

## Original Research

# Opioid-Related Emergency Department Visits Before and During COVID-19: Association with Community-Level Factors

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## Abstract

### Background

The purpose of the study was to investigate the relationship between community-level variables and emergency department (ED) visit rates before and during COVID-19. The focus was on opioid-related ED visits. Despite large declines in overall ED visits during COVID-19, opioid-related visits increased. While visits for avoidable conditions decreased, the opposite was true for opioid-related visits.

### Methods

We combined data from Florida EDs with community-level variables from the 2020 American Community Survey. The outcome measures of the study were quarterly ZIP code tabulation-area-level ED visit rates for opioid-related ED visits as well as visit rates for all other causes. Associations with opioid-related visit rates were estimated before and during COVID-19.

### Results

The associations between community-level variables and opioid-related visit rates did not match those found when analyzing overall ED visit rates. The increase in opioid-related visits during COVID-19 was not unique to or more prevalent in areas with a larger percentage of racial/ethnic minority populations. However, socioeconomic status was important, as areas with higher unemployment, lower income, lower home ownership, and higher uninsured had higher overall ED visit rates and opioid visit rates during the pandemic. In addition, the negative association with income increased during the pandemic.

### Conclusion

These results suggest socioeconomic status should be the focus of prevention and treatment efforts to reduce opioid-related visits in future pandemics. Healthcare organizations can use these results to target their prevention and treatment efforts during future pandemics.

### Keywords

opioid-related disorders; substance-related disorders; COVID-19; pandemics; SARS-CoV-2; health care disparities; drug use; Florida/epidemiology; opiate overdose; opioid analgesics

### Introduction

During the COVID-19 pandemic, all-cause emergency department (ED) visits declined sharply.<sup>1-4</sup> The average acuity of ED visits increased, suggesting patients with non-urgent needs avoided EDs.<sup>5</sup> Visits for conditions classified as “non-emergent, primary care treat-

able or preventable” experienced the largest declines, while visits for emergent conditions remained at pre-pandemic levels.<sup>6</sup> Despite being preventable, drug overdoses did not follow this pattern.

For the first time in history, drug overdose deaths exceeded 100 000 annually during the

pandemic.<sup>7</sup> Researchers have reported a variety of reasons for increased drug use during the pandemic. The overall increase in substance use during the pandemic has been attributed to increased depression during the pandemic shutdown. Feelings of anxiety, hopelessness, and isolation also contributed to increased drug use during the pandemic.<sup>8</sup> Increased stress during the pandemic was also linked to increased substance use.<sup>9</sup> In addition to mental health disorders causing increased substance use during the pandemic, pandemic restrictions and stress on the healthcare system resulted in interruptions to substance use prevention and treatment services.<sup>10</sup>

The Centers for Disease Control and Prevention (CDC) conducted a national study and documented elevated ED visit rates for mental health conditions, drug and opioid overdose, and household violence during COVID-19.<sup>11</sup> The authors noted the need for “broader societal- and community-level prevention efforts” to mitigate the impact of problems, such as opioid overdose, that worsened during COVID-19. Effectively targeting such opioid overdose prevention and treatment efforts requires a greater understanding of the community-level factors associated with elevated rates of opioid-related ED visits during COVID-19. The purpose of this study was to expand our knowledge further by considering community-level characteristics as potential predictors of opioid-related ED visits during the pandemic. We considered local communities as ZIP code tabulation areas (ZCTAs), which are generalized areal representations of ZIP code service areas. The demographic and socioeconomic variables at the ZCTA level were used to characterize the communities.

Studies have documented a disproportionate impact of COVID-19 on racial/ethnic minority populations.<sup>12,13</sup> However, the national opioid epidemic does not follow the pattern of being more prevalent in racial/ethnic minority populations, suggesting the need for further study into the characteristics associated with elevated rates of overdose during COVID-19.<sup>14</sup> A recent study examining opioid-related ED visits during the pandemic in Florida did not find evidence of disparities by race/ethnicity, as each group experienced similar increases in the likelihood of ED visits involving opioids during

the pandemic.<sup>15</sup> Instead, differences emerged according to age and insurance status.<sup>15</sup> ED visits involving those under age 18 and those with vulnerable insurance status were more likely to involve opioids during the pandemic.<sup>15</sup> The absence of a disproportionate impact on racial/ethnic minority populations suggests that opioid-related ED visits during the pandemic did not mirror the disproportionate impact of COVID-19 itself on these populations.

