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.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Change in psychological distress in response to changes in reduced mobility during the early 2020 COVID-19 pandemic: Evidence of modest effects from the U.S.

Srikant Devaraj* a, , Pankaj C. Patel b

a Ball State University, Muncie, IN, United States
b Villanova University, Villanova, PA, United States

ARTICLE INFO

Keywords:
COVID-19
Reduced mobility
Psychological distress
Understanding America study
Heterogeneity by gender

ABSTRACT

Rationale: During the early 2020 COVID-19 pandemic, several US states had implemented stay-in-place orders (SIPOs) with varying degrees of stringency which resulted in inter-state differences in mobility (i.e., longer presence at home). We test whether the inter-state differences in mobility influenced changes in reported psychological distress. Our study is not on the surge in COVID-19 in the later part of 2020.

Objective: To identify whether the change in state-level mobility is associated with the change in individuals' reported psychological distress during the early COVID-19 pandemic and whether the intensity of the association varies by older individuals, females, and non-whites.

Methods: We use differences in state-level mobility and change in reported psychological distress between the two dates of interviews of 5,132 individuals who participated in March and April 2020 waves of Understanding America Study (UAS).

Results: We find support for modest effects, i.e., a one standard deviation decline in mobility was associated with a 3.02% higher psychological distress [95% CI: 0.4%–5.64%], and the effects are robust to controlling for reported changes in exercise intensity, alcohol consumption, cannabis use, recreational drug use, and meditation intensity. We also find support for a stronger association for females, but not for older individuals or non-whites. Further, we do not find support for the mediation effects from change in chance of running out of money or change in chance of getting COVID-19.

Conclusion: Our findings show that reduced mobility from lockdowns during the early COVID-19 wave in the US is associated with a modest increase in reported psychological distress, especially for females. However, these conclusions should not be construed as a small increase in psychological distress in general, as a variety of non-mobility related factors associated with COVID-19 could have exacerbated psychological distress during the early COVID-19 wave in the US.

1. Introduction

In the U.S., mid-March was the start of a significant uptick in COVID-19 cases, with the cases peaking around mid-July 2020. However, in the so-called ‘second’ wave, there has been a significant increase in the number of cases. As of December 6, 2020, there were 14.7 million cases and 281,000 deaths in the U.S. During the early stage, states enacted a variety of non-pharmaceutical interventions to curb the pandemic. Our study focuses on the effects of these early-stage policies aimed at curbing the pandemic. The human and economic toll of the pandemic is staggering, and the reduced mobility from lockdowns may also, directly and indirectly, impact mental well-being. Studies have focused on the effects of COVID-19 on psychological distress in China (Qiu et al., 2020), Italy (Mazza et al., 2020), Spain (Losada-Baltar et al., 2020), among others.

Extending these country-level studies, our study focuses on the intra-country variation in mobility on changes in reported psychological distress during the early COVID-19 wave in the U.S. Though reduced mobility helps control the spread of COVID-19, according to Douglas et al. (2020), several groups are especially vulnerable to poorer health due to economic deterioration, social isolation, stress on family relationships, poor health, and essential services and the general social malaise, especially, as coping capacity may be limited in the face of...
sudden onset of the pandemic. The confluence of these factors could have increased the levels of psychological distress during the early COVID-19 wave in the U.S.

Though most countries initiated national lockdowns during the early COVID-19 wave, the U.S. presents an interesting case for studying the effects of variations in strictness of lock-downs that drive variations in mobility on psychological distress during this period. In the U.S., the lockdown policy was mostly initiated by the state governors and there was no national lockdown policy. Variations in lockdown policies across U.S. states starting mid-March 2020 resulted in substantial variation in mobility across states (Alvarez et al., 2020). Extending prior claims that lockdown may increase the incidence of suicide (Gunnell et al., 2020), increase stress and anxiety (Wang et al., 2020), and trigger a variety of mental conditions (Yao et al., 2020), we focus on the association between changes in mobility on the changes in reported psychological distress during the early COVID-19 wave in the U.S. The mobility restrictions have negative implications on distress, as evident in a study by Arendt et al. (2020) who find an increase in calls to crisis hotlines and reopening led to a decrease in the number of calls.

Based on stress process theory (Attell et al., 2017; Pearl and Bierman, 2013; Thoits, 2010), we elaborate the theoretical reasons for the following hypotheses, below: The decline in mobility at the state-level during the early COVID-19 wave in the U.S. is positively associated with the changes in psychological distress; and this association is stronger for older individuals, females, or non-whites. We further explore possible mediation mechanisms as auxiliary analyses by testing whether lower mobility drives an increase in psychological distress through two channels — perceived changes in the chance of running out of money or perceived changes in chances of getting COVID-19 between two waves of the interview. We use a two-wave individual-level longitudinal survey and assess changes in mobility in a state between the two interview dates, and the changes in reported psychological distress. Mobility is measured using Google’s data on Android users, where increased stay at home (measured as residential mobility) would imply reduced movement outside the home. Our effect sizes are small relative to a more recent UK based study by Niedzwiedz et al. (2020) who found that psychological distress increased one month into lockdown with the prevalence rising from 19.4% in 2017–2019 to 30.6% in April 2020, mostly affecting women, young adults, people from an Asian background and more educated. Our effect sizes are much smaller, however, we also note that we do not have pre-COVID-19 data of the respondents, and a variety of non-mobility related factors may affect reports of changes in psychological distress. We do not find support for the mediation effect through perceived changes in the chance of running out of money or perceived changes in chances of getting COVID-19. Overall, provides early intra-country evidence on the effect of lower mobility on in psychological distress, a key public health outcome of interest for policymakers, mental health practitioners, and individuals alike. Although our results only provide a snapshot of the relationship between reduced mobility during the COVID-19 pandemic and psychological distress during the early COVID-19 wave in the U.S., they contribute to the ongoing research on the effects of COVID-19 on the mental well-being of individuals.

2. Theoretical background and hypotheses

2.1. Psychological distress during the early stages of COVID-19 pandemic

The nature of psychological distress is unique for a pandemic. Health and economic uncertainty take a visible physical and mental toll on the population. At the same time, in the U.S., during the early COVID-19 wave varying state and federal narratives on containment and seriousness of the pandemic have further added to variation in the mobility of individuals. Though stay-in-place orders (SIPO) are central to the containment of spread (Courtemanche et al., 2020; Dave et al., 2020), not all states in the U.S. enacted stringent SIPO laws to contain the virus. By mid-July 2020, it was evident that states with the most stringent SIPOs and those that delayed relaxation of SIPO laws (e.g., New Jersey, New York, Pennsylvania, and others) had seen a steady decline in cases, whereas states with less stringent laws and aggressive re-opening plans had seen a surge of cases. Public compliance was equally important, for example, in California despite the stringent SIPO during early stages, excessive congregations in public places may have contributed to the resurgence of cases.

Although a combination of factors may help ‘flatten the curve,’ the differences in government mandate of SIPO were elemental in explaining variations in curbing COVID-19 spread (Courtemanche et al., 2020). In Appendix Table A, we list the SIPO law variations by the state during the early COVID-19 wave. Though studies have focused on the effect of national lockdowns on psychological distress (Mazza et al., 2020; Qiu et al., 2020), the variations in mobility across states are a unique context. Figure A (Appendix) presents the variations in the degree of mobility across states between two waves of our study period. Higher differences imply higher presence at home, in other words, lower mobility.

