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Burden of mental distress in the United States is associated with delayed medical visits and missed prescription refills during the COVID-19 pandemic

Madhu Jalan^{a,*}, Kira Riehm^b, Manali Nekkanti^a, Smisha Agarwal^a, Dustin G. Gibson^a, Alain Labrique^a, Johannes Thrun^{b,c,d}

^a Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, United States of America

^b Department of Mental Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, United States of America

^c Sidney Kimmel Comprehensive Cancer Center at Johns Hopkins, Baltimore, MD, United States of America

^d Centre for Alcohol Policy Research, La Trobe University, Melbourne, Australia

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ABSTRACT

The COVID-19 pandemic has contributed to poor health due to a decrease in healthcare utilization and those with mental health problems may be impacted.

For this analysis, data came from a cross-sectional, nationally representative December 2020 survey. Logistic regression analyses examined associations between (1) mental distress and delayed medical visits, (2) mental distress and missed prescription refills, controlling for sociodemographics, pre-existing chronic conditions, and access to health insurance. We found that, compared to those that exhibited normal levels of mental distress, those with mild (aOR = 2.83, 95% CI = 2.47–3.24), moderate (aOR = 3.43, 95% CI = 2.95–3.99), and severe (aOR = 4.96, 95% CI = 4.21–5.84) mental distress showed greater odds of delaying medical visits. Similarly, compared to those that exhibited normal levels of mental distress, those with mild (aOR = 3.93, 95% CI = 3.04–5.09), moderate (aOR = 6.52, 95% CI = 5.07–8.43), and severe (aOR = 8.69, 95% CI = 6.71–11.32) mental distress showed greater odds of missing prescription refills. Our study shows that individuals who showed signs of mental distress had increased odds of delayed medical visits and missed prescription refills, compared to those that showed normal levels of mental distress.

1. Introduction

In addition to causing death and morbidity (Centers for Disease Control and Prevention (CDC), 2022), the COVID-19 pandemic has also contributed to poor health due to an estimated 33% decrease in healthcare utilization during the pandemic (Moynihan et al., 2021). A Centers for Disease Control and Prevention (CDC) surveys administered in the last week of June 2020 showed that concerns about COVID-19 caused an estimated 41% of U.S. adults to delay or avoid medical care including urgent or emergency care (12%) and routine care (32%) (Czeisler, 2020a). The most frequently reported barrier to receiving health care was the fear of SARS-CoV-2 infection (Papautsky et al., 2021), and the top three types of care that were delayed were dental (38.1%), preventive (29.2%), and diagnostic (16.4%) care (Czeisler,

2020a).

Similar to utilization of healthcare services, rates for prescription medication refills have also fallen during the pandemic due to both supply and demand challenges. Data from prescription drug claims from 252 million patients from May 2019 through August 2020 showed that after an initial jump in prescription refills in March 2020, there was a significant drop in subsequent months (Clement et al., 2021). On the supply side, these challenges can be attributed to some pharmacies having temporarily closed down (Alexander and Qato, 2020) and shortages in availability due to a variety of factors including reduced manufacturing, and lack of raw materials (Ventola, 2011). However, independent of supply issues, there is also evidence that patients decided to forgo prescription refills for medications for chronic conditions (Clement et al., 2021).

* Corresponding author at: Department of International Health, Johns Hopkins Bloomberg School of Public Health, 615 N Wolfe St Suite E8527, Baltimore, MD 21205, United States of America.

E-mail address: mjalan1@jh.edu (M. Jalan).