The present study extends prior research by combining data from Florida EDs with community-level variables to uncover associations between community-level variables and opioid-related ED visit rates during COVID-19. Opioids were the focus of the study because the majority of drug overdoses nationally involve opioids.<sup>16</sup> Florida has the third largest population in the United States (US), is racially diverse<sup>17</sup>, and declared a public health emergency due to the opioid epidemic.<sup>18</sup> Understanding which community-level factors were associated with elevated opioid-related visit rates during COVID-19 will help direct prevention and treatment resources to where the need is greatest, thus improving health equity.

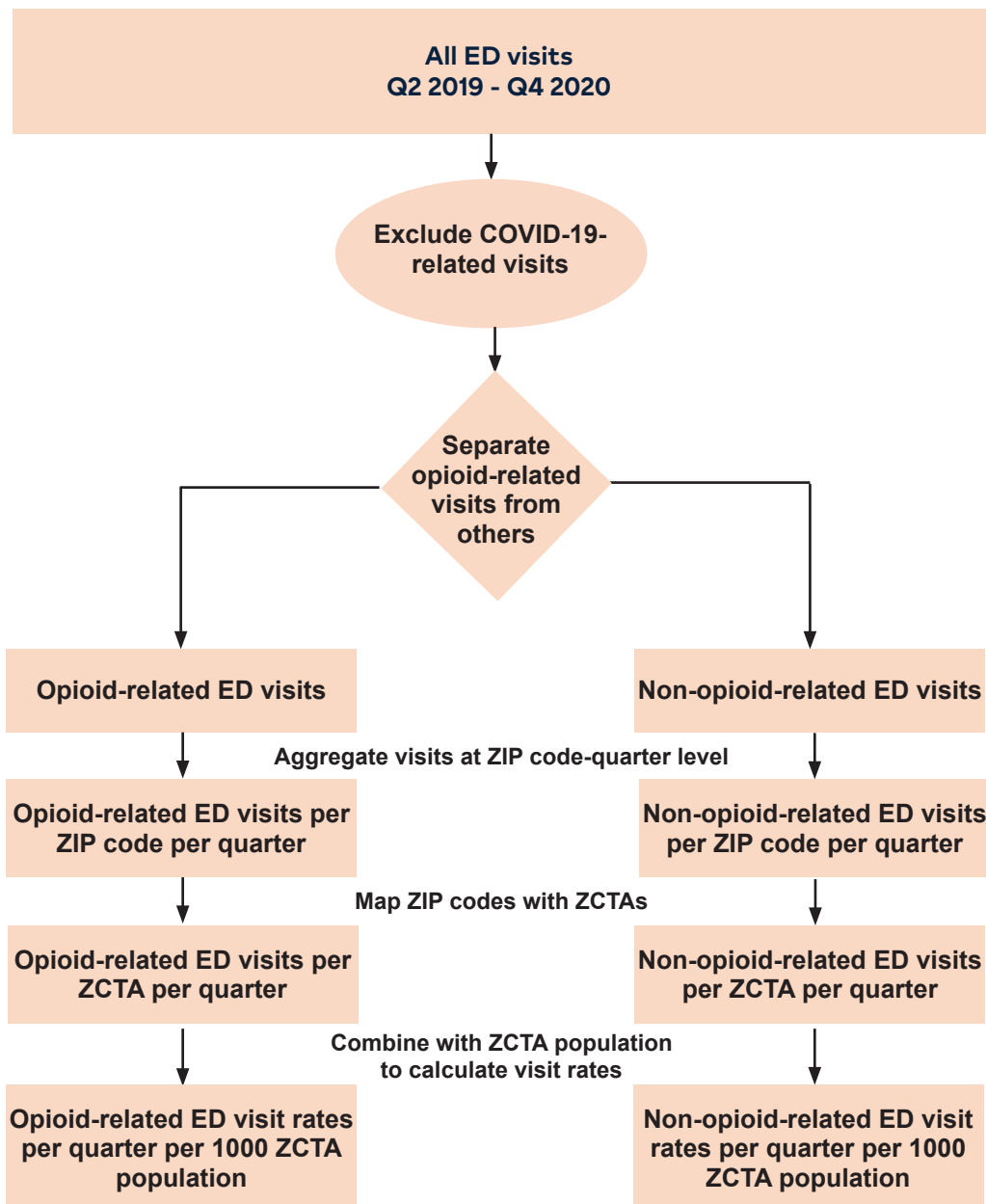
## Study Data and Methods

### Data Sources

We used ED data provided by Florida’s Agency for Health Care Administration (AHCA) from the second quarter of 2019 to the fourth quarter of 2020, which included all ED visits that occurred in Florida during the period, covering patients from 215 unique facilities. The analysis excluded visits from non-Florida residents, yielding a total of 13 467 777 ED visits during the entire study period. The ED data also included patients’ basic demographics and ZIP codes of their permanent residences. A patient’s residence in a rural area was determined using the Federal Office of Rural Health Policy’s eligible ZIP codes file for rural health grants.<sup>19</sup> Other characteristics of patients’ communities were collected at the ZCTA-level from the 2020 American Community Survey (ACS) 5-year estimates.<sup>20</sup> Using patients’ ZIP codes, visits were linked to the corresponding ZCTAs using a ZIP code-ZCTA crosswalk.<sup>21</sup>

### Variables

The outcome measures of the study were quarterly ZCTA-level opioid-related ED visit rates



**Figure 1.** A flow chart shows the study data and design. Abbreviations: ED = emergency department; ZCTA = ZIP code tabulation area

as well as visit rates for all other causes. The rates were calculated in the following steps. First, all listed ICD-10-CM diagnosis codes were used to identify opioid-related visits (ICD-10 codes T40.0X, T40.1X, T40.2X, T40.3X, T40.4X, T40.60, and T40.69)<sup>22</sup> and COVID-19-related visits (ICD-10 codes U07.1 or U07.2) among all ED visits in the data. All COVID-19-related ED visits were excluded from the analysis to enable a valid comparison between the pre-COVID-19 and COVID-19 periods. Second, individual visits were summed to obtain total non-COVID-19

