

RESEARCH ARTICLE

Relationship between dementia, COVID-19 risk, and adherence to COVID-19 mitigation behaviors among older adults in the United States

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Abstract

Objectives: To examine how dementia is associated with COVID-19 risk and adherence to COVID-19 mitigation behaviors, and whether mitigation behaviors mediate the relationship between dementia and COVID-19 risk.

Methods/Design: We analyzed 2019 and 2020 data from the National Health and Aging Trends Study, a national prospective cohort study of United States older adults age 65+. Outcomes were COVID-19 diagnosis and adherence to COVID-19 mitigation behaviors (handwashing, mask-wearing, and social distancing).

Results: Among the 3257 older adults in this study, 485 (14.9%) had dementia in 2019 and 98 (3.1%) were COVID-19 positive in 2020. Dementia significantly increased the odds of COVID-19 by 129% (odds ratio [OR] = 2.29, 95% confidence interval [CI] 1.32–3.97), and remained elevated after adjusting for socio-demographics and health (OR = 1.67, 95% CI 0.90–3.11). Dementia significantly decreased the odds of handwashing by 72% (OR = 0.28, 95% CI 0.17–0.44), which remained lower after adjusting for sociodemographics and health (OR = 0.53, 95% CI 0.23–1.21). Dementia was not significantly associated with mask-wearing and social distancing. The relationship between dementia and COVID-19 was primarily mediated by functional impairment, income, and residential setting.

Conclusions: Dementia was associated with an increased COVID-19 risk and lower adherence to handwashing among U.S. older adults. Adherence to COVID-19 mitigation behaviors did not mediate COVID-19 risk by dementia status. For older adults with dementia, COVID-19 risk could be decreased by prioritizing health interventions.

KEYWORDS

cognitive impairment, coronavirus, COVID, dementia, handwash, mask, pandemic, prevention, social distance

Key points

- Older adults with dementia have a higher risk for COVID-19.
- Older adults with dementia are less likely to wash their hands to prevent the spread of COVID-19.

- Dementia status is not associated with mask-wearing or social distancing to prevent the spread of COVID-19.
- The relationship between dementia and COVID-19 risk is primarily mediated by functional impairment, income, and residential setting.

1 | INTRODUCTION

Coronavirus disease 2019 (COVID-19) has been a worldwide pandemic since 2020. The disease was first recorded in the United States on January 21, 2020,¹ and within the following 12 months, approximately 25 million official cases and 419,000 total deaths were reported in the country.² Many risk factors for COVID-19 overlap with those for dementia such as age, obesity, cerebrovascular disease, and diabetes.³⁻⁵ COVID-19 has also been noted for its neurological effects, including viral encephalitis, which suggests that the virus SARS-CoV-2 can target the central nervous system in addition to exacerbating immune and inflammatory reactions to cause hypoxic brain damage.⁶⁻¹¹ Although there is some mixed evidence, most existing literature supports that people with dementia may have a greater risk of contracting COVID-19 than the general public.¹¹⁻¹⁶ Further, other research indicates that COVID-19 patients with pre-existing dementia or cognitive impairment are at higher risk for hospitalization (Atkins et al., 2020; Nystad et al., 2020; Wang, Q., et al., 2021),^{11,16,17} severe cases,¹⁸ and death.^{11,14,15,18-22}

The consequences of the pandemic and its associated public health measures on daily life were noted early on as potential sources of distress among people with dementia and their caregivers.^{5,10,23-28} One factor involved in both this distress and COVID-19 susceptibility among people with dementia may be a difficulty understanding and adhering to COVID-19 mitigation behaviors, such as handwashing, mask-wearing, and social distancing, due to their cognitive impairment.^{5,10,11,15} People with dementia are not only less likely to remember the pandemic and its restrictions when carrying out daily activities, but they may react more poorly to the enforcement of self-protective measures such as mask-wearing and social distancing due to a lack of comprehension or due to psychiatric symptoms worsened by isolation and stress.^{10,29} These concerns have been heightened through anecdotal evidence during the early months of the pandemic, such as in Japan, where dementia patients were reported to have difficulty adhering to social distancing requirements.³⁰

