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ORIGINAL PAPER

Knowledge and Behaviors of Adults with Underlying Health Conditions During the Onset of the COVID-19 U.S. Outbreak: The Chicago COVID-19 Comorbidities Survey

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Abstract

Accurate understanding of COVID-19 safety recommendations early in the outbreak was complicated by inconsistencies in public health and media messages. We sought to characterize high-risk adults' knowledge of COVID-19 symptoms, prevention strategies, and prevention behaviors. We used data from the Chicago COVID-19 Comorbidities (C3) survey collected between March 13 thru March 20, 2020. A total of 673 predominately older adults with ≥ 1 chronic condition completed the telephone interview. Knowledge was assessed by asking participants to name three symptoms of COVID-19 and three actions to prevent infection. Participants were then asked if and how they had changed plans due to coronavirus. Most participants could identify three symptoms (71.0%) and three preventive actions (69.2%). Commonly reported symptoms included: fever (78.5%), cough (70.6%), and shortness of breath (45.2%); preventive actions included: washing hands (86.5%) and social distancing (86.2%). More than a third of participants reported social distancing themselves (38.3%), and 28.8% reported obtaining prescription medication to prepare for the outbreak. In multivariable analyses, no participant characteristics were associated with COVID-19 knowledge. Women were more likely than men, and Black adults were less likely than White adults to report practicing social distancing. Individuals with low health literacy were less likely to report obtaining medication supplies. In conclusion, though most higher-risk individuals were aware of social distancing as a prevention strategy early in the outbreak, less than half reported enacting it, and racial disparities were apparent. Consistent messaging and the provision of tangible resources may improve future adherence to safety recommendations.

Keywords COVID-19 · Knowledge · Behavior · Disparities · Health literacy · Chicago

Introduction

Public health leadership in the United States has sought to mobilize the country and its residents to understand the gravity of the threat posed by coronavirus disease 2019 (COVID-19), the condition that results from severe acute respiratory syndrome coronavirus 2 (SARS-CoV 2). Yet contradictory messaging in the earliest stages and throughout the outbreak [1–4] may have led to confusion and inaction. Given the rapid global spread of this virus [5], and the continued increase in cases throughout the United States [6], the time sensitivity of disseminating information to communities is critical. Beyond recognizing the seriousness of COVID-19, people need functional knowledge of how the infection presents itself through symptoms and must be aware of what they can do to prevent the disease and its spread to others. Public health communication that is inconsistent, inaccurate, delayed, or not understandable to the intended audience will have severe consequences and undoubtedly lead to lives lost.

With COVID-19, those in greatest need of actionable information are individuals at highest risk to experience severe complications, specifically adults over the age of 60

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and living with underlying health conditions [7] such as cardiovascular and pulmonary disease or compromised immune systems [8]. Lessons from prior outbreaks, including the 2009 H1N1 influenza pandemic, are limited with regard to whether public health messaging reaches those at highest risk, if those individuals are more aware of their vulnerability and if so, whether this translates to the initiation and maintenance of recommended protective actions. During the initial week that COVID-19 cases manifested in Chicago, Illinois, our team created a cohort of predominantly middle age and older adults with one or more chronic conditions to examine their demonstrated awareness of the virus, and whether they were taking steps to maintain their health and prevent transmission. Referred to as the Chicago COVID-19 Comorbidities (C3) survey, our initial findings indicated many adults with comorbidities lacked critical knowledge about COVID-19 and despite concern, were not changing routines or plans early on in this pandemic [9].

As the COVID-19 outbreak continues, and the infection rate continues to increase, the city of Chicago has identified disparities by race and ethnicity in terms of infection and mortality [10]. While these disparities are likely a result of underlying structural inequities that produce differences in disease burden, our initial findings did observe differences in perceived susceptibility and degree of concern related to COVID-19 by race and socioeconomic position [9], suggesting that accurate and actionable public health messaging may not be reaching all communities. Our previous report presented consolidated outcomes related to knowledge and protective behaviors. For the current study we sought to better characterize participants' abilities to accurately recognize virus symptoms and describe which actions they believed could be taken to prevent infection. We further examined the type of modifications these high-risk adults were making to their daily lives and future plans. A range of psychosocial characteristics were also investigated as potential determinants of knowledge and behaviors.

