Article DOI: https://doi.org/10.3201/eid2704.204709

# Characteristics and Risk Factors of Hospitalized and Nonhospitalized COVID-19 Patients, Atlanta, Georgia, USA, March–April 2020

## Appendix

## Methods

### Data Collection

Hospitalized and nonhospitalized patients ≥18 years of age with laboratory-confirmed coronavirus disease (COVID-19) (defined as a positive real-time reverse transcription PCR for severe acute respiratory syndrome coronavirus 2 [SARS-CoV-2]) who were treated at 6 acute care hospitals and outpatient clinics affiliated with a single academic hospital system in the Atlanta metropolitan area were included in the study. Patients who were hospitalized for COVID-19 during March 1–30, 2020 (including those who stayed for observation or died in the emergency department) were sequentially selected from lists provided by the health system and reviewed over a 3-week period in April 2020.

Nonhospitalized patients were identified from the provided lists of patients ≥18 years of age who tested positive for SARS-CoV-2 during March 1–April 7, 2020 and were not hospitalized (including outpatient and nonadmitted emergency department patients). During this time, the healthcare system operated a telephone triage line to manage patients with COVID-19–compatible symptoms. Patients with signs of severe illness (e.g., severe shortness of breath, confusion, or hemoptysis) were directed to the emergency department. Other symptomatic persons could receive outpatient SARS-CoV-2 testing through the healthcare system; because testing capacity was limited, appointments were prioritized for healthcare personnel and persons at high risk for severe illness, such as persons ≥65 years of age and those with underlying conditions, including diabetes mellitus, cardiovascular disease, and chronic respiratory disease. Telephone and telehealth follow-up calls were conducted for some patients. Trained personnel

reviewed information from electronic medical records (EMR) during April 7–May 15, 2020 on patient demographics, occupation, medications, underlying conditions, and symptoms using REDCap version 8.8.0 (https://projectredcap.org/software).

### Analytic Methods

We categorized patients as having 0, 1, 2, or ≥3 of the following conditions: hypertension, diabetes mellitus, chronic kidney disease, chronic lung disease, HIV, chronic liver disease, history of organ transplant, cardiovascular disease, autoimmune or rheumatologic disease, obesity, and cancer. Obesity was defined as having a body mass index (BMI) ≥30. We considered insured patients to be those possessing private, Medicare, Medicaid, or other insurance policies. Race was classified as black or nonblack; data could not be disaggregated for other races or analyzed by ethnicity because of small sample sizes. We counted the number of classes of hypertension medication prescribed to patients (beta blockers, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, calcium channel blockers, thiazide diuretics, hydralazine, clonidine, or other); we analyzed combination medications by their individual components. Occupation was obtained from the EMR. Healthcare personnel (HCP) were defined as persons whose occupations included patient contact or possible exposure to infectious agents in the healthcare setting (*1*). Among the nonhospitalized group, care-seeking behavior was defined as having a COVID-19–related encounter with a healthcare provider documented in the medical record. We counted all healthcare encounters related to COVID-19 illness including doctor's office and urgent care visits (together classified as ambulatory care visits), emergency room visits, telehealth visits in which symptoms or care was reviewed, and calls to the telephone triage line. We compared characteristics and symptoms of hospitalized and nonhospitalized persons using $X^2$ or Fisher's exact tests for categorical variables; continuous variables are described with means and their standard deviations and compared with *t*-tests. We considered p values <0.05 to be significant.

Characteristics associated with hospitalization in this population have been described previously (*2*). We conducted further univariable and multivariable logistic regressions to explore the effects of additional age strata and multiple medical conditions (instead of individual conditions) on risk for hospitalization. The full multivariable logistic regression model included 6 age strata (18–29, 30–39, 40–49, 50–59, 60–69, and ≥70 years), number of underlying conditions (0, 1, 2, and ≥3), race, sex, insurance, and smoking (including current or former

smoking), as all of these characteristics were previously associated with hospitalization in this population (*2*). Firth's correction was used to account for small sample size in some groups (*3*). Because ≈50% of the nonhospitalized patients were HCP, possibly because of testing priorities in March–April 2020 (n = 168; 54%), we repeated multivariable models that excluded HCP as a sensitivity analysis.

