



Mass probation: Temporal and geographic correlation of county-level probation rates & mental health in North Carolina



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ABSTRACT

High community incarceration rates are associated with worse community mental health. However, it remains unknown whether higher rates of probation, a form of criminal legal community supervision, are similarly associated with worse community mental health. Our objective was to evaluate temporal and geographic correlations of county-level probation and mental health rates separately and to assess the association between county-level probation and mental health rates, measured by self-inflicted injury and suicide. We performed ecological analyses using North Carolina administrative data (2009–2019) and used repeated cross-section, multivariable spatial error models. From 2009 to 2019, probation rates trended downward while self-inflicted injury and suicide remained stable. We found positive spatial autocorrelation suggesting that there are spatial determinants of probation and self-harm, though less so for suicide. Hot spot analyses showed local variation with high self-harm and suicide rates being clustered in rural Western North Carolina and high probation rates being clustered in rural Eastern North Carolina. Probation was positively associated with self-inflicted injury and suicide. For example, in 2018, a 1 percentage point increase in probation was associated with a 0.05 percentage point increase in self-harm in 2019 (95% CI: 0.03, 0.06), meaning that in a county of 100,000 people, an increase in 1000 county residents being on probation would be associated with an increase in 50 self-harm injuries. High county-level probation rates may exert collateral damage on the mental health of those living in areas with much of the population under state control. These findings emphasize that the criminal legal system is not separate from communities and that future public health research and advocacy must consider these collateral consequences of probation on communities.

1. Introduction¹

There is a well-established link between mass incarceration and community mental health that extends well beyond the mental health of those directly experiencing criminal legal involvement (Mauer and Chesney-Lind, 2011; Wildeman and Wang, 2017). High rates of county-level incarceration are associated with increased county-level suicide mortality (Kajeepeeta et al., 2020), and living in a

high-incarceration area is associated with both major depressive disorder and generalized anxiety disorder (Hatzenbuehler et al., 2015). Many mechanisms explain why this negative relationship between incarceration and mental health persists (Kajeepeeta et al., 2020). First, individuals face barriers to mental healthcare while incarcerated and live in an inhumane and unpredictable environment while incarcerated, resulting in a high burden of disease upon release from incarceration, which likely contributes to high community-level mental health burdens (Rich et al.,

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¹ Abbreviations: North Carolina (NC), United States (US), Department of Public Safety (DPS), Emergency Department (ED), Violent Death Reporting System (VDRS), International Classification of Disease (ICD), Council for State and Territorial Epidemiologist (CSTE), Disease Event Tracking and Epidemiologic Collection Tool (DETECT), Rural-Urban Commuting Area (RUCA).

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2016). Second, there are psychosocial consequences of community removal and community destruction as high levels of incarceration alter the social ecology of neighborhoods through eroding social capital and disrupting social and family networks (Hatzenbuehler et al., 2015; Aminzadeh et al., 2013). This contributes to increased levels of stress and adversity in communities experiencing high levels of community removal. Third, there are ties to economic resource deprivation. At the local level, the funding used for carceral systems is often the same as for public hospitals, schools, and social services (Henrichson et al., 2015). For example, advocacy organizations in rural North Carolina (NC) have stated that high spending on carceral facilities has resulted in less available funding for social services, such as for substance use treatment, school counselors, and affordable housing (Wilkie, 2021). In areas with high economic deprivation, high rates of stress, social adversity, depressive symptoms, and suicide are also present (Kerr et al., 2017).

Despite the clear connections between incarceration and community-wide mental health, whether high rates of probation – a form of criminal legal community supervision – are similarly associated with worse community-level mental health is unknown. Almost three million adults were on probation in the United States in 2022, making up the majority of those involved in the criminal legal system (Sawyer and Wagner, 2022). Probation widens the net of state control, as it is associated with movement restrictions, mandatory meetings, required fees, home visits, and regular drug tests, and affects individuals' job prospects (Capece, 2020; Phelps, 2013). At the individual level, probation is associated with poor mental health. Specifically, the prevalence of symptoms indicative of mental disorders is higher among those who have experienced probation in the past year (27%) than those with no history of criminal legal involvement (17%) (Crilly et al., 2009) with those on probation reporting high levels of stress and a lack of access to mental health and substance use services (Plugge et al., 2014). Yet, there remains a need to understand if the observed relationship between incarceration and worse community-wide mental health extends to a similar relationship between probation and community mental health.

Prior work has also documented that the racialized, rural-urban, and class-based inequities inherent in incarceration persist for probation as well. However, how we do not yet know how these inequities are related to health and health inequities, making it important to investigate. Criminal legal involvement is a mechanism through which structural racism, defined as the totality of ways that societal systems foster racial discrimination and reinforce disparities, affects health (Groos et al., 2018). Therefore, criminal legal involvement is not randomly allocated to communities: non-White and low-income communities are over-policed and disproportionately under state control and supervision, and rural communities lack the infrastructure to provide both formal alternatives to the criminal legal system (e.g., mental health court, drug court) and upstream social resources (e.g., mental health treatment programs), resulting in community-wide health consequences (Human Rights Watch and American Civil Liberties Union, 2020; Dumont et al., 2012). Specifically, 13% of the United States (US) population is Black but 30% of adults on probation are Black (Horowitz and Utada, 2018) and those under community supervision have higher rates of poverty and lower educational attainment than the general public (Jones, 2018). Probation also poses a unique burden in rural areas given long travel distances to probation offices and a burden to rural and impoverished communities due to few community-based resources and harm reduction programs (Human Rights Watch and American Civil Liberties Union, 2020; Kang-Brown and Subramanian, 2017). As such, the health effects of community-level exposure to high rates of probation likely contribute to and worsen existing racialized, rural-urban, and class-based health disparities (Kajeeepeta et al., 2020).

