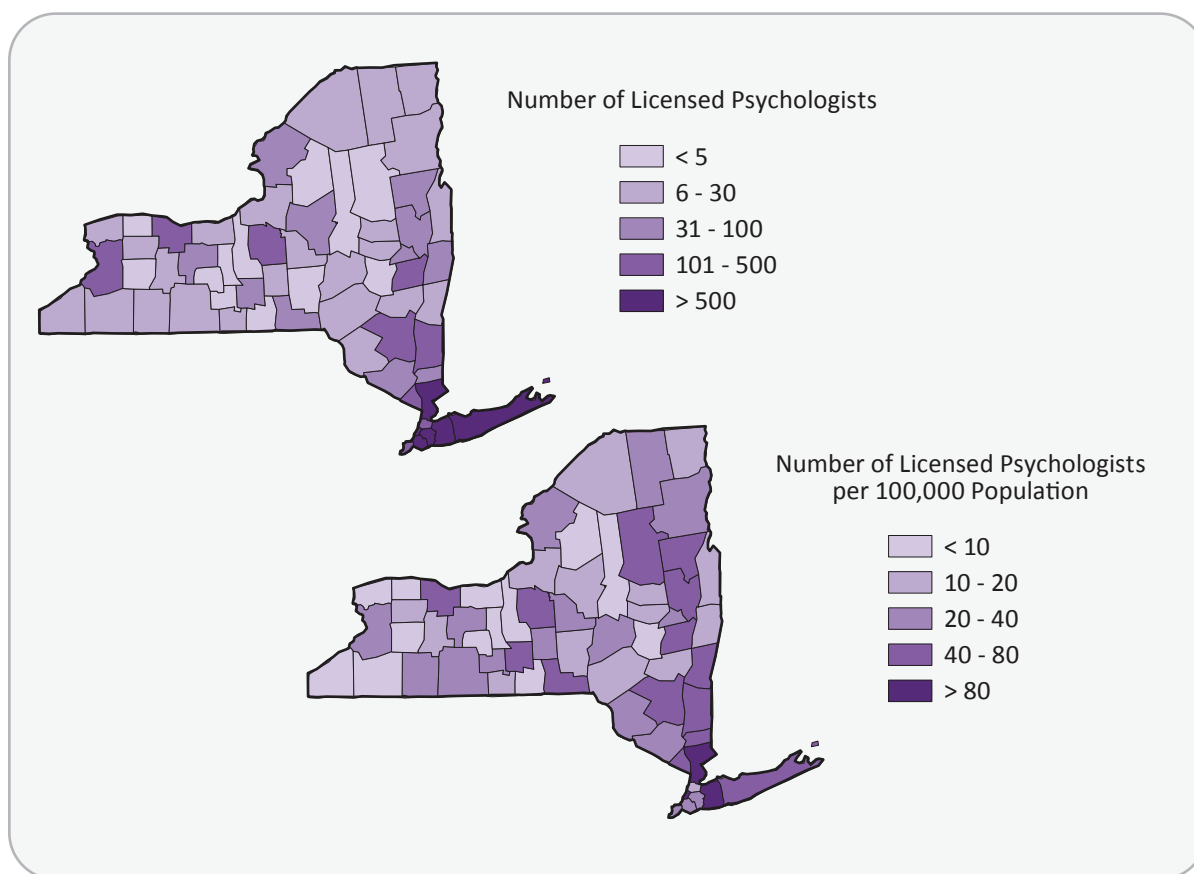
Note: This map was based on the Getis-Ord statistic generated from hot spot analysis. Number of licensed psychologists were statistically compared to the national mean. Counties in Hawaii, Oklahoma, and Utah were included in the analysis based on state means of licensed psychologists per county.

Please see online version of this map for full range of color codes.

In addition to the differences at the Region/Division level, the distribution of licensed psychologists also varied between urban and rural areas.⁵ Higher numbers and concentrations of licensed psychologists were generally found in urban areas. In the state of New York (see Figure 4), for example, New York County (Manhattan, with no rural population) had 3,394 licensed psychologists, or 209 licensed psychologists per 100,000 population. By comparison, in relatively more rural counties (i.e., those with over half of the population categorized as rural) in the state of New York, there were only 17 licensed psychologists per 100,000 population.

5. This report uses the 2010 Census Urban and Rural Classification. See detailed documentation in Appendix A.

Figure 4. Distribution of Licensed Psychologists in the State of New York, 2012-2015

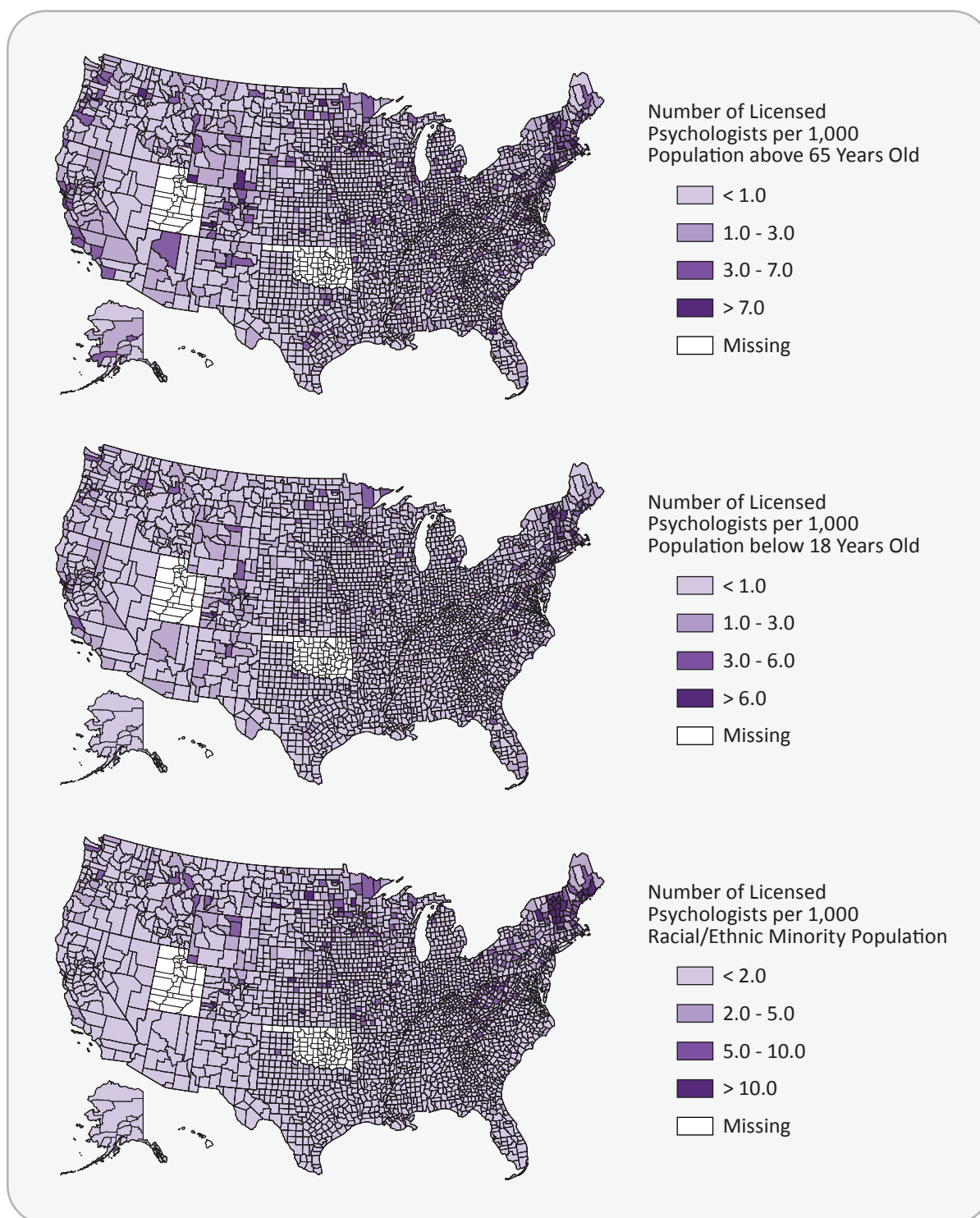


Source: American Psychological Association, 2012-2015 State Licensing Board Lists; U.S. Census Bureau, 2014 Population Estimate and 2014 County Cartographic Boundary Shape files.

The number and concentration of licensed psychologists were negatively correlated with the percentage of rural population across the nation. Counties with more rural populations were associated with both lower numbers ($r = -0.33, p < 0.001$) and lower concentrations ($r = -0.41, p < 0.001$) of licensed psychologists. Of the 734 counties that were entirely rural in the nation, 2.4 percent had 1 - 4 licensed psychologists, 4.0 percent had five or more licensed psychologists, and the remaining 93.6 percent of counties had no records of licensed psychologists.

