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The Psychological Consequences of COVID-19 Lockdowns

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Abstract

COVID-19 outbreak has resulted in the largest number of lockdowns worldwide in history. While lockdowns may reduce the spread of COVID-19, the downside costs of this approach could be dreadful. By exploiting the differential timing of lockdown implementation across the United States within a difference-in-differences framework, we find that the pandemic lockdowns are associated with a variety of adverse psychological outcomes, namely, anxiety, worry, disinterest, depression, and poor general health perception. Our mechanism analyses suggest that these detrimental impacts could be attributed to concerns towards food, housing, and employment security. We further show that African Americans and women are especially susceptible to the adverse repercussions of the lockdowns. The findings imply that lockdowns should be accompanied by policies aimed to prevent mental health burden and deepening inequality.

JEL classification: I12, I14, I18

Keywords: COVID-19, psychological consequences, mental health, lockdowns, stay-at-home orders

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1 Introduction

The detrimental ramifications of the COVID-19 pandemic have been widely felt across the globe. As of August 2020, roughly 690,000 people worldwide have died. The U.S. death toll has amounted to approximately 158,000. Such a humanitarian crisis has resulted in the largest number of lockdowns worldwide in history. Governments across countries, in the hope of ceasing transmission of COVID-19, issue lockdown orders on a massive scale requiring people to stay at home and business to shut down. Such aggressive responses have received significant attention of scholars and policymakers.¹ However, much of the focus has been placed on the direct consequences, and little attention has been given to the downside and less discernible costs of lockdowns. Focusing on the latter under-explored area, this paper quantifies the psychological ramifications associated with COVID-19 pandemic lockdowns in the U.S.

This paper makes three contributions to the branch of research on the consequences of COVID-19. First, we focus on the less discernible but dreadful costs of the pandemic lockdowns. Specifically, we examine the consequences of lockdowns on a variety of psychological outcomes, such as anxiety, worry, disinterest, depression, and general health perception. Second, perhaps due to time and data constraints, the majority of prior studies on COVID-19 related subjects are plagued with the problem of endogeneity. To ensure the internal validity of our estimates, we exploit the differential timing of lockdown implementation across the U.S. states within a difference-in-differences framework. Finally, we conduct rigorous analyses on the potential pathways to the adverse ramifications of lockdowns and the heterogeneous impacts of lockdowns for various racial and gender groups. Policywise, understanding the underlying mechanisms and identifying vulnerable groups could be helpful in designing targeted programs to minimize the costs of lockdowns.

¹ For example, lockdowns are shown to be associated with the reductions in new COVID-19 cases and COVID-19 related deaths (Hellewell et al. 2020; Roux, Massonnaud, and Crepey 2020) as well as the improvement in air quality (Mahato, Pal, and Ghosh 2020). Nevertheless, lockdowns also impose massive declines in employment opportunities and consumer spending (Coibion, Gorodnichenko, and Weber 2020).

We utilize the Household Pulse Survey Public Use File which provides rich information on individual experiences during the Coronavirus pandemic. Within a difference-in-differences framework, our paper reaches the following findings. First, we uncover adverse effects of COVID-19 pandemic lockdowns on psychological outcomes. Exposure to lockdowns makes individuals more likely to be worried, disinterested, and depressed on a daily basis by 0.5, 0.8, and 0.8 percentage points, respectively. Taking the fractions of those experiencing worry, disinterest, and depression in the lockdown unexposed group as our benchmark, these estimated impacts imply the average increases by 5%, 10%, and 10%, respectively. Our results also indicate that individuals under lockdowns are more likely to have poor general health perception by 0.2 percentage points, corresponding to an 8% increase relative to the fraction reporting poor general health in the unexposed group. The findings are in line with the vulnerable outcomes for individuals in a liberal market economy during economic hardships ([Hall and Soskice 2001](#)). Second, we discover multiple channels through which lockdowns affect psychological outcomes. The adverse consequences could be attributed to individual concerns towards food, housing, and employment security, consistent with the theoretical frameworks by [Higginbottom, Barling, and Kelloway \(1993\)](#) and [Brenner \(1990\)](#). Moreover, we detect heterogeneity in the impacts of lockdowns on mental health across racial and gender groups. Consonant with theories on racial and gender discrimination ([Brewer, Conrad, and King 2002](#); [Bjomholt and McKay 2014](#)), we find that African American and female populations are especially vulnerable to the psychologically detrimental repercussions of lockdowns during the COVID-19 pandemic.

