Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Feeling lonelier during the early COVID-19 pandemic: A cross-sectional analysis of adults living in the United States

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ABSTRACT

The Coronavirus Disease 2019 (COVID-19) pandemic had many negative consequences, one of which was the increase of loneliness. We aimed to explore associations between sociodemographic, work-related, home-related, and COVID-19-related characteristics and increased feelings of loneliness among adults living in the United States (US). We analyzed cross-sectional baseline data from The Quickly Understanding Impacts of COVID-19 Study (The QUICk Study) collected from May to October 2020 using online surveys completed by a sample of adults living in the US. We used chi-square tests, Fisher exact tests, and logistic regression to identify characteristics associated with increased loneliness. The study sample included 577 adults living in the US. Approximately 37% of the sample reported feeling lonelier than usual over the past month. Younger age, sexual minority status, lower education level, depression, living alone, part-time employment status, and student employment status were significantly associated with increased feelings of loneliness. Depression, younger age, and living alone remained significantly associated with increased feelings of loneliness in the multivariable logistic regression analysis. In the US, young adults, adults with depression, and adults who live alone may have been more likely to experience increased feelings of loneliness during the early COVID-19 pandemic.

1. Introduction

Non-pharmaceutical interventions such as shelter-in-place orders implemented to stop the spread of Coronavirus Disease 2019 (COVID-19) were critical in attempting to slow the 2020 pandemic of SARS-CoV-2 yet carry with them the potential for negative impact on mental health. Among these are the increase of loneliness and depression (Tull et al., 2020). Lockdowns and shelter-in-place orders to combat the spread of COVID-19 have sparked global research into factors that influence loneliness among adults during this time. In the United Kingdom, studies found that younger age (Bu et al., 2020; Groarke et al., 2020; Li and Wang, 2020; Niedzwiedz et al., 2021), being a woman (Li and Wang, 2020; Niedzwiedz et al., 2021), living alone (Bu et al., 2020; Groarke et al., 2020; Li and Wang, 2020), low household income (Bu et al., 2020), being unemployed (Bu et al., 2020; Li and Wang, 2020), being a student (Bu et al., 2020), relationship status, low perceived social support, depression, difficulty with emotional regulation, worse sleeping habits (Groarke et al., 2020), and having COVID-19 symptoms (Bu et al., 2020) were associated with loneliness. Unemployment, relationship status, and living alone were also found to be associated with loneliness among adults in Germany, in addition to education level, current psychiatric/psychotherapeutic treatment, COVID-19 diagnosis, being at risk for COVID-19, reduction of social contacts, distress related to restriction of social contacts, perceived changes in life due to public health measures, and appraisal of perceived changes in life (Benke et al., 2020). In Spain, female gender, younger age, lower quality of sleep, living with fewer people, having a negative self-perception about aging, more time devoted to COVID-19 information, higher expressed emotion, higher self-perception as a burden, and fewer resources to entertain oneself at home were associated with loneliness (Losada-Baltar et al., 2021).

In the United States (US), studies have suggested that adults may not have been significantly lonelier during the COVID-19 pandemic than prior to the pandemic. One study found no significant change in levels of loneliness from January/February 2020 to March 2020 or from March 2020 to April 2020 (Luchetti et al., 2020). Another study found that 13.8% of US adults always or often felt lonely in April 2020, only a 2.8% rise from 2018 (McGinty et al., 2020). However, from April to June 2020, loneliness was found to significantly increase in adults living in the US (Killgore et al., 2020a). Loneliness continued to rise from April to September 2020 (Killgore et al., 2020b). Factors associated with higher

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loneliness among adults living in the US include: lower adherence to physical activity guidelines, more screen time (Meyer et al., 2020), younger age, lower educational attainment, not living with a spouse or partner (Østertun Geirdal et al., 2021), stay-at-home orders, lower income, and lower perceived impact of COVID-19 (Tull et al., 2020). Older adults in the US have reported experiencing greater loneliness during the pandemic than before the pandemic (Emerson, 2020; Gaeta and Brydges, 2021; Krendl and Perry, 2021). Within this population, living alone (Emerson, 2020), isolation, and COVID-related anxiety (Gaeta and Brydges, 2021) were found to be related to higher levels of loneliness.

