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# Which people with asthma are most likely to be hospitalized with COVID-19 in the United States?

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***Clinical Implications***

- Guidance for increased risks for COVID-19 in people with asthma should be updated to consider the risk factors with the highest incidence of COVID-19 hospitalization: the highest level of comorbidity, black race, Hispanic ethnicity, and hypertension.

The US Centers for Disease Control and Prevention (CDC) currently classifies moderate-to-severe asthma as a disease where people *might* be at an increased risk for severe illness from the virus that causes COVID-19.[1] Multicenter analyses suggest that severe asthma, but not mild asthma, is associated with COVID-19–related mortality in the United Kingdom[2] and Korea.[3] In Spain, older age and comorbidities are associated with COVID-19–related hospital admission in people with asthma.[4] In the United States, multiple single-center studies suggest that some people with asthma are at higher risk for severe illness from COVID-19, whereas a systematic review and meta-analysis of 131 studies conducted in 40 different countries concluded that asthma is not associated with higher COVID-19 severity or worse prognosis.[5] Thus, it is important to discern risk levels for poor COVID-19 outcomes among people with asthma. In this Clinical Communication, we consider risk factors for COVID-19 hospitalization among people with asthma in a large US database.

We identified people in the Optum Labs Data Warehouse (OLDW), a database of longitudinal administrative health data including medical and pharmacy claims, laboratory results, and enrollment records for commercial and Medicare Advantage (MA) enrollees from across the United States.[6] We identified all people in OLDW with any diagnostic code for asthma between January 1, 2019, and December 31, 2019, who had continuous medical and pharmacy coverage from January 1, 2019, through March 9, 2020, the first date on which a COVID-19 diagnostic code was observed in the data. People who lost insurance coverage between March 9 and June 30 are retained in the analysis for their entire period of coverage. We are unable to perfectly distinguish people who discontinue insurance because of death versus loss or change of insurance coverage.

Among this cohort, we identified people with COVID-19 diagnostic codes (U07.1 or U07.2) linked to a hospitalization during the observation period of March 9, 2020, through June 30, 2020.[7] Next, univariate and multivariable analyses were performed with the independent variables age, gender, race, geographic region, income, insurance, Charlson comorbidity counts, specific comorbid conditions (chronic obstructive pulmonary disease [COPD], hypertension, rhinitis, sinusitis, obesity), asthma medication claims, and history of severe asthma exacerbation as defined by emergency department or hospitalization for asthma in 2019, and the dependent variable COVID-19 hospitalization. We included a category for missing data because they were unlikely to be missing at random. We included the length of follow-up as an exposure term in the model: a Poisson regression with robust standard errors.

In OLDW, 559,955 people with asthma had medical and pharmacy coverage from January 1, 2019, through March 9, 2020. We found 5445 with at least 1 COVID-19 diagnosis and 1378 with a COVID-19 diagnosis linked to a hospitalization (0.25%). Table I shows the univariate and multivariable analyses Several covariates were associated with an increased incidence of COVID-19 hospitalization: age ≥65 years, female sex, black race, Hispanic ethnicity, Northeast and South region, MA health insurance, higher number of Charlson conditions, COPD, hypertension, obesity, having a severe asthma exacerbation in 2019, having a greater number of claims for asthma medications in 2019, including inhaled corticosteroid (ICS) or ICS/long-acting β-agonist, reliever medicine, or systemic corticosteroids. In multivariable analysis, the variables with the highest incidence of COVID-19 hospitalization were 4+ Charlson conditions versus 0-1 Charlson conditions (incidence rate ratio [IRR]: 3.63, 95% confidence interval [CI]: 2.94-4.49), black race versus white race (IRR: 2.58, 95% CI: 2.24-2.97), Northeast region versus Midwest region (IRR: 2.71, 95% CI: 2.32-3.16), Hispanic ethnicity versus white ethnicity (IRR: 2.00, 95% CI: 1.70-2.37), and hypertension (IRR: 2.20, 95% CI: 1.78-2.72).

