County-Level Factors Associated With School-Required Immunization Rates Among Connecticut Kindergarteners: 2018-2023

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County-level Factors Associated with School-Required Immunization Rates Among Connecticut Kindergarteners: 2018-2023

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Master of Public Health
Epidemiology of Microbial Diseases
Yale School of Public Health
Class of 2024

Primary Advisor: Dr. Inci Yildirim
Secondary Advisor: Dr. Linda Niccolai
Abstract

The COVID-19 pandemic brought public attention to the implications of anti-vaccine sentiment to population health. However, the anti-vaccine movement began impacting school-aged children long before the pandemic. This study examines the role of socioeconomic factors in Connecticut kindergarten immunization rates between the 2018-2019 and 2022-2023 school years. Connecticut is the third smallest state in the United States, yet significantly diverse socioeconomic statuses exist within its small spatial boundary.

Analyzing data from the Connecticut Annual School Immunization Survey and the United States Census, we demonstrate a connection between socioeconomic factors and kindergarteners fully up-to-date on all required school immunizations at the county level. The findings argue that changes Connecticut kindergarten immunizations rates are more associated with median social economic status than low or high social economic status. We provide recommendations for future research to address gaps in childhood immunizations in Connecticut.
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Introduction

Outsiders typically associate New England with higher vaccination rates and wealth than the rest of the country. However, New England states experience the same inequitable wealth distribution crisis as the rest of the country. Connecticut is the third smallest state in the United States, yet significantly different socioeconomic statuses exist within its small spatial boundary. Consequently, the social determinants of health influencing childhood outcomes vary widely by county. Of the Connecticut cities included in the City Health Dashboard (Department of Population Health & NYU Langone Health, n.d.), Burlington experiences the lowest percentage (1.3) of children living below the federal poverty level, compared to the dashboard’s average of 16.9 percent. Meanwhile, Hartford ranks the highest at 37.6 percent. Childhood lead exposure is a significant social determinant of health due to the harmful behavioral and developmental delays associated with exposure. Unsurprisingly, Burlington scores one out of ten in City Health Dashboard’s 2021 housing-based Lead Exposure Risk Index, and Hartford scores ten out of ten compared to City Health’s 5.5 average.

Vaccine-preventable diseases (VPDs) exasperate such inequities. For example, a measles infection can lead to “immune amnesia,” (Guglielmi, 2019) which increases the likelihood of a child staying home from school due to susceptibility to other illnesses (e.g., influenza, seasonal colds, norovirus). A single-parent household will miss work to care for the child and supervise them while out of school or pay for a babysitter. Families may also depend on free school lunches and other services provided at school.

According to the 2018 CDC Social Vulnerability Index (SVI) 9.5% of New London County households were single-parent with at least one child under eighteen, compared to 6.3% in Tolland County (Centers for Disease Control and Prevention & Agency for Toxic Substances and Disease Registry, 2018). In the 2018-2019 school year, 96.2% of kindergarteners in New London and Tolland counties were up-to-date with their MMR immunization requirements (CT Department of Public Health & Mavani, 2023). Should a measles outbreak occur, New London families may experience a heavier burden of kindergarteners with post-measles immune amnesia than Tolland County.

In the past decade, immunization rates among school-aged children in the United States have declined (Centers for Disease Control and Prevention, 2024). There is plenty of literature investigating the national decline in childhood vaccinations. However, further analyses focuses
on California and Southern states. Literature reviews and meta-analyses on vaccine hesitancy in the United States identify several common themes:

- Engagement roles and responsibilities of individual family members (e.g., fathers, mothers, grandparents), policymakers, and healthcare practitioners (Novilla et al., 2023).
- The implications of state and local immunization policies (Siddiqui et al., 2013).
  - This includes the required documentation and approval for vaccine exemptions.
- Public Health messaging (Olson et al., 2020).
- Accessibility to primary care is needed to develop a trusting relationship between parents and healthcare practitioners (Albers et al., 2023).

A thorough literature search identified few relevant Connecticut-specific studies. A cross-sectional study surveying Connecticut pediatricians’ experiences interacting with parents about childhood vaccinations (Leib et al., 2011) was the only study examining the relationship between parental perceptions, social determinants of health, and childhood immunization rates. In a study that identifies high vaccine hesitancy in New England (Novilla et al., 2023), Connecticut is not included in the analysis. While these literature gaps are critical, existing literature on the subject is valuable. This analysis will consider the common themes in existing literature in application to Connecticut.

Our study aims to identify associations between sociodemographic factors (e.g., social determinants of health, social economic status) and kindergarteners fully up-to-date on all Connecticut school immunization requirements between 2018 and 2022.

We hypothesize that county-level rates of Connecticut kindergarteners fully up-to-date on school required immunizations are associated with undesirable socioeconomic status rates.