Methods

Sample and Procedure

The C3 survey is an ongoing, longitudinal survey; for this study we utilized data collected during the first wave of interviews that were conducted between March 13 and March 20, 2020. The cohort has been previously described in detail [9]. Briefly, the C3 cohort is comprised of active participants involved in one of five ongoing, National Institutes of Health (NIH)-funded health services research projects taking place among five academic internal medicine and two federally qualified health center primary care settings across the greater Chicago area. Inclusion criteria across studies varied by age, as one included adults of any age whereas the other four targeted middle age and older adults exclusively. Three studies focused on the presence of one or more chronic conditions (i.e. type 2 diabetes, chronic obstructive pulmonary disease, kidney transplant), one required patients to be taking five or more prescription medications for chronic conditions, and another was a longstanding cohort study of older adults. Common exclusion criteria for all studies include the presence of a severe, uncorrectable cognitive, visual or hearing impairment that would preclude a participant's ability to complete interviews.

Similar recruitment procedures were followed for the parent studies, which first involved identifying eligible participants through queries of clinic records. After obtaining physician permission, potential participants were mailed a letter informing them about the study and provided a telephone number to decline participation. Seven days following the mailing, research coordinators contacted potential participants by telephone to introduce the study, screen for eligibility, and schedule a baseline interview where written informed consent was obtained and participants consented (yes/no) to be contacted for future research interviews. The C3 survey specifically targeted participants whose last interview was performed from 2018 to the present. This timeframe was selected to ensure previously collected data from each parent study, which were merged with data from this survey, were most current.

Trained research coordinators contacted study participants outside of their normally scheduled research interviews to invite them to answer a brief survey about COVID-19 by phone. After obtaining verbal consent, interviewers administered a brief survey and recorded participant responses using REDCap® survey software. All research activities were conducted by telephone for the safety of our research participants and staff. The study was approved by the Northwestern University Institutional Review Board.

Measures

Psychosocial Characteristics

Across all five studies, there was prior, uniform collection of patient demographics (age, sex, race/ethnicity), socioeconomic status (household income, employment status), and self-reported number of chronic conditions. A single item captured self-reported overall health (excellent, very good, good, fair, poor). All studies include a measure of health literacy: four used the Newest Vital Sign (NVS) [11] and one used the validated, single item brief health literacy screen (BHLS), which asks participants 'How confident are you filling out medical forms by yourself?' [12]. For the purpose of these analyses, participants were classified as having one) low health literacy if they scored 0–1

('limited health literacy likely') on the NVS, or responded 'always' on the BHLS, two) marginal health literacy if they scored 2–3 ('possibility of limited literacy') on the NVS, or responded 'often' or 'sometimes' on the BHLS, three) adequate health literacy if they scored 4–6 ('adequate health literacy') on the NVS, or responded 'occasionally' or 'never' on the BHLS. Previous research found these classifications for these two instruments to highly correspond with one another [13].

COVID-19 Knowledge

Demonstrated knowledge of COVID-19 was assessed by asking participants to name three symptoms of the coronavirus and three actions they could take to prevent it in an open-ended format. Verbatim responses were documented and independently coded by five expert clinician raters.

Modification to Daily Lives

Participants were asked whether they had changed any plans because of the coronavirus and, if so, to describe what plans they had changed. To elicit response related to medications, research coordinators also probed whether individuals went to the pharmacy to obtain more chronic medications. Verbatim responses were recorded and independently reviewed and coded by a team of four trained raters (RO, JYB, ME, DM). A preliminary list of categories was generated based on initial review of responses. Raters worked in teams of two to review approximately 350 responses. First, raters independently reviewed 50 responses, and then met within their partnered rater, and then the larger team to review and reconcile interpretative differences and amend the list of categories. Raters then proceeded to code the remaining responses, reconciling differences in the same manner to finalize the derived categories.

