








# Rural and urban differences in perceptions, behaviors, and health care disruptions during the COVID-19 pandemic

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## Abstract

**Purpose:** The objective of this study was to assess perceptions, health behaviors, and disruptions related to the COVID-19 pandemic in a largely rural, Midwestern state, and to examine differences between rural and urban respondents.

**Methods:** A questionnaire was mailed August 2020 to a sample of 10,009 registered voters in Iowa ages 18-100 years, with oversampling from 6 select rural counties. Previously validated and tested items assessed COVID-19 precautions, health care disruptions, emotional reactions, health behavior changes, telehealth and experiences with the internet, and demographic characteristics.

**Findings:** There were 4,048 respondents (40% response rate); 65% were rural and 35% were urban residents. The average age of respondents was 58.3 years and 45% of respondents identified as female. Rural respondents reported less concern about COVID-19 in their community (29% vs 40%,  $P < .001$ ) and lower perceived importance of social distancing (51% vs 64%,  $P < .001$ ). Urban respondents more often reported experiencing disruption to daily living, stronger negative emotional reactions, and displayed more pronounced behavior change compared to their rural counterparts. For example, urban respondents reported more pandemic-related job losses (6% vs 4%,  $P = .05$ ), disruptions to daily activities (48% vs 35%,  $P < .001$ ), and use of telehealth services during the pandemic (24% vs 16%,  $P < .001$ ).

**Conclusions:** The majority of respondents reported disruptions to normal activities, medical appointment cancellations, and emotional distress during the first 6 months of the pandemic. The impact of the pandemic on urban residents appeared to be greater than for rural respondents. Timing of pandemic spread and varying beliefs are potential explanations.

## KEYWORDS

behaviors, COVID-19, experiences, rural, urban

## INTRODUCTION

The COVID-19 pandemic has altered how we engage in health behaviors, interact with others, and access health care.<sup>1</sup> COVID-19 is a highly contagious illness caused by the SARS-COV-2 virus that has infected more than 79 million individuals and resulted in the death of more than 950,000 individuals in the United States as of March 4, 2022.<sup>2</sup> During peak COVID-19 infections in the United States, businesses closed or implemented restrictions to reduce person-to-person spread of the virus.<sup>3</sup> These closures (eg, to gyms, clinics, and outpatient facilities) have prevented individuals from maintaining healthy behaviors and seeking health care;<sup>3-7</sup> combined with the impact of COVID-19 on the mental health of Americans,<sup>8-15</sup> we suspected a resulting decrease in individuals engaging in healthy behaviors to prevent chronic illnesses, and a potential differential impact on those living in rural counties compared to urban ones.

It has been well demonstrated that rural and urban populations have differences in health-related behaviors to begin with, making it difficult to anticipate the potential impacts of COVID-19 on each group.<sup>16-26</sup> For example, adult residents of rural areas have higher average caloric intake, higher body mass index, and lower diet quality across all age groups, and also have greater odds for cigarette smoking.<sup>16-21</sup>

Studies have also assessed differences in rural and urban populations regarding mental health and telehealth services prior to the COVID-19 pandemic. Compared to urban residents, rural residents attend fewer mental health visits for similar conditions, rural nursing home residents are less likely to be diagnosed with mental health conditions, and rural individuals (particularly veterans) are less likely to utilize telehealth services.<sup>27-30</sup> An exception was observed among a Medicaid beneficiary sample, where rural respondents were more likely to use telehealth services.<sup>31</sup> Since mental health care and telehealth services have been crucial during the pandemic, recognizing these pre-existing differences is helpful in understanding how the pandemic has impacted rural and urban populations.

Several surveys implemented on a national scale aimed to understand the impacts of the pandemic.<sup>32-60</sup> These surveys assessed a wide range of impacts, from mental and physical health to employment and childcare disruptions to changes in socioeconomic status. Of these, 8 surveys specifically assessed the impact of the pandemic on rural communities.<sup>8-12,34,61-63</sup> Three compared health behaviors between rural and urban respondents, and found that those in rural counties were less likely to engage in COVID-19 prevention behaviors, such as wearing a mask, maintaining at least 6 feet distance in public, and avoiding dine-in restaurants.<sup>61-63</sup> Others assessed the impact of the pandemic exclusively among rural populations of Latinx farmworkers, Black churchgoers, and high school students.<sup>8-12,34</sup> Despite existing efforts, there remains a gap in population-based surveys comprehensively assessing differences between rural and urban populations during the early months of the COVID-19 pandemic.

