Geographic Epidemiology of Hepatocellular Carcinoma and Viral Hepatitis in New York City

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Background

- Hepatocellular carcinoma (HCC) incidence and mortality rates are increasing in the United States.
- According to population-based Surveillance Epidemiology and End Results (SEER) registry data, the incidence rate of HCC has nearly doubled in the past two decades, with similar mortality trends (1).
- NYC is one of the most heavily impacted areas in the country in regard to HCC risk factors, which include chronic hepatitis B and hepatitis C, type 2 diabetes mellitus and heavy alcohol use (2).
- 1.2% of New Yorkers (100,000 people) have hepatitis B, and 2.4% (146,000 people) have hepatitis C (3).
- The geographic distribution of HCC risk factors differs within NYC.
- Variation in HCC incidence across neighborhoods may be related to regional variation in risk factor exposure or racial and ethnic group distribution (4).

Aim

- We assessed geographic pattern of HCC in NYC and geospatial associations between HCC incidence and risk factors prevalence.

Methods

- Data were collected from the NY State Cancer Registry, NYC Department of Health and Mental Hygiene Hepatitis Surveillance Registry, and NYC Community Health Survey, 2008-2012.
- Age-adjusted HCC incidence during 2009-2011 was spatially mapped by NYC United Hospital Fund (UHF) neighborhood, and geographic patterns were analyzed.
- We searched for geographic clustering in age-adjusted HCC incidence using the local Moran's I statistic (LISA) in GeoDA.
- We examined the spatial associations between HCC and viral hepatitis, heavy drinking, diabetes, and poverty (the proportion of residents with income below the federal poverty threshold, per the American Community Survey, 2008 – 2012).
- Linear regression (OLS) and geographically-weighted regression (GWR) were used to test for significance of association and local variations in the relationships using SAS and GWR4.
- After initial analysis, the data source was refined to include HCC cases from the NY State Cancer Registry, reported between 1/1/2001- 12/31/2012 matched to DOHMH surveillance with HBV and HCV cases reported between 1/1/2001- 12/31/2012.
- The new data was geocoded to zip code tabulation area (ZCTA). Hotspot analysis was performed using LISA Moran's I statistics by total HCC cases, HCC + HBV infection, HCC + HCV infection, and HCC with no viral hepatitis infection.

Results

- During 2009-2011, 2,382 HCC cases were reported in NYC, with age-adjusted HCC rates by neighborhood ranging from 5.0 to 22.8 per 100,000 (*Figure 1*).
- HCC rates were not distributed randomly (Moran's I=0.1, p<.01) with the most significant clustering detected in the South Bronx (*Figure 4*).
- Hepatitis B and Hepatitis C New Report rates per 100,000 were mapped by neighborhood. (*Figures 2 & 3*)
- In separate OLS models each controlling for age, HCC was significantly associated (p<.05) with viral hepatitis, and poverty across NYC.
- In separate GWR models controlling for age and spatial autocorrelation, the variation in HCC incidence by neighborhoods was best explained by HBV and poverty (R^2=0.7 in both models).
- From the OLS to GWR model, the largest increases in R^2 were for HCV (from 0.18 to 0.63) and poverty (from 0.18 to 0.75) (*Table 1*).

Figure 1. **Hepatocellular Carcinoma Age-Adjusted Incidence Rates by NYC neighborhood, 2009-2011**

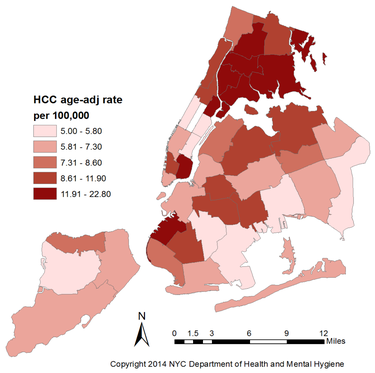


Table 1. **Standard coefficients (β) and coefficients of determination (R^2) for linear regression (OLS) and geographically-weighted regression (GWR) models**

	Standardized coefficients (β)	Adjusted R^2	Significance	Local R^2
Hepatitis B	**.61**	**.45**	**.00**	**.70**
Hepatitis C	**.43**	**.18**	**.04**	**.63**
Poverty	**.60**	**.18**	**.03**	**.75**

Boldface values denote statistically significant results.

Figure 2 and 3. **Hepatitis B and Hepatitis C Rates in NYC by neighborhood, 2009-2011**

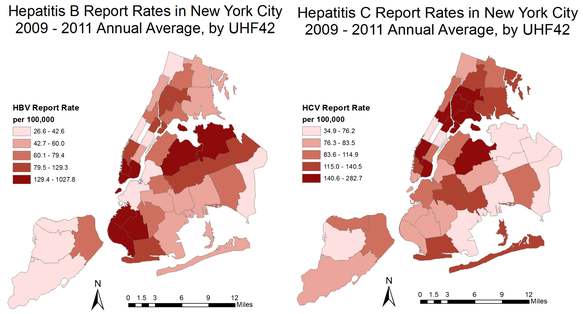
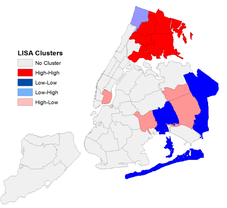
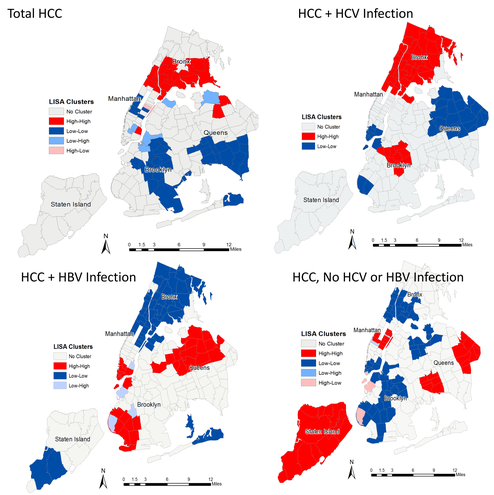


Figure 4. **Hepatocellular Carcinoma Cluster Map in NYC by neighborhood, 2009-2011**



- Between 2001 – 2012, 8,955 HCC cases were reported in NYC.
- LISA cluster detection identified 21 ZCTAs with high rates of HCC clustering.
- Once disaggregated by viral hepatitis infection, HCC incidence rates with HCV, HBV, and no HCV/HBV infection became distinct to different ZCTAs in NYC.

Figure 5-8. **Hepatocellular Carcinoma Local Indicators of Spatial Autocorrelation in NYC by Zip Code Tabulation Area and by Viral Hepatitis Infection Status, 2001-2012**



Conclusions

- HCC is distributed inequitably across NYC, with stark geographic differences seen by viral hepatitis infection.
- Geographic clustering was observed in the distribution of HCC in NYC.
- HCC disproportionally affects neighborhoods with high rates of viral hepatitis and poverty.
- These results are similar to previous studies showing that a low neighborhood-level socioeconomic status (5-8) and infection with hepatitis B (9-12) are associated with a greater incidence of HCC.
- Significant inequalities exist in HCC prevention, detection and treatment that may be due to access to care, patient attitudes, provider knowledge, local health policies or a combination of these factors (13).
- Detecting hotspots and associations with predictors like poverty offer opportunities for HCC prevention and early intervention.
- Further research is warranted that may include other risk factors, particularly in neighborhoods where HCC is not associated with viral hepatitis.

References

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