# Spatial Associations of Liver Disease Rates with Socioeconomic and Health Risk Factors in Georgia

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# Spatial Associations of Liver Disease Rates with Socioeconomic Factors in Georgia, USA


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## ABSTRACT


- CDC Cancer Statistics Report in 2020 shows Liver and Intrahepatic Bile Duct is the 6th leading cancer in both USA and the State of Georgia ranked by Rates of Cancer Death.
- Investigate liver disease in detail at the OASIS website to discover a new narrative. In Georgia, alcoholic liver disease is the leading cause of mortality between the years of 2018 and 2022 (287 vs. 211), and there are 213 vs. 159 instances between the years of 2013 and 2017.
- The Age-Adjusted Discharge Rate of Liver Disease observation geographical analysis conducted in GA County from 2018 to 2022 also reveals a greater rate of Alcoholic Liver Disease.


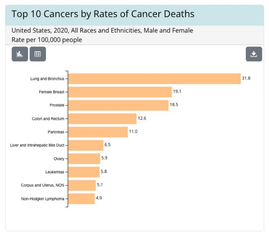


**Fig.1: Liver and Intrahepatic Bile Duct Cancer is ranked 6/10 Cancer Death Rates.**

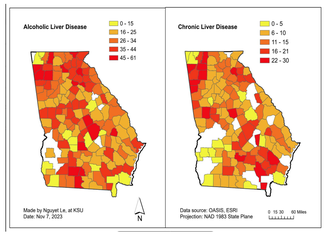


**Fig. 2: Spatial Variations comparison between 2 types of Liver Diseases by Age-Adjusted Discharge Rate.**

## OBJECTIVE

To explore the spatial variations in the associations of the rates of both type of Liver Diseases with socioeconomic and health factors at county-level in Georgia. Analyzing the correlations between **2 types of Liver Disease: Alcoholic and Chronic** and **21 socioeconomic, and health factors** using Spatial Analysis and global statistics.

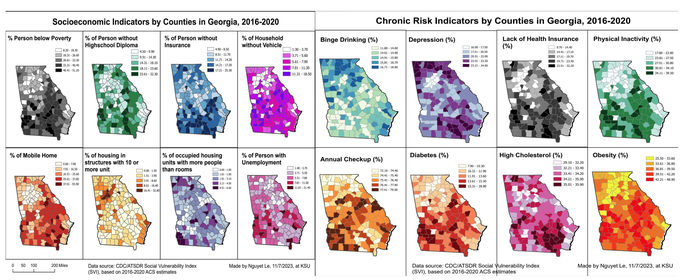


**Fig.3: Observation the geographic characteristics of risk and social factors.**

## METHODS

- Spatial studies, especially Hotspot and Cluster Analysis, are used to compare the frequencies of chronic and alcoholic liver disease in terms of regional characteristics.

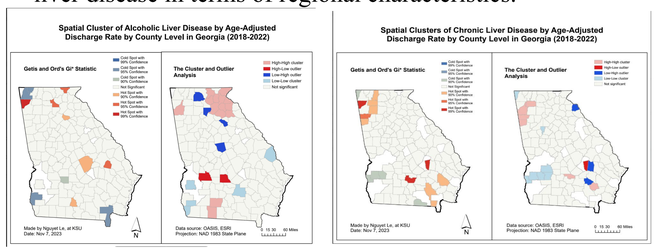


**Fig. 4: Spatial Variations of Liver Disease**

- The rates of chronic and alcoholism liver disease are compared and quantified with respect to each of the socioeconomic parameters under study using statistical studies, particularly correlation analysis. The dataset is selected and described detail in Table 1.

