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COVID-19 risk factors and predictors for handwashing, masking, and social distancing among a national prospective cohort of US older adults

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Study design: Data were retrieved for 3257 respondents from a nationally representative prospective sample of US Medicare beneficiaries aged ≥65 years. COVID-19 variables were collected in 2020, whereas all other data were collected in 2019.

Methods: We used multiple logistic regression to analyze COVID-19 risk factors and predictors for handwashing, masking, and social distancing to minimize COVID-19 spread. All models applied survey sampling weights.

Results: Factors significantly associated with increased odds of COVID-19 diagnosis among US older adults were Hispanic ethnicity (adjusted odds ratio [aOR] = 2.83, P = .01), income (aOR = 0.71, P = .04), residential care or nursing home (aOR = 2.62, P = .01), and generalized anxiety disorder (aOR = 2.38, P = .04). We identified multiple factors significantly associated with adherence to handwashing, masking, and social distancing. Most notably, older males had a significantly lower odds of practicing all three COVID-19 mitigation behaviors, and Black older adults had a significantly higher odds of masking (aOR = 7.94, P < .001) and social distancing (aOR = 2.33, P = .01).

Conclusions: When prioritizing COVID-19 prevention efforts for older adults, risk factors that should be considered are race and ethnicity, income, residential setting, and anxiety. To effectively mitigate COVID-19 disease spread, public health professionals must also recognize sociodemographic and health factors may influence whether older adults adhere to handwashing, masking, and social distancing.

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COVID-19. In countries, including the United States, where mask-spread of COVID-19. Behaviors such as masking and social distancing restrictions that increase house-bound populations may unintentionally increase transmission risk for COVID-19 in older residents still reported higher weekly new confirmed COVID-19 cases and deaths.5

Similarly, living arrangement is another common COVID-19 risk factor for older adults, given the ease of transmitting the virus. In multigenerational households, older adults are more likely to live in overcrowded housing, in which there is more than one person per room.4 When adjusting for area-level socio-economic and clinical characteristics, overcrowding in US multigenerational households remained as a risk factor for COVID-19 infection.7 Thus, social distancing restrictions that increase house-bound populations may unintentionally increase transmission risk for COVID-19 in older adults.

Public health guidelines recommend mitigation behaviors such as masking, social distancing, and handwashing to mitigate the spread of COVID-19. Behaviors such as masking and social distancing have been shown to reduce the risk of positive cases of COVID-19.8 In countries, including the United States, where masking is not the cultural norm, higher mask use was positively associated with the following factors: age <50 years; tertiary education; mask use before pandemic; knowing a family, friend, or colleague diagnosed with COVID-19; having cold or flu-like symptoms; self-reported adherence to local mask guidelines; and mask mandates.9 In the same study, New York's mask use among participants aged ≥50 years was not significantly different.

Although there is limited US domestic data on handwashing during COVID-19, few specific handwashing predictors are known. In a study that included the United States among four other countries, handwashing was significantly associated with the following factors: older age, rural residence, female, and greater educational attainment.10 The same study reported similar predictors for social distancing. In a US study, higher percentages of older adults, women, Hispanics, and Black adults self-reported that they remembered to wash their hands in multiple situations before and during the pandemic.11

Unlike handwashing, COVID-19–related social distancing and its predictors in the United States are more heavily researched. Social distancing varied by generational cohort, with older generations more likely to social distance despite lower risk perceptions.12 Social distancing compliance is positively associated with perceived susceptibility of COVID-19 and perceived benefits of social distancing.13

Although older adults have been shown to have higher prevalence and incidence rates for COVID-19, there is limited research examining risk factors that contribute to this phenomenon using a national US sample. One prior study examined sociodemographic and health characteristics in the context of personality as a predictor for COVID-19 mitigation behaviors but did not focus on these factors primarily or to the same depth as our present research, nor did it investigate these factors as predictors of COVID-19 itself.14 To our knowledge, this study is the most thorough analysis yet of sociodemographic and health predictors of COVID-19 diagnosis and of adherence to the three major COVID-19 mitigation behaviors (handwashing, masking, social distancing) among US older adults. Therefore, the purposes of this study were to (1) examine the risk factors for COVID-19 among US older adults and (2) examine the predictors for adherence to handwashing, masking, and social distancing as COVID-19 prevention measures.