Our findings suggest that lockdowns should be supplemented with policies intended to alleviate mental health burden and deepening inequality. It is also important to develop interventions that aim to ensure food, housing, and employment security since these are potential pathways to the psychological ramifications of lockdowns. Extra attention should be directed toward vulnerable groups, such as African Americans and women, to avoid deepening racial and gender inequalities. It is also important to raise awareness about various sources

of public support for psychological needs.

The paper proceeds as follows. Section 2 presents the literature review. Section 3 describes the data and outlines the empirical strategy. Section 4 displays our estimating results, potential mechanisms, and heterogeneity analyses. Section 5 provides the discussion, study limitations, and directions for future research. Section 6 concludes the study.

2 Literature Review

Our empirical study quantifies the psychological ramifications associated with COVID-19 pandemic lockdowns in the context of the U.S. In particular, we seek the answers to the following three questions. First, what are the consequences of lockdowns on individuals' mental health? Second, through which channels are these impacts transmitted? Third, do the psychologically devastating impacts differ by race and gender? We address the first question in Section 4.1, the second question in Section 4.2, and the third question in Section 4.3.

The first question arises from the theoretical framework by [Hall and Soskice \(2001\)](#). In particular, [Hall and Soskice \(2001\)](#) theorize that a liberal market economy such as the U.S is characterized by competitive market arrangements with minimal state interventions. Compared to coordinated market economies like Germany and Japan, liberal market economies offer less protection for employees such as labor unions or social welfare. In other words, employers' unilateral control over firms makes employees highly dependent on them for jobs and incomes, thus exposing employees to substantial financial vulnerability during crises. Therefore, employees in liberal market economies tend to bear heavier financial burdens than those in coordinated market economies as their jobs and incomes are less secured. A highly deregulated economic system also exposes individuals to substantial uncertainty since minimal state intervention means weak social safety net. As a result, individuals in liberal market economies are more likely to struggle and have their mental health deteriorated during economic hardships. In this study, we quantify the impacts of economic hardships induced by COVID-19 pandemic lockdowns on individual mental health measured by a variety of

psychological outcomes, including anxiety, worry, disinterest, depression, and general health perception.

Furthermore, the data allow us to answer the second question by exploring two factors that could explain why lockdowns can generate a significant psychological strain on individuals. The first factor is the financial burden, such as unemployment or reduced incomes, which might impede emotional functioning and worsen individuals' mental health ([Higginbottom, Barling, and Kelloway 1993](#)). The second factor is individuals' expectations being altered by the societal economic circumstance, thus creating distress ([Brenner 1990](#)). In particular, lockdowns might engender tremendous uncertainty and concerns about a worsening future status, which could potentially undermine mental health ([Burgard, Brand, and House 2009](#)). Regarding financial burdens, we look at individuals' actual food, housing, and employment conditions recently. As for pessimistic expectations, we explore individuals' expectations of their food, housing, and employment conditions in the next four weeks. To facilitate the discussion, we categorize the potential pathways into three major groups, namely, food security concerns, housing security concerns, and employment security concerns.

