Geographic Disparities in Chronic Kidney Disease Hospitalizations: Exploring Associations with Neighborhood Socioeconomics Status in Texas

EPH125

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INTRODUCTION

- Chronic Kidney Disease (CKD) is a prevalent chronic condition characterized by the progressive and irreversible deterioration of kidney function. CKD patients are at a higher risk of hospitalization.
- It is known that neighborhood socioeconomic status (SES) has profound impact on population health. However, evidence on the impact of neighborhood SES on hospitalizations among those with CKD is scarce.

OBJECTIVE

This study aims to evaluate the geographic variation of hospitalizations with a CKD diagnosis in Texas and identify the associations with county-level SES.

METHODS

- A cross-sectional analysis was conducted using 2021 Texas Inpatient Public Use Data, which includes statewide discharge information from Texas hospitals.
- Hospitalizations with a CKD diagnosis at any position (CKD-Hosp) were identified.
- Heatmaps were created for the number of CKD-Hosp by county and for CKD-Hosp rates and normalized by the county population.
- Hospital discharge data were supplemented with county-level socioeconomic status (SES) index constructed using data from the American Community Survey. The SES measure are listed in Table 1. The formula to calculate SES index is listed in Table 2. The county-level SES index scores were then divided into quartiles for all Texas counties (except for 2 out of 254 counties that do not have a SES score).

Table 1. Neighborhood Socioeconomic Status (SES) individual variable definitions*

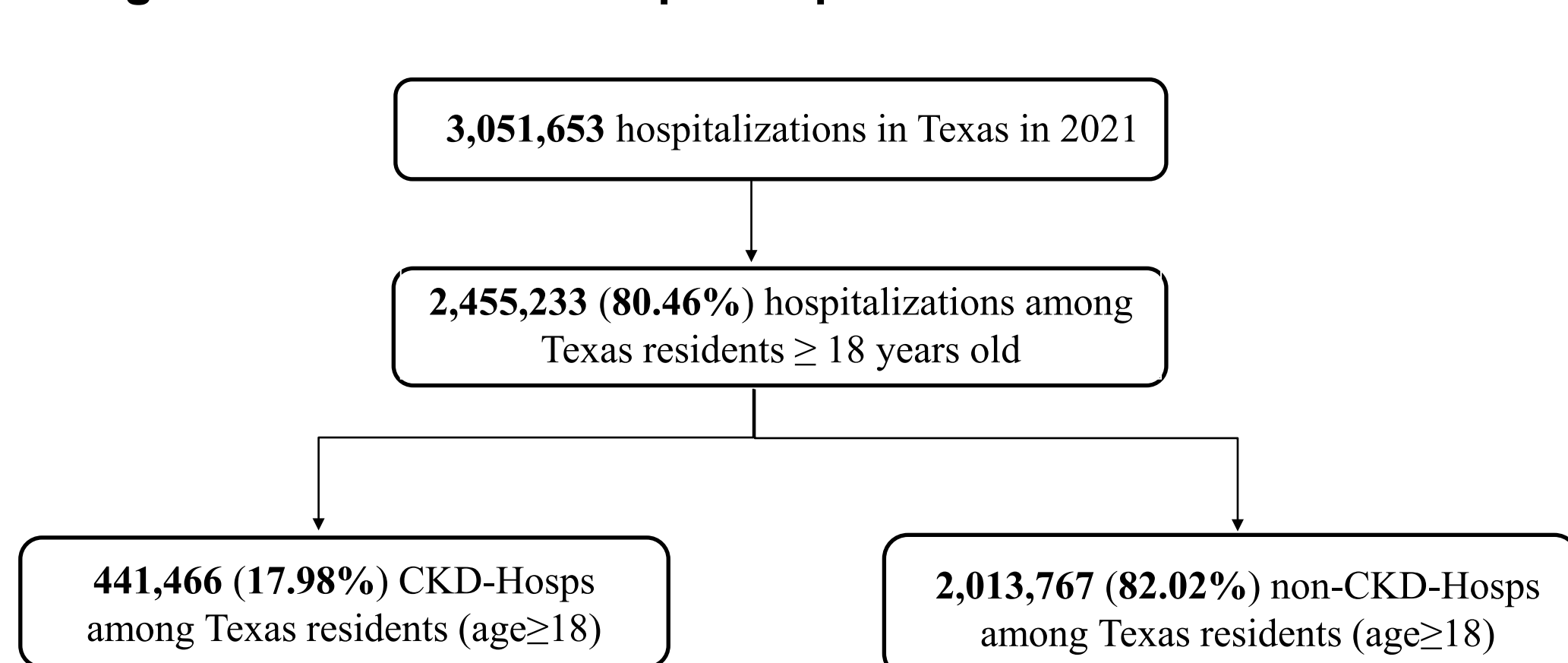| SES Measure	Definition
Income score	Median household income, standardized to range from 0 to 100
Property value score	Median value of owner-occupied property values, standardized to range from 0 to 100
Below federal poverty line (%)	Percentage of persons below the federally defined poverty line
Unemployed (%)	Percentage of persons aged 16 years or older in the labor force who are unemployed (and actively seeking work)
College graduate (%)	Percentage of persons aged > 25 years with at least 4 years of college
Education below 12th grade (%)	Percentage of persons aged > 25 years with less than a 12th-grade education
Crowded household (%)	Percentage of households containing one or more person per room