Although prior research has found evidence for an association between dementia and COVID-19,¹¹ these findings have primarily relied upon retrospective samples with inherent data limitations, such as an absence of extensive data on sociodemographics or on adherence to COVID-19 mitigation behaviors. The present study thus examines relationships between dementia status, COVID-19 mitigation behaviors, and COVID-19 risk using a nationally-representative, prospective U.S. older adult sample. The purpose of this study is to: 1) examine the association between dementia and COVID-19 risk among older adults, 2) examine the association between dementia and adherence to COVID-19 mitigation behaviors

(handwashing, mask-wearing, and social distancing) among older adults, and 3) examine whether adherence to COVID-19 mitigation behaviors mediate the relationship between dementia and COVID-19 risk among U.S. older adults. The current literature indicates that dementia is a common comorbidity among COVID-19 patients.^{13,16,17} Given that impaired memory and thinking are typical dementia symptoms, we hypothesized that older adults with dementia will have a higher COVID-19 risk and lower adherence to COVID-19 mitigation behaviors, which would serve as a key mediator to COVID-19 risk.

2 | MATERIALS AND METHODS

2.1 | Data source

Data was retrieved from the National Health and Aging Trends Study (NHATS), a longitudinal panel study that surveys a nationally representative sample of Medicare beneficiaries age 65 and older within the contiguous United States.³¹ We merged data from the most recent NHATS wave in 2019 and the NHATS COVID-19 supplement, which was mailed between June and October 2020. Most of the self-administered supplement questionnaires were completed in July 2020 (51.01%) or August 2020 (33.27%).³² There was an 82.23% response rate for the NHATS COVID-19 supplement, resulting in 3257 older adults in our final sample.³² Except for COVID-related variables, all other variables were retrieved from the 2019 wave.

2.2 | Dementia diagnosis

Our key independent variable was a dementia diagnosis in 2019, which was derived from an NHATS algorithm³³ that uses three cognitive measures: 1) AD8 Dementia Screening Interview³⁴ that assesses memory, temporal orientation, judgment, and function, 2) Cognitive tests that evaluate the respondents' memory (e.g. immediate 10-word recall), orientation (e.g. date), and executive function (e.g. clock drawing test), and 3) Self-report of an Alzheimer's disease (AD) or dementia diagnosis by a doctor. From these cognitive measures, respondents were categorized into three groups: no dementia, possible dementia, or probable dementia. We collapsed these categories into a binary variable for a broad definition of dementia (possible or probable diagnosis), which the NHATS has tested to have a high sensitivity of 85.7% when compared to dementia diagnoses in a consensus expert panel from the Aging, Demographics and Memory Study.³³

2.3 | COVID-19 diagnosis

One of the dependent variables, 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 "Yes, possibly" diagnosis from a health professional or a "Yes" from a COVID-19 diagnostic test.

2.4 | COVID-19 mitigation behaviors

The other dependent variables were the three main COVID-19 mitigation behaviors, which included handwashing, mask-wearing, 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 could be answered as "Yes" or "No". Mask-wearing was measured as, "Wear a face mask when going out" and could be answered as "Yes," "No," or "Does not apply". Social distancing was measured as, "Stay at least 6 feet away from people not living with you" and could be answered as "Yes," "No," or "Does not apply". Any "Does not apply" response was coded as missing.

2.5 | Covariates

Sociodemographic and health covariates were included in the multiple logistic regression models. Sociodemographic covariates included age, gender (male or female), race and ethnicity (non-Hispanic White, non-Hispanic Black, or other), highest level of education (less than high school, high school, or college), total income, marital status (married or unmarried), total number of people in household, metropolitan residence (metro or non-metro), and residential setting (community or residential care/nursing home).

Health covariates included self-rated overall health condition (poor, fair, good, very good, or excellent), body mass index, activities of daily living (ADL) (no ADL limitations or at least one ADL limitation), proxy respondent, major depressive disorder, generalized anxiety disorder, history of heart attack, history of hypertension, history of diabetes, and history of stroke.

