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# HISPANIC ENVIRONMENTAL AND SOCIO-ECONOMIC ISSUES: COMPARATIVE PERSPECTIVES FROM US STATES AND PUERTO RICO

## Abstract:

Environmental pollution is often observed to cause disproportionate distribution of environmental harm to ethnic and racial minorities, low-income and other disadvantaged social groups. Previous economic studies discovered a relationship between ethnic origin and exposure to harmful environmental toxins that impair human health. However, no such research was conducted comparing US states with large and diverse US Hispanic communities (California, Texas, Florida, Arizona, and New Mexico) and Puerto Rico. Thus, a highly granular set of demographic and economic data was analyzed from the US Census, combined with the latest available healthcare data from the US Center for Disease Control (CDC) and environmental pollution data from the US Environmental Protection Agency (EPA). Independent variables were selected from a variety of environmental pollution factors. The dependent variables were designated as Health Equity outcomes measured by the prevalence of three main illnesses: asthma, diabetes, and coronary heart disease. Pair correlations were then explored to determine the most important determinants of health outcomes and evaluated three study hypotheses. Multivariable linear regression analysis was used to evaluate health equity for several US states with a large Hispanic population. The analysis shows that the Puerto Rico population has been more negatively impacted by environmental and social factors than the majority Hispanic US mainland districts. Across the compared states, California had the worst environmental pressure, Arizona and Puerto Rico the most negative economic status and worst health outcomes. Overall, Florida had the best mix of outcomes for the Hispanic community.

## Keywords:

Environmental health disparities, Hispanics, Race/ethnicity

**JEL Classification:** Q53, Q56

## 1. INTRODUCTION

All people have universal rights, including rights for a safe and healthy environment, although these standards are defined differently across the world. At the most basic ecological level, all people have the right to breathe fresh air, drink clean water, and consume safe and nutritious food. However, these basic environmental rights are far from universally observed, even in the richest countries like the United States (Agyeman et al., 2016; Sayyed et al., 2024; Banzhaf et al., 2019).

Environmental pollution is often observed to cause disproportionate distribution of environmental harm to ethnic and racial minorities, low-income and other disadvantaged social groups. More specific definitions of environmental equity vary widely, depending on the source. Some social organizations take more expansive views of environmental equity, arguing for providing comparable environmental outcomes to the entire population (Konisky et al., 2021). Definitions could vary significantly across different countries of the same geo-region (MacLennan & Perch, 2012). Environmentalism has been a dominant social trend for decades and will become increasingly important as people become more aware of climate change and environmental damage caused by human activities.

Recent research suggested that US residents of lower income and ethnic minorities tend to experience worse health outcomes compared to their wealthier white and Asian peers (Sheriff & Maguire, 2020). Environmental research suggests that this health inequity is caused, in part, by a higher concentration of hazardous facilities and environmental harms in these economically or socially disadvantaged communities (Maguire & Sheriff, 2011).

While the above statements are generally well supported by extensive empirical academic research, interpretation of findings is often not as straightforward as suggested in literature. The main complication is structural: many presumably independent variables (notably race/ethnicity, income, education, and place of residence) are intertwined with high correlations (Banzhaf et al., 2019b). Some of those inter-correlations are intuitive: income and education, income and residence location, income and access to healthy quality foods. In addition, they are well-supported by fundamental US Census data (Shrider & Creamer, 2023) and academic research (Banzhaf et al., 2019a; Sheriff & Maguire, 2020).

The research produced a more complete matrix of environmental outcomes, with important factors outlined in Figure 1. Based on an extensive review of economic literature, 20 factors were identified that could be impacting Environmental Equity outcomes for US ethnic minorities. The dimensional approach for grouping could be done by categories: Economic, Geographic, Ecologic and Social, collectively resulting in Medical (Health Equity) outcomes.

