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

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ABSTRACT

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

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

Setting Seven academic and community health centres in Chicago, Illinois.

Participants 565 adults aged 23–88 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 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 (relative risk (RR) 2.32, 95% CI 1.52 to 3.53; RR 1.67, 95% CI 1.10 to 2.54), greater stress (RR 4.93, 95% CI 3.20 to 7.59; RR 3.01, 95% CI 1.96 to 4.61) and loneliness (RR 3.82, 95% CI 2.21 to 6.60; RR 5.37, 95% CI 3.21 to 8.98), greater avoidance of the doctor (RR 1.62, 95% CI 1.06 to 2.49; RR 1.54, 95% CI 1.00 to 2.36) and difficulty managing health (least square means (LS Means) 6.09, 95% CI 5.25 to 6.92 vs 4.23, 95% CI 3.70 to 4.75; LS Means 5.85, 95% CI 5.04 to 6.65 vs 4.22, 95% CI 3.70 to 4.75) and medications (LS Means 3.71, 95% CI 2.98 to 4.43 vs 2.47, 95% CI 2.02 to 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.

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, socioeconomic status and health literacy, increasing generalisability.
- 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 limit the ability to infer causation.

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 USA onset of the pandemic in March 2020, confirmed cases of COVID-19 have dramatically increased,[1] fuelling 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 as 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 utilisation of healthcare services during the COVID-19 pandemic, for instance, through adequate adherence to drug regimens, engagement in recommended health behaviours 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 twofold. First, we sought to determine the prevalence of clinically relevant depressive and anxiety symptoms during the early stages of the 2020 US 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 utilisation 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 behaviours related to the COVID-19 pandemic. An in-depth explanation of the methods and details of the study has been published elsewhere.[7] However, in brief, participants were originally recruited from one of four current National Institutes 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 were 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 1 month apart, beginning in the middle of March at the US outset of the COVID-19 outbreak. Data for this analysis were collected during wave 3 (1–22 May 2020), as standardised measures of psychological functioning were introduced into the study battery at this timepoint.

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 randomised clinical trials evaluating technology-based health system 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]

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, that is, middle-aged to older adults or those with complex drug regimens.[9 10] Other common conditions reported among study participants include hypertension, hypercholesterolemia, 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 characterised by an uncorrectable visual, hearing or cognitive impairment interfering with study participation (eg, 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

Table 1 Sample characteristics of parent studies involved in the C3 survey

Parent study (NIH project No)	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	► Aged 55–75 at study onset	► Severe, uncorrectable vision, hearing or cognitive impairments ► 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	► Aged≥50 at study onset ► Taking≥5 long-term Rx medications	► 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	► Aged≥21 at study onset ► 5 weeks to 24 months postkidney transplant ► Taking≥3 long-term Rx medications	► Severe, uncorrectable vision, hearing or cognitive impairments ► Limited English proficiency	1 academic transplant centre
EHR-based Universal Medication Schedule to Improve Adherence to Complex Regimens (R01NR015444)	Clinical trial	120	English	► Aged≥21 at study onset ► T2DM ► Haemoglobin A1c value≥7.5% at study onset ► Taking≥5 long-term Rx medications	► Severe, uncorrectable vision, hearing or cognitive impairments ► Limited English proficiency	5 academic internal medicine clinics

C3, Chicago COVID-19 Comorbidities; EHR, electronic health record; FQHC, federally qualified health centre; NIH, National Institutes of Health; Rx, prescription; T2DM, type 2 diabetes mellitus.

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 min 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, the number of chronic medical conditions was 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[11] and Consumer Health Activation Index,[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 four-item short-form questionnaires for anxiety and depression.[14] Raw scores are transformed into T-scores, which have a mean of 50 (SD 10), and are normed against the general US population. They have good agreement with legacy measures of mental health functioning such as the Generalized Anxiety Disorder-7 (GAD-7) and the Patient Health Questionaire-9 (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 (ie, moderate or greater symptom severities indicating probable anxiety

or depression) were used.[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-19-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 felt 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 were measured using the 12-item Adherence Starts with Knowledge survey (range 12–60, higher scores represent more barriers).[18] Change in physical activity and alcohol use over the past month compared with typical levels were each assessed with a single item (more than typical, less than typical, the same).