Analysis

Descriptive statistics were calculated for all patient characteristics and survey responses. Associations between patient characteristics and responses to COVID-19 symptoms, prevention and actions were then examined in bivariate analyses using chi-square tests. All outcomes were dichotomous and multivariable Poisson distribution was used to estimate the relative risk estimates rather than odds ratios [14]. All models included health literacy, age, sex, race/ethnicity, income, day the survey was conducted and parent study. Statistical analyses were performed using STATA/SE software, version 15 (College Station, TX).

Results

The average age of participants was 63 years (Mean: 62.8, Standard Deviation: 11.1). The majority were female (60.2%), approximately half self-identified as non-white (31.4% Black, 20.2% Latino). Nearly a third were living below the federal poverty level (28.9%) and 40% were working for pay. The majority were managing three or more chronic conditions (68.1%), and a total of 22.9% and 23.0% of the sample were classified as having low and marginal health literacy, respectively (Table 1).

Knowledge of COVID-19 Symptoms

The majority of participants were able to identify three symptoms of COVID-19 (71.0%) (Table 2). Specific

Table 1 Sample characteristics

Variable	Overall (N = 673)
Age group, %	
< 60	35.1
60–69	35.8
≥ 70	29.1
Gender, %	
Female	60.3
Male	39.7
Race/ethnicity	
Black	31.3
White	47.5
Latino	21.2
Living below poverty level, %	
Yes	28.9
No	71.1
Primary care setting, %	
Academic	70.0
Federally qualified health center	30.0
Employment status, %	
Working for pay	40.6
Not working (retired/Unemployed)	59.4
Health literacy, %	
Low	22.9
Marginal	23.0
Adequate	54.1
Number of chronic conditions, %	
1–2	31.9
3 or more	68.1
Self-reported overall health, %	
Good–excellent	77.0
Fair–poor	23.0

Table 2 Frequencies of knowledge of COVID-19 symptoms, steps to prevent risk of infection and modifications to daily activities during initial outbreak of COVID-19

	N (%)
Symptom	
Identified 3 symptoms of COVID-19	478 (71.0)
Fever	528 (78.5)
Cough	475 (70.6)
Shortness of breath	304 (45.2)
Tiredness/fatigue	78 (11.6)
Aches and pains	106 (15.8)
Sore throat	113 (16.8)
Nausea and GI distress	63 (9.4)
Prevention	
Identified 3 actions to prevent risk of infection	466 (69.2)
Wash hands	584 (86.8)
Social distance	581 (86.3)
Clean or disinfect objects	130 (19.3)
Avoid people who are sick	78 (11.6)
Avoid touching face	111 (16.5)
Cover when cough or sneeze	71 (10.6)
Stay home when sick	44 (6.5)
Wear a mask	95 (14.1)
Wear gloves	35 (5.2)
Use hand sanitizer	49 (7.2)
Engage in healthy behaviors (nutrition, sleep, fluids)	65 (9.7)
Avoid contact when greeting (handshake, hug)	28 (4.2)
Modifications to daily activities	
Practice physical or social distance	258 (38.3)
Cancel travel plans	223 (33.1)
Cancel leisure activities or group gatherings	220 (32.7)
Complete errands	56 (8.3)
Changes related to employment[a]	
Working from home	29 (11.3)
Reduction in hours, pay or loss of job	32 (12.5)
Cancel medical appointments	53 (7.8)
Took action to obtain medications	194 (28.8)

[a]Among those who reported being employed in parent study

symptoms that were commonly reported included fever (78.5%), cough (70.6%), and shortness of breath (45.2%). Common incorrect symptoms included sneezing (8.9%), and sinus congestion (13.5%), while rare incorrect symptoms include dry mouth or throat (n = 9), itchy or watery eyes (n = 3), drooling, dehydration, urination, irritability, issues with your feet and rash. In bivariate analyses (Table 3), individuals with low health literacy and those who identified as Black were less likely to identify fever, cough, and shortness of breath as symptoms of COVID-19, and those living below the federal poverty level were less likely to identify fever and shortness of breath. However, in fully adjusted models, no participant characteristics were associated with ability to identify these three symptoms (Table 4).