opioid-related visits and total non-COVID-19 non-opioid-related visits for each ZIP code in each quarter (**Figure 1**). Third, ZIP codes were mapped to ZCTAs and the total number of visits per ZCTA per quarter was calculated. Fourth, the quarterly ED visit rates (per 1000 ZCTA population) were calculated by dividing the total non-COVID-19 opioid-related visits and total non-COVID-19 non-opioid-related ED visits per ZCTA per quarter by ZCTA populations. The pre-COVID-19 period included ED visits from quarter 2 of 2019 to quarter 1 of

2020. The COVID-19 period included ED visits from quarter 2 of 2020 to quarter 4 of 2020.

Independent variables consisted of ZCTA-level demographics and socioeconomic characteristics, including the percentage of females; the percentage of people aged 0 to 14 (reference group), 15 to 24, 25 to 34, 35 to 54, 55 to 64, and 65 and above; the percentage of non-Hispanic White (reference group), non-Hispanic Black, Hispanic, and other races; and the logarithm of per capita income, unemployment rate, uninsured rate, percentage of renter-occupied housing units, and a rural indicator variable. Rural status was assigned based on patients' ZIP codes and then aggregated to ZCTAs. The data covered 983 distinct ZCTAs over 7 quarters for 6881 ZCTA-quarter level observations. Due to missing data on key variables, 6709 ZCTA-quarter level observations were used in the analyses (3835 from pre-pandemic quarters and 2874 from the quarters during the pandemic).

**Statistical Analyses**

Linear regression models were estimated to assess the impact of ZCTA-level characteristics in explaining overall ED visit rates (excluding opioid-related and COVID-19 visits) and opioid-related visit rates. Regressions were conducted separately for the pre-COVID-19 and COVID-19 periods. Models also included quarter-year fixed effects and county fixed effects. Standard errors were clustered at the ZCTA level. A *P* value of less than .05 was used to determine the statistical significance of the results.