Healthcare utilisation

Healthcare utilisation 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 analysed using χ^2 and independent samples t-tests, as appropriate, then modelled 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-subjects correlation within a specific study. For all multivariate models, anxiety and depression were examined as separate exposure variables; least square means (LS Means) were obtained for continuous outcomes using a generalised linear model, whereas for categorical outcomes a multivariate Poisson distribution was used to estimate relative risk (RR) estimates in lieu of ORs for ease of interpretation.[19] Pairwise deletion was used, and associations were determined to be statistically significant if they had a p value <0.05. Descriptive and bivariate analyses were performed using STATA SE software V.15 (College Station, Texas) while multivariate analyses were performed in SAS V.9.4 (SAS Institute).

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] In wave 3, up to 565 participants were retained for analysis. Of the 630 participants who originally completed the survey in wave 1 and were eligible for participation in wave 3, forty-seven 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 to 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.

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% CI 1.32 to 4.13) and low health activation (RR 2.32, 95% CI 1.44 to 3.76) were independently associated with the presence of anxiety while female gender (RR 1.95, 95% CI 1.14 to 3.33) was significantly associated with depression.

COVID-19-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 to 3.53; Stress: RR 4.93, 95% CI 3.20 to 7.59; Lonely: RR 3.82, 95% CI 2.21 to 6.60) (Depression-Worry: RR 1.67, 95% CI 1.10 to 2.54; Stress: RR 3.01, 95% CI 1.96 to 4.61; Lonely: RR 5.37, 95% CI 3.21 to 8.98).

Self-management of health

Both anxiety and depression were associated with greater reported difficulty managing health and medications

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, mean (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 centre	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	
Number of chronic conditions, %				0.03			0.05
1	24.2	35.8	22.4		34.5	22.3	

Continued

Table 2 Continued

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
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	

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 to 6.92 vs 4.23, 95% CI 3.70 to 4.75; Managing medications: LS Means 3.71, 95% CI 2.98 to 4.43 vs 2.47, 95% CI 2.02 to 2.92; Medication adherence: LS Means 21.8, 95% CI 20.6 to 23.0 vs 20.2, 95% CI 19.4 to 21.0) (Depression-Managing health: LS Means 5.85, 95% CI 5.04 to 6.65 vs 4.22, 95% CI 3.70 to 4.75; Managing medications: LS Means 3.62, 95% CI 2.92 to 4.31 vs 2.45, 95% CI 2.00 to 2.91; Medication adherence: LS Means 22.3, 95% CI 21.1 to 23.5 vs 20.0, 95% CI 19.3 to 20.8). Bivariate associations between anxiety and depressive symptoms with change in physical activity and alcohol use were non-significant.

Healthcare utilisation

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 to 2.49) and feeling very comfortable visiting the doctor after SIP ends (RR 0.54, 95% CI 0.31 to 0.93) were significant in multivariate analyses (table 3). For depression, only avoidance of doctor's visits (RR 1.54, 95% CI 1.00 to 2.36) remained significant in multivariate analysis (table 4).

DISCUSSION

Among a sample of mostly middle-aged to older aged adults with one or more chronic conditions surveyed in the early phases of the COVID-19 crisis in the USA—when cases were rising and an 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 with rates of clinically elevated distress reported among the general population in the USA during comparable stages of the pandemic, which have ranged from 20% to 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 with their younger counterparts,[24] despite their greater COVID-19 risk. Possible age-related protective factors may be a lower perceived socioeconomic 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 to increased mental health risk during the COVID-19 pandemic among middle to older adults with one or more health conditions. 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 twofold 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 associated 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 was 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

Table 3 Associations with COVID-19-related emotional distress, health self-management and healthcare utilisation, 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-19-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), mean (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), mean (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), mean (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 utilisation							
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	

Continued

Table 3 Continued

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
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 was 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	

ASK-12, 12-item Adherence Starts with Knowledge; SIP, shelter in place.