Our theoretical basis is mainly rooted in stress process theory, which links stressors to adverse mental health outcomes (Thoits, 2010). Prior empirical studies show an association between exposure to stressors and worsening mental health (Attell et al., 2017). Coping with the demands of childcare, income uncertainty, reduced socialization, and general malaise are strong stressors that could increase psychological distress. The general sense of isolation from lower mobility can increase the levels of depression and anxiety (Toraøes, O’Higgins, Castaldelli-Maia and Ventriglio, 2020).

Because COVID-19 was a recent phenomenon during the early COVID-19 wave in the U.S., we lack sufficient theoretical background on psychological distress specific to COVID-19. Thus, we rely on the literature on the psychological effects of past pandemics such as SARS, H1N1, Ebola, among others. Studies have shown that those quarantined, relative to those who are not quarantined, reported higher levels of psychological distress (Brooks et al., 2020). Quarantined individuals are prone to higher levels of post-traumatic stress disorder (PTSD) and depression (Hawryluck et al., 2004; Holmes et al., 2020; Jeong et al., 2016). According to a recent study on COVID-19, about 54.8% of respondents reported moderate or severe impact from the outbreak, with 16.5% of respondents reporting moderate to severe depressive symptoms (Wang et al., 2020). In a related study, about 35% of the 52,730 participants reported psychological distress (Qiu et al., 2020). There is also mounting evidence that isolation based on lockdowns has increased psychological distress (Toraøes et al., 2020). We hypothesize that:

H1. The decline in mobility during the COVID-19 pandemic is positively associated with an increase in reported psychological distress.

Next, we theorized about heterogeneity in the association proposed in H1.

2.2. COVID-19 psychological distress and demographic factors during the early COVID-19 wave in the U.S

COVID-19 studies during the early COVID-19 wave have focused on the effect of demographic and social factors on individual reactions to quarantine and effects on psychological outcomes (Mazza et al., 2020). The stress process theory is particularly salient in the current context. Stress process theory posits that health outcomes are distributed according to one’s social status and exposure to stress (Aneshensel, 1992), such that those in more marginalized groups in the society are prone to greater stress (Attell et al., 2017). In the stress process theory, stressors are “the broad array of problematic conditions and experiences that can challenge the adaptive capacities of people” (Pearlin, 2010, page 208). During the early stages, COVID-19 created factors that not only impacted individuals in general but more marginal populations were also more severely affected. We focus on three vulnerable groups—older
individuals, females, and non-Whites. The three groups we focus on are linked to systematic differences in socio-economic status. Clouston, Nataleb, and Link (2020) find that earlier incidence of index cases was concentrated in higher socio-economic status counties, but with higher social distancing incidence and fatality, rates declined, indicating lower socioeconomic status groups bore a disproportionate burden during the early stages of a pandemic.

The extensive set of studies on the early COVID-19 wave document that older individuals are more vulnerable to COVID-19, females are more prone to COVID-19 stress, and finally, non-Whites, have disproportionately been affected by COVID-19 (Bhala et al., 2020). Older individuals are reported to have a negative susceptibility to COVID-19 (Girdhar et al., 2020). Combining the stress process theory with the stereotype embodiment theory we expect that negative stereotypes are harbored towards older individuals. Higher susceptibility to COVID-19, lower sensitivity among younger individuals towards the spread of COVID-19 to older individuals (Ayalon et al., 2020), and the general “age walling” (Hagestad and Uhlenberg, 2005) have contributed to higher stress among the elderly. Ageism, higher mortality rates, and the general malaise among the elderly in emotional response to COVID-19 may increase their psychological distress levels. Bu, Steptoe, and Fancourt (2020), using a sample of 38,217 UK adults in the UCL COVID-19 Social Study (23/03/2020–10/05/2020) identified four latent groups on loneliness levels, where during the first few weeks of lockdown, loneliness levels increased in the highest loneliness group, remained constant in the middle two groups and declined in the lowest loneliness group. Younger adults, women, those in the lower income group, and those with mental health conditions were more likely to be in the highest loneliness class.

Females were perhaps also more prone to psychological distress during the early wave of COVID-19 (Qiu et al., 2020; Wang et al., 2020), and both younger adults (ages 18–30) and the elderly (those older than 60 years) are more likely to report psychological distress. In a nationally representative study, Qiu et al. (2020) found that during the early wave of the COVID-19 pandemic, in China, females were more prone to psychological distress, perhaps due to higher experiences of PTSD among females (Tang et al., 2020). Though PTSD is an extreme outcome, a higher expected psychological distress among females in the U.S. may likely result from variations in gender roles and gender inequality. The psychological distress for females could increase through two channels—the greater burden of housework and labor force inequality. Higher demands at home, employment in more customer-facing occupations, lower pay relative to males are some of the factors that could explain why females may experience higher psychological distress during the early wave of the COVID-19 pandemic in the U.S. These multipronged demands at home and work under reduced mobility could significantly increase psychological distress among females for two possible reasons. Indirectly, related to greater stress among females, pregnant females reported higher stress levels that could influence maternal mental and physical health, perinatal outcomes (Preis et al., 2020).

First, females bear a higher burden of household work and childcare (Stone, 2008). Collins, Landivar, Ruppanner, and Scarborough (2020) find that during the COVID-19 pandemic, in the U.S., mothers with young children reduced their work hours, indicating a growing gender gap in work hours by 20–50 percent. The evidence of a greater reduction in work and higher household responsibilities under lower mobility during the early wave of the COVID-19 pandemic could exacerbate psychological distress among females. Females may bear greater responsibility for taking care of children, those sick, and even the educational responsibility of school-aged children at home. For example, Pierce et al. (2020) using a sample of 17,452 participants in Waves 6–9 of the UK Household Longitudinal Study (UKHLS) panel (with COVID-19 web surveys conducted in Waves 8 or 9) found that mental distress rose from 18.9% in 2018–19 to 27.3% (26.3–28.2) in April 2020; a month after the start of UK lockdown and working women with younger children had higher distress levels.

Second, females tend to work in service sectors (Polacheck et al., 2015; Rendall, 2018) that tend to be more customer facing and therefore leading to higher concerns for exposure. Furthermore, it is a foregone conclusion that females make less money than males, and with greater economic insecurity gripping the U.S. during the COVID-19 pandemic, females may feel more economically vulnerable, especially during the early onset of the pandemic. Mounting unemployment rates, continuing or increasing workloads, and higher representation in lower-paying jobs are the additional reasons why we expect females to experience higher psychological distress under lower mobility during the early wave of the COVID-19 pandemic in the U.S. In a review by Connor et al. (2020) female caregivers had higher exposure to the virus, exacerbates multifactorial stress for females, and called for gender-informed policies to combat higher stress among females.

Continuing from the stress process theory, COVID-19 has also disproportionately affected racial minorities. Already subject to systemic discrimination (Reskin, 2012), greater likelihood of being employed in front-line jobs (Cubrich, 2020), and facing higher income uncertainty (Hardy, 2017), studies have highlighted significant stressors faced by racial minorities (Chowkwanyun and Reed Jr, 2020; Hooper et al., 2020). Racial minorities in the U.S. also have greater co-morbidities than whites (Metcalfe et al., 2018), live in more congested urban settings, and low pay higher COVID-19 exposure occupational settings may further strengthen psychological strain from lower mobility.

To summarize, COVID-19 studies on the early wave of the pandemic have focused on the effect of demographic and social factors on individual reactions to quarantine and effects on psychological outcomes (Mazza et al., 2020). Females are more prone to psychological distress (Qiu et al., 2020; Wang et al., 2020), and both younger adults (ages 18–30) and the elderly (those older than 60 years) are also more likely to report psychological distress (Mazza et al., 2020). The effects based on education are mixed, with individuals of both high and low education reporting higher psychological distress (Qiu et al., 2020; Wang et al., 2020). Others have focused on more behavioral traits, including personality, that influence reaction to quarantine, and the subsequent depression and anxiety outcomes (Ioannou et al., 2004).

