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Life expectancies across congressional districts in the United States

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ABSTRACT

Examining data on the congressional district level may better align with the interests of Members of Congress who have the power to implement federal health policies. Despite this importance, measurement of health indicators at the congressional district level remains widely understudied. In this study, we estimated overall life expectancy and variation within each congressional district by computing standard deviations of census tract-level age-specific life expectancies for 2010–2015. We found smaller standard deviations in congressional districts with higher overall life expectancy at younger ages, but the pattern was reversed at older ages.

1. Introduction

Congressional districts are geographic political units created for the purpose of electing Members of the House of Representatives (The United States House of Representatives, n.d). Unlike common geographic units of analyses like cities, counties, and states, where multiple policymakers have overlapping jurisdictions within the same geographic boundaries, the entirety of most congressional districts is attributed to one Representative in Congress (United States Census Bureau, 2021). Each member of Congress is responsible for representing the will of his or her constituency in the House of Representatives by introducing, supporting, and voting on legislation that they believe will benefit their constituents (The United States House of Representatives, n.d.). This responsibility, coupled with the need to be re-elected by their constituents to stay in office, creates strong incentives to support legislative initiatives that they believe are in the best interest of their constituents (Miller and Stokes, 1963). For these reasons, analyzing population health data on the congressional district level better aligns with the interests of Members of Congress who have the power to change federal health policy.

Persistent health disparities in life expectancy in the United States call for more robust monitoring to enhance political action. Previous studies have repeatedly shown enduring disparities in longevity and changes in life expectancy by race, education, income, and geographic residence (Wang et al., 2013; Dwyer-Lindgren et al., 2017; Chetty et al., 2016; Hunt et al., 2015). These disparities based on demographic factors further show a need to examine life expectancy on the congressional district level. Unlike administrative boundaries, congressional district boundaries are constitutionally mandated to be redrawn every decade (The Texas Politics Project, 2018). Although there has been increasing public support of instituting nonpartisan methods of redistricting, the political parties continue to control redistricting in most states (Loyola Law School, 2020). In states where gerrymandering occurs, the political party in power redraws congressional districts to benefit party outcomes in Congress by combining politically similar communities to create concentrated congressional districts that will surely vote in favor of the party (Martis, 2008). As a byproduct, gerrymandering often concentrates demographically similar communities, like majority-minority communities, into singular congressional districts (Hayes, 2019). For example, after the 1990 Census, the current map of Illinois's 4th Congressional District was created, which cuffs around Chicago's west side in an earmuff shape. This map combined Chicago's Latino-majority populations concentrated in the neighborhoods of Logan Square, Humboldt Park, Pilson, and Little Village — all in Cook County (Scales,

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2020). Currently, Illinois' 4th Congressional District is 67 percent Hispanic or Latino, compared to the 29 percent of Chicago as a whole (United States Census Bureau, 2015, 2019). Given that demographic factors are important predictors of population health outcomes, even counties that share a large proportion of a congressional district's population may not constitute an appropriate representation of the entire congressional district. For these reasons, the utility of congressional districts as a unit of measurement of life expectancy is key to accurate monitoring and policymaking.

Despite their importance, measurement of health indicators at the congressional district level remains widely understudied. Currently, the U.S. Census Bureau publishes demographic and socioeconomic indicators by congressional district on the *My Congressional District* website (United States Census Bureau, 2019). While a wide variety of indicators are published on this website, ranging from age structure and income distribution to education level and the size of industry in each congressional district, currently, there are no health indicators available. Moreover, few studies use congressional districts as the geographical level of interest, with the notable exception of the Geographies of Opportunity study, which estimates life expectancy but only at birth by congressional districts (Burd-Sharps and Lewis, 2015; Rolheiser et al., 2018; Hao et al., 2006). Considering the lack of knowledge on health indicators at the congressional district level, measuring a globally recognized summary indicator like life expectancy may provide a solid base in understanding the state of health across congressional districts.