**Methods**

**Data Collection**

We searched the Connecticut Open Data Dashboard (Data and Policy Analytics Unit [DAPA], 2024) for immunization datasets for the study. Our keywords were *school, immunizations, vaccinations,* and *county.* For Social Economic Status (SES) data, we searched the United States Census Data Dashboard (U.S. Census Bureau, 2024) filtered by Connecticut County.
Population

The population in our analysis were Connecticut Kindergarteners included in the Connecticut Annual School Immunization Survey and Census data on households in Connecticut counties. The Annual School Immunization Survey (CT Department of Public Health & Mavani, 2023) contains the vaccination and exemption status data on Pre-K, Kindergarten, and 7th grade students at the beginning of the academic year from 2012-2022. The data is not collected on individual students. We selected the percent of kindergarteners in each Connecticut county who are fully up-to-date on all required immunizations for school from the 2018 to 2022 school years.

Independent and Dependent Variables

The percent of fully-vaccinated Kindergarteners was our analysis’s dependent variable. The data was formatted with two numbers behind the decimal point.

Our independent variables were selected from the United States Census American Community Survey (ACS) (US Census Bureau, 2024). The ACS collects monthly data from Connecticut households, then aggregates and averages one and five-year estimates. We chose seven independent variables to include in our analysis:

- The percent of the population born outside of the United States (Foreign Born). This variable is relevant due to differing international immunization requirements and availability.
- Poverty and Unemployment Rates. These data represent possible economic barriers to immunizations.
- The percent of the population that completed some college but did not receive a degree. This data captures a middle ground between graduating high school and obtaining a bachelor’s degree.
- The percent of the population without Health Insurance. This data represents the implications of resource gaps for individuals with low healthcare literacy and barriers to receiving care.
- The percent of Households with Broadband Internet Subscriptions. Internet availability is relevant to our study as it impacts resource accessibility, education, and interactions with misinformation.
The ACS data was reported by household in each county and formatted in percentages rounded to one number behind the decimal point.

In addition, we included Median Household Income to describe the wealth disparities between counties. The Median Household Income was not included in the statistical analysis.

**Statistical Analysis**

For the statistical analysis, we used *R Statistical Software (R)* to calculate Pearson’s R as the correlation coefficient for each SES (independent) variable against the Up-to-Date (dependent) variable. Because of the small dataset, we determined that a p-value of <.20 was considered statistically significant to portray the correlations accurately. We displayed our findings in line and scatter plots generated in *R*.

We used Excel to calculate the median rates of SES variables for the descriptive tables shown in the results section.

**Results**

**Data Characteristics**

Across all Connecticut counties, the rate of kindergarteners who were fully up-to-date on required immunizations remained above 91% between the 2018 and 2022 school years (Table 1).

**Table 1. Kindergarteners Up-to-Date on all Required Immunizations by School Year**

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Fairfield</td>
<td>94.3</td>
<td>94.6</td>
<td>95</td>
<td>93.8</td>
<td>94.3</td>
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<td>92.8</td>
<td>93.8</td>
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<td>95.2</td>
</tr>
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<td>Middlesex</td>
<td>95.5</td>
<td>96</td>
<td>94.7</td>
<td>95.5</td>
<td>95.8</td>
</tr>
<tr>
<td>New Haven</td>
<td>96.1</td>
<td>95.3</td>
<td>93.8</td>
<td>94.9</td>
<td>96.2</td>
</tr>
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<td>New London</td>
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<td>95.4</td>
<td>94.7</td>
<td>94.1</td>
<td>95.2</td>
</tr>
<tr>
<td>Tolland</td>
<td>94.8</td>
<td>94.7</td>
<td>94.5</td>
<td>94.4</td>
<td>94.1</td>
</tr>
<tr>
<td>Windham</td>
<td>91.8</td>
<td>91.1</td>
<td>91.9</td>
<td>91.1</td>
<td>94.5</td>
</tr>
</tbody>
</table>

We used *R* to generate line plots summarizing the Fully Up-to-Date and individual immunization rates from the 2018 to 2022 school years (Figure 1).
Figure 1. Percentage of kindergarteners who are fully up-to-date, overall and for individual vaccines, 2018-2022

Plot 1: Fairfield Kindergarteners

Plot 2: Hartford Kindergarteners

Plot 3: Litchfield Kindergarteners

Plot 4: Middlesex Kindergarteners
From 2018 to 2021, Windham County had the lowest percentage of Kindergarteners Fully Up-to-Date on all vaccines (Figure 1 Plot 8). In 2022, Windham’s Fully Up-to-Date percent increased by 3.73% from 2021. Tolland County had the lowest percentage of Kindergarteners Fully Up-to-Date on all vaccines (94.1%) in 2022.

Middlesex (Figure 1 Plot 4) and New Haven (Figure 1 Plot 5) were most frequently the counties with the highest percent of Kindergarteners Fully Up-to-Date on all vaccines between 2018-2022. In 2020, Fairfield had the highest percentage (95%).

