

Geographic Variations of Racial Disparities of Cervical Cancer Late-stage Diagnosis in Texas



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Introduction

Cervical cancer is the third most common cancer among women in the United States. Although overall cervical cancer late-stage diagnosis and mortality rates have decreased due to the wide use of Pap smear test as a screening method, disparities still exist among different population groups. Racial disparities exist between minority groups and whites in cervical cancer late-stage diagnosis. Few studies have examined how racial disparities in cervical cancer late-stage diagnosis vary spatially. It has become one of the overarching themes of the American Cancer Society (ACS)'s 2015 goal to eliminate disparities in the cancer burden among different segments of the US population (ACS 2010).

Objectives and Research Questions

This study aims to investigate geographic patterns of racial disparities in cervical cancer late-stage diagnosis in Texas. Meanwhile, it will determine how SES, insurance, socio-demographic factor, socio-environmental factor, and spatial access to health care contribute to the disparities. The research aims to address the following questions:

1. Does racial disparity of cervical cancer late-stage diagnosis vary spatially in Texas?
2. How do SES, socio-demographic factor, socio-environmental factor, insurance, and spatial access to cervical cancer preventive service impact the geographic pattern of racial disparity?

Methods

1. Spatial access to health care: The enhanced two-step floating catchment area method (E2SFCA) (Luo and Qi 2009)

$$R_j = \frac{S_j}{\sum_{k \in \{d_{kj} \in D_t\}} P_k W_t}$$

R_j represents the supply-to-demand ratio at location j . P_k represents the population size site k in service area j . S_j is the health care capacity of location j , d_{kj} is the travel cost between j and k , D_t is the t th travel time zone, and W_t represents the impedance weight for the t th travel time zone based on the Gaussian function. A_i^F is the spatial access to supply of the population location i .



Figure 1. Study area: Texas

Data Sources

| Dataset | Source | Variables | Year of data |
|--------------------------------------|--|--|--------------|
| Cervical cancer incidence data | Texas Cancer Registry (TCR), Texas Department of State Health Services (TDSHS) | Race/ethnicity Residential address Age at diagnosis Stage at diagnosis etc. | 1995-2008 |
| Cervical cancer medical service data | TDSHS | Primary care physicians (PCPs) | 2000 |
| Health insurance data | Simplymap by Geographic Research Inc | Average household health insurance expenditure etc. | 2000 |
| Demographic data | Census 2000 | Poverty rate Unemployment rate of females % females without college education etc. | 2000 |

2. Racial disparities

Rate Difference (RD) and Rate Ratio (RR) (Lachin 2000)

$$RD(a_i) = \frac{|r_1(a_i) - r_2(a_i)|}{\sqrt{\bar{r}_i(1 - \bar{r}_i)} \left[\frac{1}{p_1(a_i)} + \frac{1}{p_2(a_i)} \right]}$$

$$RR(a_i) = \frac{\log \left(\frac{r_1(a_i)}{r_2(a_i)} \right)}{\sqrt{\frac{(1 - r_1(a_i))}{p_1(a_i)r_1(a_i)} + \frac{(1 - r_2(a_i))}{p_2(a_i)r_2(a_i)}}}$$

3. Disparities by multiple factors
Multivariate Logistic Regression

Results

1. Spatial access to primary care physicians (PCPs)

Figure 2 shows the geographic pattern of spatial access to PCPs. There is unequal distributed spatial access to PCPs in Texas. Urban areas have higher spatial access to PCPs due to the concentrated distribution of PCPs in urban areas. Part of western and southern Texas has lower spatial access to PCPs as shown in Figure 2.

2. Geographic variations of racial disparities of cervical cancer late-stage diagnosis

Figure 3 displays geographic variations of African-American cervical cancer late-stage diagnosis. Figure 4 displays geographic variations of Hispanic cervical cancer late-stage diagnosis.