We aimed to assess the impact of the COVID-19 pandemic and associated restrictions on the perceptions, behaviors, and health care experiences of a population-based sample, and how these factors differed

between rural and urban respondents. Given the increased importance of telehealth and online information seeking during the pandemic, we also assessed differences in the ability of rural and urban populations to engage in video conferencing with health providers, comfortability in using telehealth services, and ability to obtain health-related information on the internet. We hypothesized that the pandemic may have been less disruptive for behavior and lifestyle changes in rural areas, but could have created more challenges related to technology-based implications of the pandemic.

## METHODS

### Study population

In August 2020, we mailed a cross-sectional questionnaire to a stratified random sample of 10,009 Iowans from the 2018 voter registration file. Individuals eligible for inclusion in survey participation were those ages 18-100 who were registered to vote in Iowa in 2018, and could communicate in English and/or Spanish. During initial participant selection, cases that were undeliverable or were found to live outside of the state, country, or assigned strata were replaced with a random individual in the desired strata selected from the 2018 voter registration file.

### Strata

Target recipients were sampled from 7 geographic areas: 557 people from each of 6 highly rural counties located throughout Iowa as indicated by Rural-Urban Continuum Codes (RUCCs) 7 through 9 (Adair, Appanoose, Buena Vista, Mahaska, Wayne, and Winneshiek counties) and 6,667 from the rest of the state. Representatives from Critical Access Hospitals (hospitals designated were those at least 35 miles from other hospitals chosen with the goal of improving local health care services) located in these 6 highly rural counties had been involved in a previous qualitative study designed to elicit barriers and challenges to prioritizing cancer prevention and control in their communities.<sup>64</sup> Their representatives had expressed the need for more locally relevant data on cancer risk factors and access to health care.

### Mailing procedures

Approval for this study was received from the University of Iowa Institutional Review Board. A postcard was mailed to all individuals on August 7, 2020 to inform them of the subsequent arrival of their survey packet, a method reported to increase survey response rates.<sup>65</sup> Packets containing a study information and consent form, questionnaire booklet, online survey link, postage-paid business reply envelope, and \$5 cash incentive were then mailed 1 week later. Invitees were given the option of completing the paper survey or using an online survey link included in the survey packet. In cases where an individual's address

changed and was within the same stratum, updated addresses were gathered and packets were remailed. A follow-up mailing was sent to nonrespondents on October 1, 2020. The majority of completed surveys (80%) were received between August 16 and September 7, 2020, and nearly all completed surveys (98%) were received by December 31, 2020. The last survey included was returned in April 2021.

## Measures

The survey was created using a combination of previously validated and newly developed/pretested Likert-type and multiple choice items.<sup>66-68</sup> Items captured COVID-19 symptoms and testing experience, concern regarding the pandemic, social distancing behaviors, changes in health behaviors after COVID-19 restrictions were implemented, access to telehealth services, and delays in or lack of health care. Additional items assessed the influence of the pandemic in the following domains: emotional and physical reactions, disruption to daily activities, financial hardship, perceived benefits, social support, ability to manage stress, and concerns about medical care.<sup>69</sup> RUCCs were used to categorize counties as either rural (codes 4-9) or urban (codes 1-3).<sup>70</sup>

Items assessing COVID-19 symptoms and testing experience asked respondents about testing experience, symptoms, hospitalizations, and recent close physical contact with individuals who have COVID-19 and/or respiratory symptoms with yes/no/not sure response options. Concern about the pandemic was assessed as a 5-scale Likert item from “not at all concerned” to “very concerned.” Questions about social distancing behaviors included items on staying home, not having others come into their home, staying 6 feet away from others in public, and wearing a face covering when indoors and/or outdoors with yes/no response options. An additional item assessed perceived importance of social distancing on a 4-point Likert-scale from “not important” to “very important.”

Experiences with the internet and telehealth were assessed using either yes/no/not sure or Likert-scale items. Respondents were asked if they owned a device that would allow them to video conference with a health care provider (yes/no), and if yes, whether they would be comfortable using telehealth to video conference with a provider (yes/no). Experiences with telehealth were assessed by asking if respondents had participated in video conferencing (yes/no) and if yes, whether they felt comfortable doing so (yes/no). Items assessed overall confidence in getting information on medical topics and confidence in getting medical information specifically from the internet (both on 5-point Likert scales from “completely confident” to “not confident at all”), experience going online to access the internet (yes/no), and frustration/concern getting needed information from the internet (both on 4-point Likert scales from “strongly agree” to “strongly disagree”).

Health care appointment cancellations were assessed using multiple-choice items. Respondents were asked if a medical appointment was cancelled or closed because of COVID-19 (yes/no/not applicable), if they cancelled an appointment to avoid being around others (yes/no/not applicable), and if they were unable to receive

prescription medications, nonprescription medications, treatment for substance use issues, and/or mental health care counseling (able to obtain/unable to obtain/did not need). Physical barriers, such as transportation, insurance, and cost, were assessed in reference to medical appointments and mental health care or counseling.