The SES County characteristics are summarized in Tables 2-8.
Statistical Analysis

Table 9. Kindergarten Immunization Rates and SES Variables Correlation Coefficients

<table>
<thead>
<tr>
<th>County</th>
<th>Foreign Born</th>
<th>Poverty</th>
<th>Unemployment</th>
<th>Some College</th>
<th>Uninsured</th>
<th>Internet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fairfield</td>
<td>.13( .839)</td>
<td>1.81(1)</td>
<td>.23(.708)</td>
<td>.44(.457)</td>
<td>-.2(0.971)</td>
<td>-.29(.637)</td>
</tr>
<tr>
<td>Hartford</td>
<td>.21(.74)</td>
<td>.06(0.942)</td>
<td>.22(.717)</td>
<td>.1(.873)</td>
<td>.43(.47)</td>
<td>.04(.945)</td>
</tr>
<tr>
<td>Litchfield</td>
<td>-.37(.536)</td>
<td>.59(.299)</td>
<td>.42(.479)</td>
<td>.24(.701)</td>
<td>.04(.947)</td>
<td>.17(.783)</td>
</tr>
<tr>
<td>Middlesex</td>
<td>-.28(.645)</td>
<td>-.34(.57)</td>
<td>.79(.114)</td>
<td>-.89(.04)</td>
<td>-.74(.155)</td>
<td>.02(.978)</td>
</tr>
<tr>
<td>New Haven</td>
<td>-.5(.392)</td>
<td>.45(.447)</td>
<td>.69(.199)</td>
<td>-.36(.55)</td>
<td>.83(.081)</td>
<td>-.22(.722)</td>
</tr>
<tr>
<td>New London</td>
<td>-.53(.361)</td>
<td>.39(0.515)</td>
<td>.56(325)</td>
<td>-.31(.609)</td>
<td>-.35(.558)</td>
<td>-.54(.343)</td>
</tr>
<tr>
<td>Tolland</td>
<td>.13(.836)</td>
<td>-.91(.033)</td>
<td>.85(.071)</td>
<td>.82(.09)</td>
<td>-.37(.544)</td>
<td>-.91(.031)</td>
</tr>
<tr>
<td>Windham</td>
<td>.18(.777)</td>
<td>-.14(.825)</td>
<td>.44(.453)</td>
<td>-.36(.55)</td>
<td>.36(.551)</td>
<td>.34(.576)</td>
</tr>
</tbody>
</table>

1 Coefficient (r)

2 P-value

We found no statistically significant correlations between Kindergarteners who were Fully Up-to-Date on all Immunization requirements and the Foreign-Born population between 2018 and 2022 (Table 9).

No significant correlations were found between Kindergarteners Fully Up-to-Date and all SES variables in Fairfield, Hartford, New London, and Windham Counties. Tolland had the highest amount of significant correlations between Fully Up-to-Date and Poverty Rate \( r(3) = -0.91, p < .033 \), Unemployment Rate \( r(3) = .85, p > .071 \), Some College \( r(3) = .82, p < .09 \), and Households with Broadband Internet Subscriptions \( r(3) = -.9, p < .031 \). New Haven and Middlesex also had strong significant positive correlations between Fully Up-to-Date and Unemployment Rate \( r(3) = .69, p > .199; r(3) = .79, p > .114 \). Kindergarteners’ Fully Up-to-Date in Middlesex had a strong negative correlation with Some College \( r(3) = -.89, p < .04 \) and a strong positive correlation with No Health Insurance in New Haven \( r(3) = .83, p < .081 \).

We used R to generate scatter plots (figures 3-10) illustrating the correlation coefficient results.

Discussion

The COVID-19 pandemic helped open our eyes to the implications of the national vaccine resistance movement on population health. Questions remain on the weight of anti-vaccine
sentiment versus socioeconomic status barriers on childhood immunization rates. Our findings provide preliminary research on Connecticut's childhood immunization rates.

Fairfield

Fairfield had the highest income, the number of Households with Broadband Internet Subscriptions, No Health Insurance, and the lowest rate of completing Some College across all years included in this study. Sociodemographically, Fairfield is in the higher end of extremes in most categories. Therefore, it is surprising that there were no significant associations with the percentage of Kindergarteners entirely up to date on all required school immunizations and any of the SES variables. There was no strong absolutive value correlation coefficients within the insignificant results. The strongest was Some College education with moderate positive strength \( r(3) = .44, p > .457 \). Fairfield had the lowest rate of Some College education across all years, but it remains weak for Unemployment, Foreign Birth, No Health Insurance, and Households with Broadband Internet Subscriptions.

Hartford

No significant correlations were found between Kindergarteners Up-to-Date on all required immunizations and the SES variables in Hartford County between 2018 and 2022. Hartford's median income across all years ($75,704) was 4.74% lower than the total median income for all counties and on the lower end of the median across each year. Hartford's median Poverty Rate across all years (11) was 2% higher than the median Poverty Rate for all counties. Hartford also tied with Litchfield and Windham for the highest Poverty Rate (11) in 2021. In 2019, Hartford households were 4.2 percent lower than the median percent of Households with Broadband Internet Subscriptions (87.2). Overall, Hartford was further than closer from the median in all SES variables.