To fill this information gap around life expectancy by congressional district, we estimated age-specific life expectancy by congressional district and within district variation using census tract life expectancies in the United States from 2010 to 2015. Then, we analyzed the relationship between overall age-specific life expectancy and its variation across the congressional districts.

We chose to present age-specific life expectancy and its standard deviation, as the former can show changes in population-level risks throughout the life course and the latter can show disparities. Both measures are relatively easy to communicate to policymakers, congressional staff, and advocacy groups. Age-specific life expectancy incorporates varying health risks across one's life course. Life expectancy at younger ages not only captures disparities at younger ages, but also captures the accumulation of health risks across one's life. At the same time, life expectancy at older ages shows important aspects of health disparity later in life. As we seek to inform policymakers, life expectancy is an indicator that is easy to interpret and conveys powerful meaning even for those who are not experts in health measurement.

2. Methods

Life expectancy data at the census tract level for the period 2010 to 2015 was obtained from the United States Small-area Life Expectancy Estimates Project (USALEEP) of the Centers for Disease Control and Prevention, a publicly available dataset containing full life tables for all the census tracts in the United States (National Center for Health Statistics, 2018). We chose to use USALEEP data as it reports age-specific life expectancy estimates that account for undercounting and age reporting issues. In addition to this, we used the GeoCorr 2018's census tract to congressional district equivalence file that reports an allocation factor which determines the proportion of the census tract's population that lives within a specified congressional district from the 2010 decennial census. Congressional district shapefiles were used for mapping and were obtained from the U.S. Census Bureau's Public Law 94–171 redistricting files from the 2020 decennial census that had the 116th Congress shapefile (Missouri Census Data Center, n.d.; United States Census Bureau, 2021).

The GeoCorr 2018's Census Tract to 116th Congressional District equivalency file allows for more accurate congressional district estimates. The AFACT variable indicates the proportion of a census tract's population that falls within a specified congressional district. Out of the 70,857 total census tracts with available life expectancy (LE) data, 63,486 census tracts, approximately 89.6%, neatly nested within a congressional district. Measures of within-congressional district inequality were estimated using standard deviations of the distribution of only neatly nested census tract life expectancies within any given congressional district. Within-district variation allows us to geographically identify census tracts within a particular congressional district that are doing extremely well and extremely poorly in terms of life expectancy. We are also able to find the heterogeneity of congressional districts and life expectancy using between-district comparisons of the standard deviation.

We derived the LE values and the standard deviation for each congressional district for 11 different age groups (At Birth, 1–4 years, 5–14 years, 15–24 years, 25–34 years, 35–44 years, 45–54 years, 55–64 years, 65–74 years, 75–84 years, 85 years and older). This is important because some areas that do worse in LE at birth might do substantially better for increasing the longevity of its elderly residents. A weighted approach was used to find life expectancies by congressional district. Table 1 shows the variables used to compute adjusted population value, population weight, computation weight values, and the final LE value. Adjusted population value for each census tract was computed by multiplying the total population (b) with the GeoCorr AFACT (c). The adjusted population value was then divided by the sum of the adjusted population (SUM(d)) to find the population weight. Computation weighted values (f) was derived by multiplying the population weight (e) with the Sample LE values (a). Lastly, the final LE value was found via the sum of the computation weighted values (SUM(f)). As a sensitivity analysis, we explored four other methods to calculate the LE value for each congressional district which include:

- The average value computed from counting all census tract within a congressional district
- The average of only the neatly nested census tracts within a congressional district
- The median value of the neatly nested census tracts
- The average weighted accounting for non-neatly nested census tracts (no population weight)

We chose to use the average population weighted method accounting for non-neatly nested census tracts within a congressional district described above. The correlation results for each of the 11 age groups for each method can be found in Supplementary Table 1. All the methods are highly correlated with one another, confirming the robustness of our new methodology.