Finally, the third question comes from the theories on racial and gender discrimination which emphasize the oppression of African Americans and women in the U.S. economy. [Brewer, Conrad, and King \(2002\)](#) argue that capitalism generates racism to the extent that they are mutually reinforcing. In times of crises, [Bjomholt and McKay \(2014\)](#) contend that deep cuts in public expenditures along with pay and recruitment freezes disproportionately affect women. Given enormous impacts of lockdowns on the economy, we expect that African Americans and women are particularly vulnerable. For example, they might receive unfair wage reduction or lay-off and unequal access to government supports or public facilities. All these circumstances are likely to further impair the psychological well-being of African Americans and women. Therefore, it is of interest to examine the heterogeneous impacts of lockdowns on mental health along the lines of race and gender.

Empirically, the paper is closely related to two strands of literature. The first strand focuses on the impacts of COVID-19 lockdowns. It is documented that lockdowns are effective nonpharmaceutical intervention measures to contain the spread of COVID-19 in the absence of the vaccine. For instance, large scale lockdowns implemented by the French government contribute to the declines in COVID-19 related hospitalizations and ICU admissions (Roux, Massonnaud, and Crepey 2020). Besides curtailing transmissions, lockdowns also lead to an improvement in air quality (Mahato, Pal, and Ghosh 2020). Nevertheless, lockdowns caused substantial disruptions to the economy such as depressing employment opportunities, consumer spending, and business revenues (Chetty et al. 2020, Coibion, Gorodnichenko, and Weber 2020). The second line of literature our study also fits into is the stressful impacts of quarantine during pandemics. Prior studies document that social isolation due to lockdowns generates a tremendously traumatic experience for both children and adults. For example, quarantined individuals during the SARS outbreak in Canada tend to report psychological distress and display depressive symptoms (Hawryluck et al. 2004, Reynolds et al. 2008). Individuals in quarantine during the H1N1 pandemic in the U.S. are inclined to exhibit posttraumatic stress disorder symptoms (Sprang and Silman 2013). The authors point out that parents of children with such symptoms are more likely to suffer from depression as well.

3 Data and Empirical Methodology

3.1 *Data*

In this study, we employ four currently available waves of the Household Pulse Survey Public Use File (HPS-PUF). The four waves correspond to the four survey weeks, including Week 1 from April 23 to May 5, Week 2 from May 7 to May 12, Week 3 from May 14 to May 19, and Week 4 from May 21 to May 26. The survey is conducted by United States Census Bureau in conjunction with other agencies, such as Bureau of Labor Statistics (BLS), National Center for Health Statistics (NCHS), Department of Agriculture Economic Research Service (ERS), National Center for Education Statistics (NCES), Department of Housing and Urban

Development (HUD).

Reaching over 350,000 respondents across 51 states of the U.S (including DC), the survey seeks to provide meaningful insights into individual experiences during the Coronavirus pandemic. The average response rate is approximately 2.74% with a standard deviation of 0.56. Overall, Alaska has the highest response rate (5%) and Mississippi has the lowest response rate (1.9%). This is visually illustrated in Figure A1. The response rate is not very high because this is not face-to-face interview (respondents are contacted via phone or email due to the COVID-19 pandemic). Table A1 in the appendix provides the response rates by state and survey week (the response rate data are taken from U.S. Census Bureau (2020)). It is worth noting that 7.79% of individuals in the survey sample are African American although African Americans account for 13.4% of total U.S. population. According to Figure A1, all the five states with the lowest response rate (Mississippi, Louisiana, Arkansas, Alabama, Oklahoma) are the Deep South states with a high concentration of African Americans. Furthermore, 83% of respondents are white while the proportion of whites in the U.S. population is 76.3%.² In other words, whereas African Americans are underrepresented in the sample, whites are overrepresented. As shown later, African Americans are more heavily affected by pandemic lockdowns than whites (Section 4.3), making our estimates the lower bounds of the true effects because of the underrepresentation of the more vulnerable group.

Besides standard demographic characteristics (age, gender, race, marital status, etc.), our analysis also draws from the HPS-PUF four groups of outcomes, including (i) mental health, (ii) food security concerns, (iii) housing security concerns, and (iv) employment security concerns. Table A2 and A3 in the Appendix detail summary statistics and variable construction. We briefly discuss our main outcome variables as below.

