BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-052495
Article Type:	Original research
Date Submitted by the Author:	19-Apr-2021
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Keywords:	COVID-19, MENTAL HEALTH, PRIMARY CARE

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Prevalence of clinically-relevant anxiety and depressive symptoms and impact on self-management of chronic conditions amidst COVID-19: a cross-sectional analysis

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Abstract Word Count: 278/300
Manuscript Word Count: 3117/4000
Number of Tables: 3
Number of References: 28
Keywords: COVID-19, mental health, depression, anxiety, health self-management, healthcare utilization

ABSTRACT

Objectives: To determine the prevalence and factors associated with clinically-relevant anxiety and depressive symptoms among adults with high COVID-19 risk due to underlying health conditions during the acceleration phase of the U.S. pandemic. Secondarily, to examine associations between mental health symptoms and COVID-related emotional distress, health self-management, and healthcare utilization.

Design: Cross-sectional analysis of Wave 3 (May 1 – 22, 2020) survey data from the ongoing Chicago COVID-19 and Comorbidities (C3) study.

Setting: Five academic internal medicine practices and two federally qualified health centers in Chicago, IL.

Participants: 565 adults aged 23 to 88 with one or more chronic conditions completing at least one prior C3 study Wave.

Primary and secondary outcome measures: Clinically-relevant anxiety and depressive symptoms were measured using Patient-Reported Outcomes Measurement Information System (PROMIS) short-forms and defined as T-scores of 63.2 and 59.9, respectively. Self-reported emotional and health-related responses to COVID-19 were measured through a combination of single-item questions and validated measures.

Results: Rates of clinically-relevant anxiety and depressive symptoms were 14% and 15%, respectively. Female gender was independently associated with greater risk for anxiety and depressive symptoms after controlling for other sociodemographic factors; low health activation was a significant predictor of anxiety. In adjusted multivariate analyses, anxiety and depressive symptoms were separately associated with greater worry about contracting COVID-19, higher levels of stress and loneliness related to the pandemic, poorer treatment adherence, as well as

greater avoidance of the doctor, and difficulty managing health and medications due to the pandemic.

Conclusions: In addition to optimizing emotional well-being during the pandemic, adequately identifying and addressing mental health concerns may also be an important factor to consider in COVID-19 prevention and management among high-risk medical populations.

ARTICLE SUMMARY

Strengths and Limitations of this Study

- A major strength of this study was the intentional focus on adults with one or more chronic medical conditions, a population at higher risk for adverse COVID-19 outcomes.
- Our sample was diverse by race/ethnicity, SES, and health literacy, increasing generalizability.
- Mental health symptoms were based on self-report, not diagnostic assessment.
- The cross-sectional nature of the analysis and lack of information on mental health functioning prior to the COVID-19 pandemic limits the ability to infer causation.

Funding

This work was supported by grants R01AG030611, R01AG046352, R01DK110172, R01NR015444, and P30AG059988 from the National Institutes of Health (NIH). The funding organization had no role in the design of the study and collection, analysis, and interpretation of data, and in writing the manuscript.

Competing Interests

MS reports personal fees from BioVie outside the submitted work. SCB reports grants from the NIH during the conduct of the study; grants from Merck, the NIH, the Gordon and Betty Moore Foundation, and Eli Lilly outside the submitted work; grants and personal fees from Pfizer outside the submitted work; and personal fees from Sanofi, University of Westminster, and Luto outside the submitted work. MSW reports grants from the NIH during the conduct of the study; grants from Merck, the Gordon and Betty Moore Foundation, the NIH, and Eli Lilly outside the submitted work; and personal fees from Sanofi, Pfizer, and Luto outside the submitted work. Authors not named here have disclosed no conflicts of interest.

Data Sharing

Data available upon reasonable request to the corresponding author.

INTRODUCTION

The rapid emergence and ongoing spread of the SARS-CoV-2 virus underlying the COVID-19 respiratory disease has resulted in an unprecedented disruption to the health and daily lives of Americans and poses a significant challenge to mental health. Since the U.S. onset of the pandemic in March 2020, confirmed cases of COVID-19 have dramatically increased,[1] fueling fear of contagion and concerns for healthcare shortages. Social distancing and shelter-in-place (SIP) restrictions, while vital to mitigate the virus' spread, have also resulted in significant economic and social challenges,[2] such as loss of livelihoods and family/community connectedness, which may also inadvertently increase emotional distress. Results from several population-based surveys have indicated Americans overall are reporting higher rates of loneliness and stress,[3] as well as symptoms of depression and anxiety since the pandemic first began.[4]

However, comparatively little research has focused on how the COVID-19 pandemic has affected the mental health of adults with chronic medical conditions, who are considered to be at an elevated risk for severe illness should they contract the virus, and for whom public health authorities have recommended especially close adherence to COVID-19 safety precautions.[5] Early evidence has found support for declines in mental health and well-being among this group.[6] However, factors contributing to mental health risk, as well the significance of these changes, including impact on daily function, are unclear. In particular, it is necessary to better understand the degree to which significantly elevated anxiety and depressive symptoms may interfere with management of health and utilization of healthcare services during the COVID-19 pandemic, for instance through adequate adherence to drug regimens, engagement in recommended health behaviors, and maintaining access to healthcare. Such investigations are of particular importance

in this population, for whom the ability to continue to successfully self-manage pre-existing health concerns during the pandemic may help serve to decrease COVID-19 risk.[5]

The objective of the present study was thus two-fold. First, we sought to determine the prevalence and predictors of clinically-relevant depressive and anxiety symptoms during the early stages of the 2020 U.S. COVID-19 outbreak, within a population at increased COVID-19 risk due to medical comorbidity. Second, we examined associations between significant anxiety and depressive symptoms with rates of worry, stress, and loneliness related to the pandemic, in addition to health self-management and utilization of healthcare services. Findings from this investigation may inform the need for targeted mental health screening and intervention efforts related to the COVID-19 pandemic among vulnerable populations, or offer insight on the mental health effects of future public health emergencies should they arise.

METHODS

The Chicago COVID-19 Comorbidities (C3) Study is an ongoing longitudinal, telephone-based survey examining attitudes and behaviors related to the COVID-19 pandemic. An in-depth explanation of the methods and details of the study have been published elsewhere.[7] However in brief, participants were originally recruited from one of four current National Institute of Health-sponsored research projects across Chicago, Illinois (R01AG030611; R01NR015444; R01AG046352; R01DK110172(.[8-10] Objectives and methods of the parent studies varied, however, studies were selected for the C3 Study if they enrolled mostly middle-aged or older adults with at least one chronic condition. The goal was to create a cohort of participants considered to be at higher risk for an adverse outcome should they contract COVID-19. All participants had given prior consent to be contacted for future research opportunities.

Data collection has occurred over three waves approximately one month apart, beginning in the middle of March at the U.S. outset of the COVID-19 outbreak. Data for this analysis was collected during Wave 3 (May 1 – 22, 2020), as standardized measures of psychological functioning were introduced into the study battery at this timepoint.

Ethics Approval

The C3 protocol was reviewed and approved by the Northwestern University Institutional Review Board (IRB) prior to each study wave as a modification for each individual parent study (Wave 3 IRB Approval numbers: STU00026255-MOD0062, STU00204465-MOD0034, STU00203777-MOD0032, STU00201639-MOD0039). The cohort remains active with additional planned survey waves.

Patient and Public Involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of the C3 Study.

Sample

Specific eligibility criteria for the parent studies varied, however all participants were recruited from primary care settings and reported the presence of at least one chronic health condition. To ensure any data obtained from the parent study was current, only participants who had completed their most recent parent study interview in 2018 or later were eligible for inclusion in the C3 survey. Across studies, common and previously assessed exclusion criteria included the presence of a visual, hearing, or cognitive impairment interfering with study participation.

Procedure

Trained research interviewers contacted eligible participants by telephone to invite them to participate in the C3 survey. The survey took approximately 30-40 minutes to complete, and adults were then mailed a $15 gift card for their involvement.

Measurement

Demographic characteristics (age, sex, race/ethnicity), socioeconomic status (income, employment, educational attainment), married status, insurance type, and self-reported chronic conditions were determined from participants' most recent parent study interview. Health literacy and health activation were also measured at their last parent study visit and assessed using the Newest Vital Sign (NVS)[11] and Consumer Health Activation Index (CHAI),[12] respectively. Previous research has demonstrated associations between these factors and measures of physical and mental health.[13] A single question was also used across studies to gauge self-reported health (excellent, very good, good, fair, poor).

Clinically-Relevant Anxiety and Depressive Symptoms

Current psychological functioning was assessed using the validated Patient-Reported Outcomes Measurement Information System (PROMIS) four-item short-form questionnaires for anxiety and depression.[14] Raw scores are transformed into T-scores, which have a mean of 50 (Standard Deviation (SD) 10), and are normed against the general U.S. population. They have good agreement with legacy measures of mental health functioning such as the GAD-7 and PHQ-9,[15, 16] and have been used to assess mental health among various medical populations.[17] Higher scores represent greater symptom burden. Thresholds previously proposed in the literature and corresponding to symptom levels with clinical significance (i.e. moderate or greater symptom severities indicating probable anxiety or depression) were utilized.[15, 16] This translated to a T-

score equal to or greater than 63.2 and 59.9 for clinically-relevant anxiety and depressive symptoms, respectively.

COVID-Related Emotional Distress

Emotional distress due to the pandemic was assessed using single-item questions asking about worry about contracting COVID-19 (not at all worried, a little worried, somewhat worried, very worried), as well as how often participants felts stressed or lonely due to COVID-19 in the past week (never, some of the time, most of the time, all of the time).

Self-Management of Health

Two single-item questions were used to assess perceived difficulty managing health and accessing and remembering to take medications during the COVID-19 pandemic (1-10 scale, of increasing difficulty). Barriers to general medication adherence was measured using the 12-item Adherence Starts with Knowledge (ASK-12) survey (range 12-60, higher scores represent more barriers).[18] Change in physical activity and alcohol use over the past month compared to typical levels were each assessed with a single item (more than typical, less than typical, the same).