**Results**

**Summary Statistics**

The average ZCTA-level quarterly ED visit rate, excluding COVID-19 and opioid-related ED vis-

its, was 118.04 during the pre-COVID-19 period and dropped to 83.60 during the pandemic (**Table 1**). The average opioid visit rate, however, increased from 0.24 per 1000 population during the pre-pandemic period to 0.27 during the pandemic (*P* < .001). ZCTA-level demographic and socioeconomic measures were obtained from ACS 2020 5-year estimates (covering 2016-2020) and thus had no variation from the pre-pandemic to the pandemic period. For these variables, the summary statistics were based on all observations used in the regression analyses, over the whole sample period.

The mean per-capita income of ZCTAs used in the analysis was \$33 280 (**Table 2**). The average percentage of non-Hispanic White residents was roughly 62%, with non-Hispanic Black and Hispanic populations averaging 13% and 20%, respectively. The average ZCTA unemployment rate was 6%, and the average uninsured rate was 12%.

**Overall ED Visits Excluding COVID-19 and Opioid-Related Visits**

Coefficients and standard errors from regressions of overall ED visits, excluding COVID-19 and opioid-related visits, are presented in **Tables 3** and **4** for pre-pandemic and pandemic periods, respectively. During the pre-COVID-19 period, ZCTAs with higher percentages of non-Hispanic Black and Hispanic, and higher uninsured rates were associated with elevated visit rates. The percentage of people aged 15-24, logarithm of per capita income, and rural status were associated with lower visit rates. During the pandemic, patterns were similar, although smaller in magnitude due to the overall decline in ED visits during this period. There were also some changes in age and racial/

**Table 1.** Quarterly Emergency Department (ED) Visit Rates per 1000 ZCTA Population

Quarterly ED visit rate (per 1000 ZCTA population)	Pre-Pandemic (n = 3835)		Pandemic (n = 2874)		Difference <i>P</i> value
	Mean	Standard deviation	Mean	Standard deviation	
All-cause visit rate (excluding COVID-19 and opioids)	118.04	54.92	83.60	39.54	<.001
Opioid-related visit rate	0.24	0.31	0.27	0.35	<.001

Note: The reported summary statistics were based on 6709 non-missing observations used in the regression analyses. The pre-pandemic period was from 2019 quarter 2 to 2020 quarter 1. The pandemic period was from 2020 quarter 2 to quarter 4. The last column presents the *P* values from *t*-tests for differences between the means during the pre-pandemic and pandemic periods.

**Table 2.** Summary Statistics of ZCTA-Level Demographic and Socioeconomic Measures

Variables	Mean	Standard deviation
Females (%)	50.45	4.88
Age groups (%)		
0-14	15.59	5.77
15-24	11.37	7.6
25-34	12.18	5.18
35-54	24.07	6.12
55-64	14.09	4.49
65+	22.69	12.47
Racial/ethnic groups (%)		
Non-Hispanic White	61.95	25.13
Non-Hispanic Black	13.22	15.97
Hispanic	19.82	20.02
Other races	5.01	3.58
Per capita income (in \$1000, 2020 inflation-adjusted dollars)	33.28	16.07
Unemployment rate (%)	5.57	4.34
Uninsured rate (%)	12.39	6.69
Share of renter-occupied housing units (%)	30.84	18.14
Rural (%)	15	35.68

Note: The reported summary statistics were based on 6709 non-missing observations used in the regression analyses.

ethnic groups which were significantly associated with the visit rates for non-COVID-19 and non-opioid reasons. Moreover, the log of per capita income became statistically insignificant, indicating there was no protective effect of income on overall ED visit rates during the pandemic.