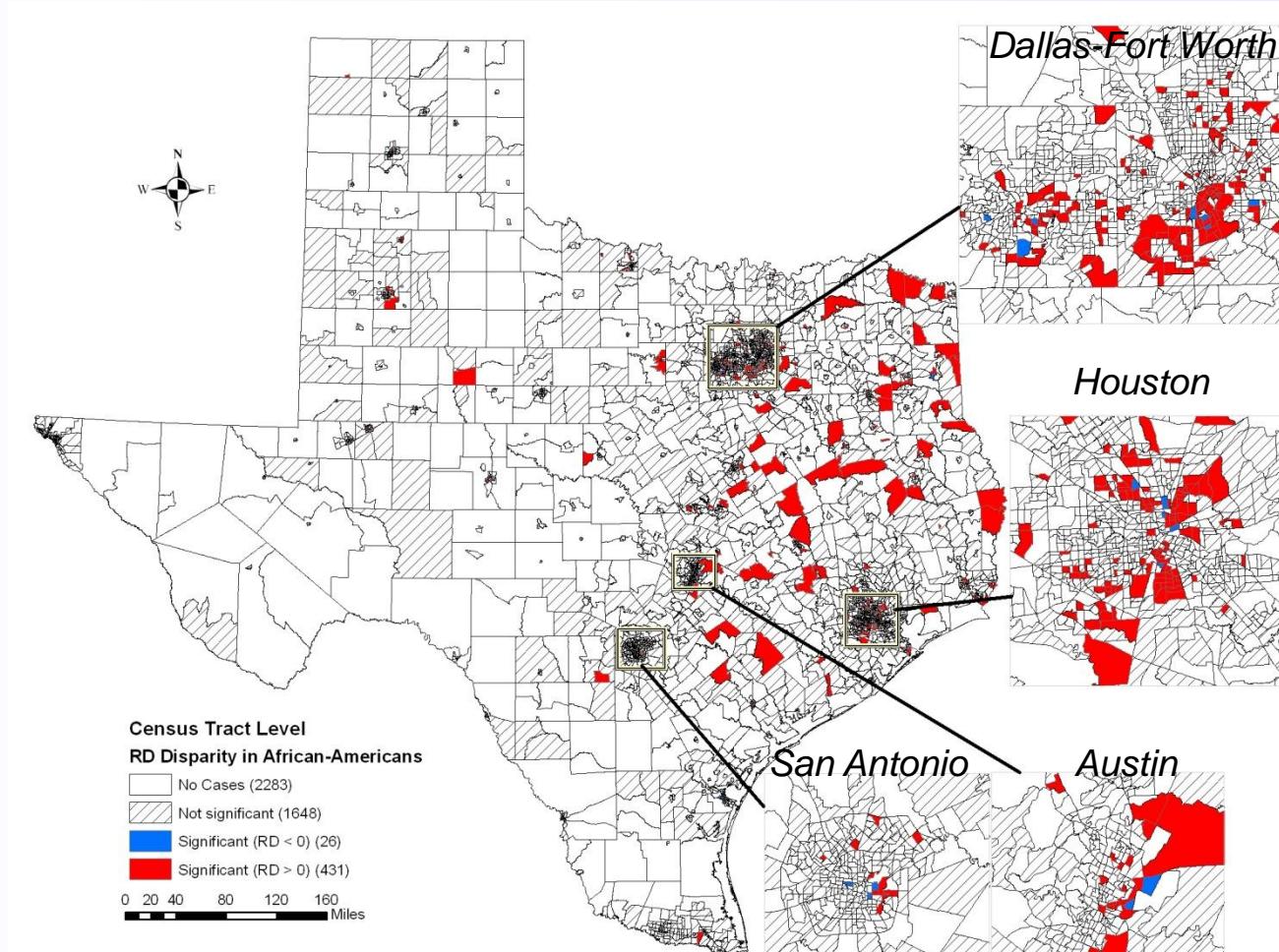


Figure 3. African-American cervical cancer late-stage diagnosis according to the Rate Difference (RD) statistics