Healthcare Utilization

Healthcare utilization was measured through two single-item questions (yes/no) asking whether participants had missed or cancelled any medical appointments, or avoided the emergency department or urgent care due to worry about contracting COVID-19. Comfort visiting the doctor once SIP restrictions ended was also assessed (very comfortable, somewhat comfortable, not that comfortable, not comfortable at all).

Statistical Analysis

Descriptive statistics (mean, SD, frequency (%)) were conducted for all participant characteristics, overall and by the presence or absence (yes/no) of clinically-relevant depressive

and anxiety symptoms. Cross-sectional associations between participant characteristics and anxiety and depression symptoms were first analyzed using chi-square and independent samples t-tests, as appropriate, then modeled using multivariate logistic regressions, adjusting for any characteristics that were significant in bivariate analyses. This process was then repeated, but instead examining associations between anxiety and depression with each of our outcomes of interest. Covariate selection for multivariate models at this stage was based on the literature as well as prior investigations using this cohort,[7] and included age, sex, race/ethnicity, income, health literacy, health activation, self-reported health, and date of interview. Additionally, all multivariate models were adjusted for parent study, to control for any between-subject correlation within a specific study. For all multivariate models, anxiety and depression were examined as separate exposure variables; least squared means (LS Means) were obtained for continuous outcomes using a generalized linear model (GLM), whereas for categorical outcomes a multivariate Poisson distribution was used to estimate relative risk (RR) estimates in lieu of odds ratios for ease of interpretation.[19] Pairwise deletion was used, and associations were determined to be statistically significant if they had a p value of < 0.05. Descriptive and bivariate analyses were performed using STATA SE software, version 15 (College Station, TX), while multivariate analyses were performed in SAS Version 9.4 (SAS Institute Inc.).

RESULTS

A total of 565 participants completed Wave 3. Of the 630 participants who completed the survey at Wave 1 and were eligible for participation in Wave 3, 47 were unable to be contacted and 18 declined participation, resulting in an 89.7% overall retention rate. Participant characteristics, overall and by the presence of clinically-relevant anxiety and depression, are listed in Table 1. Our sample was older, primarily female, and diverse by race/ethnicity and

socioeconomic status. All participants had at least one chronic health condition, while nearly two-thirds reported having three or more. Approximately a quarter of participants self-rated their health as fair to poor.

Table 1. Sample Characteristics, Overall and by Clinically-relevant Anxiety and Depressive Symptoms

Variable	Wave 3 C3 Sample N=565	Clinically-relevant Anxiety Symptoms N=81			Clinically-relevant Depressive Symptoms N=84		
		Yes	No	*p*-value	Yes	No	*p*-value
Age, M (SD)	62.3 (10.9)	61.2 (10.1)	62.5 (11.0)	0.31	62.5 (11.5)	62.3 (10.8)	0.87
Age Group, %				0.33			0.99
< 60	36.3	40.7	35.7		35.7	36.5	
60 - 69	37.0	39.5	36.7		36.9	36.7	
≥ 70	26.7	19.8	27.6		27.4	26.7	
Gender, %				<0.001			<0.001
Female	61.4	81.7	57.9		78.6	58.3	
Male	38.6	18.5	42.1		21.4	41.8	
Race, %				0.06			0.08
Latinx	21.9	30.0	20.4		31.3	20.3	
Non-Latinx White	45.1	36.3	46.5		34.9	46.8	
Non- Latinx Black	29.8	27.5	30.3		28.9	29.9	
Other	3.2	6.3	2.7		4.8	2.3	
Below Poverty Level, %				0.003			0.001
Yes	29.2	43.2	26.7		44.1	26.5	
No	70.8	56.8	73.3		55.9	73.5	
Marital Status, %				0.29			0.06
Married	39.9	34.3	40.9		30.3	41.7	
Unmarried	60.1	65.7	59.1		69.7	58.3	
Health Insurance, %				0.007			0.008
Medicare	16.1	11.1	16.8		16.7	16.1	
Medicaid	12.8	23.5	11.0		22.6	11.1	
Private	25.0	18.5	26.2		15.5	26.6	
Medicare + Private	29.6	24.7	30.4		23.8	30.8	
Medicare + Medicaid	16.5	22.2	15.6		21.4	15.5	
Self-pay/None	0.0	0.0	0.0		0.0	0.0	
Primary Care Setting, %				0.006			0.006
Academic	68.7	55.6	71.0		56.0	71.0	
Federally Qualified Health Center	31.3	44.4	29.1		44.1	29.0	
Employment Status, %				0.15			0.03
Working for Pay	30.1	23.5	31.4		20.2	31.8	
Not Working (Retired/Unemployed)	69.9	76.5	68.6		79.8	68.2	
Health Literacy, %				0.13			0.05
Low	23.4	28.4	22.4		27.4	22.8	
Marginal	23.2	28.4	22.2		31.0	21.7	
Adequate	53.4	43.2	55.4		41.7	55.5	
Health Activation, %				<0.001			0.02
Low	47.6	70.4	43.8		59.5	45.3	
Adequate	52.4	29.6	56.2		40.5	54.7	
# Chronic Conditions, %				0.03			0.05
1	24.2	35.8	22.4		34.5	22.3	
2	16.5	13.6	16.8		11.9	17.1	
3 or more	59.3	50.6	60.8		53.6	60.5	

Self-Reported Health, %			0.21			0.02
Excellent	9.0	6.2	9.5	4.8	9.8	
Very Good	29.9	37.0	28.6	27.4	30.3	
Good	39.7	33.3	40.7	34.5	40.5	
Fair	17.9	22.2	17.2	25.0	16.7	
Poor	3.5	1.2	3.9	8.3	2.7	

Fourteen percent (14%) of the sample reported the presence of clinically-relevant anxiety symptoms, while 15% endorsed significant depressive symptoms (Table 1). In multivariate models, female gender (RR 2.34, 95% Confidence Interval (CI) 1.32 – 4.13) and low health activation (RR 2.32, 95% CI 1.44 – 3.76) were independently associated with the presence of anxiety, while female gender (RR 1.95, 95% CI 1.14 – 3.33) was a significant predictor of depression.

COVID-Related Emotional Distress

In bivariate analyses, anxiety and depression were both associated with more worry about contracting COVID-19, in addition to greater stress and loneliness as a result of the virus (Table 2). These associations remained significant in multivariate analyses (Table 3;Anxiety - Worry: RR 2.32, 95% CI 1.52 – 3.53; Stress: RR 4.93, 95% CI 3.20 – 7.59; Lonely: RR 3.82, 95% CI 2.21 – 6.60) (Depression - Worry: RR 1.67, 95% CI 1.10 – 2.54; Stress: RR 3.01, 1.96 – 4.61; Lonely: RR 5.37, 95% CI 3.21 – 8.98).

Table 2. Associations with COVID-related Emotional Distress, Health Self-Management and Healthcare Utilization, Overall and by Clinically-relevant Anxiety and Depressive Symptoms

Variable	**Wave 3 C3 Sample N=565**	**Clinically-relevant Anxiety Symptoms N=81**			**Clinically-relevant Depressive Symptoms N=84**		
		Yes	**No**	***p*-value**	**Yes**	**No**	***p*-value**
COVID-related Emotional Distress							
How worried are you about getting the coronavirus?, %				<0.001			0.01
Not worried at all	10.7	4.2	11.7		10.4	10.7	
A little worried	22.8	12.5	24.6		15.6	23.9	
Somewhat worried	39.9	34.7	40.7		32.5	41.2	
Very worried	26.6	48.6	23.0		41.7	24.2	
Over the past week, how often have you felt nervous or "stressed" because of the coronavirus?, %				<0.001			<0.001
Never	27.8	4.9	31.7		7.1	31.5	
Some of the time	54.0	37.0	56.6		48.8	54.7	
Most of the time	13.8	40.7	9.3		26.2	11.7	
All of the time	4.4	17.3	2.3		17.9	2.1	

Over the past week, how often have you felt alone or lonely because of the coronavirus?, %				<0.001			<0.001
Never	53.3	19.8	59.1		19.1	59.5	
Some of the time	34.5	46.9	32.2		41.7	33.0	
Most of the time	9.2	23.5	6.9		23.8	6.7	
All of the time	3.0	9.9	1.9		15.5	0.8	
Health Self-Management							
Difficulty managing health due to the coronavirus (1-10), M (SD)	4.1 (3.3)	5.8 (3.2)	3.8 (3.2)	<0.001	5.8 (3.4)	3.8 (3.2)	<0.001
Difficulty with medications due to the coronavirus (1-10), M (SD)	2.5 (2.9)	3.8 (3.3)	2.3 (2.7)	<0.001	3.8 (3.4)	2.3 (2.7)	<0.001
ASK-12 total score (12-60), M (SD)	20.2 (5.2)	22.6 (5.7)	19.8 (5.0)	<0.001	23.1 (5.3)	19.7 (5.0)	<0.001
Thinking about the last month, would you say your physical activity was more, less, or about the same than what is typical for you?, %				0.12			0.15
More than typical	17.0	12.4	17.8		9.5	18.2	
Less than typical	54.9	65.4	53.1		60.7	54.1	
The same	28.1	22.2	29.1		29.8	27.8	
Thinking about the last month, would you say your alcohol consumption was more, less, or about the same than what is typical for you?, %				0.13			0.07
More than typical	9.0	14.8	7.9		14.3	8.2	
Less than typical	23.8	22.2	24.1		28.6	22.8	
The same	67.2	63.0	68.0		57.1	69.0	
Healthcare Utilization							
Over the past month, have you chosen to miss or cancel any medical appointments because you were too worried about getting the coronavirus?, %				<0.001			0.01
Yes	22.0	38.3	19.3		32.1	20.1	
No	78.0	61.7	80.7		67.9	79.9	
Over the past month, have you needed to go to the Emergency Room or urgent care but were too worried about getting the coronavirus to seek care?, %				0.06			0.002
Yes	3.7	7.4	3.1		9.5	2.7	
No	96.3	92.6	96.9		90.5	97.3	
Comfortable visiting your doctor in person once SIP lifted, %				<0.001			0.004
Very comfortable	36.9	18.5	40.0		25.0	39.2	
Somewhat comfortable	42.1	48.2	41.3		44.1	41.5	
Not that comfortable	16.5	24.7	15.0		20.2	15.9	
Not comfortable at all	4.4	8.6	3.8		10.7	3.4	

