



## Research Paper

## Factors associated with COVID-19-related mental health among Asian Indians in the United States

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## ABSTRACT

**Background:** In the United States, the COVID-19 pandemic has caused increased mental health symptoms and mental illness. Specific subgroups such as Asian Indians in the US have also been subject to additional stressors due to unprecedented loss of lives in their home country and increased Asian hate due to the misperception that Asians are to be blamed for the spread of the SARS-CoV-2.

**Objective:** We examined the various factors including discrimination associated with COVID-19-related mental health symptoms among Asian Indians.

**Methods:** We administered an online survey between May 2021 and July 2021 using convenient and snowball sampling methods to recruit Asian Indian adults (age > 18 years,  $N = 289$ ). The survey included questions on mental health and the experience with unfair treatment in day-to-day life. Descriptive analysis and logistic regressions were performed.

**Results:** Overall, 46.0% reported feeling down, depressed, or lonely and feeling nervous, tense, or worried due to the COVID-19 pandemic; 90.0% had received at least one dose of vaccination and 74.7% reported some form of discrimination. In the fully-adjusted logistic regression, age (AOR = 0.95; 95%CI- 0.92, 0.97;  $p < 0.01$ ) and general health (AOR=0.84; 95%CI- 0.73, 0.97;  $p < 0.015$ ) were negatively associated with mental health symptoms. Participants who experienced discrimination were more likely (AOR=1.26; 95%CI- 1.08, 1.46;  $p < 0.01$ ) to report mental health symptoms.

**Conclusion:** In this highly vaccinated group of Asian Indians discriminatory behaviors were associated with mental health symptoms suggesting the need for novel institutional level policy responses to reduce anti-Asian racism

## 1. Introduction

The increased health regulations, restrictions, and uncertainties of COVID-19 have led to increased mental health symptoms and mental

illness (Peterson et al., 2021; Fisher et al., 2021; WHO 2022; Liu et al., 2020; Brooks et al., 2020). The World Health Organization (WHO) estimated a 27.6% increase in major depressive disorders and a 25.6% increase in anxiety disorders with 137.1 (depressive disorders) and

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116.1 (anxiety disorders) additional disability-adjusted years per 100,000 population (WHO 2022). Several studies in the US have evaluated mental health issues during the COVID-19 pandemic and reported increased rates of depression and anxiety among all age groups (Liu et al., 2020; Holman et al., 2020; Czeisler et al., 2020). However, these studies have generally focused on Whites, African Americans, and Hispanic populations (Czeisler et al., 2020; Penner et al., 2021; Snowden and Snowden, 2021).

In the US, examining mental health in other groups such as Asians is important because they were subjected to an increased rate of discrimination during the COVID-19 pandemic (Ruiz et al., 2020; Lee and Waters, 2021). According to the Pew Research Center, Asians faced more discrimination during the COVID-19 pandemic compared to Black, Hispanics, and Whites (Ruiz et al., 2020). Increased discrimination may have been due to the alleged origin of SARS-CoV-2 in China and the misperception that Asians are to be blamed for the virus (Tahmasbi et al., 2021; Huynh et al., 2022). Such discriminatory behaviors can put Asians at risk of poor mental health and the role of discrimination in poor mental health has been well-documented in the literature (Lee and Ahn, 2011; Ayalon and Gum, 2011).

Asians in the US represent diverse ethnic groups that differ from each other in several characteristics such as language, religion, and culture. As mental health issues significantly vary among different ethnic groups (American Psychiatric Association 2017; Budhwani et al., 2015; Siddiqui and Sambamoorthi, 2022), their prevalence in subgroups such as in Asian Indians might vary significantly compared to other ethnic groups. Asian Indians were not immune from such discrimination, according to a published national pool that included 924 Asian Indians, 52.6% (486) reported that they were subjected to a major threat during the pandemic. Morning Consult Even before the COVID-19 pandemic, studies have reported that Asian Indians face discriminatory behaviors in the US (Yoshihama et al., 2012). For example, a pre-COVID-19 study on 733 Asian Indians revealed that higher discrimination was significantly associated with higher depressive symptoms and anxiety (Nadimpalli et al., 2016). It is possible that increased discrimination toward Asian Indians during the COVID-19 pandemic may also contribute to mental health symptoms among Asian Indians. However, to date, no studies have evaluated the effect of COVID-19 on mental health and factors associated with mental health among Asian Indians living in the US.