Litchfield

No significant correlations were found between Kindergarteners Up-to-Date on all required immunizations and the SES variables in Litchfield County between 2018 and 2022. Although not statistically significant, Litchfield had a moderately strong correlation coefficient in the same direction for No Health Insurance and Kindergartens Fully Up-to-Date \( r(3) = .43, p > .47 \). Litchfield had the lowest Poverty Rate (7%) in 2020 (1.5% below the median poverty rate) and tied for the lowest Poverty Rate (6.9%), with Middlesex County in 2020. The 0.1 percent
difference between the Poverty Rate for 2019 and 2020 is notable, considering the impact the pandemic onset had on poverty across the country (Han et al., 2020). Overall, Litchfield's median Poverty Rate across all years (7%) was the second lowest compared to each county's median Poverty Rate. Opposite Hartford, Litchfield was at the higher end of positive and lower end of negative SES variables, indicating it was closer to the extreme than the median.

**Middlesex**

There was a strong positive association between Kindergarten Immunization Rates and Unemployment \([r(3)= .79, p< .114]\), indicating that between 2018 and 2022, as more Kindergarteners were fully up-to-date on required immunizations, more people in Middlesex County became unemployed. It is essential to consider that Middlesex had the lowest Unemployment Rate among all counties between 2018 and 2020 and tied with Tolland County for the lowest Unemployment Rate (4.7) in 2021. During this time, Middlesex's Unemployment Rate remained stable and did not fluctuate by more than 0.4 percent each year.

There were significant and strong negative associations between Kindergarten Immunization Rates and Some College \([r(3)= -.89, p< .4]\) and No Health insurance \([r(3)= -.74, p< .155]\). This indicates that as Kindergarten Immunization Rates rose, the rate of completing Some College fell. Likewise, as Kindergarten Immunization Rates rose, more people in Middletown secured health insurance, and as Kindergarten Immunization Rates fell, more people became uninsured. These findings suggest Middlesex Kindergarteners are more likely to be Up-to-Date on required immunizations when fewer people are without health insurance.

**New Haven**

Similar to Middlesex, Kindergarten Immunization Rates in New Haven had a significant, positive association with Unemployment \([r(3)= .69, p< .199]\). Unlike Middlesex, New Haven's statistically significant association with Kindergarten Immunization Rates and No Health Insurance was positive \([r(3)= .83, p< .81]\). These findings indicate that as more New Haven kindergarteners are up-to-date on their required school immunizations, the more unemployed people without health insurance will grow. One possible explanation for the contrast between New Haven and Middlesex is that much of the Yale New Haven Health system is centralized in New Haven County. In New Haven County, there may be more opportunities for and awareness of affordable and accessible immunizations through Yale New Haven Health. Additionally, New
Haven County is more urban than Middlesex County, so there may be more transportation options for receiving immunizations.

**New London**

There were no significant associations between Kindergarteners who were Fully Up-to-Date on required immunizations and the SES variables in New London County. Aside from statistical significance, two notable takeaways from the New London data exist. First, while not statistically significant, all correlation coefficients for New London had a moderate or strong effect size. This contrasts with Fairfield, Litchfield, and Windham counties, which had no significant associations but mostly weak effect sizes. Second, except for Some College, New London's median value remained closer than not to the total median for all counties across all SES. This finding differs from the medians in Fairfield, Litchfield, and Hartford, which were closer to one end of the extreme than the median.

**Tolland**

Tolland County experienced more statistically significant associations between Kindergarteners’ Up-to-Date on required immunizations and SES variables than all other Connecticut counties. In Tolland County, Kindergarten Immunization Rates were very strongly correlated in the opposite direction with Tolland's Poverty Rate \( r(3) = -0.91, p < .033 \) and the percent of Households with Broadband Internet Subscriptions \( r(3) = -0.91, p < .031 \). This indicates that as more Kindergarteners are Fully Up-to-Date on their required school immunizations, fewer households acquire Broadband Internet, and fewer people live below the poverty line in Tolland County. Tolland is the only county with a significant association between Kindergarteners who are Up-to-Date on required immunizations for school with poverty and at-home internet access.

Similar to Middlesex and New Haven, Tolland's Kindergarten Immunization Rates and the Unemployment Rate rose and fell in the same direction \( [r(3) = .85, p < .071] \). While Tolland tied with Middlesex for the lowest 2021 Unemployment Rate, Tolland's Unemployment Rate remained closer to the median than Middlesex each year. However, unlike Middlesex, Tolland had a significant association with Kindergarten Immunization Rates and completion of Some College in the same direction \( r(3) = 0.82, p < .09 \). The higher the number of kindergarteners who are Fully Up-to-Date on all immunization requirements, the more people in Tolland County
have completed Some College. Further research is warranted for the association between the level of education, internet accessibility, and school immunization rates.

**Windham**

There were no statistically significant associations between Fully Up-to-Date Kindergarteners on all required school immunizations and any SES variables in Windham County. The strongest, non-significant correlation coefficient in Windham County was moderately strong Kindergarten Immunization Rates and Unemployment \( r(3) = 44, p > .453 \). In most SES categories, Windham was the opposite of Fairfield. For example, Windham had the lowest median income each year and was 15.75% below the total median income across all years.