SIP = Shelter-in-place

Table 3. Multivariate Associations between Clinically Relevant Anxiety and Depressive Symptoms and COVID-related Outcomes

Variable	Clinically-relevant Anxiety Symptoms			Clinically-relevant Depressive Symptoms		
	Yes	No	P-value	Yes	No	P-value
COVID-related Emotional Distress	Summary Value	Summary Value		Summary Value	Summary Value	
Very worried about COVID 19, RR (95% CI)	2.32 (1.52,3.53)	REF	<0.001	1.67 (1.10,2.54)	REF	0.02
Stressed due to COVID-19, RR (95% CI)	4.93 (3.20,7.59)	-	<0.001	3.01 (1.96,4.61)	-	<0.001
Lonely due to COVID-19,	3.82 (2.21,6.60)	-	<0.001	5.37 (3.21,8.98)	-	<0.001

RR (95% CI)						
Health Self-Management						
Difficulty managing health due to COVID-19, LS Means (95% CI)	6.09 (5.25,6.92)	4.23 (3.70,4.75)	<0.001	5.85 (5.04,6.65)	4.22 (3.70,4.75)	<0.001
Difficulty with medications due to COVID-19, LS Means (95% CI)	3.71 (2.98,4.43)	2.47 (2.02,2.92)	<0.001	3.62 (2.92,4.31)	2.45 (2.00,2.91)	<0.001
ASK-12 Total Score, LS Means (95% CI)	21.8 (20.6,23.0)	20.2 (19.4,21.0)	0.01	22.3 (21.1,23.5)	20.0 (19.3,20.8)	<0.001
Healthcare Utilization						
Missed or cancelled doctor appointment/Avoided ER visit due to COVID-19, RR (95% CI)	1.62 (1.06,2.49)	-	0.03	1.54 (1.00,2.36)	-	0.05
Very comfortable visiting doctor after SIP lifted, RR (95% CI)	0.54 (0.31,0.93)	-	0.03	0.71 (0.44,1.13)	-	0.14

+ Models have been adjusted for age, gender, race, poverty level, health literacy, health activation, self-reported overall health, study number and date of interview

RR = Relative Risk; CI = Confidence Interval; LS = Least Square; SIP = Shelter-in-place

Self-Management of Health

Both anxiety and depression were associated with greater reported difficulty managing health and medications during COVID-19, in addition to more barriers to medication adherence (Table 2). All associations remained significant in multivariate analyses (Table 3;Anxiety - Managing health: LS Means 6.09, 95% CI 5.25 – 6.92 vs. 4.23, 95% CI 3.70 – 4.75; Managing medications: LS Means 3.71, 95% CI 2.98 – 4.43 vs. 2.47, 95% CI 2.02 – 2.92; Medication adherence: LS Means 21.8, 95% CI 20.6 – 23.0 vs. 20.2, 95% CI 19.4 – 21.0) (Depression - Managing health: LS Means 5.85, 95% CI 5.04 – 6.65 vs. 4.22, 95% CI 3.84 – 4.70; Managing medications: LS Means 3.62, 95% CI 2.92 – 4.31 vs. 2.45, 95% CI 2.00 – 2.91; Medication adherence: LS Means 22.3, 95% CI 21.1– 23.5 vs. 20.0, 95% CI 19.3 – 20.8). Bivariate associations between anxiety and depressive symptoms with change in physical activity and alcohol use were non-significant.

Healthcare Utilization

In bivariate analyses, both anxiety and depression were associated with avoidance of routine medical visits, as well as less comfort visiting the doctor once SIP is lifted (Table 2). Depression alone was associated with avoidance of emergency care. For anxiety, associations with avoiding doctor's visits (RR 1.62, 95% CI 1.06 – 2.49) and feeling very comfortable visiting the

doctor after SIP ends (RR 0.54, 95% CI 0.31 – 0.93)–were significant in multivariate analyses (Table 3). For depression, only avoidance of doctor's visits (RR 1.54, 95% CI 1.00 – 2.36) remained significant in multivariate analysis (Table 3).

DISCUSSION

Among a sample of mostly middle to older-age adults with one or more chronic conditions surveyed in the early phases of the COVID-19 crisis in the U.S. – when cases were rising and a SIP order was in effect in most states – clinically-relevant anxiety and depressive symptoms were relatively common, with rates of 14 and 15%, respectively. While still considerable, it should be noted estimates observed in this sample were slightly lower as compared to rates of clinically elevated distress reported among the general population in the U.S. during comparable stages of the pandemic, which have ranged from 20-45%.[20-23] Differences in samples, measurement, or clinical thresholds among studies may in part help to explain this discrepancy. Additionally, the generally older age of our sample's participants may also account for these differences. Studies examining age differences in mental health symptoms have found older adults are reporting fewer symptoms of anxiety and depression in response to the COVID-19 pandemic compared to their younger counterparts,[24] despite their greater COVID-19 risk. Possible age-related protective factors may be a lower perceived socio-economic impact of the pandemic, as well as older adults' tendency to display greater resiliency in the face of acute stress due to accumulated experience navigating other life stressors.

This investigation also helps to elucidate possible risk factors contributing increased mental health risk during the COVID-19 pandemic. Consistent with prior research among the general population,[25] women reported a higher mental health burden after accounting for additional

sociodemographic factors, with a nearly two to threefold increase in risk. This may reflect the disproportionate challenges women have faced in regard to family caretaking, household responsibilities, and job loss as a result of the pandemic.[26] Low health activation was also a predictor of significant anxiety symptoms. In the context of the COVID-19 pandemic, psychosocial characteristics such as lower confidence in managing physical or mental health, less ability to engage in problem-solving around new health challenges, and/or greater passivity communicating personal health needs may have contributed to higher levels of uncertainty or distress.

Interestingly, while all adults in this sample had at least one chronic medical condition, neither greater medical comorbidity nor poorer self-reported health were associated with significant anxiety and depressive symptoms after adjusting for other sociodemographic and health-related factors. It could be that personal health plays a lesser role in mental health functioning during the pandemic than expected, or that no additional risk to mental health was conferred by having more than one medical condition. Alternatively, it may also be that our sample did not consider themselves to be at higher COVID-19 risk due to their health conditions, which may have served as a protective factor against psychosocial distress. This could have been due to general perceptions of their health or medical illness, as over three-quarters of our sample self-reported their health as at least 'good', despite a similar amount reporting the presence of at least two chronic conditions. However, it may also be that the rapidly changing, and often conflicting, public health messaging around risk and prevention in the early stages of the pandemic contributed to confusion around personal susceptibility.[27] Future studies may consider understanding of and perceptions of personal risk as a possible mediating factor between multimorbidity and a high mental health burden.

As expected, the presence of significant anxiety and depressive symptoms were both associated with higher rates of COVID-related emotional distress. Specifically, respondents with clinically-relevant symptoms were much more likely to report they were very worried about contracting COVID-19, and three to five times as likely to endorse feelings of stress and loneliness as a result of the pandemic. Worry and stress were particularly high for individuals with anxiety, while loneliness was elevated in those with depression. These findings support the need for targeted mental health screening among adults with underlying medical conditions reporting high levels of isolation or worry and stress related to the pandemic. Conversely, clinicians should be aware that adults with pre-existing anxiety or depressive disorders may be at increased risk of COVID-specific emotional distress.

Finally, our results indicate that a high mental health burden may also translate to increased difficulty managing health and maintaining access to routine and emergency medical services during the pandemic among those with pre-existing medical conditions. Both anxiety and depression were separately associated with greater self-reported difficulty managing health and medications, more barriers to medication adherence, as well as greater avoidance of the doctor due to worry about contracting COVID-19. Those with high levels of anxiety, in particular, also reported less comfort returning to the doctor once stay-at-home restrictions ended, indicating concerns about COVID-19 may continue to impact healthcare service use even after restrictions are lifted and the acute crisis improves. While our sample overall reported less physical activity, alcohol use remained relatively stable; furthermore, a higher mental health burden was not associated change in either of these behaviors. Taken together, these findings have particular relevance to clinicians and public health authorities alike. As vaccine availability remains limited and hesitancy high,[28] and treatments for early disease are still in development, optimization of

health and chronic disease status among those with multimorbidity remains a potentially important barrier against infection and serious illness. Thus, any psycho-behavioral factors impacting adequate chronic disease management among this population should be addressed.

There are several limitations which should be noted. Foremost, this study was cross-sectional, which prevents the ability to infer causation. It is not clear whether a high mental health burden led to higher rate of COVID-related distress and maladaptive health behaviors observed, or vice versa. As information on mental health functioning prior to the pandemic was not currently available for the full sample, it is difficult to determine whether any psychological distress and its associated impact are a result of the pandemic, or merely a continuation or exacerbation of a previous condition. This assessment was also conducted at the initial stages of the crisis; it is unclear how these findings may change as the pandemic progresses. Additional analyses with follow-up survey waves of the C3 cohort will therefore be necessary. Given the sample was also primarily older, female, and with chronic medical conditions this limits generalizability. However, the diversity of the sample with regard to race/ethnicity, socioeconomic status, and health literacy should also be noted.

Conclusion

Within a sample consisting of primarily older adults with underlying medical conditions, clinically-relevant symptoms of anxiety and depression were relatively common during the early stages of the COVID-19 pandemic in the U.S., with women and those with low health activation disproportionately exhibiting greater risk. Importantly, a high mental health burden may also interfere with the ability to sufficiently manage health during the pandemic. At a time when it is of the utmost importance that individuals with underlying conditions adequately self-manage their health to minimize COVID-19 risk, factors which may interfere with this ability should be

addressed, including mental health. As the COVID-19 crisis continues and daily life remains drastically altered, findings from this study reinforce the need for increased awareness surrounding the mental health risks associated with the COVID-19 pandemic among individuals with underlying medical conditions. Health systems and practitioners should respond accordingly through enhanced screening and provision of mental health resources for individuals at high COVID-19 risk.