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Experts have speculated on the possible reasons for deferring health care. These include the desire to avoid exposure to COVID-19 (Lopes and Muñana, 2020), particularly in high incidence areas, financial reasons stemming from lost income or insurance coverage (Keeter, 2020; Chen and McGeorge, 2020), and increased caregiving responsibilities (DeJong et al., 2021). The decision to defer or forego healthcare during COVID-19 could also stem from anxiety, depression, or other mental health concerns (American Psychological Association (APA), 2021). Consequences of the pandemic such as prolonged isolation, (Brooks et al., 2020) financial stress (Drydakis, 2016; Farré et al., 2018), and witnessing death and illness on a massive scale (Galbraith et al., 2021; Jackson et al., 2016) can result in emotional distress and increased risk of psychiatric disorders. For example, surveys found marked jumps in mental health symptoms in April–June of 2020 in comparison to similar time frames in 2019 (McKnight-Eily, 2021; Czeisler, 2020b). A cross-sectional study of almost 190 million emergency department visits collected through the National Syndromic Surveillance Program (NSSP) at the CDC found that visit rates for mental health conditions, suicide attempts, drug overdose, and, domestic abuse were higher in mid-March through October 2020 compared with the same period in 2019 (Holland et al., 2021).

Previous studies on associations between mental health and healthcare utilization traditionally point to a rise in health care utilization with an increase in mental health challenges among children, adults, and the elderly (Lavigne and Meyers, 2019; Jonassaint et al., 2016; Luppá et al., 2012; König et al., 2020). However, the COVID-19 pandemic may have induced avoidance of seeking medical care for a number of reasons. Since the early days of the epidemic, healthcare settings such as hospitals, medical clinics, and pharmacies were perceived as potential sites for virus transmission (Choi et al., 2021). In addition, there has been shortages of beds, medical supplies, and even personal protection equipment (Emanuel et al., 2020; Abbasi, 2020). Given such stressors, avoiding healthcare may seem like a rational strategy to reduce potential exposures.

Patterns of healthcare use in the general population have changed across the pandemic. Following the initial drop during the pandemic onset, a Kaiser Family Foundation (KFF) study found that there was an increase in healthcare utilization over the summer of 2020 for non-COVID related visits, where hospital admissions increased to 90.8% of predicted levels by August 8, 2020 (Heist et al., 2021). A study based on a nationally representative survey conducted in the summer of 2020 (June 11–16) found that symptoms of depression and anxiety were associated with deferring and avoiding medical visits (Ganson et al., 2020). In November 2020, however, as COVID-19 cases surged, non-COVID-19 hospitalizations declined again and were about 80% of predicted hospitalizations (Heist et al., 2021). Building on the study based on data from June 2020 (Ganson et al., 2020), our objective was to examine the association of mental distress with delayed medical visits and missed prescription refills in December 2020, during the third wave of the COVID-19 pandemic in the US. The current study also adds missed prescription refills as additional outcome of interest. This is important because in 2020, only 20.3% of adults had received any mental health treatment including 16.5% of adults who prescription medication, which was the most common type of treatment (Terlizzi and Norris, 2020). Missed prescription refills implies a lack of medication adherence which can result in worsening health conditions and a resultant increase in future healthcare utilization (Dynata 1 Data and Insights Platform, 2022).

2. Methods

2.1. Study design and participants

Data for this study came from National Pandemic Pulse, a cross-sectional survey that sampled participants on the Dynata platform (Dynata 1 Data and Insights Platform, 2022). Dynata maintains a

database of >62 million unique users with accompanying demographic information in the U.S. Dynata employs a series of quality control measures which include digital fingerprinting to prevent duplication, spot checking via third party verification to prove identity, reward redemption quality procedures, and benchmarking against known external data points. The online survey was administered to a representative sample of U.S. adults (≥ 18 years old) matched based on age, race/ethnicity, gender, education, income, and census divisions using a random sample from Dynata's database in December 15–23, 2020.

Of the 10,107 individuals invited to participate, 8481 provided consent via the online platform and completed the survey (completion rate of 83.6%). Responses of “refuse” ($n = 65$), and missing values for the primary variables of interest ($n = 308$; missed delayed medical visits, missed prescription refills, and mental distress variables) were removed from the analysis. A small proportion of respondents reported “other” as their gender ($n = 31$) and hence were excluded from analyses. Responses of “refuse” on income ($n = 427$), “refuse” and “don't know” for health insurance ($n = 166$), and missing values for demographic variables ($n = 1$) were excluded from analysis as well.