Our results are consistent with results from the United Kingdom, which showed an increased risk of COVID-related mortality in people with baseline features suggestive of severe asthma.[2] Our findings provide new information by identifying additional measures of asthma disease activity that are associated with COVID-19 hospitalization, beyond the previously identified risk factor of prior year oral corticosteroid use. These findings support the current CDC guidance to consider moderate-to-severe asthma a risk factor for poorer COVID-19 outcomes in comparison to mild asthma.

Because of the timing of the analysis, which extended through the end of June 2020, we anticipated that people in the US Northeast region would be more likely to be hospitalized than those in the rest of the country because of higher COVID-19 rates there in the early months of the pandemic. We expected to find several comorbid conditions associated with COVID-19 hospitalization, as these comorbid conditions have been associated with poor COVID-19 outcomes in general populations as well. Similarly, black and Hispanic people having higher incidence of COVID-19–related hospitalization was also expected, highlighting the important factors of race and ethnicity as risk factors for COVID-19–related hospitalization.[8,9] Finally, finding that rhinitis was associated with lower COVID-19 hospitalization is consistent with previous studies suggesting that allergic rhinitis is protective for COVID-19.[10]

Limitations of this analysis are using COVID-19 hospitalization instead of COVID-19–related mortality or a measure of the long-term effects on a person's quality of life, limiting the sample