In this analysis, we (1) explore spatiotemporal patterns and identify clustering of county-level probation and mental health rates and (2) assess the association between them. We performed ecologic analyses using NC administrative data from 2009 to 2019 using county-level self-inflicted injury and suicide rates as mental health proxy measures. NC is

an ideal setting for this work given that its probation rate that is similar to that of the entire US, it has a combination of rural and urban areas, it has a large degree of racial, ethnic, and socioeconomic diversity, and there is intercounty discretion in sentencing law interpretation (Oudekerk and Kaeble, 2019; North Carolina Office of State, 2020; Markham and Denning, 2018; United States Census Bureau, 2020).

2. Materials and methods

2.1. Data

Adult probation data come from the NC Department of Public Safety (DPS) from 2009 to 2019. The DPS takes a census of the state-wide probation population each year, which we aggregated by county (Department of Corrections Office of, 2020). County of residence when placed on probation was used rather than county of conviction to represent where an individual lived when placed on probation.

County-level injury and suicide data come from NC's emergency department (ED) and Violent Death Reporting System (VDRS) data from 2009 to 2019, respectively. An indicator for self-inflicted injury as reason for the ED visit was created based on *International Classification of Disease* (ICD)-9 (2009–2015) and ICD-10 (2016–2019) codes. The self-inflicted injury definition and codes come from the Council for State and Territorial Epidemiologist (CSTE) Injury Surveillance Toolkit under suicide attempt or self-harm and were collated by the NC Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT) (NC DETECT Emergency Department Syndrome Definitions, 2021). NC's VDRS system is an incident-based, relational database that combines data from death certificates, medical examiner reports, and law enforcement reports on suicides completed in NC each year (InjuryViolence Prevention Branch, 2020). To create annual probation, self-inflicted injury, and suicide rates, we used annual county resident population from the US Census Bureau for the denominator.

For relevant covariate data, we gathered county-level values from a variety of sources. We chose covariates due to these indicators confounding the relationship between probation and self-inflicted injury and suicide. As we conceptualize criminal legal involvement as a mechanism through which structural racism affects health, we used the following covariates as measures of structural racism, drawing on prior literature: poverty rate, percent Black, unemployment rate, incarceration rate, and violent crime rate (Brown, 2020). We also identified rurality and mental health provider shortage as relevant covariates.

For poverty rate, percent Black, and unemployment rate, we used the US Census Bureau's 2010 and 2017 American Community Survey 5-year estimates (United States Census Bureau, 2020). We used the Marshall Project's data on incarceration rate (including Immigration and Customs Enforcement, federal and state prisons, local jails, residential facilities, and military jails) gathered from the 2010 census (Marshall Project, 2000). For a measure of rurality, we used the US Department of Agriculture's Rural-Urban Commuting Area (RUCA) Codes based on the 2010 census (United States Department of Agriculture, 2020). We used annual violent crime rates compiled by the Inter-university Consortium for Political and Social Research from reports of Uniform Crime Reporting Program Data collected by the US Department of Justice Federal Bureau of Investigation (United States Federal Bureau of Investigation, 2016). Data compiled by researchers at The University of North Carolina at Chapel Hill Cecil G. Sheps Center for Health Services Research in 2006 was used to represent access to mental healthcare – defined as the percentage of unmet need for mental health visits in a county and calculated by estimating the prevalence of serious mental illness and combining estimates of provider time needed by individuals with and without serious mental illness (Thomas et al., 2009).

2.2. Analysis

We calculated county-level rates of probation, self-inflicted injury,

and suicide per 100,000 residents annually from 2009 to 2019 and the annual percentage point change. The denominator for rate calculations included all county residents. We conducted exploratory spatial data analyses to determine how county-level probation, self-harm, and suicide rates varied across geography and over time. We measured spatial autocorrelation (e.g., if counties with similar rates were located near each other) using Moran's I (Getis et al., 2010), which was calculated separately for each year's data and averaged to produce a single estimate. P-values were calculated using permutation inference (500 permutations) with those ≤ 0.05 considered statistically significant. We then assessed if a county's rates of probation, self-harm, and suicide are high or low relative to the counties around it. To do this, a Local Indicators of Spatial Autocorrelation analysis was used to identify spatial clusters and outliers for probation, self-harm, and suicide. Spatial clusters were indicated as high-high counties (high-rate counties located near other high-rate counties), low-low counties (low-rate counties located near other low-rate counties), and spatial outliers were indicated as high-low counties or low-high counties. High-high and high-low counties were coded as high-rate counties and low-low and low-high counties coded as low-rate counties and summed for all years to get the percentage of years the county had high and low values. Pseudo p-values were calculated using Monte Carlo simulation with 999 permutations. Spatial neighbors were assigned using first-order queen contiguity where neighboring counties were those sharing an immediate border or corner.

We also conducted a sensitivity analysis assessing how the county-level probation and incarceration varied together across geography and over time to determine if probation was generally used in substitution of or in addition to incarceration. We did this both by calculating county-level rates of incarceration and using Local Indicators of Spatial Autocorrelation. We descriptively compared maps of incarceration rates and probation rates to assess whether these two indicators of criminal legal involvement tracked together. With Local Indicators of Spatial Autocorrelation, we compared if counties labeled as high-probation (e.g., high-rate counties located near other high-rate counties; high-rate counties located near low-rate counties) were in the same area as counties labeled as high-incarceration counties or not.

Repeated cross-section, multivariable ordinary least squares models were first used to determine associations between probation and mental health from 2009 to 2019 and to assess changes in these relationships over time. Thus, we calculated separate models for self-inflicted injury and suicide for each year. We used empirical Bayes smoothing to account for instability of probation, self-inflicted injury, and suicide rates in multivariable models, which produced rates that were the weighted average of a county's raw rates and its adjacent counties' rates (Morris, 1983). The residuals from the ordinary least squares models were spatially autocorrelated, which indicated that a spatial error model would be appropriate to account for clustering. Spatial error models incorporate into the error term a weighted average of the error terms of neighboring counties, thus accounting for spatial interdependence of the error structure (Anselin and Hudak, 1992). Models were run with a one-year lag on probation and relevant covariates to establish time-ordering. All models were adjusted for county-level poverty rate, percent Black, unemployment rate, incarceration rate, rurality, violent crime rate, and mental health provider shortage. Previous work found that a one-year lag, rather than a longer lag, was most salient for the relationship between county-level incarceration and deaths with a short latency, including suicide (Kajeeepeta et al., 2020).