Methods

Data source

We retrieved data from the National Health and Aging Trends Study (NHATS), a prospective longitudinal survey containing a nationally representative sample of US Medicare beneficiaries aged ≥65 years. The study oversamples persons at older ages and Black individuals. We merged data from the 2019 NHATS and the 2020 NHATS COVID-19 supplement, in which most of these self-administered questionnaires were completed in July 2020 (51.0%) or August 2020 (33.3%). There was an 82.2% response rate for the NHATS COVID-19 supplement, resulting in 3257 older adults in our final sample. Aside from the COVID-related dependent variables, all other variables were retrieved from the 2019 data.

Dependent variables

COVID-19 diagnosis

Self-reported COVID-19 diagnosis was derived from two questions. First, respondents were asked, ‘Has a doctor or other health professional told you that you may have had COVID-19?’ and available responses were, ‘Yes, definitely,’ ‘Yes, possibly,’ and ‘No.’ Second, respondents were asked, ‘Have you had a positive test for COVID-19?’ and could answer either ‘Yes’ or ‘No.’ We defined a positive COVID-19 diagnosis as a ‘Yes, definitely’ or a ‘Yes, possibly’ diagnosis from a health professional and a ‘Yes’ from a COVID-19 test.

COVID-19 mitigation behaviors

Three COVID-19 mitigation behaviors included handwashing, masking, and social distancing. All three behaviors were asked under the question, ‘During the COVID-19 outbreak, have you ever done the following to keep the disease from spreading?’ Handwashing was measured as, ‘Frequently wash your hands or use sanitizer,’ and responses included ‘Yes’ or ‘No.’ Masking was measured as, ‘Wear a face mask when going out,’ and responses included ‘Yes,’ ‘No,’ or ‘Does not apply.’ Social distancing was measured as, ‘Stay at least 6 feet away from people not living with you,’ and responses included ‘Yes,’ ‘No,’ or ‘Does not apply.’ Any ‘Does not apply’ response was coded as missing. For one of the regression models, we constructed a composite score (range 0–3) by aggregating the number of mitigation behaviors.

Independent variables

Sociodemographic and health variables were included in the regression models. Sociodemographic variables included age, gender, race, and ethnicity (non-Hispanic White [hereafter, White], non-Hispanic Black [hereafter, Black], Hispanic, or Other), highest level of education (less than high school, high school, or college), total household income, marital status (married or unmarried), metropolitan residence (metro or non-metro), and residential setting (community or residential care/nursing home).

Health variables included self-rated health (poor to excellent), body mass index (BMI), activities of daily living (no ADL limitations or at least one ADL limitation), proxy respondent, major depressive disorder in 2019, generalized anxiety disorder in 2019, dementia in...
2019, history of heart attack, history of hypertension, history of diabetes, and history of stroke.

**Analysis plan**

For the dependent variable of COVID-19 diagnosis, we used a series of multiple logistic regression models that first included sociodemographic variables (Model A), then added health variables (Model B), then added COVID-19 mitigation behaviors (Model C). In Model C, there were statistically significant correlations between all three COVID-19 mitigation behaviors, causing the model to automatically omit some behaviors due to multicollinearity. As a result, Model C contained only the aggregate score combining the three mitigation behaviors. The highest individual variance inflation factor (VIF) was 1.88, and the average VIF was 1.23, which indicates there is no evidence of multicollinearity.

Additional multiple logistic regression models were constructed to determine which sociodemographic and health variables were predictors for each COVID-19 mitigation behavior as a dependent variable. There was no evidence for multicollinearity since the average VIF was 1.24 for all three models.