2.6 | Analysis plan

To examine the relationship between dementia and the dependent variables of COVID-19 diagnosis and each of the three COVID-19 mitigation behaviors, we used a series of hierarchical logistic

regression models that were unadjusted (Model A), adjusted for sociodemographics (Model B), and finally adjusted for sociodemographics and health (Model C). There were statistically significant correlations between all three mitigation behaviors, leading to model non-convergence due to multicollinearity. Therefore, all three mitigation behaviors could not be included simultaneously in any model. Average variance inflation factor across all models ranged from 1.24 to 1.25, which indicates there is no harmful multicollinearity. To maximize the full number of respondents in the data set and minimize bias due to missing data (approximately 10%), multiple imputation by chained equations (MICE) generated 100 imputed data files with 10 iterations each for regression analyses. There were no substantial differences in results computed from MICE compared to listwise deletion. All models applied complex survey sampling weights using the *svy* suite of commands in Stata statistical software version 16.1 (StataCorp LLC, College Station, TX, USA) with two-tailed tests and 0.05 significance level.

To examine the mediating effects of COVID-19 mitigation behaviors between dementia and COVID-19 diagnosis, we utilized the Karlson-Holm-Breen method, which decomposes these relationships into total, direct, and indirect effects.³⁵ Specifically, for our study, it decomposes the total effect of dementia on COVID-19 diagnosis without mediators into a direct effect (e.g. the effect of dementia on COVID-19 diagnosis after adjusting for mediator, sociodemographics, and health) and indirect effect (e.g. the effect of dementia on COVID-19 diagnosis explained by mediator).

3 | RESULTS

3.1 | Sample characteristics

Among the 3257 respondents, 14.89% ($n = 485$) had dementia in 2019 and 3.07% ($n = 98$) were COVID-19 positive in 2020. Most positive diagnoses came from a COVID-19 test alone (53.06%, $n = 52$), while the remaining came from a health professional alone (20.41%, $n = 20$) or from both a test and health professional (26.53%, $n = 26$). As shown in Table 1, the average age was 74.18 ($SD = 6.56$) and most were female (57.94%). About 75.90% were White, 16.67% were Black, and 7.43% were another race/ethnicity. The highest level of education for most respondents was a high school degree or equivalent (48.23%). Respondents had an average total income of approximately \$61,090 and nearly half were married (49.16%). Most were living in a metropolitan area (80.14%) and were community-dwelling (93.12%). Average overall self-rated health was 2.28 ($SD = 0.98$), which is between "good" (2) and "very good" (3) health. Most respondents did not have any ADL limitations (84.20%), and average BMI was 27.91 ($SD = 6.08$), indicating most were overweight. A small proportion (2.21%) of the interviews were completed by a proxy. The most common health conditions were hypertension (73.88%) and diabetes (28.10%).