The findings of this study did not support our hypothesis that undesirable SES outcomes were associated with the rate of Kindergarteners Up-to-Date with Immunization requirements for schools in Connecticut counties. In most cases, we found that associations existed in the space between the highest and lowest values. For example, Fairfield and Windham counties were at the highest or lowest end of each SES variable and had no statistically significant associations. Likewise, there were no statistically significant associations for Hartford, Litchfield, or New London, whose SES variables were usually closer to one end of the extreme than the median.

The SES-variable rates for counties with statistically significant associations, New Haven, Middlesex, and Tolland Counties, mostly fell closer than not to the median. While some findings support our hypothesis (e.g., Tolland County was the only county to have a statistically significant association with the Poverty Rate and had the lowest Poverty Rate among all counties between 2018 and 2021), the findings imply that most variation exists in average socioeconomic statuses.

**Strengths and Limitations**

Our study had several limitations. First, the generalizability of the results is limited by the short time period included in our analysis. Second, the percentage of Kindergartners Fully Up-to-Date on all required immunizations was not included in the Connecticut Annual School Immunization Survey until 2018. Due to the lack of data on total immunization rates, we cannot confirm if our findings reflected a larger pattern. Third, the reliability of our data is impacted by the available Census data. Because the American Community Survey data for 2022 has yet to be available, we repeated the 2021 data to substitute for 2022 in our analysis. Lastly, it is beyond the scope
of this study to statistically consider the impact the COVID-19 pandemic had on immunization rates. The pandemic may have confounded our analysis.

Despite the limitations, our study had several strengths. Our findings provide direction for focus areas in future research. Additionally, our analysis provided a framework for immunization initiatives to increase immunization rates by identifying potential gaps at the county level.

**Recommendations**

To the best of our knowledge, this is the first study analyzing the relationship between socioeconomic status and school immunization rates at the county level in Connecticut. Therefore, further analysis is needed to verify the validity of our findings. Our analysis allowed us to identify critical socioeconomic variables in Connecticut’s kindergarten immunization rates. Future research should explore the role of education, unemployment, and health insurance in more detail. Researchers in Connecticut have the advantage of publicly available data on individual immunization, exemption, and compliance rates at the county, district, and individual school levels. Future research is needed to determine the impact of exemptions and compliance on the total up-to-date immunization rates. Lastly, it was beyond the scope of this study to analyze the individual immunization rates on required vaccines for Kindergarteners in Connecticut. It is critical to assess this further as immunization rates impact population health. For example, New York City has experienced continuous measles cases since the 2018 outbreak (Zucker et al., 2020). Measles is among the most contagious infectious diseases, with an R0 between 12-18 in a susceptible population (Guerra et al., 2017). Fairfield County is right above New York City, and many Fairfield residents travel daily to and from New York for work (Prinz, 2023). This leaves children in Fairfield County who are not up-to-date on MMR immunizations vulnerable. Connecticut is a small state, so Measles could quickly spread throughout the entire state due to the high transmissibility of the virus. Identifying factors that contribute to vaccine hesitancy in Connecticut mitigates such risks.

**Conclusion**

This study aimed to identify associations between socioeconomic factors and kindergarteners fully up-to-date on all Connecticut school immunization requirements between 2018 and 2022. Based on our analysis we conclude that socioeconomic factors influence counties in the middle of highly desirable socioeconomic outcomes and highly undesirable desirable socioeconomic outcomes. To better understand the implications of our findings, future research should focus on
the role of education, unemployment, and health insurance in Connecticut childhood immunization rates.
References


CT Department of Public Health, & Mavani, D. M. (2023). *County Immunizations and Exemption Rates by School Year, Grade, Vaccine, and School Type* [Dataset]. https://data.ct.gov/stories/s/n5kk-6ext


https://www.census.gov/programs-surveys/acs

## Appendix

### Tables

#### Table 1

**Percentage of Kindergarteners Up-to-Date on all Required Immunizations by School Year**

<table>
<thead>
<tr>
<th></th>
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<tbody>
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<td>94.6</td>
<td>95</td>
<td>93.8</td>
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<td>Hartford</td>
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<td>92.8</td>
<td>93.8</td>
<td>95.5</td>
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<td>91.8</td>
<td>91.1</td>
<td>91.9</td>
<td>91.1</td>
<td>94.5</td>
</tr>
</tbody>
</table>