| Variable Groups | Variables | Abbreviation | Minimum | Maximum | Mean | Data Sources |
|---|---|---|---|---|---|---|
| Hospital Discharge Rate (2018-2022, 5-year Aggregates, Age-Ajusted) | Alcoholic Liver Disease (per 100,000 Residents) | 1822_Alcohol | 0 | 61 | 29.53 | Online Analytical Statistical Information System (OASIS) |
| | Chronic Liver Disease (per 100,000 Residents) | 1822_Chronic | 0 | 30 | 11.71 | |
| Chronic Disease Indicators (2020, Age-Adjusted Revelance) | Binge drinking (%) | BINGE | 11.8 | 18.9 | 15.189 | CDC, PLACES: Local Data for Better Health |
| | Physical inactivity (%) | PHLTH | 7.9 | 18.9 | 12.767 | |
| | Lack of health insurance (%) | | 29.1 | 35.9 | 33.867 | |
| | Annual checkup (%) | CHECKUP | 25.5 | 48.9 | 38.247 | |
| | Diabetes (%) | DIABETES | 16 | 24.9 | 21.611 | |
| | High cholesterol (%) | HIGHCHOL | 17.8 | 39.5 | 29.029 | |
| | Frequent mental health distress (%) | DEPRESSION | 72.1 | 79.5 | 75.958 | |
| | Obesity (%) | OBESITY | 9.7 | 32.2 | 18.586 | |
| Socioeconomic variables (2020) | Percentage of persons below 150% poverty | EP_POV150 | 8.2 | 51.2 | 30.045 | Agency for Toxic Substances and Disease Registry (ADSDR), CDC SVI Documentation 2020 |
| | Percentage of persons with no high school diploma (25+) | EP_NOHSDP | 4.5 | 32.3 | 16.599 | |
| | Percentage of housing in structures with 10 or more units | EP_MUNIT | 0 | 32.8 | 3.247 | |
| | Percentage of occupied housing units with more people than rooms | EP_CROWD | 0 | 6.6 | 2.282 | |
| | Percentage of persons without vehicle | EP_NOVEH | 1.3 | 18.5 | 6.864 | |
| | Percentage of persons living in Mobile home | EP_MOBILE | 0.6 | 55.9 | 21.56 | |
| | Percentage of persons without insurance | EP_UNINSUR | 4.9 | 25.3 | 14.047 | |
| | Percentage of persons without Emloyment | EP_UNEMPL | 1.4 | 21.4 | 6.069 | |
| | Percentile ranking (SVI) in socioeconomic status theme | RPL_THEME1 | 0 | 1 | 0.499603 | |
| | Percentile ranking (SVI) in household characteristics theme | RPL_THEME2 | 0 | 1 | 0.499004 | |
| | Percentile ranking (SVI) in racial & ethnic minority status theme | RPL_THEME3 | 0 | 1 | 0.498923 | |
| | Percentile ranking (SVI) in housing type & transportation theme | RPL_THEME4 | 0 | 1 | 0.499403 | |
| | Overall percentile ranking (SVI) | RPL_THEMES | 0 | 1 | 0.499921 | |

**Table 1: Dataset Description**

| | N | Skewness | | Kurtosis | |
|---|---|---|---|---|---|
| | Statistic | Statistic | Std. Error | Statistic | Std. Error |
| Alcohol_Age_Ad | 147 | 0.146 | 0.2 | -0.252 | 0.397 |
| Chronic_Age_Ad | 133 | 0.74 | 0.21 | 0.332 | 0.417 |
| BINGE | 159 | 0.19 | 0.192 | -0.305 | 0.383 |
| DIABETES | 159 | 0.113 | 0.192 | -0.503 | 0.383 |
| HIGHCHOL | 159 | -0.93 | 0.192 | 1.536 | 0.383 |
| OBESITY | 159 | -0.419 | 0.192 | 0.095 | 0.383 |
| DEPRESSION | 159 | -0.715 | 0.192 | 0.425 | 0.383 |
| Physical_Inactivi | 159 | -0.268 | 0.192 | -0.466 | 0.383 |
| CHECKUP | 159 | 0.053 | 0.192 | -0.48 | 0.383 |
| Lack_Health_Ins | 159 | 0.52 | 0.192 | 1.12 | 0.383 |
| EP_POV150 | 159 | -0.2 | 0.192 | -0.27 | 0.383 |
| EP_NOHSDP | 159 | 0.261 | 0.192 | -0.244 | 0.383 |
| EP_MUNIT | 159 | 3.475 | 0.192 | 16.512 | 0.383 |
| EP_CROWD | 159 | 0.988 | 0.192 | 0.79 | 0.383 |
| EP_NOVEH | 159 | 0.724 | 0.192 | 0.371 | 0.383 |
| EP_MOBILE | 159 | 0.189 | 0.192 | -0.584 | 0.383 |
| EP_UNINSUR | 159 | 0.425 | 0.192 | 0.434 | 0.383 |
| EP_UNEMP | 159 | 1.881 | 0.192 | 6.985 | 0.383 |
| RPL_THEME1 | 159 | -0.001 | 0.192 | -1.196 | 0.383 |
| RPL_THEME2 | 159 | 0.005 | 0.192 | -1.201 | 0.383 |
| RPL_THEME3 | 159 | 0.005 | 0.192 | -1.195 | 0.383 |
| RPL_THEME4 | 159 | 0.002 | 0.192 | -1.2 | 0.383 |
| RPL_THEMES | 159 | 0 | 0.192 | -1.2 | 0.383 |
| Valid N (listwise) | 130 | | | | |