This yielded a sample of 7649 participants for analysis. Fig. 1 shows a complete flow diagram for participant inclusion in analyses. The study protocol and survey instruments were approved by the Institutional Review Board at Johns Hopkins Bloomberg School of Public Health (IRB00012413).

2.2. Measures

The primary outcomes of interest were assessed using two questions about delaying medical visits and missed prescription refills. The specific questions were “In the past month, have you delayed getting medical care (including dental, physical, or mental health visits)?” and “In the past month, have you avoided getting a medical prescriptions refilled because you didn't want to leave your house due to COVID-19?” The responses were coded as (1) Yes, (2) No, and (3) I didn't need to go/I didn't need a prescription refill. Responses of “I didn't need to go” (1181) on the question of delaying medical visits and “I didn't need a prescription refill” (1208) on the question of missing prescription refills, were re-coded as “No” for our main analysis. We conducted additional sensitivity analyses recoding these responses as missing, to evaluate if findings were robust to this coding decision.

The independent variable of interest, mental distress, was assessed using a 4-item version of the Patient Health Questionnaire (PHQ-4) (Choi et al., 2021), which has been validated in the general population (Löwe et al., 2010). This measure asks about the frequency of being bothered by feelings of nervousness, worry, depression, and loss of interest over the previous 2 weeks. Response options to each of the four questions include not at all (0), several days (1), more than half the days (2), and nearly every day (3). A score of 3 or higher for the first 2 questions suggests “anxiety”, while a score of 3 or higher on the last 2 questions suggests “depression”. A participant's total score is determined by adding the scores of each of the 4 questions. Based on the score range, individuals are categorized as experiencing normal distress (0–2), mild distress (3–5), moderate distress (6–8), or severe distress (9–12) (Kroenke et al., 2009).

Sociodemographic factors age, gender, race/ethnicity, education, and income have consistently been identified as important factors in explaining the variability in depression prevalence rates and hence were included in analyses (Akhtar-Danesh and Landeen, 2007). US Census region was added as a variable of interest due to the differences in COVID-19 incidence and deaths related to COVID-19 across the US (Centers for Disease Control and Prevention (CDC), 2022). Race/ethnicity was categorized as Non-Hispanic White, Non-Hispanic Black, Hispanic, and Other. Income categories were collapsed into <20 K, 20–39 K, 40–69 K, 70–99 K, 100–149 K and 150 K+. Age categories included 18–24, 25–34, 35–44, 45–54, 55–64, and 65+ years. State data were collapsed into census regions (Midwest, Northeast, South, and West).