We conducted two sensitivity analyses. We first assessed the role of the one-year lag on probation by running models without a lag on probation or relevant covariates. Second, we ran pooled spatial error models separately for suicide and self-harm with year fixed effects. All analyses were performed in R version 4.0.3. The study was approved by the Institutional Review Board at the University of North Carolina at Chapel Hill.

3. Results

All 100 NC counties had complete data from 2009 to 2019, representing 1100 county-years over the 11-year study period. Overall, probation rates decreased over the study from a median of 1234 per 100,000 county residents on probation in 2009 to 899 per 100,000 residents on probation in 2019 (Table 1; Fig. 1; Appendix Figs. 1–3). The median incarceration rate in 2010 was 286.10 per 100,000, around one-quarter of the median probation rate during the study period. Self-inflicted injury rates decreased slightly from 126 self-inflicted injuries per 100,000 residents in 2009 to 108 injuries per 100,000 in 2019. Suicide rates remained more stable at 14 suicide deaths per 100,000 in 2009 and 15 deaths per 100,000 in 2019.

Using Moran's I , we found that probation and mental health rates were spatially clustered (Appendix Table 1). Specifically, probation was consistently spatially autocorrelated (minimum $I = 0.23$, $p < 0.01$; maximum $I = 0.34$, $p < 0.01$; average $I = 0.28$, $p < 0.01$) with all 11 years of data having statistically significant positive autocorrelation at $p < 0.05$. Self-inflicted injury was also consistently spatially autocorrelated but I was more varied for self-inflicted injury than for probation (minimum $I = 0.05$, $p = 0.16$; maximum $I = 0.34$, $p < 0.01$; average $I = 0.18$, $p = 0.02$) with 10 out of 11 years of data having statistically significant positive autocorrelation. Lastly, suicide had inconsistent results (minimum $I = -0.14$, $p < 0.01$; maximum $I = 0.17$, $p < 0.01$; average $I = 0.06$, $p = 0.15$) with five out of 11 years having statistically significant positive spatial autocorrelation and one year having statistically significant negative autocorrelation. Using Local Indicators of Spatial Autocorrelation analysis, we identified persistent local clusters in probation, self-inflicted injury, and suicide (Fig. 2). High self-inflicted injury and suicides rates (e.g., counties labeled as high-high or high-low) were clustered in rural Western NC whereas high probation rates were clustered in rural Eastern and Southern NC. Sensitivity analyses showed that probation was generally used in addition to incarceration rather than as a substitution for incarceration (e.g., probation and incarceration rates tended to track together (Appendix Figs. 1–4) and the Eastern region of NC persistently labeled as 'high-probation' with Local Indicators of Spatial Autocorrelation was also labeled as 'high-incarceration' in the 2010 census (Appendix Fig. 4).

The multivariable models (Table 2) indicate that a county's probation rate is positively associated with self-inflicted injury and suicide rates while controlling for county-level poverty rate, percent Black, unemployment rate, incarceration rate, rurality, violent crime rate, and mental health provider shortage. Importantly, estimates did not substantively change between unadjusted and fully adjusted models that controlled for all relevant county-level variables (e.g., incarceration rate). When looking across the years 2009–2019, we found that this relationship was strongest and most precise in more recent years. For example, a 1 percentage point difference in probation in 2018 was associated with a 0.05 percentage point difference (95% CI: 0.03, 0.06) in self-inflicted injury in 2019 and a 0.0027 percentage point difference in suicide (95% CI: 0.0014, 0.0040) in 2019. This means that in two counties of 100,000 people that are otherwise equal, if County A had 1000 more county residents on probation in 2018 than County B, we would expect County A to experience 50 more self-harm injuries and 3 more suicides than County B did in 2019, which has 1000 fewer county residents on probation. Sensitivity analyses in which we removed the one-year lag produced almost identical results and sensitivity analyses in which we ran pooled models controlling for year also produced similar results (Pooled Model: Self-Inflicted Injury RD: 0.04; 95% CI: 0.03, 0.04; Suicide RD: 0.0023; 95% CI: 0.0014, 0.0032).

4. Discussion

This study uses novel methods to add to a sparse literature on the spatiotemporal patterning and correlations of county-level criminal legal involvement and mental health. We find that probation and mental

Table 1
North Carolina county characteristics 2009–2019 (N = 100).