Knowledge of Actions to Prevent Infection of COVID-19

The majority of participants (69.2%) were able to identify three actions they could take to prevent the risk of infection (Table 2). Commonly reported preventive actions included washing hands (86.5%), and engaging in social distance from others (86.2%), while less common preventive steps included cleaning and disinfecting objects (19.0%), avoiding touching one's face (16.6%), wearing a mask (13.9%), avoiding people who are sick (11.5%), and engaging in health behaviors such as maintaining adequate nutrition, rest and drinking fluids (9.7%).

In bivariate analyses (Table 3), individuals with low health literacy, living below the poverty level, and who identified as Black or Latino, and completed the interview before the third day (March 17, 2020) were less likely to identify maintaining social distance as a preventive strategy to reduce the risk of COVID-19 infection. Additionally, Latino individuals were more likely to report washing or disinfecting objects as a strategy to reduce the risk of COVID-19 infection. In adjusted analyses (Table 4), no participant characteristics were associated with identification of these prevention strategies, but the day the interview was completed was predictive of identifying social distancing as a preventive strategy. Participants who completed interviews on or after the third day (March 17, 2020) were more likely to report social distance as a preventive strategy.

Modifications to Daily Activities

During the initial outbreak in Illinois, approximately a third of participants reported enacting social distance precautions (38.3%), canceling leisure activities (e.g. dining out, going to the gym) or group gatherings (e.g. attending church, concerts, weddings) (32.7%), and postponing or canceling upcoming travel (33.1%) (Table 2). Some reported modifications to their employment; among those currently employed, 11.3% reported working from home, and 12.5% reported a reduction in hours, pay or loss of a job. Regarding health management activities, a few canceled routine medical appointments (7.8%), and approximately a quarter (28.8%) reported taking anticipatory action to obtain prescription medications. In bivariate analyses (Table 3), men and those living above the federal poverty level were less likely to report enacting social distancing behaviors in their own lives. Additionally, adults less than 70 years old, who identified as Latino, were living below the federal poverty level, had three or more chronic conditions, or had low health literacy were less likely to report stopping leisure activities or

Table 3 COVID-19 Knowledge and reported behaviors across sample characteristics (n = 673)

Variable	Identified symptoms			Prevention knowledge			Reported behavior		
	Fever, %	Cough, %	Shortness of breath %	Wash hands, %	Social distance, %	Wash or disinfect, %	Social distance, %	Stop leisure activities, %	Took action to obtain medicine, %
Age group								‡	
< 60	81.8	71.6	49.2	89.0	85.6	20.8	33.5	**22.9**	25.4
60–69	78.4	71.8	46.1	87.1	87.6	19.5	37.8	**36.1**	29.9
≥ 70	74.5	67.9	39.3	83.7	85.7	17.4	44.9	**40.3**	31.6
Sex			*				†		
Female	80.1	72.7	**43.1**	86.2	85.7	20.2	**42.4**	35.2	28.8
Male	76.0	67.4	**48.3**	87.6	87.3	18.0	**32.2**	28.8	28.8
Race[a]	†	*	‡		‡	†		‡	†
Latino	**82.2**	**65.9**	**48.2**	88.2	**82.2**	**28.9**	40.0	**21.5**	**17.8**
White	**82.5**	**75.5**	**51.3**	88.7	**92.1**	**16.9**	40.7	**38.7**	**31.8**
Black	**70.9**	**66.3**	**34.7**	82.4	**81.4**	**16.6**	32.2	**29.2**	**29.7**
Below poverty level[b]	†		*		†		*	†	†
Yes	**71.0**	65.8	**38.9**	82.9	**80.3**	21.2	**44.0**	**24.4**	**21.8**
No	**81.5**	72.6	**47.4**	88.2	**88.6**	18.7	**35.6**	**36.0**	**31.8**
[#]Chronic conditions								‡	
1–2	81.4	70.7	44.7	87.0	89.3	22.3	40.0	**43.7**	32.4
3 or more	77.1	70.5	45.4	86.7	84.9	17.9	37.6	**27.5**	36.8
Health literacy	‡	‡	‡		‡			‡	*
Low	**70.1**	**70.8**	**32.5**	83.8	**77.9**	24.7	43.5	**21.4**	**20.8**
Marginal	**72.3**	**58.1**	**45.2**	83.9	**84.5**	14.8	37.4	**31.6**	**29.0**
Adequate	**84.6**	**75.8**	**50.6**	89.3	**90.7**	19.0	36.5	**37.9**	**32.1**
Self-reported health		*							
Good–excellent	80.1	**73.0**	46.7	87.1	87.1	20.3	36.5	34.2	29.0
Fair–poor	72.9	**62.6**	40.0	85.8	83.9	16.1	44.5	27.7	28.4
Day of interview					‡		‡	†	†
1	88.2	60.8	43.1	92.2	**56.9**	21.6	**19.6**	**27.5**	**21.6**
2	73.9	75.7	43.2	88.3	**81.1**	15.3	**35.1**	**27.0**	**24.3**
3	83.1	69.6	48.0	88.5	**90.5**	12.8	**31.1**	**30.4**	**19.6**
4	79.7	71.7	40.7	83.2	**88.5**	20.4	**40.7**	**31.0**	**32.7**
5	73.5	72.6	48.7	86.7	**92.9**	24.8	**50.4**	**48.7**	**37.2**
6	75.9	67.7	45.9	85.0	**90.2**	22.6	**44.4**	**29.3**	**35.3**