3. Results

The final dataset contained 436 congressional districts, including the District of Columbia, which spanned 70,857 census tracts. The highest life expectancy at birth was California's 17th Congressional District, located in the San Francisco Bay Area, at 83.29 years. In contrast, Alabama's 1st Congressional District, which includes parts of Birmingham, Montgomery and Tuscaloosa, had the lowest life expectancy at birth at 73.21 years — a 10-year difference. Table 2 shows the top and bottom five congressional districts by age-specific life expectancy. Ranking in life expectancy stayed relatively constant until age 55, in which districts in California and New York began to be outranked by Hawaii and Florida. At the bottom end of the ranking were districts in Alabama, Kentucky, Michigan, and Tennessee, but after age 55, districts in Georgia, Indiana, and Texas entered the bottom five, replacing Michigan and Kentucky.

Table 3 shows the top and bottom five congressional districts by age-specific standard deviation in life expectancy. The district with the lowest inequality in life expectancy at birth as measured by within-district standard deviation was 2.10 years for Texas' 26th District in

Table 1
Example of computing the Life Expectancy values for each Congressional District.

Sample Census Tracts	Sample LE Values (a)	Total Population 2010 (b)	GeoCorr AFACT (c)	Adjusted Population (d)	Population Weight (e)	Computation Weighted Values (f)	Final Value (g)
CT1	60	200	1	200	0.16	9.52	63.97
CT2	70	500	1	500	0.40	27.78	
CT3	60	700	0.8	560	0.44	26.67	
Total Values	N/A	1400	N/A	1260	N/A	N/A	

Table 2
Top five congressional districts by age-specific life expectancy.

Rank	Under 1	1-4	5-14	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85 and older
1	83.29 (CA-17)	82.68 (CA-17)	78.76 (NY-10)	68.86 (NY-10)	59.25 (NY-03)	49.74 (NY-03)	40.17 (NY-03)	30.85 (NY-03)	22.22 (NY-10)	14.53 (HI-01)	8.94 (HI-02)
2	83.28 (NY-03)	82.68 (CA-33)	78.76 (NY-03)	68.84 (NY-03)	59.23 (CA-33)	49.59 (CA-33)	39.97 (CA-33)	30.82 (NY-10)	22.21 (CA-27)	14.45 (CA-27)	8.76 (HI-01)
3	83.27 (NY-10)	82.68 (NY-10)	78.75 (CA-33)	68.83 (CA-33)	59.22 (NY-10)	49.55 (NY-10)	39.95 (NY-10)	30.78 (CA-27)	22.15 (NY-06)	14.43 (NY-06)	8.76 (FL-21)
4	83.27 (CA-33)	82.66 (NY-03)	78.74 (CA-17)	68.82 (CA-17)	59.15 (CA-17)	49.49 (CA-27)	39.93 (CA-27)	30.7 (NY-06)	22.12 (NY-03)	14.4 (NY-10)	8.73 (NY-13)
5	83.07 (CA-18)	82.58 (CA-27)	78.67 (CA-27)	68.77 (CA-27)	59.11 (CA-27)	49.47 (CA-17)	39.85 (NY-06)	30.65 (CA-33)	22.01 (HI-01)	14.35 (FL-21)	8.7 (NY-06)
432	74.26 (AL-04)	74.12 (TN-09)	70.27 (TN-09)	60.42 (TN-09)	51.01 (TN-09)	41.85 (TN-09)	33.04 (TN-09)	24.93 (TN-09)	17.62 (AL-07)	11.32 (MS-04)	6.14 (GA-11)
433	74.23 (TN-09)	73.95 (AL-04)	70.11 (AL-04)	60.28 (AL-04)	50.87 (AL-04)	41.72 (AL-04)	32.85 (AL-04)	24.74 (AL-07)	17.57 (IN-07)	11.29 (KY-05)	6.09 (GA-10)
434	73.73 (KY-05)	73.46 (KY-05)	69.64 (KY-05)	59.8 (KY-05)	50.38 (AL-07)	41.39 (AL-07)	32.68 (AL-07)	24.72 (AL-04)	17.56 (MI-13)	11.28 (AL-03)	5.98 (TX-02)
435	73.22 (MI-13)	73.31 (AL-07)	69.49 (AL-07)	59.67 (AL-07)	50.35 (KY-05)	41.31 (KY-05)	32.6 (KY-05)	24.63 (KY-05)	17.43 (KY-05)	11.25 (TN-01)	5.92 (TX-06)
436	73.21 (AL-07)	73.14 (MI-13)	69.29 (MI-13)	59.46 (MI-13)	50.17 (MI-13)	41.16 (MI-13)	32.39 (MI-13)	24.48 (MI-13)	17.4 (AL-04)	10.93 (AL-04)	5.72 (GA-07)

Table 3
Top and bottom five most equal and least equal congressional districts by age-specific standard deviation in life expectancy.