Figure 5 depicts the number of licensed psychologists in relation to specific groups of the population, such as older adults, adolescents, and racial/ethnic minority populations. The patterns of the distributions are similar to the overall distribution of licensed psychologists, with higher concentrations of psychologists in the Northeast and lower concentrations in the South. However, the distribution of licensed psychologists in relation to the older population was relatively more uneven across the country, with much more geographic variation compared to its distribution in relation to the younger population. The concentration of licensed psychologists in relation to racial/ethnic minority populations was lower along the Pacific coast.

Figure 5. Number of Licensed Psychologists in Relation to Groups of Population, 2012-2015



Source: American Psychological Association, 2012-2015 State Licensing Board Lists; U. S. Census Bureau, 2014 Population Estimate and 2014 County Cartographic Boundary Shape files.

2. Licensed Psychologists and County-Level Health Indicators

An analysis using cross-sectional multiple linear regression found that county-level concentrations of licensed psychologists were significantly associated with a number of county-level health indicators, even when controlling for various demographic, socio-economic, health insurance-related and other environmental variables (see Appendix B for details of the analysis.) Counties with higher concentrations of licensed psychologists were generally healthier. According to the analysis, on average, every one licensed psychologist per 1,000 population in a county was associated with estimates of:⁶

- 0.8 percentage-point fewer adults with poor or fair health;
- 0.2 fewer poor mental health days per month;
- 0.3 fewer poor physical health days per month;
- 3.3 percentage-point fewer adults who were obese;
- 3.5 percentage-point fewer adults who were physically inactive;
- 3.0 percentage-point fewer adults who were smokers;
- 3.9 fewer teen birth cases per 1,000 females ages 15-19;
- 1.7 percentage-point fewer adults who reported excessive drinking; and
- 1.2 percentage-point fewer adults with diagnosed diabetes in the county.

Results of this analysis reveal correlations only and do not by themselves justify any claims about causal relationships.

The correlations between the concentrations of licensed psychologists and county-level health indicators were closely associated with the geographic patterns of the population's health outcomes. Looking at population health status at the county level (Figure 6),⁷ there was a cluster of poor health outcomes in the South Region for most indicators. This cluster corresponded to the area with a low concentration of licensed psychologists, as shown in Figure 2, and the “cold spot” of licensed psychologists identified in Figure 3.

Figure 7 shows the concentration of licensed psychologists in relation to several county health indicators (percent population obese, smoking, or physically inactive).⁸ Higher concentrations were found in the Northeast and the West for all of the measurements, indicating areas with higher numbers of licensed psychologists as well as better population health outcomes. Lower ratios were mostly located in the South, with lower numbers of psychologists and worse health outcomes.

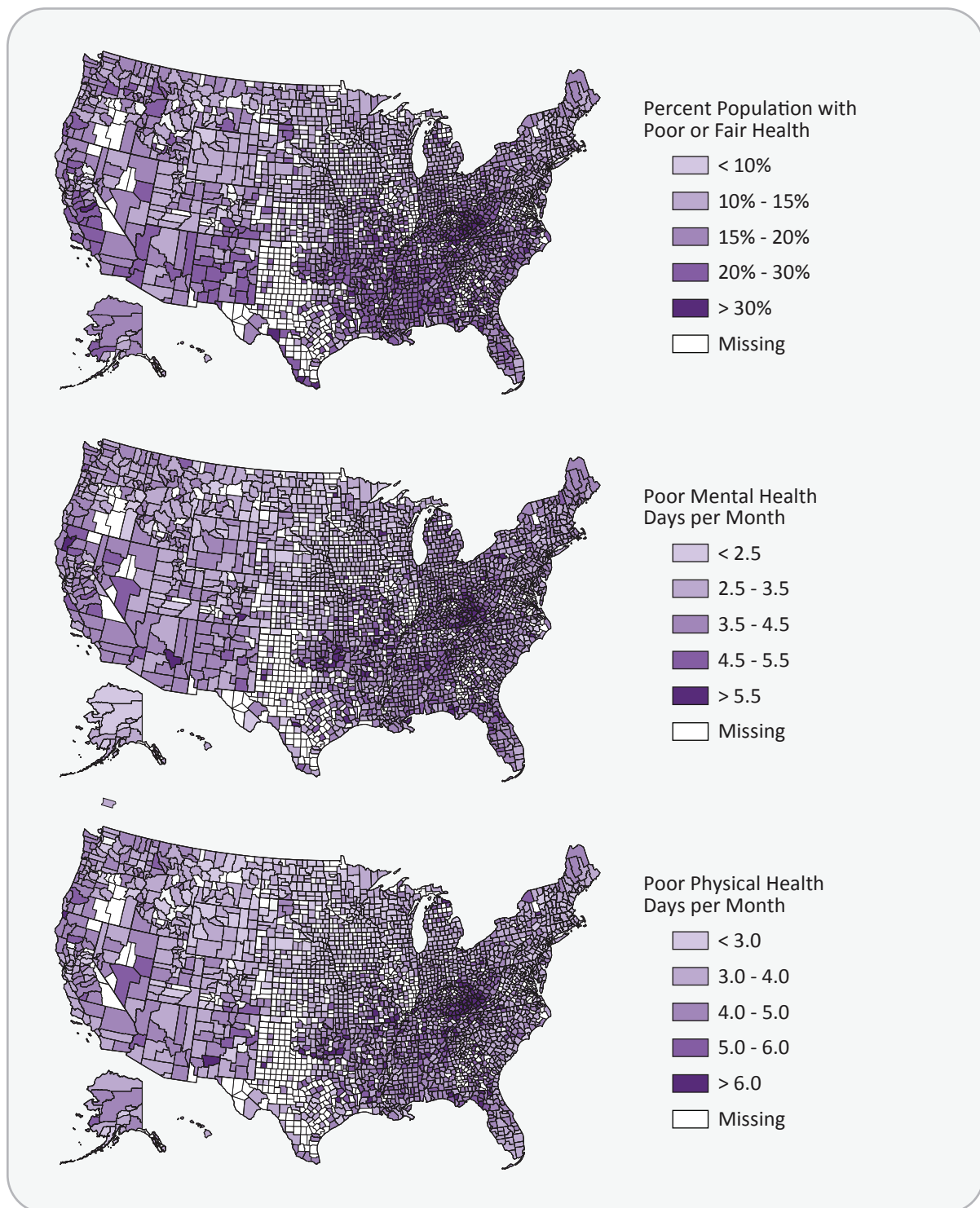
Table 2 lists population health indicators by Census Regions and Divisions.