[a]37 participants missing race data

[b]Four participants missing income data

*$p < 0.05$

†$p < 0.01$

‡$p < 0.001$

group gatherings. Individuals who identified as Latino, lived below the federal poverty level, or had low health literacy, were also less likely to take early action to obtain prescription medications. In adjusted analyses (Table 4), women were more likely to practice social distancing, while Black adults were less likely to report social distancing. Additionally, individuals who completed interviews on or after March 18th were more likely to report practicing social distancing. Individuals with low health literacy were less likely to report stopping leisure or group activities, and were less likely to take action to obtain prescription medications.

Discussion

Among this sample of predominantly older adults with comorbid conditions, we found that during the initial outbreak of COVID-19 in the U.S., the majority of participants

Table 4 Multivariable models examining patient characteristics and COVID-19 knowledge and behaviors (N = 673)

Variable	Identified symptoms			Prevention knowledge			Reported behavior		
	Fever RR (95% CI)	Cough RR (95% CI)	Shortness of breath RR (95% CI)	Wash hands RR (95% CI)	Social distance RR (95% CI)	Wash or disinfect RR (95% CI)	Social distance RR (95% CI)	Stop leisure activities RR (95% CI)	Took action to obtain medicine RR (95% CI)
Age group									
< 60	1.00 (ref)	–	–	–	–	–	–	–	–
60–69	0.97 (0.76,1.22)	1.01 (0.79,1.29)	1.02 (0.75,1.38)	0.98 (0.79,1.23)	1.02 (0.81,1.27)	1.16 (0.74,1.81)	1.02 (0.73,1.45)	1.33 (0.89,1.98)	1.20 (0.80,1.81)
≥ 70	0.91 (0.69,1.21)	0.98 (0.73,1.33)	0.87 (0.60,1.28)	0.93 (0.71,1.22)	1.01 (0.77,1.32)	1.13 (0.65,1.97)	1.21 (0.81,1.80)	1.35 (0.85,2.13)	1.17 (0.72,1.91)
Sex									
Female	1.12 (0.92,1.36)	1.15 (0.94,1.41)	0.99 (0.77,1.27)	1.01 (0.84,1.21)	1.02 (0.84,1.22)	1.16 (0.78,1.73)	**1.38 (1.03,1.85)***	1.29 (0.84,1.78)	0.98 (0.71,1.36)
Male	1.00 (ref)	–	–	–	–	–	–	–	–
Race[a]									
Latino	1.05 (0.80,1.39)	0.86 (0.64,1.16)	1.03 (0.72,1.47)	1.02 (0.78,1.33)	0.92 (0.70,1.20)	1.45 (0.86,2.47)	0.78 (0.52,1.18)	0.76 (0.46,1.23)	0.88 (0.52,1.48)
White	1.00 (ref)	–	–	–	–	–	–	–	–
Black	0.90 (0.71,1.14)	0.89 (0.70,1.14)	0.78 (0.57,1.06)	0.95 (0.76,1.18)	0.91 (0.73,1.13)	0.87 (0.53,1.42)	**0.68 (0.48,0.96)***	0.80 (0.56,1.14)	1.03 (0.71,1.48)
Below poverty level[b]									
Yes	0.87 (0.68,1.10)	0.92 (0.72,1.18)	0.78 (0.57,1.07)	0.94 (0.75.1.18)	0.92 (0.73,1.15)	0.99 (0.63,1.58)	1.14 (0.82,1.59)	0.88 (0.59,1.30)	1.00 (0.66,1.50)
No	1.00 (ref)	–	–	–	–	–	–	–	-
Health literacy[d]									
Low	0.86 (0.66,1.13)	1.00 (076,1.32	0.76 (0.52,1.10)	0.98 (0.76,1.26)	0.91 (0.70,1.17)	1.15 (0.70,1.90)	1.34 (0.92,1.95)	**0.62 (0.39,0.99)***	**0.58 (0.36,0.94)***
Marginal	0.88 (0.69,1.12)	0.77 (0.59,1.01)	0.98 (0.72,1.34)	0.96 (0.77,1.21)	0.95 (0.75,1.19)	0.72 (0.43,1.21)	1.01 (0.71,1.44)	0.84 (0.58,1.22)	0.86 (0.58,1.27)
Adequate	1.00 (ref)	–	–	–	–	–	–	–	–