	Average ^a	Median	IQR	Minimum	Maximum
<i>Probation Rate^b</i>					
2009	1133.58	1234.40	1032.50–1409.20	579.60	2368.10
2010	1104.67	1200.50	1028.70–1371.10	438.80	2237.20
2011	1056.54	1160.10	984.20–1371.50	464.10	2077.90
2012	1006.36	1107.40	934.80–1320.30	454.50	2059.90
2013	979.38	1100.40	922.50–1342.60	410.30	1960.50
2014	933.95	1016.80	886.10–1249.70	435.10	1931.30
2015	874.14	978.30	829.30–1193.70	416.10	2570.70
2016	832.01	961.90	784.80–1148.60	367.40	2681.40
2017	820.99	978.50	808.60–1126.70	369.60	3220.10
2018	791.91	915.60	761.70–1132.80	333.80	2961.20
2019	753.39	899.00	750.60–1061.60	318.20	2687.20
<i>Self-Inflicted Injury Rate^b</i>					
2009	125.85	122.70	85.10–162.30	0.00	536.70
2010	117.97	115.53	84.80–157.64	11.55	249.74
2011	119.45	120.60	86.53–156.26	16.61	269.46
2012	115.26	122.19	82.73–151.84	19.82	219.18
2013	108.46	107.63	73.01–134.92	3.28	214.32
2014	114.63	99.37	76.98–141.71	8.65	221.97
2015	76.34	75.22	46.51–107.87	12.80	167.47
2016	106.29	99.86	78.89–129.17	9.62	275.17
2017	105.78	101.27	77.75–133.83	18.99	271.91
2018	108.98	102.98	83.26–138.54	25.94	283.95
2019	108.49	104.55	77.82–125.28	25.10	271.84
<i>Suicide Rate^b</i>					
2009	12.61	13.63	9.65–18.14	0.00	50.21
2010	12.63	13.11	9.38–17.43	0.00	62.75
2011	12.71	13.28	10.32–17.62	0.00	68.74
2012	13.40	15.18	9.88–19.45	0.00	57.47
2013	13.22	15.04	9.87–19.58	0.00	34.96
2014	13.58	15.23	11.03–19.69	0.00	49.62
2015	14.08	15.20	9.69–20.36	0.00	55.27
2016	13.71	14.40	10.25–19.70	0.00	44.09
2017	15.09	16.99	11.81–21.28	0.00	47.85
2018	14.45	16.97	11.08–21.99	0.00	53.87
2019	13.30	15.26	11.46–19.37	0.00	60.77
<i>Rurality (0–1)</i>					
2010	0.24	0.48	0.00–1.00	0.00	1.00
<i>Incarceration^b</i>					
2010	646.85	286.10	159.90–1049.30	0.00	14,204.70
<i>Violent Crime^b</i>					
2009	398.22	255.30	176.00–416.30	0.00	1013.40
2010	348.54	230.20	149.40–369.40	0.00	878.40
2011	337.62	224.30	165.20–358.70	0.00	771.70
2012	346.41	243.30	153.90–338.90	0.00	872.60
2013	323.62	206.60	151.70–352.50	0.00	805.20
2014	314.09	210.10	147.40–312.70	0.00	832.80
2016	324.50	210.70	134.80–308.80	0.00	732.70
<i>Mental Health Provider Shortage (0–100)</i>					
2006	–	28.91	21.77–34.49	0.00	94.94
<i>Percent Black</i>					
2010	21.16	18.45	5.35–33.53	0.11	61.88
2017	21.16	17.44	5.27–32.62	0.16	61.64
<i>Poverty Rate^b</i>					
2010	15,099.97	16,209.00	13,750.00–20,208.00	8430.00	29,538.00
2017	15,716.10	17,393.00	14,283.00–20,593.00	8799.00	28,454.00
<i>Unemployment Rate^b</i>					
2010	8717.07	9324.00	7879.00–10,378.00	3488.00	16,608.00
2017	7173.77	8009.00	6654.00–9485.00	3586.00	14,035.00

^a Created average rate for entire population.

^b Per 100,000.

health were spatially clustered in NC from 2009 to 2019 with self-inflicted injury and suicides rates being clustered in rural Western NC and high probation rates being clustered in rural Eastern and Southern NC. Beyond local clustering of probation and mental health, our analyses found that high probation rates were positively associated with self-inflicted injury and suicide mortality rates in unadjusted analyses and after controlling for county-level poverty rate, percent Black, unemployment rate, incarceration rate, rurality, violent crime rate, and mental health provider shortage.

The observed spatiotemporal clustering reveals regional patterns in

probation and mental health that may be driven by surrounding counties' trends and their policies and practices around probation and mental health. Probation policy is set at the state level but implemented at the county and district level in NC, and elected judges and district attorneys have large discretion on their interpretation of NC's structured sentencing laws (e.g., deciding if certain convictions result in time incarcerated or time on probation and the regulations associated with time spent on probation) (Markham and Denning, 2018). Thus, these findings indicate that counties near each other use probation similarly. Our findings from spatiotemporal clustering analyses also support the