AUTHOR CONTRIBUTIONS

RML contributed to manuscript conception, design of the work, data analysis, interpretation of data, as well as drafted the manuscript and revised it following author feedback. LO contributed to manuscript conception, data analysis, interpretation of data, and editing of manuscript drafts. AR, EY, SWL, MS and SCB contributed to manuscript conception, interpretation of data, and editing of manuscript drafts. MSW contributed to manuscript conception, design of the work, interpretation of data, and editing of manuscript drafts. All authors have approved the submitted version.

REFERENCES

1. Centers for Disease Control and Prevention [Internet]. COVID Data Tracker: United States COVID-19 Cases and Deaths by State. [Date accessed 2021 10 Feb]. Available from: https://covid.cdc.gov/covid-data-tracker/#datatracker-home.

2. Nicola M, Alsafi Z, Sohrabi C, et al. The socio-economic implications of the coronavirus pandemic (COVID-19): A review. *Int J Surg* 2020;78:185-93.

3. American Psychological Association [Internet]. Stress in America 2020: A National Mental Health Crisis. [Date accessed 2021 10 Feb]. Available from: https://www.apa.org/news/press/releases/stress/2020/report-october

4. Czeisler MÉ, Lane RI, Petrosky E, et al. Mental health, substance use, and suicidal ideation during the COVID-19 pandemic - United States, June 24-30, 2020. *MMWR: Morbidity & Mortality Weekly Report* 2020;69(32):1049-57.

5. Centers for Disease Control and Prevention [Internet]. COVID-19: Your Health: People with Certain Medical Conditions. [Date accessed 2021 10 Feb]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fneed-extra-precautions%2Fgroups-at-higher-risk.html

6. Wong SYS, Zhang D, Sit RWS, et al. Impact of COVID-19 on loneliness, mental health, and health service utilisation: a prospective cohort study of older adults with multimorbidity in primary care. *Br J Gen Pract* 2020;70(700):e817-e24.

7. Wolf MS, Serper M, Opsasnick L, et al. Awareness, attitudes, and actions related to COVID-19 among adults with chronic conditions at the onset of the U.S. outbreak: A cross-sectional curvey. *Ann Intern Med* 2020;173(2):100-9.

8. O'Conor R, Arvanitis M, Wismer G, et al. Rationale and design of the regimen education and messaging in diabetes (REMinD) trial. *Contemp Clin Trials* 2019;83:46-52.

9. Wolf MS, Curtis LM, Wilson EA, et al. Literacy, cognitive function, and health: results of the LitCog study. *J Gen Intern Med*. 2012;27(10):1300-7.

10. Bailey SC, Wismer GA, Parker RM, et al. Development and rationale for a multifactorial, randomized controlled trial to test strategies to promote adherence to complex drug regimens among older adults. *Contemp Clin Trials* 2017;62:21-6.

11. Weiss BD, Mays MZ, Martz W, et al. Quick assessment of literacy in primary care: the newest vital sign. *Ann Fam Med* 2005;3(6):514-22.

12. Wolf MS, Smith SG, Pandit AU, et al. Development and calidation of the consumer health activation index. *Med Decis Making* 2018;38(3):334-43.

13. Smith SG, Curtis LM, Wardle J, et al. Skill set or mind set? Associations between health literacy, patient activation and health. *PloS One* 2013;8(9):e74373.

14. Cella D, Riley W, Stone A, et al. The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005-2008. *J Clin Epidemiol* 2010;63(11):1179-94.

15. Choi SW, Schalet B, Cook KF, et al. Establishing a common metric for depressive symptoms: linking the BDI-II, CES-D, and PHQ-9 to PROMIS depression. *Psychol Assess* 2014;26(2):513-27.

16. Schalet BD, Cook KF, Choi SW, et al. Establishing a common metric for self-reported anxiety: linking the MASQ, PANAS, and GAD-7 to PROMIS Anxiety. *J Anxiety Disord* 2014;28(1):88-96.

17. Schalet BD, Pilkonis PA, Yu L, et al. Clinical validity of PROMIS Depression, Anxiety, Anger across diverse clinical samples. *J Clin Epidemiol* 206;73:119-27.

18. Matza LS, Park J, Coyne KS, et al. Derivation and validation of the ASK-12 adherence barrier survey. *Ann Pharmacother* 2009;43(10):1621-30.

19. Zou G. A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol* 2004;159(7):702-6.

20. Centers for Disease Control and Prevention [Internet]. National Center for Health Statistics. Mental Health: Household Pulse Survey. [Date accessed 10 Feb 2021]. Available from: https://www.cdc.gov/nchs/covid19/pulse/mental-health.htm.

21. Bryan CJ, Bryan AO, Baker JC. Associations among state-level physical distancing measures and suicidal thoughts and behaviors among U.S. adults during the early COVID-19 pandemic. *Suicide Life-Threat Behav* 2020. [Epub ahead of print].

22. Liu CH, Zhang E, Wong GTF, et al. Factors associated with depression, anxiety, and PTSD symptomatology during the COVID-19 pandemic: Clinical implications for U.S. young adult mental health. *Psychiatry Res* 2020;290:113172.

23. Fitzpatrick KM, Harris C, Drawve G. Fear of COVID-19 and the mental health consequences in America. *Psycholog Trauma* 2020. [Epub ahead of print].

24. Bruine de Bruin W. Age differences in COVID-19 risk perceptions and mental health:Evidence from a national US survey conducted in March 2020. *J Gerontol B Psychol Sci Soc Sci* 2020. [Epub ahead of print].

25. Pierce M, Hope H, Ford T, et al. Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. *Lancet Psychiatry* 2020. [Epub ahead of print].

26. Adams-Prassl AB, Golin, M, Rauh, C. Inequality in the impact of the coronavirus shock: Evidence from real time surveys. Cambridge Working Papers in Economics: 2032. 2020;Cambridge-INET Working Paper Series No: 2020/18.

27. American Public Health Association [Internet]. Countering the "infodemic" of misinformation. [Date accessed 10 Feb 2021]. Available from: https://www.apha.org/covid19.

28. Khubchandani J, Sharma S, Price JH, et al. COVID-19 Vaccination Hesitancy in the United States: A Rapid National Assessment. *J Community Health* 2021:1-8.

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*
Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6-7
Objectives	3	State specific objectives, including any pre-specified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	7-8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7-8
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	7-8
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*8-10*
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	N/A – secondary analysis
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	10-11
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	11
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed	N/A

		Case-control study—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11
		(b) Give reasons for non-participation at each stage	11
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11-12
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	N/A
		Cross-sectional study—Report numbers of outcome events or summary measures	12-15
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12-15
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	15-19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18-19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	4

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Prevalence of anxiety and depressive symptoms and impact on self-management among adults with chronic conditions in Chicago, IL, USA during the COVID-19 pandemic: a cross-sectional survey

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2021-052495.R1
Article Type:	Original research
Date Submitted by the Author:	08-Oct-2021
Complete List of Authors:	Lovett, Rebecca; Northwestern University Feinberg School of Medicine, Department of General Internal Medicine & Geriatrics Opsasnick, Lauren; Northwestern University Feinberg School of Medicine Russell, Andrea; Northwestern University Feinberg School of Medicine, Department of General Internal Medicine & Geriatrics Yoon, Esther; Northwestern University Feinberg School of Medicine, Department of General Internal Medicine & Geriatrics Weiner-Light, Sophia; Northwestern University Feinberg School of Medicine, Department of General Internal Medicine & Geriatrics Serper, Marina; University of Pennsylvania Perelman School of Medicine, Department of Medicine Cooper Bailey, Stacy; Northwestern University Wolf, Michael; Northwestern University, Department of General Internal Medicine
Primary Subject Heading:	Infectious diseases
Secondary Subject Heading:	Mental health
Keywords:	COVID-19, MENTAL HEALTH, PRIMARY CARE

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Prevalence of anxiety and depressive symptoms and impact on self-management among adults with chronic conditions in Chicago, IL, USA during the COVID-19 pandemic: a cross-sectional survey

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Abstract Word Count: 277/300
Manuscript Word Count: 3634/4000
Number of Tables: 4
Number of References: 28
Keywords: COVID-19, mental health, depression, anxiety, health self-management, healthcare utilization

ABSTRACT

Objectives: To examine the prevalence of mental health symptoms during the first surge of COVID-19 in the U.S, and their associations with COVID-related emotional distress, health self-management, and healthcare utilization.

Design: Cross-sectional analysis of Wave 3 (May 1 – 22, 2020) survey data from the ongoing Chicago COVID-19 and Comorbidities (C3) study.

Setting: Seven academic and community health centers in Chicago, IL.

Participants: 565 adults aged 23 to 88 with one or more chronic conditions completing at least one prior C3 study Wave.

Primary and secondary outcome measures: Clinically-relevant anxiety and depressive symptoms as measured using Patient-Reported Outcomes Measurement Information System (PROMIS) short-forms. Self-reported emotional and health-related responses to COVID-19 were measured through a combination of single-item questions and validated measures.

Results: Rates of anxiety and depressive symptoms were 14% (81/563) and 15% (84/563), respectively. Anxiety and depressive symptoms were then each separately associated with greater worry about contracting COVID-19 (RR 2.32, 95% CI 1.52 – 3.53; RR 1.67, 95% CI 1.10 – 2.54), greater stress (RR 4.93, 95% CI 3.20 – 7.59; RR 3.01, 1.96 – 4.61) and loneliness (RR 3.82, 95% CI 2.21 – 6.60; RR 5.37, 95% CI 3.21 – 8.98), greater avoidance of the doctor (RR 1.62, 95% CI 1.06 – 2.49; RR 1.54, 95% CI 1.00 – 2.36), and difficulty managing health (LS Means 6.09, 95% CI 5.25 – 6.92 vs. 4.23, 95% CI 3.70 – 4.75; LS Means 5.85, 95% CI 5.04 – 6.65 vs. 4.22, 95% CI 3.84 – 4.70) and medications (LS Means 3.71, 95% CI 2.98 – 4.43 vs. 2.47, 95% CI 2.02 – 2.92) due to the pandemic.