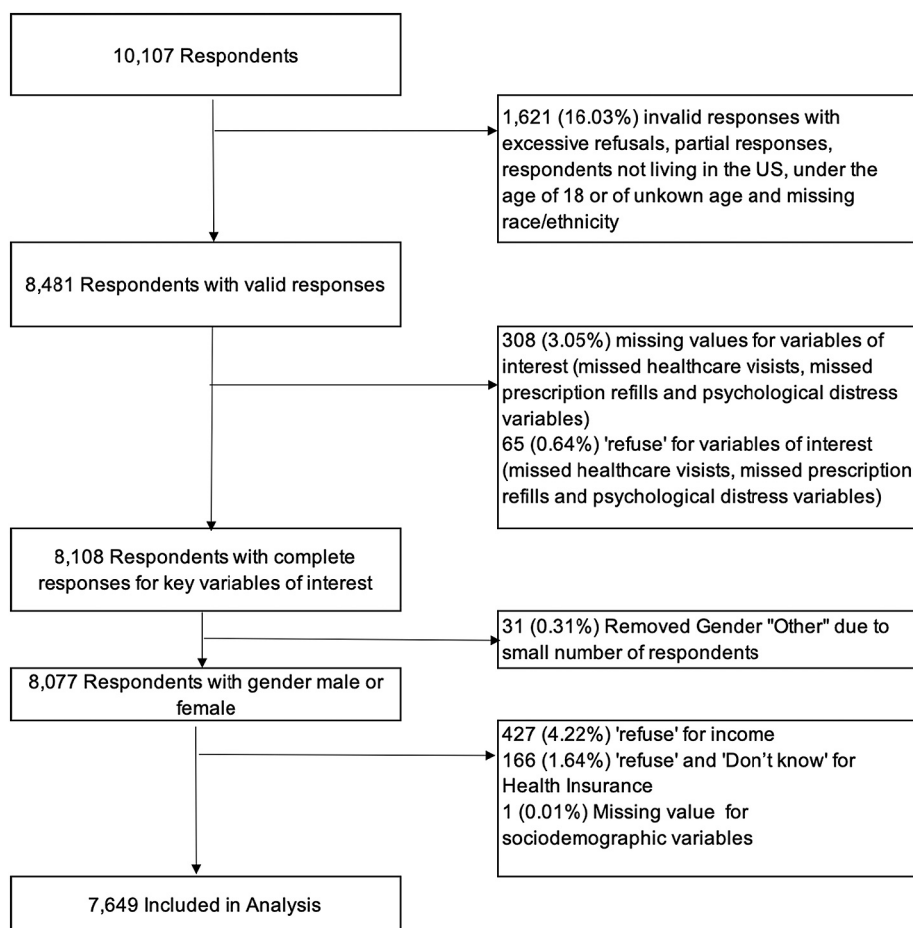


Fig. 1. Explanation for responses included in the analysis.

Common confounders, presence of chronic conditions (Moussavi et al., 2007) and access to health insurance (Baicker et al., 2018), were additional variables included in the analysis. Presence of chronic conditions was coded as a binary variable with 1 as presence of one or more chronic conditions and 0 as absence of chronic conditions. Access to health insurance was also coded as a binary variable with 1 access to health insurance and 0 no access to health insurance.

2.3. Statistical analysis

In separate models, we estimated associations between PHQ-4 levels (coded as a categorical variable) as the main exposure of interest and outcomes delayed medical visits (binary) and missed prescription refills (binary), controlling for sociodemographic variables (gender, race/ethnicity, education, income, age, and census region), presence of chronic conditions, and access to health insurance, using logistic regression models. We first estimated two unadjusted logistic regression models to measure the association between mental distress and delayed medical visits and mental distress, and missed prescription refills, respectively. For the adjusted logistic regression models, we then added sociodemographic variables, the presence of chronic conditions, and access to health insurance to the initial unadjusted models. We also conducted a sensitivity analysis after removing responses of no need for medical visits and no need for prescription refills, respectively. In order to account for pre-pandemic need for care that may be related to anxiety and depression symptoms, we conducted additional sensitivity analyses for participants with one or more chronic conditions. Last, we conducted a sensitivity analysis including responses with “refused to answer” for income, and “refused to answer/unknown” for health insurance as

additional response categories, rather than excluding them from analyses.

Dynata sent out invitations to participate in the survey in large batches and respondents had multiple days to complete the survey. Though the difference in the sample composition was small when compared to the desired nationally representative sample, we applied post-stratification weights based on age, sex, race/ethnicity, and census division using data from the 2019 US Census Estimates. Cross-tabulations and chi-squared tests were used to describe the sample. Variance Inflation Factors (VIFs) were calculated to examine potential multicollinearity between covariates (Supplementary Tables 1 and 2); all values were less than 5, suggesting that multicollinearity did not substantially affect our results (Kim, 2019).

Significance was considered at $p < 0.05$ and all tests were two-sided. Analyses were conducted using Stata, Version 16 (StataCorp, 2019) and the Stats package (stats package - RDocumentation, 2022) in R version 4.0.4 (R Core Team, 2021) and RStudio Version 1.4.1106 (RStudio Team, 2020).

Table 1 describes the demographic makeup of the study sample with raw numbers and weighted percentages. 2117 (28%) participants reported they missed medical visits and 806 (10%) reported they missed prescription refills due to COVID-19 pandemic. PHQ-4 scores indicated that 3955 (55%) reported a normal range of mental distress, 1494 (20%) reported mild mental distress, 1140 (14%) reported moderate mental distress, and 894 (11%) reported severe mental distress.