We further explored the 3 most common medical conditions among the hospitalized and nonhospitalized populations: hypertension, diabetes, and obesity, all of which have been associated with increased risk of severe illness from COVID-19 (*4–8*). Diagnoses of hypertension and diabetes were identified from the medical history documented in the EMR; obesity was defined using calculations of BMI from weight and height recorded in the EMR. We investigated the effect of combinations of these 3 conditions, as well as degree of severity or control of these conditions, on risk for hospitalization. Among patients with hypertension, we investigated whether use of multiple classes of hypertension medication, considered a potential indicator of hypertension severity, was associated with hospitalization. Among patients with diabetes, we investigated the association of hemoglobin A1c (proportion of glycosylated hemoglobin in the blood tested within ≤1 year of when the medical records was reviewed for this study) and risk for hospitalization. Hemoglobin A1c levels were categorized as values <7% or ≥7%; this level was chosen as it is considered an indicator of adequate blood glucose control in patients with diabetes (*9*). Because of small sample size in the concurrent condition combination model (which tested for interactions between hypertension, diabetes, and obesity), we could not adjust for all previously identified risk factors. Therefore, we used confounding variables documented in the published literature, including: age (18–44, 45–64, and ≥65 years of age), race, HCP status, and the third comorbidity not used in the interaction term (*10–12*). Similarly, the models evaluating degree of control of concurrent conditions (BMI, number of antihypertensive medications, and hemoglobin A1c value) included age (18–44, 45–64, and ≥65 years of age), race, sex, HCP status, and hypertension (among patients with diabetes) and diagnosis of diabetes (all other models). We assessed additive interaction by calculating relative excess risk caused by interaction.

For all models, nonhospitalized patients were limited to those with a medical history and medication list documented in the EMR (n = 288). Multivariable models were limited to patients with complete data for all included variables; patients with missing data on any variable were

excluded from the analysis and the distribution and number of missing values were assumed to be random. All analyses were performed using SAS version 9.4 (SAS Institute Inc., https://www.sas.com). This activity was reviewed by the US Centers for Disease Control and Prevention. The study was conducted in accordance with applicable federal law and Centers for Disease Control and Prevention policy and by the Georgia Department of Public Health as an institutional review board–exempt public health evaluation.

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**Appendix Table 1.** Concurrent conditions among patients with coronavirus disease, Atlanta, Georgia, USA, 2020

| Condition | Hospitalized, no. (%)* n = 220 | Nonhospitalized, no. (%)* n = 311 |
|---|---|---|
| Hypertension | 142 (65) | 101 (32) |
| Diabetes | 81 (37) | 30 (10) |
| Type I | 2 (1) | 2 (1) |
| Type II | 74 (34) | 28 (9) |
| Hemoglobin A1c, mean (SD) | 8.1 (2.3) | 6.8 (1.8) |
| Immunocompromising conditions | 18 (8) | 23 (7) |
| HIV/AIDS | 5 (2) | 10 (3) |
| Leukemia or lymphoma | 1 (<1) | 2 (1) |
| Solid organ or stem cell transplant | 1 (<1) | 0 |
| Immunosuppressant use | 12 (5) | 11 (4) |
| Chronic kidney disease | 38 (17) | 7 (2) |
| End-stage renal disease | 14 (6) | 1 (<1) |
| Chronic lung disease | 45 (20) | 56 (18) |
| Asthma | 22 (10) | 40 (13) |
| Chronic obstructive pulmonary disease or emphysema | 8 (4) | 0 |
| Obstructive sleep apnea | 12 (5) | 14 (5) |
| Interstitial lung disease | 3 (1) | 0 |
| Sarcoidosis | 0 | 3 (1) |
| Obesity | | |
| BMI <30 | 86 (39) | 123 (40) |
| BMI ≥30 | 124 (56) | 104 (33) |
| Cardiovascular disease | 56 (25) | 36 (12) |
| Coronary artery disease | 28 (13) | 14 (5) |
| Cerebrovascular disease or stroke | 5 (2) | 4 (1) |
| Aortic regurgitation | 7 (3) | 9 (3) |
| Atrial fibrillation | 12 (5) | 9 (3) |
| Congestive heart failure | 23 (10) | 2 (1) |
| Other | 10 (5) | 14 (5) |
| Chronic liver disease | 5 (2) | 4 (1) |
| Alcoholic hepatitis | 1 (<1) | 0 |
| Hepatitis B or C | 3 (1) | 0 |
| Nonalcoholic fatty liver disease | 1 (<1) | 1 (<1) |
| Other | 0 | 2 (1) |

*Values are no. (%), except where indicated. BMI, body mass index.