#### Table 2

**Median Household Income per County 2018-2021**

<table>
<thead>
<tr>
<th>Year</th>
<th>Fairfield</th>
<th>Hartford</th>
<th>Litchfield</th>
<th>Middlesex</th>
<th>New Haven</th>
<th>New London</th>
<th>Tolland</th>
<th>Windham</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>101,194</td>
<td>80,320</td>
<td>84,797</td>
<td>90,833</td>
<td>75,043</td>
<td>79,040</td>
<td>88,525</td>
<td>71,418</td>
<td>82,559</td>
</tr>
<tr>
<td>2020</td>
<td>97,539</td>
<td>76,259</td>
<td>81,590</td>
<td>84,907</td>
<td>71,370</td>
<td>75,831</td>
<td>87,809</td>
<td>67,365</td>
<td>78,925</td>
</tr>
<tr>
<td>2019</td>
<td>95,645</td>
<td>75,148</td>
<td>79,906</td>
<td>85,898</td>
<td>69,905</td>
<td>73,490</td>
<td>87,069</td>
<td>66,550</td>
<td>77,527</td>
</tr>
<tr>
<td>2018</td>
<td>92,969</td>
<td>72,321</td>
<td>78,314</td>
<td>84,761</td>
<td>67,128</td>
<td>71,368</td>
<td>84,916</td>
<td>64,774</td>
<td>75,318</td>
</tr>
<tr>
<td>Median</td>
<td>96,592</td>
<td>75,704</td>
<td>80,748</td>
<td>85,403</td>
<td>70,638</td>
<td>74,661</td>
<td>87,439</td>
<td>66,958</td>
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</tbody>
</table>

#### Table 3

**Percentage of Foreign Born Population per County 2018-2021**

<table>
<thead>
<tr>
<th>Year</th>
<th>Fairfield</th>
<th>Hartford</th>
<th>Litchfield</th>
<th>Middlesex</th>
<th>New Haven</th>
<th>New London</th>
<th>Tolland</th>
<th>Windham</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>22.0</td>
<td>15.0</td>
<td>8.0</td>
<td>8.0</td>
<td>13.0</td>
<td>9.0</td>
<td>7.0</td>
<td>5.0</td>
<td>8.5</td>
</tr>
<tr>
<td>2020</td>
<td>22.0</td>
<td>15.0</td>
<td>8.0</td>
<td>8.0</td>
<td>13.0</td>
<td>9.0</td>
<td>7.0</td>
<td>5.0</td>
<td>8.5</td>
</tr>
<tr>
<td>2019</td>
<td>22.0</td>
<td>15.4</td>
<td>8.0</td>
<td>7.8</td>
<td>12.7</td>
<td>8.7</td>
<td>6.9</td>
<td>4.9</td>
<td>8.4</td>
</tr>
<tr>
<td>2018</td>
<td>21.7</td>
<td>15.3</td>
<td>7.9</td>
<td>7.6</td>
<td>12.2</td>
<td>8.5</td>
<td>7.1</td>
<td>5.1</td>
<td>8.2</td>
</tr>
<tr>
<td>Median</td>
<td>22.0</td>
<td>15.2</td>
<td>8.0</td>
<td>7.9</td>
<td>12.9</td>
<td>8.9</td>
<td>7.0</td>
<td>5.0</td>
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</table>
### Table 4

**Poverty Rate per County 2018-2021**

<table>
<thead>
<tr>
<th>Year</th>
<th>Fairfield</th>
<th>Hartford</th>
<th>Litchfield</th>
<th>Middlesex</th>
<th>New Haven</th>
<th>New London</th>
<th>Tolland</th>
<th>Windham</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>9.0</td>
<td>11.0</td>
<td>8.0</td>
<td>6.0</td>
<td>11.0</td>
<td>9.0</td>
<td>10.0</td>
<td>11.0</td>
<td>9.5</td>
</tr>
<tr>
<td>2020</td>
<td>9.0</td>
<td>11.0</td>
<td>7.0</td>
<td>7.0</td>
<td>11.0</td>
<td>8.0</td>
<td>8.0</td>
<td>12.0</td>
<td>8.5</td>
</tr>
<tr>
<td>2019</td>
<td>8.9</td>
<td>10.8</td>
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<td>11.7</td>
<td>9.4</td>
<td>7.3</td>
<td>11.4</td>
<td>9.2</td>
</tr>
<tr>
<td>2018</td>
<td>8.8</td>
<td>11.1</td>
<td>7.0</td>
<td>6.9</td>
<td>11.9</td>
<td>10.2</td>
<td>6.9</td>
<td>10.5</td>
<td>9.5</td>
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<tr>
<td>Median</td>
<td>9.0</td>
<td>11.0</td>
<td>7.0</td>
<td>6.9</td>
<td>11.4</td>
<td>9.2</td>
<td>7.7</td>
<td>11.2</td>
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### Table 5

**Unemployment Rate per County 2018-2021**

<table>
<thead>
<tr>
<th>Year</th>
<th>Fairfield</th>
<th>Hartford</th>
<th>Litchfield</th>
<th>Middlesex</th>
<th>New Haven</th>
<th>New London</th>
<th>Tolland</th>
<th>Windham</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>6.9</td>
<td>5.8</td>
<td>6.0</td>
<td>4.7</td>
<td>6.7</td>
<td>5.1</td>
<td>4.7</td>
<td>6.9</td>
<td>5.9</td>
</tr>
<tr>
<td>2020</td>
<td>6.9</td>
<td>5.8</td>
<td>5.8</td>
<td>4.3</td>
<td>6.4</td>
<td>5.3</td>
<td>4.9</td>
<td>6.9</td>
<td>5.8</td>
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<tr>
<td>2019</td>
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<td>5.8</td>
<td>5.0</td>
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<td>6.4</td>
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<td>4.9</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>2018</td>
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<td>4.7</td>
<td>6.6</td>
<td>5.6</td>
<td>4.9</td>
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### Table 6