Therefore, this study assessed the prevalence of mental health and factors associated with mental health symptoms among Asian Indians. We hypothesized that self-reported discrimination will be associated with increased mental health symptoms.

## 2. Methods

We developed a cross-sectional online survey and included Asian Indians who were 18 years and older. The survey consisted of 41 items and was administered using the Qualtrics platform. The screening questions consisted of the age and self-identification of Asian Indians. We used convenient and snowball sampling methods. These methods included posting the survey link and flyer on social media (for example LinkedIn, and Facebook), emailing the survey link and flyer to the network of the authors and their associates, and posting the fliers in nearby temples and university boards.

The survey was approved by the Institutional review board of West Virginia University and the University of North Texas. After passing the screening, 289 Asian Indians participated in the survey. The data for the current study were collected between May 15, 2021, and July 29, 2021.

### 2.1. Dependent variable: mental health symptoms (Yes/No)

The survey included the following probe – “The COVID-19 pandemic may cause challenges for some people, whether they get COVID-19 or not” and “In the past month, have you or your family experienced any of

the below challenges?”. The participants were asked to select all that apply from a list of 9 items. Two of the items were “feeling down, depressed, or lonely” and “feeling nervous, tense, or worried”. If respondents checked either one of the two items they were considered as having mental health symptoms.

### 2.2. Explanatory variables

**Self-reported Discrimination:** The participants were asked whether in the last 12 months they were i) treated with less respect, ii) threatened or harassed, iii) made feel like an outsider who doesn't fit in because of your dress, speech, or other characteristics related to your ethnicity. Questions i and ii were taken from the California Health Interview Survey, Multicultural Discrimination Module- 2007 and 2009 (California Health Interview Survey 2022; 2007 CHIS Discrimination Module 2022; 2009 CHIS Discrimination Module 2022), and question iii was taken from the Brief Perceived Ethnic Discrimination Questionnaire-Community Version (Brief PEDQ-CV) (Brondolo et al., 2005). Psychometric properties of both questionnaires have been validated among different racial/ethnic groups, including Asian Americans, in the literature (Kwok et al., 2011; Shariff-Marco et al., 2011). For each question, the responses were never, rarely, sometimes, often, and always. The responses were coded as follows- never = 0, rarely = 1, sometimes = 2, often = 3, and always = 4. We created a summary score of these responses by summing them. Thus the score can range from 0 to 12, with zero representing no discrimination and higher numbers representing greater levels of discrimination. We also derived binary indicators (yes/no) for each of the three items. Respondents who answered rarely, sometimes, often, and always were combined into one group (yes).

### 2.3. COVID-19 preventive behaviors (yes/no)

A total of seven survey questions queried participants about their COVID-19 preventive behaviors. These questions were adapted from the Centers for Disease Control and Prevention COVID-19 everyday prevention actions (Centers for Disease Control and Prevention 2022). The areas that preventative behaviors covered were – COVID-19 vaccination (yes/no), COVID-19 testing (yes/no), mask-wearing, hand washing, maintaining a 6-ft distance, avoiding gathering, and staying home. For mask-wearing, hand washing, maintaining a 6-ft distance, avoiding gathering, and staying home we combined never, some of the time, very often into one group (no).

### 2.4. Other variables

We included age as years (> 18, continuous), sex (female/male), annual household income (less than \$75 K/greater than or equal to \$75 K), doctor visit (within past 12 months/others), education levels (less than college/college), general health (measured in a scale of 0–100) in the analysis. In general health 0 represented the worst health and 100 represented the best health. We divided the general health by 5 for interpretation purposes. We imputed age and sex information for some participants using the single imputation method (Khan and Hoque, 2020; Jakobsen et al., 2017; Dziura et al., 2013). We imputed the mean age for the missing age values and imputed female for the missing sex values as female was the most frequent value for the variable sex.

### 2.5. Statistical analyses

Chi-square tests were used for determining statistically significant differences in categorical variables by mental health status. T-tests were used to test differences in continuous variables (for example: age). Multivariable logistic regression models were used to determine the association of various factors to mental health symptoms. In regression analyses, we controlled for age, sex, income, doctor visit, COVID-19

preventive behaviors, and general health. All analyses were performed using (SAS v 9.4 (SAS Institute, Inc)).