To minimize bias due to missing data (10–15% depending on the dependent variable), multiple imputation by chained equations generated 100 imputed data files with 10 iterations each. There were no substantial differences in the results generated from multiple imputation by chained equation compared with listwise deletion. Odds ratios and 95% confidence intervals (CIs) were produced from the logistic regression models, which applied complex survey sampling weights to ensure the results are representative. Statistical analyses were performed in Stata statistical software version 16.1 (StataCorp LLC, College Station, TX, USA) with two-tailed tests at a 0.05 significance level.

**Results**

**Sample characteristics**

The 3257 survey respondents are described in Table 1. They ranged in age from 65 to 107 years, with a mean age of 74.2 years (standard deviation = 6.6 years), and a slight majority (57.9%) were female. White was the most common race and ethnicity (75.9%) and a high school degree being the most common highest level of education attained (48.2%). The average household income was approximately $61,090. About 80% of respondents resided in a metropolitan area, and most were community dwelling (93.1%). The average self-rated health was between good and very good (2.28 on a scale of 0–4; standard deviation = 0.98), and 15.8% had at least one ADL limitation. The most common health conditions include a history of hypertension (73.9%) and a history of diabetes (28.1%).

**Risk factors for positive COVID-19 diagnosis**

All the COVID-19 diagnosis models were significant, including our final model [F(24,53) = 8.54, P < .01; Table 2]. Three sociodemographic characteristics were significant risk factors for COVID-19 across all models. Hispanic ethnicity increased the odds of COVID-19 by 183% (adjusted odds ratio [aOR] = 2.83, 95% CI = 1.30–6.17, P = .01) compared with White older adults. A log increase in household income decreased the odds of COVID-19 by 29% (aOR = 0.71, 95% CI = 0.50–0.99, P = .04) and residential care increased the odds by 162% (aOR = 2.62, 95% CI = 1.27–5.41, P = .01).

Two health-related characteristics also had significant results. Every one unit increase in BMI increased the odds of COVID-19 by 162% (aOR = 2.62, 95% CI = 1.27–5.41, P = .01).

**Table 1**

Sample characteristics for the National Health and Aging Trends Study.

| Characteristic                      | Mean (SD) or % (n) |
|------------------------------------|--------------------|
| Age (range 65–107)                 | 74.18 ± 6.55       |
| Female                             | 57.94% (1887)      |
| Race and ethnicity                 |                    |
| White, non-Hispanic                | 75.90% (2472)      |
| Black, non-Hispanic                | 16.67% (543)       |
| Hispanic                           | 4.08% (133)        |
| Other                              | 3.35% (109)        |
| Highest level of education         |                    |
| Less than high school              | 14.64% (471)       |
| High school degree                 | 48.23% (1552)      |
| College degree                     | 37.13% (1195)      |
| Income (thousands, USD)            | 61.09 (67.35)      |
| Marital status                     |                    |
| Not married                        | 50.64% (1655)      |
| Married                            | 49.16% (1600)      |
| Household size (no. of individuals)| 1.93 (1.01)        |
| Metropolitan residence             | 80.14% (2610)      |
| Residential setting                |                    |
| Community dwelling                 | 93.12% (3033)      |
| Residential care or nursing home   | 6.88% (224)        |
| Self-rated health (0–4; poor to excellent) | 2.28 (0.98)    |
| Body mass index (kg/m²)            | 27.91 (6.08)       |
| ADL limitations                    |                    |
| None                               | 84.20% (2728)      |
| At least one                       | 15.80% (512)       |
| Proxy respondent                   | 2.21% (72)         |
| Depression                         | 8.91% (288)        |
| Anxiety                            | 7.66% (248)        |
| Dementia                           | 14.8% (485)        |
| History of heart attack            | 16.9% (548)        |
| History of hypertension            | 73.88% (2401)      |
| History of diabetes                | 28.10% (910)       |
| History of stroke                  | 12.43% (402)       |

ADL, activities of daily living; SD, standard deviation.