The potential consequences of increased loneliness during the COVID-19 pandemic have also recently been studied globally among adults. In Europe, studies conducted during the pandemic have found that greater loneliness was associated with one's perceived impact of COVID-19 on health (Cerami et al., 2020), depression, anxiety (González-Sanguino et al., 2020; Jia et al., 2020), PTSD (González-Sanguino et al., 2020), stress (Jia et al., 2020), drug use (Vanderbruggen et al., 2020), and insomnia (Voitsidis et al., 2020). Similarly, in Israel, studies found that loneliness was related to anxiety (Elran-Barak and Mozeikov, 2020; Horesh et al., 2020), stress (Palgi et al., 2020), and depression (Horesh et al., 2020), in addition to decreased physical, mental, and general self-reported health (Palgi et al., 2020), worry about COVID- 19, financial worries, fearing infection, and quality of life (Horesh et al., 2020). In Hong Kong, loneliness was associated with depression, stress, anxiety, psychosis risk symptoms, and self-reported health (Tso and Park, 2020). In the US, loneliness was found to be positively correlated with depression and suicidal ideation among adults (Killgore et al., 2020a). Among older adults in the US, loneliness was reported as a source of stress (Whitehead and Torossian, 2021). Loneliness among younger adults in the US was found to be associated with depression (Killgore et al., 2020c; Liu et al., 2020), suicidal ideation (Killgore et al., 2020c), anxiety, and PTSD (Liu et al., 2020).

The literature on loneliness among the adult population during the COVID-19 pandemic is growing, but there are gaps that need to be filled. First, previous findings regarding levels of loneliness prior to and during the pandemic among adults in the US are inconsistent (Killgore et al., 2020a, 2020b; Luchetti et al., 2020; McGinty et al., 2020). Second, there is limited knowledge about which demographic, clinical, environmental, or behavioral factors are associated with increased feelings of loneliness during the COVID-19 pandemic, specifically among adults living in the US. Lack of information limits the potential for development of effective interventions to allay loneliness, depression, and other mental health conditions. Third, there is currently a lack of knowledge about the relationships between loneliness and race, sexual orientation, and non-conforming gender identities. We aimed to investigate the relationships between sociodemographic, work-related, household-related, and COVID-19-related characteristics and increased feelings of loneliness among adults living in the US. Adults living in the US have a unique experience with the COVID-19 pandemic given the political climate, unequal burden of the virus among certain groups, and high number of COVID-19 cases and deaths. Addressing increased feelings of loneliness during the COVID-19 pandemic is crucial since loneliness during this period may lead to poor mental and physical health outcomes. Understanding correlates of loneliness may inform future interventions for handling pandemic crises as well as finding ways to support communities as they recover from the pandemic.

2. Methods

2.1. Data collection methods

To address the aims of the study, we analyzed data from The Quickly Understanding Impacts of COVID-19 Study (The QUICk Study). The QUICk study is a longitudinal study initiated in May 2020 following the first shutdown orders in the US in response to the pandemic and continuing for five monthly follow ups. We used baseline data collected from May 4, 2020, through October 14, 2020, for this cross-sectional study. Participants were asked to take one baseline online survey along with five follow up surveys at monthly intervals. As of this writing follow up continues, and thus we only analyzed baseline data in this paper. The survey was intended to be short (< 5 min) and feasible on both desktops and smartphone devices. The survey was implemented using a REDCap (Research Electronic Data Capture) interface (Harris et al., 2009). Study data were collected and managed using REDCap hosted at Children's National Health System. As well known, REDCap is a secure, web-based application designed to support data capture for research studies. Participants were recruited using a convenience sampling approach generated by non-incentivized peer referral, word of mouth, and initial postings to occupational and neighborhood listserves. All instruments and procedures were approved by the George Washington University Institutional Review Board.