Based on the above discussion we propose the following hypotheses on the heterogeneity in the changes in mobility and psychological distress by older individuals, females, and non-whites.

**H2.** The decline in mobility during the COVID-19 pandemic is more strongly associated with an increase in reported psychological distress for older individuals.

**H3.** The decline in mobility during the COVID-19 pandemic is more strongly associated with an increase in reported psychological distress for females.

**H4.** The decline in mobility during the COVID-19 pandemic is more strongly associated with an increase in reported psychological distress for non-whites.

### 3. Methods

#### 3.1. Understanding America Study (UAS) survey data during the early COVID-19 wave in the U.S.

Though pre-COVID-19 mental well-being data of individuals is generally unavailable in the U.S. studies (except for large scale studies such as Health and Retirement Study, National Longitudinal Survey of Youth who are planning for assessments in the latter part of 2020), we exploit the effect of change in mobility and change in reported psychological distress from the same individuals during peak months of the early wave of COVID-19. Our data relies on a two-wave longitudinal national survey – The Understanding America Study (UAS) COVID-19
survey conducted by the University of Southern California via an online survey (Kapteyn et al., 2020). The sample consists of members of the Center for Economic and Social Research’s UAS probability-based internet panel that started in 2014. This nationally representative panel of American households was randomly recruited from the United States Postal Service delivery sequence files. The members were individuals age 18 and older who could respond to the survey online. The participants had a choice to complete the online survey in English/Spanish by using their computer, mobile device, or tablet, any day/time during the study period. For those households without online access, an internet-connected tablet was provided.

A total of 8815-panel members were invited to participate in the first wave of the COVID-19 survey. The first wave of the COVID-19 survey was held from March 10th to March 31st 2020. The members were randomly assigned a particular day of the week to complete the survey during the 14 days. The respondents were compensated for their participation and an additional incentive was provided if they responded on their assigned day. The participation rate was about 82%, with 7145 adult U.S. residents participating in the survey. The margin of sampling error was ± 2 percentage points for Wave 1. UAS administrators computed the survey weights based on the base weights that account for probabilities of selecting into the sample and also by post-stratification weights aligning with benchmark distributions from U.S. Census Current Population Surveys. The final sample released by UAS after curating the data was 6930. For detailed methodology, weighting methods, and sample selection, please refer to https://uasdata.usc.edu/index.php.

Wave 2 of the COVID-19 survey was administered from April 1st to April 28th 2020. The survey was sent to a total of 9063 panel members, 154 individuals had not completed the Wave 1 survey, and 1606 individuals from the Wave 1 survey respondents did not participate in the Wave 2 survey. After removing observations with missing covariates, our final sample consists of 5,132 individuals who were surveyed for both the UAS waves. Appendix Figure B shows the flowchart for our sample selection. Appendix Figure C shows the distribution of our sample across all U.S. states. A higher share of the sample is located in highly populated states in the U.S.

3.2. Mobility data

We obtain the mobility data from Google’s COVID-19 community mobility reports (published at https://www.google.com/covid19/mobility/). The daily mobility reports provide public health officials and researchers with estimates of changes in mobility patterns due to the COVID-19 pandemic and also to test the effectiveness of policies that are implemented to flatten the curve. The daily mobility patterns data show changes in trends at places such as residences, workplaces, retail/recreational venues, parks, grocery/pharmacies, and transit centers. The anonymized and aggregated data capture location from Google users across the nation who had opted to turn on their location history settings. To protect user privacy and improve the accuracy of the aggregated data, random noise is added by Google’s research team to each metric.

We use the changes in mobility data at the place of residence to proxy for reduced mobility in our analysis (in other words, an increase in mobility at residence implies reduced overall mobility). For each day, the signals such as relative frequency, time, and duration of visits combined with the average amount of time spent at home (in hours) are used to compute residential data (Aktay et al., 2020). The mobility changes are compared to a baseline (median) value for a particular day of the week between January 3rd and February 6th 2020. Additional information on Google mobility trends and the associated calculations are available at https://www.google.com/covid19/mobility/data documentation.html?hl=en. The ratio between each day’s metric and baseline are then published as a percentage. Due to the addition of noise for privacy, the margin measurement errors are ± 2.5%. Further, when the percentage chance of residential metrics has a 5% chance of being wrong, then such geographic data is not reported.

We then merge the daily state-level mobility trends provided by Google based on the date of the UAS interview to estimate the changes in reduced mobility between the two waves of interviews in the state where the individual resides.

3.3. COVID-19 incidence proportion

We obtain state-level cumulative COVID-19 incidence data from USAFacts, an organization that aggregates confirmed COVID-19 data released by U.S. Center for Disease Control and Prevention (CDC), and confirmed by referencing state- and local-level public health agencies. The cumulative positive COVID-19 cases and death data are collected and updated each day from public health websites. They are presented both at the state- and county-level. Conforming to CDC’s reporting methodology, USAFacts counts presumptive positive cases as confirmed cases and assign location based on where individuals were diagnosed. We then divide the cumulative COVID-19 incidence by 100,000 population to express the data as the incidence proportion.

We then merged the daily state-level COVID-19 incidence proportion data with the date of the UAS interview across both the waves. We use this data to estimate the changes in incidence proportions between two waves of the survey to measure the exposure of COVID-19 in the individuals’ residence state.

3.4. Empirical specification

Our model approach allows U.S. to account for state-level changes related to the propensity to follow lockdown orders by staying home (that is, higher reduced mobility), and also control for the individual characteristics in reporting and managing reactions to COVID-19. To estimate the impact of reduced mobility on psychological distress, we use the following specification:

\[
\Delta Y_{it} = \alpha_0 + \alpha_1(\Delta \text{Reduced mobility})_{is} + \alpha_2 \Delta C_s + \alpha_3 \Delta M_s + \alpha_4 X_i + \mu_i \tag{1}
\]

Where \(i\) is the individual located in state \(s\) in wave \(t\).

Our outcome measure (\(\Delta Y_{it}\)) in both methods is the change in psychological distress between the two waves. We use the psychological distress scale from the Generalized Anxiety Disorder seven-item scale (Spitzer et al., 2006) and is used as a proxy for short-term psychological distress (Vasiliadis et al., 2015), including in recent COVID-19 research (Zhang et al., 2020). Our psychological distress measure is the average of four-point Likert scale (1: Not at all; 2: Several days; 3: More than half the days; 4: Nearly every day) of four variables asking the respondent “Over the last two weeks, how often have you been bothered by any of the following problems?”: 1) Feeling nervous, anxious, or on edge; 2) not being able to stop or control worrying; 3) Feeling down, depressed, or hopeless; and 4) Little interest or pleasure in doing things. The Cronbach’s \(\alpha\) for the psychological distress measure for Wave 1 was 0.89. The Cronbach’s \(\alpha\) for Wave 2 was 0.88.

The coefficient, \(\alpha_1\), in equation (1) provides an estimate of the impact of change in reduced mobility between Wave 2 and Wave 1 of the UAS survey on change in reported psychological distress. The reduced mobility implies that individuals are staying home and therefore a positive coefficient implies a higher increase in distress.