**Predictors for handwashing**

The model for handwashing was significant [F(23,53) = 4.46, P < .01; Table 3]. Only two characteristics were significantly associated with handwashing. Being female increased the odds of handwashing by 155% (aOR = 2.55, 95% CI = 1.54–4.21, P < .01). In addition, older adults with dementia had a 55% significantly decreased odds of handwashing (aOR = 0.45, 95% CI = 0.24–0.85, P = .01).

**Predictors for masking**

Masking also had a significant model [F(22,52) = 7.46, P < .01] and a large number of significant predictors (Table 3). Females had a significantly higher odds of masking by 251% (aOR = 3.51, 95% CI = 2.03–6.09, P < .01). Race and ethnicity were significant predictors as well. Black older adults were 7.9 times more likely to mask than White older adults (aOR = 7.94, 95% CI = 2.33–27.04, P < .01). Each unit increase in the five-point self-rated health score, measured decreased the odds of masking by 0.7 times (aOR = 0.72, 95% CI = 0.55–0.94, P = .02). Using a proxy respondent for the survey was associated with a decrease in masking by 0.1 times (aOR = 0.10, 95% CI = 0.02–0.53, P < .01), and anxiety also notably decreased the odds of masking by 0.3 times (aOR = 0.30, P < .01).
Predictors for social distancing

Finally, the model for social distancing was significant \( \chi^2(23,52) = 3.29, P < .01 \) and had several sociodemographic predictors (Table 3). Female gender significantly increased the odds of social distancing by 50% (aOR = 150, 95% CI = 1.08–2.08, \( P = .02 \)), and those who self-identified as Black has 133% increased odds compared with White older adults (aOR = 2.33, 95% CI = 1.28–4.24, \( P = .01 \)). Metropolitan residence was also significantly associated with social distancing and increased the odds by 53% (aOR = 1.53, 95% CI = 1.09–2.15, \( P = .02 \)).

Discussion

Three sociodemographic characteristics were shown to be consistently associated with COVID-19 in older adults across all three models: residential care or nursing home residence, Hispanic ethnicity, and income. All three of these findings are supported by current literature. Older adults in nursing homes are at a greater risk due to their congregate setting and the exchange of patients with hospitals.\(^6\) CDC data, meanwhile, report that Hispanic/Latino persons share the highest rate of COVID-19 cases in the United States with American Indian and Alaskan Native persons.\(^7\) This association is likely due to socioeconomic status, healthcare access, working frontline jobs, and multigenerational housing,\(^8,5,7,10\) which ties into income as a COVID-19 risk factor. Neighborhoods with lower average incomes or greater income inequality are significantly correlated with higher COVID-19 incidence,\(^20,21\) and low income is associated with higher rates of COVID-related hospitalizations.\(^22\)

Two health characteristics were also associated with COVID-19 risk, though not consistently. BMI was significantly associated with a positive diagnosis before controlling for mitigation behaviors. Although the mechanism is unclear, a diagnosis of anxiety in 2019 or earlier should be especially noted for its association with COVID-19 in 2020, especially with its 138% increased odds.

Each of the mitigation behaviors had significant predictors, as well. For example, female gender was positively associated with handwashing, masking, and social distancing. This may be due to women’s traditional role as caregivers, which would encourage them to do more to protect themselves and their families or it may be that women are less susceptible than men to an ‘honor culture’ that values the projection of strength and rejection of weakness.\(^24,28\) Acknowledging the SARS-CoV-2 virus as a threat worth taking precautions against may indicate undesirable vulnerability and weakness in various US populations.\(^25\) The data also found that Black older adults were more likely to mask and social distance.
than White older adults, and this may be because of a greater perception of risk due to health histories.33 Black older adults may also know more family members who had been hospitalized with COVID-19, further increasing their perceived risk for the disease.34