**Table 1. Matrix of Key Determinants for Environmental Equity Outcomes**

| Social | Ecologic | Geographic | Economic | Health Equity Outcomes |
|---|---|---|---|---|
| Demographics | Local Climate | Greenery | Income, % (vs average in the area) | Heart Desease |
| Race / Ethnicity | Proximity to Air Toxins | Traffic Volume | Poverty % (<100% US avg) | Asthma |
| Education | Proximity to Water Toxins | Disadvantaged Neighborhoods | Occupational Environment | Diabetes |

This matrix is significantly more comprehensive than several other conceptual diagrams discussed in prior research (Banzhaf et al., 2019a; Cushing et al., 2015; Gee et al., 2004), that mostly focused on select ecologic and chemical pollution factors. While these factors are certainly important, they do not provide a complete picture of the interactions in the human ecosystem, which encompasses economic, geographic, ecologic and social dimensions, collectively translating into Health Equity outcomes for impacted communities.

The Hispanic population is a logical choice for Environmental fairness research as Hispanics are the second largest US ethnic group and the fastest-growing ethnic cohort in the United States. Note that the term “Hispanic state” in this research paper does not necessarily imply the majority of a given US state population being Hispanic, but instead denotes US states with large percentage of Hispanic population, usually in the range of 22% to 50% of the total.

Previous economic research has discovered links between ethnic background and proximity to toxic environmental factors, which harm human health (Banzhaf S. et al., 2019a; Konisky D. et al., 2021; Sheriff, G., & Maguire, K. 2020). However, no research was conducted comparing Puerto Rico (PR) to other group of large and diverse US mainland Hispanic communities.

Among all US states and territories, Puerto Rico is a unique subject for socio-environmental analysis in several aspects: it is large, ethnically homogeneous (99% Hispanic), completely geographically autonomous, and with a high level of poverty. One of purpose of our research was to compare Puerto Rico with several US states with large Hispanic populations: California (CA), Texas (TX), Florida (FL), Arizona (AZ), and New Mexico (NM).

## 2. METHODOLOGY

### Selection of Independent Variables

After a literature review, a series of independent factors was identified in Table 1, based on population proximity to environmental contamination sources and adverse living conditions.

**Table 1. List of Independent Variables**

| # | Abbrev. | Description of Independent Variables | # | Abbrev. | Independent Variables |
|---|---|---|---|---|---|
| 1 | DPM | Diesel Particles Matter in the air | 4 | NPL | Proximity to Superfund NPL Sites |
| 2 | PM | Fine Particle Matter (PM 2.5) in air | 5 | RPM | Proximity to Risk Mangt Plan Sites |
| 3 | TRAF | Traffic Proximity and Volume | 6 | HW | Proximity of Hazardous Waste Sites |
| | | | 7 | DN | Disadvantaged Neighborhoods |

All pollutant proximity values are expressed in percentiles within the USA: the higher the value, the closer the polluting source to a given tract's population relative to the entire USA dataset. All the above values are shown on the same scale from 0 to 100, with 100 value indicating the closest proximity to a polluting source within the USA. Such homogeneity in expressing different variable greatly facilitates the comparison of the results across very different categories.

The Health Equity Index was compiled to represent the relative frequency of three major diseases: asthma, diagnosed diabetes, and coronary heart disease among those aged 18 and older (percentile), as well as low life expectancy (all values expressed as percentiles within the USA).

Considering all factors, our research definition of Hispanic Health Equity Index (HHE) is expressed in the following equation:

$$HHE_i = \beta_0 + \beta_1 * DPM + \beta_2 * PM + \beta_3 * Traf + \beta_4 * NPL + \beta_5 * RPM + \beta_6 * HW + \beta_7 * DN + \varepsilon_i$$

The HHE Index is the dependent variable is $HHI_i$ = Average of percentiles of Diseases (Asthma, Diabetes and Heart Diseases, equally weighted), $\varepsilon i$ represents the random error in the equation, and β are correlation coefficients for each variable.

## Research Hypotheses

The research hypotheses are summarized below, with consideration of prevailing prior literature.