6. All estimates are statistically significant at $p < 0.05$. See definitions for health indicators in Appendix A.

7. County-level maps for health indicators in addition to Figure 6 are included in Appendix C.

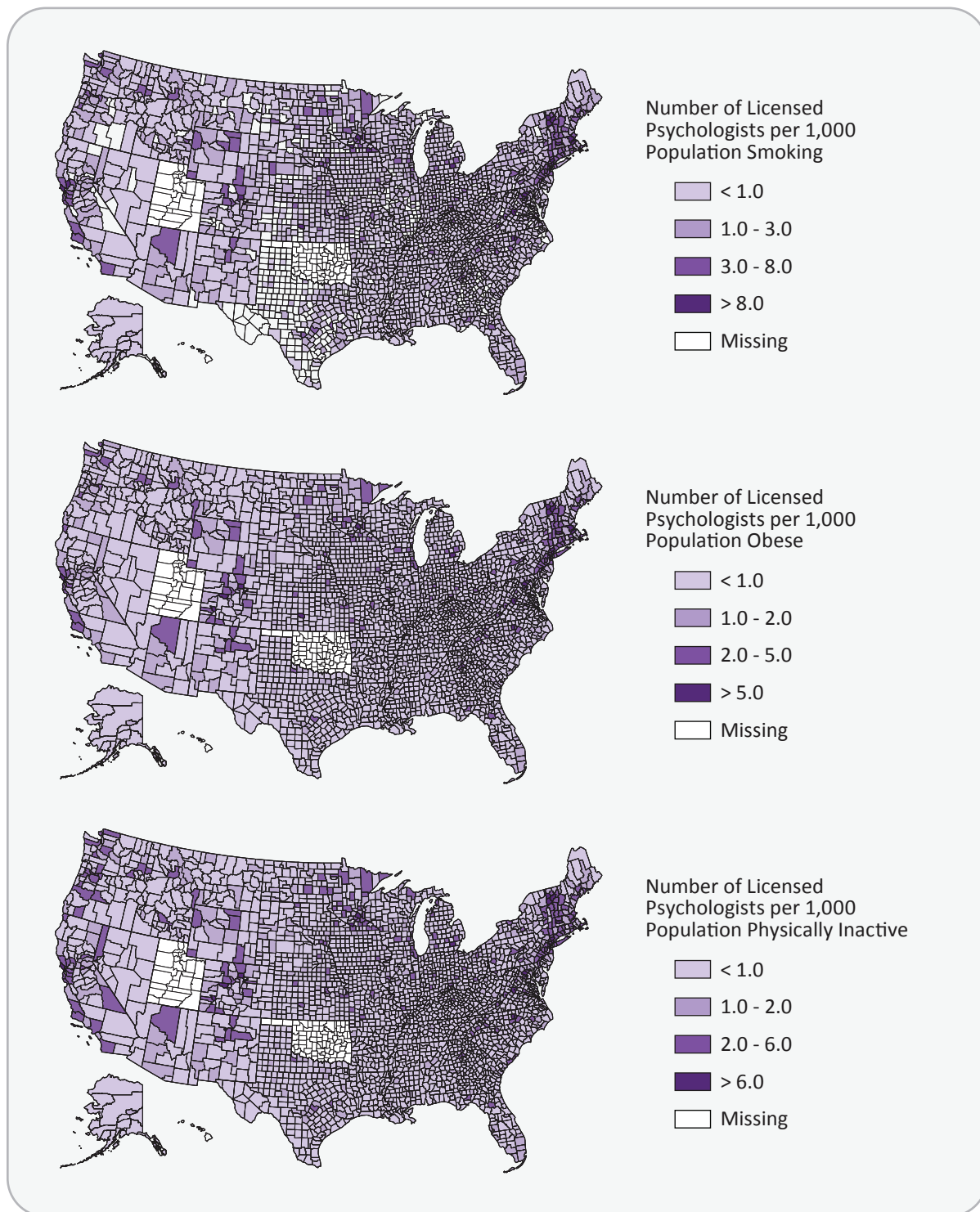
8. County-level maps of number of licensed psychologists in relation to other health indicators, in addition to Figure 7, are included in Appendix C. Note that maps on number of licensed psychologists in relation to poor mental health days and poor physical health days were not shown due to the incomparability between measurements of licensed psychologists (count) and the indicators (days).

Figure 6. County-Level Health Indicators: Reported Poor or Fair Health, Poor Mental Health Days, and Poor Physical Health Days, 2006-2012



Source: Robert Wood Johnson Foundation, 2015 County Health Rankings; U.S. Census Bureau, 2014 County Cartographic Boundary Shape files.

Figure 7. Number of Licensed Psychologists and Behavioral Health Indicators: Smoking, Obese, and Physical Inactivity, 2006-2012



Source: American Psychological Association, 2012-2015 state licensing board lists; Robert Wood Johnson Foundation, 2015 County Health Rankings; U. S. Census Bureau, 2014 Population Estimate and 2014 County Cartographic Boundary Shape files.

Table 2(a). Health Indicators by Geographic Region and Division, 2006-2012

Region/Division	(1) Percent Adult with Poor or Fair Health (Mean)	(2) Number of Poor Mental Health Days per Month (Mean)	(3) Number of Poor Physical Health Days per Month (Mean)	(4) Percent Adult Obese (Mean)	(5) Percent Population Physically Inactive (Mean)
Northeast Region	0.14 (-)	3.56	3.53 (-)	0.28 (-)	0.25 (-)
New England Division	0.12 (-)	3.51	3.34 (-)	0.26 (-)	0.22 (-)
Middle Atlantic Division	0.15 (-)	3.59	3.61 (-)	0.28 (-)	0.26 (-)
Midwest Region	0.14 (-)	3.16 (-)	3.32 (-)	0.31 (-)	0.28
East North Central Division	0.16 (-)	3.6	3.78	0.31 (+)	0.28
West North Central Division	0.13 (-)	2.80 (-)	2.94 (-)	0.31 (+)	0.27 (-)
South Region	0.21 (+)	3.98 (+)	4.33 (+)	0.32 (+)	0.30 (+)
South Atlantic Division	0.19 (+)	3.77 (+)	4.00 (+)	0.31 (+)	0.28
East South Central Division	0.23 (+)	4.34 (+)	4.91 (+)	0.34 (+)	0.34 (+)
West South Central division	0.20 (+)	3.93 (+)	4.24 (+)	0.32 (+)	0.30 (+)
West Region	0.15 (-)	3.37 (-)	3.62 (-)	0.26 (-)	0.22 (-)
Mountain Division	0.15 (-)	3.36 (-)	3.54 (-)	0.25 (-)	0.23 (-)
Pacific Division	0.16	3.37 (-)	3.76	0.27 (-)	0.20 (-)
United States	0.17	3.58	3.82	0.31	0.28

Source: Robert Wood Johnson Foundation, 2015 County Health Rankings.

(+) Statistically higher than all other areas in the nation (based on independent samples t test)

(-) Statistically lower than all other areas in the nation (based on independent samples t test)

Table 2(b). Health Indicators by Geographic Region and Division, 2006-2012 (Continued)

Region/Division	(6) Percent Adult Smoking (Mean)	(7) Number of Teen Birth Cases per 1,000 Females Ages 15-19 (Mean)	(8) Percent Population Reported Excessive Drinking (Mean)	(9) Percent Population with Diagnosed Diabetes (Mean)
Northeast Region	0.19 (-)	24.10(-)	0.15	0.10(-)
New England Division	0.17 (-)	21.35(-)	0.13(-)	0.09(-)
Middle Atlantic Division	0.20 (-)	25.42(-)	0.17	0.10(-)
Midwest Region	0.21 (+)	35.52(-)	0.19(+)	0.10(-)
East North Central Division	0.23 (+)	38.41(-)	0.18(+)	0.10(-)
West North Central Division	0.19 (-)	32.98(-)	0.19(+)	0.10(-)
South Region	0.23 (+)	54.76(+)	0.13(-)	0.12(+)
South Atlantic Division	0.22 (+)	48.13(+)	0.13(-)	0.12(+)
East South Central Division	0.25 (+)	56.48(+)	0.11(-)	0.13(+)
West South Central division	0.23 (+)	61.93(+)	0.14(-)	0.11(+)
West Region	0.18 (-)	40.90(-)	0.16	0.08(-)
Mountain Division	0.18 (-)	42.48	0.15	0.08(-)
Pacific Division	0.18 (-)	38.28(-)	0.16	0.09(-)
United States	0.21	44.30	0.16	0.11

Source: Robert Wood Johnson Foundation, 2015 County Health Rankings.

(+) Statistically higher than all other areas in the nation (based on independent samples t test)

(-) Statistically lower than all other areas in the nation (based on independent samples t test)

Conclusion

This report provided an overview of the distribution of licensed psychologists at the county level and its relationship to population characteristics and health outcomes. Licensed psychologists were unevenly distributed across the country, with higher concentrations located in the Northeast, along the Pacific coast, and generally in urban areas. The concentration of licensed psychologists was significantly related to a number of health indicators: counties with higher concentrations of licensed psychologists were comparably healthier. In the South, not only was the concentration of licensed psychologists significantly lower, but the population's mental, physical and behavioral health were also significantly worse than in other areas in the country.

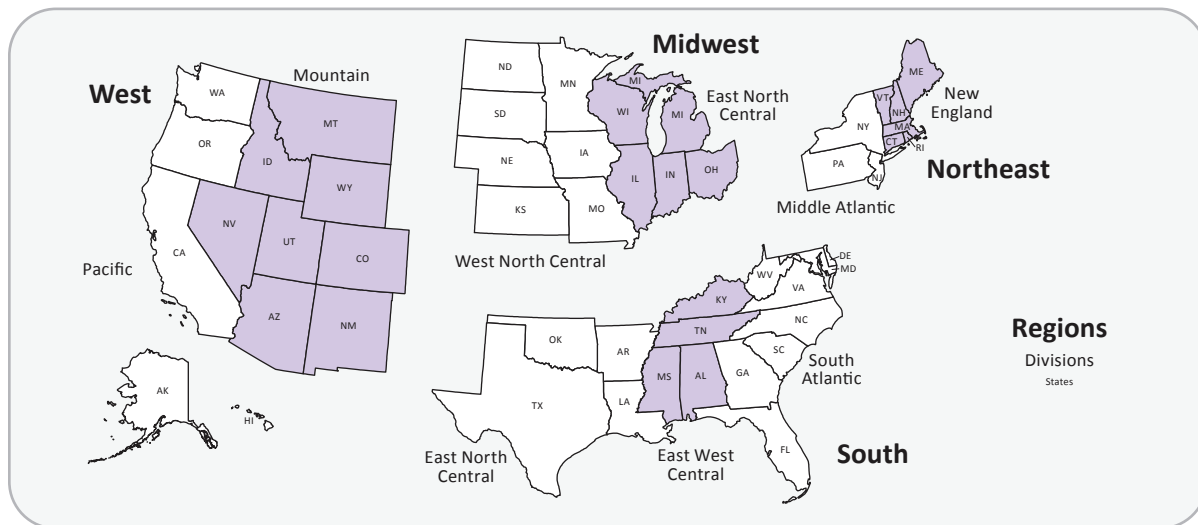
As the estimated numbers of licensed psychologists were based only on state licensing board records with zip codes, one limitation of this report is that it may provide undercounts of the mean numbers and concentrations of licensed psychologists. In contrast, the strength of this report lies in the large number of records acquired from the state licensing boards. Although a complete list of licensed psychologists from all counties is currently unavailable, the existing sample of licensed psychologists by county was large enough to analyze the distribution of licensed psychologists in the nation, and to allow for hot spot and regression analyses. Although the relationships between the distribution of licensed psychologists and health indicators can only be understood as correlational and not causal, these findings capture important geographic patterns in the health of the U.S. population and will help identify regions in which there are shortages and high demand for licensed psychologists.