Day of interview									
1	1.00 (ref)	–	–	–	–	–	–	–	–
2	0.86 (0.58,1.26)	1.33 (0.86,2.05)	1.21 (0.71,2.06)	0.96 (0.67,1.39)	1.41 (0.91,2.18)	0.64 (0.29,1.41)	1.69 (0.83,3.44)	1.00 (0.50, 2.00)	1.20 (0.57,2.52)
3	0.94 (0.66,1.34)	1.18 (0.77,1.79)	1.26 (0.76,2.09)	0.95 (0.67,1.34)	**1.53 (1.01,2.32)***	0.58 (0.27,1.23)	1.61 (0.80,3.24)	1.18 (0.61,2.27)	0.93 (0.45,1.93)
4	0.94 (0.64,1.38)	1.25 (0.81,1.95)	1.18 (0.68,2.04)	0.92 (0.63,1.34)	**1.57 (1.02,2.43)***	0.85 (0.40,1.81)	**2.10 (1.04,4.26)***	1.28 (0.64,2.56)	1.45 (0.70,3.03)
5	0.83 (0.57,1.22)	1.25 (0.81,1.92)	1.34 (0.79,2.26)	0.94 (0.65,1.36)	**1.60 (1.04,2.45)***	1.22 (0.60,2.50)	**2.33 (1.17,4.65)***	1.73 (0.91,3.30)	1.66 (0.82,3.38)
6	0.88 (0.61,1.27)	1.19 (0.77,1.83)	1.27 (0.75,2.13)	0.91 (0.63,1.30)	**1.55 (1.02,2.37)***	1.06 (0.52,2.17)	**2.05 (1.03,4.09)***	1.03 (0.53,2.02)	1.54 (0.76,3.12)

[a]37 participants missing race data

[b]Four participants missing income data; also controlling for parent study, data not shown

*$p < 0.05$

†$p < 0.01$

‡$p < 0.001$

were able to identify the basic symptoms of COVID-19 and steps they could take prevent risk of infection. However, gaps in knowledge were identified among approximately one-third of the sample and less than half of participants identified shortness of breath as a symptom of COVID-19. There were no demographic differences in knowledge of COVID-19 symptoms or preventive actions. Examining the specific modifications to daily activities, relatively few individuals reported taking steps to mitigate their risk of exposure, with approximately a third of individuals reporting that they were practicing social distancing.

The first wave of the C3 survey began on March 13, 2020 when there were fewer than 50 cases of COVID-19 in Illinois with no deaths yet reported. By the time the survey ended on March 20, there were nearly 600 cases and five deaths. During this week, schools in Illinois closed, employers sent staff home to work remotely, public restrictions were set in place (bar and restaurant closures, no large gatherings) and a 'shelter at home' order was implemented on March 21, 2020. We observed an increase in knowledge of social distancing, and participants were reporting enacting social distance behaviors beginning on the third and fourth day of our survey (March 17 and 18th). This corresponds with March 16th announcements by the Illinois governor that the state would require closure of all restaurants and bars, and banned public gatherings of more than 50 persons. The shelter at home order ultimately came on March 20th, and there had been increased discussion about its possibility in the days leading up. Our study was able to observe in real-time the dissemination of recommendations to practice social distancing and the adoption among our participants. These findings underscore the importance of governmental and public health messaging in order to convey critical information to its residents.