We control for a series of contextual and demographic confounds that may influence the reporting of psychological distress. Related to contextual confounds, due to daily changes in local COVID-19 conditions, we control for the change in state-level COVID-19 incidence proportions (\(\Delta C_s\)) on the day of the interview from the previous day. Related to personal experience of COVID-19 on the household economic situation that could increase reporting of distress, we control for the change in reported chance of running out of money (range of 1–100) and change in reported chance of getting COVID-19 (range 1–100) between
two waves (i.e., $\Delta M_s$ in equation (1)). Older individuals are more likely to report distress (Schieman et al., 2001), and experiences of distress vary by gender (Cook, 1990) and by race (Kessler and Neighbors, 1986). Furthermore, those with higher education are likely to hold better-paying jobs (Branlund and Hammarstrom, 2014) and those with a partner have necessary emotional support (Hope et al., 1999) to lower reporting of distress. We also note that the effects based on education are mixed, with individuals of both high and low education reporting higher psychological distress (Qiu et al., 2020; Wang et al., 2020). Similarly, immigrants may face higher distress (Ritsner and Ponizovsky, 1999), and those with a lower household income may further higher distress due to greater economic uncertainty from COVID-19 (Matthews et al., 2001). Therefore, related to demographic confounds, we control for age, gender, whether the respondent identifies as White, education status, marital status, employment status, immigrant status, and household income. Further, we cluster our standard errors by state.

As a robustness test, we also perform a first difference model to capture all of the time-invariant factors between two waves. The first difference model is a modification of equation (1) and takes the following form:

$$\Delta Y_{it} = \beta_1 (\Delta \text{Reduced mobility})_{it} + \beta_2 \Delta C_{it} + \beta_3 \Delta D_{it} + \Delta \phi_{it} \tag{2}$$

where $\Delta \phi_{it}$ are the changes in idiosyncratic error and $\beta_1$ is the first-difference estimator of reduced mobility.

Table 1 presents the descriptive statistics of our sample. Appendix Table B shows the detailed questions and scale used in UAS survey variables.

## 4. Results

### 4.1. State-level preliminary evidence of SIPO on mobility

We first test whether the changes in SIPO order had any effect on changes in mobility at a state-level. For our predictor variable, we compute the changes in SIPO order between April 14th (Wave 1) and March 20th 2020 (Wave 2). We measure the outcome variable as changes in state-level mobility between those two dates. Our control variables include the log of the state population in 2018, the log of gross state product, the unemployment rate in 2018, and the state minimum wage in 2018. Appendix Table C describes the descriptive statistics of the state-level variables used in this analysis. Our results are shown in Appendix Table D, where we find that the SIPO had reduced overall mobility (implying an increase in residential presence).

### 4.2. Main results on the effects of reduced mobility on psychological distress

Table 2 shows the results of our model specifications. Estimates in Models 1 through 5 are based on OLS; Model 5 estimates are based on the first-difference specification. Model 1 is the base model without controls. In Model 2 we add individual characteristics as controls. In Model 3 we add state-level changes to COVID-19 incidence proportions between the two waves. In Model 4, our preferred model, we include the mediators – change in chance of running out of money and change in chance of getting COVID-19 between two waves. In Model 5, we add state dummies to the previous model. Model (6) shows the results of our first difference specification.

We find that across all models, the changes in reduced mobility increases psychological distress, however, with a modest effect sizes. Using our preferred model, we find that one standard deviation decline in mobility is associated with an increase in reported psychological distress by 3.02% [95% CI: 0.4%-5.64%]. The estimates were computed as follows: The average decline in mobility is 15.1105 (SD = 6.8376), and OLS Coefficient is 0.00441 [95% CI: 0.00059 to 0.00825] from Model 5.
Table 1 (continued)

| Variable | Description of variables | Mean | Std. |
|----------|--------------------------|------|------|
| HH income $15 k to $19,999 | Household income is $15 k to $19,999 ($1); otherwise (0) | 0.0357 | 0.1855 |
| HH income $20 k to $24,999 | Household income is $20 k to $24,999 ($1); otherwise (0) | 0.0435 | 0.2039 |
| HH income $25 k to $29,999 | Household income is $25 k to $29,999 ($1); otherwise (0) | 0.0456 | 0.2086 |
| HH income $30 k to $34,999 | Household income is $30 k to $34,999 ($1); otherwise (0) | 0.0472 | 0.2120 |
| HH income $35 k to $39,999 | Household income is $35 k to $39,999 ($1); otherwise (0) | 0.0458 | 0.2091 |
| HH income $40 k to $49,999 | Household income is $40 k to $49,999 ($1); otherwise (0) | 0.0735 | 0.2609 |
| HH income $50 k to $59,999 | Household income is $50 k to $59,999 ($1); otherwise (0) | 0.0883 | 0.2837 |
| HH income $60 k to $74,999 | Household income is $60 k to $74,999 ($1); otherwise (0) | 0.1085 | 0.3111 |
| HH income $75 k to $99,999 | Household income is $75 k to $99,999 ($1); otherwise (0) | 0.1442 | 0.3513 |
| HH income $100 k to $149,999 | Household income is $100 k to $149,999 ($1); otherwise (0) | 0.1419 | 0.3489 |
| HH income $150 k or more | Household income is $150 k or more ($1); otherwise (0) | 0.1208 | 0.2529 |

The average change in distress variable is 0.1662 (SD = 0.6426); a one standard deviation increase in reduced mobility is associated with increased distress of 3.02 percent (i.e., $0.8376 \times 0.00441$).

4.3. Heterogeneity by age, gender, and race

We test our hypotheses — H2, H3, and H4, on whether or not the effects of reduced mobility on psychological distress varies by age, gender, and race. Table 3 presents the results of this heterogeneity. We do not find statistical evidence of reduced mobility among older individuals or by race on distress. Though reduced mobility increases psychological distress overall, we find that a stronger association for females than for males. One standard deviation decline in mobility increases reported psychological distress among females by 6.61% relative to males, again with modest effect sizes.

5. Robustness tests

5.1. Changes in behavior

It is plausible that individuals could have changed their behavior between two waves when their mobility is restricted outside their residence and that may influence reported psychological distress. To test for that possibility, we also include changes to self-reported exercise intensity, alcohol consumption, cannabis use, recreational drug use, and meditation intensity to our preferred specification. These changes in activities were calculated from the change in an individual’s response to the number of days the respondent did each of the above activities in the past week of the survey between Wave 2 and Wave 1. Table 4 shows the results of our analysis controlling for changes in behavior. We find that our original results of reduced mobility impacting higher psychological distress remain consistent.

5.2. Alternate measures of mobility

We perform a counterfactual placebo analysis by replacing reduced mobility with workplace mobility [mobility trends across places of work], as both are conversely related. Additionally, we also test for changes to retail and recreation mobility [which include mobility trends across food establishments, shopping malls, theme parks, museums, libraries, and movie theaters] on psychological distress. Appendix Table E shows that higher workplace mobility (or retail/recreation mobility) leads to lower psychological distress.

5.3. Mediation effects

At an individual level, we assess whether changes in reduced mobility affect the reported changes in the chance of running out of money (or, the chance of getting COVID), which in turn increases psychological distress. We estimate this relationship using a structural equation model (SEM) as shown in Appendix Figure D. Appendix Table F presents the estimates of the structural equation model (SEM). We find that the changes to reduced mobility increase the reported change in chances of running out of money (Panel A) and the reported change in chances of getting COVID-19 (Panel B), in turn, increases psychological distress, however, the effect size is negligible. Our estimates show that the mediation effects are negligible, suggesting that psychopathology of distress is not strongly influenced by perceived chances of running out of money or chances of getting COVID-19. Perhaps reporting of small changes in psychological distress seems to be driven by individual-specific factors and less likely to be driven by broader socio-epidemiological trends of COVID-19.