2.2. Measures

2.2.1. Increased feelings of loneliness

We measured the primary outcome of interest, increased feelings of loneliness, by asking participants, "Over the past month, which of the following has applied to you?". Participants had the option to select the response, "I feel lonelier than usual". We dichotomized this variable into participants who selected "I feel lonelier than usual" and those who did not select this response.

2.2.2. Sociodemographic characteristics

We measured age by asking participants, "How old are you today?". For the analysis, we categorized age as 18–24, 25–59, and 60+. We measured gender identity by asking participants to select their sex assigned at birth and current gender identity. For the analysis, we categorized gender identity as cis-male, cis-female, and gender minority. Gender minority included persons who identified as non-binary, transgender, or other. We measured sexual orientation by asking participants to select their sexual orientation from a list that included: bisexual/bi, heterosexual/straight, homosexual/gay, pansexual, and other. For the analysis, we dichotomized sexual orientation as straight/heterosexual and sexual minority. Due to small sample sizes in certain sexual orientation categories, we needed to dichotomize the variable. We measured race/ethnicity by asking participants to select their race/ethnicity from a list that included: American Indian/Alaskan Native, Asian, Black or African American, Latino/Latinx/Hispanic, Native Hawaiian or Other Pacific Islander, White, and Other. For the analysis, we dichotomized race/ethnicity as white and persons of color. Persons of color included persons who identified as one or more of the races/ethnicities listed above except for White race/ethnicity. Due to small sample sizes in certain race/ethnicity categories, we needed to dichotomize the race/ethnicity variable. We measured current level of education by asking participants to select their current level of education from a list that included: less than high school, high school degree or equivalent, some college, college degree, some graduate education, and graduate degree. For the analysis, we categorized current level of education as high school degree or equivalent or some college, college degree, and some graduate education or graduate degree. We measured depression using the 2-item Patient Health Questionnaire (PHQ-2). PHQ-2 scores range from 0 to 6. The optimal cutoff point has been identified as a score of 3 or higher for depression screening purposes (Kroenke et al., 2003). For the analysis, we dichotomized PHQ-2 scores as less than 3 and greater than or equal to 3.

2.2.3. Work-related characteristics

We measured work-related characteristics by asking participants, "Over the past month, which of the following has applied to your work situation? (check all that apply)". Reponses to select from included: I am a full-time employee, I am a part-time employee, I am retired, I am a

healthcare worker, I provide essential services, I recently lost my job, I am working from home, I am volunteering, and I am a student.

2.2.4. Home-related characteristics

We measured home-related characteristics by asking participants, "Over the past month, which of the following has applied to you in your home situation?" (check all that apply). Responses to select from included: I am a parent, I am a single-parent, I live alone, I live with my spouse or romantic partner, I live with one or more children 0–2 years of age, I live with one or more children 3–17 years of age, I live with one or more children aged 18 or older, and I live with one or more persons 65 years or older. For the analysis, we combined the responses I live with one or more children 0–2 years of age and I live with one or more children 3–17 years of age into one variable, living with one or more children less than 18 years old.

2.2.5. COVID-19-related characteristics

We measured COVID-19-relatd characteristics by asking participants, "Over the past month, which of the following has applied to you about COVID-19?" (check all that apply). Responses to select from included: I have been exposed, I have a household member with it, I have symptoms, I have tested negative, I have tested positive, I have been hospitalized, I am at high risk due to other health conditions, I am at high risk due to work exposures, and I am worried about me or my family getting it.