Appendix A. Terms and Definitions

Regions and Divisions

This report used Census defined geographic Regions and Divisions in the analysis of the distribution of licensed psychologists. Figure 8 displays the delineation of Census Region and Census Divisions.

Figure 8. Census Regions and Divisions of the United States



Source: U.S. Census Bureau, Regions and Divisions of the United States.

Urban and Rural Areas

The report uses the 2010 Census Urban and Rural Classification, which defined urban and rural areas as follows:

“An urban area will comprise a densely settled core of census tracts and/or census blocks that meet minimum population density requirements, along with adjacent territory containing non-residential urban land uses as well as territory with low population density included to link outlying densely settled territory with the densely settled core. To qualify as an urban area, the territory identified according to criteria must encompass at least 2,500 people, at least 1,500 of which reside outside institutional group quarters. The Census Bureau identifies two types of urban areas:

- Urbanized Areas (UAs) of 50,000 or more people;
- Urban Clusters (UCs) of at least 2,500 and less than 50,000 people.

‘Rural’ encompasses all population, housing, and territory not included within an urban area.”

Health Indicators

Percent Adults with Poor or Fair Health: Percentage of adults reporting poor or fair health (age-adjusted). This measure is based on survey responses to the question: “In general, would you say that your health is excellent, very good, good, fair, or poor?”

Source: Behavioral Risk Factor Surveillance System, 2006-2012

Mean Poor Mental Health Days: Average number of mentally unhealthy days reported in the past 30 days (age-adjusted). This measure is based on survey responses to the question: “Thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?”

Source: Behavioral Risk Factor Surveillance System, 2006-2012

Mean Poor Physical Health Days: Average number of physically unhealthy days reported in the past 30 days (age-adjusted). This measure is based on survey responses to the question: “Thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?”

Source: Behavioral Risk Factor Surveillance System, 2006-2012

Percent Adult Obese: Percentage of the adult population that reports a body mass index (BMI) greater than or equal to 30 kg/m².

Source: National Center for Chronic Disease Prevention and Health Promotion, 2011

Percent Physically Inactive: Percentage of adults age 20 and over reporting no leisure-time physical activity. Examples of physical activities provided include running, calisthenics, golf, gardening, or walking for exercise.

Source: National Diabetes Surveillance System, 2011

Percent Adult Smoking: Percentage of adults (age 20 and older) who are current smokers, defined as adults who currently smoke every day or most days and have smoked at least 100 cigarettes in their lifetime.

Source: Behavioral Risk Factor Surveillance System, 2006-2012

Percent Excessive Drinking: Percentage of adults reporting binge or heavy drinking. Binge drinking was defined as consuming more than 4 (women) or 5 (men) alcoholic beverages on a single occasion in the past 30 days. Heavy drinking was defined as drinking more than one (women) or 2 (men) drinks per day on average.

Source: Behavioral Risk Factor Surveillance System, 2006-2012

Teen Births: Number of births per 1,000 female population ages 15-19.

Source: National Vital Statistics System, 2006-2012

Percent Adult with Diabetes: Percentage of adults aged 20 and above with diagnosed diabetes.

Source: The National Diabetes Surveillance System, 2011

Appendix B. Data and Methodology

This report uses data for active, doctoral-level psychologists (as defined by license type and license status for each state) obtained from state licensing boards from the 50 states and the District of Columbia. Records of psychologists were from 2012 to 2015, depending on the most recent state licensing board lists available. Forty-two out of the 51 lists were from 2014 or 2015.

Psychologists were first de-duplicated based on their records from the state licensing boards. Two records of licensed psychologists were regarded as duplicates when records had

- a) Exact match of names (first names and last names),
and
- b) Exact match of email addresses, zip codes, addresses (street numbers, street names, *and* city names), *or* phone numbers.

In case of misspelled names, records were also de-duplicated based on the exact match of email addresses and *approximate* match of names.⁹

Records of licensed psychologists were then linked to counties through zip codes, and aggregated and counted at the county level.

The addresses provided by the state licensing boards were not necessarily the practicing addresses of the psychologists, but could be their *home addresses*. It is unclear what proportion of licensed psychologists reported home addresses instead of practicing addresses. However, the inclusion of home addresses can only minimally affect the analysis given the usual geographic proximity between one's work location and home location.

The numbers of records from all states are listed in Table 3.

9. Exact match refers to cases where specific fields of records were exactly the same. Approximate match refers to cases where fields of records were 80 percent similar.

Table 3. Number of Records of Licensed Psychologists by State, 2012-2015

State	Number of Records with Zip Codes	Number of Records with Missing Zip Codes	Total Number of Records
AK	195	-	195
AL	733	-	733
AR	481	2	483
AZ	1,532	2	1,534
CA	12,851	5	12,856
CO	2,290	253	2,543
CT	1,906	3	1,909
DC	971	27	998
DE	315	-	315
FL	4,756	19	4,775
GA	2,290	-	2,290
HI	N/A*	N/A	665
IA	539	1	540
ID	257	-	257
IL	4,596	-	4,596
IN	1,418	-	1,418
KS	736	1	737
KY	946	-	946
LA	638	-	638
MA	5,120	7	5,127
MD	2,872	20	2,892
ME	600	2	602
MI	2,705	-	2,705
MN	3,639	16	3,655
MO	1,641	2	1,643
MS	363	-	363
MT	249	-	249
NC	3,642	1	3,643
ND	225	-	225
NE	603	1	604
NH	610	3	613
NJ	3,941	76	4,017
NM	649	-	649
NV	441	1	442
NY	10,661	530	11,191
OH	3,494	5	3,499
OK	N/A	N/A	576
OR	1,591	1	1,592
PA	5,543	13	5,556
RI	653	-	653
SC	669	5	674
SD	191	1	192
TN	1,188	19	1,207
TX	5,701	13	5,714
UT	N/A	N/A	820
VA	3,162	12	3,174
VT	607	1	608
WA	2,459	5	2,464
WI	1,685	1	1,686
WV	512	-	512
WY	182	-	182
Grand Total	103,048	1,048	106,157

Source: American Psychological Association, 2012-2015 State Licensing Board Lists

* Numbers of records in Hawaii (HI), Oklahoma (OK), and Utah (UT) were only reported in totals due to the unavailability of records with zip codes in these states.

Hot Spot Analysis

Hot spot analysis identifies statistically significant spatial clusters of high values (hot spots) and low values (cold spots), and is widely used in spatial analysis by federal agencies such as the Centers for Disease Control and Prevention.

Hot spot analysis uses a z-score statistic called Getis-Ord local statistic (G_i^*) to identify locations (i.e., counties in this analysis) with statistically higher or lower values. The Getis-Ord statistic is calculated as follows:

$$G_i^* = \frac{\sum_{j=1}^n w_{ij} x_j - \bar{x} \sum_{j=1}^n w_{ij}}{\sqrt{\frac{[n \sum_{j=1}^n w_{ij}^2 - (\sum_{j=1}^n w_{ij})^2]}{n-1}}}$$

where x_i is the value for county i , w_{ij} is the spatial weight between county i and j (assigned based on inverse geographic distance such that closer counties were assigned larger weights), n is the total number of counties, and

$$\bar{x} = \frac{\sum_{j=1}^n x_j}{n}, \quad S = \sqrt{\frac{\sum_{j=1}^n x_j^2}{n} - (\bar{x})^2}$$

Counties in Hawaii, Oklahoma, and Utah were included in the analysis using state means of licensed psychologists per county. Note that the spatial weight assigned was determined only by geographic distance between counties, therefore the effect of state borders was not included in this spatial analysis.