**Table 2: Observation the variable distribution**

**Spearman Correlation between Dependent and Independent Variables**

| Variables | Alcohol | | Chronic | |
|---|---|---|---|---|
| | r | p-value | r | p-value |
| BINGE | -0.026 | 0.753 | 0.034 | 0.698 |
| DIABETES | -0.015 | 0.859 | -0.096 | 0.271 |
| HIGHCHOL | 0 | 0.999 | -0.083 | 0.341 |
| OBESITY | -0.055 | 0.51 | -0.155 | 0.075 |
| DEPRESSION | 0.061 | 0.463 | -0.017 | 0.846 |
| Physical_Inac | -0.103 | 0.213 | -.212* | 0.014 |
| CHECKUP | 0.003 | 0.971 | -0.056 | 0.526 |
| Lack_healthIn | -0.03 | 0.716 | -0.1 | 0.25 |
| EP_POV | -0.076 | 0.05 | 0.031 | 0.725 |
| EP_NOHSDP | 0.36 | 0.544 | .296** | <.001 |
| EP_MUNIT | 0.122 | 0.142 | -0.167 | 0.055 |
| EP_CROWD | 0.085 | 0.308 | 0.035 | 0.688 |
| EP_NOVEH | -0.162 | 0.051 | -0.109 | 0.213 |
| EP_MOBILE | -0.122 | 0.14 | .193* | 0.026 |
| EP_UNINSUR | 0.071 | 0.395 | 0.108 | 0.215 |
| EP_UNEMPL | -0.001 | 0.991 | -0.061 | 0.485 |
| RPL_THEME1 | 0.017 | 0.836 | 0.08 | 0.36 |
| RPL_THEME2 | 0.081 | 0.329 | 0.014 | 0.871 |
| RPL_THEME3 | -.192* | 0.02 | -.334** | <.001 |
| RPL_THEME4 | -0.084 | 0.313 | -0.059 | 0.496 |
| RPL_THEMES | -0.05 | 0.549 | -0.041 | 0.639 |

**Table 3: Spearman's Correlations**

**1. Observation of the variable distribution:** This is run to make sure there are abnormal distribution of the factors and liver diseases.

**2. Conducting Spearman's correlation analysis between each of the Liver Disease and each of the 21 explanatory factors.** It is a type of global statistics, showing the some of correlations that cover the entire study area (Table 3).

**3. Running some of the explanatory factors using Bivariate regression**. There are significant correlations among the explanatory factors shown in influential explanatory factors were selected using Linear regression for each Liver Disease (dependent variable). It is also a type of global statistics, showing the correlations that cover the entire study area (Table 3).

## RESULTS and CONCLUSION

**Bivariate Analysis between Alcohol Liver Disease with other Risk Factor**

| Risk Factors | R2 | p-value of F-test | p-value for intercept | p-value for independent variable |
|---|---|---|---|---|
| BINGE | 0.84 | <.001 | <.001 | <.001 |
| DIABETES | 0.007 | 0.331 | 0.494 | 0.331 |
| HIGHCHOL | 0.761 | <.001 | <.001 | <.001 |
| OBESITY | 0.017 | 0.115 | 0.083 | 0.115 |
| DEPRESSION | 0.612 | <.001 | <.001 | <.001 |
| Physical_Inac | 0.035 | 0.24 | 0.13 | 0.24 |
| CHECKUP | 0.908 | <.001 | <.001 | <.001 |
| Lack_healthIn | 0.776 | <.001 | <.001 | <.001 |
| EP_POV | 0.15 | 0.137 | 0.058 | 0.137 |
| EP_NOHSDP | 0.193 | <.001 | <.001 | <.001 |
| EP_MUNIT | 0.141 | <.001 | 0.131 | <.001 |
| EP_CROWD | 0.004 | 0.466 | 0.148 | 0.466 |
| EP_NOVEH | 0.016 | 0.129 | 0.036 | 0.129 |
| EP_MOBILE | 0.012 | 0.187 | 0.049 | 0.187 |
| EP_UNINSUR | 0.168 | <.001 | <.001 | <.001 |
| EP_UNEMPL | 0.349 | <.001 | <.001 | <.001 |
| RPL_THEME1 | 0.816 | <.001 | <.001 | <.001 |
| RPL_THEME2 | 0.018 | 0.102 | 0.555 | 0.102 |
| RPL_THEME3 | 0.01 | 0.229 | 0.836 | 0.229 |
| RPL_THEME4 | 0 | 0.972 | 0.385 | 0.972 |
| RPL_THEMES | 0.005 | 0.388 | 0.918 | 0.388 |