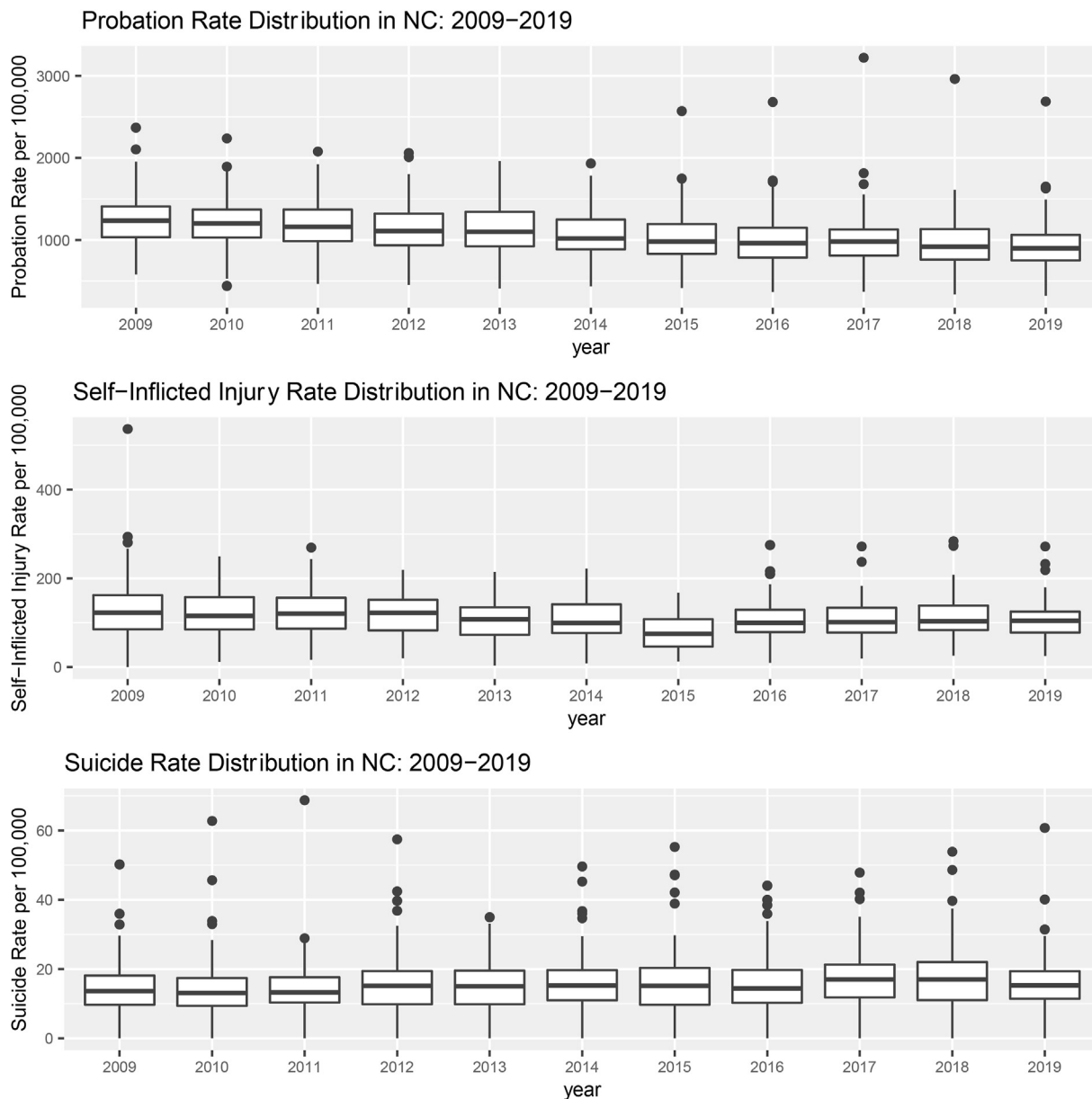


Fig. 1. North Carolina county probation, self-inflicted injury, and suicide rate trends 2009–2019 (N = 100).

hypothesis that probation use may be driven by access to community resources (e.g., rural areas may place individuals in prison if they feel that there are not sufficient community resources to address an individual’s mental health needs) and political climate, both of which vary regionally.

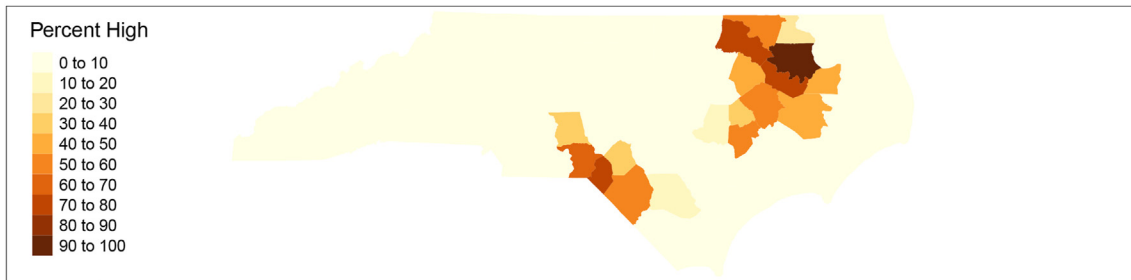
Disproportionately high probation rates were clustered in rural Eastern NC consistently from 2009 to 2019. This area has a high concentration of poverty, a high proportion of Black individuals, and has historically had low political power, as manifested, for example, by the polluting industries in this region (America Counts, 2021; Wing et al., 2000). These rates are also clustered in rural Southern NC, which has a high proportion of Black individuals and American Indian individuals. For example, The Lumbee Tribe of NC, the largest tribe east of the Mississippi River, is based in Robeson County in Southern NC, where the median annual income is half the state average. (Robeson County) In this county, Black and American Indian residents report particularly high stress, frequent instances of discrimination, and poor health due to historical and present-day structural inequities (e.g., historical colonialism and current systemic racism) (Lowery, 2010; Richman et al., 2019).

Future work should delve more deeply into these regions and explore potentially excessive probation use in addition to the other injustices faced by these communities, as these injustices are overlapping and may have multiplicative effects on these regions. Furthermore, it is important for future work to explore these trends at a national level, as prior work has found that while states vary in their use of incarceration, they vary even more widely in their use of probation (Jones, 2018).

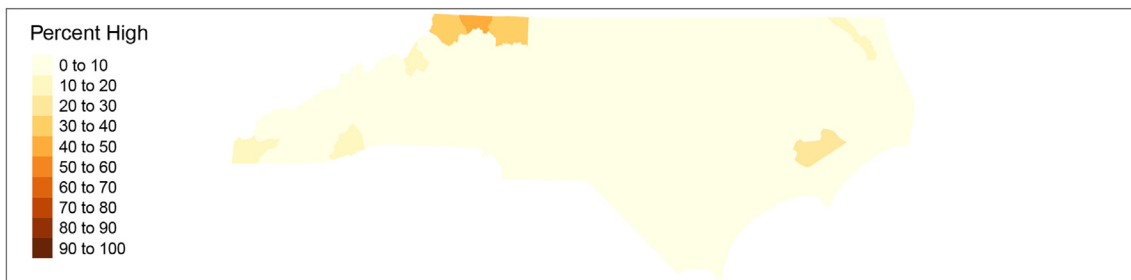
Our spatiotemporal analysis also revealed that high rates of self-inflicted injury and suicide are patterned by space and time with a cluster in Western NC, which is in rural Appalachia. Prior work, including in NC, has found that suicide risk is clustered by space and time, due to an area’s social deprivation (e.g., unemployment, affordable housing), rurality, social isolation, access to firearms, and stigma around mental health care seeking with particularly high clusters in Western NC (Sugg et al., 2021; Searles et al., 2014). These findings emphasize the need for locally targeted self-inflicted injury and self-harm prevention efforts, which may be more effective than focusing on individual-level risk factors alone.

Beyond the clustering of probation and mental health on their own,

A. Probation



B. Suicide



C. Self-Inflicted Injury

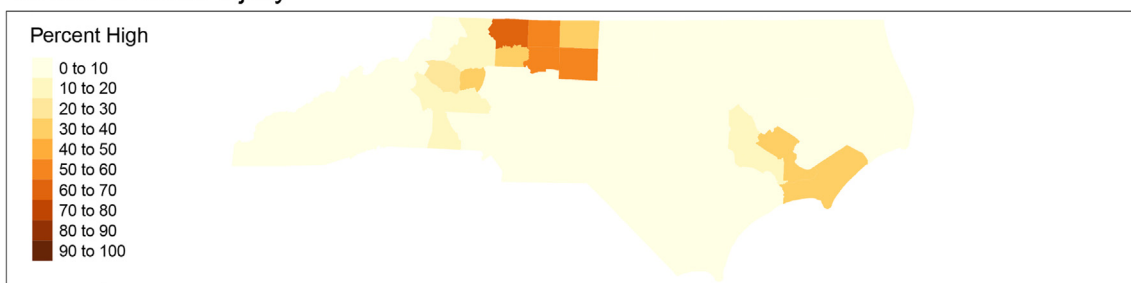


Fig. 2. Local indicators of spatial autocorrelation for North Carolina’s 100 counties (2009–2019).