Rank	LE0	LE4	LE5	LE15	LE 25	LE 35	LE45	LE55	LE 65	LE 75	LE 85
1	TX-26 2.10	OH-16 2.07	OH-16 2.07	TX-26 2.06	OH-16 2.04	OH-16 1.99	OH-16 1.89	OH-16 1.72	OH-16 1.52	AL-04 1.61	OH-16 2.14
2	OH-16 2.13	TX-26 2.08	TX-26 2.08	TX-06 2.07	TX-06 2.04	TX-06 2.01	TX-06 1.93	TX-06 1.82	AL-04 1.58	OH-16 1.65	MI-09 2.21
3	TX-29 2.18	TX-06 2.10	TX-06 2.08	OH-16 2.09	TX-26 2.09	TX-26 2.08	TX-26 2.06	MI-04 1.90	MI-04 1.68	PA-14 1.70	PA-17 2.23
4	TX-06 2.26	TX-29 2.13	TX-29 2.14	TX-29 2.15	TX-29 2.09	TX-29 2.11	TX-29 2.06	AL-04 1.93	TX-06 1.68	IL-03 1.70	PA-15 2.26
5	MN-02 2.29	GA-13 2.17	GA-13 2.18	GA-13 2.17	AZ-07 2.17	AZ-07 2.15	AZ-07 2.12	TX-26 1.94	MI-10 1.72	MI-10 1.76	MI-07 2.26
423	IL-01 4.66	WV-03 4.54	WV-03 4.51	WV-03 4.49	OH-10 4.39	MI-14 4.22	IL-07 3.89	IA-02 3.44	MN-01 3.23	HI-02 3.15	MN-03 3.66
424	MI-14 4.74	MI-14 4.57	MI-14 4.56	MI-14 4.51	WV-03 4.44	OK-02 4.29	FL-18 3.92	MN-07 3.50	FL-21 3.25	FL-21 3.17	NC-06 3.66
425	DC-AL 5.18	DC-AL 4.96	DC-AL 4.92	IL-07 4.88	IL-07 4.66	IL-07 4.30	OK-02 4.07	OK-02 3.59	IA-02 3.25	IA-02 3.23	MS-01 3.77
426	IL-07 5.22	IL-07 5.00	IL-07 4.93	DC-AL 4.89	DC-AL 4.73	DC-AL 4.51	MD-07 4.16	DC-AL 3.64	FL-18 3.29	MN-01 3.27	MN-01 3.78
427	MD-07 5.44	MD-07 5.18	MD-07 5.15	MD-07 5.10	MD-07 4.92	MD-07 4.67	DC-AL 4.22	FL-18 3.64	MN-07 3.38	MN-07 3.39	MN-07 3.81

suburban Dallas. Maryland's 7th District in Baltimore had the highest inequality with a standard deviation of 5.44 years. Ranking in inequality showed more variation across the life course including districts from many different states. For the top five most equal congressional districts, districts in Ohio and Texas consistently had low standard deviations. The five most unequal districts were in the District of Columbia, Illinois, Maryland, Michigan, and West Virginia until replaced at age 55 by districts in Florida, Iowa, and Minnesota.

As expected, boxplots of life expectancy between congressional districts (Fig. 1) show that life expectancy decreases with increasing age groups. The range of life expectancy are consistent until age group 35–44, which aligns with the stable standard deviations in life expectancy among census tracts for this group.

