

Letters

RESEARCH LETTER

Variation in COVID-19 Hospitalizations and Deaths Across New York City Boroughs

In the US, New York City has emerged as the epicenter of the coronavirus disease 2019 (COVID-19) outbreak.¹ As of April 25, 2020, more than 150 000 cases had been reported, which is approximately 17% of total cases in the US.^{2,3} New York City is composed of 5 boroughs (the Bronx, Brooklyn, Manhattan, Queens, and Staten



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Island), each with unique demographic, socioeconomic, and community characteristics.

Prior analyses have shown health inequities across these boroughs, but whether similar patterns have also emerged amid the COVID-19 pandemic is unknown.⁴ Understanding the patterns could inform public health and policy strategies to mitigate the ongoing spread of COVID-19, and future approaches to address a possible resurgence of the disease. Therefore, in this study, we aimed to examine population characteristics and hospital bed capacities across the 5 boroughs and evaluate whether differences in the rates of

Table. Population and Hospital Characteristics Among New York City Boroughs^a

| | New York City borough | | | | |
|--|-----------------------|-----------|-----------|-----------|---------------|
| | Bronx | Brooklyn | Manhattan | Queens | Staten Island |
| Total population, No. | 1 432 132 | 2 582 830 | 1 628 701 | 2 278 906 | 476 179 |
| Population density per square mile | 33 721 | 37 163 | 71 434 | 21 081 | 8112 |
| Persons per household, mean | 2.74 | 2.62 | 2.08 | 2.86 | 2.80 |
| Demographic characteristics | | | | | |
| Age, median, y | 34.4 | 35.4 | 37.6 | 39.2 | 40.1 |
| Aged ≥65 y, % | 12.8 | 13.9 | 16.5 | 15.7 | 16.2 |
| Sex, % | | | | | |
| Males | 47.1 | 47.4 | 47.3 | 48.5 | 48.5 |
| Females | 52.9 | 52.6 | 52.7 | 51.5 | 51.5 |
| Non-US-born, % | 34.4 | 35.6 | 29.2 | 47.6 | 25.2 |
| Race/ethnicity, % ^b | | | | | |
| White | 25.1 | 46.6 | 59.2 | 39.6 | 75.1 |
| Black or African American | 38.3 | 33.5 | 16.9 | 19.9 | 11.5 |
| Asian | 4.6 | 13.4 | 14.0 | 27.5 | 11.0 |
| Other race ^c | 36.8 | 10.4 | 15.4 | 17.0 | 5.2 |
| Hispanic ^d | 56.4 | 19.1 | 25.9 | 28.1 | 18.7 |
| Socioeconomic status | | | | | |
| Household income, median, \$ | 38 467 | 61 220 | 85 066 | 69 320 | 82 166 |
| Persons living under poverty, % ^e | 27.4 | 19.0 | 15.5 | 11.5 | 11.4 |
| Education level, % | | | | | |
| High school graduate or higher | 73.3 | 83.4 | 87.7 | 82.5 | 87.7 |
| Bachelor's degree or higher | 20.7 | 38.9 | 61.4 | 33.5 | 34.3 |
| Hospital characteristics ^f | | | | | |
| Total short-term acute care hospitals, No. | 7 | 14 | 16 | 9 | 2 |
| Beds per 100 000 population | 336 | 214 | 534 | 144 | 234 |

^a The 2018 American Community Survey was used to identify population, demographic, and socioeconomic characteristics of the 5 New York City boroughs. The American Hospital Association 2016 file was used to determine hospital characteristics.

^b Respondents could self-identify as 1 or more of the following racial groups: white, black or African American, Asian, American Indian and Alaskan Native, Native Hawaiian and other Pacific Islander, or other. Respondents could also identify as Hispanic or Latino or not Hispanic or Latino. Race/ethnicity was assessed because it is associated with health inequities. Race was self-identified singularly or in combination with 1 or more races; therefore, the sum of all races may exceed 100%.