5.4. Heterogeneity by other characteristics

We further test whether reduced mobility differentially impacts individuals based on their education status, marital status, employment status, immigrant status, and household income. Appendix Table G shows the results of this test and we find no statistical evidence to show that there is heterogeneity across most of these individual characteristics. With reduced mobility, an increase in psychological distress among first-generation immigrants relative to non-immigrants.

5.5. Alternate measure for the COVID-19 incidence proportion

It is plausible that testing for COVID-19 may have varied substantially across states based on each state’s approach to the pandemic. We test whether the changes in incidence proportions between two waves as controls could be biasing our results. As a sensitivity check, we include changes in COVID-19 death rates between two waves as an alternate measure of incidence proportions in our model. Appendix Table H shows the results of our analysis and we find that our original results of reduced mobility impacting higher psychological distress are consistent.

5.6. Diagnostic cut-off of distress

The psychological distress scale in the UAS includes four scale items with responses ranging from 1 to 4. The traditional diagnostic cutoffs for high psychological distress are not feasible with the scale in UAS as it has fewer scale items. We first take the sum of all responses to the four scale items. We then create a dummy variable with a diagnostic cut-off of 6 (median value of total distress score for the Wave 2 survey) or 7 (average of the total distress score for the Wave 2 survey). We then estimate the change in the psychological distress at the diagnostic cut-off dummy between two waves as the outcome variable. Appendix Table I shows the results of our analysis and we find that reduced mobility increases psychological distress across the two diagnostic cut-offs.

5.7. Test with alternate standard errors

In addition to the standard errors clustered at the state-level in the main specification, we also test our results using Huber-White robust standard errors, clustering by date of survey, and state by date of survey clustering (Appendix Table J Models 1 to 5). We find that our results are robust to these alternate standard errors.

5.8. The intensity of incidence proportions

We test whether our results are consistent across lower and higher COVID-19 incidence proportions. We first create quartiles of changes to
Table 2
Main effects on change in psychological distress.

| VARIABLES | Model 1: Change in psychological distress | Model 2: Change in psychological distress | Model 3: Change in psychological distress | Model 4: Change in psychological distress | Model 5: Change in psychological distress | Model 6: Change in psychological distress |
|-----------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|
| Model estimation | OLS | OLS | OLS | OLS | OLS | First difference |
| State dummies included in model | No | No | No | No | Yes | No |
| Change in reduced mobility | 0.00570*** (0.00193) | 0.00576*** (0.00197) | 0.00573*** (0.00206) | 0.00441** (0.00191) | 0.00448** (0.00203) | 0.00820*** (0.000874) |
| Change in COVID-19 state incidence proportion | | | | | | |
| Change in the chance of running out of money | | | | | | |
| Change in the chance of getting COVID-19 | | | | | | |
| Age | −0.00125 (0.000987) | −0.00125 (0.000987) | −0.00104 (0.00103) | −0.00137 (0.00106) | | |
| Male | −0.0663** (0.0251) | −0.0663** (0.0251) | −0.0650** (0.0252) | −0.0649** (0.0253) | | |
| White | 0.0237 (0.0347) | 0.0237 (0.0348) | 0.029 (0.0337) | 0.00313 (0.0337) | | |
| High school graduate | −0.157** (0.0729) | −0.156** (0.0725) | −0.160** (0.0730) | −0.171** (0.0751) | | |
| Some college | −0.106* (0.0628) | −0.106* (0.0625) | −0.109* (0.0627) | −0.110* (0.0630) | | |
| Bachelor’s degree or more | −0.111* (0.0629) | −0.111* (0.0627) | −0.101 (0.0625) | −0.104 (0.0633) | | |
| Married (spouse not there) | −0.209** (0.0932) | −0.209** (0.0930) | −0.201** (0.0934) | −0.214** (0.0972) | | |
| Separated | −0.00116 (0.0934) | −0.00106 (0.0935) | −0.00101 (0.0938) | −0.00228 (0.0931) | | |
| Divorced | −0.0916** (0.0425) | −0.0917** (0.0427) | −0.0948** (0.0413) | −0.0906** (0.0427) | | |
| Widowed | 0.0281 (0.0513) | 0.0280 (0.0510) | 0.0299 (0.0517) | 0.0245 (0.0531) | | |
| Never married | −0.0462 (0.0332) | −0.0464 (0.0328) | −0.0445 (0.0338) | −0.0398 (0.0331) | | |
| Employed | 0.0151 (0.0258) | 0.0151 (0.0258) | 0.0218 (0.0272) | 0.0229 (0.0249) | | |
| First-generation immigrant | −0.0334 (0.0354) | −0.0335 (0.0353) | −0.0344 (0.0337) | −0.0496 (0.0334) | | |
| Second-generation immigrant | 0.0236 (0.0438) | 0.0235 (0.0439) | 0.0267 (0.0446) | 0.0241 (0.0458) | | |
| Third-generation immigrant | 0.00505 (0.0338) | 0.00502 (0.0342) | 0.00538 (0.0348) | 0.00599 (0.0350) | | |
| Unknown immigrant status | −0.0965 (0.0703) | −0.0966 (0.0704) | −0.102 (0.0714) | −0.0972 (0.0730) | | |
| HH income $5 k to $7499 | 0.205 (0.146) | 0.204 (0.145) | 0.205 (0.143) | 0.218 (0.138) | | |
| HH income $7.5 k to $9999 | 0.270* (0.150) | 0.270* (0.150) | 0.254* (0.147) | 0.262* (0.141) | | |
| HH income $10 k to $12,499 | 0.146 (0.117) | 0.147 (0.117) | 0.147 (0.117) | 0.140 (0.119) | | |
| HH income $12.5 k to $14,499 | 0.131 (0.142) | 0.131 (0.141) | 0.128 (0.142) | 0.129 (0.143) | | |
| HH income $15 k to $19,999 | 0.316** (0.128) | 0.316** (0.128) | 0.325** (0.129) | 0.342** (0.124) | | |
| HH income $15 k to $19,999 | 0.155 (0.255**) | 0.155 (0.255**) | 0.168 (0.269**) | 0.187 (0.284**) | | |
| HH income $20 k to $24,999 | 0.190* (0.177) | 0.189* (0.176) | 0.194* (0.176) | 0.208* (0.180) | | |
| HH income $25 k to $29,999 | 0.113 (0.117) | 0.113 (0.117) | 0.113 (0.117) | 0.114 (0.119) | | |
| HH income $30 k to $34,999 | 0.167* (0.0951) | 0.167* (0.0951) | 0.176* (0.0940) | 0.180* (0.0965) | | |
| HH income $30 k to $34,999 | 0.0989 (0.0989) | 0.0987 (0.0987) | 0.112 (0.0987) | 0.133 (0.0987) | | |

(continued on next page)
incidence proportion changes between two waves. We then re-run our preferred specification for each of the quartiles. Appendix Table K shows the results for each quartile. We find that reduced mobility increases psychological distress for both lower or upper quartiles. One plausible explanation is that those in the states with a lower change in incidence proportion may be affected by the expectation effect of greater COVID-19 incidences and those in the higher quartile of change in incidence proportions may also be distressed.

5.9. Heterogeneity across a stay at home order status

We test whether the states that passed stay at home order at different points of time could influence the outcomes directly. Appendix Table L shows the interaction of reduced mobility with the number of days since the stay at home order was effective is not significant. Further, Model (2) shows the interaction of reduced mobility with the number of days since the stay at home order was effective is not significant. Therefore, we find no evidence from our analysis that the stay at home order directly influenced the psychological distress.