*Data was collected from American Community Survey 2021 5-year data.

Table 2. SES Index calculating formula

SES Index	$50 + (0.11 \times$ median household income score$) + (-0.10 \times$ % below federal poverty line$) + (-0.08 \times$ %unemployed$) + (0.10 \times$ % college graduates$) + (-0.11 \times$ % education below 12th grade$) + (0.08 \times$ median property value score$) + (-0.07 \times$ % crowded households$)$

RESULTS

Figure 1. 2021 Texas Hospital Inpatient Encounter Attrition Chart

3,051,653 hospitalizations in Texas in 2021

2,455,233 (80.46%) hospitalizations among Texas residents ≥ 18 years old

441,466 (17.98%) CKD-Hosps among Texas residents (age≥18)

2,013,767 (82.02%) non-CKD-Hosps among Texas residents (age≥18)

RESULTS

Figure 2. Heatmap of CKD-Hosp encounters by county in Texas in 2021

Number of CKD Hospitalizations

CKD Hospitalizations
- (50000,71577] (1)
- (10000,50000] (9)
- (5000,10000] (7)
- (1000,5000] (43)
- (500,1000] (38)
- (250,500] (46)
- (100,250] (40)
- (50,100] (34)
- [0,50] (36)

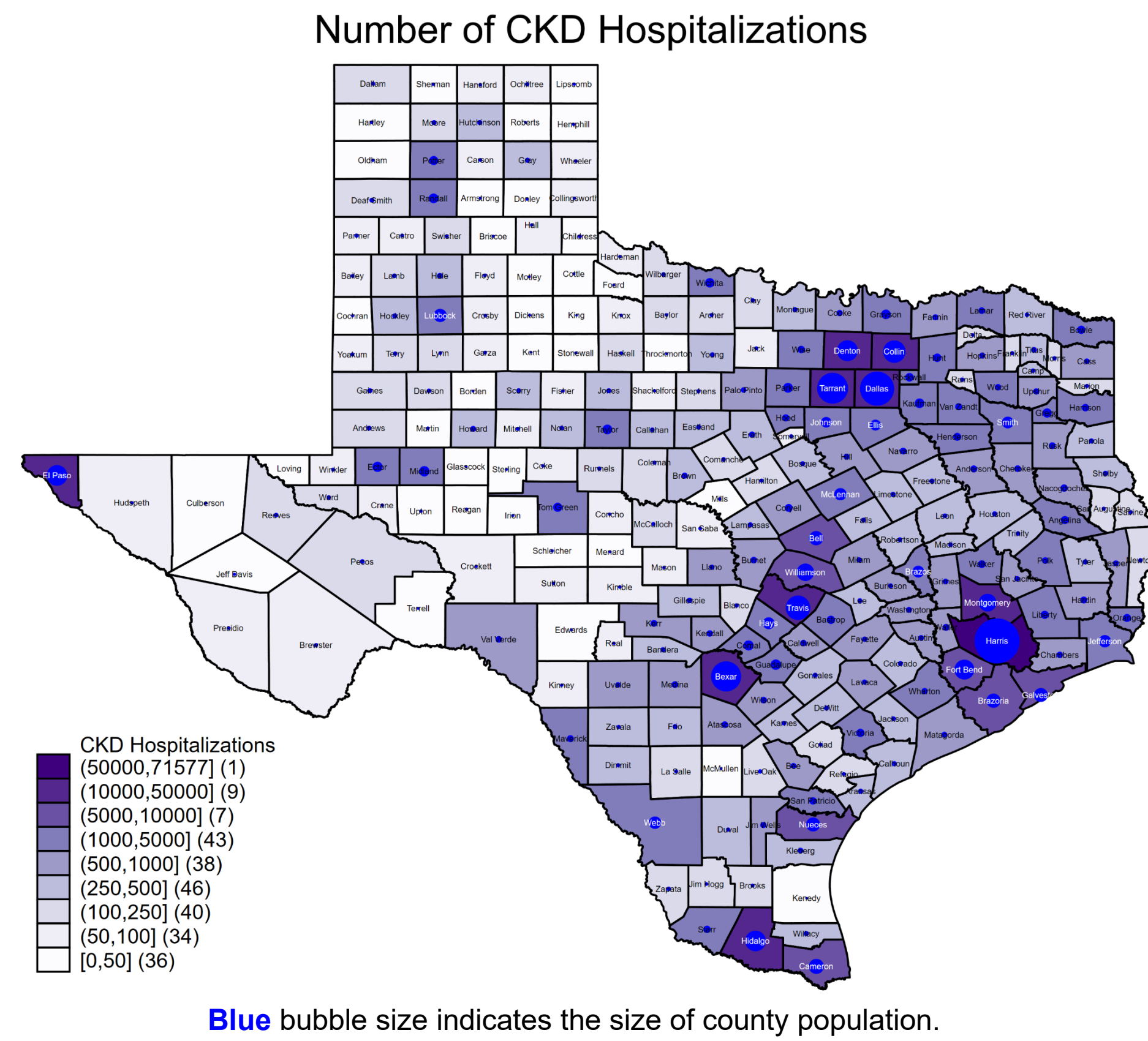**Blue** bubble size indicates the size of county population.