Life expectancy among census tracts decreases from age group 45–54

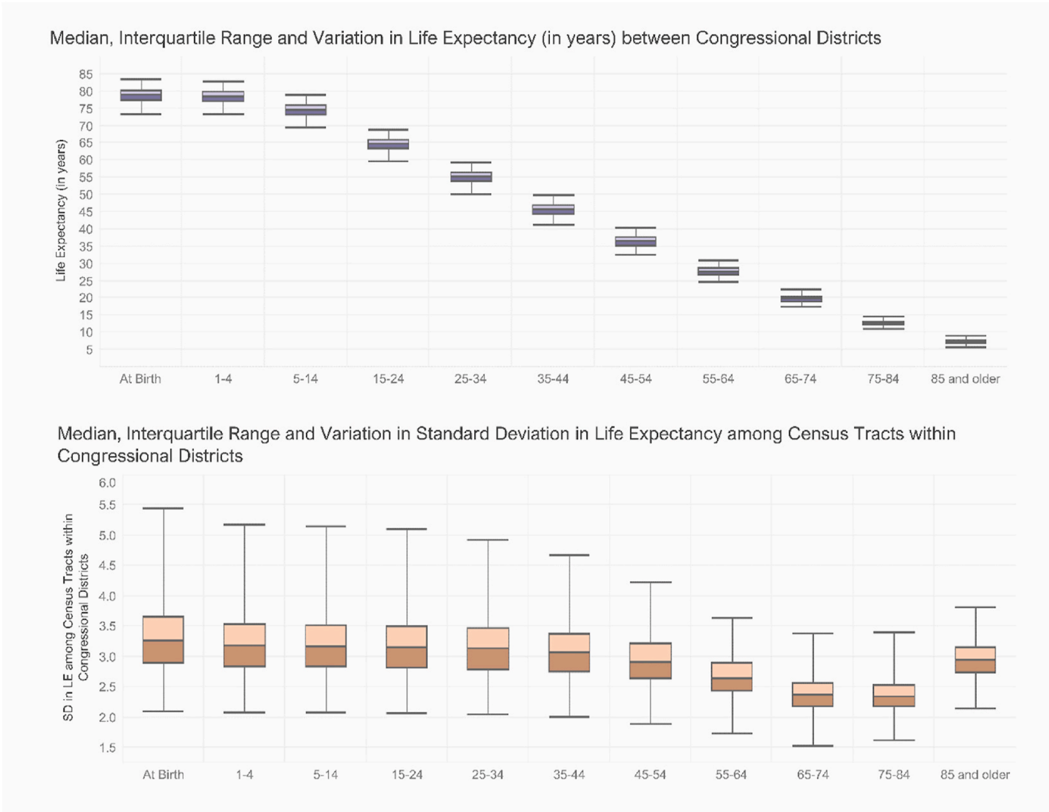

Fig. 1. Boxplots of life expectancy between congressional districts and standard deviation in life expectancy among census tracts.

as evidenced from decreasing width of the box plots, which occurs while standard deviations in life expectancy among census tracts decreases until age group 75–84. The standard deviations of life expectancy among census tracts increase in the last age group (85 and older), which may be due to smaller sample size or due to wider bin size.

Plots of average congressional district life expectancy against standard deviation across the life course show a transition from negative to positive association, suggesting that inequality is highest among districts with low average life expectancy at younger ages, but at older ages inequality is highest among districts with high life expectancy (Fig. 2, Supplementary Figure 1). Spatial patterns in standard deviation of life expectancy were also variable over the life course (Fig. 3, Supplementary Figure 2). Supplementary Figure 2 shows the geographic distribution of life expectancy and the standard deviation of life expectancy across congressional districts. Congressional districts in the Pacific Northwest with low life expectancy at birth showed improvements by age 74. By contrast, areas of Upper Midwest with high life expectancy at birth declined in relative rank for age 74. Areas in the Deep South remained low throughout the life course and the urban Northeast and West Coast had consistently high life expectancy. Areas with low life expectancy tended to have less inequality.