Regression Model

In analyzing the relationship between the county-level concentration of licensed psychologists and health indicators, the following regression model was used:

$$H_i = \alpha + \beta_1 LP_i + \beta_2 D_i + \beta_3 SE_i + \beta_4 HC_i + \beta_5 EV_i + c_i + \varepsilon_i,$$

H_i is the value of health indicator in county i . LP_i is the concentration of licensed psychologists (number of licensed psychologists per 100,000 population). D_i is a vector of county-level demographic variables including population, percent population below 18 years old, percent population above 65 years old, percent population White (non-Hispanic), percent population female, and percent population in rural areas. SE_i is a vector of county-level socio-economic variables including median household income, unemployment rate, education attainment, and violent crime cases. HC_i is a vector of control variables related to health care including insurance coverage and relative healthcare cost. EV_i is a vector of county-level environmental variables including air pollution, percent population exposed to drinking water violations, and percent population with severe housing problems. Regressions were conducted with Regional fixed effects c_i . Regression results (with original coefficients and standardized coefficients) are listed in Tables 4 and Table 5.

Table 4(a). Regression Results: County-Level Licensed Psychologists with Health Indicators

Dependent Variables Independent Variables	(1) Percent Population with Poor or Fair Health	(2) Poor Mental Health Days per Month	(3) Poor Physical Health Days per Month
Licensed Psychologists per 100,000 Population	-0.0001* (-2.30)	-0.0018* (-2.26)	-0.0032*** (-4.20)
Demographic Variables			
Population	0.0000 (1.80)	-0.0000 (-0.56)	0.0000 (0.40)
Percent Population below 18 Years Old	0.1502** (3.28)	-2.8792** (-2.81)	-1.2593 (-1.33)
Percent Population above 65 Years Old	0.0116 (0.36)	-0.2819 (-0.38)	-0.9228 (-1.36)
Percent Population White	-0.0322*** (-3.86)	-1.2944*** (-7.28)	-1.6757*** (-9.29)
Percent Population Female	-0.1143 (-1.86)	0.9325 (0.68)	-2.9109* (-2.25)
Percent Population Living in Rural Areas	0.0097* (2.39)	-0.1853* (-2.03)	0.0434 (0.50)
Socio-Economic Variables			
Median Household Income	-0.0000*** (-3.52)	-0.0000 (-1.96)	-0.0000*** (-3.56)
Unemployment Rate	0.2569*** (5.61)	2.5623* (2.44)	3.3706*** (3.63)
Percent Population with High School Degrees	0.0035 (0.31)	-0.4506 (-1.70)	-0.1264 (-0.48)
Violent Crime Cases per 100,00 Population	0.0000 (1.36)	0.0002 (1.70)	0.0001 (1.28)
Health Insurance			
Percent Uninsured Adults	0.0696* (1.99)	-2.1732** (-2.74)	--2.1920** (-2.89)
Percent Uninsured Children	-0.2883*** (-6.48)	-0.9569 (-0.98)	-3.1760*** (-3.38)
Price-Adjusted Healthcare Cost	0.2649*** (9.44)	3.2575*** (5.40)	5.0465*** (8.45)
Could not See Doctor due to Cost	0.3780*** (13.49)	7.2482*** (10.82)	7.0744*** (12.29)
Environmental Variables			
Air Pollution- Density of Particulate Matter	0.0007 (1.07)	0.0575*** (4.22)	0.0444*** (3.32)
Percent Population Exposed to Drinking Water Violation	0.0012 (0.21)	-0.0749 (-0.55)	0.0360 (0.26)
Percent Households with Severe Housing Problems	-0.0875** (-2.66)	-0.6560 (-0.88)	-1.8912* (-2.53)
R-Squared	0.678	0.378	0.544
N	2008	1962	2008

Note: Regressions were conducted with constant, regional fixed effects, and robust standard errors; t values are in parenthesis. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: American Psychological Association, 2012-2015 State Licensing Board Lists; Robert Wood Johnson Foundation, 2015 County Health Rankings.

Table 4(b). Regression Results: County-Level Licensed Psychologists with Health Indicators (Continued)

Dependent Variables Independent Variables	(4) Percent Adult Smoking	(5) Percent Adult Obese	(6) Percent Population Physically Inactive
Licensed Psychologists per 100,000 Population	-0.0003*** (-6.60)	-0.0003*** (-8.08)	-0.0004*** (-8.37)
Demographic Variables			
Population	-0.0000*** (-4.11)	-0.0000** (-3.16)	-0.0000* (-2.24)
Percent Population below 18 Years Old	-0.0765 (-1.30)	0.3660*** (9.02)	0.2427*** (6.03)
Percent Population above 65 Years Old	-0.0971* (-2.44)	-0.0612 (-1.94)	0.0591 (1.90)
Percent Population White	-0.1063*** (-9.86)	0.0475*** (6.61)	0.0020 (0.31)
Percent Population Female	-0.0922 (-1.34)	-0.1273** (-2.71)	0.0080 (0.18)
Percent Population Living in Rural Areas	0.0105* (2.11)	0.0225*** (6.53)	0.0170*** (4.57)
Socio-Economic Variables			
Median Household Income	-0.0000*** (-6.25)	-0.0000*** (-8.94)	-0.0000*** (-4.98)
Unemployment Rate	0.1679** (2.78)	0.0809 (1.93)	-0.0888* (-2.21)
Percent Population with High School Degrees	-0.0392** (-2.71)	-0.0171 (-1.91)	0.0170 (1.90)
Violent Crime Cases per 100,00 Population	0.0000* (2.40)	0.0000** (3.28)	0.0000*** (4.74)
Health Insurance			
Percent Uninsured Adults	-0.1434** (-3.28)	0.0181 (0.60)	0.0965** (2.94)
Percent Uninsured Children	-0.0649 (-1.19)	-0.3070*** (-7.81)	-0.3203*** (-8.10)
Price-Adjusted Healthcare Cost	0.1379*** (4.96)	0.1005*** (4.79)	0.2659*** (10.99)
Could not See Doctor due to Cost	0.4011*** (11.96)	-0.0362 (-1.90)	0.0624** (3.05)
Environmental Variables			
Air Pollution- Density of Particulate Matter	0.0041*** (5.70)	-0.0016*** (-3.42)	0.0030*** (5.42)
Percent Population Exposed to Drinking Water Violation	0.0158* (2.12)	-0.0080 (-1.78)	-0.0016 (-0.32)
Percent Households with Severe Housing Problems	-0.2216*** (-5.50)	-0.1356*** (-5.31)	-0.2738*** (-10.63)
R-Squared	0.524	0.665	0.731
N	2006	2027	2027

Note: Regressions were conducted with constant, regional fixed effects, and robust standard errors; t values are in parenthesis. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: American Psychological Association, 2012-2015 State Licensing Board Lists; Robert Wood Johnson Foundation, 2015 County Health Rankings.

Table 4(c). Regression Results: County-Level Licensed Psychologists with Health Indicators (Continued)

Dependent Variables Independent Variables	(7) Teen Births	(8) Percent Excessive Drinking	(9) Percent Population Diagnosed with Diabetes
Licensed Psychologists per 100,000 Population	-0.0009* (-1.96)	-0.0010** (-3.02)	-0.0011*** (-6.58)
Demographic Variables			
Population	0.0000** (2.65)	-0.0000 (-0.42)	-0.0000 (-0.12)
Percent Population below 18 Years Old	7.9982*** (17.57)	-1.1991** (-3.22)	1.5269*** (7.51)
Percent Population above 65 Years Old	3.4131*** (10.69)	-0.2684 (-0.95)	1.7312*** (12.82)
Percent Population White	-0.1450*** (-3.35)	-0.0149 (-0.23)	0.1184*** (3.30)
Percent Population Female	-4.3940*** (-10.39)	-1.4301** (-3.09)	0.2678 (1.38)
Percent Population Living in Rural Areas	-0.1975*** (-6.40)	0.0342 (1.05)	0.0617*** (3.98)
Socio-Economic Variables			
Median Household Income	-0.0000*** (-11.56)	0.0000*** (3.45)	-0.0000*** (-4.82)
Unemployment Rate	0.4842 (1.64)	-0.1925 (-0.52)	1.2860*** (6.62)
Percent Population with High School Degrees	-0.5908*** (-7.74)	-0.2094* (-2.03)	-0.2312*** (-5.54)
Violent Crime Cases per 100,00 Population	0.0004*** (10.53)	0.0001* (2.09)	0.0000* (2.37)
Health Insurance			
Percent Uninsured Adults	0.8841*** (3.41)	-0.9571** (-3.07)	0.2936* (2.05)
Percent Uninsured Children	-0.3171 (-1.00)	1.6136*** (4.44)	-1.2243*** (-7.29)
Price-Adjusted Healthcare Cost	0.2282 (1.45)	-0.7482*** (-3.50)	0.5035*** (5.47)
Could not See Doctor due to Cost	1.0825*** (7.21)	-0.4642* (-2.06)	-0.0967 (-1.12)
Environmental Variables			
Air Pollution- Density of Particulate Matter	0.0135** (3.20)	-0.0244*** (-4.87)	0.0040 (1.69)
Percent Population Exposed to Drinking Water Violation	-0.1089* (-2.30)	0.0571 (1.11)	-0.0351 (-1.76)
Percent Households with Severe Housing Problems	-1.4478*** (-6.84)	1.5198*** (5.88)	-0.5210*** (-4.23)
R-Squared	0.775	0.405	0.733
N	2027	1623	2027