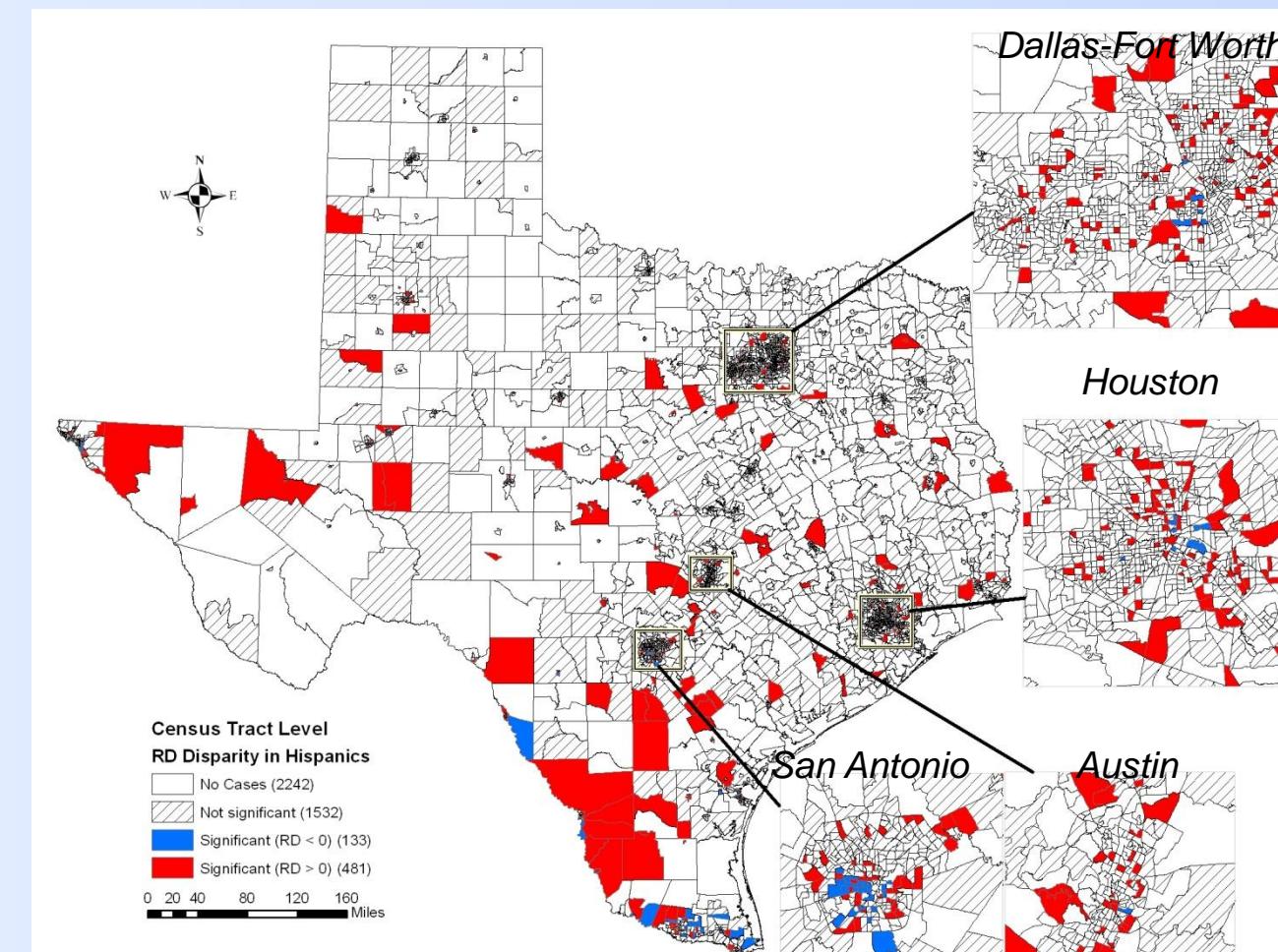


Figure 4. Hispanic cervical cancer late-stage diagnosis according to the Rate Difference (RD) statistics

3. Multivariate Logistic Regression results

Table 1 and 2 reveal odds ratio of cervical cancer late-stage diagnosis for African-Americans and Hispanics with the dependent variable of racial disparity and independent variable of SES, spatial access to primary care physicians, socio-demographic factor, socio-environmental factor, and Insurance.