Interestingly, in multivariable analyses we found that only health literacy was associated with whether participants reported taking anticipatory action to obtain necessary prescription medications at the onset of the outbreak. It is not surprising that health literacy, the degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions [15], was associated with such a preemptive step to ensure access to needed medicines, as there is a sizable body of evidence demonstrating health literacy to be a significant determinant of self-management behaviors related to chronic conditions [16]. This action requires individuals to first recognize the threat of COVID-19, understand that minimizing exposure to people in public settings was critical to prevention of transmission, and then recognize that they will need their prescription medicines and must obtain these medicines in advance.

Stark racial disparities continue to be documented in infection and mortality rates of COVID-19, with the Black and Latino communities most affected in Chicago [10]. In multivariable models, we found that there were no racial or ethnic differences in knowledge of individual symptoms or preventive measures, including social distancing. Yet, in self-report of specific behavior modifications, Black participants reported lower rates of social distancing. This finding must be considered in light of the longstanding history of racial and economic oppression in the U.S. that has produced circumstances that make it more difficult for Black residents to practice social distancing. As a result, a significant number of Black individuals must continue to leave their homes because they work in positions that cannot be done remotely, do not offer paid sick leave, and provide low wages that often results in financial insecurity. Due to low pay, many rely on public transportation, or live in multigenerational and shared residences. Given these circumstances, broader public health action is needed to enable people to social distance. One example of a new initiative is the Cook County Alternative Housing Program, which will provide separate housing for individuals who test positive for COVID-19, and are in need of housing to isolate themselves. Additionally, individuals who continue to work during this pandemic must receive support from workplaces to enable them to enact protective measures.

Limitations

Our findings should be recognized in the context of several limitations. First, this survey was conducted among research participants enrolled in ongoing NIH-funded cohort studies or clinical trials in one, large U.S. city. Thus, these findings may have limited generalizability, especially for younger adults and those without underlying health conditions. However, our study samples purposefully include men and women who are socioeconomically and racial/ethnically diverse, and at increased risk from COVID-19 due to age and underlying conditions. Second, we rapidly implemented our survey to capture knowledge and behaviors at the onset of the outbreak, and as a result, we were limited in the depth of our survey and number of items utilized. Prior research on virus outbreaks guided our selection and creation of survey items [17], but we were unable to validate all questions. However, items followed best practices for the design of assessments for use among lower literate individuals [18]. Third, our outcomes only capture initial knowledge of COVID-19, and resulting modifications to behaviors and were asked prior to state-wide mandates to shelter in place and as social distancing recommendations were being made.

Conclusion

During the initial outbreak of COVID-19 in the U.S., the majority of participants were able to identify the basic symptoms of COVID-19, and steps they could take to prevent their risk of infection. There were no demographic differences in knowledge of COVID-19 symptoms or prevention strategies, yet fewer individuals reported taking steps to mitigate their risk of exposure, with only a third of individuals reporting social distancing practices. We continue to conduct follow-up interviews to examine change in knowledge and behaviors, and ultimately the impact that this pandemic has on people's lives. During the COVID-19 pandemic, it is critical that concise and consistent public health messaging, across all media platforms, reaches those at greatest risk of complications from infection. However, public health communication is just the first step, and must be accompanied with broader public health actions that enable individuals to take preventive actions, especially among individuals who have difficulty enacting social distancing precautions.

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Compliance with Ethical Standards

Conflict of interest All other authors report no conflicts of interest.

