RESEARCH LETTER

Clinical Outcomes in Young US Adults Hospitalized With COVID-19

Coronavirus disease 2019 (COVID-19) is increasing rapidly among young adults in the US.[1] Often described as a disease affecting older adults, to our knowledge, few studies have included younger patients to better understand their anticipated clinical trajectory. We investigated the clinical profile and outcomes of 3222 young adults (defined by the US Census as age 18-34 years) who required hospitalization for COVID-19 in the US.

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Methods | Young adults age 18 to 34 years with the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10)* code U07.1 (COVID-19, virus identified) discharged between April 1 and June 30, 2020, were identified in the Premier Healthcare Database, a hospital-based, all-payer database including 1030 US hospitals and health care systems and more than 8 million annual inpatient admissions.[2,3] Pregnant young adults (n = 1644) were excluded because many were admitted for childbirth and not for COVID-19 infection. Only a patient's first hospitalization for COVID-19 was considered.

Comorbidities and outcomes during COVID-19 hospitalization were defined using diagnosis, procedure, or billing *ICD-10* codes. Intensive care utilization was defined by a billing code for intensive care unit room or daily ventilator management. Independent factors associated with the composite outcome of mechanical ventilation or death were identified by multivariable logistic regression. Race and ethnicity were reported by participating hospitals.

Data were collected and deidentified by Premier and transferred to and analyzed at Brigham and Women's Hospital using Stata, version 14 (StataCorp). The Mass General Brigham institutional review board approved the study protocol; the requirement for informed consent was waived because of the deidentified nature of the data. A 2-sided *P* value of <.05 was considered significant.

Results | Among 780 969 adults discharged between April 1, 2020, and June 30, 2020, 63 103 (8.1%) had the *ICD-10* code for COVID-19, of whom 3222 (5%) were nonpregnant young adults (age 18-34 years) admitted to 419 US hospitals. The mean (SD) age of this population was 28.3 (4.4) years; 1849 (57.6%)

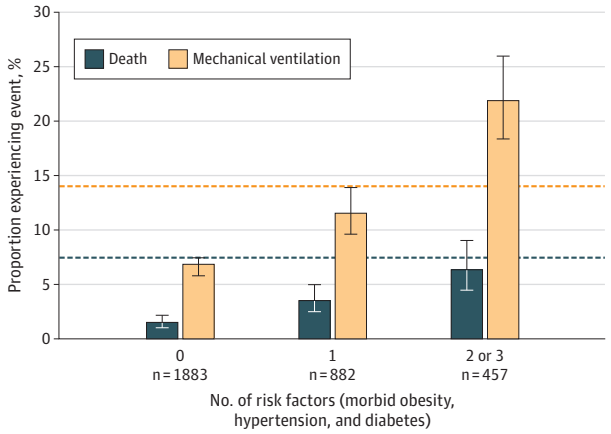
Table. Baseline Characteristics of Young Adults Age 18 to 34 Years With COVID-19[a]

Characteristic	No. (%) Full case series (N = 3222)	No death or ventilation (n = 2879)	Death or ventilation (n = 343)	*P* value
Age, mean (SD), y	28.3 (4.4)	28.3 (4.4)	28.3 (4.5)	.90
Men	1849 (57.6)	1626 (56.7)	223 (65.0)	.003
Race/ethnicity				
White non-Hispanic	536 (16.6)	479 (16.6)	57 (16.6)	.14
White Hispanic	350 (10.9)	324 (11.3)	26 (7.6)	
Black non-Hispanic	748 (23.2)	675 (23.4)	73 (21.3)	
Black Hispanic	14 (0.4)	13 (0.5)	1 (0.3)	
Other/unknown	1574 (48.9)	1388 (48.2)	186 (54.2)	
Black and/or Hispanic	1838 (57.0)	1669 (58.0)	169 (49.3)	.002
Discharge month				
April 2020	1680 (52.1)	1495 (51.9)	185 (53.9)	.004
May 2020	1063 (33.0)	936 (32.5)	127 (37.0)	
June 2020	479 (14.9)	448 (15.6)	31 (9.0)	
Region				
Northeast	1298 (40.3)	1161 (40.4)	137 (39.9)	.002
South	1130 (35.1)	1032 (35.9)	98 (28.6)	
Midwest	558 (17.3)	488 (17.0)	70 (20.4)	
West	233 (7.2)	195 (6.8)	38 (11.1)	
Any obesity, BMI ≥ 30	1187 (36.8)	1007 (35.0)	180 (52.5)	<.001
Morbid obesity, BMI ≥ 40	789 (24.5)	649 (22.5)	140 (40.8)	<.001
Asthma	545 (16.9)	495 (17.2)	50 (14.6)	.22
Hypertension	519 (16.1)	412 (14.3)	107 (31.2)	<.001
Smoking	513 (15.9)	472 (16.4)	41 (12.0)	.03
Diabetes	588 (18.2)	494 (17.2)	94 (27.4)	<.001