**Appendix Table 2.** Characteristics of coronavirus disease patients with hypertension, diabetes, or obesity, Atlanta, Georgia, USA, 2020

| Characteristic | Hospitalized, n (%) | Nonhospitalized, n (%) |
|---|---|---|
| Hypertension | 142 | 101 |
| Age, y | | |
| 18–29 | 0 | 3 (3) |
| 30–39 | 8 (6) | 12 (12) |
| 40–49 | 12 (8) | 18 (18) |
| 50–59 | 27 (19) | 31 (31) |
| 60–69 | 44 (31) | 24 (24) |
| ≥70 | 51 (36) | 13 (13) |
| Race | | |
| Black | 113 (80) | 68 (67) |
| Nonblack | 23 (16) | 25 (25) |
| Missing data | 6 (4) | 8 (8) |
| Sex | | |
| M | 72 (51) | 39 (39) |
| F | 70 (49) | 62 (61) |
| Insurance | | |
| No | 6 (4) | 3 (3) |
| Yes | 135 (95) | 97 (96) |
| Missing data | 1 (1) | 1 (1) |
| Smoking | | |
| Never | 90 (63) | 75 (74) |
| Current | 8 (6) | 3 (3) |

| Characteristic | Hospitalized, n (%) | Nonhospitalized, n (%) |
|---|---|---|
| Past | 37 (26) | 16 (16) |
| Missing data | 7 (5) | 7 (7) |
| Diabetes | 81 | 30 |
| Age, y | | |
| 18–29 | 1 (1) | 2 (7) |
| 30–39 | 7 (9) | 4 (13) |
| 40–49 | 5 (6) | 3 (10) |
| 50–59 | 18 (22) | 9 (30) |
| 60–69 | 23 (28) | 9 (30) |
| ≥70 | 27 (33) | 3 (10) |
| Race | | |
| Black | 66 (81) | 21 (70) |
| Nonblack | 13 (16) | 5 (17) |
| Missing data | 2(2) | 4 (13) |
| Sex | | |
| M | 42 (52) | 10 (33) |
| F | 39 (48) | 20 (67) |
| Insurance | | |
| No | 7 (9) | 1 (3) |
| Yes | 74 (91) | 29 (97) |
| Smoker | | |
| Never | 55 (68) | 22 (73) |
| Current | 2 (2) | 1 (3) |
| Past | 19 (23) | 4 (13) |
| Missing data | 5 (6) | 3 (10) |
| Obesity | 123 | 104 |
| Age, y | | |
| 18–29 | 4 (3) | 14 (13) |
| 30–39 | 19 (15) | 23 (22) |
| 40–49 | 22 (18) | 23 (22) |
| 50–59 | 29 (24) | 30 (29) |
| 60–69 | 32 (26) | 11 (11) |
| ≥70 | 17 (14) | 3 (3) |
| Race | | |
| Black | 103 (84) | 67 (64) |
| Nonblack | 16 (13) | 23 (22) |
| Missing data | 4 (3) | 14 (13) |
| Sex | | |
| M | 55 (45) | 29 (28) |
| F | 68 (55) | 75 (72) |
| Insurance | | |
| No | 13 (11) | 6 (6) |
| Yes | 109 (89) | 96 (92) |
| Missing data | 1 (1) | 2 (2) |
| Smoker | | |
| Never | 88 (72) | 86 (83) |
| Current | 8 (7) | 1 (1) |
| Past | 22 (18) | 13 (13) |
| Missing data | 5 (4) | 4 (4) |