TABLE 1 Sample characteristics^a

| Characteristic | Whole sample (n = 3257) | No dementia (n = 2772) | Dementia (n = 485) |
|---|-------------------------|------------------------|--------------------|
| Age | 74.18 (6.56) | 73.42 (6.10) | 78.50 (7.35) |
| Female (% , n) | 57.94% (1887) | 57.40% (1591) | 61.03% (296) |
| Race/ethnicity (% , n) | | | |
| White, non-Hispanic | 75.90% (2472) | 77.20% (2140) | 68.45% (332) |
| Black, non-Hispanic | 16.67% (543) | 15.87% (440) | 21.24% (103) |
| Other | 7.43% (242) | 6.93% (192) | 10.31% (50) |
| Highest level of education (% , n) | | | |
| Less than high school | 14.64% (471) | 11.81% (325) | 31.33% (146) |
| High school degree | 48.23% (1552) | 48.87% (1345) | 44.42% (207) |
| College degree | 37.13% (1195) | 39.32% (1082) | 24.25% (113) |
| Income (thousands) | 61.09 (67.35) | 64.23 (64.72) | 43.15 (78.46) |
| Marital status (% , n) | | | |
| Not married | 50.84% (1655) | 48.59% (1346) | 63.71% (309) |
| Married | 49.16% (1600) | 51.41% (1424) | 36.29% (176) |
| Household size | 1.93 (1.01) | 1.91 (0.97) | 2.03 (1.20) |
| Metropolitan residence (% , n) | 80.14% (2610) | 80.88% (2242) | 75.88% (368) |
| Residential setting (% , n) | | | |
| Community-dwelling | 93.12% (3033) | 95.35% (2643) | 80.41% (390) |
| Residential care or nursing home | 6.88% (224) | 4.65% (129) | 19.59% (95) |
| Self-rated health (0–4; poor–excellent) | 2.28 (0.98) | 2.36 (0.95) | 1.86 (1.05) |
| Body mass index | 27.91 (6.08) | 28.12 (6.05) | 26.67 (6.12) |
| ADL limitations (% , n) | | | |
| None | 84.20% (2728) | 88.80% (2458) | 57.20% (270) |
| At least one | 15.80% (512) | 11.20% (310) | 42.80% (202) |
| Proxy respondent (% , n) | 2.21% (72) | 0.32% (9) | 12.99% (63) |
| Depression (% , n) | 8.91% (288) | 6.88% (190) | 20.76% (98) |
| Anxiety (% , n) | 7.66% (248) | 6.09% (168) | 16.81% (80) |
| History of heart attack (% , n) | 16.94% (548) | 15.37% (424) | 26.11% (124) |
| History of hypertension (% , n) | 73.88% (2401) | 73.04% (2021) | 78.67% (380) |
| History of diabetes (% , n) | 28.10% (910) | 27.01% (745) | 34.30% (165) |
| History of stroke (% , n) | 12.43% (402) | 10.08% (278) | 26.05% (124) |

Abbreviation: ADL, activities of daily living.

^aUnless otherwise indicated, data are expressed as mean (SD).

3.2 | Bivariate results

3.2.1 | COVID-19 diagnosis

There was a statistically significant relationship between dementia status and COVID-19 diagnosis ($\chi^2(1) = 12.61, p < 0.001$; Table 2). In particular, the COVID-19 positivity rate was higher among respondents with dementia (5.66%) compared to those without dementia (2.62%).

3.2.2 | COVID-19 mitigation behaviors

Among the three major COVID-19 mitigation behaviors, there was only a statistically significant relationship between dementia status and handwashing ($\chi^2(1) = 34.77, p < 0.001$; Table 2). Handwashing was lower among respondents with dementia (92.93%) compared to those without dementia (97.86%). Mask-wearing was similar for individuals with dementia (96.95%) and without dementia (96.59%). Social distancing was also

comparable for those with dementia (91.16%) and without dementia (92.35%).

3.3 | Multiple logistic regression results

3.3.1 | COVID-19 diagnosis

For the first research question, we examined the association between dementia and COVID-19 diagnosis, with results shown in Table 3. As shown in Model A, our unadjusted crude model indicates dementia significantly increased the odds of COVID-19 by 129% (odds ratio [OR] = 2.29, 95% confidence interval [CI] 1.32–3.98). In Model B, after adjusting for sociodemographic covariates, dementia continued to increase the odds of COVID-19 by 74%, but this was no longer statistically significant (adjusted odds ratio [aOR] = 1.74, 95% CI 0.93–3.23). COVID-19 risk remained elevated, but insignificant after further adjusting for health covariates in Model C (aOR = 1.42, 95% CI 0.75–2.68).

3.3.2 | COVID-19 mitigation behaviors

For the second research question, we examined the association between dementia and adherence to each of the three major COVID-19 mitigation behaviors, with results shown in Table 3. In Model A, our unadjusted crude model shows that dementia significantly decreased the odds of handwashing as a COVID-19 preventive measure by 73% (OR = 0.27, 95% CI 0.17–0.43). In Model B, after adjusting for sociodemographics, dementia continued to significantly decrease the

odds of handwashing by 68% (aOR = 0.32, 95% CI 0.18–0.58). The odds of handwashing remained significantly lower by 55% after further adjusting for health covariates in Model C (aOR = 0.45, 95% CI 0.24–0.84).