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); COVID-19, coronavirus disease 2019.

[a] Race/ethnicity groups include only patients whose race and ethnicity were reported. Patients with missing data for 1 or both were considered other/unknown.

Figure. Death and Mechanical Ventilation in Young Adults With and Without Morbid Obesity, Hypertension, and Diabetes



Morbid obesity, diabetes, and hypertension were determined by *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10)* codes during coronavirus disease 2019 (COVID-19) admission. Proportions of patients experiencing death and mechanical ventilation were compared with a reference group of 8862 middle-aged (age 35-64 years) nonpregnant patients with COVID-19 with none of these conditions in the Premier database (dotted lines). Error bars refer to 95% CIs.

were men and 1838 (57.0%) were Black or Hispanic. Overall, 1187 (36.8%) had obesity, 789 (24.5%) morbid obesity, 588 (18.2%) diabetes, and 519 (16.1%) hypertension (**Table**).

During hospitalization, 684 patients (21%) required intensive care, 331 (10%) required mechanical ventilation, and 88 (2.7%) died. Vasopressors or inotropes were used for 217 patients (7%), central venous catheters for 283 (9%), and arterial catheters for 192 (6%). The median length of stay was 4 days (interquartile range, 2-7 days). Among those who survived hospitalization, 99 (3%) were discharged to a postacute care facility.

Morbid obesity (adjusted odds ratio [OR], 2.30; 95% CI, 1.77-2.98; vs no obesity; $P < .001$) and hypertension (adjusted OR, 2.36; 95% CI, 1.79-3.12; $P < .001$) were common and in addition to male sex (adjusted OR, 1.53; 95% CI, 1.20-1.95; $P = .001$) were associated with greater risk of death or mechanical ventilation. Odds of death or mechanical ventilation did not vary significantly with race and ethnicity. Morbid obesity was present in 140 patients (41%) who died or required ventilation. Diabetes was associated with increased risk of this outcome in univariable analysis (OR, 1.82; 95% CI, 1.41-2.36; $P < .001$) but did not reach statistical significance after adjustment (adjusted OR, 1.31; 95% CI, 0.99-1.73; $P = .06$). Patients with multiple risk factors (morbid obesity, hypertension, and diabetes) faced risks similar to 8862 middle-aged (age 35-64 years) nonpregnant adults with COVID-19 infection without these conditions (**Figure**).

Discussion | Young adults age 18 to 34 years hospitalized with COVID-19 experienced substantial rates of adverse outcomes: 21% required intensive care, 10% required mechanical ventilation, and 2.7% died. This in-hospital mortality rate is lower than that reported for older adults with COVID-19, but approximately double that of young adults with acute myocardial infarction.[4] Morbid obesity, hypertension, and diabetes were common and associated with greater risks of adverse events. Young adults with more than 1 of these conditions faced risks comparable with those observed in middle-aged adults without them. More than half of these patients requiring hospitalization were Black or Hispanic, consistent with prior findings of disproportionate illness severity in these demographic groups.[5,6]

Limitations of this study included defining COVID-19 infection and comorbidities by *ICD-10* codes, which may be subject to misclassification, and variable reporting of race and ethnicity across hospitals. The definition of COVID-19 infection did not require microbiological confirmation. Given the sharply rising rates of COVID-19 infection in young adults, these findings underscore the importance of infection prevention measures in this age group.