### Opioid-Related Visits

Regression results for non-COVID-19 opioid-related ED visits are also presented in **Tables 3** (before the pandemic) and **4** (during the pandemic). The results do not mirror those for overall ED visits. Age variables were not significant in either the pre- or during-pandemic period. The percentage of non-Hispanic Black and percentage of Hispanic populations were negatively associated with ZCTA ED visit rates for opioids. Although the magnitude of the coefficients was small, it contrasted with the positive association found in the overall ED visit rate. It implied a lower risk of opioid-related visits among non-Hispanic Black and Hispanic residents relative to non-Hispanic White residents. While income was not associated

with overall ED visit rates during the pandemic, income was negatively associated with opioid-related visit rates before and during the pandemic and thus did play a protective role for opioid-related visits. The magnitude of the association was slightly larger during COVID-19, suggesting income continued to play a role in preventing opioid-related ED visits during the pandemic. The percentage of renter-occupied housing was positively associated with opioid ED visit rates in both periods. The unemployment rate was not statistically significant before the pandemic but became statistically significant during the pandemic. These results suggest socioeconomic status was a key correlate of opioid-related ED visit rates before the pandemic and increased in importance during the pandemic.

### Discussion

In this study, we examined the relationship between community-level variables and ED visits before and during COVID-19, with a focus on opioids. Several key findings emerged. First, opioid-related ED visits became a larger

**Table 3.** ZCTA Demographic and Socioeconomic Measures in Association With Overall and Opioid-Related ED Visit Rates Before the Pandemic

Variables	Overall visit rate	Opioid-related visit rate
Females (%)	0.889 (0.531)	0.001 (0.002)
Age groups (%)		
15-24	-1.569* (0.736)	-0.002 (0.002)
25-34	-1.406 (0.765)	0.003 (0.003)
35-54	-0.608 (0.635)	0.005 (0.004)
55-64	-1.292 (0.737)	0.001 (0.002)
65+	-0.748 (0.384)	0.001 (0.002)
Racial/ethnic groups (%)		
Non-Hispanic Black	1.303** (0.164)	-0.002* (0.001)
Hispanic	0.392* (0.189)	-0.003** (0.001)
Other races	-0.551 (0.927)	0.001 (0.005)
Logarithm of per capita income	-15.479* (7.352)	-0.099** (0.035)
Unemployment rate	1.640 (1.102)	0.004 (0.005)
Uninsured rate	1.280** (0.461)	0.004* (0.002)
Renter-occupied housing units (%)	0.240 (0.193)	0.001* (0.001)
Rural (%)	-0.156* (0.061)	-0.001** (0.000)

Note: Reported in the table are coefficient estimates and standard errors (in parentheses) from linear regressions with 3835 ZCTA-quarter observations from 2019 quarter 2 to 2020 quarter 1. The dependent variables are overall ED visits (excluding COVID-19 and opioid-related ED visits) and opioid-related visits per 1000 ZCTA population. The standard errors were clustered at the ZCTA level. \*\*, and \* represent significance levels of  $P < .01$  and  $.05$ , respectively.

problem during COVID-19 despite a significant decline in overall ED visits. Associations between community-level variables and opioid-related visits did not match those found when analyzing overall ED visit rates. Second, the increase in opioid-related ED visits during COVID-19 was not unique to or more prevalent in areas with larger percentages of racial/ethnic minority populations. During the pandemic, the opposite was true. Third, consistent with the previous research, socioeconomic status was important, as areas with higher unemployment, lower income, lower home ownership, and a higher proportion of uninsured had higher opioid visit rates during the pandemic.<sup>15</sup> These variables were more strongly associated with opioid visit rates compared to overall visit rates during COVID-19, again supporting the argument that opioids present a unique problem.

Our study had limitations. First, causality cannot be inferred in an observational study, so the study results represent associations. Second, the focus on a single state may also present a threat to external validity. Third, patient socioeconomic status was not directly observed

but proxied by ZCTA-level measures. Lastly, ZCTA-level measures were from 2020 ACS 5-year estimates. There was no across-year variation within the 5-year window (and thus during the study period), which limits model fit. Despite these limitations, the size of the sample and the diversity of the Florida population mitigate possible threats to internal and external validity. Florida is the third largest in the nation with respect to population size and is racially and ethnically diverse. The study sample covered 983 ZCTAs based on over 13 million ED visits. Trends between the pre-COVID-19 and COVID-19 periods were consistent with national trends, as overall ED visit rates declined sharply while opioid-related visit rates increased. Models included quarter-year fixed effects to eliminate the impact of seasonal factors and county-fixed effects to control for unobserved county-specific impact. The analyses were restricted to Florida residents to address concerns about changes in tourism and seasonal residence before and during COVID-19.