**Hypothesis 1 (H1).** A greater proportion of the Hispanic population in an area correlates positively with increased proximity to sources of environmental pollution.

**Hypothesis 2 (H2).** A greater proportion of the Hispanic population in a location correlates positively with an increased prevalence of illnesses among the local populace.

**Hypothesis 3 (H3).** A higher prevalence of diseases among the population in a location is positively associated with a closer proximity of environmentally disadvantaged neighborhoods.

This gap in existing literatures leads to the research question: How do environmental and socio-economic factors impact the health of Hispanics in the prevalence of major chronic diseases—specifically asthma, diabetes, and heart disease in US Hispanic states and PR?

## Methods and Data Sources

Traditional econometric analytical methods, including pairwise correlation among several variables, were used along with a comprehensive application of multivariable linear regression. Pair correlation is used to measure the strength and the type (positive or negative) of relationship between independent and dependent variables. Multivariable regression analysis was used to understand the individual contribution of each variable while adjusting for others. This analysis presented a more realistic view of the contribution of each variable in a complex relationship.

The overall dataset was compiled using specific datasets from several comprehensive US Government sources. The most recent highly detailed US Census (2020) provided granular demographic information for 77, 240 Census Tracks (small areas) in the USA and Puerto Rico. The latest healthcare data was sourced from the Center for Disease Control (CDC), while environmental pollution data was sourced from the Environmental Protection Agency (EPA).

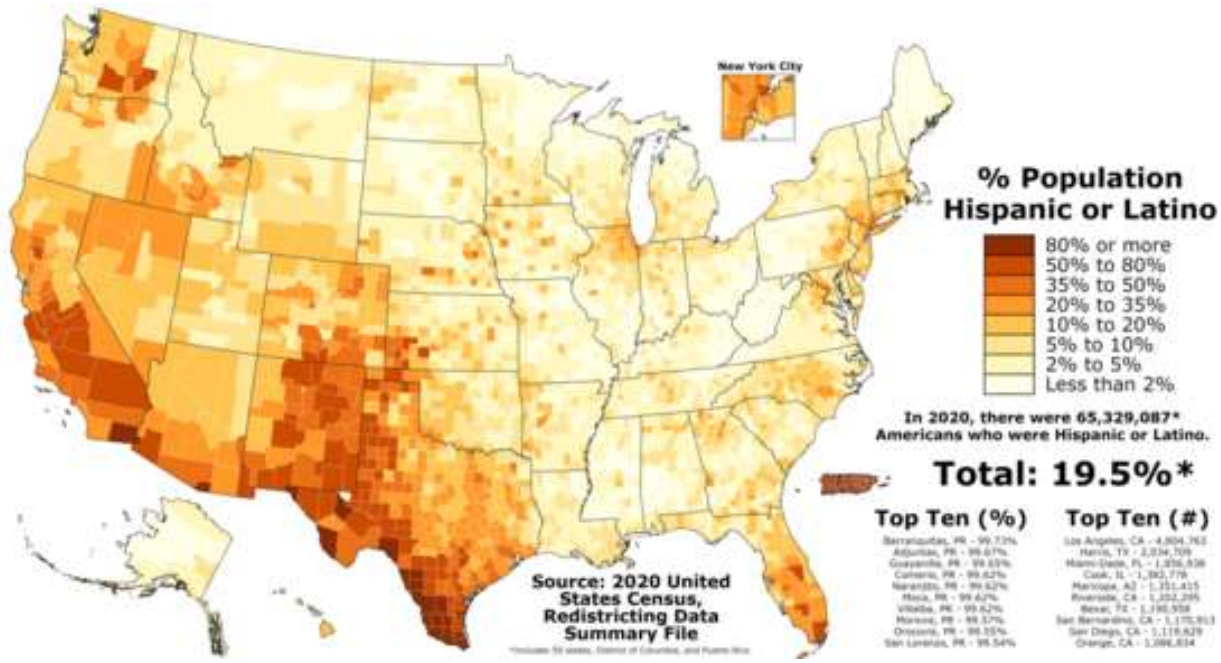
Hispanics account for 19.1% of the overall US population, and the Table 2 shows data on seven selected US states that have higher than US average Hispanics population (from 22% in Colorado to 50% in New Mexico). Puerto Rico is unique due to essentially monolithic Hispanic population of 98.7%, which is higher than percentage of ethnic Hispanics in Spain (85%). Puerto Rico is also very different from all the US states in the median household income, which is only 29% compared to USA average (Table 2). Puerto Rico and the five US states (CA, TX, FL, AZ, and NM) are the primary focus of this research, representing 62% of US Hispanics.