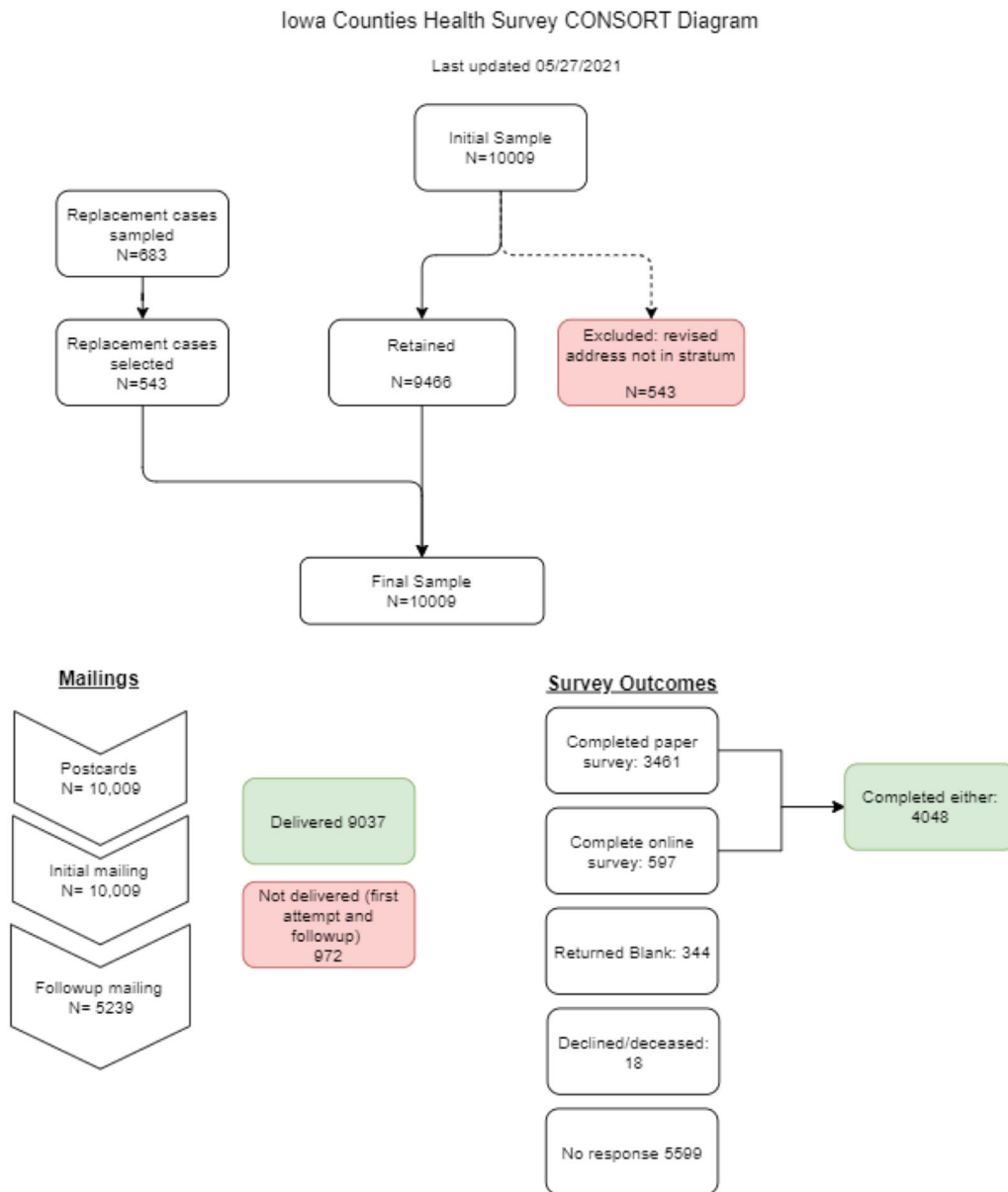
Health behaviors and changes in these behaviors were assessed in multiple ways. Items borrowed from the validated Behavioral Risk Factor Surveillance System questionnaire and the Health Information National Trends Survey asked respondents to indicate the frequency of physical activity (30 minutes of at least moderate intensity), fruit intake, vegetable intake, and alcohol consumption in the 30 days prior to survey completion.<sup>66,67</sup> They were also asked to indicate if they had used any smoking/tobacco products in 30 days prior to completion (yes/no), and if they did, which types were used (cigarettes, cigars, chewing tobacco, electronic cigarettes or other vaping products, other products, none of the above). Use of alternative therapies was asked as a yes/no question for the use of complementary, alternative, or unconventional therapies, such as vitamins, minerals, herbal supplements, or homeopathy in the 12 months prior to survey completion. For each of the behaviors listed above, respondents were also asked to indicate whether they have changed the amount of the behavior compared to before the COVID-19 pandemic (more than before the pandemic, less than before the pandemic, same amount as before the pandemic, did not use the product during or before the pandemic).