**TABLE I.** Covariate association with COVID-19 hospitalization in people with asthma

| Variable | COVID hospitalization (N = 1378) | No COVID hospitalization (N = 558,577) | Total (N = 559,955) | Hospitalizations per 1000 person-years | Univariate IRR (95% CI) | Multivariable IRR (95% CI) |
|---|---|---|---|---|---|---|
| Age 65+ y (ref <65) | 907 (65.8%) | 187,806 (33.6%) | 188,713 (33.7%) | 15.60 | 3.7708 (3.374, 4.2142)* | 1.0441 (0.9029, 1.2074) |
| Male (ref female) | 459 (33.3%) | 209,038 (37.4%) | 209,497 (37.4%) | 7.20 | 0.8361 (0.7476, 0.9351)* | 1.1388 (1.0144, 1.2785)* |
| Asian (ref white) | 35 (2.5%) | 17,480 (3.1%) | 17,515 (3.1%) | 6.55 | 1.2406 (0.8817, 1.7456) | 1.4522 (1.0252, 2.057)* |
| Black (ref white) | 400 (29.0%) | 62,477 (11.2%) | 62,877 (11.2%) | 20.90 | 3.9519 (3.4743, 4.4953)* | 2.5818 (2.243, 2.9717)* |
| Hispanic (ref white) | 220 (16.0%) | 55,643 (10.0%) | 55,863 (10.0%) | 12.96 | 2.4474 (2.0932, 2.8616)* | 2.0036 (1.6965, 2.3662)* |
| Northeast region (ref Midwest) | 524 (38.0%) | 82,371 (14.7%) | 82,895 (14.8%) | 20.72 | 3.8259 (3.2909, 4.4479)* | 2.7073 (2.3173, 3.163)* |
| $75,000-$124,999 (ref <$40,000) | 176 (12.8%) | 117,065 (21.0%) | 117,241 (20.9%) | 4.91 | 0.326 (0.2747, 0.3869)* | 0.7149 (0.5964, 0.8569)* |
| $125,000-$199,999 (ref <$40,000) | 66 (4.8%) | 64,318 (11.5%) | 64,384 (11.5%) | 3.35 | 0.2226 (0.1723, 0.2876)* | 0.7191 (0.5492, 0.9414)* |
| $200,000+ (ref <$40,000) | 30 (2.2%) | 48,646 (8.7%) | 48,676 (8.7%) | 2.01 | 0.1339 (0.0926, 0.1934)* | 0.697 (0.4736, 1.0258) |
| Medicare Advantage (ref commercial) | 1130 (82.0%) | 219,097 (39.2%) | 220,227 (39.3%) | 16.66 | 6.9945 (6.0969, 8.0242)* | 1.469 (1.2014, 1.796)* |
| Charlson 2-3 (ref 0-1) | 358 (26.0%) | 115,462 (20.7%) | 115,820 (20.7%) | 10.09 | 5.0751 (4.2796, 6.0186)* | 2.1643 (1.7609, 2.6601)* |
| Charlson 4+ (ref 0-1) | 811 (58.9%) | 99,433 (17.8%) | 100,244 (17.9%) | 26.52 | 13.2998 (11.4257, 15.4814)* | 3.632 (2.9376, 4.4905)* |
| Diabetes | 756 (54.9%) | 108,316 (19.4%) | 109,072 (19.5%) | 22.69 | 5.0199 (4.5154, 5.5807)* | 1.1743 (1.035, 1.3322)* |
| COPD | 590 (42.8%) | 80,348 (14.4%) | 80,938 (14.5%) | 23.89 | 4.4292 (3.9819, 4.9267)* | 1.434 (1.2686, 1.621)* |
| Hypertension | 1203 (87.3%) | 250,569 (44.9%) | 251,772 (45.0%) | 15.62 | 8.3973 (7.1665, 9.8394)* | 2.1984 (1.7783, 2.7177)* |
| Rhinitis | 297 (21.6%) | 163,802 (29.3%) | 164,099 (29.3%) | 5.93 | 0.6623 (0.5825, 0.7529)* | 0.8738 (0.7648, 0.9983)* |
| Sinusitis | 187 (13.6%) | 98,261 (17.6%) | 98,448 (17.6%) | 6.23 | 0.7359 (0.6308, 0.8584)* | 0.9429 (0.8052, 1.1043) |
| Obesity | 406 (29.5%) | 84,209 (15.1%) | 84,615 (15.1%) | 15.74 | 2.3464 (2.0902, 2.6339)* | 1.2573 (1.116, 1.4164)* |
| Severe exacerbation in 2019 | 180 (13.4%) | 29,318 (5.3%) | 29,498 (5.3%) | 20.22 | 2.7564 (2.3568, 3.2237)* | 1.5343 (1.3062, 1.8023)* |
| ICS or ICS/LABA MPR in 2019 | 0.230 (0.324) | 0.167 (0.285) | 0.167 (0.285) | NA | 1.9164 (1.6399, 2.2395)* | 1.2255 (1.0275, 1.4615)* |
| OCS MPR in 2019 | 0.074 (0.198) | 0.028 (0.105) | 0.028 (0.105) | NA | 6.3615 (5.0843, 7.9595)* | 1.9236 (1.4755, 2.5077)* |
| Reliever MPR in 2019 | 0.195 (0.270) | 0.117 (0.195) | 0.117 (0.195) | NA | 4.0562 (3.3827, 4.864)* | 1.309 (1.058, 1.6195)* |

*CI*, Confidence interval; *COPD*, chronic obstructive pulmonary disease; *ICS*, inhaled corticosteroid; *IRR*, incidence rate ratio; *LABA*, long-acting β-agonist; *MPR*, medication possession ratio; *OCS*, oral corticosteroid.
*Indicates statistical significance ($P < .05$).

to people who have insurance coverage, the risk of missing COVID-19–related hospitalizations by relying on billing code only, and the analysis of the earlier stage of the pandemic (March-June 2020). The strengths of the analysis are the national sample representing people in the United States across multiple health care systems and the availability of independent variables that represent multiple domains (race, ethnicity, annual income, comorbid conditions, asthma medication claims, and 2019 baseline asthma risk).

Guidance for increased risks for COVID-19 in people with asthma should be updated from moderate-to-severe asthma to consider the additional risk factors we identified in this analysis, particularly the 4 nongeographic factors with the highest odds associated with them: the highest level of comorbidity, black race, Hispanic ethnicity, and hypertension. These updated criteria should be considered when prioritizing prevention strategies for COVID-19 in people with asthma.

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