## Table 2. Puerto Rico and US States with Largest Hispanic Population

| States | Hispanic Residents, M | Hispanic % of state Total | Urban | Rural | Rural as % of total state | Median Household Income, $K | Income as %-tile of US Avg |
|---|---|---|---|---|---|---|---|
| Puerto Rico | 3.16 | 98.7% | 98.6% | 99% | 6.4% | 21.5 | 29% |
| New Mexico | 1.05 | 49.9% | 50.5% | 48.3% | 25.5% | 56.4 | 76% |
| Texas | 12.21 | 39.4% | 40.6% | 33.3% | 16.3% | 74.6 | 100% |
| California | 15.13 | 38.9% | 40.1% | 19.1% | 5.8% | 85.3 | 114% |
| Arizona | 2.38 | 31.7% | 32.3% | 26.4% | 10.7% | 73.5 | 99% |
| Nevada | 0.96 | 29.8% | 30.5% | 18.7% | 5.9% | 72.3 | 97% |
| Florida | 5.96 | 25.9% | 26.8% | 16.7% | 8.5% | 65.4 | 88% |
| Colorado | 1.31 | 22.1% | 22.1% | 22.0% | 14.0% | 89.9 | 121% |
| SUM of 7 States + PR | 42.14 | 36.7% | average % in 7 states | | | | |
| USA | 64 | 19.1% | | | 13% | 74.6 | 100% |

Note: 66% of all Hispanics in US live in those 8 states

## Figure 2. Distribution of US Hispanic or Latino Population




*Note.* Source of data for the table and the chart: US Census (2020)

## 3. RESULTS AND DISCUSSION

All research factors are grouped into Economic, Environmental Pollution, and Health Outcomes. The tables are very intensely populated with data; hence results are color-coded for faster visual interpretation of results. Blue symbolizes low prevalence of the variable, while red signifies high.

Table 3 summarizes median values of various outcomes for the top five most Hispanic US states (defined as % of Hispanics in the state's population). It is important to compare the state averages with that of two extremes: a group of tracts with very high (>75%, MAX category) and very low (<10%, MIN category) Hispanic population.

As a group, Hispanics have the following common attributes across all states: negative environmental pressure, negative economic circumstances and mixed outcomes in health (better than average US in asthma, and worse than average in diabetes). More specifically, Hispanic population have the following experiences:

- Higher exposure to air pollution and closer proximity to environmentally hazardous sites.

- Significantly higher prevalence of being unemployed, in poverty, and with incomplete high school education.

- Lower than US average prevalence of asthma, much higher prevalence of diabetes, lower prevalence of heart disease, and comparable to average life expectancy.

Across the compared states, CA had the worst environmental pressure, AZ and Puerto Rico the most negative economic status and worst health outcomes. Overall, Florida had the best mix of outcomes for the Hispanic community.