Conclusions: Identifying and addressing mental health concerns may be an important factor to consider in COVID-19 prevention and management among high-risk medical populations.

ARTICLE SUMMARY

Strengths and Limitations of this Study

- A major strength of this study was the intentional focus on adults with one or more chronic medical conditions, a population at higher risk for adverse COVID-19 outcomes.
- Our sample was diverse by race/ethnicity, SES, and health literacy, increasing generalizability.
- Mental health symptoms were based on self-report, not diagnostic assessment.
- The cross-sectional nature of the analysis and lack of information on mental health functioning prior to the COVID-19 pandemic limits the ability to infer causation.

Funding

This work was supported by grants R01AG030611, R01AG046352, R01DK110172, R01NR015444, and P30AG059988 from the National Institutes of Health (NIH). The funding organization had no role in the design of the study and collection, analysis, and interpretation of data, and in writing the manuscript.

Competing Interests

MS reports personal fees from BioVie outside the submitted work. SCB reports grants from the NIH during the conduct of the study; grants from Merck, the NIH, the Gordon and Betty Moore Foundation, and Eli Lilly outside the submitted work; grants and personal fees from Pfizer outside the submitted work; and personal fees from Sanofi, University of Westminster, and Luto outside the submitted work. MSW reports grants from the NIH during the conduct of the study; grants from Merck, the Gordon and Betty Moore Foundation, the NIH, and Eli Lilly outside the submitted work; and personal fees from Sanofi, Pfizer, and Luto outside the submitted work. Authors not named here have disclosed no conflicts of interest.

Data Sharing

Data available upon reasonable request to the corresponding author.

INTRODUCTION

The rapid emergence and ongoing spread of the SARS-CoV-2 virus underlying the COVID-19 respiratory disease has resulted in an unprecedented disruption to the health and daily lives of Americans and poses a significant challenge to mental health. Since the U.S. onset of the pandemic in March 2020, confirmed cases of COVID-19 have dramatically increased,[1] fueling fear of contagion and concerns for healthcare shortages. Social distancing and shelter-in-place (SIP) restrictions, while vital to mitigate the virus' spread, have also resulted in significant economic and social challenges,[2] such as loss of livelihoods and family/community connectedness, which may also inadvertently increase emotional distress. Results from several population-based surveys have indicated Americans overall are reporting higher rates of loneliness and stress,[3] as well as symptoms of depression and anxiety since the pandemic first began.[4]

However, comparatively little research has focused on how the COVID-19 pandemic has affected the mental health of adults with chronic medical conditions, who are considered to be at an elevated risk for severe illness should they contract the virus, and for whom public health authorities have recommended especially close adherence to COVID-19 safety precautions.[5] Early evidence has found support for declines in mental health and well-being among this group.[6] However, factors contributing to mental health risk, as well the significance of these changes, including impact on daily function, are unclear. In particular, it is necessary to better understand the degree to which significantly elevated anxiety and depressive symptoms may interfere with management of health and utilization of healthcare services during the COVID-19 pandemic, for instance through adequate adherence to drug regimens, engagement in recommended health behaviors, and maintaining access to healthcare. Such investigations are of particular importance

in this population, for whom the ability to continue to successfully self-manage pre-existing health concerns during the pandemic may help serve to decrease COVID-19 risk.[5]

The objective of the present study was thus two-fold. First, we sought to determine the prevalence of clinically-relevant depressive and anxiety symptoms during the early stages of the 2020 U.S. COVID-19 outbreak, within a population at increased COVID-19 risk due to medical comorbidity. Second, we examined associations between anxiety and depressive symptoms with rates of worry, stress, and loneliness related to the pandemic, in addition to health self-management and utilization of healthcare services. Findings from this investigation may inform the need for targeted mental health screening and intervention efforts related to the COVID-19 pandemic among vulnerable populations, or offer insight on the mental health effects of future public health emergencies should they arise.

METHODS

The Chicago COVID-19 Comorbidities (C3) Study is an ongoing longitudinal, telephone-based survey examining attitudes and behaviors related to the COVID-19 pandemic. An in-depth explanation of the methods and details of the study have been published elsewhere.[7] However, in brief, participants were originally recruited from one of four current National Institute of Health-sponsored research projects across Chicago, Illinois, USA (R01AG030611; R01NR015444; R01AG046352; R01DK110172).[8-10] Objectives and methods of the parent studies varied, however, studies were selected for the C3 Study if they enrolled mostly middle-aged or older adults with at least one chronic condition. The goal was to create a cohort of participants considered to be at higher risk for an adverse outcome should they contract COVID-19. As part of their parent study participation, all participants recruited for the C3 study had given prior consent to be contacted for future research opportunities. To ensure any data obtained from the parent study was

current, only participants who had completed their most recent parent study interview in 2018 or later were eligible for inclusion in the C3 survey.

To date, data collection has occurred over three waves approximately one month apart, beginning in the middle of March at the U.S. outset of the COVID-19 outbreak. Data for this analysis was collected during Wave 3 (May 1 – 22, 2020), as standardized measures of psychological functioning were introduced into the study battery at this timepoint.

Ethics Approval

The C3 protocol was reviewed and approved by the Northwestern University Institutional Review Board (IRB) prior to each study wave as a modification for each individual parent study (Wave 3 IRB Approval numbers: STU00026255-MOD0062, STU00204465-MOD0034, STU00203777-MOD0032, STU00201639-MOD0039). The cohort remains active with additional planned survey waves.

Sample

Specific eligibility criteria for the parent studies varied, however all participants were eligible for the C3 survey if they had 1) reported at least one chronic medical condition during their parent study interview, 2) completed their parent study in 2018 or later, and 3) given previous consent to be contacted for future research opportunities during their parent study involvement, as detailed above. Table 1 includes more detailed information about each parent study, including sample characteristics and specific inclusion/exclusion criteria. Three studies – EHR-based Universal Medication Schedule to Improve Adherence to Complex Regimens (R01NR01544); A Universal Medication Schedule to Promote Adherence to Complex Drug Regimens (R01AG046352); Transplant Regimen Adherence for Kidney Recipients by Engaging Information Technologies: The TAKE IT Trial (R01DK110172) - are randomized clinical trials evaluating

technology-based health systems strategies to enhance patient adherence and safe use of complex drug regimens.[8,10] The Health Literacy and Cognitive Function Among Older Adults (R01AG030611) cohort study examines cognitive and psychosocial factors impacting chronic disease self-management and health outcomes over time.[9]

Table 1. Sample Characteristics of Parent Studies Involved in the C3 Survey

Parent Study (NIH Project Number)	Design	Sample Characteristics				
		Wave 3 C3 Sample (n = 565), n	Language	Clinical Inclusion Criteria	Clinical Exclusion Criteria	Setting
Health Literacy and Cognitive Function Among Older Adults (R01AG030611)	Cohort	137	English	1) Aged 55-75 at study onset	1) Severe, uncorrectable vision, hearing, or cognitive impairments 2) Limited English proficiency	1 academic internal medicine clinic, 5 FQHCs
A Universal Medication Schedule to Promote Adherence to Complex Drug Regimens (R01AG046352)	Clinical Trial	197	English or Spanish	1) Aged ≥50 at study onset 2) Taking ≥5 long-term Rx medications	1) Severe, uncorrectable vision, hearing, or cognitive impairments	1 academic internal medicine clinic, 1 FQHC
Transplant Regimen Adherence for Kidney Recipients by Engaging Information Technologies: The TAKE IT Trial (R01DK110172)	Clinical Trial	111	English	1) Aged ≥21 at study onset 2) 5 weeks to 24 months post-kidney transplant 3) taking ≥3 long-term Rx med	1) Severe, uncorrectable vision, hearing, or cognitive impairments 2) Limited English proficiency	1 academic transplant center
EHR-Based Universal Medication Schedule to Improve Adherence to Complex Regimens (R01NR015444)	Clinical Trial	120	English	1) Aged ≥21 at study onset 2) T2DM 3) Hemoglobin A1C value ≥7.5% at study onset 4) taking ≥5 long-term Rx med	1) Severe, uncorrectable vision, hearing, or cognitive impairments 2) Limited English proficiency	5 academic internal medicine clinics

C3 = Chicago COVID-19 Comorbidities; COVID-19 = coronavirus disease 2019; EHR = electronic health record; FQHC = federally qualified health center; NIH = National Institutes of Health; Rx = prescription; T2DM = type 2 diabetes mellitus.

Two studies specifically recruited adults with a type-2 diabetes diagnosis or recent kidney transplant.[8] The remaining two studies did not target participants by a specific medical condition, however their inclusion criteria included populations with high likelihood of having a chronic condition, i.e. middle aged to older adults or those with complex drug regimens.[9,10] Other common conditions reported among study participants include hypertension, hypercholesteremia,

heart disease, stroke, cancer, and chronic lung disease.[8-10] Participants were not explicitly excluded from any parent study on the basis of having a certain chronic condition, except if that condition were to be characterized by an uncorrectable visual, hearing, or cognitive impairment interfering with study participation (e.g., dementia).

Procedure

Prior to each study wave, trained research interviewers contacted eligible participants by telephone to invite them to participate in the C3 survey. Interested participants were given the option to complete the survey at this initial contact, or to schedule an interview for a later date. All participants provided verbal consent to participate in the survey at the start of the interview and prior to any data collection activities. All survey responses were recorded using REDCap software. The survey took approximately 30-40 minutes to complete, and adults were then mailed a $15 gift card for their involvement.

Measurement

Demographic characteristics (age, sex, race/ethnicity), socioeconomic status (income, employment, educational attainment), married status, and insurance type were determined from participants' most recent parent study interview. As part of their parent study involvement, number of chronic medical conditions were assessed via self-report and medical chart review. For the purpose of this analysis, responses were summed due to the variability between studies in how this information was collected. Health literacy and health activation were also measured at their last parent study visit and assessed using the Newest Vital Sign (NVS)[11] and Consumer Health Activation Index (CHAI),[12] respectively. Previous research has demonstrated associations between these factors and measures of physical and mental health.[13] A single question was also

used across studies to gauge self-reported health (excellent, very good, good, fair, poor), which was also collected at participants' last parent study interview date.