Table 1

Descriptive statistics of sample characteristics for U.S. adults in round 2 of National Pandemic Pulse (Raw N and weighted percentages).

Characteristic	N = 7483 ¹
Gender	
Female	3723 (50%)
Male	3760 (50%)
Race	
Non-Hispanic White	4690 (63%)
Hispanic	1257 (17%)
Non-Hispanic black	945 (12%)
Other	591 (8%)
Education	
High school or less	1399 (19%)
Some college but no degree	1468 (20%)
Associate degree	809 (11%)
Bachelors	2207 (29%)
Graduate	1600 (21%)
Income	
<20 K	1120 (15%)
20-39 K	1275 (17%)
40-69 K	1572 (22%)
70-99 K	1282 (17%)
100-149 K	1278 (17%)
150+	956 (12%)
Age	
18-24	815 (10%)
25-34	1190 (15%)
35-44	1363 (17%)
45-54	1454 (19%)
55-64	1275 (16%)
65+	1386 (23%)
Region	
Midwest	1575 (21%)
Northeast	1340 (18%)
South	2788 (37%)
West	1780 (24%)
Chronic conditions	
No	4550 (59%)
Yes	2993 (41%)
Health insurance	
No	906 (11%)
Yes	6577 (89%)
Delayed healthcare visits	
I didn't need to go	1181 (16%)
No	4185 (56%)
Yes	2117 (28%)
Missed prescriptions refills	
I didn't need a refill	1208 (16%)
No	5469 (74%)
Yes	806 (10%)
Mental distress	
Normal	3955 (55%)
Mild	1494 (20%)
Moderate	1140 (14%)
Severe	894 (11%)

¹ n (%).

3. Results

3.1. Delayed medical visits

Table 2 presents the results of logistic regression analyses for delayed medical visits. After adjusting for sociodemographic variables (gender, race/ethnicity, education, income, age, and census region), presence of chronic conditions, and access to health insurance, mental distress was significantly associated with delaying medical visits. Compared to those that exhibited normal levels of mental distress, those with mild (adjusted odds ratio (aOR) = 2.83, 95% confidence interval (CI) = 2.47–3.24), moderate (aOR = 3.43, 95% CI = 2.95–3.99), and severe (aOR = 4.96, 95% CI = 4.21–5.84) mental distress showed successively greater odds of delaying medical visits.

Table 2

Logistic Regression – Delayed Healthcare Visits with PHQ-4 modeled as a categorical variable. Significant results are shown in bold.

Variables	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Mental distress		
Normal	–	–
Mild	3.24 (2.84, 3.69)***	2.83 (2.47, 3.24)***
Moderate	4.3 (3.74, 4.95)***	3.43 (2.95, 3.99)***
Severe	6.01 (5.17, 7.00)***	4.96 (4.21, 5.84)***
Gender		
Female	–	–
Male	0.97 (0.87, 1.08)	–
Race		
Non-Hispanic White	–	–
Hispanic	–	1.60 (1.38, 1.84)***
Non-Hispanic black	–	1.47 (1.24, 1.73)***
Other	–	1.11 (0.91, 1.36)
Education		
High school or less	–	–
Some college but no degree	–	1.12 (0.95, 1.33)
Associate degree	–	1.08 (0.88, 1.32)
Bachelors	–	1.10 (0.93, 1.31)
Graduate	–	1.34 (1.11, 1.61)***
Income		
<20 K	–	–
20-39 K	–	0.93 (0.78, 1.12)
40-69 K	–	0.95 (0.80, 1.14)
70-99 K	–	0.98 (0.80, 1.19)
100-149 K	–	1.02 (0.83, 1.24)
150+	–	0.92 (0.73, 1.15)
Age		
18-24	–	–
25-34	–	1.04 (0.85, 1.27)
35-44	–	1.01 (0.83, 1.23)
45-54	–	0.75 (0.61, 0.91)***
55-64	–	0.55 (0.44, 0.68)***
65+	–	0.55 (0.44, 0.68)***
Region		
Midwest	–	–
Northeast	–	1.14 (0.97, 1.35)
South	–	1.00 (0.86, 1.16)
West	–	1.14 (0.97, 1.34)
Chronic conditions		
No	–	–
Yes	–	1.67 (1.50, 1.87)***
Health insurance		
No	–	–
Yes	–	1.54 (1.30, 1.83)***

*p < 0.1; **p < 0.05; ***p < 0.01.