**Table 3. Summary of Median Values for the Five Most Hispanic US States**

| Percentiles (within US) | | USA | CA | TX | FL | N. Mexico | AZ | Avg of | PR | PR Comparison |
|---|---|---|---|---|---|---|---|---|---|---|
| Hispanic as % of population | | 19% | 39% | 39% | 26% | 50% | 32% | 5 States | 98% | vs. avg 5 states |
| Air Pollution (Diesel PM) | Total | 50 | 65 | 42 | 60 | 24 | 71 | 52 | | |
| | MAX | 76 | 85 | 35 | 92 | 32 | 81 | 65 | 3 | Due to mostly rural |
| | MIN | 35 | 47 | 37 | 47 | 5 | 45 | 36 | | PR is MUCH lower |
| Hazard Waste Sites | Total | 50 | 83 | 36 | 27 | 28 | 55 | 46 | | |
| | MAX | 74 | 92 | 40 | 49 | 24 | 64 | 54 | 38 | PR is lower |
| | MIN | 37 | 76 | 24 | 24 | 14 | 44 | 36 | | (less exposed) |
| Superfund Sites | Total | 50 | 61 | 37 | 54 | 43 | 47 | 48 | | |
| | MAX | 66 | 73 | 56 | 76 | 51 | 55 | 62 | 58 | Similar |
| | MIN | 41 | 55 | 27 | 36 | 31 | 35 | 37 | | |
| Unemployment, % | Total | 50 | 57 | 48 | 52 | 59 | 56 | 54 | | |
| | MAX | 70 | 75 | 65 | 38 | 75 | 76 | 66 | 96 | PR is much higher |
| | MIN | 43 | 40 | 36 | 52 | 68 | 46 | 48 | | |
| Poverty Percentile | Total | 50 | 46 | 56 | 51 | 69 | 54 | 55 | | |
| (Income <100% | MAX | 80 | 76 | 84 | 64 | 85 | 87 | 79 | 97 | Much Higher |
| of US level) | MIN | 43 | 22 | 31 | 43 | 49 | 28 | 35 | | |
| No High School Diploma | Total | 50 | 60 | 66 | 49 | 59 | 47 | 56 | | |
| | MAX | 97 | 98 | 97 | 80 | 87 | 97 | 92 | 86 | Similar |
| | MIN | 39 | 13 | 26 | 36 | 40 | 19 | 27 | | |
| Asthma | Total | 50 | 22 | 24 | 20 | 45 | 60 | 34 | | |
| | MAX | 32 | 35 | 27 | 4 | 59 | 80 | 41 | 73 | Much Higher |
| | MIN | 57 | 7 | 18 | 20 | 43 | 40 | 26 | | |
| Diabetes | Total | 50 | 39 | 67 | 67 | 57 | 39 | 54 | | |
| | MAX | 80 | 69 | 92 | 87 | 84 | 82 | 83 | 87 | Similar |
| | MIN | 51 | 21 | 48 | 69 | 44 | 48 | 46 | | |
| Heart disease | Total | 49 | 25 | 47 | 67 | 49 | 43 | 46 | | |
| | MAX | 41 | 27 | 62 | 53 | 55 | 49 | 49 | 57 | Higher |
| | MIN | 62 | 25 | 47 | 81 | 51 | 73 | 55 | | |
| Low Life Expectancy % | Total | 49 | 30 | 56 | 50 | 48 | 51 | 47 | | |
| | MAX | 54 | 50 | 62 | 18 | 57 | 67 | 51 | 58 | Higher |
| | MIN | 52 | 13 | 42 | 56 | 39 | 30 | 36 | | |

Notes: MAX = Hispanic Majority Tracts (>75%) MIN = Hispanic Minority Tracts (<10%)

Compared to the Hispanic population of the five most Hispanic US states, PR's population has several distinct features: lower environmental pressure, more negative economic situation: much higher unemployment, much higher poverty, and lower prevalence of high school diploma.

After examining pair correlations of various factors, it is appropriate to bring the most meaningful drivers together to explore their respective contributions to Health Equity outcomes.

Linear Model Regression Analysis allows quantification of the impact of six environmental hazards and one socio-economic factors on the three major diseases: asthma, diabetes and coronary artery disease, as shown on Table 4 for TX Hispanics.