Figure 3. Heatmap of CKD-Hosp rates (as a percentage of county population) in Texas in 2021

CKD hospitalization rates

Quartiles: %CKD
- (2.04,3.26] (61)
- (1.66,2.04] (65)
- (1.31,1.66] (65)
- [0,1.31] (65)
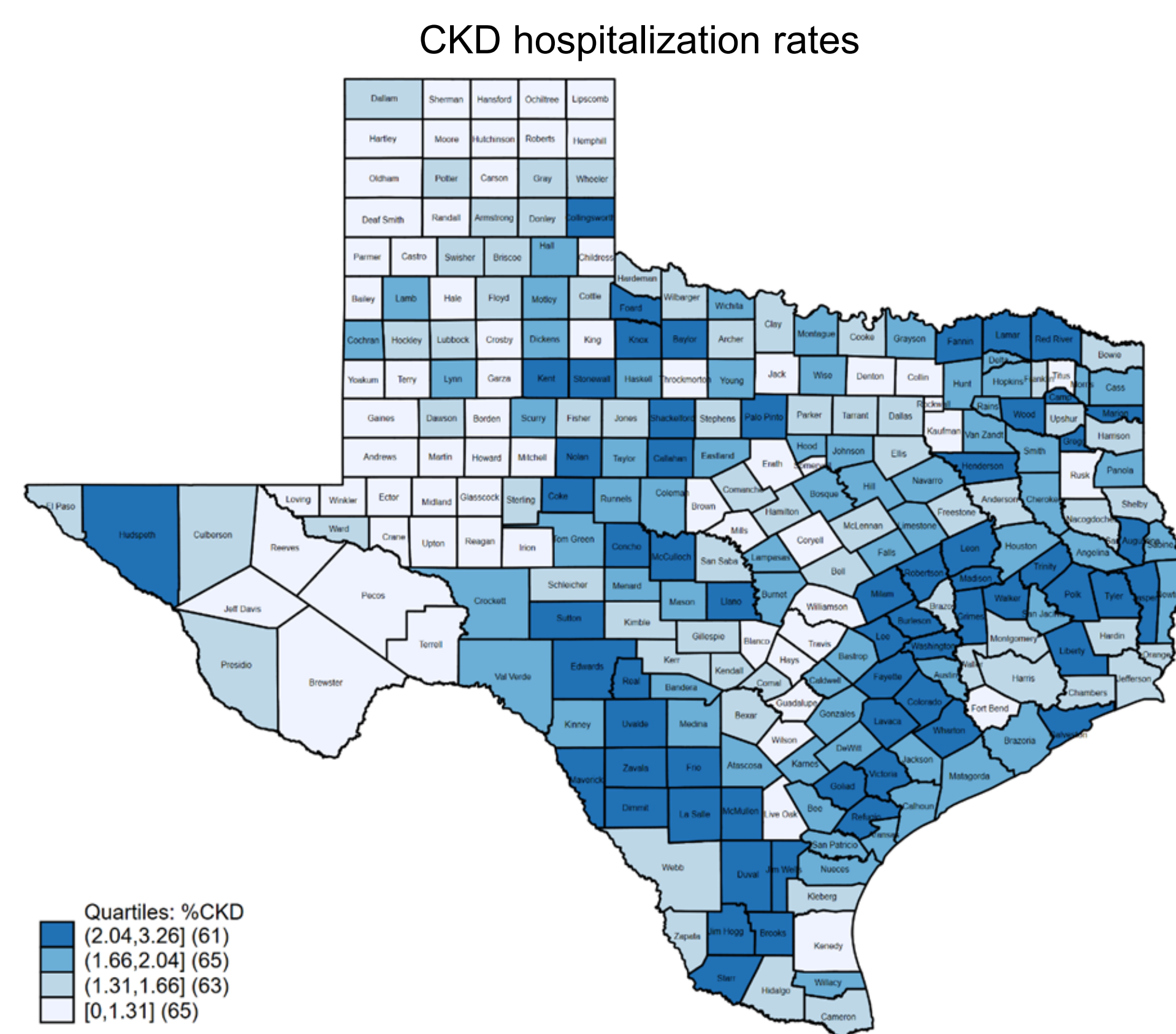
Figure 4. County-level SES Index Score distribution in Texas 2017-2021 (by quartile)