To reflect individuals' mental health, we construct five indicators, namely Poor General Health Perception, Anxiety Every Day, Worry Every Day, Disinterest Every Day, and Depression

² www.census.gov/quickfacts/fact/table/US/RHI225219

Every Day. These variables are based on respondents' answers to the questions about their current self-assessed state of health. The responses are placed into a five or four-point scale ranging from the best state to the worst state. We then compute these health variables as dummies taking the value of one if the response falls into the worst state, and zero otherwise. With the Cronbach's Alpha of 0.79, Poor General Health Perception, Anxiety Every Day, Worry Every Day, Disinterest Every Day, and Depression Every Day are good measures of the psychological well-being of individuals.

To capture concerns towards food security, we construct five one-zero variables, namely Afford More Food, Get Out to Buy Food, Get Food Delivered, Food Availability, and Food Sufficiency Confidence. The first four indicators take the value of zero if the respondent agrees to the statements: (i) could not afford to buy more food, (ii) could not get out to buy food, (iii) could not get food delivered, and (iv) the stores did not have the food needed. The last indicator, Food Sufficiency Confidence, takes a value of one if the respondent is highly confident that he/she could afford food for the next four weeks, and zero otherwise.

The third and fourth groups of indicators focus on individual concerns towards housing and employment security. Housing concerns are measured by two one-zero variables, namely: (i) Last Payment on Time takes a value of one if the respondent paid last month's mortgage or rent on time, and (ii) Next Payment Confidence takes a value of one if the respondent is highly confident in his/her ability to pay mortgage or rent next month. Employment concerns are represented by two one-zero indicators, including: (i) Recent Unemployment takes a value of one if there is a job loss in his/her household recently, and (ii) Expected Unemployment takes a value of one if the respondent expects a job loss in his/her household in the next four weeks.

Our main explanatory variable is an indicator for whether the lockdown is currently effective in the respondent's residence state at the time of survey. The date of implementation and the date of expiration of lockdowns are collected from the state government websites. Given these

implementation and expiration dates as well as the time of survey, we can identify whether an individual is currently exposed to a lockdown. In particular, we consider an individual to be in the lockdown if he/she is interviewed after the lockdown being imposed and before the lockdown being lifted. Table A4 in the appendix presents the timing of lockdowns across states and indicates whether the date of survey falls into the lockdown period. The value of one (zero) indicates that the survey was (was not) conducted during the lockdown period. The final row gives the fractions of states where lockdowns were still in place as of the survey week. For example, if the average is 0.58, the fraction of states where lockdowns were still effective is 58%.

3.2 Empirical Methodology

To investigate the extent to which lockdowns affect individuals' mental well-being, we exploit the differential timing of implementation across states in a difference-in-differences (DiD) framework given by,

$$Y_{ist} = \beta_0 + \beta_1 LD_{ist} + \lambda_s + \theta_t + X'_{ist}\Gamma + \epsilon_{ist} \quad (1)$$

where the subscripts i , s , and t refers to the individual, state, and time of survey. The dependent variable Y_{ist} stands for various measures of individual mental well-being, including whether an individual thinks his/her general health is currently in poor condition (Poor General Health Perception), whether the individual experiences anxiety every day (Anxiety Every Day), whether the individual feels worried on a daily basis (Worry Every Day), whether the individual feels disinterested or detached every day (Disinterest Every Day), and whether the individual suffers from depression on a daily basis (Depression Every Day). Besides, in the mechanism analysis, Y_{ist} represents various mechanism variables reflecting concerns towards food, housing, and employment security. Concerns towards food security are captured by five indicators, namely Afford More Food, Get Out to Buy Food, Get Food Delivered, Food Availability, and Food Sufficiency Confidence. Concerns towards housing

security are reflected by two indicators, Last Payment on Time and Next Payment Confidence. Employment security concerns are measured by two indicators, Recent Unemployment and Expected Unemployment.