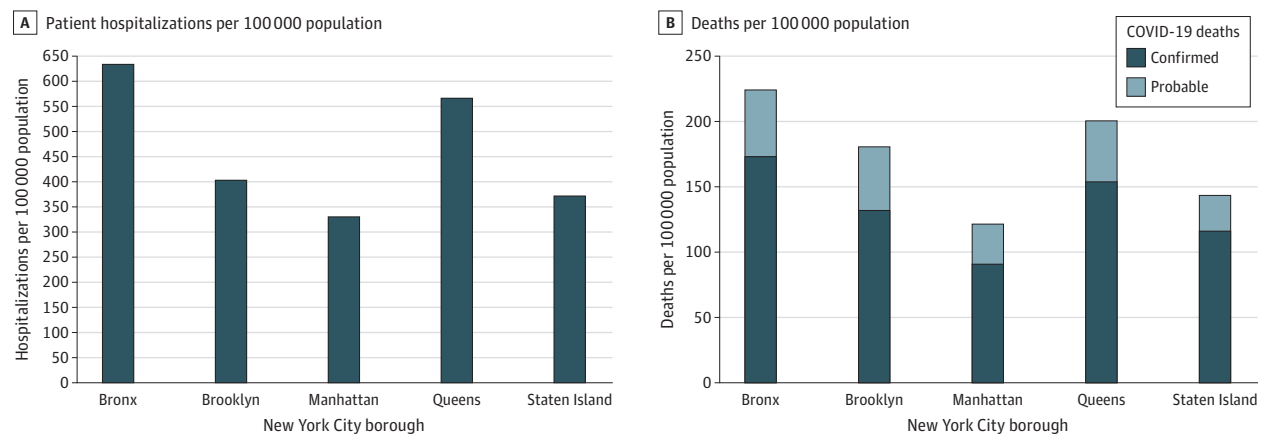
^c Includes those who self-identified as American Indian and Alaskan Native, Native Hawaiian and other Pacific Islander, or "other race" in the 2018 American Community Survey File.

^d Indicates Hispanic or Latino of any race.

^e Poverty status was based on the total income of the householder's family compared with appropriate poverty thresholds, which vary based on family size, number of children, and the age of the householder.

^f Excluded pediatric, specialty only (eg, orthopedic), psychiatric, and hospice facilities.

Figure. Rates of Coronavirus Disease 2019 (COVID-19) Hospitalizations and Deaths by New York City Borough



The New York City Department of Health and Mental Hygiene (DOHMH) estimates the number of patients with COVID-19 who have ever been hospitalized through data linkages with the New York City DOHMH syndromic surveillance database and the New York State Department of Health Hospital Emergency Response Data System based on key fields from known cases that are reported by laboratories to New York City DOHMH.² Probable COVID-19 deaths are defined by the New York City DOHMH as patients who have no known positive laboratory test for severe acute respiratory syndrome coronavirus 2, but for whom the death certificate lists COVID-19 (or an equivalent) as a cause of death. Fifteen deaths were excluded because the

borough of residence was unknown. The number of patients with COVID-19 who were hospitalized per 100 000 population was 634 in the Bronx; 404 in Brooklyn; 331 in Manhattan; 568 in Queens; and 373 in Staten Island. The total number of deaths per 100 000 population was 224 in the Bronx; 181 in Brooklyn; 122 in Manhattan; 200 in Queens; and 143 in Staten Island. The number of laboratory-confirmed COVID-19 deaths per 100 000 population was 173 in the Bronx; 132 in Brooklyn; 91 in Manhattan; 154 in Queens; and 117 in Staten Island. The number of probable COVID-19 deaths per 100 000 population was 51 in the Bronx; 49 in Brooklyn; 31 in Manhattan; 46 in Queens; and 27 in Staten Island.

COVID-19 testing, hospitalizations, and deaths have emerged in these communities.

Methods | The 2018 American Community Survey, an annual nationwide audit conducted by the US Census Bureau, was used to describe the population characteristics of the 5 New York City boroughs. Hospitals and their bed capacities were identified using the American Hospital Association 2016 file and a manual search of hospital websites.

The cumulative number of COVID-19 tests performed, the number of patients with COVID-19 who were hospitalized, and the number of deaths related to COVID-19 according to borough of residence for each patient were obtained using data from the New York City Department of Health and Mental Hygiene and last updated on April 25, 2020.² Both laboratory-confirmed and probable COVID-19 deaths were examined.