3.2. Missed prescription refills

Table 3 presents the results of logistic regression analyses for missed prescription refills. After adjusting for sociodemographic variables (gender, race/ethnicity, education, income, age, and census region), presence of chronic conditions, and access to health insurance, mental distress was significantly associated with missed prescription refills. Compared to those that exhibited normal mental distress, those with mild (aOR = 3.93, 95% CI = 3.04–5.09), moderate (aOR = 6.52, 95% CI = 5.07–8.43), and severe (aOR = 8.69, 95% CI = 6.71–11.32) mental distress showed greater odds of missing prescription refills.

3.3. Sensitivity analyses

We conducted sensitivity analyses recoding responses on outcome variables as missing, if respondents indicated “I didn't need to go/I didn't need a prescription refill”, as opposed to coding them as “No”, like we did in our main analyses. Findings were robust to this coding decision and demonstrated that participants with mild, moderate, and severe mental distress had greater odds of delayed medical visits and missing prescription refills (Supplementary Table 3 and Supplementary Table 4).

We conducted additional sensitivity analyses for the subgroup of

Table 3
Logistic Regression – Missed Prescription Refills with PHQ-4 modeled as a categorical variable.

Variables	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Mental distress		
Normal	–	–
Mild	5.84 (4.59, 7.46)***	3.93 (3.04, 5.09)***
Moderate	12.09 (9.59, 15.35)***	6.52 (5.07, 8.43)***
Severe	14.97 (11.81, 19.10)***	8.69 (6.71, 11.32)***
Gender		
Female	–	–
Male		1.92 (1.61, 2.30)***
Race		
Non-Hispanic White	–	–
Hispanic		1.96 (1.59, 2.42)***
Non-Hispanic black		1.89 (1.45, 2.44)***
Other		0.87 (0.61, 1.22)
Education		
High school or less	–	–
Some college but no degree		0.66 (0.50, 0.88)***
Associate degree		0.97 (0.71, 1.33)
Bachelors		0.96 (0.73, 1.26)
Graduate		1.64 (1.23, 2.20)***
Income		
<20 K	–	–
20-39 K		0.73 (0.56, 0.97)**
40-69 K		0.52 (0.38, 0.71)***
70-99 K		0.93 (0.69, 1.26)
100-149 K		1.24 (0.91, 1.69)
150+		1.16 (0.83, 1.63)
Age		
18–24	–	–
25–34		1.06 (0.83, 1.38)
35–44		0.82 (0.63, 1.07)
45–54		0.31 (0.23, 0.41)***
55–64		0.15 (0.10, 0.23)***
65+		0.06 (0.03, 0.09)***
Region		
Midwest	–	–
Northeast		1.25 (0.95, 1.65)
South		1.39 (1.10, 1.77)***
West		1.28 (0.98, 1.67)*
Chronic conditions		
No	–	–
Yes		2.54 (2.14, 3.01)***
Health insurance		
No	–	–
Yes		1.92 (1.5, 2.48)***

*p < 0.1; **p < 0.05; ***p < 0.01.

participants with one or more chronic conditions. For the outcome of delayed medical visits among participants with one or more chronic conditions, those with mild (aOR = 2.94, 95% CI = 2.39–3.63), moderate (aOR = 3.5, 95% CI = 2.77–4.43), and severe (aOR = 5.2, 95% CI = 4.06–6.67) mental distress showed greater odds of missing prescription refills, compared to those that exhibited normal mental distress. For the outcome of missed prescription refills among participants with one or more chronic conditions, those with mild (aOR = 5.24, 95% CI = 3.59–7.78), moderate (aOR = 9.13, 95% CI = 6.24–13.58), and severe (aOR = 7.68, 95% CI = 5.17–11.59) mental distress showed greater odds of missing prescription refills, compared to those that exhibited normal mental distress.