SES Index Score

Quartiles: SES
- (57.93697,71.90508] (63)
- (54.89504,57.93697] (63)
- (52.69167,54.89504] (63)
- [43.24582,52.69167] (63)
- No data (2)
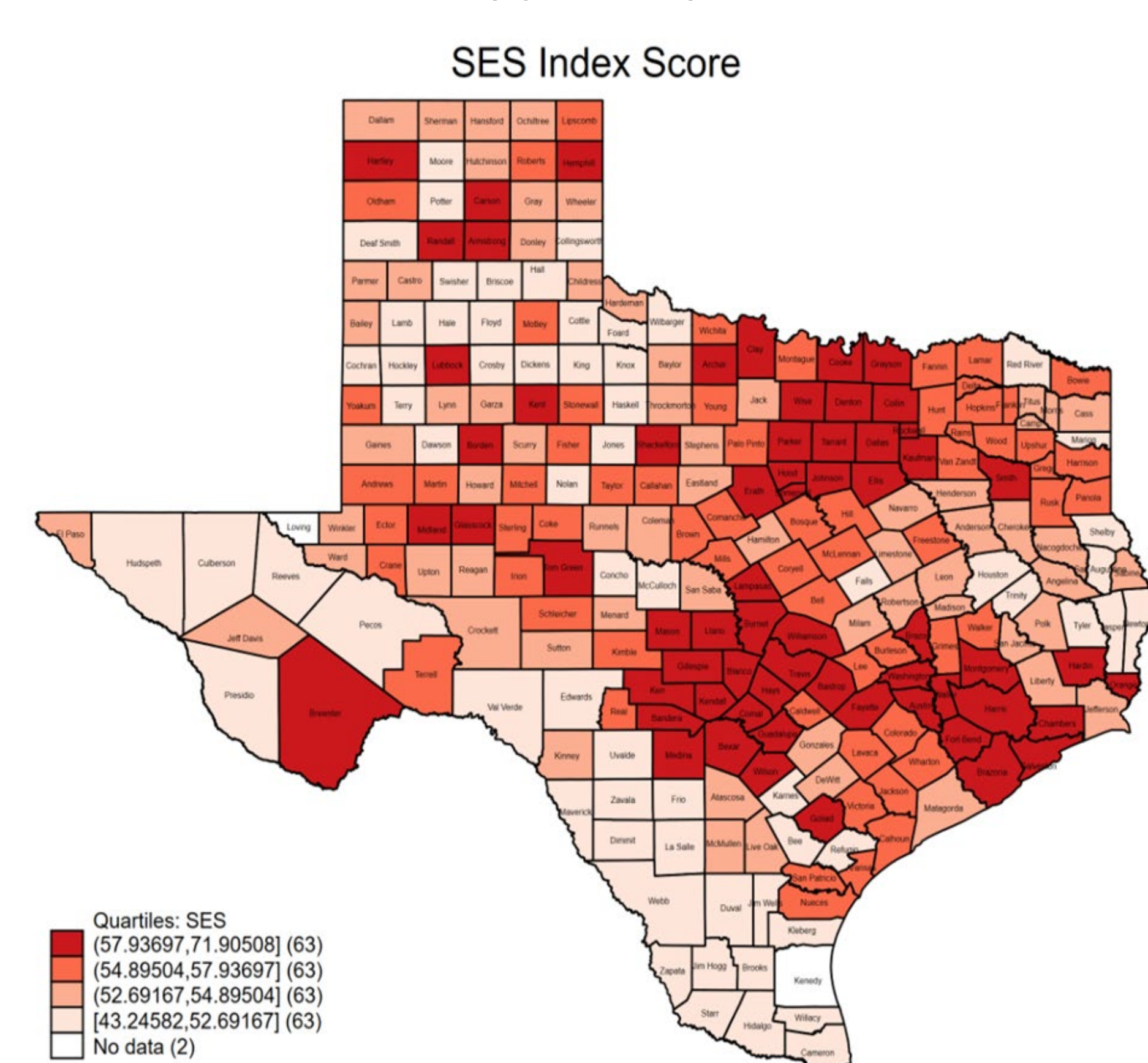
RESULTS