Descriptive statistical analyses were performed to calculate the total number of COVID-19 tests, hospitalizations, and deaths per 100 000 persons using the population of each borough as a denominator. Institutional review board approval was not sought due to the use of publicly available, deidentified data, per usual institutional policy.

Results | The total population of New York City was 8 398 748. Across the 5 boroughs, the population density ranged from 8112 per square mile in Staten Island to 71 434 per square mile in Manhattan (Table). The proportion of older adults (aged ≥ 65 years) was lowest in the Bronx (12.8%) and highest in Manhattan (16.5%), whereas the proportion of black or African American persons was highest in the Bronx (38.3%) and lowest in Staten Island (11.5%).

Household median income was lowest in the Bronx (\$38 467) as was the proportion of persons with a bachelor's degree or higher (20.7%). There were 48 short-term acute care hospitals. The number of hospitals per borough ranged from 2 in Staten Island to 16 in Manhattan. The number of hospital beds per 100 000 population was lowest in Queens (144 beds) and highest in the Bronx (336 beds) and in Manhattan (534 beds).

Among New York City boroughs, there was variation in the number of COVID-19 tests performed per 100 000 population (4599 in the Bronx; 2970 in Brooklyn; 2844 in Manhattan; 3800 in Queens; and 5603 in Staten Island). The number of patients with COVID-19 who were hospitalized per 100 000 population was highest in the Bronx (634) and lowest in Manhattan (331). The number of deaths related to COVID-19 per 100 000 population was also highest in the Bronx (224) and lowest in Manhattan (122) (Figure).

Discussion | The substantial variation in the rates for COVID-19 hospitalizations and deaths across the New York City boroughs is concerning. The Bronx, which has the highest proportion of racial/ethnic minorities, the most persons living in poverty, and the lowest levels of educational attainment had higher rates of hospitalization and death related to COVID-19 than the other 4 boroughs.

In contrast, the rates for hospitalizations and deaths were lowest among residents of the most affluent borough, Manhattan, which is composed of a predominately white population. Manhattan and the Bronx have the highest number of per capita hospital beds, and Manhattan has the highest population density, indicating that other factors, such as

underlying comorbid illnesses, occupational exposures, socioeconomic determinants, and race-based structural inequities may explain the disparate outcomes among the boroughs.^{5,6}

This study has limitations, including an ecological design and limited follow-up through April 25, 2020. Demographic characteristics for patients who died were not available by borough of residence. The rate of COVID-19 cases was not evaluated given significant variability in testing.

Further studies are needed to examine whether the disproportionate burden of COVID-19 is being borne by lower income and minority communities in other regions of the US.

Rishi K. Wadhera, MD, MPP, MPhil

Priya Wadhera, MD, MS

Prakriti Gaba, MD

Jose F. Figueroa, MD, MPH

Karen E. Joynt Maddox, MD, MPH

Robert W. Yeh, MD, MSc

Changyu Shen, PhD

Author Affiliations: Richard A. and Susan F. Smith Center for Outcomes Research in Cardiology, Beth Israel Deaconess Medical Center, Boston, Massachusetts (R. K. Wadhera, Yeh, Shen); Department of Medicine, NYU Langone Medical Center, New York, New York (P. Wadhera); Department of Medicine, New York Presbyterian/Columbia University Medical Center, New York, New York (Gaba); Department of Health Policy and Management, Harvard T. H. Chan School of Public Health, Boston, Massachusetts (Figueroa); Cardiovascular Division, Washington University School of Medicine in St Louis, St Louis, Missouri (Joynt Maddox); Associate Editor, *JAMA* (Joynt Maddox).

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Corresponding Author: Rishi K. Wadhera, MD, MPP, MPhil, Richard A. and Susan F. Smith Center for Outcomes Research in Cardiology, Beth Israel Deaconess Medical Center, Harvard Medical School, 375 Longwood Ave, Boston, MA 02215 (rwadhera@bidmc.harvard.edu).

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Drafting of the manuscript: R. Wadhera, Figueroa.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: R. Wadhera, Gaba, Shen.

Administrative, technical, or material support: R. Wadhera.

Supervision: P. Wadhera, Yeh.

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