From the sensitivity analyses, we found that the life expectancy estimates do not differ across 5 different methodologies. This can be seen with the correlation matrixes as in the Supplementary Table 1. In addition, Supplementary Figure 2 contains the full data for all 436 congressional districts and provides the LE values for all the methodologies described in this paper. An interactive dashboard has been developed for users to view all the results by congressional districts: https://geographicinsights.iq.harvard.edu/CongressionalDistrict-LifeExpectancy.

4. Discussion

This study sought to measure age-specific life expectancy and its variation within congressional districts using census tract level data. Congressional districts represent a policy-relevant geography for Members of Congress and are not well captured by typical geographical units such as counties and states. By analyzing patterns in standard deviations, we capture an important dimension of disparities within congressional districts, which is consistent with the results presented in previous studies conducted using administrative boundaries for measurement (Dwyer-Lindgren et al., 2017; Kulkarni et al., 2011; Wang et al., 2013). Policies based solely on aggregate life expectancy may miss key indications of inequality and mask particular neighborhoods doing relatively well or poorly within a given congressional district. In particular, it is important that congressional districts with high life expectancy and high standard deviation address the issues facing communities in their districts that are faring much poorer than the average for their districts. Therefore, the standard deviation within each congressional district presented in this paper could be interpreted as a measure of inequality.

While the geographic distribution of congressional district-wise life expectancy resembles the county-wise estimates, the regions at the extremes differed. In general, the residents of higher income regions tended to live longer. For instance, California's 17th and New York's 3rd districts, in which the district-wise life expectancy was the highest, are both known to have one of the highest median incomes in the United States (The World Bank, 2003). At the same time, the districts with higher population of living below poverty line, black residents and lower education levels showed lower life expectancy. Michigan's 13th district, which ranked lowest in seven out of the eleven age groups, exemplifies the association between socioeconomic status and longevity: more than half of the population identify themselves as black, more than a quarter of the population live below the poverty line, while about 16% of the

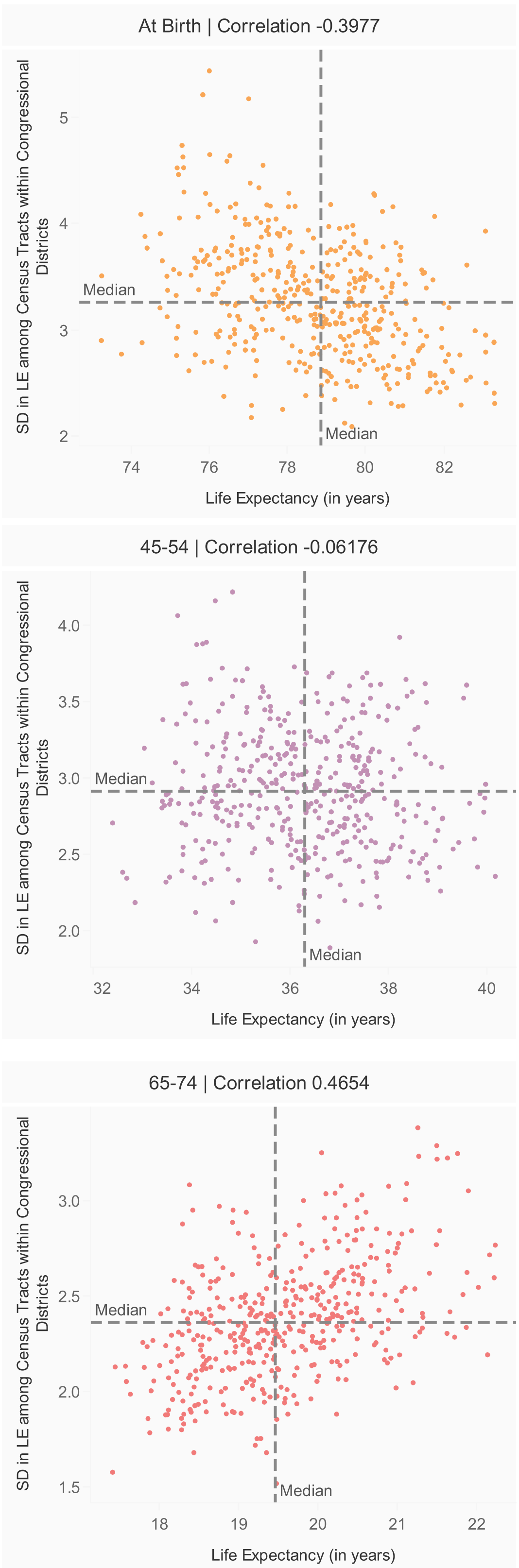

Fig. 2. Congressional district aggregate age-specific life expectancy versus standard deviation.