2.3. Data analysis

We described categorical variables using frequencies, and compared socioeconomic, work-related, home-related, and COVID-19-related characteristics by loneliness status using chi-square tests and Fisher's exact tests (for questions with low cell sizes). We used a purposeful selection approach to build a multivariable logistic regression model to explain increased feelings of loneliness (Hosmer et al., 2013). Since this approach retains important confounders in addition to significant covariates, the use of a purposeful selection approach is advantageous compared to other selection techniques when building an explanatory model (Bursac et al., 2008). We included variables with a p-value of less than 0.25 in the bivariate analyses in a preliminary multivariable logistic regression model. We then removed variables with a p-value of greater than 0.05 in the preliminary model. If the coefficient of a variable changed by greater than 10% in the reduced model from the preliminary model, then we removed variables that were not significant in the preliminary model one at a time. If a removed variable changed the coefficient of a significant variable by greater than 10%, then that variable was kept in the model to account for potential confounding. Additionally, we checked for potential interactions between variables in the model. We added interaction terms that had a p-value of less than 0.05 to the model. We removed interaction terms if the term had a p-value of greater than 0.05 when added to the model including all significant interactions. We used a Hosmer-Lemeshow goodness of fit test to evaluate the fit of the final model. We performed all analyses using Stata 17 (College Station, TX).

3. Results

Six-hundred persons completed the QUICk survey. We excluded twenty-three participants from the analysis due to missing data on key covariates. The final analytic sample included 577 participants. Most participants were aged 25–59 (72.0%, 415/577), cis-female (80.8%, 466/577), heterosexual/straight (84.9%, 490/577), white (80.0%, 450/577), worried about themselves or a family member getting COVID-19 (71.6%, 413/577), and had a college degree or higher (84.9%, 490/577) (Table 1).

Among participants included in the sample, 37% (214/577) reported feeling lonelier than usual over the past month. Younger age ($p<0.001$), sexual minority status ($p< 0.001$), less than college degree level of education ($p< 0.001$), higher depression score ($p<0.001$), living alone ($p< 0.001$), being a part-time employee ($p = 0.003$), and being a student ($p< 0.001$) were significantly associated with increased feelings of loneliness. Being a full-time employee ($p<0.001$), being a healthcare worker ($p = 0.026$), being a parent ($p = 0.015$), and living with a spouse or romantic partner ($p< 0.001$) were significantly associated with similar or decreased feelings of loneliness (Table 2).

Table 1
Baseline characteristics of sample ($N = 577$).

	n (%)
Sociodemographic characteristics	
Age	
18–24	58 (10.1)
25–29	22 (3.8)
30–39	151 (26.2)
40–49	151 (26.2)
50–59	113 (19.6)
60–69	44 (7.6)
70–79	36 (6.2)
80+	2 (0.4)
Gender identity	
Cis-female	466 (80.8)
Cis-male	102 (17.7)
Nonbinary	5 (0.9)
Transgender	2 (0.3)
Other	2 (0.3)
Sexual orientation	
Heterosexual/Straight	490 (84.9)
Bisexual/Bi	29 (5.0)
Homosexual/Gay	52 (9.0)
Pansexual	2 (0.4)
Other	4 (0.7)
Race/ethnicity	
White	450 (80.0)
Persons of color[1]	127 (22.0)
Current level of education	
High school degree or equivalent	8 (1.4)
Some college	79 (13.7)
College degree	139 (24.1)
Some graduate education	27 (4.7)
Graduate degree	324 (56.1)
Depression Score (PHQ-2)	
< 3	488 (84.6)
≥ 3	89 (15.4)
Work-related characteristics (check all that apply)	
Full-time employee	319 (55.3)
Working from home	255 (44.2)
Healthcare worker	105 (18.2)
Student	74 (12.8)
Part-time employee	63 (10.9)
Retired	53 (9.2)
Volunteer	40 (6.9)
Essential services worker	28 (4.9)
Recently lost job	15 (2.6)
Home-related characteristics (check all that apply)	
Living with a spouse or romantic partner	352 (61.0)
Parent	278 (48.2)
Living with one or more children less than 18 years old	260 (45.1)
Living with one or more children 18 years or older	79 (13.7)
Living with one or more persons aged 65 years or older	69 (12.0)
Living alone	65 (11.3)
Single parent	31 (5.4)
COVID-19-related characteristics (check all that apply)	
Worry about self or a family member getting COVID-19	413 (71.6)
At high risk for COIVD-19 due to work exposures	96 (16.6)
At high risk for COVID-19 due to other health conditions	93 (16.1)
Exposed to COIVD-19 in the past month	51 (8.8)
Tested Negative for COVID-19 in the past month	32 (5.6)
Experienced COVID-19 symptoms in the past month	19 (3.3)
Tested Positive for COVID-19 in the past month	7 (1.2)
Household member had COVID-19 in the past month	6 (1.0)
Hospitalized with COIVD-19 in the past month	0 (0.0)