Texas is the second largest US state (after California), and it is well ahead of the US averages in its fast population growth and high ethnical diversity. The population growth of Texas is twice the rate of the overall US, and 95% of this faster growth was attributable to growth in minority population, half of which being Hispanic. Therefore, Texas is one of a few so-called "majority-minorities" US states (along with California and Florida), where non-Hispanic whites represent less than half of the total population, while Hispanic population is the second largest ethnic group. Extrapolating the recent long-term US population trends, Texas indicates a future demographic trend for the nation.

**Table 4**. **Linear Model Regression Analysis for Health Equity Among Hispanics in Texas**

| TEXAS | Asthma | | | | Diabetes | | | | Coronary Artery Disease | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Coeff.* | *t Stat* | *P-value* | *P-Signif.* | *Coeff.* | *t Stat* | *P-value* | P-Signif. | *Coeff.* | *t Stat* | *P-value* | *P-Signif.* |
| Intercept | 18.710 | | | | 51.345 | | | | 57.487 | | | |
| Diesel Particles | 1.00 | 4.8551 | 0.0000 | * * * | -2.56 | -12.7802 | 0.0000 | * * * | -1.70 | -7.3175 | 0.0000 | * * * |
| Air Pollution PM 2.5 | -0.15 | -0.9770 | 0.0329 | * * | -1.16 | -7.9952 | 0.0000 | * * * | -1.76 | -10.4743 | 0.0000 | * * * |
| Traffic Volume | -0.88 | -6.2133 | 0.0000 | * * * | -0.50 | -3.6279 | 0.0003 | * * * | -0.99 | -6.1657 | 0.0000 | * * * |
| Superfund (NPL) | -0.38 | -3.0157 | 0.0026 | * * * | 1.25 | 10.2507 | 0.0000 | * * * | 0.32 | 2.2335 | 0.0256 | * * |
| RPM Facilities | 0.15 | 1.2256 | 0.2204 | not signif. | 0.70 | 5.8009 | 0.0000 | * * * | 0.17 | 1.2274 | 0.2197 | not signif. |
| Hazardous Waste | 0.09 | 0.4839 | 0.6285 | not signif. | -0.56 | -2.9694 | 0.0030 | * * * | -1.71 | -7.7919 | 0.0000 | * * |
| Disadvant. Community | 2.74 | 33.223 | 0.0000 | * * * | 5.33 | 66.472 | 0.0000 | * * * | 4.09 | 43.9016 | 0.0000 | * * |

Note that P-values are marked as the following: * p < 0.1, ** p < 0.05, and *** p < 0.01. Diseases were dependent variables

All coefficients are normalized to the "diesel Particles" coefficient, to facilitate the comparison among various independent variables

Proximity to environmental pollution is frequently cited as the leading negative factor in health outcomes, which makes intuitive sense. However, the Texas-derived findings was mixed: Diesel particles' amount (air quality) and proximity to Superfund sites (water contamination) had the greatest impact (closer proximity was positively correlated with higher disease rates), whereas regular hazardous waste sites (RPM) did not show such a correlation, presumably due to more efficient environmental management of those RPM sites.

Proximity to disadvantaged communities was a major significant negative in health outcomes across all diseases. This is a powerful example how environmental factors could disproportionately impact ethnic minorities, which happens often in such situations.