Table 1. African Americans

| | Odds ratio of Model I (95% CI) | Odds ratio of Model II (95% CI) |
|---|--------------------------------|---------------------------------|
| SES | 1 | 1 |
| Q1 (High) | 1.33 (0.9 - 1.97)* | 1.04 (0.65 - 1.66) |
| Q2 | 2.42 (1.7 - 3.45)* | 1.19 (0.76 - 1.87) |
| Q3 | 2.27 (1.59 - 3.24)* | 1.03 (0.65 - 1.61) |
| Q4 (Low) | | |
| Spatial access to primary care physicians | | |
| Q1 (High access) | 1 | 1 |
| Q2 | 0.95 (0.73 - 1.24) | 1.17 (0.85 - 1.6) |
| Q3 | 0.47 (0.35 - 0.64) | 0.8 (0.56 - 1.13) |
| Q4 (Low access) | 0.34 (0.24 - 0.47) | 0.73 (0.48 - 1.11) |
| Socio-demographic factor | | |
| Q1 (High) | 1 | 1 |
| Q2 | 0.26 (0.2 - 0.36) | 0.35 (0.25 - 0.49) |
| Q3 | 0.28 (0.21 - 0.37) | 0.34 (0.24 - 0.49) |
| Q4 (Low) | 0.23 (0.17 - 0.32) | 0.24 (0.16 - 0.36) |
| Socio-environmental factor | | |
| Q1 (High) | 1 | 1 |
| Q2 | 1.33 (0.85 - 2.1) | 1.25 (0.78 - 2) |
| Q3 | 3.14 (2.09 - 4.71)* | 2.56 (1.64 - 4)* |
| Q4 (Low) | 10.7 (7.3 - 15.68)* | 4.93 (3.05 - 7.97)* |
| Insurance expenditure | | |
| Q1 (High) | 1 | 1 |
| Q2 | 2.21 (1.15 - 4.25)* | 2.47 (1.26 - 4.86)* |
| Q3 | 3.82 (2.09 - 7.08)* | 3.19 (1.63 - 6.24)* |
| Q4 (Low) | 18.69 (10.43 - 33.49)* | 5.71 (2.87 - 11.38)* |

Table 2. Hispanics

| | Odds ratio of Model I (95% CI) | Odds ratio of Model II (95% CI) |
|---|--------------------------------|---------------------------------|
| SES | 1 | 1 |
| Q1 (High) | 0.76 (0.54 - 1.08) | 1 (0.68 - 1.49) |
| Q2 | 1.12 (0.82 - 1.54) | 1.27 (0.87 - 1.84) |
| Q3 | 1.76 (1.31 - 2.36)* | 1.59 (1.11 - 2.28)* |
| Q4 (Low) | | |
| Spatial access to primary care physicians | | |
| Q1 (High access) | 1 | 1 |
| Q2 | 0.97 (0.73 - 1.28) | 1.02 (0.76 - 1.37) |
| Q3 | 0.87 (0.66 - 1.15) | 0.94 (0.7 - 1.27) |
| Q4 (Low access) | 0.62 (0.46 - 0.84) | 0.88 (0.6 - 1.2) |
| Socio-demographic factor | | |
| Q1 (High) | 1 | 1 |
| Q2 | 1.55 (1.1 - 2.18)* | 1.51 (1.06 - 2.16)* |
| Q3 | 1.85 (1.33 - 2.58)* | 1.69 (1.16 - 2.45)* |
| Q4 (Low) | 2.52 (1.82 - 3.51)* | 2.06 (1.39 - 3.05)* |
| Socio-environmental factor | | |
| Q1 (High) | 1 | 1 |
| Q2 | 1.07 (0.82 - 1.4) | 1 (0.76 - 1.34) |
| Q3 | 0.97 (0.73 - 1.29) | 0.92 (0.67 - 1.27) |
| Q4 (Low) | 1.25 (0.93 - 1.69) | 1.17 (0.8 - 1.7) |
| Insurance expenditure | | |
| Q1 (High) | 1 | 1 |
| Q2 | 1.81 (1.27 - 2.59)* | 1.41 (0.96 - 2.06) |
| Q3 | 1.46 (1.02 - 2.1)* | 1 (0.66 - 1.5) |
| Q4 (Low) | 1.84 (1.27 - 2.67)* | 1.21 (0.76 - 1.93) |

*p<0.005
Model I is unadjusted Odds ratio. Model II is adjusted for all factors.