Clinically-Relevant Anxiety and Depressive Symptoms

Current psychological functioning was assessed using the validated Patient-Reported Outcomes Measurement Information System (PROMIS) four-item short-form questionnaires for anxiety and depression.[14] Raw scores are transformed into T-scores, which have a mean of 50 (Standard Deviation (SD) 10), and are normed against the general U.S. population. They have good agreement with legacy measures of mental health functioning such as the GAD-7 and PHQ-9,[15, 16] and have been used to assess mental health among various medical populations.[17] Higher scores represent greater symptom burden. Thresholds previously proposed in the literature and corresponding to symptom levels with clinical significance (i.e. moderate or greater symptom severities indicating probable anxiety or depression) were utilized.[15, 16] This translated to a T-score equal to or greater than 63.2 and 59.9 for clinically-relevant anxiety and depressive symptoms, respectively.

COVID-Related Emotional Distress

Emotional distress due to the pandemic was assessed using single-item questions asking about worry about contracting COVID-19 (not at all worried, a little worried, somewhat worried, very worried), as well as how often participants felts stressed or lonely due to COVID-19 in the past week (never, some of the time, most of the time, all of the time).

Self-Management of Health

Two single-item questions were used to assess perceived difficulty managing health and accessing and remembering to take medications during the COVID-19 pandemic (1-10 scale, of increasing difficulty). Barriers to general medication adherence was measured using the 12-item

Adherence Starts with Knowledge (ASK-12) survey (range 12-60, higher scores represent more barriers).[18] Change in physical activity and alcohol use over the past month compared to typical levels were each assessed with a single item (more than typical, less than typical, the same).

Healthcare Utilization

Healthcare utilization was measured through two single-item questions (yes/no) asking whether participants had missed or cancelled any medical appointments, or avoided the emergency department or urgent care due to worry about contracting COVID-19. Comfort visiting the doctor once SIP restrictions ended was also assessed (very comfortable, somewhat comfortable, not that comfortable, not comfortable at all).

Statistical Analysis

Descriptive statistics (mean, SD, frequency (%)) were conducted for all participant characteristics, overall and by the presence or absence (yes/no) of clinically-relevant depressive and anxiety symptoms. Cross-sectional associations between participant characteristics and anxiety and depression symptoms were first analyzed using chi-square and independent samples t-tests, as appropriate, then modeled using multivariate logistic regressions, adjusting for any characteristics that were significant in bivariate analyses. This process was then repeated, but instead examining associations between anxiety and depression with each of our outcomes of interest. Covariate selection for multivariate models at this stage was based on the literature as well as prior investigations using this cohort,[7] and included age, sex, race/ethnicity, income, health literacy, health activation, self-reported health, and date of interview. Additionally, all multivariate models were adjusted for parent study, to control for any between-subject correlation within a specific study. For all multivariate models, anxiety and depression were examined as separate exposure variables; least squared means (LS Means) were obtained for continuous

outcomes using a generalized linear model (GLM), whereas for categorical outcomes a multivariate Poisson distribution was used to estimate relative risk (RR) estimates in lieu of odds ratios for ease of interpretation.[19] Pairwise deletion was used, and associations were determined to be statistically significant if they had a p value of < 0.05. Descriptive and bivariate analyses were performed using STATA SE software, version 15 (College Station, TX), while multivariate analyses were performed in SAS Version 9.4 (SAS Institute Inc.).

Patient and Public Involvement

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of the C3 Study.

RESULTS

A total of 733 participants were originally approached to participate in Wave 1 of the C3 survey, of which 630 completed the survey for an initial cooperation rate of 85.9% (630/733).[7] At Wave 3, 565 participants were retained for analysis. Of the 630 participants who originally completed the survey at Wave 1 and were eligible for participation in Wave 3, 47 were unable to be contacted and 18 declined participation, resulting in a cooperation rate of 77.1% (565/733) for this study wave and a retention rate of 89.7% (565/630) from Wave 1 – Wave 3.

Participant characteristics, overall and by the presence of clinically-relevant anxiety and depression, are listed in Table 2. Our sample was older, primarily female, and diverse by race/ethnicity and socioeconomic status. All participants had at least one chronic health condition, while nearly two-thirds reported having three or more. Approximately a quarter of participants self-rated their health as fair to poor.

Table 2. Sample Characteristics, Overall and by Clinically-relevant Anxiety and Depressive Symptoms

Variable	Wave 3 C3 Sample N=565	Clinically-relevant Anxiety Symptoms N=81			Clinically-relevant Depressive Symptoms N=84		
		Yes	No	*p*-value	Yes	No	*p*-value
Age, M (SD)	62.3 (10.9)	61.2 (10.1)	62.5 (11.0)	0.31	62.5 (11.5)	62.3 (10.8)	0.87
Age Group, %				0.33			0.99
< 60	36.3	40.7	35.7		35.7	36.5	
60 - 69	37.0	39.5	36.7		36.9	36.7	
≥ 70	26.7	19.8	27.6		27.4	26.7	
Gender, %				<0.001			<0.001
Female	61.4	81.7	57.9		78.6	58.3	
Male	38.6	18.5	42.1		21.4	41.8	
Race, %				0.06			0.08
Latinx	21.9	30.0	20.4		31.3	20.3	
Non-Latinx White	45.1	36.3	46.5		34.9	46.8	
Non- Latinx Black	29.8	27.5	30.3		28.9	29.9	
Other	3.2	6.3	2.7		4.8	2.3	
Below Poverty Level, %				0.003			0.001
Yes	29.2	43.2	26.7		44.1	26.5	
No	70.8	56.8	73.3		55.9	73.5	
Marital Status, %				0.29			0.06
Married	39.9	34.3	40.9		30.3	41.7	
Unmarried	60.1	65.7	59.1		69.7	58.3	
Health Insurance, %				0.007			0.008
Medicare	16.1	11.1	16.8		16.7	16.1	
Medicaid	12.8	23.5	11.0		22.6	11.1	
Private	25.0	18.5	26.2		15.5	26.6	
Medicare + Private	29.6	24.7	30.4		23.8	30.8	
Medicare + Medicaid	16.5	22.2	15.6		21.4	15.5	
Self-pay/None	0.0	0.0	0.0		0.0	0.0	
Primary Care Setting, %				0.006			0.006
Academic	68.7	55.6	71.0		56.0	71.0	
Federally Qualified Health Center	31.3	44.4	29.1		44.1	29.0	
Employment Status, %				0.15			0.03
Working for Pay	30.1	23.5	31.4		20.2	31.8	
Not Working (Retired/Unemployed)	69.9	76.5	68.6		79.8	68.2	
Health Literacy, %				0.13			0.05
Low	23.4	28.4	22.4		27.4	22.8	
Marginal	23.2	28.4	22.2		31.0	21.7	
Adequate	53.4	43.2	55.4		41.7	55.5	
Health Activation, %				<0.001			0.02
Low	47.6	70.4	43.8		59.5	45.3	
Adequate	52.4	29.6	56.2		40.5	54.7	
# Chronic Conditions, %				0.03			0.05
1	24.2	35.8	22.4		34.5	22.3	
2	16.5	13.6	16.8		11.9	17.1	
3 or more	59.3	50.6	60.8		53.6	60.5	
Self-Reported Health, %				0.21			0.02
Excellent	9.0	6.2	9.5		4.8	9.8	
Very Good	29.9	37.0	28.6		27.4	30.3	
Good	39.7	33.3	40.7		34.5	40.5	
Fair	17.9	22.2	17.2		25.0	16.7	
Poor	3.5	1.2	3.9		8.3	2.7	

Approximately 14% (81/563) of the sample reported the presence of clinically-relevant anxiety symptoms, while roughly 15% (84/563) endorsed significant depressive symptoms (Table 3). In multivariate models (Table 4), female gender (RR 2.34, 95% Confidence Interval (CI) 1.32 – 4.13) and low health activation (RR 2.32, 95% CI 1.44 – 3.76) were independently associated with the presence of anxiety, while female gender (RR 1.95, 95% CI 1.14 – 3.33) was significantly associated with depression.

COVID-Related Emotional Distress

In bivariate analyses, anxiety and depression were both associated with more worry about contracting COVID-19, in addition to greater stress and loneliness as a result of the virus (Table 3). These associations remained significant in multivariate analyses (Table 4;Anxiety - Worry: RR 2.32, 95% CI 1.52 – 3.53; Stress: RR 4.93, 95% CI 3.20 – 7.59; Lonely: RR 3.82, 95% CI 2.21 – 6.60) (Depression - Worry: RR 1.67, 95% CI 1.10 – 2.54; Stress: RR 3.01, 1.96 – 4.61; Lonely: RR 5.37, 95% CI 3.21 – 8.98).