Consistent with previous research, the problem of opioid use disorder and overdose has unique



**Table 4.** ZCTA Demographic and Socioeconomic Measures in Association With Overall and Opioid-Related ED Visit Rates During the Pandemic

Variables	Overall visit rate	Opioid-related visit rate
Females (%)	0.660 (0.378)	0.003 (0.003)
Age groups (%)		
15-24	-0.980 (0.580)	-0.010 (0.005)
25-34	-1.037* (0.426)	-0.002 (0.004)
35-54	-0.151 (0.475)	0.001 (0.004)
55-64	-0.703 (0.545)	0.004 (0.004)
65+	-0.564* (0.273)	-0.003 (0.004)
Racial/ethnic groups (%)		
Non-Hispanic Black	0.783** (0.119)	-0.003** (0.001)
Hispanic	0.158 (0.135)	-0.004** (0.001)
Other races	-0.515 (0.641)	-0.007 (0.004)
Logarithm of per capita income	-7.611 (5.176)	-0.149* (0.071)
Unemployment rate	1.315 (0.731)	0.004* (0.002)
Uninsured rate	0.645* (0.320)	0.007* (0.003)
Renter-occupied housing units (%)	0.200 (0.116)	0.002** (0.001)
Rural (%)	-0.096* (0.048)	-0.002** (0.000)

Note: Reported in the table are coefficient estimates and standard errors (in parentheses) from linear regressions, with 2874 ZCTA-quarter observations from 2020 quarter 2 to quarter 4. The dependent variables are overall ED visits (excluding COVID-19 and opioid-related ED visits) and opioid-related visits per 1000 ZCTA population. The standard errors were clustered at the ZCTA level. \*\*, and \* represent significance levels of  $P < .01$  and  $.05$  respectively.

features, different from other health problems. Despite activity being restricted and the tendency among patients to avoid receiving care in hospital settings, opioid-related visits increased during COVID-19 as observed in national trends.<sup>11</sup> This finding suggests the need for additional public health resources to be allocated toward opioid overdose during pandemics. The estimated associations between opioid-related ED visit rates and community-level characteristics offer guidance for allocating these resources. Associations between opioid visit rates and community-level variables differed from the associations between overall visit rates and community-level variables.

While the national narrative has been that COVID-19 disproportionately impacted racial/ethnic minority populations, the opposite was true for opioids. The negative associations between the percentage of non-Hispanic Black and Hispanic populations within a ZIP code remained significant during COVID-19, suggesting that elevated rates of opioid-related ED visits were larger in areas with a larger percentage of non-Hispanic White residents. These

associations were the opposite of those estimated for overall ED visit rates, which showed a positive relationship between the percentage of non-Hispanic Black and Hispanic in a ZCTA and overall ED visit rates.

Socioeconomic variables were associated with an increase in opioid visit rates, with a stronger impact during the pandemic compared to before. Income, the uninsured rate, the percentage of renter-occupied housing units, and rural status were associated with opioid-related ED visits before the pandemic, and their associations became larger in magnitude during the pandemic. The unemployment rate was significantly associated with opioid-related ED visits during COVID-19 but was not associated with overall ED visit rates. Therefore, it appears that socioeconomic status, independent of race/ethnicity, should be the focus of prevention and treatment efforts to reduce opioid overdoses in future pandemics.

## Conclusion

Opioid-related ED visits were found to be especially problematic in areas of lower so-

cio-economic status. To improve health equity in future pandemics, proven prevention tactics and evidence-based treatments, such as linkages to community resources, educational interventions, counseling/behavioral therapies, medications, or telehealth/in-home services should be made available in and accessible to communities of low socio-economic status. Community-level variables were significantly associated with overall ED visit rates and opioid-related visit rates, but patterns were different before and during COVID-19, suggesting the need for targeted approaches to prevention and treatment in future pandemics.

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### Conflicts of Interest

The authors declare no conflicts of interest.

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