**Percent of Population that Completed Some College per County 2018-2021**

<table>
<thead>
<tr>
<th>Year</th>
<th>Fairfield</th>
<th>Hartford</th>
<th>Litchfield</th>
<th>Middlesex</th>
<th>New Haven</th>
<th>New London</th>
<th>Tolland</th>
<th>Windham</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>7.7</td>
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<td>3.6</td>
<td>3.2</td>
<td>5.1</td>
<td>4.2</td>
<td>3.1</td>
<td>4.3</td>
<td>4.2</td>
</tr>
<tr>
<td>2020</td>
<td>7.6</td>
<td>4.0</td>
<td>3.6</td>
<td>3.3</td>
<td>4.9</td>
<td>4.2</td>
<td>2.7</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>2019</td>
<td>8.4</td>
<td>4.1</td>
<td>3.9</td>
<td>3.2</td>
<td>5.0</td>
<td>4.0</td>
<td>2.6</td>
<td>4.1</td>
<td>4.1</td>
</tr>
<tr>
<td>2018</td>
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<td>4.4</td>
<td>4.2</td>
<td>3.3</td>
<td>5.2</td>
<td>4.3</td>
<td>3.1</td>
<td>3.9</td>
<td>4.3</td>
</tr>
<tr>
<td>Median</td>
<td>8.1</td>
<td>4.1</td>
<td>3.8</td>
<td>3.3</td>
<td>5.1</td>
<td>4.2</td>
<td>2.9</td>
<td>4.1</td>
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</tr>
</tbody>
</table>
### Table 7

*Percent of Population with No Health Insurance per County 2018-2021*

<table>
<thead>
<tr>
<th>Year</th>
<th>Fairfield</th>
<th>Hartford</th>
<th>Litchfield</th>
<th>Middlesex</th>
<th>New Haven</th>
<th>New London</th>
<th>Tolland</th>
<th>Windham</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>91.2</td>
<td>88.0</td>
<td>90.0</td>
<td>88.7</td>
<td>86.9</td>
<td>89.8</td>
<td>91.0</td>
<td>87.1</td>
<td>89.3</td>
</tr>
<tr>
<td>2020</td>
<td>89.9</td>
<td>86.1</td>
<td>88.8</td>
<td>87.2</td>
<td>84.9</td>
<td>88.6</td>
<td>89.9</td>
<td>85.7</td>
<td>87.9</td>
</tr>
<tr>
<td>2019</td>
<td>88.5</td>
<td>82.2</td>
<td>86.7</td>
<td>86.4</td>
<td>83.2</td>
<td>86.4</td>
<td>88.2</td>
<td>83.6</td>
<td>86.4</td>
</tr>
<tr>
<td>2018</td>
<td>87.1</td>
<td>83.9</td>
<td>85.1</td>
<td>85.3</td>
<td>81.0</td>
<td>84.9</td>
<td>87.3</td>
<td>80.1</td>
<td>85.0</td>
</tr>
<tr>
<td>Median</td>
<td>89.2</td>
<td>85.0</td>
<td>87.8</td>
<td>86.8</td>
<td>84.1</td>
<td>87.5</td>
<td>89.1</td>
<td>84.7</td>
<td>87.2</td>
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</table>

### Table 8

*Percent of Households with Broadband Internet Subscriptions per County 2018-2021*

<table>
<thead>
<tr>
<th>Year</th>
<th>Fairfield</th>
<th>Hartford</th>
<th>Litchfield</th>
<th>Middlesex</th>
<th>New Haven</th>
<th>New London</th>
<th>Tolland</th>
<th>Windham</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>91.2</td>
<td>88.0</td>
<td>90.0</td>
<td>88.7</td>
<td>86.9</td>
<td>89.8</td>
<td>91.0</td>
<td>87.1</td>
<td>89.3</td>
</tr>
<tr>
<td>2020</td>
<td>89.9</td>
<td>86.1</td>
<td>88.8</td>
<td>87.2</td>
<td>84.9</td>
<td>88.6</td>
<td>89.9</td>
<td>85.7</td>
<td>87.9</td>
</tr>
<tr>
<td>2019</td>
<td>88.5</td>
<td>82.2</td>
<td>86.7</td>
<td>86.4</td>
<td>83.2</td>
<td>86.4</td>
<td>88.2</td>
<td>83.6</td>
<td>86.4</td>
</tr>
<tr>
<td>2018</td>
<td>87.1</td>
<td>83.9</td>
<td>85.1</td>
<td>85.3</td>
<td>81.0</td>
<td>84.9</td>
<td>87.3</td>
<td>80.1</td>
<td>85.0</td>
</tr>
<tr>
<td>Median</td>
<td>89.2</td>
<td>85.0</td>
<td>87.8</td>
<td>86.8</td>
<td>84.1</td>
<td>87.5</td>
<td>89.1</td>
<td>84.7</td>
<td>87.2</td>
</tr>
</tbody>
</table>