Table 3. Associations with COVID-related Emotional Distress, Health Self-Management and Healthcare Utilization, Overall and by Clinically-relevant Anxiety and Depressive Symptoms

Variable	Wave 3 C3 Sample N=565	Clinically-relevant Anxiety Symptoms N=81			Clinically-relevant Depressive Symptoms N=84		
		Yes	No	*p*-value	Yes	No	*p*-value
COVID-related Emotional Distress							
How worried are you about getting the coronavirus?, %				<0.001			0.01
Not worried at all	10.7	4.2	11.7		10.4	10.7	
A little worried	22.8	12.5	24.6		15.6	23.9	
Somewhat worried	39.9	34.7	40.7		32.5	41.2	
Very worried	26.6	48.6	23.0		41.7	24.2	
Over the past week, how often have you felt nervous or "stressed" because of the coronavirus?, %				<0.001			<0.001
Never	27.8	4.9	31.7		7.1	31.5	
Some of the time	54.0	37.0	56.6		48.8	54.7	
Most of the time	13.8	40.7	9.3		26.2	11.7	
All of the time	4.4	17.3	2.3		17.9	2.1	
Over the past week, how often have you felt alone or lonely because of the coronavirus?, %				<0.001			<0.001
Never	53.3	19.8	59.1		19.1	59.5	
Some of the time	34.5	46.9	32.2		41.7	33.0	
Most of the time	9.2	23.5	6.9		23.8	6.7	

All of the time	3.0	9.9	1.9		15.5	0.8	
Health Self-Management							
Difficulty managing health due to the coronavirus (1-10), M (SD)	4.1 (3.3)	5.8 (3.2)	3.8 (3.2)	<0.001	5.8 (3.4)	3.8 (3.2)	<0.001
Difficulty with medications due to the coronavirus (1-10), M (SD)	2.5 (2.9)	3.8 (3.3)	2.3 (2.7)	<0.001	3.8 (3.4)	2.3 (2.7)	<0.001
ASK-12 total score (12-60), M (SD)	20.2 (5.2)	22.6 (5.7)	19.8 (5.0)	<0.001	23.1 (5.3)	19.7 (5.0)	<0.001
Thinking about the last month, would you say your physical activity was more, less, or about the same than what is typical for you?, %				0.12			0.15
More than typical	17.0	12.4	17.8		9.5	18.2	
Less than typical	54.9	65.4	53.1		60.7	54.1	
The same	28.1	22.2	29.1		29.8	27.8	
Thinking about the last month, would you say your alcohol consumption was more, less, or about the same than what is typical for you?, %				0.13			0.07
More than typical	9.0	14.8	7.9		14.3	8.2	
Less than typical	23.8	22.2	24.1		28.6	22.8	
The same	67.2	63.0	68.0		57.1	69.0	
Healthcare Utilization							
Over the past month, have you chosen to miss or cancel any medical appointments because you were too worried about getting the coronavirus?, %				<0.001			0.01
Yes	22.0	38.3	19.3		32.1	20.1	
No	78.0	61.7	80.7		67.9	79.9	
Over the past month, have you needed to go to the Emergency Room or urgent care but were too worried about getting the coronavirus to seek care?, %				0.06			0.002
Yes	3.7	7.4	3.1		9.5	2.7	
No	96.3	92.6	96.9		90.5	97.3	
Comfortable visiting your doctor in person once SIP lifted, %				<0.001			0.004
Very comfortable	36.9	18.5	40.0		25.0	39.2	
Somewhat comfortable	42.1	48.2	41.3		44.1	41.5	
Not that comfortable	16.5	24.7	15.0		20.2	15.9	
Not comfortable at all	4.4	8.6	3.8		10.7	3.4	

SIP = Shelter-in-place

Table 4. Multivariate Associations between Clinically Relevant Anxiety and Depressive Symptoms and COVID-related Outcomes

Variable	Clinically-relevant Anxiety Symptoms			Clinically-relevant Depressive Symptoms		
	Yes	No	P-value	Yes	No	P-value
COVID-related Emotional Distress	Summary Value	Summary Value		Summary Value	Summary Value	
Very worried about COVID 19, RR (95% CI)	2.32 (1.52,3.53)	REF	<0.001	1.67 (1.10,2.54)	REF	0.02
Stressed due to COVID-19, RR (95% CI)	4.93 (3.20,7.59)	-	<0.001	3.01 (1.96,4.61)	-	<0.001
Lonely due to COVID-19, RR (95% CI)	3.82 (2.21,6.60)	-	<0.001	5.37 (3.21,8.98)	-	<0.001
Health Self-Management						
Difficulty managing health due to COVID-19, LS Means (95% CI)	6.09 (5.25,6.92)	4.23 (3.70,4.75)	<0.001	5.85 (5.04,6.65)	4.22 (3.70,4.75)	<0.001
Difficulty with medications due to COVID-19, LS Means (95% CI)	3.71 (2.98,4.43)	2.47 (2.02,2.92)	<0.001	3.62 (2.92,4.31)	2.45 (2.00,2.91)	<0.001
ASK-12 Total Score,	21.8 (20.6,23.0)	20.2 (19.4,21.0)	0.01	22.3 (21.1,23.5)	20.0 (19.3,20.8)	<0.001

LS Means (95% CI)						
Healthcare Utilization						
Missed or cancelled doctor appointment/Avoided ER visit due to COVID-19, RR (95% CI)	1.62 (1.06,2.49)	-	0.03	1.54 (1.00,2.36)	-	0.05
Very comfortable visiting doctor after SIP lifted, RR (95% CI)	0.54 (0.31,0.93)	-	0.03	0.71 (0.44,1.13)	-	0.14

+ Models have been adjusted for age, gender, race, poverty level, health literacy, health activation, self-reported overall health, study and date of interview

RR = Relative Risk; CI = Confidence Interval; LS = Least Square; SIP = Shelter-in-place

Self-Management of Health

Both anxiety and depression were associated with greater reported difficulty managing health and medications during COVID-19, in addition to more barriers to medication adherence (Table 3). All associations remained significant in multivariate analyses (Table 4;Anxiety - Managing health: LS Means 6.09, 95% CI 5.25 – 6.92 vs. 4.23, 95% CI 3.70 – 4.75; Managing medications: LS Means 3.71, 95% CI 2.98 – 4.43 vs. 2.47, 95% CI 2.02 – 2.92; Medication adherence: LS Means 21.8, 95% CI 20.6 – 23.0 vs. 20.2, 95% CI 19.4 – 21.0) (Depression - Managing health: LS Means 5.85, 95% CI 5.04 – 6.65 vs. 4.22, 95% CI 3.84 – 4.70; Managing medications: LS Means 3.62, 95% CI 2.92 – 4.31 vs. 2.45, 95% CI 2.00 – 2.91; Medication adherence: LS Means 22.3, 95% CI 21.1– 23.5 vs. 20.0, 95% CI 19.3 – 20.8). Bivariate associations between anxiety and depressive symptoms with change in physical activity and alcohol use were non-significant.

Healthcare Utilization

In bivariate analyses, both anxiety and depression were associated with avoidance of routine medical visits, as well as less comfort visiting the doctor once SIP is lifted (Table 3). Depression alone was associated with avoidance of emergency care. For anxiety, associations with avoiding doctor's visits (RR 1.62, 95% CI 1.06 – 2.49) and feeling very comfortable visiting the doctor after SIP ends (RR 0.54, 95% CI 0.31 – 0.93)-were significant in multivariate analyses

(Table 3). For depression, only avoidance of doctor's visits (RR 1.54, 95% CI 1.00 – 2.36) remained significant in multivariate analysis (Table 4).

DISCUSSION

Among a sample of mostly middle to older-age adults with one or more chronic conditions surveyed in the early phases of the COVID-19 crisis in the U.S. – when cases were rising and a SIP order was in effect in most states – clinically-relevant anxiety and depressive symptoms were relatively common, with rates of 14 and 15%, respectively. While still considerable, it should be noted estimates observed in this sample were slightly lower as compared to rates of clinically elevated distress reported among the general population in the U.S. during comparable stages of the pandemic, which have ranged from 20-45%.[20-23] Differences in samples, measurement, or clinical thresholds among studies may in part help to explain this discrepancy. Additionally, the generally older age of our sample's participants may also account for these differences. Studies examining age differences in mental health symptoms have found older adults are reporting fewer symptoms of anxiety and depression in response to the COVID-19 pandemic compared to their younger counterparts,[24] despite their greater COVID-19 risk. Possible age-related protective factors may be a lower perceived socio-economic impact of the pandemic, as well as older adults' tendency to display greater resiliency in the face of acute stress due to accumulated experience navigating other life stressors.

This investigation also helps to elucidate possible risk factors contributing increased mental health risk during the COVID-19 pandemic. Consistent with prior research among the general population,[25] women reported a higher mental health burden after accounting for additional sociodemographic factors, with a nearly two to threefold increase in risk. This may reflect the

disproportionate challenges women have faced in regard to family caretaking, household responsibilities, and job loss as a result of the pandemic.[26] Low health activation was also a sassociated with significant anxiety symptoms. In the context of the COVID-19 pandemic, psychosocial characteristics such as lower confidence in managing physical or mental health, less ability to engage in problem-solving around new health challenges, and/or greater passivity communicating personal health needs may have contributed to higher levels of uncertainty or distress.

Interestingly, while all adults in this sample had at least one chronic medical condition, neither greater medical comorbidity nor poorer self-reported health were associated with significant anxiety and depressive symptoms after adjusting for other sociodemographic and health-related factors. It could be that personal health plays a lesser role in mental health functioning during the pandemic than expected, or that no additional risk to mental health was conferred by having more than one medical condition. Alternatively, it may also be that our sample did not consider themselves to be at higher COVID-19 risk due to their health conditions, which may have served as a protective factor against psychosocial distress. This could have been due to general perceptions of their health or medical illness, as over three-quarters of our sample self-reported their health as at least 'good', despite a similar amount reporting the presence of at least two chronic conditions. However, it may also be that the rapidly changing, and often conflicting, public health messaging around risk and prevention in the early stages of the pandemic contributed to confusion around personal susceptibility.[27] Future studies may consider understanding of and perceptions of personal risk as a possible mediating factor between multimorbidity and a high mental health burden.

As expected, the presence of significant anxiety and depressive symptoms were both associated with higher rates of COVID-related emotional distress. Specifically, respondents with clinically-relevant symptoms were much more likely to report they were very worried about contracting COVID-19, and three to five times as likely to endorse feelings of stress and loneliness as a result of the pandemic. Worry and stress were particularly high for individuals with anxiety, while loneliness was elevated in those with depression. These findings support the need for targeted mental health screening among adults with underlying medical conditions reporting high levels of isolation or worry and stress related to the pandemic. Conversely, clinicians should be aware that adults with pre-existing anxiety or depressive disorders may be at increased risk of COVID-specific emotional distress.