Table 2 (continued)

| VARIABLES | Model 1: Change in psychological distress | Model 2: Change in psychological distress | Model 3: Change in psychological distress | Model 4: Change in psychological distress | Model 5: Change in psychological distress | Model 6: Change in psychological distress |
|-----------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|
| HH income $35 k to $39,999 | (0.113) | (0.113) | (0.114) | (0.112) |
| HH income $40 k to $49,999 | 0.132 | 0.132 | 0.145 | 0.151 |
| HH income $50 k to $59,999 | (0.109) | (0.109) | (0.107) | (0.110) |
| HH income $60 k to $74,999 | 0.242** | 0.241** | 0.262** | 0.280** |
| HH income $75 k to $99,999 | (0.221) | (0.221) | (0.239) | (0.247) |
| HH income $100 k to $149,999 | 0.216** | 0.215** | 0.233** | 0.246** |
| HH income $150 k or more | (0.101) | (0.101) | (0.0998) | (0.0997) |
| HH income $35 k to $39,999 | (0.248) | (0.248) | 0.262** | 0.280** |
| HH income $40 k to $49,999 | (0.0971) | (0.0967) | (0.0949) | (0.0949) |
| HH income $50 k to $59,999 | 0.202** | 0.201** | 0.216** | 0.239** |
| HH income $60 k to $74,999 | (0.0934) | (0.0931) | (0.0920) | (0.0928) |
| HH income $75 k to $99,999 | 0.211** | 0.209** | 0.0468 | 0.143 |
| HH income $100 k to $149,999 | (0.0334) | (0.111) | (0.112) | (0.110) |
| HH income $150 k or more | 0.0819 | 0.0818 | 0.0906 | 0.132 |
| Constant | 0.0787** | 0.0787** | 0.0787** | 0.0787** |
| Observations | 5132 | 5132 | 5132 | 5132 | 5132 | 5132 |
| R² | 0.004 | 0.025 | 0.025 | 0.034 | 0.058 | 0.064 |

6. Discussion

In this study, we examined the relationship between reduced mobility and change in reported psychological distress between interview dates of the two waves of a nationally representative survey conducted during the early COVID-19 wave in the U.S. The following findings emerge from the study. First, in line with our first hypothesis, reduced mobility between two waves had a positive association with an increase in psychological distress, with modest effect sizes (Table 2). In a sample of 1468 individuals, McGinty et al. (2020) found that in April 2020, 13.8% (11%) of U.S. adults reported always or often felt lonely and the small difference in reported loneliness indicates that other factors may be driving psychological distress during the COVID-19. The modest effect size confirmed in our study confirms potential heterogeneity in the effects. Based on stress process theory we argued that COVID-19 would induce a significant number of stressors through reduced mobility that in turn would increase distress. We find that the effects are small but positive, a one-standard-deviation decline in mobility was associated with an increase in reported psychological distress by 3.02%. Our metric of reduced mobility, though with potential measurement errors, is a reliable metric of the general decline in mobility at the state-level and used in a variety of studies. Our modeling approach allows us to control for the time-invariant individual fixed-effects in reporting and managing psychological distress in response to COVID-19. By drawing on a national survey and controlling for a variety of demographic factors the estimates are based on a large set of U.S. residents.

Second, based on stress process theory we also argued that the effect of reduced mobility will disproportionately influence older individuals (H2), females (H3), and non-whites (H4). The results lend support for H3, but not for the remaining two hypotheses (H2 and H4) (Table 3). The findings consistent with COVID-19 studies, in general, are that females are more disproportionately distressed by the pandemic. Though widely acknowledged that older individuals and racial minorities have disproportionately been affected by COVID-19, we did not find support...
for these moderation effects. Related to additional heterogeneity tests, we find that those who are more educated or with a higher reported household income did not report a significant change in psychological distress (see Appendix Table F). Overall, higher psychological distress experienced by females could be added responsibilities to the lower burden on their female partners. At workplaces on the added consideration of gender in assessing the job and home responsibilities and the mental health of female employees. At workplaces, however, the effects of non-mobility related stressors should not be ruled out. In combination with the effects of reduced mobility and additional stressors, policymakers must provide necessary amenities and resource allocation to improve mental health during the pandemic. As the experience of psychological distress is idiosyncratic, the findings inform mental health professionals on the modest impact of reduced mobility on higher psychological distress during the early COVID-19 wave in the U.S. Duan, Bu, and Chen (2020) highlight that COVID-19 mobility on higher psychological distress during the early COVID-19 wave in the U.S. Phenomenologically, distress from COVID-19 is visible, experienced, and widely discussed. In our study, we focused on the effect of reduced mobility. It seems that a decline in mobility has a smaller effect, however, this should not be interpreted as lower distress due to COVID-19 in general. In other words, though the effect of reduced mobility on psychological distress is modest, additional stressors could have a higher impact on psychological distress, and therefore, the effects of non-mobility related stressors should not be ruled out. In combination with the effects of reduced mobility and additional stressors, policymakers must provide necessary amenities and resource allocation to improve mental health during the pandemic. As the experience of psychological distress is idiosyncratic, the findings inform mental health professionals on the modest impact of reduced mobility on higher psychological distress during the early COVID-19 wave in the U.S. Duan, Bu, and Chen (2020) highlight that COVID-19 related stigma could also be distressing. Adding to their findings, it may be that efficacy of government programs to lower stigma and distress and promoting social cohesion is also conditional on sex, race, and age.

Higher psychological distress for females lends support to our earlier arguments on disproportionate household responsibilities borne by females, their greater presence in customer-facing service sector jobs coupled with higher economic vulnerability as some factors that could explain why females would be more likely to report higher psychological distress during COVID-19. Our findings inform both policymakers and workplaces on the added consideration of gender in assessing the job and home responsibilities and the mental health of female employees. At the household level, male partners in heterosexual couples could take added responsibilities to the lower burden on their female partners. Overall, higher psychological distress experienced by females could be an added consideration for policymakers, employers, and households.

### Table 3

| VARIABLES                                      | Model 1: | Model 2: | Model 3: |
|------------------------------------------------|----------|----------|----------|
| Change in psychological distress              | 0.00120  | 0.00888** | 0.00312  |
| Age                                           | -0.00210 | -0.00103 | -0.00105 |
| Change in reduced mobility × Age              | 6.85e-05 | (0.009133)| -0.0651** |
| Male × Change in reduced mobility × Age       | 0.0791   | (0.0251) | (0.00963)** |
| White × Change in reduced mobility × White    | 0.0257   | 0.0265   | 0.00194  |
| Change in COVID-19 state incidence proportion| 1.70e-05 | 3.12e-05 | 2.14e-05 |
| Change in running out of money                | 0.00172**| 0.00163**| 0.00172**|
| Change in the chance of getting COVID-19      | 0.00164**| 0.00165**| 0.00164**|
| Constant                                      | 0.0961   | -0.0192  | 0.0664   |
| All controls                                  | Included  | Included  | Included  |

Robust standard errors clustered by State in parenthesis. All models are weighted by survey weights.

### Table 4

| VARIABLES                                      | Change in psychological distress | Standard error |
|------------------------------------------------|----------------------------------|---------------|
| Change in reduced mobility                     | 0.00439**                       | 0.00192       |
| Change in COVID-19 state incidence proportion | 2.31e-05                        | 4.04e-05      |
| Change in the chance of running out of money   | 0.00170**                       | 0.000653      |
| Change in the chance of getting COVID-19       | 0.00163**                       | 0.000650      |
| Change in exercise behavior                    | -0.00710                        | 0.00549       |
| Change in alcohol consumption                  | 0.00650                         | 0.0143        |
| Change in Cannabis use                         | 0.0294                          | 0.0168        |
| Change in recreational drug use                | 0.0114                          | 0.0298        |
| Change in Meditation                          | 0.00548                         | 0.00723       |
| All controls                                   | Included                        |               |

Robust standard errors clustered by State in parenthesis. All models are weighted by survey weights.