Table 2

Associations between a 1 percentage point change in county probation rate and change in self-inflicted injury and suicide, North Carolina’s 100 counties, 2009–2019^a.

Year	Self-Inflicted Injury	Suicide
	RD ^b (95% CI)	RD ^b (95% CI)
2009	0.09(0.05,0.13)	0.0018(-0.0001,0.0037)
2010	0.05(0.01,0.08)	0.002(0,0.0041)
2011	0.03(0,0.07)	0.0022(0,0.0043)
2012	0.03(0,0.06)	0.002(-0.0001,0.004)
2013	0.01(-0.02,0.05)	-0.0002(-0.0022,0.0019)
2014	0.01(-0.02,0.05)	0.0006(-0.0021,0.0033)
2015	0(-0.03,0.02)	0.0018(-0.0013,0.0049)
2016	0.04(0.01,0.06)	0.0021(-0.0006,0.0047)
2017	0.04(0.02,0.06)	0.0014(-0.0005,0.0033)
2018	0.05(0.03,0.07)	0.0051(0.0031,0.007)
2019	0.05(0.03,0.06)	0.0027(0.0014,0.004)

^a All models include poverty rate, percent Black, unemployment rate, incarceration rate, rurality score, violent crime rate, and access to mental health care score. Probation rate is lagged 1-year before self-inflicted injury and suicide.

^b This can be interpreted as a risk difference, the absolute percentage change in self-inflicted injury and suicide rate that can be expected for a one percentage point change in the probation rate.

we find that higher probation rates are associated with the mental health of those living in areas with a high amount of the population under state control – through both increased self-inflicted injury and through suicide mortality. This observation supports the hypothesis that non-carceral

involvement in the criminal legal system may impact the health of entire communities (Wildeman and Wang, 2017; Kajeepeta et al., 2020; Hatzenbuehler et al., 2015; Holaday et al., 2021). Given that (1) probation is generally used in addition to incarceration in a county, rather than as a substitution, and (2) that adjusting for county-level incarceration rate, and other county-level variables, did not substantively change results, these detrimental effects on health are likely above and beyond detrimental impacts of incarceration.

There are multiple possible mechanisms underlying this potential relationship, which are likely similar to those linking incarceration to community-wide mental health. The first potential mechanism is related to direct consequences (e.g., individuals on probation living in counties with high probation rates have worse mental health) while the other mechanisms are related to collateral consequences (e.g., individuals not on probation living in counties with high probation rates have worse mental health). First, those on probation lack access to sufficient mental health and substance use treatment services due to disproportionately being low-income (e.g., not being able to afford treatment) and living in rural areas (e.g., not living physically close to treatment). This lack of access creates a high community-level burden of mental health (Plugge et al., 2014). Second, while those on probation are not removed from their community, the movement restrictions, mandatory meetings, required fees, home visits, drug testing, and lowering of individuals’ job prospects create severe levels of stress – not only of those directly involved but likely for their family and social networks (Phelps, 2013). Furthermore, given the high probation rates across NC counties, disrupting these individuals’ job prospects may have reverberating effects

for the entire community. Prior work has also found that substance use recovery, employment, housing, and food security often take priority over accessing healthcare and ultimately achieving health and well-being for those on probation (Dong et al., 2018). Substance use recovery, employment, housing, and food security thus serve as stressors for individuals on probation and their families and may then lead to additional mental health needs. Third, as probation is part of the carceral system, there remains a tradeoff in funding between criminal legal involvement and social services for entire communities (Henrichson et al., 2015). This is most obvious in rural areas where there are already few community-based resources and harm reduction programs, so probation officers often become *de facto* service providers (Colley et al., 1986), which they are not trained to do, likely worsening the mental health of those on probation and not meeting the needs of other community members.

The change in strength of the relationship between probation rates and mental health over time is likely due to both substantive and administrative reasons. Substantively, the evolving fentanyl crisis has led to changes in overdose starting around 2011, which may explain the changing strength of the relationships over time, particularly for suicides due to intentional overdoses (Zoorob, 2019; Boulger et al., 2022). Administratively, the change in ICD-9 and ICD-10 codes for self-inflicted injury may lead to inconsistencies in 2015 and 2016 data. However, given that we see weaker associations between probation and mental health in the years preceding this change as well, these weak associations are likely not due entirely to the change in coding.

There are limitations to our analyses and opportunities for future research to expand on these analyses. First, we are only able to conduct these analyses in NC rather than on a national level given the availability of probation data. Given that probation was generally used in addition to incarceration in this setting, findings may be different for states in which probation is often used as a substitute for incarceration (e.g., Rhode Island) (Wagner, 2015). Furthermore, findings may be different in states that have expanded Medicaid and provided more holistic access to mental healthcare during this time period. However, NC is an ideal setting for this work given, previously stated, its combination of rural and urban areas, its size as the 10th most populous state, and its probation and suicide rates that are similar to that of the entire US. (Oudekerk and Kaebler, 2019; North Carolina Office of State, 2020; National Center for Health Statistics, 2022) Similarly, we are only able to conduct these analyses using adult data due to data limitations. However, 15% of those on probation are under the age of 18 (Wildeman et al., 2019). Additionally, the adolescent population increasingly has a disproportionate number of ED visits for self-inflicted injuries and suicide is a leading cause of death among this age group (Mercado et al., 2017). It is important for future work to include adolescent data. Second, to understand community-level effects of probation, it would be advantageous to have more granular data than the county (e.g., census tract). However, for ecologic analyses, county-level data are relevant as probation policies are implemented at the county level within states. Additionally, access to mental health treatment is often measured at the county level (Thomas et al., 2009; Berwick et al., 1991). Relatedly, given the ecologic nature of the analysis, we observe correlations between probation and self-inflicted injury and suicide rates but cannot determine a causal relationship. We hope that future work is able to collect more granular data to better assess if the associations we found between probation and mental health are due to direct (e.g., those on probation experiencing worse mental health in counties with high probation rates) or collateral consequences (e.g., those not on probation experiencing worse mental health in counties with high probation rates) of probation and to assess causality. Third, our classification of mental health is imperfect. We use self-inflicted injury given that other indicators of mental health (e.g., depression, anxiety) are less likely to prompt an ED visit. Thus, ED data likely do not capture the majority of the burden of depression and anxiety in each county. Furthermore, we do not know the method of suicide,