### 3. Results

#### 3.1. Sample characteristics

Among the survey participants, 53.98% ( $N = 156$ ) did not report any mental health symptoms, 10.38% ( $N = 30$ ) reported they were "nervous, tense, or worried", 4.15% ( $N = 12$ ) reported they were "down, depressed, or lonely", and 31.49% ( $N = 91$ ) reported they were "nervous, tense, or worried," and "down, depressed, or lonely".

A majority of the participants were female (65.1%), and had a mean age of 35.79; 70.9% of the participants had bachelor's or graduate degrees, and 59.8% had a greater than \$75,000 median annual household income (Table 1). A comparison of study sample characteristics with Asian Indians represented in the National Health Interview Survey (NHIS), 2018 is also presented in Table 1. Compared to the NHIS sample, our study sample participants were younger (average age = 35.79 years vs 42.44 years). A higher percentage of our study sample was female (65% vs 49.04%) compared to the NHIS. The differences were not tested for statistical significance (Table 2).

#### 3.2. COVID-19 preventive behaviors (Fig. 1)

A majority of Asian Indians practiced preventative behaviors all the time or most of the time. Also, a majority of the Asian Indians (61.2%) had COVID-19 tests.

Overall, 90.0% of the participants reported that they received the COVID-19 vaccination. 82.7% of participants reported that they received two doses of the vaccine and 7.2% received one dose of the COVID-19 vaccine and 4.8% reported they did not receive any vaccine. However, most participants indicated they were very likely to get the vaccine.

#### 3.3. Sample description: self-reported discrimination

In the study sample, 59.5% reported that they were treated with less respect, 51.6% reported they were made feel like outsiders, and 28.4% reported they were threatened or harassed in the past 12 months.

**Table 1**

A Comparison of Selected Study Sample Characteristics of Asian Indians with National Health Interview Survey, 2018.

|                           | National Health Interview Survey |            | Study Sample |             |
|---------------------------|----------------------------------|------------|--------------|-------------|
|                           | Total                            | Percent    | Total        | Percent     |
| <b>ALL</b>                | 881                              | 100.0      | 289          | 100.0       |
| <b>Sex</b>                |                                  |            |              |             |
| Female                    | 432                              | 49.0       | 188          | 65.1        |
| Male                      | 449                              | 51.0       | 101          | 34.9        |
| <b>Income</b>             |                                  |            |              |             |
| LT 75 K                   | 243                              | 27.6       | 55           | 19.0        |
| >= 75K                    | 511                              | 58.0       | 144          | 49.8        |
| <b>Education (Degree)</b> |                                  |            |              |             |
| LT College                | 269                              | 30.5       | 45           | 15.5        |
| College                   | 603                              | 68.4       | 205          | 70.9        |
| <b>Age in years</b>       |                                  |            |              |             |
| Mean (SD)                 |                                  | 42.4(15.2) |              | 35.8 (12.9) |

Note: Based on 289 adult participants in the study sample and 881 adult Asian Indian participants from the National Health Interview Survey, 2018. Total percentages may not add up to 100% because of the missing data on income and education.

LT = Less than; SD = Standard deviation values are rounded to the nearest 10th after the decimal.

**Table 2**

Characteristics of Asian Indian Adults by Mental Health Status (row percentage).

| Variable Name      | Mental Health Symptoms | %    | No Mental Health Symptoms | %    | p-value |
|--------------------|------------------------|------|---------------------------|------|---------|
| Education          |                        |      |                           |      | <0.001  |
| Less than college  | 28                     | 62.2 | 17                        | 37.8 |         |
| College            | 104                    | 50.7 | 101                       | 49.3 |         |
| Income             |                        |      |                           |      | <0.001  |
| Less than 75K      | 37                     | 67.3 | 18                        | 32.7 |         |
| >= 75K             | 76                     | 52.8 | 68                        | 47.2 |         |
| Sex                |                        |      |                           |      | 0.8978  |
| Women              | 86                     | 45.7 | 102                       | 54.3 |         |
| Men                | 47                     | 46.5 | 54                        | 53.5 |         |
| Saw doctor         |                        |      |                           |      | <0.001  |
| Never/other        | 45                     | 46.9 | 51                        | 53.1 |         |
| Within 12 months   | 88                     | 49.7 | 89                        | 50.3 |         |
| COVID-19 diagnosed |                        |      |                           |      | <0.01   |
| Yes                | 24                     | 72.7 | 9                         | 27.3 |         |
| No                 | 107                    | 42.3 | 146                       | 57.7 |         |
| Less Respect       |                        |      |                           |      | <0.001  |
| No                 | 38                     | 32.5 | 79                        | 67.5 |         |
| Yes                | 95                     | 55.2 | 77                        | 44.8 |         |
| Felt Outsider      |                        |      |                           |      | <0.001  |
| No                 | 47                     | 37.3 | 79                        | 62.7 |         |
| Yes                | 86                     | 57.7 | 63                        | 42.3 |         |
| Threatened         |                        |      |                           |      | 0.3279  |
| No                 | 99                     | 47.8 | 108                       | 52.2 |         |
| Yes                | 34                     | 41.5 | 48                        | 58.5 |         |