### Table 9

*Kindergarten Immunization Rates and SES Variables Correlation Coefficients*

<table>
<thead>
<tr>
<th>County</th>
<th>Foreign Born</th>
<th>Poverty</th>
<th>Unemployment</th>
<th>Some College</th>
<th>Uninsured</th>
<th>Internet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fairfield</td>
<td>.13( .839²)</td>
<td>1.81(1)</td>
<td>.23(.708)</td>
<td>.44(.457)</td>
<td>-.2(0.971)</td>
<td>-.29(.637)</td>
</tr>
<tr>
<td>Hartford</td>
<td>.21(.74)</td>
<td>.06(0.942)</td>
<td>.22(.717)</td>
<td>.1(.873)</td>
<td>.43(.47)</td>
<td>.04(.945)</td>
</tr>
<tr>
<td>Litchfield</td>
<td>-.37(.536)</td>
<td>.59(.299)</td>
<td>.42(.479)</td>
<td>.24(.701)</td>
<td>.04(.947)</td>
<td>.17(.783)</td>
</tr>
<tr>
<td>Middlesex</td>
<td>-.28(.645)</td>
<td>-.34(.57)</td>
<td>.79(.114)</td>
<td>-.89(.04)</td>
<td>-.74(.155)</td>
<td>.02(.978)</td>
</tr>
<tr>
<td>New Haven</td>
<td>-.5(.392)</td>
<td>.45(.447)</td>
<td>.69(.199)</td>
<td>-.36(.55)</td>
<td>.83(.081)</td>
<td>-.22(.722)</td>
</tr>
<tr>
<td>New London</td>
<td>-.53(.361)</td>
<td>.39(.515)</td>
<td>.56(.325)</td>
<td>-.31(.609)</td>
<td>-.35(.558)</td>
<td>-.54(.343)</td>
</tr>
<tr>
<td>Tolland</td>
<td>.13(.836)</td>
<td>-.91(.033)</td>
<td>.85(.071)</td>
<td>.82(.09)</td>
<td>-.37(.544)</td>
<td>-.91(.031)</td>
</tr>
<tr>
<td>Windham</td>
<td>.18(.777)</td>
<td>-.14(.825)</td>
<td>.44(.453)</td>
<td>-.36(.55)</td>
<td>.36(.551)</td>
<td>.34(.576)</td>
</tr>
</tbody>
</table>

1. Correlation Coefficient (Person's R)
2. P-value (<.20 statistically significant)
Figures

Figure 1

*Immunization Line Plots (1-4)*
Figure 2
Immunization Line Plots (5-8)
Figure 3
Fairfield County Scatterplots (9-14)
Figure 4

Hartford County Scatterplots (15-20)

Plot 15: Hartford County
Up-to-Date and Foreign Born

Plot 16: Hartford County
Up-to-Date and Poverty Rate

Plot 17: Hartford County
Up-to-Date and Unemployment Rate

Plot 18: Hartford County
Up-to-Date and Some College

Plot 19: Hartford County
Up-to-Date and No Health Insurance

Plot 20: Hartford County
Up-to-Date and Internet at Home
Figure 5
*Litchfield County Scatterplots (21-26)*

- Plot 21: *Litchfield County Up-to-Date and Foreign Born*
  - Correlation: -0.37 (.636)

- Plot 22: *Litchfield County Up-to-Date and Poverty Rate*
  - Correlation: 0.59 (.289)

- Plot 23: *Litchfield County Up-to-Date and Unemployment Rate*
  - Correlation: -0.42 (.479)

- Plot 24: *Litchfield County Up-to-Date and Some College*
  - Correlation: 0.24 (.701)

- Plot 25: *Litchfield County Up-to-Date and No Health Insurance*
  - Correlation: 0.04 (.947)

- Plot 26: *Litchfield County Up-to-Date and Internet at Home*
  - Correlation: 0.17 (.783)
Figure 6
Middlesex County Scatterplots (27-32)
Figure 7

New Haven County Scatterplots (33-38)

Plot 33: New Haven County
Up-to-Date and Foreign Born

Plot 34: New Haven County
Up-to-Date and Poverty Rate

Plot 35: New Haven County
Up-to-Date and Unemployment Rate

Plot 36: New Haven County
Up-to-Date and Some College

Plot 37: New Haven County
Up-to-Date and No Health Insurance

Plot 38: New Haven County
Up-to-Date and Internet at Home
Figure 8

New London County Scatterplots (39-44)
Figure 9
Tolland County Scatterplots (45-50)

Plot 45: Tolland County
Up-to-Date and Foreign Born

Plot 46: Tolland County
Up-to-Date and Poverty Rate

Plot 47: Tolland County
Up-to-Date and Unemployment Rate

Plot 48: Tolland County
Up-to-Date and Some College

Plot 49: Tolland County
Up-to-Date and No Health Insurance

Plot 50: Tolland County
Up-to-Date and Internet at Home
Figure 10

*Windham County Scatterplots (51-56)*