[1] American Indian/Alaskan Native, Asian, Black or African American, Latino/Latinx/Hispanic, Native Hawaiian or Other Pacific Islander, and/or Other.

Table 2
Baseline characteristics of sample by loneliness status ($N = 577$).

Characteristics	Not lonelier ($n = 363$) n (%)	Lonelier ($n = 214$) n (%)	p-value
Age			<0.001 *
18–24	14 (3.9)	44 (20.6)	
25–59	289 (79.6)	148 (69.2)	
60+	60 (16.5)	22 (10.3)	
Current gender identity			0.432
Cis-male	67 (18.5)	35 (16.4)	
Cis-female	292 (80.4)	174 (81.31)	
Gender minority	4 (1.1)	5 (2.3)	
Sexual orientation			<0.001 *
Heterosexual/Straight	325 (89.5)	165 (77.1)	
Sexual minority	38 (10.5)	49 (22.9)	
Race/ethnicity			0.289
White	278 (76.6)	172 (80.4)	
Persons of color	85 (23.4)	42 (19.6)	
Current level of education			<0.001 *
High school degree or equivalent or some college	33 (9.1)	54 (25.2)	
College degree	92 (25.3)	47 (22.0)	
Some graduate education or graduate degree	238 (65.6)	113 (52.8)	
Depression Score (PHQ-2)			<0.001 *
< 3	341 (93.9)	147 (68.7)	
≥ 3	22 (6.1)	67 (31.3)	
Full-time employee			<0.001 *
No	141 (38.8)	117 (54.7)	
Yes	222 (61.2)	97 (45.3)	
Part-time employee			0.003*
No	334 (92.0)	180 (84.1)	
Yes	29 (8.0)	34 (15.9)	
Retired			0.091
No	324 (89.3)	200 (93.5)	
Yes	39 (10.7)	14 (6.5)	
Healthcare worker			0.026*
No	287 (79.1)	185 (86.4)	
Yes	76 (20.9)	29 (13.5)	
Essential services worker			0.294
No	348 (95.9)	201 (93.9)	
Yes	15 (4.13)	13 (6.1)	
Recently lost job			0.436
No	355 (97.8)	207 (96.7)	
Yes	8 (2.2)	7 (3.3)	
Working from home			0.920
No	202 (55.6)	120 (56.1)	
Yes	161 (44.4)	94 (43.9)	
Volunteer			0.463
No	340 (93.7)	197 (92.1)	
Yes	23 (6.3)	17 (7.9)	
Student			<0.001 *
No	337 (92.8)	166 (77.6)	
Yes	26 (7.2)	48 (22.4)	
Parent			0.015*
No	174 (47.9)	125 (58.4)	
Yes	189 (52.1)	89 (41.6)	
Single parent			0.567
No	342 (94.2)	204 (95.3)	
Yes	21 (5.8)	10 (4.7)	
Living alone			<0.001 *
No	338 (93.1)	174 (81.3)	
Yes	25 (6.9)	40 (18.7)	
Living with a spouse or romantic partner			<0.001 *
No	107 (29.5)	118 (55.1)	
Yes	256 (70.5)	96 (44.9)	
Living with one or more children less than 18 years old			0.265
No	193 (53.2)	124 (57.9)	
Yes	170 (46.8)	90 (42.1)	
Living with one or more children 18 years or older			0.564
No	311 (85.7)	187 (87.4)	
Yes	52 (14.3)	27 (12.6)	
Living with one or more persons aged 65 years or older			0.673
No	318 (87.6)	190 (88.8)	
Yes	45 (12.4)	24 (11.2)	
Exposed to COIVD-19 in the past month			0.123
No	336 (92.6)	190 (88.8)	
Yes	27 (7.4)	24 (11.2)	
Experienced COVID-19 symptoms in the past month			0.056
No	355 (97.8)	203 (94.9)	
Yes	8 (2.2)	11 (5.1)	
Tested Negative for COVID-19 in the past month			0.670
No	344 (94.8)	201 (93.9)	
Yes	19 (5.2)	13 (6.1)	
Tested Positive for COVID-19 in the past month			0.433
No	360 (99.2)	210 (98.1)	
Yes	3 (0.8)	4 (1.9)	
At high risk for COVID-19 due to other health conditions			0.727
No	303 (83.5)	181 (84.6)	
Yes	60 (16.5)	33 (15.4)	
At high risk for COIVD-19 due to work exposures			0.126
No	296 (81.5)	185 (86.4)	
Yes	67 (18.5)	29 (13.6)	
Worry about self or a family member getting COVID-19			0.135
No	111 (30.6)	53 (24.8)	
Yes	252 (69.4)	161 (75.2)	