Finally, for sociodemographic factors, metropolitan residence was significantly associated with adherence to COVID-19 mitigation behaviors.30 Metropolitan residence was positively associated with social distancing, which may be because of lower perceived risk due to health histories.29 Black older adults may be more anxious about those conditions than about COVID-19.35 Anxiety decreasing the odds of masking is a perplexing finding because we found it is also associated with increased COVID-19 risk. Older adults with anxiety could have both lower feelings of control over their own health and lower perceived efficacy of masks,34 suggesting that they are not only more likely to be mask resistant but that they may be especially susceptible to conspiracy theories regarding the pandemic.36

There are three notable limitations to this study. First, self-reported responses for all measures restrict psychometric information for the dependent variables in each model. Second, these results include only the first two waves of COVID-19 cases in the United States and therefore before other major variants that contributed to subsequent waves of infection. Third, our results are only generalizable to older adults aged 65 years; however, other gerontological research on COVID-19 mitigation may consider older adults aged 65 years.14 Despite these limitations, to our knowledge, the findings in our study present the first examination of factors associated with COVID-19 infection and adherence to major COVID-19 mitigation behaviors using a nationally representative US older adult sample.

Future research can take an even broader view of COVID-19 risk and mitigation beyond the scope presented here. In a global pandemic, the United States is far from the only nation affected by viral infection and mitigation behavior non-adherence, and other work on these topics has been conducted in countries as disparate as Saudi Arabia, Italy, Singapore, and South Africa.8,26–28 Although some similarities presented themselves internationally, such as the

### Table 3

| Independent variable | Handwashing, aOR (95% CI), P | Masking, aOR (95% CI), P | Social distancing, aOR (95% CI), P |
|----------------------|-----------------------------|------------------------|-----------------------------------|
| Age                  | 0.99 (0.95–1.04), 0.80      | 1.03 (0.99–1.07), 0.10 | 0.97 (0.94–1.00), 0.06            |
| Female               | 2.55 (1.54–4.21), 0.001     | 3.51 (2.03–6.09), 0.001 | 1.50 (1.08–2.08), 0.02            |
| Race and ethnicity   |                             |                        |                                   |
| White, non-Hispanic  | Reference                   | Reference              | Reference                         |
| Black, non-Hispanic  | 2.18 (0.81–5.91), 0.12      | 7.94 (2.33–27.04), 0.001 | 2.33 (1.28–4.24), 0.01            |
| Hispanic             | 6.53 (0.80–25.21), 0.08     | NA                     | 2.41 (0.79–7.29), 0.19            |
| Other                | 4.00 (0.77–20.83), 0.10     | 18.13 (1.90–173.21), 0.01 | 1.22 (0.44–3.35), 0.70            |
| Highest level of education |                         |                        |                                   |
| Less than high school | Reference                   | Reference              | Reference                         |
| High school degree   | 0.86 (0.32–2.30), 0.76      | 0.95 (0.32–2.97), 0.92 | 0.76 (0.43–1.38), 0.28            |
| College degree       | 1.05 (0.39–2.85), 0.92      | 1.81 (0.55–5.95), 0.32 | 1.45 (0.72–2.92), 0.29            |
| Income (log)         | 0.93 (0.61–1.43), 0.74      | 1.07 (0.76–1.50), 0.71 | 1.02 (0.79–1.31), 0.87            |
| Marital status       |                             |                        |                                   |
| Not married          | Reference                   | Reference              | Reference                         |
| Married              | 1.48 (0.66–3.35), 0.34      | 1.33 (0.74–2.40), 0.34 | 0.91 (0.56–1.48), 0.69            |
| Household size       | 0.92 (0.73–1.17), 0.48      | 0.91 (0.75–1.11), 0.36 | 1.08 (0.86–1.37), 0.50            |
| Metropolitan residence | 1.32 (0.61–2.83), 0.47    | 1.26 (0.64–2.51), 0.50 | 1.53 (1.09–2.15), 0.02            |
| ADL limitations      |                             |                        |                                   |
| None                 | Reference                   | Reference              | Reference                         |
| At least one         | 0.58 (0.26–1.41), 0.23      | 2.69 (0.95–7.81), 0.07 | 0.75 (0.43–1.32), 0.31            |
| Proxy respondent     | 0.42 (0.12–1.39), 0.15      | 0.10 (0.02–0.43), 0.01 | 1.43 (0.44–4.71), 0.54            |
| Depression           | 0.64 (0.26–1.55), 0.32      | 1.88 (0.57–6.19), 0.29 | 1.47 (0.74–2.94), 0.27            |
| Anxiety              | 1.55 (0.51–4.75), 0.44      | 0.30 (0.13–0.70), 0.01 | 0.70 (0.33–1.48), 0.35            |
| Dementia             | 0.45 (0.24–0.85), 0.01      | 1.23 (0.51–3.00), 0.64 | 1.05 (0.54–1.71), 0.85            |
| History of heart attack | 0.59 (0.29–1.28), 0.26   | 1.02 (0.47–2.18), 0.97 | 1.22 (0.80–1.86), 0.34            |
| History of hypertension | 1.18 (0.62–2.26), 0.61 | 1.18 (0.60–2.31), 0.62 | 1.26 (0.82–1.91), 0.28            |
| History of diabetes  | 0.99 (0.53–1.82), 0.96      | 0.47 (0.31–0.72), 0.01 | 1.13 (0.76–1.66), 0.55            |
| History of stroke    | 1.14 (0.56–2.30), 0.72      | 0.48 (0.24–0.97), 0.04 | 0.66 (0.42–1.04), 0.08            |
| Weighted sample size | 26,195,301                  | 26,188,528             | 26,186,801                       |
| Model significance   | F(23,53) = 4.46, P < .001   | F(23,52) = 7.46, P < .001 | F(23,52) = 3.29, P < .001         |