For mask-wearing, all of our models with and without adjustments for sociodemographic and health covariates indicated that dementia increased the odds of mask-wearing, but this relationship was not statistically significant for any model (Model C: aOR = 1.25, 95% CI 0.52–3.02). For social distancing, dementia decreased the odds of social distancing by 17% in Model A, but was not statistically significant (aOR = 0.83, 95% CI 0.54–1.27). Dementia increased the odds of social distancing after adjusting for sociodemographic and health covariates in Model C, but was also not statistically significant (aOR = 1.04, 95% CI 0.64–1.69).

3.4 | Mediating effect of COVID-19 mitigation behaviors

For the third research question, we examined the mediating effect of each of the three COVID-19 mitigation behaviors between dementia and COVID-19 diagnosis using the Karlson-Holm-Breen method (35). As shown in Table 4, the effect of dementia on COVID-19 diagnosis was not significantly mediated by handwashing (OR = 0.97, 95% CI 0.91–1.03), mask-wearing (OR = 1.00, 95% CI 0.99–1.01), or social distancing (OR = 1.00, 95% CI 0.99–1.02). For example, dementia increased the odds of a positive COVID-19 diagnosis by 1.65 times after adjusting for sociodemographics and health, however, further adjusting for the handwashing mediator increased the OR to 1.71.

TABLE 2 COVID-19 diagnosis and adherence to COVID-19 mitigation behaviors by dementia status

| | Whole sample | No dementia | Dementia | Chi-square test |
|---|--------------|--------------|-------------|--------------------------------|
| COVID-19 diagnosis (%), n | | | | |
| Negative | 96.93 (3091) | 97.38 (2641) | 94.34 (450) | $\chi^2(1) = 12.61, p < 0.001$ |
| Positive | 3.07 (98) | 2.62 (67) | 5.66 (27) | |
| Adherence to COVID-19 mitigation behaviors (%), n | | | | |
| Handwashing | 97.14 (3087) | 97.86 (2653) | 92.93 (434) | $\chi^2(1) = 34.77, p < 0.001$ |
| Mask-wearing | 96.67 (2962) | 96.59 (2607) | 96.95 (413) | $\chi^2(1) = 0.14, p = 0.704$ |
| Social distancing | 92.18 (2841) | 92.35 (2439) | 91.16 (402) | $\chi^2(1) = 0.75, p = 0.387$ |

TABLE 3 Multiple logistic regression for the influence of dementia on COVID-19 diagnosis and adherence to COVID-19 mitigation behaviors^a

| Dependent variable | Model A OR (95% CI) | Model B aOR (95% CI) | Model C aOR (95% CI) |
|--------------------|---------------------|----------------------|----------------------|
| COVID-19 positive | 2.29 (1.32–3.98) | 1.74 (0.93–3.23) | 1.42 (0.75–2.68) |
| Handwashing | 0.27 (0.17–0.43) | 0.32 (0.18–0.58) | 0.45 (0.24–0.84) |
| Mask-wearing | 1.29 (0.61–2.76) | 1.07 (0.45–2.51) | 1.25 (0.52–3.02) |
| Social distancing | 0.83 (0.54–1.27) | 0.97 (0.60–1.58) | 1.04 (0.64–1.69) |

Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio.

^aModel A is an unadjusted crude model, Model B is adjusted for sociodemographics, and Model C is adjusted for sociodemographics and health.

To better understand which factors mediate the relationship between dementia and COVID-19 diagnosis, we included all socio-demographic and health variables as mediators. As shown in Table 5, three separate mediation models were created, each with a separate COVID-19 mitigation behavior because the inclusion of all three behaviors precluded model convergence due to multicollinearity.

Across all three models, the relationships between dementia and COVID-19 risk were predominantly mediated by health (range 22%–25%), followed by sociodemographics (range 15%–19%). Specifically, the three variables with the highest mediating effects were: ADL limitations (range 15%–17%), income (range 14%–16%), and residential setting (range 8%–13%).