**Appendix Table 3.** Detailed characteristics of hospitalized and nonhospitalized patients with coronavirus disease, Atlanta, Georgia, USA, 2020*

| Characteristic | Patients, no. (%) Total hospitalized n = 220 | Total nonhospitalized n = 311 | Hospitalized, non-HCP n = 212 | Nonhospitalized, non-HCP n = 143 |
|---|---|---|---|---|
| Age, y | | | | |
| 18–29 | 5 (2) | 52 (17) | 3 (1) | 16 (11) |
| 30–39 | 24 (11) | 79 (25) | 23 (11) | 22 (15) |
| 40–49 | 36 (16) | 54 (17) | 35 (17) | 24 (17) |
| 50–59 | 41 (19) | 63 (20) | 39 (18) | 33 (23) |
| 60–69 | 56 (25) | 41 (13) | 55 (26) | 27 (19) |
| ≥70 | 58 (26) | 22 (7) | 57 (27) | 21 (15) |
| Race | | | | |
| Black | 174 (79) | 139 (45) | 168 (79) | 70 (49) |
| Nonblack | 36 (16) | 100 (32) | 34 (16) | 53 (37) |
| Missing data | 10 (5) | 72 (23) | 10 (5) | 20 (14) |
| Sex | | | | |
| F | 106 (48) | 197 (63) | 101 (48) | 72 (50) |
| M | 114 (52) | 114 (37) | 111 (52) | 71 (50) |
| Insurance | | | | |
| No | 22 (10) | 20 (6) | 21 (10) | 8 (6) |
| Yes | 195 (89) | 285 (92) | 188 (89) | 133 (93) |
| Missing data | 3 (1) | 6 (2) | 3 (1) | 2 (1) |
| Smoker | | | | |
| Nonsmoker | 157 (71) | 230 (74) | 151 (71) | 105 (73) |
| Smoker | 54 (25) | 37 (12) | 52 (25) | 24 (17) |
| Missing data | 9 (4) | 44 (14) | 9 (4) | 14 (10) |
| No. concurrent conditions | | | | |
| 0 | 21 (10) | 122 (39) | 20 (9) | 44 (31) |
| 1 | 48 (22) | 80 (26) | 46 (22) | 38 (27) |
| 2 | 71 (32) | 68 (22) | 69 (33) | 38 (27) |
| ≥3 | 80 (36) | 41 (13) | 77 (36) | 23 (16) |

*HCP, healthcare personnel.

**Appendix Table 4.** Multiple concurrent conditions among coronavirus disease patients, Atlanta, Georgia, USA, 2020*

| Conditions | Patients, n (%) Hospitalized (n = 220) | Nonhospitalized (n = 288) | Estimate† | SE | p value | RERI (95% CI) |
|---|---|---|---|---|---|---|
| Hypertension and diabetes | | | | | | |
| Intercept | | | −0.8952 | 0.3345 | <0.01 | 0.08 (−4.09 to 4.26) |
| Hypertension | 77 (35) | 72 (25) | 0.2496 | 0.3118 | 0.64 | |
| Diabetes | 16 (7) | 6 (2) | 1.1662 | 0.5804 | 0.04 | |
| Hypertension + diabetes | 65 (30) | 19 (7) | −0.1448 | 0.6974 | 0.84 | |
| Diabetes and obesity | | | | | | |
| Intercept | | | −0.9403 | 0.3392 | <0.01 | 0.34 (−4.80 to 5.48) |
| Obesity | 70 (32) | 81 (28) | 0.8239 | 0.2982 | <0.01 | |
| Diabetes | 25 (11) | 8 (3) | 1.3913 | 0.5128 | <0.01 | |
| Diabetes + obesity | 53 (24) | 13 (5) | −0.4829 | 0.6533 | 0.46 | |
| Hypertension and obesity | | | | | | |
| Intercept | | | −1.0593 | 0.3550 | <0.01 | −1.36 (−3.79 to 1.07) |
| Hypertension | 53 (24) | 29 (10) | 0.6455 | 0.3944 | 0.10 | |
| Obesity | 41 (19) | 46 (16) | 1.0671 | 0.3700 | <0.01 | |
| Hypertension + obesity | 82 (37) | 48 (17) | −0.8162 | 0.5130 | 0.11 | |

*RERI: relative excess risk due to interaction; SE, standard error.
†Adjusted for age, race, healthcare personnel status, and other concurrent conditions.