ADL, activities of daily living; aOR, adjusted odds ratio; CI, confidence interval; NA, not available.

Hispanic was merged with ‘Other’ due to low statistical power.
association between female gender and mitigation behavior adherence.26–28 Absolute rates of adherence can vary dramatically between geographic regions.20,26 Part of this may be due to differing social and political norms, such as pre-existing acceptance of masking in certain East Asian countries,27 but some researchers suggest religion may play a role as well.20,27 For example, cleanliness practices codified in the Islamic faith may have predisposed Saudi Arabian to regularly wash their hands and avoid anything that could be considered unclean.20 Further work on COVID-19 and associated behaviors thus may want to analyze predictors on a global level or apply a sociocultural lens to their local populations.

Conclusion

Our study of US older adults from a nationally representative sample identified numerous risk factors for COVID-19 and predictors for adhering to mitigation behaviors. Knowledge of these nuanced relationships of social, clinical, and environmental factors with infection risk will help prioritize preventative public health approaches to alleviate the public health emergency caused by COVID-19 and other future pandemics. For example, the COVID-19 vaccine supply was severely restricted during the early phase of the pandemic, and our findings indicate prioritizing prevention efforts toward underserved communities and congregate settings may be worthwhile when new vaccines are in development during future disease outbreaks. Public health messaging should also focus on promoting adherence to disease mitigation behaviors among older males and older adults with comorbidities, which were subsequently associated with increased disease risk. Further research is warranted to investigate the connection between anxiety and elevated COVID-19 risk and reasons for racial and ethnic differences in adhering to mitigation behaviors.

Author statements

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Ethical approval

This study was approved by the SUNY Upstate Institutional Review Board for the Protection of Human Subjects (#1769765-1).

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Competing interests

The authors have no real or perceived competing interests to disclose.

Author contributions

R.W. conceived the study and conducted the analysis, J.R.G. and M.A.L. critically contributed to data interpretation. All authors drafted the article and approved the final submitted version.

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