population hold a bachelor's degree or higher (United States Census Bureau, 2019). However, the congressional districts with the lowest life expectancy did not overlap with counties with the lowest life expectancy. For instance, Ogala Lakota County in South Dakota recorded the lowest life expectancy when tabulated at the county level (Institute for Health Metrics and Evaluation, 2016). Nevertheless, the pattern that the life expectancy is shorter in districts with higher levels of poverty, black population and lower education level persisted.

One important contribution of this study is the illustration of a life course perspective on measurement of inequality in life expectancy across smaller units. Presenting life expectancy across different age groups is of substantive interest in developed countries. Increasing heterogeneity of survival probabilities in older age groups has been reported globally (Liou et al., 2020). Particularly in developed countries, the differences in survival across socioeconomic subgroups were larger in older ages while the difference of the life expectancy at birth has converged (Beltran-Sanchez and Subramanian, 2019).

This study expands on the Geographies of Opportunity study by incorporating life expectancy at different ages (Burd-Sharps and Lewis, 2015). Life expectancy is often only measured and reported at birth, but we show that relative rank in life expectancy does not necessarily stay constant from young to old age. Congressional districts with high life expectancy at birth did not always have high life expectancy at older ages and similarly among congressional districts with low life expectancy at birth. In fact, we show that higher life expectancy is associated with lower levels of inequality at birth through age 45, but higher levels of inequality after age 55. Only considering life expectancy at birth misses potential differences at different ages in terms of rank, spatial patterns, and inequality. Furthermore, congressional districts with consistently high, consistently low, or variable life expectancy estimates across the life course compared to the overall age-specific distribution are of substantive interest.

Congressional districts, compared to administrative boundaries, possess distinctive characteristics in that the boundaries are altered more frequently and strategically. Congressional district boundaries are determined at least every 10 years, because of which the estimates presented in this paper are subject to change with continued Censuses and gerrymandering. However, changing boundaries does not mean that the estimates are uninformative and should not be produced; rather, it implies the needs of a robust monitoring framework that is applied to changing boundaries over time. Given that monitoring and evaluation at political unit boundaries can improve political accountability of public health policies, congressional district-level monitoring can enhance evidence-based political discourse.

This study had several limitations. First, life expectancy is uniquely subject to the underlying population demographic age structures, and it is not immediately clear that simple averages of constituent census tract life expectancies are valid for the particular population residing within a congressional district. Second, although newer data may shed light on more recent life expectancy trends, one of the purposes of this study was to capture the within-district variation of life expectancy. This measure is resistant to temporal changes, thus the value of the within-district variation life expectancies found in this study outweigh the potential limitation of older data. Furthermore, standard deviation as a measure of inequality fails to capture which populations within a particular congressional district are faring better or worse. In this respect, standard deviation is still a summary measure indicating overall level of inequality within any given congressional district.

In this paper, we presented life expectancy and its variation across congressional districts in the United States. Despite some limitations, this study adds to the current state of knowledge regarding life expectancy in the United States by characterizing broad patterns at the congressional district level and across the life course. The findings presented here represent a significant advance over previous work that has not considered congressional districts, age-specific life expectancy, or measures of inequality. We make the case for evaluating both averages