*p < 0.1, **p < 0.05, ***p < 0.1.
6.1. Limitations

Our study is not without limitations. This study is limited by its design and provides only a limited snapshot of the COVID-19 experiences during the early COVID-19 wave in the U.S. A complex set of interactions among political, social, and healthcare factors along with unobserved individual experiences could also explain the effects. We note that causal interpretation should not be made from our findings, and inferences are only limited to the early wave of COVID-19. We note that in the latter part of 2020 the cases surged and therefore our findings may not be generalizable to the later surge in cases in the U.S. The dynamics of COVID-19 are evolving and fluid at the time of writing this article. Increasing concerns of a second-wave may also have a multiplier effect on psychological distress. Over time, attitudes about reduced mobility may likely mitigate psychological distress as individuals learn to cope with it better. As more specific data on COVID-19 become available, richer comparisons across countries and individuals over time may provide a clearer picture of individuals who adapted and coped with COVID-19 mobility restrictions. Though we use an established scale of psychological distress, we cannot rule out that it may have a different meaning and context during the pandemic. A COVID-19 specific scale of psychological distress was not used, and therefore, the psychometric validity, along with similar concerns in extant COVID-19 studies using non-COVID-19 validated scales remains.

7. Conclusions

The study provides intra-country evidence on the effect of lower mobility on a modest increase in psychological distress during the early COVID-19 wave in the U.S. Our modeling approach allows us to assess that increase in distress is related to COVID-19 related reduced mobility changes during the first wave in the U.S. The results provide early evidence of benchmark psychological distress levels and assessing the impact of change in reduced mobility on psychological distress in the U.S. population. Others have focused on behavioral traits, including personality, that influence reaction to quarantine, and the subsequent depression and anxiety outcomes (Ioannou et al., 2004). We call on future research to assess these additional drivers of psychological distress during COVID-19.

Credit author statement

Authors contributed equally.

Acknowledgment

The project described in this paper relies on data from survey(s) administered by the Understanding America Study, which is maintained by the Center for Economic and Social Research (CESR) at the University of Southern California. The content of this paper is solely the responsibility of the authors and does not necessarily represent the official views of USC or UAS. The collection of the UAS COVID-19 tracking data is supported in part by the Bill & Melinda Gates Foundation and by grant U01AG054580 from the National Institute on Aging.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.socscimed.2020.113615.

References

Aksay, A., Bavadaker, S., Consou, G., Davis, J., Desfontaines, D., Fabrikant, A., Guevara, M., 2020. Google Covid-19 Community Mobility Reports: Anonymization Process Description arXiv preprint arXiv:2004.04145, version 1.0.
Alvarez, F.E., Argente, D., Lippi, F., 2020. A Simple Planning Problem for Covid-19 Lockdown (0898-2937). (Retrieved from).

Arenz, F., Markiewitz, A., Mestan, M., Scher, S., 2020. Covid-19 pandemic, government responses, and public mental health: investigating consequences through crisis hotline calls in two countries. Soc. Sci. Med. 115352.
Attell, B.K., Brown, K.K., Treiber, L.A., 2017. Workplace bullying, perceived job stressors, and psychological distress: gender and race differences in the stress process. Soc. Sci. Res. 65, 210–221.
Ayadon, L., Chastenn, A., Diel, M., Levy, B., Neupert, S.D., Rothermund, K., Wahl, H.-W., 2020. Aging in times of the covid-19 pandemic: avoiding ageism and fostering intergenerational solidarity. The Journals of Gerontology: Series B.
Bhala, N., Curry, G., Martinez, A.R., Agyemang, C., Bhopal, R., 2020. Sharpening the global focus on ethnicity and race in the time of covid-19. Lancet 395 (10238), 1673–1676.
Braunlund, A., Hammarstrom, A., 2014. Higher education and psychological distress: a 27-year prospective cohort study in Sweden. Scand. J. Publ. Health 42 (2), 155–162.
Brooks, S.K., Webster, R.K., Smith, L.E., Woodland, L., Wessely, S., Greenberg, N., Rubin, G.J., 2020. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet 395 (10227), 912–920.
Bu, F., Septoe, A., Fancourt, D., 2020. Loneliness during a strict lockdown: trajectories and predictors during the covid-19 pandemic in 38,217 United Kingdom adults. Social science & medicine. p. 113521.
Chowkwanyaun, M., Reid Jr., A.L., 2020. Racial health disparities and covid-19—caution and context. N. Engl. J. Med. 383 (3), 201–203.
Clouton, S.A., Nataleb, G., Link, B., 2020. Socioeconomic inequalities in the spread of coronavirus-19 in the United States: a examination of the emergence of social inequalities. Soc. Sci. Soc. Med. 113554.
Collins, C., Landivar, L.C., Ruppanner, L., Scarborough, W.J., 2020. Covid-19 and the Gender Gap in Work Hours. Gender, Work & Organizations.
Connor, J., Madhavan, S., Mokashi, M., Ansamuel, H., Johnson, N.R., Pace, L.E., Bartz, D., 2020. Health risks and outcomes that disproportionately affect women during the covid-19 pandemic: a review. Soc. Sci. Med., 113364.
Cook, E.P., 1990. Gender and psychological distress. J. Counsel. Dev. 68 (4), 371–375.
Courtenanche, A., 2020. Le, A., Pinkston, J., Yelowitz, A., 2020. Social distancing measures in the United States reduced the covid-19 growth rate: study evaluates the impact of social distancing measures on the growth rate of confirmed covid-19 cases across the United States. Health Aff. https://doi.org/10.1377/ haff.2020.00680.
Cubrick, M., 2020. On the Frontlines: Protecting Low-Wage Workers During Covid-19. Psychological Trauma: Theory, Research, Practice and Policy.
Dave, D.M., Friedson, A.L., Matsuzawa, K., Sabia, J.J., 2020. When do shelter-in-place orders fight covid-19 best? (Retrieved from). In: Policy Heterogeneity across States and Adoption Time (0898-2937).
Douglas, M., Katikireddi, S.V., Taulbut, M., McKee, M., McCartney, G., 2020. Mitigating the wider health effects of covid-19 pandemic response. BMJ 369.
Duan, W., Bu, H., Chen, Z., 2020. Covid-19-related stigma profiles and risk factors among people who are at high risk of contagion. Soc. Sci. Med. 266, 113425.
Girdhar, R., Srivastava, V., Sethi, S., 2020. Managing mental health issues among elderly during covid-19 pandemic. Journal of Geriatric Care and Research 7 (1), 29–32.
Gunnell, D., Appleby, L., Arensman, E., Hawton, K., John, A., Kapur, N., Caine, E.D., 2020. Suicide risk and prevention during the covid-19 pandemic. The Lancet Psychiatry 7 (6), 468–471.
Hagstrø, G.O., Uhlenberg, P., 2005. The social separation of old and young: a root of ageism. J. Soc. Issues 61 (2), 343–360.
Hardy, B.L., 2017. Income instability and the response of the safety net. Contemp. Econ. Pol. 35 (2), 312–330.
Havryluck, L., Gold, W.L., Robinson, S., Pogorski, S., Galea, S., Fryra, R., 2004. Sars control and psychological effects of quarantine, toronto, Canada. Emerg. Infect. Dis. 10 (7), 1206.
Holmes, E.A., O’Connor, R.C., Perry, V.H., Tracey, I., Wessely, S., Arseneault, L., Everall, L., 2020. Multidisciplinary research priorities for the covid-19 pandemic: a call for action for mental health science. The Lancet Psychiatry 7 (6), 547–560.
Hooper, M.W., Nápoles, A.M., Pérez-Stable, E.J., 2020. Covid-19 and racial/ethnic disparities. Jama 332 (24), 2466–2467.
Hope, S., Rodgers, B., Power, C., 1999. Marital status transitions and psychological distress: longitudinal evidence from a national population sample. Psychol. Med. 29 (2), 381–389.
Ioannou, M.C., Mogg, K., Bradley, B.P., 2004. Vigilance for threat: effects of anxiety and defensiveness. Pers. Indiv. Differ. 36 (8), 1897–1899.
Jeong, H., Yim, H.W., Song, Y.-J., Ki, M., Min, J.-A., Cho, J., Chae, J.-H., 2016. Mental health status of people isolated due to middle east respiratory syndrome. Epidemiology and health 38.
Kaptyn, A., Angriawan, M., Bennett, D., Brune de Bruin, W., Darling, J., Gutsche, T., Liu, Y., Meijer, E., Perez-Arce, F., Schaner, S., Thomas, K., Weerman, B., 2020. Tracking the Effect of the COVID-19 Pandemic on the Lives of American Households. Surv. Res. Methods 14 (2), 179–186. https://doi.org/10.18148/srm/2020/v14i2.7737.
Kessler, R.C., Neighbors, H.W., 1986. A new perspective on the relationships among race, social class, and psychological distress. J. Health Soc. Behav. 107–115.
Losada-Baltar, A., Jimenez-Gonzalo, I., Gallego-Alberto, L., Pedroso-Chaparro, M.L.S., Fernandez-Perez, J., Márquez-González, M., 2020. ‘We’re staying at home’. Association of self-perceptions of ageing, personal and family resources and loneliness with psychological distress during the lock down period of covid-19. J. Gerontol.: Ser. B. Bibliogr. https://doi.org/10.1093/geronb/gbaa048.
Martins, S., Power, C., Stoodley, S., 2001. Psychological distress and work and home roles: effects of socio-economic differences in distress. Psychol. Med. 31 (4), 725
Mazza, C., Ricci, E., Biondi, S., Colasanti, M., Ferracuti, S., Napoli, C., Roma, P., 2020. A nationwide survey of psychological distress among Italian people during the covid-19 pandemic: immediate psychological responses and associated factors. Int. J. Environ. Res. Publ. Health 17 (9), 3165.