Note: Based on 289 adult participants in the study sample. Total percentages may not add to 100% because of the missing data.

#### 3.4. Factors associated with mental health symptoms

Table 3 presents the factors associated with the presence of mental health symptoms among Asian Indians. The result from unadjusted logistic regressions indicated a significant association between self-reported discrimination and the presence of mental health symptoms (UOR = 1.25, 95% CI = 1.11, 1.42;  $p < 0.001$ ). When adjusted for age, sex, income, education, doctor visit, health status, and COVID-19 preventive behaviors a significant association between discrimination and mental health symptoms remained (AOR = 1.26; 95% CI = 1.08, 1.46;  $p < 0.01$ ). Among the demographic variables, age was significantly associated with mental health symptoms (AOR = 0.95; 95% CI = 0.92, 0.97;  $p < 0.001$ ). We also found a statistically significant association between general health and mental health symptoms (AOR = 0.84; 95% CI = 0.73, 0.97;  $p < 0.015$ ).

We also performed logistic regressions among adults who were vaccinated. The findings remained similar to those obtained from the overall sample

### 4. Discussion

During the COVID-19 pandemic, a surge in mental health issues has been observed globally (Santomauro et al., 2021). In the US, the rates of anxiety and depression were as high as 37.2% and 31.1% respectively during COVID-19 (CDC 2022). In our study, the rate was even higher among Asian Indians with 41.9% of the sample reported feeling nervous, tense, or worried and 35.6% of the sample reported feeling down, depressed, or lonely. Studies on Asian Indians conducted before COVID-19 suggest much lower rates of depression and anxiety. For example, a study conducted on Asian Indians reported that the prevalence of depression was 17.7% (Leung et al., 2012). Another study on immigrant Asian Indian women reported that 28% experienced depression symptomatology (Goyal et al., 2006). While our study did not analyze major depressive disorder or generalized anxiety disorder, our study findings suggest increased mental health symptoms during

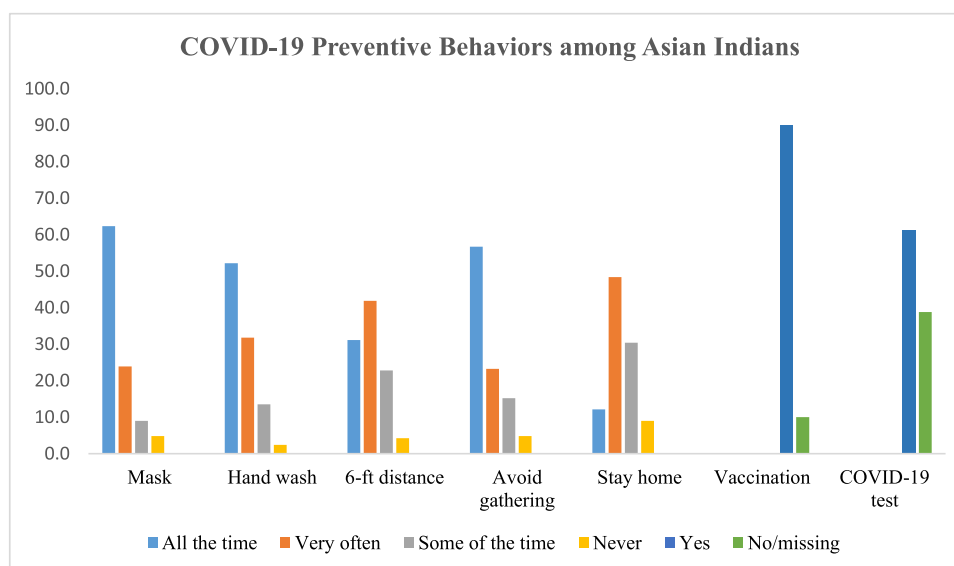


Fig. 1. COVID-19 Preventive Behaviors among Asian Indians.