Demographic information included age in years, sex assigned at birth (male or female, prefer not to answer), identified gender (male, female, transgender, nonbinary, prefer not to answer), weight (in pounds), height (in feet and inches), race (White, Black, American Indian or Alaska Native, Asian, Native Hawaiian/Pacific Islander, other), ethnicity (Mexican, Chicano/a, Puerto Rican, Cuban, other Hispanic/Latinx/Spanish origin, or not of Hispanic/Latinx/Spanish origin), household income (categorized into 9 levels), education level (less than 8th grade, 8th-11th grade, high school diploma or GED, vocational or technical school, some college, college graduate, postgraduate), insurance coverage (employer-provided, private coverage, Medicare, Medicaid, TRICARE/Veterans Affairs/Military, Alaska Native/Indian Health Service/Tribal Health Services, other), marital status (single/never married, married, not married but living with a romantic partner, separated, divorced, widowed), and employment status (employed for wages, self-employed, out of work, homemaker, student, retired).

Returned surveys were logged, manually edited, scanned using TeleForm Scan Station, reviewed using TeleForm Verifier software, and exported to an MS SQL Server database. Research team members attempted to contact respondents who skipped entire pages of the survey. If the respondent provided a phone number in the survey, a research team member attempted to call the respondent, offering to collect responses via phone; otherwise, contact was attempted via mail.

## Statistical analysis

All data were cleaned and analyzed using SAS 9.4 software (SAS Institute, Cary, NC). To account for oversampling in the 6 rural county strata,



**FIGURE 1** CONSORT flow diagram outlining participant sampling, mailing, and survey completion

data were weighted based on the sampling rate and proportion of the state the county represented. Frequencies were generated for all questions by strata and for composite weighted estimates for the entire state. Chi-square tests were run to assess respondent differences in the state's rural counties compared to urban counties.

## RESULTS

### Demographics

The survey yielded a 40% response rate with 4,048 responses (Figure 1). Our analytic dataset contained 2,347 respondents in rural counties (65.1%) and 1,258 respondents in urban counties (34.9%) after weighting for oversampling. Rural respondents were significantly

older, and more likely to be white, married, straight/heterosexual, retired, and have lower average income and educational attainment compared to urban respondents (Table 1). Those in rural counties more frequently identified commuting to work (72.4% vs 64.0%,  $P = .001$ ) as opposed to working from home (17.7% vs 38.6%,  $P < .001$ ). Rural respondents less frequently identified being in excellent or very good health (48.6% vs 53.8%,  $P = .01$ ) and less frequently reported having had a routine checkup in the past year compared to those in urban counties (10.5% vs 13.2%,  $P = .04$ ).

### Experiences with the internet and telehealth

A significantly lower proportion of rural respondents reported owning a device that would allow them to video conference with a health

**TABLE 1** Characteristics of survey respondents stratified by rural/urban county residence

Characteristic	Respondent location		P
	Rural (n = 2,347)	Urban (n = 1,278)	
Age			.002
<50	22.7%	28.6%	
50-64	28.2%	28.2%	
65-74	26.1%	24.8%	
75+	23.0%	18.4%	
White race	99.1%	96.6%	<.001
Hispanic ethnicity	1.2%	1.9%	.17
Identified gender			.43
Female	44.9%	42.0%	
Male	55.1%	57.7%	
Transgender or none of the above	0.0%	0.3%	
Marital status			.006
Single, not married	8.1%	10.7%	
Married/living with a romantic partner	72.2%	69.0%	
Separated, divorced, widowed	19.7%	20.4%	
Sexual orientation			<.001
Straight/heterosexual	96.3%	94.4%	
Gay/lesbian	0.4%	1.8%	
Bisexual	3.0%	1.5%	
Male height in inches, mean (SD)	70.3 (0.1)	70.5 (0.1)	
Female height in inches, mean (SD)	64.8 (0.1)	64.6 (0.1)	
Male weight in pounds, mean (SD)	208.5 (2.0)	200.9 (1.9)	
Female weight in pounds, mean (SD)	173.8 (1.8)	168.8 (1.6)	
Household income			<.001
<\$50,000	40.4%	28.8%	
\$50,000-\$99,999	38.3%	38.2%	
\$100,000+	21.3%	33.0%	
Education			<.001
High school/GED or less	34.2%	23.8%	
Some college or technical/vocational school	32.0%	29.2%	
College degree or more	33.6%	47.0%	
Employment status			<.001
Employed for wages	40.2%	43.9%	
Self-employed	11.3%	6.9%	
Out of work	1.5%	3.2%	
Homemaker	3.3%	3.3%	
Student	0.9%	1.3%	
Retired	42.8%	41.3%	
Commuted to work	72.4%	64.0%	<.001
Worked from home	17.7%	38.6%	<.001
Health insured	94.6%	94.9%	.92
Self-reported excellent/very good health	48.6%	53.8%	.01
Had a routine check-up in the past year	10.5%	13.2%	.04