**Bivariate Analysis between Chronic Liver Disease with other Risk Factors**

| Risk Factors | R2 | p-value of F-test | p-value for intercept | p-value for independent variable |
|---|---|---|---|---|
| BINGE | 0 | 0.81 | 0.047 | 0.81 |
| DIABETES | 0.007 | 0.338 | <0.001 | 0.338 |
| HIGHCHOL | 0.035 | 0.031 | <0.001 | 0.031 |
| OBESITY | 0.026 | 0.66 | <0.001 | 0.66 |
| DEPRESSION | 0.008 | 0.319 | 0.04 | 0.319 |
| Physical_ Inactive | 0.042 | 0.018 | <0.001 | 0.018 |
| CHECKUP | 0.029 | 0.048 | <0.001 | 0.048 |
| Lack_healthIns urance | 0.014 | 0.172 | <0.001 | 0.172 |
| EP_POV | 0 | 0.856 | <0.001 | 0.856 |
| EP_NOHSDP | 0.114 | <0.001 | <0.001 | <0.001 |
| EP_MUNIT | 0.009 | 0.275 | <0.001 | 0.275 |
| EP_CROWD | 0.005 | 0.423 | <0.001 | 0.423 |
| EP_NOVEH | 0.023 | 0.084 | <0.001 | 0.084 |
| EP_MOBILE | 0.023 | 0.081 | <0.001 | 0.081 |
| EP_UNINSUR | 0.017 | 0.138 | <0.001 | 0.138 |
| EP_UNEMPL | 0.005 | 0.407 | <0.001 | 0.407 |
| RPL_THEME1 | 0.041 | 0.019 | <0.001 | 0.019 |
| RPL_THEME2 | 0.001 | 0.708 | <0.001 | 0.708 |
| RPL_THEME3 | 0.104 | <0.001 | <0.001 | <0.001 |
| RPL_THEME4 | 0.001 | 0.662 | <0.001 | 0.662 |
| RPL_THEMES | 0.001 | 0.776 | <0.001 | 0.776 |

**Table 4: Bivariate Analysis between Alcoholic and Chronic Liver Disease with other Risk and Social Factors**

- In descriptive analysis, the Skewness and Kurtosis techniques highlight significant anomalies in the variable distribution. The majority of the variables, particularly the unemployment rate, have a distribution that is either excessively peaky or too flatter than typical. A possible relationship between 21 risk factors and the Liver Diseases
- Based on such strong abnormal findings, a Spearman's correlation analysis is conducted. It provides little significant positive association with both Alcoholic and Chronic Liver Disease. A significant p-value<0.05 is associated with Physical Inactivity, Poverty, No High School Diploma and Racial & ethnic minority status theme. (Table 3)
- The results of linear regression show that those variables have significant positive or negative associations with two independent variables of liver disease. Racial and ethnic minority status, as well as physical inactivity, are linked to Chronic Liver Disease, whereas a lack of a high school diploma is linked to both alcoholism and chronic liver disease.
- Linear Regression Analysis also reveals a strong link between risk and social factors and alcoholic liver disease, as seen by binge drinking, high cholesterol, depression, and a lack of annual health checks...
- This is merely a preliminary study for additional research into the components related with Liver Diseases, as well as the concern of an increased mortality rate from Alcoholic Liver Disease.
- Raising awareness of the dangers of excessive drinking or health negligence is also a part of this project.


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