The Proportion of Adult Americans at Risk of Severe COVID-19 Illness

INTRODUCTION

The COVID-19 pandemic has affected more than 23 million people worldwide, including 5.6 million Americans. Because of these numbers, identifying the population(s) at risk is important. The US Centers for Disease Control and Prevention (CDC) announced on July 17, 2020, that conditions including obesity, diabetes mellitus (DM), chronic kidney disease (CKD), heart disease, and chronic obstructive pulmonary disease (COPD) are well-established risk factors predisposing individuals to severe illness from COVID-19. Other probable risk factors with less robust evidence include asthma and hypertension. We aimed to estimate the proportion of adult Americans at risk from severe COVID-19 illness.

METHODS

In this analysis, participants in the United States National Health and Nutrition Examination Survey (NHANES) 2011–2016 aged ≥20 years were included. Pregnant participants and those with missing relevant laboratory/examination/self-reported data were excluded. The prevalence and 95% confidence intervals (95% CI) of established risk factors (obesity, DM, CKD, heart disease, and COPD), probable risk factors (asthma, stroke, hypertension, taking immunosuppressive agents, and liver disease), and any risk factors (established or probable risk factors) were calculated. Subgroups according to age (<50 and ≥50 years), sex, ethnicity, education, and income level were compared. Data analysis was performed using the R statistical package “survey” (version 3.6.3).

RESULTS

Altogether, 7744 NHANES participants with a mean age of 49.5 years were included (Table 1). Overall, the prevalence of having ≥1 established, probable, or any risk factor were 58.9% (95% CI 56.7–61.0), 55.5% (95% CI 53.2–58.0), and 73.7% (95% CI 71.6–76.0), respectively (Table 2).

Obesity was the most common established risk factor (41.0%), followed by DM (24.0%) and CKD (18.4%). Hypertension was the most common probable risk factor (50.1%), followed by asthma (8.9%) and stroke (3.6%). Obesity and hypertension were consistently the leading risk factors in both age groups: the prevalence of obesity and hypertension in the younger age group were 38.9% and 31.1%, respectively, whereas in the older age group, 43.0% and 68.4% had obesity and hypertension, respectively.

Older participants were more likely to have ≥1 any risk factor; 86.2% of people aged ≥50 years had ≥1 any risk factor, compared to 60.9% in people aged <50 years (P<0.001). Whereas obesity was almost equally common in the young and the old, DM, CKD, heart disease, COPD, stroke, and hypertension were all much more common in people aged 50 years or older.

There were minor differences in the percentage of people with ≥1 established and ≥1 any risk factor according to sex, ethnicity, education, and income level, but the percentages remained around 60% and 75%, respectively. Non-Hispanic Asian appeared to have a lower risk.

DISCUSSION

This is the first study to estimate the proportion of the Americans in the general population at risk from severe COVID-19 illness using data from a nationally representative survey. Alarming three-quarters of adult Americans are at risk. COVID-19 is a threat to people across all age groups, sexes, ethnicities, education, and income levels. Consequently, the three-quarters of adult Americans at risk should stay at home as much as possible during a pandemic. They should observe strict social distancing and personal hygiene measures, such as face covering and hand disinfection. They should have priority access to masks, viral tests, treatment facilities, drugs, and vaccines.

Our study shows that obesity and hypertension are the leading risk factors for severe COVID-19 illness, especially in those aged <50 years. Those at risk should seriously consider lifestyle modifications, including weight control, healthy diet, alcohol moderation, smoking cessation, and regular physical activity. These can also alleviate other risk factors.
Obesity was defined as body mass index (BMI) ≥ 30 kg/m². The prevalence of obesity was calculated using the NHANES data. Prevalence of any risk factors was calculated by adding the prevalence of each individual risk factor. Prevalence of probable risk factors was calculated by adding the prevalence of any probable risk factor to the prevalence of any risk factor. Prevalence of established risk factors was calculated by adding the prevalence of each individual risk factor to the prevalence of any risk factor. Prevalence of probable risk factors was calculated by adding the prevalence of each individual risk factor to the prevalence of any probable risk factor.