making it possible that we are capturing some unintentional overdoses. Relatedly, while we found less patterning for suicide completion specifically than for self-inflicted injury, this may be driven by the small suicide numbers in rural counties and a general underreporting of suicide (Tøllefsen et al., 2012). Additionally, accurate suicide reporting may vary regionally, with under resourced counties potentially having more underreporting of suicides than others. Lastly, there are multiple opportunities for future analyses to expand our understanding of how the criminal legal system affects community health. While our spatiotemporal analyses explored probation specifically, performing these analyses for other aspects of the criminal legal system (e.g., prison, the combination of incarceration and community supervision) is important to deepen our understanding of how the criminal legal system operates across space and time. Additionally, while this analysis focused on the relationship between probation rates and mental health while controlling for incarceration rate, we hope that future work builds on these analyses to explore the effect of the entire criminal legal system (e.g., probation, parole, jail, and prison together) on mental health at the community level.

5. Conclusion

The associations this analysis found between probation and self-inflicted injury and suicide rates indicate that higher county-level probation rates may exert collateral damage on the mental health of those living in areas with a high amount of the population under state control. These findings emphasize that the criminal legal system is not separate from communities and that future public health research and advocacy must consider these potential collateral consequences of probation on communities. Critically, policies emphasizing decarceration ([Advancing Public Health Interventions to, 2021](#)) must ensure that they do not simply place individuals on probation instead of sentencing them to incarceration or release individuals from incarceration and place them on probation. Policies must create community-driven alternatives to criminal legal involvement, as placing individuals on probation may also have consequences for both individual and for community-wide health.

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CRedit authorship contribution statement

Katherine LeMasters: Conceptualization, Methodology, Formal analysis, Data curation, Writing – original draft, Writing – review & editing, Visualization, Funding acquisition. **Paul Delamater:** Conceptualization, Methodology, Formal analysis, Software, Supervision, Writing – review & editing, Visualization. **Lauren Brinkley-Rubinstein:** Conceptualization, Writing – review & editing, Supervision. **Jesse K. Edwards:** Supervision, Writing – review & editing. **Whitney R. Robinson:** Conceptualization, Writing – review & editing, Supervision. **Brian Pence:** Writing – review & editing, Supervision.

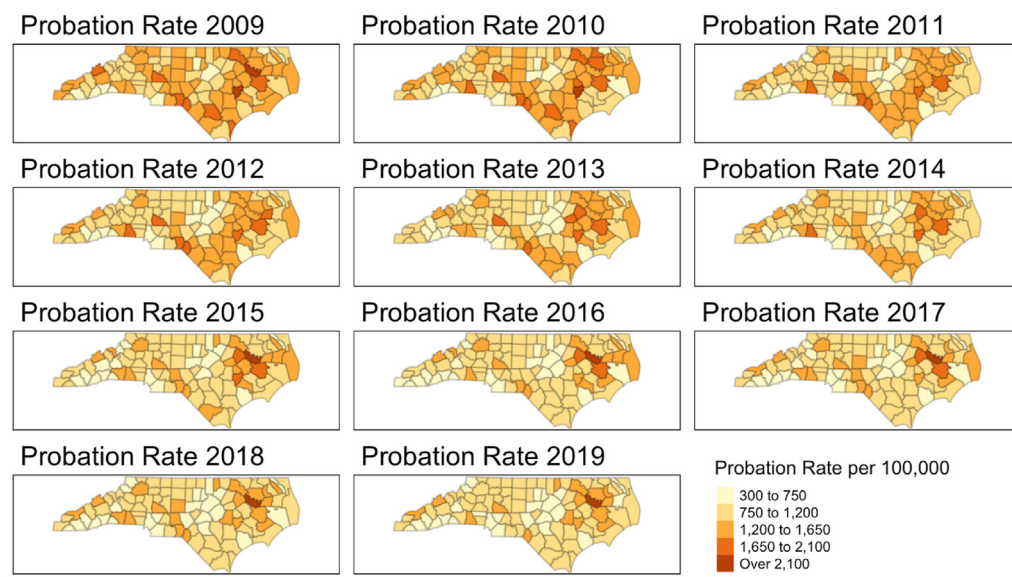
Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