Last, we conducted a sensitivity analysis including responses with “refused to answer” for income, and “refused to answer/unknown” for health insurance as additional response categories, rather than excluding them from analyses, and found that neither group was significant, and inclusion did not change results for the main exposure of interest.

4. Discussion

In this study, we found significant associations between mental

distress and delayed medical visits, and mental distress and missed prescription refills, controlling for sociodemographics, chronic conditions, and access to health insurance. Individuals who showed signs of mild, moderate, or severe mental distress had increased odds of delayed medical visits and missed prescription refills, compared to those that showed normal levels of mental distress.

The National Alliance of Mental Illness (NAMI), estimates that almost 60% of those with mental illness do not receive treatment (*Mental Health By the Numbers - NAMI Cumberland and Perry Counties, PA - NAMI Cumberland and Perry Counties, PA, 2022*). Individuals with serious mental illness are more likely than members of the general population to forgo medical care which may be attributed to challenges with accessing services, long wait times, lack of transportation, and affordability (*Mojtabai et al., 2014*). Moreover, studies conducted during early phases of the COVID-19 pandemic reported that individuals who experienced symptoms of anxiety and depression were more likely to avoid seeking non-COVID-19 related medical care, despite needing it (*Ganson et al., 2020*). The COVID-19 pandemic may have exacerbated anxiety due to healthcare settings being depicted as potential sites for virus transmission (*Choi et al., 2021*) and shortages of supplies, personnel, and personal protective equipment (*Emanuel et al., 2020; Abbasi, 2020*). Considering these challenges, it may seem like a rational strategy for those with mental distress to delay medical visits.

Even before the onset of the COVID-19 pandemic, research has shown that most patients find it challenging to keep track of refills of various prescription medications (*Kroenke et al., 2009*). Medication nonadherence is common in people with serious and chronic disorders for a variety of reasons including poor insight, fear or side effects, inadequate efficacy with persistent symptoms, and believing that medications are no longer needed (*Velligan et al., 2010*). Patients treated with antidepressants often discontinue use prior to the recommended treatment duration of six months (*Bushnell et al., 2016*). When there are additional logistical issues in supply of medication with pharmacies being closed (*Alexander and Qato, 2020*), and shortages in availability (*Drug Shortages Statistics - ASHP, 2022*) during the pandemic, it is not surprising that those with mental distress would find it difficult to navigate refilling prescriptions on time.

Multiple studies have found that social isolation (*Brooks et al., 2020*), financial stressors (*Keeter, 2020; Chen and McGeorge, 2020*), and prolonged exposure to death and illness have exacerbated mental health and other problems including suicide attempts, substance use disorders, mental distress, and domestic violence during the pandemic (*McKnight-Eily, 2021; Czeisler, 2020b; Holland et al., 2021*). Our analysis suggests that efforts to improve healthcare utilization are required to address mental health needs of the populations such as challenges with delaying medical visits and missing prescription refills.

The finding that the presence of a chronic condition was associated with increased risks of delayed medical visits and missed prescription refills is not surprising, given CDC guidance that those with chronic condition may be more likely to get severely ill from COVID-19 (*Centers for Disease Control and Prevention (CDC), 2020*). Thus, those individuals may be more likely to avoid public places, and healthcare settings more specifically, out of fear of getting infected. Moreover, individuals with chronic conditions may have mobility challenges and may require assistance to travel, which could be more difficult to obtain during a global pandemic (*Kriegsman et al., 1997*).