**TABLE 2** Experiences with the internet and telehealth

Characteristic	Respondent location		P
	Rural (n = 2,347)	Urban (n = 1,278)	
Owens a device that would allow them to video conference with their health care provider	73.4%	83.3%	<.001
Would feel comfortable communicating with their health care provider in a video conference format through a device	74.8%	80.0%	.12
Had engaged in a video conference visit with any of their health care providers	16.0%	24.4%	<.001
Felt comfortable communicating with their health care provider in a video conference visit	89.3%	93.9%	.07
Goes online to access the internet or world wide web, or to send and receive email	75.1%	85.3%	<.001
How much do you agree or disagree with this statement? "I feel confident in using information from the Internet to make health decisions"			<.001
Strongly agree	5.0%	6.7%	
Agree	25.5%	28.4%	
Undecided	43.1%	37.4%	
Disagree	17.2%	18.6%	
Strongly disagree	9.2%	8.8%	
Feels they are able to seek information and plan accordingly to address concerns over the pandemic	58.3%	62.5%	.02

care provider (73.4% vs 83.3%,  $P < .001$ ) (Table 2). Among those who reported owning a device, comfort levels for video conferencing with their health provider were generally high and there was no difference between urban and rural respondents in anticipated level of comfort with telehealth. A significantly lower proportion of the rural population reported that they had engaged in a video conference with their health care provider (16.0% vs 24.4%,  $P < .001$ ). Among those who had engaged in a video conference, comfort was generally high and there was no difference in comfort level between urban and rural respondents. Although internet use in both groups was relatively high, a smaller proportion of rural respondents reported using the internet compared to urban respondents (75.1% vs 85.3%,  $P < .001$ ). Similarly, a smaller proportion of rural respondents indicated that they felt confident in using information from the internet to make health decisions (30.5% vs 35.1% for strongly agree and agree responses,  $P < .001$ ) and were able to seek information to address concerns related to the pandemic (58.3% vs 62.5%,  $P = .02$ ).

### Effects and concerns during the pandemic

Reported impacts of COVID-19 were greater in urban counties than in rural ones (Table 3). Urban respondents more frequently reported

losing their job or primary source of income compared to rural respondents (6.2% vs 4.0%,  $P = .05$ ), though rural respondents more frequently reported finding it difficult or very difficult to get by on their household's income at the time of survey response (12.7% vs 10.0%,  $P = .009$ ). Urban respondents more frequently identified having conflict with household members (19.3% vs 14.7%,  $P = .004$ ), having difficulty doing their job well due to needing to care for others in their home (6.9% vs 3.4%,  $P < .001$ ), having to take over teaching or instructing a child (11.3% vs 7.1%,  $P = .02$ ), having difficulty taking care of children in their home (3.3% vs 1.9%,  $P = .01$ ), and balancing their child's needs with other responsibilities (10.2% vs 7.4%,  $P = .005$ ). Urban respondents also more frequently identified experiencing disruptions in day-to-day activities (72.1% vs 61.4%,  $P < .001$ ) and an inability to follow daily routines (34.5% vs 47.4%,  $P < .001$ ). However, more urban respondents reported receiving tangible support from loved ones when needed (24.6% vs 19.9%,  $P = .005$ ).

### Concerns about the pandemic

Rural respondents reported great concern about COVID-19 in their community less often than urban respondents (28.9% vs 40.0%  $P < .001$ ) (Table 3). Additionally, a lower proportion of rural