Note: Regressions were conducted with constant, regional fixed effects, and robust standard errors; t values are in parenthesis. Dependent variables were normalized based on log transformation due to skewness in original distributions. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: American Psychological Association, 2012-2015 State Licensing Board Lists; Robert Wood Johnson Foundation, 2015 County Health Rankings.

Table 5(a). Regression Results: County-Level Licensed Psychologists with Health Indicators, Standardized Coefficients

Dependent Variables Independent Variables	(1) Percent Population with Poor or Fair Health	(2) Poor Mental Health Days per Month	(3) Poor Physical Health Days per Month
Licensed Psychologists per 100,000 Population	-0.032* (-2.30)	-0.043* (-2.26)	-0.067*** (-4.20)
Demographic Variables			
Population	0.012 (1.80)	-0.008 (-0.56)	0.002 (0.40)
Percent Population below 18 Years Old	0.077** (3.28)	-0.093** (-2.81)	-0.036 (-1.33)
Percent Population above 65 Years Old	0.007 (0.36)	-0.011 (-0.38)	-0.033 (-1.36)
Percent Population White	-0.089*** (-3.86)	-0.221*** (-7.28)	-0.258*** (-9.29)
Percent Population Female	-0.034 (-1.86)	0.018 (0.68)	-0.049* (-2.25)
Percent Population Living in Rural Areas	0.047* (2.39)	-0.056* (-2.03)	0.012 (0.50)
Socio-Economic Variables			
Median Household Income	-0.090*** (-3.52)	-0.071 (-1.96)	-0.107*** (-3.56)
Unemployment Rate	0.108*** (5.61)	0.068* (2.44)	0.079*** (3.63)
Percent Population with High School Degrees	0.005 (0.31)	-0.043 (-1.70)	-0.011 (-0.48)
Violent Crime Cases per 100,00 Population	0.024 (1.36)	0.041 (1.70)	0.025 (1.28)
Health Insurance			
Percent Uninsured Adults	0.074* (1.99)	-0.144** (-2.74)	-0.130** (-2.89)
Percent Uninsured Children	-0.152*** (-6.48)	-0.031 (-0.98)	-0.094*** (-3.38)
Price-Adjusted Healthcare Cost	0.324*** (9.44)	0.248*** (5.40)	0.345*** (8.45)
Could not See Doctor due to Cost	0.349*** (13.49)	0.414*** (10.82)	0.365*** (12.29)
Environmental Variables			
Air Pollution- Density of Particulate Matter	0.017 (1.07)	0.092*** (4.22)	0.064*** (3.32)
Percent Population Exposed to Drinking Water Violation	0.003 (0.21)	-0.011 (-0.55)	0.005 (0.26)
Percent Households with Severe Housing Problems	-0.050** (-2.66)	-0.029 (-0.88)	-0.073* (-2.53)
R-Squared	0.678	0.378	0.544
N	2008	1962	2008

Note: Regressions were conducted with constant, regional fixed effects, and robust standard errors; t values are in parenthesis. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: American Psychological Association, 2012-2015 State Licensing Board Lists; Robert Wood Johnson Foundation, 2015 County Health Rankings.

Table 5(b). Regression Results: County-Level Licensed Psychologists with Health Indicators, Standardized Coefficients (Continued)

Dependent Variables Independent Variables	(4) Percent Adult Smoking	(5) Percent Adult Obese	(6) Percent Population Physically Inactive
Licensed Psychologists per 100,000 Population	-0.115*** (-6.60)	-0.164*** (-8.08)	-0.141*** (-8.37)
Demographic Variables			
Population	-0.025*** (-4.11)	-0.042** (-3.16)	-0.019* (-2.24)
Percent Population below 18 Years Old	-0.040 (-1.30)	0.246*** (9.02)	0.131*** (6.03)
Percent Population above 65 Years Old	-0.064* (-2.44)	-0.052 (-1.94)	0.040 (1.90)
Percent Population White	-0.299*** (-9.86)	0.170*** (6.61)	0.006 (0.31)
Percent Population Female	-0.028 (-1.34)	-0.050** (-2.71)	0.003 (0.18)
Percent Population Living in Rural Areas	0.052* (2.11)	0.142*** (6.53)	0.086*** (4.57)
Socio-Economic Variables			
Median Household Income	-0.197*** (-6.25)	-0.269*** (-8.94)	-0.135*** (-4.98)
Unemployment Rate	0.072** (2.78)	0.045 (1.93)	-0.039* (-2.21)
Percent Population with High School Degrees	-0.061** (-2.71)	-0.034 (-1.91)	0.28 (1.90)
Violent Crime Cases per 100,00 Population	0.048* (2.40)	0.057** (3.28)	0.070*** (4.74)
Health Insurance			
Percent Uninsured Adults	-0.154** (-3.28)	0.025 (0.60)	0.108** (2.94)
Percent Uninsured Children	-0.035 (-1.19)	-0.212*** (-7.81)	-0.178*** (-8.10)
Price-Adjusted Healthcare Cost	0.171*** (4.96)	0.160*** (4.79)	0.341*** (10.99)
Could not See Doctor due to Cost	0.376*** (11.96)	-0.044 (-1.90)	0.061** (3.05)
Environmental Variables			
Air Pollution- Density of Particulate Matter	0.108*** (5.70)	-0.055*** (-3.42)	0.081*** (5.42)
Percent Population Exposed to Drinking Water Violation	0.037* (2.12)	-0.024 (-1.78)	-0.004 (-0.32)
Percent Households with Severe Housing Problems	-0.157*** (-5.50)	-0.122*** (-5.31)	-0.198*** (-10.63)
R-Squared	0.524	0.665	0.731
N	2006	2027	2027

Note: Regressions were conducted with constant, regional fixed effects, and robust standard errors; t values are in parenthesis. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: American Psychological Association, 2012-2015 State Licensing Board Lists; Robert Wood Johnson Foundation, 2015 County Health Rankings.

Table 4(c). Regression Results: County-Level Licensed Psychologists with Health Indicators
Standardized Coefficients (Continued)

Dependent Variables Independent Variables	(7) Teen Births	(8) Percent Excessive Drinking	(9) Percent Population Diagnosed with Diabetes
Licensed Psychologists per 100,000 Population	-0.041* (-1.96)	-0.074** (-3.02)	-0.109*** (-6.58)
Demographic Variables			
Population	0.018** (2.65)	-0.007 (-0.42)	-0.001 (-0.12)
Percent Population below 18 Years Old	0.497*** (17.57)	-0.120** (-3.22)	0.201*** (7.51)
Percent Population above 65 Years Old	0.267*** (10.69)	-0.034 (-0.95)	0.288*** (12.82)
Percent Population White	-0.048*** (-3.35)	-0.007 (-0.23)	0.083*** (3.30)
Percent Population Female	-0.159*** (-10.39)	-0.077** (-3.09)	0.021 (1.38)
Percent Population Living in Rural Areas	-0.115*** (-6.40)	0.029 (1.05)	0.076*** (3.98)
Socio-Economic Variables			
Median Household Income	-0.382*** (-11.56)	0.158*** (3.45)	-0.140*** (-4.82)
Unemployment Rate	0.025 (1.64)	-0.015 (-0.52)	0.139*** (6.62)
Percent Population with High School Degrees	-0.109*** (-7.74)	-0.058* (-2.03)	-0.090*** (-5.54)
Violent Crime Cases per 100,00 Population	0.70*** (10.53)	0.053* (2.09)	0.038* (2.37)
Health Insurance			
Percent Uninsured Adults	0.113*** (3.41)	-0.187** (-3.07)	0.080* (2.05)
Percent Uninsured Children	-0.020 (-1.00)	0.155*** (4.44)	-0.166*** (-7.29)
Price-Adjusted Healthcare Cost	0.034 (1.45)	-0.155*** (-3.50)	0.158*** (5.47)
Could not See Doctor due to Cost	0.121*** (7.21)	-0.072* (-2.06)	-0.023 (-1.12)
Environmental Variables			
Air Pollution- Density of Particulate Matter	0.042** (3.20)	-0.115*** (-4.87)	0.026 (1.69)
Percent Population Exposed to Drinking Water Violation	-0.030* (-2.30)	0.024 (1.11)	-0.021 (-1.76)
Percent Households with Severe Housing Problems	-0.121*** (-6.84)	0.198*** (5.88)	-0.092*** (-4.23)
R-Squared	0.775	0.405	0.733
N	2027	1623	2027