McGinty, E.E., Presskreischer, R., Han, H., Barry, C.L., 2020. Psychological Distress and Loneliness Reported by U.S. Adults in 2018 and April 2020 (Jama).

Metcalfe, A., Wick, J., Ronksley, P., 2018. Racial disparities in comorbidity and severe maternal morbidity/mortality in the United States: an analysis of temporal trends. Acta Obstet. Scand. 97 (1), 89–96.

Niedzwiedz, C.L., Green, M.J., Benzvi, M., Campbell, D., Craig, P., Demos, E., Whitley, E., 2020. Mental health and health behaviours before and during the initial phase of the covid-19 lockdown: longitudinal analyses of the UK household longitudinal study. J. Epidemiol. Community Health. https://doi.org/10.1136/jech-2020-215060.

Nivette, A., Ribeaud, D., Murray, A., Steinhoff, A., Bechtiger, L., Hepp, U., Eiser, M., 2020. Non-compliance with covid-19-related public health measures among young adults in Switzerland: insights from a longitudinal cohort study. Soc. Sci. Med. 268, 113370.

Niedzwiedz, C.L., Green, M.J., Benzeval, M., Campbell, D., Craig, P., Demos, E., Whitley, E., 2020. Mental health and health behaviours before and during the initial phase of the covid-19 lockdown: longitudinal analyses of the UK household longitudinal study. J. Epidemiol. Community Health. https://doi.org/10.1136/jech-2020-215060.

Pierce, M., Hope, H., Ford, T., Hatch, S., Hotopf, M., John, A., McManus, S., 2020. Mental health before and during the covid-19 pandemic: a longitudinal probability sample survey of the UK population. The Lancet Psychiatry 7 (10), 883–892.

Preis, H., Mahaffey, B., Heiselman, C., Lobel, M., 2020. Vulnerability and resilience to pandemic-related stress among U.S. women pregnant at the start of the covid-19 pandemic. Soc. Sci. Med. 266, 113348.

Qiu, J., Shen, B., Zhao, M., Wang, Z., Xie, B., Xu, Y., 2020. A nationwide survey of psychological distress among Chinese people in the covid-19 epidemic: implications and policy recommendations. General psychiatry 33 (2).

Rendall, M., 2018. Female market work, tax regimes, and the rise of the service sector. Rev. Econ. Dynam. 28, 269–289.

Reskin, B., 2012. The race discrimination system. Annu. Rev. Sociol. 38, 17–35.

Rittner, M., Ponizovsky, A., 1999. Psychological distress through immigration: the two-phase temporal pattern? Int. J. Soc. Psychiatr. 45 (2), 125–139.

Schieman, S., Van Gundy, K., Taylor, J., 2001. Status, role, and resource explanations for age patterns in psychological distress. J. Health Soc. Behav. 80–96.

Sobol, M., Blachnio, A., Przepiora, A., 2020. Time of pandemic: temporal perspectives related to compliance with public health regulations concerning the covid-19 pandemic. Soc. Sci. Med. 265, 113408.

Spitzer, R.L., Kroenke, K., Williams, J.B., Lowe, B., 2006. A brief measure for assessing generalized anxiety disorder: the gad-7. Arch. Intern. Med. 166 (10), 1092–1097.

Stone, P., 2008. Opting Out?: Why Women Really Quit Careers and Head Home. Univ of California Press.

Tang, W., Hu, T., Hu, B., Jin, C., Wang, G., Xie, C., Xu, J., 2020. Prevalence and correlates of PTSD and depressive symptoms one month after the outbreak of the COVID-19 epidemic in a sample of home-quarantined Chinese university students. J. Affect. Disord. 274, 1–7.

Thoits, P.A., 2010. Stress and health: major findings and policy implications. J. Health Soc. Behav. 51 (1 Suppl.), S41–S53.

Torales, J., O’ Higgins, M., Castaldelli-Maia, J.M., Ventriglio, A., 2020. The outbreak of COVID-19 coronavirus and its impact on global mental health. Int. J. Soc. Psychiatr., 0020764020915212.

Vasiliadis, H.-M., Chudzinski, V., Gontijo-Guerra, S., Préville, M., 2015. Screening instruments for a population of older adults: the 10-item kessler psychological distress scale (K10) and the 7-item generalized anxiety disorder scale (GAD-7). Psychiatr. Res. 228 (1), 89–94.

Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C.S., Ho, R.C., 2020. Immediate psychological responses and associated factors during the initial stage of the 2019 coronavirus disease (covid-19) epidemic among the general population in China. Int. J. Environ. Res. Publ. Health 17 (5), 1729.

Yao, H., Chen, J.-H., Xu, Y.-F., 2020. Patients with mental health disorders in the covid-19 epidemic. The Lancet Psychiatry 7 (4), e21.

Zhang, J., Lu, H., Zeng, H., Zhang, S., Du, Q., Jiang, T., Du, B., 2020. The Differential Psychological Distress of Populations Affected by the Covid-19 Pandemic. Brain, Behavior, and Immunity.