**TABLE 3** Effects and concerns during COVID-19 pandemic

Characteristic	Respondent location		P
	Rural (n = 2,347)	Urban (n = 1,278)	
Lost job or primary source of income due to COVID-19	4.0%	6.2%	.05
Lost primary source of insurance due to COVID-19	0.5%	1.0%	.08
Found it difficult or very difficult to get by on household income	12.7%	10.0%	.009
Had difficulty purchasing or obtaining basic necessities	19.4%	20.0%	.37
Worked in close contact with people who might be infected with COVID-19	16.1%	18.8%	.32
Since the outbreak of the COVID-19 pandemic:			
Experienced conflict with household members	14.7%	19.3%	.004
Had a hard time doing their job well due to needing to care for others in their home	3.4%	6.9%	<.001
Had trouble adequately taking care of family members or friends they provide for	9.1%	11.2%	.11
Took over teaching or instructing a child	7.1%	11.3%	.02
Had difficulty taking care of children in the home	1.9%	3.3%	.01
Had difficulty taking care of their children's needs and/or balancing their needs with other responsibilities	7.4%	10.2%	.005
Moved or relocated due to COVID-19	0.5%	0.8%	.05
Experienced disruptions in day-to-day activities with family and/or friends	61.4%	72.1%	<.001
Was unable to follow daily routines	34.5%	47.4%	<.001
General medical care has been disrupted or delayed	67.0%	64.3%	.09
Clinic, doctor's office, or dental practice closed or cancelled an appointment due to COVID-19	56.3%	60.7%	.14
Respondent cancelled a clinic, doctor, or dental appointment to avoid being around others	27.4%	30.2%	.24
Received tangible support from family or friends when needed	19.9%	24.6%	.005
Felt social distancing is very important during COVID-19	50.8%	63.6%	<.001
Reported great concern about COVID-19 in their community	28.9%	40.0%	<.001

respondents reported feeling that social distancing during COVID-19 was very important compared to urban respondents (50.8% vs 63.6%,  $P < .001$ ).

Urban respondents reported stronger emotional reactions to COVID-19 (Table 4). Compared to rural respondents, urban respondents more frequently reported feeling nervous, anxious, or on edge (40.0% vs 30.4%,  $P < .001$ ), feeling anxious about getting COVID-19 (42.0% vs 35.2%,  $P < .001$ ), being concerned about a friend or family member getting or dying from COVID-19 (68.8% vs 61.9%,  $P < .001$ ),

and being concerned about dying from COVID-19 (33.7% vs 26.3%,  $P < .001$ ). Urban respondents also more often reported experiencing changes in their sleep, eating, concentration, feelings of sadness/depression and negativity about the future, and feelings of social isolation or loneliness (all  $P < .001$ ). However, urban respondents also more frequently reported receiving emotional support than rural respondents (62.8% vs 52.5%,  $P < .001$ ). Rural and urban respondents did not significantly differ in feeling lack of control over how COVID-19 will impact their life ( $P = .09$ ).

**TABLE 4** Emotional reactions to COVID-19

Since the COVID-19 pandemic, respondents reported agreement/strong agreement with:	Respondent location		P
	Rural (n = 2,347)	Urban (n = 1,278)	
Feeling nervous, anxious, or on edge	30.4%	40.0%	<.001
Feeling anxious about getting COVID-19	35.2%	42.0%	<.001
Worrying about possibly infecting others	39.9%	44.4%	.002
Being concerned about a family member or close friend getting or dying from COVID-19	61.9%	68.8%	<.001
Worrying about the possibility of dying from COVID-19	26.3%	33.7%	<.001
Feeling they have no control over how COVID-19 will impact their life	41.7%	46.2%	.09
Experiencing feelings of sadness or depression	29.2%	38.8%	<.001
Feeling negative about the future	21.4%	26.0%	<.001
Experiencing changes in their sleep	19.3%	25.8%	<.001
Experiencing changes in their eating	17.2%	24.6%	<.001
Experiencing difficulty concentrating	16.0%	21.7%	<.001
Experiencing feelings of social isolation or loneliness	33.2%	40.9%	<.001
Has received emotional support from family or friends when needed	52.5%	62.8%	<.001
Feels a greater appreciation for family and friends since the onset of COVID-19	71.1%	77.5%	<.001
Feels a greater appreciation for life since the onset of COVID-19	64.4%	68.5%	.05

## Health behaviors

Key differences emerged in health behaviors between rural and urban respondents reported from before the pandemic to time of survey response (Table 5). Urban respondents more frequently reported decreased engagement in physical activity (26.5% vs 17.5%,  $P < .001$ ) and weight gain (23.3% vs 17.2%,  $P < .001$ ) compared to rural respondents. However, they also more often met daily recommendations for vegetable consumption (3.3% vs 1.9%,  $P = .003$ ) and more frequently reported an increase in their fruit and vegetable consumption (6.7% vs 4.6%,  $P = .03$ ). Urban respondents reported more frequent alcohol consumption in the 30 days prior to survey response ( $P < .001$ ) as well as more frequently reported COVID-related increases in levels of alcohol consumption compared to rural respondents (14.2% vs 7.5%,  $P < .001$ ). Rural and urban respondents reported similar physical activity frequency over the past 30 days, lifetime cigarette use, change in smoking/tobacco use, and use of complementary/alternative therapies.