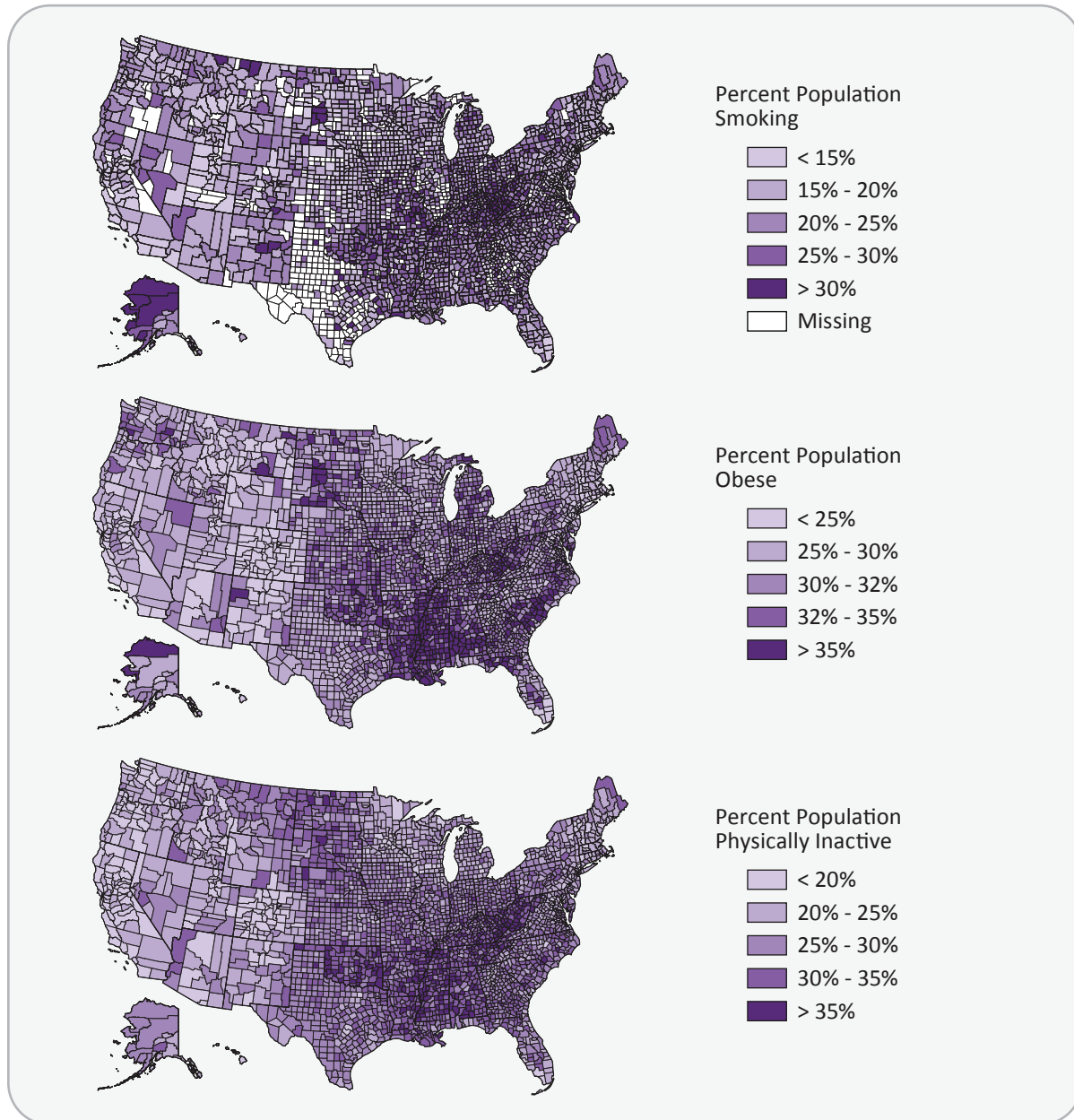
Note: Regressions were conducted with constant, regional fixed effects, and robust standard errors; t values are in parenthesis. Dependent variables were normalized based on log transformation due to skewness in original distributions. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: American Psychological Association, 2012-2015 State Licensing Board Lists; Robert Wood Johnson Foundation, 2015 County Health Rankings.

Appendix C. County-Level Maps on Population Health Indicators

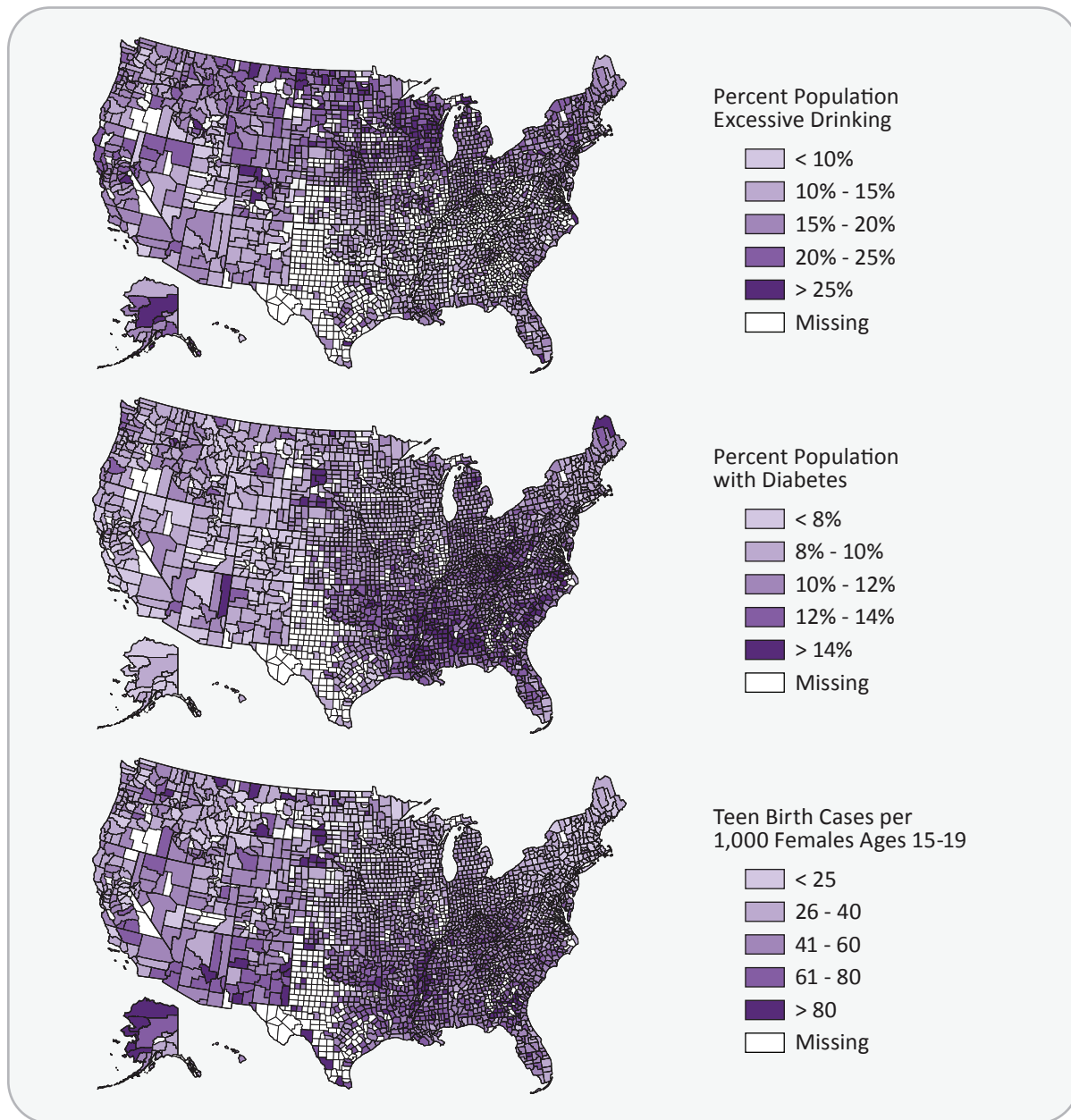
This section presents additional figures on county-level licensed psychologists and population health indicators.