TABLE 4 Mediating effects of COVID-19 mitigation behavior between dementia and COVID-19 diagnosis

| | Handwashing OR (95% CI) | Mask-wearing OR (95% CI) | Social distancing OR (95% CI) |
|-------------------|-------------------------|--------------------------|-------------------------------|
| Total effect | 1.65 (0.89–3.07) | 1.75 (0.95–3.24) | 1.75 (0.92–3.34) |
| Direct effect | 1.71 (0.92–3.18) | 1.75 (0.95–3.25) | 1.75 (0.92–3.33) |
| Indirect effect | 0.97 (0.91–1.03) | 1.00 (0.99–1.01) | 1.00 (0.99–1.02) |
| Mediation percent | –6.74% | –0.46% | 0.31% |

Abbreviations: CI, confidence interval; OR, odds ratio.

| | Model A | Model B | Model C |
|-----------------------------------|---------------|---------------|---------------|
| Sociodemographics total | 18.63% | 16.86% | 14.95% |
| Age | 1.23% | 1.45% | 0.66% |
| Gender | –0.23% | 0.47% | –0.26% |
| Race/ethnicity | 1.53% | 1.29% | 1.52% |
| Highest level of education | –7.85% | –5.07% | –6.70% |
| Income | 16.20% | 14.03% | 16.02% |
| Marital status | –0.76% | –0.53% | –3.69% |
| Household size | –0.88% | 0.12% | –0.48% |
| Metropolitan residence | –3.31% | –3.31% | –3.18% |
| Residential setting | 12.70% | 8.41% | 11.06% |
| Health total | 25.27% | 22.56% | 22.04% |
| Self-rated health | 7.53% | 7.22% | 6.00% |
| Body mass index | –3.32% | –3.55% | –3.91% |
| ADL limitations | 15.79% | 14.88% | 16.51% |
| Proxy respondent | 6.72% | 4.20% | 4.86% |
| Depression | –4.31% | –8.34% | –3.15% |
| Anxiety | 7.90% | 7.70% | 8.72% |
| History of heart attack | 6.87% | 7.06% | 6.83% |
| History of hypertension | –0.13% | –0.29% | –0.75% |
| History of diabetes | –0.55% | –0.46% | –0.68% |
| History of stroke | –11.23% | –5.86% | –12.39% |
| Mitigation behaviors total | –6.59% | –0.28% | –0.26% |
| Handwashing | –6.59% | - | - |
| Mask-wearing | - | –0.28% | - |
| Social distancing | - | - | –0.26% |

TABLE 5 Mediating effects of sociodemographics, health, and COVID-19 mitigation behavior between dementia and COVID-19 diagnosis

Abbreviation: ADL, activities of daily living.

Note: Bolded rows are the total percentages for variables within each respective group.

4 | DISCUSSION

This study examined how dementia was associated with COVID-19 risk and adherence to COVID-19 mitigation behaviors (handwashing, mask-wearing, and social distancing) among older adults in the United States. For our first research question, we found that U.S. older adults with dementia in 2019 were significantly more likely to have a positive COVID-19 diagnosis in 2020. This remained elevated, but no longer statistically significant after adjusting for sociodemographics and health. These results align with prior studies that have found general associations between dementia and COVID-19 morbidity.^{11,15} Differences in magnitude for our odds ratios may be attributed to a more thorough list of sociodemographic covariates included in our models, and differences in statistical significance could stem from our smaller sample size. Our findings also support previous research suggesting that dementia by itself may not be a risk factor for SARS-CoV-19 infection, but rather other correlated factors.¹⁴ The morbidities with the strongest evidence for COVID-19 hospitalization risk so far have included cancer, cerebrovascular disease, chronic kidney disease, chronic obstructive pulmonary disease, diabetes mellitus, heart conditions, and obesity.³ Several of these conditions have been tied to dementia, such as cerebrovascular disease, diabetes, and obesity.^{4,36}

For our second research question, we found older adults with dementia in 2019 were significantly less likely to adhere to handwashing in 2020 as a COVID-19 preventive measure. In addition, we found dementia was not significantly associated with mask-wearing and social distancing. This partially contradicts our initial hypothesis, and we believe this is because mask-wearing and social distancing are often required and enforced in most public and private settings, whereas handwashing is a typically unmonitored behavior. Despite our extensive review of the literature, there remains very limited understanding of the interplay between dementia and COVID-19 mitigation behaviors. One study, however, indicates that regular visual stimuli, such as caregivers wearing masks, may be enough to influence people with dementia to wear their own mask.³⁰