* p-value < 0.05.

While there were numerous variables that were significantly associated with increased feelings of loneliness prior to adjustment (Table 3), after adjustment for potential confounding, several characteristics had a statistically significant independent association. Young adults (18–24 vs. 60+), those with a depression score of greater or equal to 3 (vs. less than 3), and those who lived alone (vs. did not live alone) had significantly higher odds of increased feelings of loneliness (aOR=5.15, 95%CI:1.24- 21.45, aOR=6.50, 95%CI:3.71–11.40, and aOR=2.33, 95% CI:1.12–4.82, respectively). However, adults who were full-time employees had significantly lower odds of increased feelings of loneliness compared to those who were not full-time employees (aOR = 0.57, 95% CI: 0.36–0.89). Those who were both not parents and living with their romantic partners had significantly lower odds of increased feelings of loneliness (aOR = 0.30, 95% CI: 0.12–0.77). The final multivariable model adequately fit the data ($p = 0.461$) (Table 4).

4. Discussion

The COVID-19 pandemic offers a unique opportunity to examine how people function in an extremely stressful context. Characterizing the mental health impacts of the pandemic may inform the development of future novel approaches to prevent negative mental health consequences. In addition, as the pandemic recedes over time with successful vaccination strategies (Kyriakidis et al., 2021), identifying factors that predispose people to negative impacts may allow strategies to reach those at greatest risk first. Those at greatest risk of suicide and self-harm, for example, could be prioritized for intervention. Our study suggests that young adults, adults with depressive symptomatology, and adults living alone may be at risk as a result of the pandemic as these factors

Table 3
Unadjusted association between baseline characteristics and feeling lonelier than usual over the past month ($N = 577$).