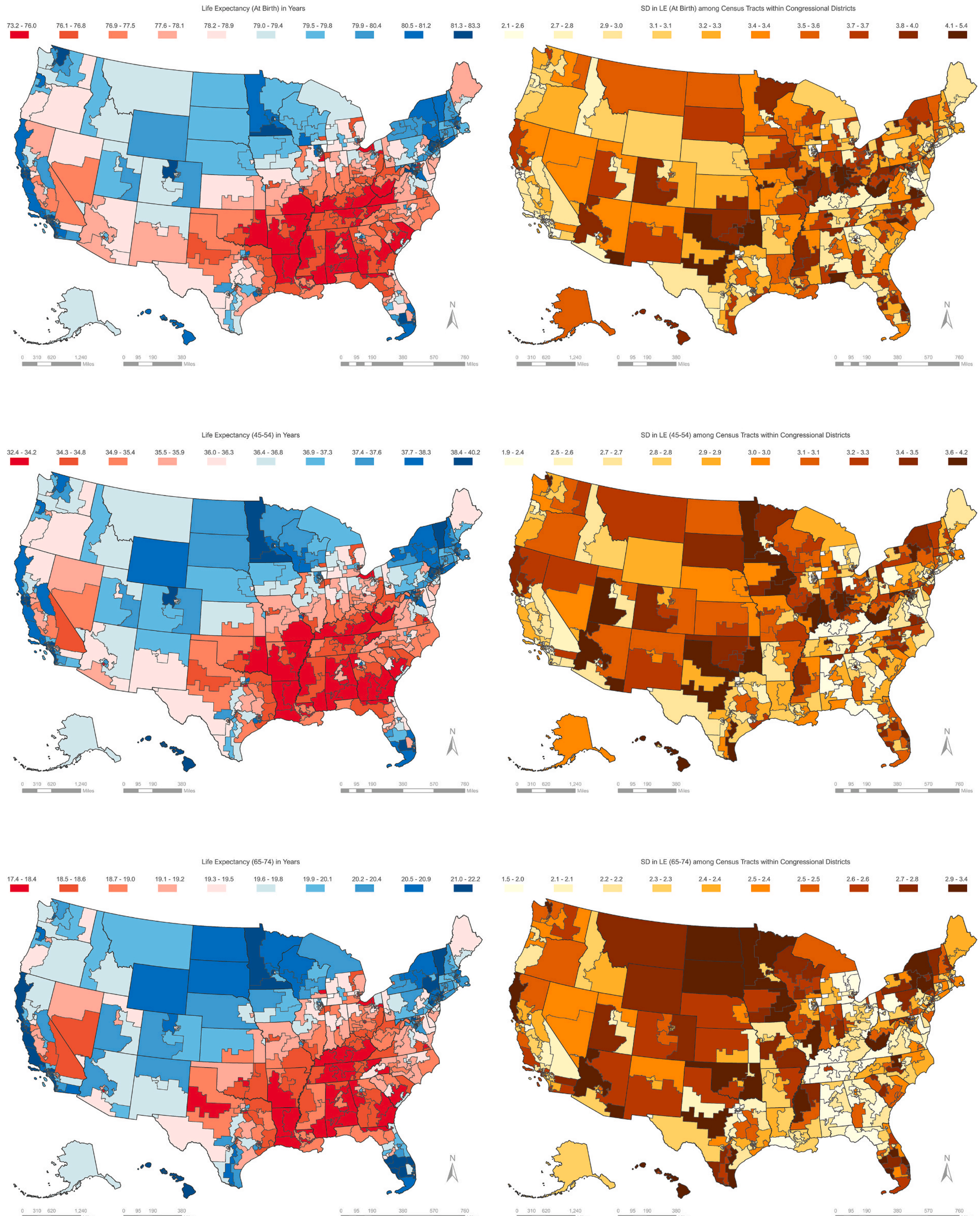

Fig. 3. Geographic distribution of life expectancy and the standard deviation of life expectancy across congressional districts.

and standard deviations to capture both aggregate performance and inequality. Furthermore, we find that congressional districts themselves as well as their spatial patterns are highly incongruous between the two measures at all ages. We therefore recommend that Members of Congress consider how averages and inequalities in life expectancy fluctuate for specific ages in their districts to inform policy and aid advocacy.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2022.114855.

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