Due to impaired memory common among those with dementia, we expected adherence to COVID-19 mitigation behaviors would mediate the relationship between dementia and COVID-19 diagnosis. For our third research question, our results indicated that the three mitigation behaviors do not mediate this relationship, which is in contrast to our initial hypothesis. Instead, functional impairment, income, and residential settings were the top three mediators. All three of these characteristics were notably different by dementia status in our sample. For example, respondents with dementia were substantially more likely to report functional impairments in ADL limitations, lower average total household income, and living in residential care or a nursing home. The impact of residential setting on COVID-19 morbidity in particular is supported by prior research.^{10,14,37,38} Given that dementia was not significantly associated with mask-wearing and social distancing, we did not expect either behavior to be significant mediators for COVID-19 risk. The

lower rate of handwashing we found among people with dementia had suggested that hand hygiene could possibly mediate COVID-19 infection. This was not supported by our mediation models and may relate to the growing research that SARS-CoV-19 spreads primarily through airborne means as aerosolized microdroplets.³⁹ Consequently, handwashing may not be as important for mediating the viral spread of COVID-19 compared to mask-wearing and social distancing.³⁹

Our findings indicate older adults with dementia were still 42% more likely to be diagnosed with COVID-19, even after fully adjusting for sociodemographics and health. Other studies indicating higher COVID-19 risk for people with dementia have proposed poor adherence to mitigation behaviors or other unadjusted socioeconomic factors as potential reasons for their results,^{11,12,15} but neither of these hypotheses are supported by our findings. A third possibility is the effect of dementia on the blood-brain barrier, in which dementia is theorized to make the blood-brain barrier more permeable to viral infections such as SARS-CoV-2.^{10,11} If this is the case, susceptibility to COVID-19 among those with dementia may not be specific to the SARS-CoV-2 virus, but potentially other infectious viruses as well.

There were several limitations in our study. First, it is possible the number of COVID-19 cases was underestimated due to limited availability of diagnostic tests during the early stages of the pandemic. Second, questions on COVID-19 mitigation behaviors asked if respondents had “ever done” these behaviors during the pandemic, which potentially inflates the number who may regularly adhere to these behaviors.³² Third, information on COVID-19 behaviors and infection were only available in the 2020 data, whereas all other variables were in the 2019 data. As a result, our mediation model assumes our socioeconomic and health covariates precede dementia diagnosis, and adherence to COVID-19 mitigation behaviors also precedes COVID-19 diagnosis. Fourth, similar to other major data sets of older adults in the U.S., there is no information on level of cognitive impairment and cause of dementia, which could both influence adherence to mitigation behaviors and COVID-19 risk. Fifth, there may be biases in the responses and sample because respondents needed to recall their behaviors during the pandemic and mail the questionnaire back, resulting in a moderate response rate of about 82%. Despite these limitations, our findings fill a major gap in the literature as it is the first examination of the relationship between dementia, COVID-19 mitigation behaviors, and COVID-19 diagnosis. Likewise, one contribution that is especially important is our analysis of whether adherence to COVID-19 mitigation behaviors mediate the association between dementia and COVID-19 diagnosis using a nationally representative U.S. older adult sample.

AUTHOR CONTRIBUTION

Roger Wong conceived the study and conducted the analysis. Margaret Anne Lovier critically contributed to data interpretation, results, discussion, and manuscript preparation. All authors approved the final manuscript.

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CONFLICT OF INTEREST

None declared.

DATA AVAILABILITY STATEMENT

This study uses non-public sensitive data, which may be obtained through an application from the National Health and Aging Trends Study (<https://nhats.org/>).

ETHICS APPROVAL

This study was approved by the SUNY Upstate Institutional Review Board for the Protection of Human Subjects (#1758296-1). Patient consent for publication was not required.

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