COVID-19 among the Asian Indians living in the US.

We speculate that a higher prevalence of mental health symptoms in Asian Indians could be due to the presence of COVID-19-related and other stressors. For example, stressors that may not be COVID-19-related are: acculturation, language preference, religion, and cultural barriers (Mann et al., 2017; Joseph et al., 2020). COVID-19-related stressors may have also contributed to the high prevalence of mental health problems. For example, the high rates of morbidity and mortality due to COVID-19 in the Asian subcontinent may have also contributed higher prevalence of mental health burdens (Lancet, 2021; Jha et al., 1979). It has to be noted that COVID-19 was associated with 29% of all deaths in India during 2020–2021 (Jha et al., 1979). A substantial proportion of the Asian Indians living in the US are new immigrants from India (Pew Research Center 2022). Anecdotal evidence from Asian Indians living in the US suggests that at least one member of their immediate or extended family in India was affected by COVID-19. Asian Indians who have families in India may experience mental health symptoms due to increased uncertainties regarding the health conditions of their family members and relatives. In addition, quarantine restrictions might have prevented many individuals from traveling to India to support their families during a time of high need (Fisher et al., 2021; Zhai and Du, 2020). Furthermore, social isolation within the US caused due to COVID-19 restrictions may have also contributed to the increased mental health symptoms. A study conducted on COVID-19 restrictions and mental health in the US found that 52.42% of young adults had moderate mental distress (Sojli et al., 2021). Similarly, another study on young adults suggested that increased disruptions during COVID-19 were associated with increased mental health issues (Giuntella et al., 2021). As our sample was mostly young adults (average age of 35.8 years), we speculate that this may be the case among Asian Indians as well.

In this study, we observed that self-reported discrimination was associated with increased odds of mental health symptoms in Asian Indians. Studies conducted before COVID-19 have also documented the association between self-reported discrimination and mental health burden in immigrant populations (Nadimpalli et al., 2016; Bernstein et al., 2011). Moreover, viewing Asian Indians as “models” for and/or “better than” minority and better than other ethnic groups, can contribute to hostile views of Asian Americans including Asian Indians (McGowan and Lindgren, 2006; Yi and Museus, 2015). Therefore, preventive interventions at the institutional level, programs, and policies are needed to mitigate the impact of racism on population health,

specifically mental health among Asian Americans.

The high prevalence rate of mental health symptoms in Asian Indians has implications for mental health screening and treatment. In the US, Asian Indians are perceived to be a model minority, which may have led many to overlook healthcare needs such as mental health issues in this group (Shih et al., 2019; Lee et al., 2009). Moreover, mental health issues are considered a taboo subject to many Asian Indians and tie them to karma, past sins, and religious beliefs which lead them to seek help from family members or close relatives rather than healthcare professionals (Leung et al., 2012; Conrad and Pacquiao, 2005). Professional help-seeking behaviors may also depend on how social support systems interfere with an individual’s need for professional help (Leung et al., 2012). Treatment considerations should accommodate Asian Indians’ holistic conceptualization of health that include religious, cultural, and social context (Tirodkar et al., 2011).

This study has some important limitations. The survey was internet-based and we had a relatively small sample. A comparison to the NHIS suggests that our sample was disproportionately female, and highly educated with a high income, which may have affected their vaccination status and COVID-19 preventive behaviors. Our study is also subjected to survey-related biases. Some participants did not answer demographic questions. As in our sample, the number of unvaccinated participants was very low, there was not enough power to analyze data based on unvaccinated participants. Similarly, due to the small sample size for some categories, we could not analyze “feeling down, depressed, or lonely” or “feeling nervous, tense, or worried” as a separate dependent variable. We compared our sample with the 2018 NHIS, as NHIS did not collect racial/ethnic information for Asian Indians in the following years. The study findings may not be applicable to other racial/ethnic groups.