Finally, our results indicate that a high mental health burden may also translate to increased difficulty managing health and maintaining access to routine and emergency medical services during the pandemic among those with pre-existing medical conditions. Both anxiety and depression were separately associated with greater self-reported difficulty managing health and medications, more barriers to medication adherence, as well as greater avoidance of the doctor due to worry about contracting COVID-19. Those with high levels of anxiety, in particular, also reported less comfort returning to the doctor once stay-at-home restrictions ended, indicating concerns about COVID-19 may continue to impact healthcare service use even after restrictions are lifted and the acute crisis improves. While our sample overall reported less physical activity, alcohol use remained relatively stable; furthermore, a higher mental health burden was not associated change in either of these behaviors. Taken together, these findings have particular relevance to clinicians and public health authorities alike. As vaccine availability remains limited and hesitancy high,[28] and treatments for early disease are still in development, optimization of

health and chronic disease status among those with multimorbidity remains a potentially important barrier against infection and serious illness. Thus, any psycho-behavioral factors impacting adequate chronic disease management among this population should be addressed.

There are several limitations which should be noted. Foremost, this study was cross-sectional, which prevents the ability to infer causation. It is not clear whether a high mental health burden led to higher rate of COVID-related distress and maladaptive health behaviors observed, or vice versa. As information on mental health functioning prior to the pandemic was not currently available for the full sample, it is difficult to determine whether any psychological distress and its associated impact are a result of the pandemic, or merely a continuation or exacerbation of a previous condition. Furthermore, while all participants in our sample had at least one underlying chronic medical condition, comprehensive data regarding condition type was not available for analysis. Different medical conditions may have had differing effects on both the presence of mental health symptoms, as well as health self-management and utilization. This assessment was also conducted at the initial stages of the crisis; it is unclear how these findings may change as the pandemic progresses. Additional analyses with follow-up survey waves of the C3 cohort will therefore be necessary. Given the sample was also primarily older, female, and with chronic medical conditions this limits generalizability to the broader population, although it should be noted this latter characteristic was an intentional methodological choice given the heightened COVID-19 risk chronic conditions confer. However, the diversity of the sample with regard to race/ethnicity, socioeconomic status, and health literacy should also be noted.

Conclusion

Within a sample consisting of primarily older adults with underlying medical conditions, clinically-relevant symptoms of anxiety and depression were relatively common during the early

stages of the COVID-19 pandemic in the U.S., with women and those with low health activation disproportionately exhibiting greater risk. Importantly, a high mental health burden may also interfere with the ability to sufficiently manage health during the pandemic. At a time when it is of the utmost importance that individuals with underlying conditions adequately self-manage their health to minimize COVID-19 risk, factors which may interfere with this ability should be addressed, including mental health. As the COVID-19 crisis continues and daily life remains drastically altered, findings from this study reinforce the need for increased awareness surrounding the mental health risks associated with the COVID-19 pandemic among individuals with underlying medical conditions. Health systems and practitioners should respond accordingly through enhanced screening and provision of mental health resources for individuals at high COVID-19 risk.

AUTHOR CONTRIBUTIONS

RML contributed to manuscript conception, design of the work, data analysis, interpretation of data, as well as drafted the manuscript and revised it following author feedback. LO contributed to manuscript conception, data analysis, interpretation of data, and editing of manuscript drafts. AR, EY, SWL, MS and SCB contributed to manuscript conception, interpretation of data, and editing of manuscript drafts. MSW contributed to manuscript conception, design of the work, interpretation of data, and editing of manuscript drafts. All authors have approved the submitted version.

REFERENCES

1. Centers for Disease Control and Prevention [Internet]. COVID Data Tracker: United States COVID-19 Cases and Deaths by State. [Date accessed 2021 10 Feb]. Available from: https://covid.cdc.gov/covid-data-tracker/#datatracker-home.

2. Nicola M, Alsafi Z, Sohrabi C, et al. The socio-economic implications of the coronavirus pandemic (COVID-19): A review. *Int J Surg* 2020;78:185-93.

3. American Psychological Association [Internet]. Stress in America 2020: A National Mental Health Crisis. [Date accessed 2021 10 Feb]. Available from: https://www.apa.org/news/press/releases/stress/2020/report-october

4. Czeisler MÉ, Lane RI, Petrosky E, et al. Mental health, substance use, and suicidal ideation during the COVID-19 pandemic - United States, June 24-30, 2020. *MMWR: Morbidity & Mortality Weekly Report* 2020;69(32):1049-57.

5. Centers for Disease Control and Prevention [Internet]. COVID-19: Your Health: People with Certain Medical Conditions. [Date accessed 2021 10 Feb]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fneed-extra-precautions%2Fgroups-at-higher-risk.html

6. Wong SYS, Zhang D, Sit RWS, et al. Impact of COVID-19 on loneliness, mental health, and health service utilisation: a prospective cohort study of older adults with multimorbidity in primary care. *Br J Gen Pract* 2020;70(700):e817-e24.

7. Wolf MS, Serper M, Opsasnick L, et al. Awareness, attitudes, and actions related to COVID-19 among adults with chronic conditions at the onset of the U.S. outbreak: A cross-sectional curvey. *Ann Intern Med* 2020;173(2):100-9.

8. O'Conor R, Arvanitis M, Wismer G, et al. Rationale and design of the regimen education and messaging in diabetes (REMinD) trial. *Contemp Clin Trials* 2019;83:46-52.

9. Wolf MS, Curtis LM, Wilson EA, et al. Literacy, cognitive function, and health: results of the LitCog study. *J Gen Intern Med*. 2012;27(10):1300-7.

10. Bailey SC, Wismer GA, Parker RM, et al. Development and rationale for a multifactorial, randomized controlled trial to test strategies to promote adherence to complex drug regimens among older adults. *Contemp Clin Trials* 2017;62:21-6.

11. Weiss BD, Mays MZ, Martz W, et al. Quick assessment of literacy in primary care: the newest vital sign. *Ann Fam Med* 2005;3(6):514-22.

12. Wolf MS, Smith SG, Pandit AU, et al. Development and calidation of the consumer health activation index. *Med Decis Making* 2018;38(3):334-43.

13. Smith SG, Curtis LM, Wardle J, et al. Skill set or mind set? Associations between health literacy, patient activation and health. *PloS One* 2013;8(9):e74373.

14. Cella D, Riley W, Stone A, et al. The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005-2008. *J Clin Epidemiol* 2010;63(11):1179-94.

15. Choi SW, Schalet B, Cook KF, et al. Establishing a common metric for depressive symptoms: linking the BDI-II, CES-D, and PHQ-9 to PROMIS depression. *Psychol Assess* 2014;26(2):513-27.

16. Schalet BD, Cook KF, Choi SW, et al. Establishing a common metric for self-reported anxiety: linking the MASQ, PANAS, and GAD-7 to PROMIS Anxiety. *J Anxiety Disord* 2014;28(1):88-96.

17. Schalet BD, Pilkonis PA, Yu L, et al. Clinical validity of PROMIS Depression, Anxiety, Anger across diverse clinical samples. *J Clin Epidemiol* 206;73:119-27.

18. Matza LS, Park J, Coyne KS, et al. Derivation and validation of the ASK-12 adherence barrier survey. *Ann Pharmacother* 2009;43(10):1621-30.

19. Zou G. A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol* 2004;159(7):702-6.

20. Centers for Disease Control and Prevention [Internet]. National Center for Health Statistics. Mental Health: Household Pulse Survey. [Date accessed 10 Feb 2021]. Available from: https://www.cdc.gov/nchs/covid19/pulse/mental-health.htm.

21. Bryan CJ, Bryan AO, Baker JC. Associations among state-level physical distancing measures and suicidal thoughts and behaviors among U.S. adults during the early COVID-19 pandemic. *Suicide Life-Threat Behav* 2020. [Epub ahead of print].

22. Liu CH, Zhang E, Wong GTF, et al. Factors associated with depression, anxiety, and PTSD symptomatology during the COVID-19 pandemic: Clinical implications for U.S. young adult mental health. *Psychiatry Res* 2020;290:113172.

23. Fitzpatrick KM, Harris C, Drawve G. Fear of COVID-19 and the mental health consequences in America. *Psycholog Trauma* 2020. [Epub ahead of print].

24. Bruine de Bruin W. Age differences in COVID-19 risk perceptions and mental health:Evidence from a national US survey conducted in March 2020. *J Gerontol B Psychol Sci Soc Sci* 2020. [Epub ahead of print].

25. Pierce M, Hope H, Ford T, et al. Mental health before and during the COVID-19 pandemic: a longitudinal probability sample survey of the UK population. *Lancet Psychiatry* 2020. [Epub ahead of print].

26. Adams-Prassl AB, Golin, M, Rauh, C. Inequality in the impact of the coronavirus shock: Evidence from real time surveys. Cambridge Working Papers in Economics: 2032. 2020;Cambridge-INET Working Paper Series No: 2020/18.

27. American Public Health Association [Internet]. Countering the "infodemic" of misinformation. [Date accessed 10 Feb 2021]. Available from: https://www.apha.org/covid19.

28. Khubchandani J, Sharma S, Price JH, et al. COVID-19 Vaccination Hesitancy in the United States: A Rapid National Assessment. *J Community Health* 2021:1-8.

STROBE 2007 (v4) checklist of items to be included in reports of observational studies in epidemiology*
Checklist for cohort, case-control, and cross-sectional studies (combined)

Section/Topic	Item #	Recommendation	Reported on page #
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2-3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	6-7
Objectives	3	State specific objectives, including any pre-specified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	7-8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	7-8
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants	7-8
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case	N/A
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	8-10
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	*8-10*
Bias	9	Describe any efforts to address potential sources of bias	
Study size	10	Explain how the study size was arrived at	N/A – secondary analysis
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	8-11
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	10-11
		(*b*) Describe any methods used to examine subgroups and interactions	N/A
		(*c*) Explain how missing data were addressed	11
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed	N/A

		Case-control study—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	11
		(b) Give reasons for non-participation at each stage	11
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	11-12
		(b) Indicate number of participants with missing data for each variable of interest	
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	N/A
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	N/A
		Case-control study—Report numbers in each exposure category, or summary measures of exposure	N/A
		Cross-sectional study—Report numbers of outcome events or summary measures	12-15
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	12-15
		(*b*) Report category boundaries when continuous variables were categorized	
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	15-19
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	18-19
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15-19
Generalisability	21	Discuss the generalisability (external validity) of the study results	19
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	4

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.