Characteristics	Unadjusted OR (95% CI)	*p*-value
Age		
18–24	8.57 (3.95–18.60)	<0.001**
25–59	1.40 (0.82–2.37)	0.214
60+	Reference	
Gender identity		
Cis-male	Reference	
Cis-female	1.14 (0.73–1.79)	0.566
Gender minority	2.39 (0.60–9.48)	0.214*
Sexual orientation		
Heterosexual/straight	Reference	
Sexual minority	2.54 (1.60–4.04)	<0.001**
Race/ethnicity		
White	Reference	
Persons of color	1.25 (0.83–1.90)	0.289
Current level of education		
High school degree or equivalent or some college	Reference	
College degree	0.31 (0.18–0.55)	<0.001**
Some graduate education or graduate degree	0.29 (0.18–0.47)	<0.001**
Depression Score (PHQ-2)		
<3	Reference	
≥ 3	7.06 (4.20–11.87)	<0.001**
Full-time employee		
No	Reference	
Yes	0.53 (0.37–0.74)	<0.001**
Part-time employee		
No	Reference	
Yes	2.18 (1.28–3.69)	0.004**
Retired		
No	Reference	
Yes	0.58 (0.31–1.10)	0.095*
Healthcare worker		
No	Reference	
Yes	0.59 (0.37–0.94)	0.027**
Essential services worker		
No	Reference	
Yes	1.50 (0.70–3.22)	0.297
Recently lost job		
No	Reference	
Yes	1.50 (0.54–4.20)	0.439
Working from home		
No	Reference	
Yes	0.98 (0.70–1.38)	0.920
Volunteer		
No	Reference	
Yes	1.28 (0.67–2.45)	0.464
Student		
No	Reference	
Yes	3.75 (2.25–6.25)	<0.001**
Parent		
No	Reference	
Yes	0.66 (0.47–0.92)	0.015**
Single parent		
No	Reference	
Yes	0.80 (0.37–1.73)	0.568
Living alone		
No	Reference	
Yes	3.11 (1.83–5.29)	<0.001**
Living with a spouse or romantic partner		
No	Reference	
Yes	0.34 (0.23–0.48)	<0.001**
Living with one or more children less than 18 years old		
No	Reference	
Yes	0.82 (59–1.16)	0.266
Living with one or more children 18 years or older		
No	Reference	
Yes	0.86 (0.52–1.42)	0.564
Living with one or more persons aged 65 years or older		
No	Reference	
Yes	0.89 (0.53–1.51)	0.673
Exposed to COIVD-19 in the past month		
No	Reference	
Yes	1.57 (0.88–2.80)	0.125*
Experienced COVID-19 symptoms in the past month		
No	Reference	
Yes	2.40 (0.95–6.08)	0.064*
Tested negative for COVID-19 in the past month		
No	Reference	
Yes	1.17 (0.57–2.42)	0.670
At high risk for COVID-19 due to other health conditions		
No	Reference	
Yes	0.92 (0.58–1.46)	0.727
At high risk for COIVD-19 due to work exposures		
No	Reference	
Yes	0.69 (0.43–1.11)	0.128*
Worry about self or a family member getting COVID-19		
No	Reference	
Yes	1.34 (0.91–1.96)	0.135*

* *p*-value <0.25.
** *p*-value <0.05.

Table 4
Adjusted association between selected characteristics and feeling lonelier than usual over the past month ($N = 577$).

Characteristics	Adjusted[1] OR (95% CI)	*p*-value
Age		
18–24	5.15 (1.24- 21.45)	0.024*
25–59	1.83 (0.78- 4.27)	0.163
60+	Reference	
Current level of education		
High school degree or equivalent or some college	Reference	
College degree	0.63 (0.30–1.32)	0.222
Some graduate education or graduate degree	0.81 (0.41–1.63)	0.559
Depression Score (PHQ-2)		
< 3	Reference	
≥ 3	6.50 (3.71–11.40)	<0.001*
Full-time employee		
No	Reference	
Yes	0.57 (0.36–0.89)	0.015*
Retired		
No	Reference	
Yes	0.82 (0.30–2.24)	0.696
Student		
No	Reference	
Yes	0.74 (0.29–1.92)	0.539
Parent		
No	Reference	
Yes	0.59 (0.27–1.30)	0.188
Living alone		
No	Reference	
Yes	2.33 (1.12–4.82)	0.023*
Living with a spouse or romantic partner		
No	Reference	
Yes	1.06 (0.55–2.08)	0.846
Exposed to COIVD-19 in the past month		
No	Reference	
Yes	1.81 (0.90–3.62)	0.096
Not a parent x living with a spouse or romantic partner	0.30 (0.12–0.77)	0.013*