## 5. Conclusion

In this sample of Asian Indians with a high vaccination rate and high socioeconomic status 4 in 10 experienced mental health symptoms during COVID-19. Asian Indians who self-reported discrimination were more likely to report mental health symptoms compared to those who did not report discrimination.

## CRedit authorship contribution statement

**Mohammad Ikram:** Conceptualization, Investigation, Formal

**Table 3**

Unadjusted Odds Ratios (UOR), Adjusted Odds Ratios (AOR), and 95% Confidence Intervals (CI), From Logistic Regressions on Mental Health Symptoms among Adults (> 18 years).

|  | Unadjusted Model |              |         | Fully-Adjusted Model |              |         |
|--|------------------|--------------|---------|----------------------|--------------|---------|
|  | UOR              | 95%CI        | P-Value | AOR                  | 95%CI        | P-Value |
| <b>Among All Discrimination</b>        |                  |              |         |                      |              |         |
| Yes                                    | 1.25             | [1.11, 1.42] | 0.0004  | 1.26                 | [1.08, 1.46] | 0.0033  |
| No (ref)                               |                  |              |         |                      |              |         |
| <b>Mask</b>                            |                  |              |         |                      |              |         |
| No                                     | 1.33             | [0.83, 2.15] | 0.2393  | 1.86                 | [0.97, 3.60] | 0.0634  |
| Yes (ref)                              |                  |              |         |                      |              |         |
| <b>Hand wash</b>                       |                  |              |         |                      |              |         |
| No                                     | 0.69             | [0.44, 1.11] | 0.1246  | 0.60                 | [0.32, 1.11] | 0.1034  |
| Yes (ref)                              |                  |              |         |                      |              |         |
| <b>6-ft</b>                            |                  |              |         |                      |              |         |
| No                                     | 2.00             | [1.19, 3.35] | 0.0084  | 1.37                 | [0.67, 2.82] | 0.3865  |
| Yes (ref)                              |                  |              |         |                      |              |         |
| <b>Avoid gathering</b>                 |                  |              |         |                      |              |         |
| No                                     | 1.09             | [0.68, 1.73] | 0.7254  | 0.89                 | [0.47, 1.68] | 0.7126  |
| Yes (ref)                              |                  |              |         |                      |              |         |
| <b>Stayed home</b>                     |                  |              |         |                      |              |         |
| No                                     | 1.74             | [0.83, 3.65] | 0.1409  | 1.07                 | [0.41, 2.83] | 0.8873  |
| Yes (ref)                              |                  |              |         |                      |              |         |
| <b>Sex</b>                             |                  |              |         |                      |              |         |
| Female                                 | 0.97             | [0.60, 1.57] | 0.8977  | 1.44                 | [0.79, 2.65] | 0.2358  |
| Male (ref)                             |                  |              |         |                      |              |         |
| <b>Age</b>                             |                  |              |         |                      |              |         |
| Continuous                             | 0.95             | [0.93, 0.97] | <0.001  | 0.95                 | [0.92, 0.97] | 0.0002  |
| <b>Education</b>                       |                  |              |         |                      |              |         |
| Less than college                      | 1.60             | [0.83, 3.10] | 0.1643  | 0.67                 | [0.28, 1.61] | 0.3703  |
| College (ref)                          |                  |              |         |                      |              |         |
| <b>Income</b>                          |                  |              |         |                      |              |         |
| Less than 75K                          | 1.84             | [0.96, 3.53] | 0.0667  | 1.21                 | [0.54, 2.71] | 0.6418  |
| >= 75 K (ref)                          |                  |              |         |                      |              |         |
| <b>Doctor visit</b>                    |                  |              |         |                      |              |         |
| Never/other                            | 0.89             | [0.54, 1.47] | 0.6537  | 1.10                 | [0.59, 2.08] | 0.7618  |
| Within 12 months (ref)                 |                  |              |         |                      |              |         |
| <b>Vaccine status</b>                  |                  |              |         |                      |              |         |
| No                                     | 0.83             | [0.70, 0.98] | 0.0291  | 0.21                 | [0.04, 1.22] | 0.0822  |
| Yes (ref)                              |                  |              |         |                      |              |         |
| <b>General health</b>                  |                  |              |         |                      |              |         |
| Continuous                             | 0.86             | [0.77, 0.96] | 0.0067  | 0.84                 | [0.73, 0.97] | 0.0155  |
| <b>COVID-19 test</b>                   |                  |              |         |                      |              |         |
| No                                     | 0.60             | [0.37, 0.98] | 0.0017  | 1.03                 | [0.56, 1.91] | 0.9246  |
| Yes (ref)                              |                  |              |         |                      |              |         |
| <b>Among Vaccinated Discrimination</b> |                  |              |         |                      |              |         |
| Yes                                    | 1.27             | [1.11, 1.44] | 0.0003  | 1.26                 | [1.08, 1.48] | 0.0036  |
| No (ref)                               |                  |              |         |                      |              |         |
| <b>Mask</b>                            |                  |              |         |                      |              |         |
| No                                     | 1.37             | [0.83, 2.26] | 0.2242  | 1.99                 | [1.01, 3.91] | 0.0477  |
| Yes (ref)                              |                  |              |         |                      |              |         |
| <b>Hand wash</b>                       |                  |              |         |                      |              |         |
| No                                     | 0.59             | [0.36, 0.96] | 0.0345  | 0.54                 | [0.29, 1.03] | 0.0598  |
| Yes (ref)                              |                  |              |         |                      |              |         |