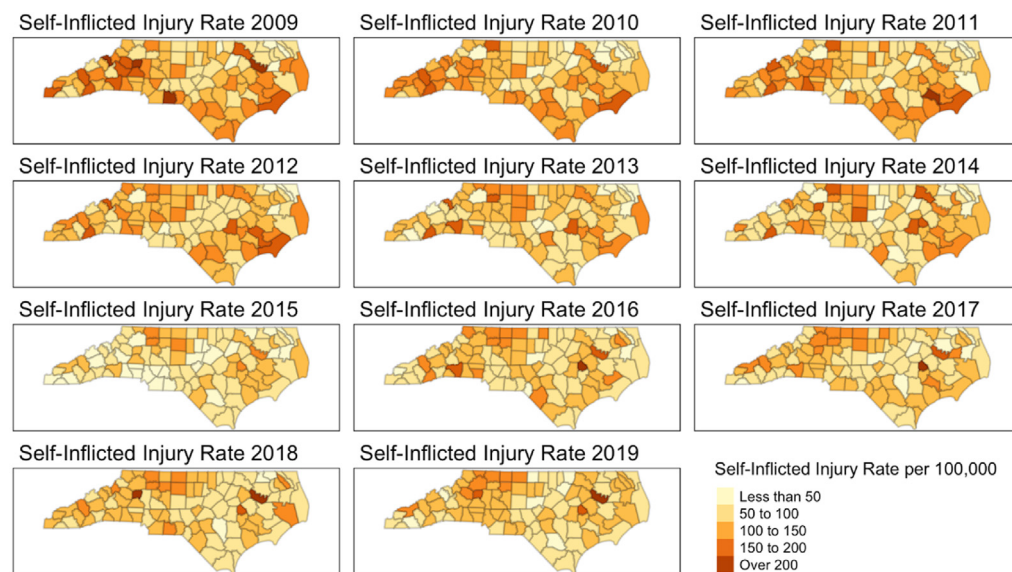
Appendix

Appendix Table 1: Spatial Autocorrelation for Probation, Self-Inflicted Injury, and Suicide for North Carolina's 100 counties, 2009–2019

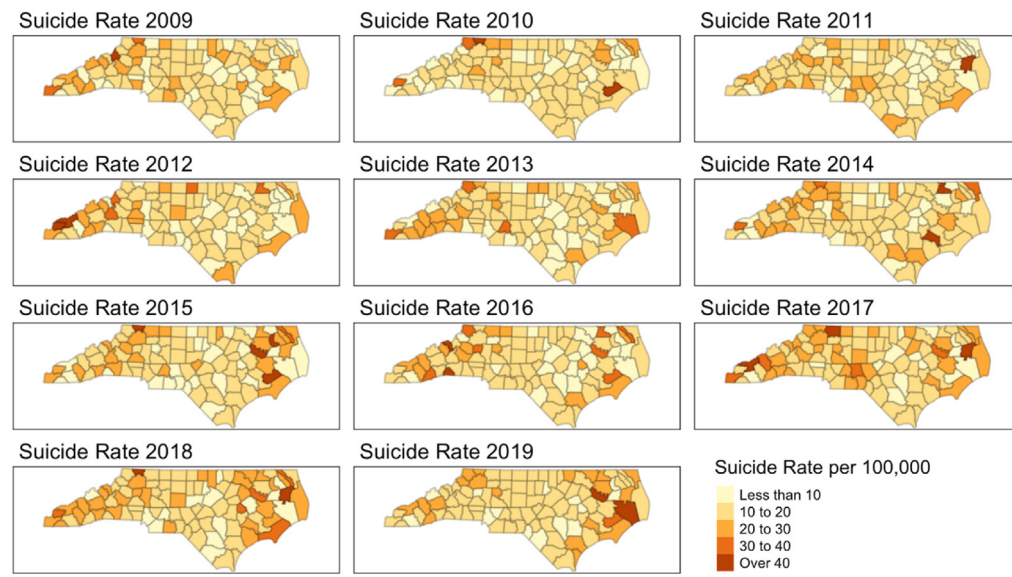
Year	Probation		Self-Inflicted Injury		Suicide	
	Moran's I	P-Value	Moran's I	P-Value	Moran's I	P-Value
2009	0.23	<0.01	0.05	0.16	-0.02	0.46
2010	0.23	<0.01	0.21	<0.01	0.12	0.02
2011	0.27	<0.01	0.23	<0.01	-0.14	<0.01
2012	0.30	<0.01	0.15	0.01	0.17	<0.01
2013	0.34	<0.01	0.14	0.01	0.11	0.03
2014	0.27	<0.01	0.21	<0.01	0.07	0.11
2015	0.29	<0.01	0.34	<0.01	0.04	0.19
2016	0.25	<0.01	0.14	0.01	0.03	0.22
2017	0.30	<0.01	0.15	0.01	0.10	0.04
2018	0.28	<0.01	0.15	0.01	-0.01	0.54
2019	0.27	<0.01	0.25	<0.01	0.13	0.01
Average	0.28	<0.01	0.18	0.02	0.06	0.15



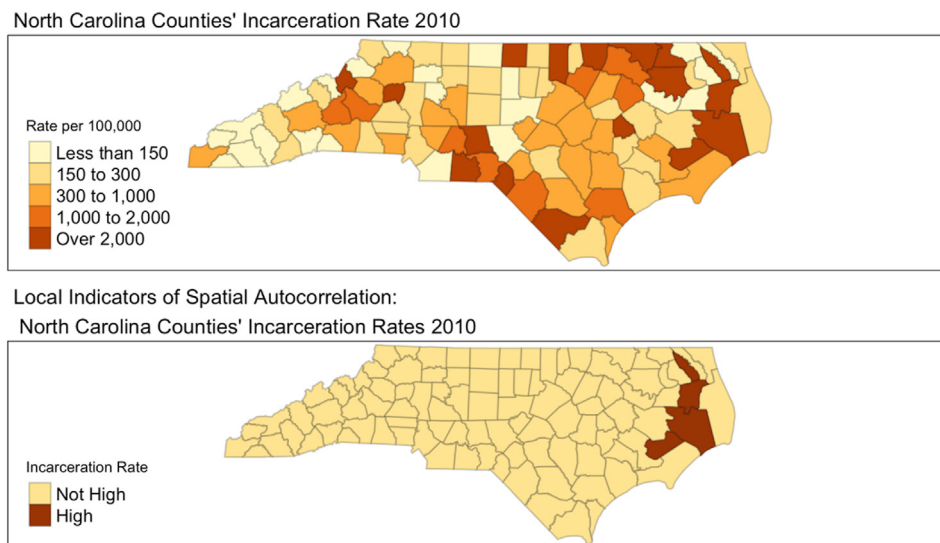
Appendix Fig. 1. North Carolina County Probation Rates 2009–2019 (N = 100) .



Appendix Fig. 2. North Carolina County Self-Inflicted Injury Rates 2009–2019 (N = 100) .



Appendix Fig. 3. North Carolina County Suicide Rates 2009–2019 (N = 100) .



Appendix Fig. 4. Incarceration Rate and Local Indicators of Spatial Autocorrelation for Incarceration Rate in North Carolina's 100 Counties 2010 .

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