Interestingly, access to health insurance was also significantly associated with delayed medical visits and missed prescription refills. While this finding may seem counterintuitive at first, it may simply reflect that individuals without health insurance do not engage with the healthcare system in a proactive and preventative fashion (*Freeman et al., 2008*), and use emergency services for urgent and unavoidable healthcare needs. Since those emergency services are unscheduled, uninsured individuals may not delay medical care as much as those with insurance. This interpretation is in line with CDC data that showed more U.S. adults reported delaying routine care (32%) compared to urgent or emergency

care (12%), due to concerns about COVID-19 (Czeisler, 2020a). Future studies may want to investigate if the type of health insurance (e.g., employment-based, Medicare, Medicaid) may differentially impact healthcare utilization during COVID.

Our study is based on a nationally representative sample, which is a strength. However, a number of limitations should be highlighted. First, our respondents were identified using a web-based platform, which required access to a smartphone or computer with internet access to participate in the survey. As a consequence, segments of the population that do not have access to this technology may have been excluded. Generalizability of findings may be further reduced because some responses were excluded from analyses (e.g., “unknown” gender; “refused to answer” for income; “refused to answer/unknown” for health insurance). While our study established a relationship between mental distress and delaying medical visits and missing prescription refills, we did not study the setting of the medical visits missed or types of prescriptions that were not refilled. This study also presents results from a cross sectional analysis which cannot be used to establish causality. Due to the cross-sectional nature of our data we cannot dispute potential reverse causality. At the time of data collection, the COVID-19 pandemic in the US had been ongoing for almost an entire year and it is possible that individuals whose health care had been disrupted were experiencing additional distress as a result. This alternative explanation would be in line with previous studies which demonstrated that sickness and death of close family and friends, and lack of access to medical care and medications during a disaster can predict adverse mental and physical health (Raker et al., 2020). In addition, a recent longitudinal study suggested that pre-pandemic serious mental distress predicted disrupted health care early on in the COVID-19 pandemic (May 2020), which in turn predicted subsequent serious mental distress assessed in August 2020 (Breslau et al., 2021). These findings suggest that associations between mental distress and healthcare disruptions may be bidirectional. Another limitation is that our survey used the Patient Health Questionnaire (PHQ)-4 which, despite favorable reliability and validity data (Löwe et al., 2010), is a brief screening instrument for anxiety and depression and may not reflect a diagnosed disorder according to DSM-5. Lastly, we selected a consistent set of confounders for both outcomes, but unmeasured or residual confounding cannot be ruled out.

Findings of this study suggest a number of important implications for healthcare services and future research. A February 2021 poll of the American Psychological Association showed that the indirect impact of the pandemic is likely to extend beyond the acute phase, with many adults reporting difficulties with managing stressors (American Psychological Association (APA), 2021). It is therefore important to continue to study the long-term impact of delayed medical visits and missed prescription refills on quality of life, mental health, morbidity, and mortality. Future studies could also develop interventions that assist those at risk of delaying medical visits and missing prescription refills by ensuring appropriate follow up through mechanisms such as medication adherence platforms and telehealth visits. Finally, concerted efforts to improve healthcare utilization and to address the mental health needs of the U.S. population are needed.

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Ethical approval

The study protocol and survey instruments were approved by the Institutional Review Board at Johns Hopkins Bloomberg School of Public Health (IRB00012413). All participants provided consent (electronically).

CRediT authorship contribution statement

Madhu Jalan: Conceptualization, Methodology, Software, Validation, Formal analysis, Data curation, Resources, Writing – original draft, Visualization, Project administration. **Kira Riehm:** Methodology, Writing – original draft, Writing – review & editing, Visualization. **Manali Nekkanti:** Writing – original draft, Writing – review & editing. **Smisha Agarwal:** Conceptualization, Investigation, Resources, Writing – review & editing. **Dustin G. Gibson:** Conceptualization, Software, Validation, Investigation, Resources, Data curation, Writing – review & editing. **Alain Labrique:** Conceptualization, Writing – review & editing, Funding acquisition. **Johannes Thrul:** Conceptualization, Methodology, Writing – review & editing, Supervision.

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.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.yjmed.2022.107195>.

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