## DISCUSSION

The majority of respondents in our survey, which was administered 6 months into the pandemic, reported experiencing disruptions to their normal activities, having medical appointments cancelled due to

the pandemic, and feeling concern about a family member or friend getting or dying from COVID-19. A considerable portion of respondents reported working closely to persons who might be infected with COVID-19, experiencing negative changes in their sleep, eating, ability to concentrate, and outlook for the future. More respondents in our survey reported negative pandemic-related behavior change (decreased physical activity, increased tobacco and other smoking product use, and increased alcohol consumption) than positive pandemic-related behavior change (increased physical activity, decreased tobacco use and alcohol consumption).

There were marked differences between urban and rural respondents in levels of emotional distress and concern about the pandemic and perceived importance of social distancing behaviors, with those in rural communities being significantly less concerned about COVID-19 in their community and less likely to think social distancing is important to prevent the spread of COVID-19. This trend is reflected in other observed rural/urban differences; urban respondents more often reported experiencing disruption to their daily living, stronger negative emotional reactions, and displayed more pronounced behavior change compared to their rural counterparts.

Our findings are largely consistent with studies during COVID-19 in rural communities. For surveys that compare rural and urban community members, those in rural communities were less likely to participate in social distancing behaviors (76% vs 82%).<sup>61-63</sup> This was



**TABLE 5** Changes in health behaviors from before to during COVID-19

Characteristic	Respondent location		P
	Rural (n = 2,347)	Urban (n = 1,278)	
Physical activity frequency in the last 30 days			.17
0 days	18.4%	15.8%	
1-10 days	49.2%	53.6%	
11-20 days	15.5%	15.3%	
21-30 days	17.0%	15.3%	
Change in physical activity compared to before the pandemic			<.001
Less activity	17.5%	26.5%	
Same amount of activity	73.6%	58.7%	
Increased activity	9.0%	14.8%	
Weight changed compared to before the pandemic			<.001
Increased weight	17.2%	23.3%	
Same weight	69.8%	60.8%	
Decreased weight	13.0%	15.8%	
Met daily recommendations (4 servings) for fruit consumption in the past 30 days	3.5%	3.4%	.76
Met daily recommendations (5 servings) for vegetable consumption in the past 30 days	1.9%	3.3%	.003
Change in fruit/vegetable consumption compared to before the pandemic			.03
Decreased consumption	4.6%	6.7%	
Same consumption	88.1%	84.5%	
Increased consumption	7.3%	8.8%	
Have smoked at least 100 cigarettes in their lifetime	37.1%	37.4%	.81
Change in smoking/tobacco use compared to before the pandemic			.44
Increased use	2.4%	3.3%	
Same amount of use	11.6%	8.9%	
Decreased use	2.7%	3.1%	
Did not use these products before or during the pandemic	83.3%	84.7%	
Alcohol consumption in the past 30 days			<.001
0 days	47.6%	38.1%	
1-10 days	31.4%	34.9%	
11-20 days	9.9%	13.2%	
21-30 days	11.1%	13.7%	
Change in alcohol consumption compared to before the pandemic			<.001
Increased consumption	7.5%	14.2%	
Same amount of consumption	46.5%	46.3%	
Decreased consumption	3.6%	5.6%	
Did not use these products before or during the pandemic	42.3%	33.9%	

(Continues)

TABLE 5 (Continued)

Characteristic	Respondent location		P
	Rural (n = 2,347)	Urban (n = 1,278)	
Used complementary/alternative therapies in the past 12 months	48.4%	45.1%	.07
Change in complementary/alternative therapies compared to before the pandemic			.07
Increased use	5.1%	5.9%	
Same amount of use	34.8%	37.8%	
Decrease use	0.6%	0.7%	
Did not use these products before or during the pandemic	59.5%	55.5%	

consistent in our survey, where a lower proportion of rural residents identified social distancing as very important (50.8% vs 63.6%). Additionally, respondents in rural communities less frequently identified concern about COVID-19 in their community compared to rural respondents (28.9% vs 40.0%). However, this could reflect the timing of survey implementation and the pandemic impacting urban communities earlier than rural ones.

In some ways, our findings reflect those of studies assessing rural/urban differences in health behaviors prior to the COVID-19 pandemic. Prior studies have identified that obesity rates are typically higher in rural areas, which was consistent with our findings.<sup>16,17</sup> Despite having similar average heights, rural males weighed 8 pounds higher on average compared to urban males, and rural women weighed 5 pounds higher on average compared to urban women. One survey found that those in rural communities were less likely to meet physical activity recommendations;<sup>61</sup> while 3% more rural respondents in our survey indicated having not engaged in physical activity in the month prior to survey completion, this difference was not significant compared to urban respondents. Our item on physical activity frequency in the 30 days prior to survey completion suggests that rural and urban residents report similar levels of prior physical activity ( $P = .17$ ) though our measures may have not been sufficiently precise to detect smaller differences or differences at the lowest end of the activity scale.