**Table 5. Linear Model Regression for Health Equity Among Hispanics in TX, CA and FL**

| | TEXAS | | | | CALIFORNIA | | | | FLORIDA | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Coeff.* | *t Stat* | *P-value* | *P-Signif.* | *Coeff.* | *t Stat* | *P-value* | P-Signif. | *Coeff.* | *t Stat* | *P-value* | *P-Signif.* |
| Intercept | 42.51 | | | | 43.2014 | | | | 49.4293 | | | |
| Diesel Particles | -1.09 | -6.1906 | 0.0000 | * * * | -0.21 | -1.8081 | 0.0706 | * | -2.64 | -13.5753 | 0.0000 | * * * |
| Air Pollution PM 2.5 | -1.02 | -8.0416 | 0.0000 | * * * | 0.16 | 1.4784 | 0.0139 | * * | -1.87 | -5.1531 | 0.0000 | * * * |
| Traffic Volume | -0.79 | -6.5251 | 0.0000 | * * * | 0.02 | 0.2893 | 0.7724 | not signif. | 0.80 | 5.7908 | 0.0000 | * * * |
| Superfund (NPL) | 0.40 | 3.7043 | 0.0002 | * * * | -0.30 | -3.6668 | 0.0002 | * * * | -0.56 | -4.5392 | 0.0000 | * * * |
| RPM Facilities | 0.34 | 3.2250 | 0.0013 | * * * | 0.83 | 10.3415 | 0.0000 | * * * | 1.19 | 9.5384 | 0.0000 | * * * |
| Hazardous Waste | -0.73 | -4.3774 | 0.0000 | * * * | -3.18 | -27.4807 | 0.0000 | * * * | 0.03 | 0.1445 | 0.8851 | not signif. |
| Disadvant. Community | 4.05 | 57.6069 | 0.0000 | * * * | 3.15 | 57.8224 | 0.0000 | * * * | 3.62 | 42.7568 | 0.0000 | * * * |

Dependent variable is Health Equity Index = Equally weighted 3 diseases (Asthma, Diabetes and Coronary Disease)

Note that P-values are marked as the following: * p < 0.1, ** p < 0.05, and *** p < 0.01.

To get a more comprehensive picture, Table 5 compares TX, CA and FL, the three states with largest Hispanic population. The comparison confirmed results observed TX results, with few notable differences:

- CA residents had more pronounced impact from air pollution, given much higher population density in its major metropolitan areas in Northern and South California.
- TX had largest impact from Superfund sites, which is expected based on very high concentration of chemical and processing industries in TX
- FL has relatively low concentration of hazardous waste sites, as manufacturing industries are much less prevalent in FL compared to other large states.

## Limitations

This project used the classic US government Census definition of Hispanics and Latinos as people who share a common language and, in some degree, a common culture. As a result, Hispanics in the US states and Puerto Rico were analyzed as if they were the same monolithic ethnic group. This is a significant oversimplification, resulting in more generalized research findings. It would be essential to examine different US Hispanics sub-groups of various regional origin to account for their diverse backgrounds (most relevant for recent immigrants and their first-generation children). Descendants from Mexico, Central and South America, Cuba, and the Caribbean have vastly different recent histories, including varying levels and quality of education, prior diet, health care, etc and hence different predispositions to chronic diseases. All of these previous factors could cause fluctuations in health and diseases that were not caused by the more recent US environment.

## 4. CONCLUSIONS

The Hispanic community is a large and rapidly growing US ethnic group, so understanding its position in terms of environmental fairness is becoming increasingly important. This paper uncovered a few important observations in environmental, health and economic aspects for the Hispanic community:

**Hypothesis 1 (H1) was confirmed.** A higher Hispanic Population percentage in a county is positively associated with a higher value of proximity (closer) to most environmental pollution sources with very high degree of statistical significance ***p<0.001.

**Hypothesis 2 (H2) was partially confirmed.** A higher Hispanic population percentage in a county is positively associated with disease prevalence (with the exception of asthma, which has low prevalence in general within Hispanic community).

**Hypothesis 3 (H3) was confirmed.** A higher prevalence of diseases among the population in a tract is positively associated with proximity to environmentally disadvantaged neighborhoods.

## LIST OF ABBREVIATIONS:

| | |
|---|---|
| AZ | Arizona (a US state) |
| CA | California (a US state) |
| CDC | US Center of Disease Control, a US Federal Government Agency |
| Census | US Census, the main US Federal Agency in charge of demographic statistics |
| DOT | US Department of Transportation |
| EPA | US Environmental Protection Agency |
| FL | Florida (a US state) |
| NM | New Mexico (a US state) |
| NPL | Superfund National Priorities List (NPL) sites are the most serious hazardous waste sites in the USA that pose a significant risk to human health or the environment |
| PR | Puerto Rico (a US territory) |
| TX | Texas (a US state) |

## CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

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