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Editor's Note

Regardless of Age, Obesity and Hypertension Increase Risks With COVID-19

Older age has consistently been associated with higher mortality in patients with coronavirus disease 2019 (COVID-19).[1,2] Unfortunately, as shown by Cunningham et al[3] in this issue of *JAMA Internal Medicine*, COVID-19 does not spare young people. Using a national all-payer hospital database, the investigators identified 3222 nonpregnant adults aged 18 to 34 years who were admitted to US hospitals for COVID-19. Morbidity was substantial: 21% required intensive care, and 2.7% died. Mortality was higher among those who had obesity, hypertension, and male sex, as has been noted in general adult populations.

Combined with what we know about the greater risk of older persons, what does this study tell us about COVID-19 and young adults? First, while young adults are much less likely than older persons to become seriously ill, if they reach the point of hospitalization, their risks are substantial. Second, obesity, hypertension, and male sex put patients of all ages at greater risk. As obesity and hypertension are preventable and treatable conditions, reducing the risk of serious COVID 19 illness should be added to the already long list of reasons to increase medical and public health efforts in young adults to promote healthful diets and increased exercise. Finally, the article by Cunningham et al[3] establishes that COVID-19 is a life-threatening disease in people of all ages and that social distancing, facial coverings, and other approaches to prevent transmission are as important in young adults as in older persons.

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Outcomes of Contact Tracing in San Francisco, California—Test and Trace During Shelter-in-Place

Given the pressing need to reopen economic activity prior to the availability of a vaccine, the US and other nations are investing in contact tracing as a core component of the coronavirus disease 2019 (COVID-19) response.[1] An estimated 75% of infected contacts need to be quarantined to contain COVID-19.[2,3] We evaluated case investigation and contact tracing outcomes in San Francisco, California, during shelter-in-place restrictions.

Methods | San Francisco residents diagnosed with COVID-19 were routinely reported to the health department and assigned for case investigation and contact tracing.[4] On May 5, 2020, universal testing for COVID-19 contacts was recommended, regardless of symptoms. This study included cases diagnosed during shelter-in-place from April 13 to June 8, 2020. Cases identified through outbreak investigations in long-term care facilities were excluded (10% of cases).[5]

To evaluate the outcomes of contact tracing, we calculated the proportion of people who were interviewed, identified close contacts, and had at least 1 contact notified, tested, and newly diagnosed with COVID-19. A deterministic match based on personal identifiers was performed between contact and testing databases to (1) exclude contacts who were known to have COVID-19, (2) deduplicate previously named household contacts, and (3) ascertain testing results. We report the median number of days (with interquartile range [IQR]) taken to process each step. Analyses were conducted in SAS, version 9.4 (SAS Institute). Bivariate tests including χ^2 tests to compare categorical variables and *t*-tests for continuous variables were conducted, as appropriate, and a $P < .05$ identified statistical significance. This work was conducted as part of San Francisco Department of Public Health COVID-19 surveillance; institutional review board approval and informed consent were not required.

Results | Among 1633 cases reported, 1394 (85.4%) people were interviewed. Median (IQR) age was 37 (26-49) years; 972 (69.7%) were Latino (85% primarily Spanish-speaking), and 842 (60.3%) were male. Of the 603 (43.2%) interviewed people residing in a household with at least 5 persons, 510 (84.6%) were Latino. Half of interviewed people reported contact with someone diagnosed with COVID-19 (**Table**).

Among 791 people interviewed after recommending universal testing for close contacts, 404 (51.1%) identified a contact not previously diagnosed with COVID-19, 356 (45.0%) had at least 1 contact notified, 206 (26.0%) had at least 1