Figure 5. Box plot of CKD-Hosp rates by SES index score quartiles*
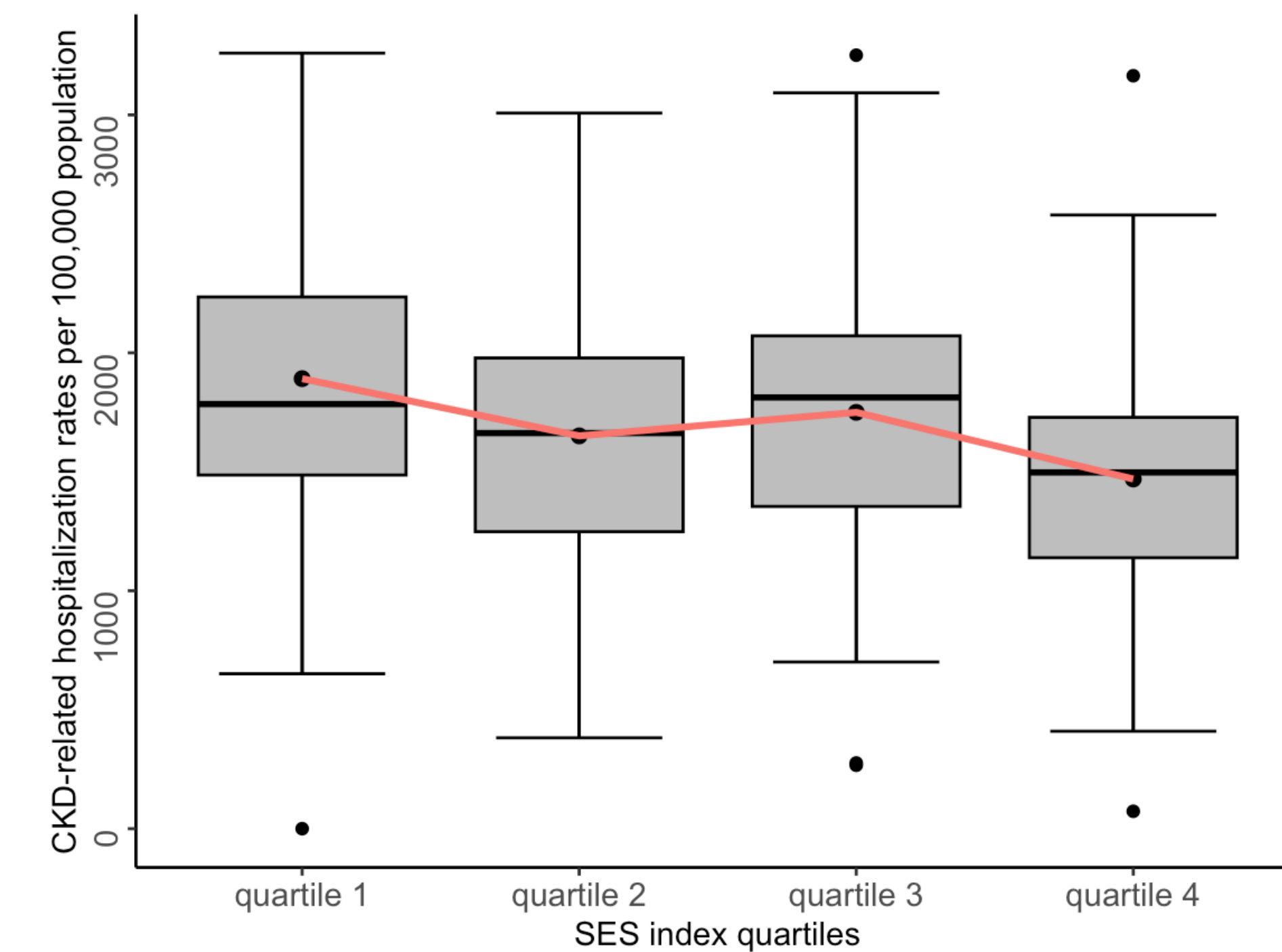
* Quartile 4 correspond to the top 25 percentile counties in terms of SES index scores. The means or CKD-Hosp rates for each quartile are labeled with black dots connected by the orange line.