* *p*-value <0.05.
[1] Adjusted for all other variables in the table.

appear to make an independent contribution to the perception of increased loneliness. This corroborates the findings from other countries (Benke et al., 2020; Bu et al., 2020; Groarke et al., 2020; Li and Wang, 2020; Losada-Baltar et al., 2021; Niedzwiedz et al., 2021). Additionally, this corroborates findings from the US with respect to younger age and living alone (Emerson, 2020; Østertun Geirdal et al., 2021), but not other findings (Gaeta and Brydges, 2021; Meyer et al., 2020; Østertun Geirdal et al., 2021). Feeling lonely during the pandemic may also contribute to other negative mental health outcomes (Elran-Barak and Mozeikov, 2020; González-Sanguino et al., 2020; Horesh et al., 2020; Jia et al., 2020; Killgore et al., 2020a, 2020c; Liu et al., 2020; Palgi et al., 2020; Tso and Park, 2020; Vanderbruggen et al., 2020; Voitsidis et al., 2020; Whitehead and Torossian, 2021). Our study highlights that young adults, adults with baseline depression, and adults living alone in the US may in fact be at greater risk of this negative mental health outcome and related consequences, necessitating greater attention to their support.

Our findings are subject to several limitations. The single-item, binary measure of loneliness used in this study may not be as robust of a measurement compared to a multi-item scale such as the 20-item UCLA Loneliness Scale (Russel et al., 1978). However, we chose to use this shorter yet validated measure to make the survey as brief as possible. The cross-sectional nature of this analysis prevents us from establishing either temporality or causality. This is a baseline analysis of a longitudinal dataset and future studies will provide a better understanding of changes over time and relationships between independent variables and the outcome of loneliness. Use of a convenience sample of largely white, educated, cis-gender, and heterosexual participants limits our ability to generalize to more representative populations. The non-incentivized peer-referral recruitment may also bias the results of this study if loneliness is higher in some social networks compared to others. Finally, the relatively low sample size in several key population including persons of color and sexual and gender minorities limit our ability to examine how these key groups were impacted. Unadjusted analyses suggested that sexual and gender minorities were significantly more likely to experience increases in loneliness, but the associations did not remain after inclusion in the final model due to low statistical power. Future studies should examine specific populations with enough sample size to identify their unique needs which may emerge following this challenging time. Finally, we examined loneliness as a characteristic on its own, recognizing that it may be found in as just one of a constellation of factors that may place persons at greater risk of harm.

This study has several strengths. Focusing on loneliness with an easy measure may make this information rapidly actionable as it does not require extensive measurement or investigation. The brevity of this survey which was conducted on a handheld device increased participation and retention. The non-incentivized peer-referral approach to recruitment means that persons who may not usually participate in surveys could be recruited, thus our population may represent people who are more reticent to participate in research than those who respond to paid advertisements or banner ads. Despite the lack of diversity in our sample, understanding correlates of loneliness among those with resources such as education underscores that those without such resources may be at increased risk. This study points to the need to provide outreach to key populations at risk at the same time as conducting more research to support persons in need during, and after, the pandemic. The longitudinal nature of the study will allow us to examine changes over time in the future.

Findings from this study point to key characteristics that may be associated independently with loneliness during the pandemic. Should the pandemic continue or begin to resolve, there remains an urgent public health need to address resulting mental health impacts. Survey data are helpful to provide insight into who may be at greatest risk of loneliness and enable development of tailored interventions that can be rapidly deployed to those most in need.

CRediT authorship contribution statement

Sydney Bornstein: Conceptualization, Methodology, Formal analysis, Software, Writing – original draft. **Manya Magnus:** Conceptualization, Methodology, Supervision, Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of the article.

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