Table 1 Characteristics of the NHANES Participants Analyzed

| Characteristics                        | Overall          | Age < 50 years | Age ≥ 50 years | P value |
|----------------------------------------|------------------|----------------|----------------|---------|
| N                                      | 7744             | 3590           | 4154           |         |
| Age                                    | 49.5 ± 0.4       | 35.1 ± 0.3     | 63.5 ± 0.2     |         |
| Ethnicity                              |                  |                |                |         |
| Non-Hispanic White                     | 67.2 (62.8–71.0) | 59.9 (54.8–65.0)| 74.2 (70.0–78.0)| <0.001 |
| Non-Hispanic Black                     | 10.3 (8.4–13.0)  | 11.2 (9.0–14.0) | 9.5 (7.5–12.0) |         |
| Mexican American                       | 8.3 (6.3–11.0)   | 11.6 (9.0–15.0) | 5.1 (3.5–7.0)  |         |
| Other Hispanics                        | 6.0 (4.6–8.0)    | 7.5 (5.8–10.0)  | 4.5 (3.3–6.0)  |         |
| Non-Hispanic Asian                     | 5.4 (4.4–7.0)    | 6.6 (5.4–8.0)   | 4.2 (3.3–5.0)  |         |
| Other ethnicities                      | 2.9 (2.2–4.0)    | 3.2 (2.5–4.0)   | 2.6 (1.8–4.0)  |         |
| Prevalence of established risk factors |                  |                |                |         |
| ≥ 1 established risk factor            | 58.9 (56.7–61.0) | 47.9 (45.4–50.0)| 69.5 (66.5–72.0)| <0.001 |
| Obesity                                | 41.0 (38.9–43.0) | 38.9 (36.3–41.0)| 43.0 (40.1–46.0)| 0.016  |
| DM                                     | 24.0 (22.4–26.0) | 11.7 (10.4–13.0)| 35.8 (33.7–38.0)| <0.001 |
| CKD                                    | 18.4 (17.3–20.0) | 9.0 (8.2–10.0)  | 27.6 (25.6–30.0)| <0.001 |
| Heart disease                          | 8.0 (7.2–9.0)    | 1.8 (1.3–3.0)   | 14.0 (12.6–15.0)| <0.001 |
| COPD                                   | 7.6 (6.6–9.0)    | 4.5 (3.6–6.0)   | 10.6 (9.1–12.0)| <0.001 |
| Prevalence of probable risk factors    |                  |                |                |         |
| ≥ 1 probable risk factor               | 55.5 (53.2–58.0) | 37.4 (34.7–40.0)| 73.1 (70.3–76.0)| <0.001 |
| Asthma                                 | 8.9 (8.0–10.0)   | 7.6 (6.5–9.0)   | 10.2 (8.9–12.0)| 0.011  |
| Stroke                                 | 3.6 (3.2–4.0)    | 0.8 (0.5–1.0)   | 6.4 (5.6–7.0)  | <0.001 |
| Liver disease                          | 2.4 (2.1–3.0)    | 1.8 (1.3–2.0)   | 3.0 (2.4–4.0)  | 0.022  |
| Hypertension                           | 50.1 (47.9–52.0) | 31.1 (28.8–34.0)| 68.4 (65.3–71.0)| <0.001 |
| Taking immuno-suppressive agents       | 2.5 (2.0–3.0)    | 1.2 (0.8–2.0)   | 3.6 (2.9–5.0)  | <0.001 |
| Prevalence of any risk factors          |                  |                |                |         |
| ≥ 1 any risk factor                    | 73.7 (71.6–76.0) | 60.9 (58.2–63.0)| 86.2 (83.7–88.0)| <0.001 |
| ≥2 any risk factors                    | 46.6 (44.5–49.0) | 29.7 (27.5–32.0)| 62.9 (60.2–66.0)| <0.001 |
| ≥3 any risk factors                    | 26.2 (24.3–28.0) | 11.5 (10.0–13.0)| 40.5 (37.8–43.0)| <0.001 |

Data are presented as weighted mean ± standard error, or weighted percentage (95% confidence interval).

DM, diabetes mellitus; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease

P values for age group comparison were obtained by multivariate logistic regression, adjusted for sex and ethnicity, where appropriate, or by chi-square test, where appropriate.

Obesity was defined as body mass index (BMI) ≥ 30 kg/m².

DM was defined as (1) answering “yes” to “(Other than during pregnancy), have you ever been told by a doctor or other health professional that you have diabetes or sugar diabetes?” or (2) glycated hemoglobin ≥ 6.5%, or (3) fasting glucose ≥ 126 mg/dl.

Heart disease was defined as answering “yes” to any of the questions below: (1) “Has a doctor or other health professional ever told you that you had congestive heart failure?” or (2) “Has a doctor or other health professional ever told you that you had coronary heart disease?” or (3) “Has a doctor or other health professional ever told you that you had a heart attack (also called myocardial infarction)?”