Table 3. Ordinary Least Square (OLS) regression analysis of CKD-Hosp rates (per 100,000 population) by SES index quartiles

CKD-Hosp rates (per 100,000 population)	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
ref: SES quartile1						
SES quartile 2	-240.44	105.05	-2.29	0.023	-447.35	-33.55
SES quartile 3	-141.58	105.05	-1.35	0.179	-348.48	65.31
SES quartile 4	-421.81	105.05	-4.02	0.000	-628.70	-214.91
cons	1891.37	74.28	25.46	0.000	1745.07	2037.67

Table 4. Socio-demographic characteristics of inpatient encounters by county SES quartiles*

# of encounters	SES quartile 1 counties N=42,237	SES quartile 2 counties N=36,878	SES quartile 3 counties N=54,611	SES quartile 4 counties N=300,223
Age				
18-44	3,242 (8%)	2,298 (6%)	3,477 (6%)	22,899 (8%)
45-64	12,828 (30%)	10,397 (28%)	15,200 (28%)	88,161 (29%)
65-74	11,013 (26%)	10,195 (28%)	15,212 (28%)	80,012 (27%)
75+	15,154 (36%)	13,988 (38%)	20,722 (38%)	109,151 (36%)
Sex				
female	19,069 (45%)	16,328 (44%)	24,286 (44%)	132,749 (44%)
male	21,133 (50%)	18,829 (51%)	27,621 (51%)	149,231 (50%)
unknown	2,035 (5%)	1,721 (5%)	2,704 (5%)	18,243 (6%)
Race Group				
American Indian/Eskimo/Aleut	59 (0%)	37 (0%)	92 (0%)	572 (0%)
Asian or Pacific Islander	100 (0%)	122 (0%)	334 (1%)	6,793 (2%)
Black	1,468 (3%)	5,202 (14%)	8,881 (16%)	72,054 (24%)
Other	5,973 (14%)	3,361 (9%)	3,861 (7%)	38,162 (13%)
White	34,637 (82%)	28,156 (76%)	41,443 (76%)	182,638 (61%)
unknown	0 (0%)	0 (0%)	0 (0%)	4 (0%)
Ethnicity Group				
Hispanic Origin	27,604 (65%)	12,596 (34%)	10,114 (19%)	61,390 (20%)
Not of Hispanic Origin	14,492 (34%)	24,088 (65%)	44,241 (81%)	238,076 (79%)
unknown	141 (0%)	194 (1%)	256 (0%)	757 (0%)
Insurance Coverage				
medicaid	2,796 (7%)	1,752 (5%)	2,679 (5%)	18,395 (6%)
medicare	17,806 (42%)	17,124 (46%)	30,581 (56%)	140,912 (47%)
other	1,718 (4%)	626 (2%)	1,512 (3%)	3,935 (1%)
private	17,493 (41%)	15,391 (42%)	17,156 (31%)	117,025 (39%)
uninsured	2,141 (5%)	1,744 (5%)	2,529 (5%)	19,052 (6%)
unknown	283 (1%)	241 (1%)	154 (0%)	904 (0%)
Rurality				
rural	15,618 (37%)	18,144 (49%)	17,172 (31%)	5,211 (2%)
urban	26,619 (63%)	18,734 (51%)	37,439 (69%)	295,012 (98%)

*The SES quartiles were defined based on SES scores by counties, not based on encounters.