Alcohol use and abuse has been linked to young adults in advantaged and more educated urban areas,<sup>26</sup> which is consistent with our finding of urban adults drinking more days in a 30-day period compared to rural adults ( $P < .001$ ). The finding from the previous study could also provide some insight on our finding where individuals in urban areas more frequently reporting increased consumption of alcohol compared to before the COVID-19 pandemic.

Our survey also had significant departures from studies assessing rural/urban differences in health behaviors prior to the COVID-19 pandemic. While prior studies have reported greater odds for cigarette smoking among adults in rural counties,<sup>21,22</sup> we found no difference between the rural and urban respondents who did not use tobacco products during or before the pandemic. The frequency of rural and urban respondents who have smoked at least 100 cigarettes in their lifetime was also similar between rural and urban respondents. Addi-

tionally, our results demonstrated that among individuals who owned a device allowing them to participate in telehealth visits, there was no difference between rural and urban residents in their comfortability in doing so ( $P = .12$ ).<sup>29</sup>

Prior surveys that focused exclusively on rural communities found respondents had significant concerns regarding finances, mental health, and employment.<sup>8-12</sup> In our survey, 13% of rural respondents reported difficulties getting by on their present household income and less than half of respondents reported living comfortably on their current income. Additionally, while rural respondents in our survey had less pronounced emotional responses compared to urban respondents, there were still one-third of rural respondents who indicated feeling anxious about getting COVID-19, worrying about possibly infecting others, experiencing feelings of sadness or depression, and feeling nervous, anxious, or on edge.

There are several factors that could contribute to the observed differences between rural and urban residents in our results. As this survey was administered from August to December 2020, respondents in rural counties may not have been impacted by the pandemic. A previous study reported that 84% of confirmed COVID-19 cases resided in urban counties, and another reported that the incidence rate was higher in urban counties compared to rural ones in the first 2 surges of the pandemic (April-June 2020 and June-September 2020).<sup>71,72</sup> This could support our finding of urban residents reporting stronger emotional reactions and more disruptions to childcare, work schedules, and daily activities. Another theory is that stoicism (the "tough it out" mentality) differentially impacted how rural and urban counties responded to the pandemic. Previous studies have found that stoicism and perceived stigma independently predicted lower odds of seeking mental and physical health services, and were more frequently identified among rural residents.<sup>73-75</sup> In addition, a number of polls have indicated that political affiliation is associated with differing perspectives on COVID-19, and rural districts in Iowa tend to be more conservative than urban districts.<sup>76</sup>

There were several strengths of our study. This was a large population-based survey in which we received a 40% response rate. In addition, we used a sampling strategy that allowed us to oversample select rural counties to describe their experiences. Often, the

experiences of rural respondents are not well represented in surveys; 65% of the respondents in our weighted sample lived in rural counties. Additionally, our questionnaire used previously validated items from other surveys and was offered in multiple modalities (paper and online) in 2 languages (English and Spanish), and used a modified Dillman method to encourage increased participant response.

Limitations include that the study was conducted in 1 state and may not be generalizable to other states/regions. Additionally, our sample was drawn from a relatively rural area of the United States with above average educational attainment, which may further limit generalizability to other samples. Data were drawn from a voter registry file in this state, which has been shown to underrepresent minority populations; only 3% of our overall dataset self-identified as racial minorities, which is lower than the 2019 population estimate (9%) for the state.<sup>77</sup> The mean age of respondents in our survey was 61 years of age; this is higher than the 2019 state average of 39 years of age.<sup>78</sup> A fourth limitation in our study was the inability to follow up with those who had undeliverable surveys. If surveys were returned with a forwarding address, we were able to resend the survey to the updated address; we were unable to do the same for undeliverable surveys. Due to the cross-sectional nature of the study, our results are subject to recall bias from respondents. We attempted to minimize the latter limitation by using specific as well as shorter recall time frames (eg, “last 7 days” and “last 30 days”) and asking few questions that required participants to remember information from longer than 1 month prior to survey completion.

Our findings provide important insight regarding the experiences of rural lowans during COVID-19 and how these compare to their urban counterparts. Assessing impacts of the COVID-19 pandemic is important in understanding its effects on rural populations, and how to better tailor services to fit the needs of those who may be experiencing increased difficulties due to the pandemic. The impacts of COVID-19 in the early parts of the pandemic varied by population density, geographic area, political affiliations of leaders, and behaviors of the communities before the pandemic. Further research using common data items should assess the effects of the pandemic in diverse areas to reveal true differences between rural and urban community members. Additionally, these observed differences in behaviors and health care access call for further research to assess the impact of COVID-19 on long-term health outcomes of rural populations.

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## DISCLOSURES

The authors of this manuscript do not have any conflicts of interest to disclose.

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