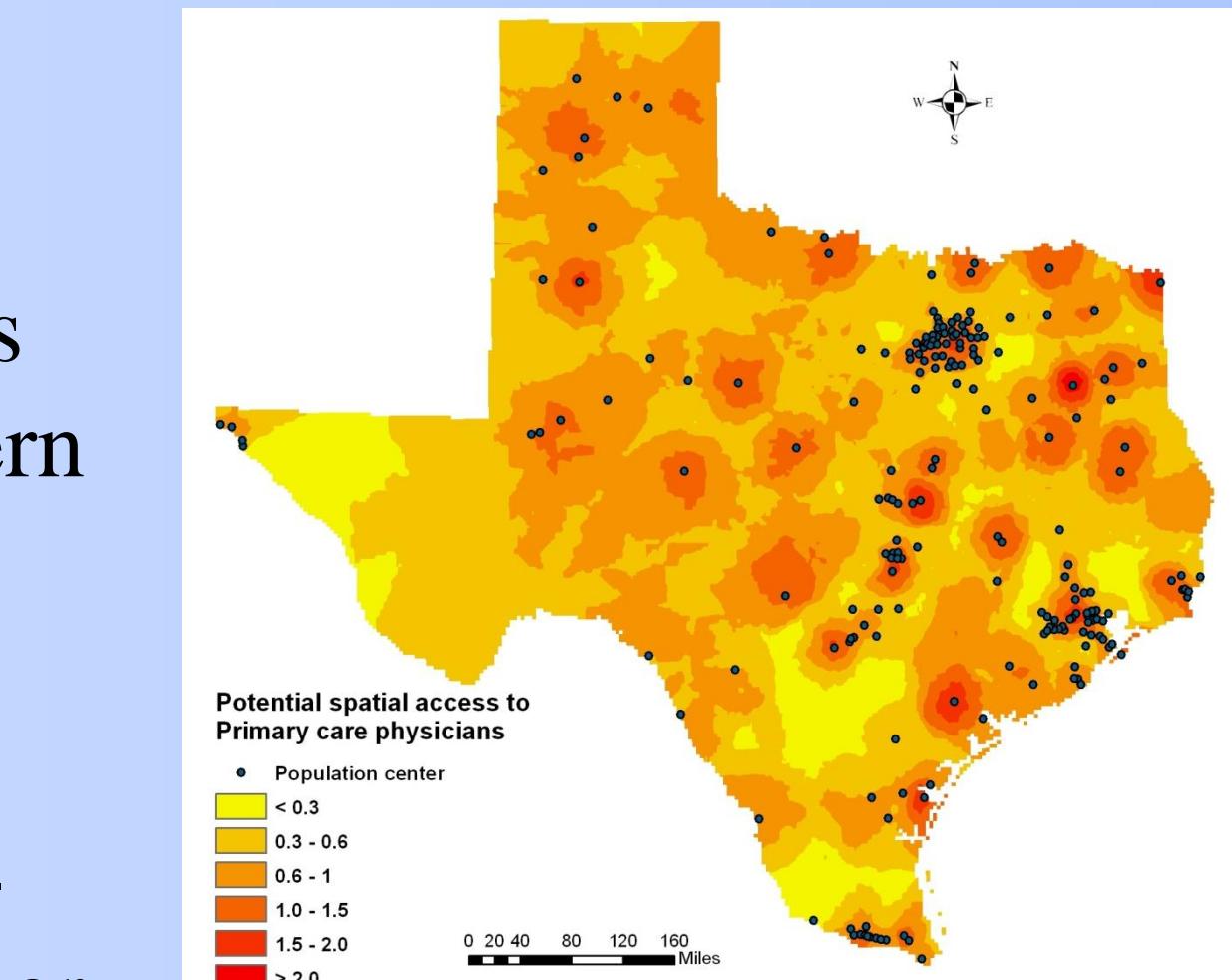


Figure 2. Spatial access to PCPs in Texas

According to the result of rate difference (RD) statistic shown in figure 3, 431 out of 4388 census tracts have exhibited statistically significant higher late-stage diagnosis rate in African-Americans. They are observed in metropolitan areas of Dallas-Fort Worth, Austin-San Antonio, and Houston. Several census tracts in eastern Texas are identified with higher late-stage diagnosis rate in African-Americans as well. Figure 4 identifies 481 census tracts with statistically significant higher late-stage diagnosis rate in Hispanics. The significant census tracts were found in metropolitan areas of Dallas-Fort Worth, Austin-San Antonio, and Houston. Southwest US-Mexico border areas exhibited higher rate in Hispanics as well.

Conclusions

1. Racial disparities in cervical cancer late-stage diagnosis vary across space in Texas.
2. SES, socio-environment factor, and insurance explained the geographic variation in racial disparities between African-Americans and non-Hispanic whites.
3. SES, socio-demographic factor, and insurance explained the geographic variation in racial disparities between Hispanics and non-Hispanic whites.

References

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Luo, W., and Y. Qi. 2009. An enhanced two-step floating catchment area (E2SFCA) method for measuring spatial accessibility to primary care physicians. *Health & Place*, 15(4), 1100-1107.
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