Figure 9. County-Level Health Indicators: Smoking, Obese, and Physical Inactivity, 2006-2012



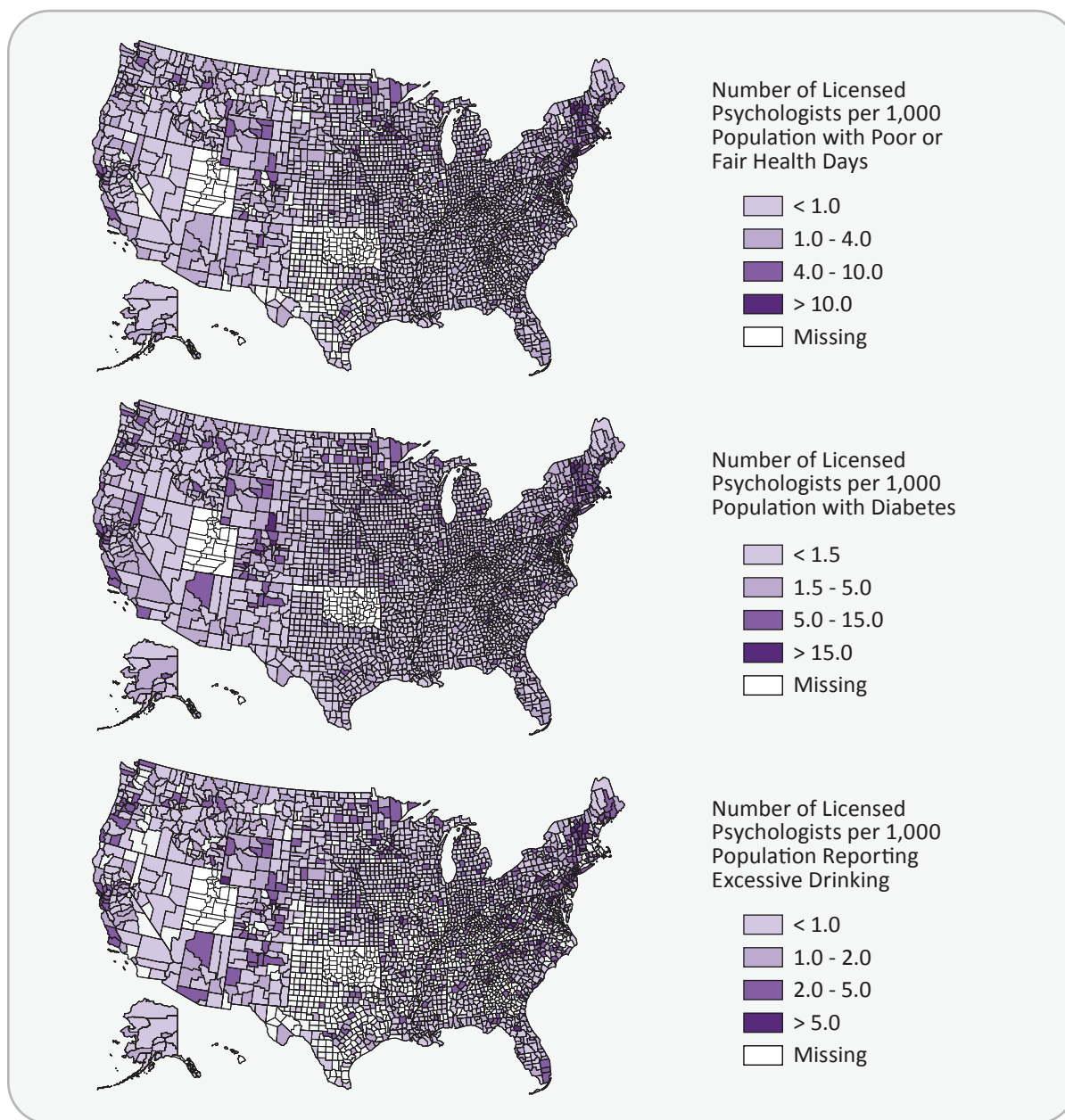
Source: Robert Wood Johnson Foundation, 2015 County Health Rankings; U.S. Census Bureau, 2014 County Cartographic Boundary Shape files.

Figure 10. County-Level Health Indicators: Excessive Drinking, Diabetes, and Teen Births, 2006-2012



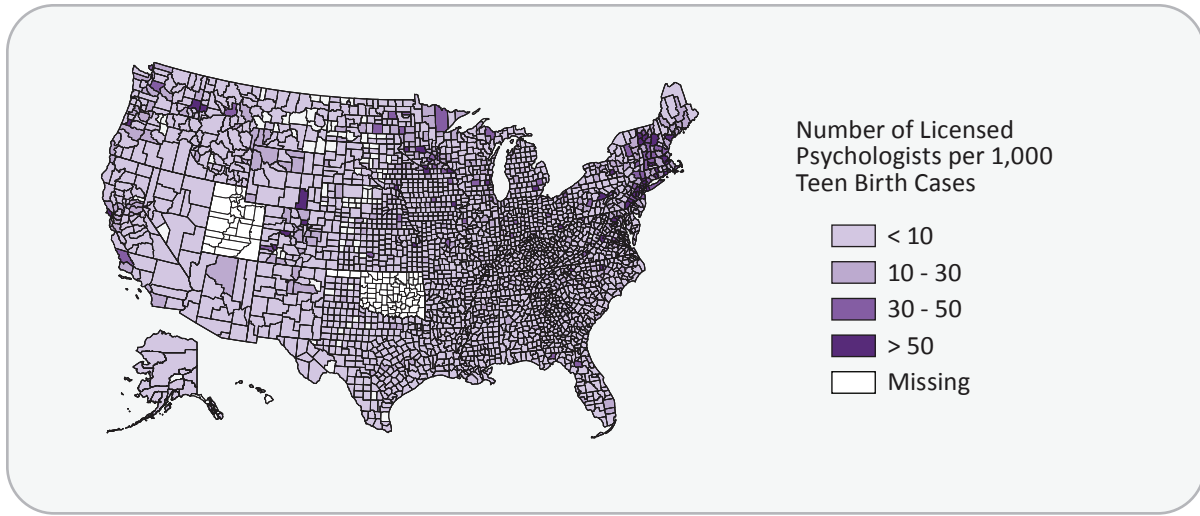
Source: Robert Wood Johnson Foundation, 2015 County Health Rankings; U.S. Census Bureau, 2014 County Cartographic Boundary Shape files.

Figure 11. Number of Licensed Psychologists and Behavioral Health Indicators: Poor or Fair Health Days, Diabetes, and Excessive Drinking, 2006-2012



Source: American Psychological Association, 2012-2015 state licensing board lists; Robert Wood Johnson Foundation, 2015 County Health Rankings; U. S. Census Bureau, 2014 Population Estimate and 2014 County Cartographic Boundary Shape files.

Figure 12. Number of Licensed Psychologists and Behavioral Health Indicators: Teen Births, 2006-2012



Source: American Psychological Association, 2012-2015 state licensing board lists; Robert Wood Johnson Foundation, 2015 County Health Rankings; U. S. Census Bureau, 2014 Population Estimate and 2014 County Cartographic Boundary Shape files.

References

- American Psychological Association. (2015). *State licensing board lists* [Unpublished special analysis]. Washington, DC: Author.
- Robert Wood Johnson Foundation. (2015). *2015 County Health Rankings National Data*. Retrieved from <http://www.countyhealthrankings.org/rankings/data>
- Robert Wood Johnson Foundation. (2015). *2015 CHR Analytic Data Documentation*. Retrieved from <http://www.countyhealthrankings.org/rankings/data>
- U.S. Census Bureau. (2014). *Annual estimates of the resident population: April 1, 2010, to July 1, 2014*. Retrieved from www.census.gov/popest/data/metro/totals/2014/CBSA-EST2014-alldata.html
- U.S. Census Bureau. (2014). *Cartographic Boundary Shapefiles – Counties*. Retrieved from https://www.census.gov/geo/maps-data/data/cbf/cbf_counties.html
- U.S. Census Bureau. (2013). *Regions and Divisions of the United States*. Retrieved from http://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf
- U.S. Census Bureau. (2010). *2010 Census Urban and Rural Classification and Urban Area Criteria*. Retrieved from <https://www.census.gov/geo/reference/ua/urban-rural-2010.html>