CKD was defined as (1) answering “yes” to “Have you ever been told by a doctor or other health professional that you had weak or failing kidneys?” or (2) estimated glomerular filtration rate (eGFR) < 60 ml/min/1.73 m² using the Chronic Kidney Disease Epidemiology Collaboration (CKD – EPI) equation, or (3) urine albumin – creatinine ratio ≥ 30 mg/g.

COPD was defined as answering “yes” to either of the questions below: (1) “Has a doctor or other health professional ever told you that you had emphysema?” or (2) “Has a doctor or other health professional ever told you that you had chronic bronchitis?”

Asthma was defined as answering “yes” to any of the questions below: (1) “Has a doctor or other health professional ever told you that you have asthma?” and (2) “Do you still have asthma?”

Stroke was defined as answering “yes” to the question “(Other than during pregnancy), have you ever been told by a doctor or other health professional that you had a stroke?”

Liver disease was defined as answering “yes” to both of the questions below: (1) “Has a doctor or other health professional ever told you that you had liver disease or cirrhosis?” or (2) “Do you still have liver disease?”

Hypertension was defined as (1) having at least three of the blood pressure measurements on the day of examination as ≥ 130 mmHg for systolic measurement or ≥ 80 mmHg for diastolic measurement, or (2) answering “yes” to “Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?”

including DM, CKD, and asthma, and help reduce the adverse psychological consequences of social distancing.5

A limitation of NHANES is the reliance on self-reported medical history that might cause underestimation of risk factors. Moreover, we have not included cancer as it is highly heterogeneous, or less common conditions such as sickle cell anemia and post-transplant immunodeficiency.

In conclusion, an alarming three-quarters of Americans are at increased risk of severe COVID-19 illness. Obesity and hypertension are the leading risk factors. Individuals with increased risk should strictly follow social distancing and personal hygiene measures and adopt lifestyle modifications.

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### Table 2 Prevalence of ≥1 Established and Any Risk Factor According to Ethnicity, Education Level, and Income level

|                        | ≥1 established risk factor | ≥1 any risk factor | P value  |
|------------------------|---------------------------|--------------------|----------|
| **Sex**                |                           |                    |          |
| Male (referent)        | 56.8 (54.3–59.0)          | 74.5 (71.0–77.0)   |          |
| Female                 | 60.8 (58.2–63.0)          | 72.9 (70.7–75.0)   | 0.019    |
| **Ethnicity**          |                           |                    |          |
| Non-Hispanic White     | 58.0 (55.3–61.0)          | 74.0 (71.2–77.0)   |          |
| Non-Hispanic Black     | 68.7 (65.7–72.0)          | <0.001             |          |
| Mexican American       | 64.9 (60.4–69.0)          | 82.7 (80.3–85.0)   | <0.001   |
| Other Hispanics        | 57.9 (53.1–62.0)          | 73.1 (69.2–77.0)   | 0.355    |
| Non-Hispanic Asian     | 39.5 (35.3–44.0)          | 68.9 (63.6–74.0)   | 0.534    |
| Other ethnicities      | 64.5 (56.0–72.0)          | 56.6 (52.4–61.0)   | <0.001   |
| **Education level**    |                           |                    |          |
| Low                    | 67.1 (64.6–70.0)          | 81.1 (78.4–83.0)   | 0.977    |
| Middle (referent)      | 63.2 (61.0–65.0)          | 77.2 (75.4–79.0)   |          |
| High                   | 46.9 (43.3–51.0)          | <0.001             |          |
| **Income level**       |                           |                    |          |
| Low                    | 65.2 (62.6–68.0)          | 76.9 (74.3–79.0)   | <0.001   |
| Low middle             | 64.3 (60.3–68.0)          | 78.8 (75.7–82.0)   | 0.002    |
| High middle            | 62.9 (59.0–57.0)          | 75.1 (71.4–78.0)   | 0.144    |
| High (referent)        | 52.9 (49.8–56.0)          | 70.5 (67.1–74.0)   |          |

Data are presented as weighted percentage (95% confidence interval). P values were obtained by multivariate logistic regression, adjusted for age, sex, ethnicity, education level, and income level, where appropriate. Education level was classified as low (less than a high school degree), middle (high school graduate/GED or some college/AA degree), or high (college graduate or above). Income level was classified as low (poverty income ratio (PIR) < 1.3), low middle (PIR ≥ 1.3 and < 1.85), high middle (PIR ≥ 1.85 and < 3), or high (PIR ≥ 3).

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