Table 5. GLM* regression model to assess the associations between county-level SES status and the LOS of CKD-Hosps

Length of Stay (LOS)	Delta-method diff (days)	Std. Err.	z	P>|z|	[95% Conf. Interval]	
ref: SES quartile 1						
SES quartile 2	-0.24	0.064	-3.52	0.000	-0.35	-0.10
SES quartile 3	-0.54	0.060	-8.96	0.000	-0.65	-0.42
SES quartile 4	-0.42	0.055	-7.57	0.000	-0.52	-0.31

*General linear model (log link function with gamma distribution) were applied. The model controlled for covariates including CKD stages, discharge quarter, age, sex, race, ethnicity, insurance types, rurality and comorbidities.

RESULTS

Table 6. SES index and individual scores stratified by high/low percentage of CKD-Hosp rates

	Low CKD-hosp rates* Mean	Low CKD-hosp rates* [95% Conf. Interval]	High CKD-hosp rates* Mean	High CKD-hosp rates* [95% Conf. Interval]	p-value
SES index score	56.45	(55.51, 57.40)	54.39	(53.73, 55.05)	0.0004
Income score	48.38	(44.94, 51.82)	40.05	(37.84, 42.26)	0.0001
Property value score	33.45	(29.88, 37.01)	27.30	(25.07, 29.54)	0.0041
Ratio of people below poverty	14.03	(12.92, 15.14)	16.05	(14.96, 17.15)	0.0106
Unemployment rate	4.60	(4.16, 5.04)	5.45	(4.97, 5.93)	0.01
Education attainment least 4-year college	22.32	(20.57, 24.06)	18.42	(17.45, 19.40)	0.0002
Education attainment less than 12 years	16.00	(14.28, 17.72)	15.75	(14.60, 16.90)	0.809
Crowding	4.32	(3.73, 4.92)	3.81	(3.41, 4.20)	0.1504

* High and low CKD-Hosp rates were defined as the top 50 and lower 50 percentiles of CKD-Hosp rates by county in Texas.

RESULTS SUMMARY

- In 2021, there were 2,455,233 hospitalizations among Texas residents aged 18 and above, of which 441,466 (18.0%) had a CKD diagnosis (CKD-Hosp).
- The number of CKD-Hosp strongly correlates with county population sizes, with most hospitalizations clustered within or near large metropolitan areas.
- After adjusting for county population, the average CKD-Hosp rate in 254 Texas counties was 1,687 (range: 0-3,260; median: 1659; SD: 604) per 100,000 people.
- The top 25 percentile SES counties have on average 422 fewer CKD-Hosps per 100,000 people compared to the bottom 25 percentile counties (P<0.001).
- Counties with high and low CKD-Hosp rates show statistically significant difference in individual SES measures on income, property value, poverty level, unemployment, and education.

LIMITATIONS

- The data is encounter-based and not patient-based.
- CKD diagnosis are based on ICD-10 diagnosis codes and no lab data was available. Underdiagnosis should be taken into consideration.

CONCLUSIONS

- The study reveals significant variations in CKD-hop rates among Texas counties. Higher SES counties exhibit notably fewer CKD-Hosps per 100,000 people compared to lower SES counties.
- Our results highlight the importance of addressing socio-economic disparities to potentially reduce the burden of hospitalizations among CKD patients.

DISCLOSURE

REFERENCE

Data source: Texas Hospital Inpatient Discharge Public Use Data File, [Q1-Q4, 2021]. Texas Department of State Health Services, Center for Health Statistics, Austin, Texas.

Bhavsar, N. A., Gao, A., Phelan, M., Pagidipati, N. J., & Goldstein, B. A. (2018). Value of Neighborhood Socioeconomic Status in Predicting Risk of Outcomes in Studies That Use Electronic Health Record Data. JAMA Network Open, 1(5), e182716-e182716.

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