**Table 3 (continued)**

|                        | Unadjusted Model |              | P-Value | Fully-Adjusted Model |               | P-Value |
|------------------------|------------------|--------------|---------|----------------------|---------------|---------|
|                        | UOR              | 95%CI        |         | AOR                  | 95%CI         |         |
| <b>6-ft</b>            |                  |              |         |                      |               |         |
| No                     | 1.85             | [1.08, 3.16] | 0.0251  | 1.09                 | [0.51, 2.29]  | 0.828   |
| Yes (ref)              |                  |              |         |                      |               |         |
| <b>Avoid gathering</b> |                  |              |         |                      |               |         |
| No                     | 1.12             | [0.69, 1.84] | 0.6411  | 0.93                 | [0.48, 1.79]  | 0.8242  |
| Yes (ref)              |                  |              |         |                      |               |         |
| <b>Stayed home</b>     |                  |              |         |                      |               |         |
| No                     | 1.63             | [0.75, 3.50] | 0.215   | 1.15                 | [0.42, 3.11]  | 0.7899  |
| Yes (ref)              |                  |              |         |                      |               |         |
| <b>Sex</b>             |                  |              |         |                      |               |         |
| Female                 | 1.09             | [0.66, 1.80] | 0.7458  | 1.41                 | [0.76, 2.62]  | 0.2818  |
| Male (ref)             |                  |              |         |                      |               |         |
| <b>Age</b>             |                  |              |         |                      |               |         |
| Continuous             | 0.75             | [0.67, 0.85] | <0.001  | 0.94                 | [0.92, 0.97]  | <0.001  |
| <b>Education</b>       |                  |              |         |                      |               |         |
| Less than college      | 1.67             | [0.84, 3.34] | 0.0018  | 0.65                 | [0.26, 1.62]  | 0.3589  |
| College (ref)          |                  |              |         |                      |               |         |
| <b>Income</b>          |                  |              |         |                      |               |         |
| Less than 75K          | 2.13             | [1.07, 4.25] | 0.0314  | 1.34                 | [0.58, 3.14]  | 0.4938  |
| >= 75 K (ref)          |                  |              |         |                      |               |         |
| <b>Doctor visit</b>    |                  |              |         |                      |               |         |
| Never/other            | 0.93             | [0.56, 1.56] | 0.7935  | 1.21                 | [0.62, 2.33]  | 0.5759  |
| Within 12 months (ref) |                  |              |         |                      |               |         |
| <b>General Health</b>  |                  |              |         |                      |               |         |
| Continuous             | 0.88             | [0.79, 0.98] | 0.0224  | 0.86                 | [0.75, 0.999] | 0.0426  |
| <b>COVID-19 test</b>   |                  |              |         |                      |               |         |
| No                     | 0.70             | [0.42, 1.17] | 0.1737  | 1.10                 | [0.58, 2.09]  | 0.7671  |
| Yes (ref)              |                  |              |         |                      |               |         |

Note: Based on 289 adult participants in the study sample.

Note: Factors associated with mental health symptoms among all adults and among vaccinated adults.

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#### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper



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