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 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 was both associated with higher rates of COVID-19-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

Table 4 Multivariate associations between clinically relevant anxiety and depressive symptoms and COVID-19-related outcomes

Variable	Clinically relevant anxiety symptoms*			Clinically relevant depressive symptoms*		
	Yes	No	P value	Yes	No	P value
COVID-19-related emotional distress	Summary value	Summary value		Summary value	Summary value	
Very worried about COVID-19, RR (95% CI)	2.32 (1.52 to 3.53)	Ref	<0.001	1.67 (1.10 to 2.54)	Ref	0.02
Stressed due to COVID-19, RR (95% CI)	4.93 (3.20 to 7.59)	–	<0.001	3.01 (1.96 to 4.61)	–	<0.001
Lonely due to COVID-19, RR (95% CI)	3.82 (2.21 to 6.60)	–	<0.001	5.37 (3.21 to 8.98)	–	<0.001
Health self-management						
Difficulty managing health due to COVID-19, LS Means (95% CI)	6.09 (5.25 to 6.92)	4.23 (3.70 to 4.75)	<0.001	5.85 (5.04 to 6.65)	4.22 (3.70 to 4.75)	<0.001
Difficulty with medications due to COVID-19, LS Means (95% CI)	3.71 (2.98 to 4.43)	2.47 (2.02 to 2.92)	<0.001	3.62 (2.92 to 4.31)	2.45 (2.00 to 2.91)	<0.001
ASK-12 total score, LS Means (95% CI)	21.8 (20.6 to 23.0)	20.2 (19.4 to 21.0)	0.01	22.3 (21.1 to 23.5)	20.0 (19.3 to 20.8)	<0.001
Healthcare utilisation						
Missed or cancelled doctor appointment/ avoided ER visit due to COVID-19, RR (95% CI)	1.62 (1.06 to 2.49)	–	0.03	1.54 (1.00 to 2.36)	–	0.05
Very comfortable visiting doctor after SIP was lifted, RR (95% CI)	0.54 (0.31 to 0.93)	–	0.03	0.71 (0.44 to 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.
ASK-12, 12-item Adherence Starts with Knowledge; ER, emergency room; LS, least square; RR, relative risk; SIP, shelter in place.

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-19-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 with change in either of these behaviours. 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, optimisation of health and chronic disease status among those with multimorbidity remains a potentially important barrier against infection and serious illness. Thus, any psychobehavioural 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 a higher rate of COVID-19-related distress and maladaptive health behaviours 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 were 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 utilisation. 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 generalisability 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 USA, 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 minimise 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.

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Patient consent for publication Not applicable.

Ethics approval This study involves human participants. 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. Participants gave informed consent to participate in the study before taking part.

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REFERENCES

1 Centers for Disease Control and Prevention [Internet]. COVID data Tracker: United States COVID-19 cases and deaths by state. Available: https://covid.cdc.gov/covid-data-tracker/#datatracker-home [Accessed 10 Feb 2021].
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. Available: https://www.apa.org/news/press/releases/stress/2020/report-october [Accessed 10 Feb 2021].
4 Czeisler Mark É, 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 Morb Mortal Wkly Rep* 2020;69:1049–57.
5 Centers for Disease Control and Prevention [Internet]. COVID-19: your health: people with certain medical conditions.. Available: 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 [Accessed 10 Feb 2021].
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:e817–24.
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 survey. *Ann Intern Med* 2020;173:100–9.
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 EAH, *et al*. Literacy, cognitive function, and health: results of the LitCog study. *J Gen Intern Med* 2012;27:1300–7.
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;3:514–22.
12 Wolf MS, Smith SG, Pandit AU, *et al*. Development and validation of the consumer health activation index. *Med Decis Making* 2018;38:334–43.
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: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;63:1179–94.
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;26:513–27.
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;28:88–96.
17 Schalet BD, Pilkonis PA, Yu L, *et al*. Clinical validity of PROMIS depression, anxiety, and anger across diverse clinical samples. *J Clin Epidemiol* 2016;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;43:1621–30.
19 Zou G. A modified poisson regression approach to prospective studies with binary data. *Am J Epidemiol* 2004;159:702–6.
20 Centers for Disease Control and Prevention [Internet]. National center for health statistics. mental health: household pulse survey. Available: https://www.cdc.gov/nchs/covid19/pulse/mental-health.htm [Accessed 10 Feb 2021].
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.
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. *Psychol Trauma* 2020;12:S17–21.
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.
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;7:883–92.
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*. Cambridge-INET Working Paper Series No: 2020/18, 2020.
27 American Public Health Association. Countering the “infodemic” of misinformation. Available: https://www.apha.org/covid19 [Accessed 10 Feb 2021].
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;46:270–7.