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References

1. McNeil, D. G. (2020). Coronavirus has become a pandemic, W.H.O. says. *The New York Times*. Retrieved April 22, 2020, from https://www.nytimes.com/2020/03/11/health/coronavirus-pandemic-who.html.
2. Reiger, J. M. (2020). 34 Times Trump downplayed the coronavirus. Retrieved April 22, 2020, from https://www.washingtonpost.com/video/politics/34-times-trump-downplayed-the-coronavirus/2020/03/05/790f5afb-4dda-48bf-abe1-b7d152d5138c_video.html.
3. Qiu, L., & Bouchard, M. (2020). Tracking Trump's claims on the threat from coronavirus. *The New York Times*. Retrieved April 22, 2020, from https://www.nytimes.com/2020/03/05/us/politics/trump-coronavirus-fact-check.html?searchResultPosition=2.
4. Qiu, L. (2020). As cases surge, Pence misleads on coronavirus pandemic. *The New York Times*. Retrieved July 21, 2020, from https://www.nytimes.com/2020/06/26/us/politics/coronavirus-pence-fact-check.html.
5. World Health Organization. (2020). WHO coronavirus (COVID-19) dashboard. Retrieved July 21, 2020, from https://who.sprinklr.com/.
6. Centers for Disease Control & Prevention. (2020). Cases in the U.S. Retrieved July 21, 2020, from https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html.
7. CDC COVID-19 Response Team. (2020). Severe outcomes among patients with coronavirus disease 2019 (COVID-19) - United States, February 12-March 16, 2020. *Morbidity and Mortality Weekly Report, 69*(12), 343–346. https://doi.org/10.15585/mmwr.mm6912e2.
8. Yang, J., Zheng, Y., Gou, X., Pu, K., Chen, Z., Guo, Q., et al. (2020). Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: a systematic review and meta-analysis. *International Journal of Infectious Diseases, 94*, 91–95. https://doi.org/10.1016/j.ijid.2020.03.017.
9. Wolf, M. S., Serper, M., Opsasnick, L., O'Conor, R. M., Curtis, L. M., Benavente, J. Y., et al. (2020). 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. *Annals of Internal Medicine, 173*(2), 100–109. https://doi.org/10.7326/M20-1239.
10. City of Chicago. (2020). COVID-19: Latest data. Retrieved July 21, 2020, from https://www.chicago.gov/city/en/sites/covid-19/home/latest-data.html.
11. Weiss, B. D., Mays, M. Z., Martz, W., Castro, K. M., DeWalt, D. A., Pignone, M. P., et al. (2005). Quick assessment of literacy in primary care: The newest vital sign. *The Annals of Family Medicine, 3*(6), 514–522.
12. Chew, L. D., Griffin, J. M., Partin, M. R., Noorbaloochi, S., Grill, J. P., Snyder, A., et al. (2008). Validation of screening questions for limited health literacy in a large VA outpatient population. *Journal of General Internal Medicine, 23*(5), 561–566. https://doi.org/10.1007/s11606-008-0520-5.
13. Stagliano, V., & Wallace, L. S. (2013). Brief health literacy screening items predict newest vital sign scores. *Journal American Board Family Medicine, 26*(5), 558–565. https://doi.org/10.3122/jabfm.2013.05.130096.
14. Zou, G. (2004). A modified poisson regression approach to prospective studies with binary data. *American Journal of Epidemiology, 159*(7), 702–706. https://doi.org/10.1093/aje/kwh090.
15. Institute of Medicine. (2004). *Health literacy: A prescription to end confusion*. Washington DC: National Academy Press.
16. Berkman, N. D., Sheridan, S. L., Donahue, K. E., Halpern, D. J., & Crotty, K. (2011). Low health literacy and health outcomes: An updated systematic review. *Annals of Internal Medicine, 155*(2),

97–107. https://doi.org/10.7326/0003-4819-155-2-201107190-00005.
17. Kelly, B., Squiers, L., Bann, C., Stine, A., Hansen, H., & Lynch, M. (2015). Perceptions and plans for prevention of Ebola: Results from a national survey. *BMC Public Health, 15*, 1136. https://doi.org/10.1186/s12889-015-2441-7.
18. Shoemaker, S. J., Wolf, M. S., & Brach, C. (2014). Development of the patient education materials assessment tool (PEMAT): A new measure of understandability and actionability for print and audiovisual patient information. *Patient Education and Counseling, 96*(3), 395–403. https://doi.org/10.1016/j.pec.2014.05.027.