Our main explanatory variable LD_{ist} is an indicator that takes the value of one if the lockdown is in place in the individual’s state of residence at the time of survey, and zero otherwise. The terms λ_s and θ_t represent state and survey week fixed effects, respectively. The covariate X'_{ist} includes individual characteristics such as age, age squared, marital status, race, gender, occupational sector, and educational attainment. Finally, we denote by ϵ_{ist} the error term. Standard errors throughout the paper are clustered at the state-by-week level.

The coefficient of interest is β_1 which captures the impacts of lockdowns. In this setup, we compare the outcomes for individuals currently exposed to lockdowns with those no longer exposed to lockdowns within the same state, relative to the analogous differences for individuals whose states of residence implement the statewide lockdowns in a different time frame or never enforce such orders. In other words, our treatment group consists of individuals residing in states where lockdowns are still effective at the time of survey. Our control group comprises individuals residing in states which either never implement statewide lockdowns or their lockdown periods expire at the time of survey.

4 Results

4.1 *Main Results*

We provide the estimated psychological impacts of lockdowns in Table 1. Each column is a separate regression and the column heading specifies the outcome variable. The reported coefficient is β_1 from the DiD specification in equation (1). We also display the results for the uncoded psychological measures in Table A5 in the Appendix. Overall, we find that the implementation of lockdowns during the COVID-19 pandemic exerts a devastating mental burden on individuals.

First, those exposed to lockdowns report worse general health conditions. Evident from Column 1, experiencing lockdowns deteriorates the health outcomes of those affected by raising the probability of poor general health status by 0.2 percentage points. This represents an 8% increase relative to the fraction reporting poor general health in the control group (Table A2). Second, those exposed to lockdowns are also more likely to report mental problems. In particular, lockdowns tend to raise the incidence of daily anxiety although the coefficient in the anxiety regression falls short of conventional statistical significance (Column 2). Moving to Columns 3 through 5, we find that the effects of lockdowns are all positive and statistically distinguishable from zero. Exposure to lockdowns makes individuals more likely to be worried, disinterested, and depressed on a daily basis by 0.5, 0.8, and 0.8 percentage points, respectively. Taking the fractions of those experiencing worry, disinterest, and depression in the unexposed group as our benchmark, these estimated impacts imply the average increases by 5%, 10%, and 10%, respectively.

[Table 1 near here]

4.2 *Potential Mechanisms*

We proceed to explore potential channels through which the implementation of lockdowns inflicts psychological health risks for individuals. Given the available information from our data, we investigate three groups of mechanisms, including (i) food security concerns, (ii) housing security concerns, and (iii) employment security concerns. To analyze the extent to which these concerns transmit the impacts of lockdowns on mental well-being, we estimate the DiD model as in equation (1) but replace the mental well-being outcomes with mechanism variables indicating various measures of concerns. The estimating results are provided in Table 2 and 3. Each column presents a separate regression and the column heading specifies the outcome variable. The reported coefficient is β_1 from the DiD specification in equation (1).

Food Security Concerns - We capture the financial burden regarding food security by four indicators, whether the individual can afford more food (Afford More Food), whether the individual can get out to buy food (Get Out to Buy Food), whether the individual can get food delivered to him/her (Get Food Delivered), and whether the individual can get the food he/she wants from the store (Food Availability). Individual pessimistic expectation of food security is measured by an indicator for whether the individual is confident about his/her food sufficiency in the next four weeks (Food Sufficiency Confidence). Evident from Table 2, individuals under COVID-19 pandemic lockdowns are less likely to afford more food, to get out for food purchase, to have food delivered to their doors, and to obtain the food they want from local stores by 0.5, 0.3, 0.2, and 1.2 percentage points, respectively (Columns 1 through 4). All estimates except the one in the food delivery regression are statistically significant. Finally, exposure to lockdowns during the COVID-19 pandemic raises individuals' concerns over future food sufficiency. Specifically, individuals exposed to lockdowns are less likely to be confident about their food sufficiency in the next four weeks by 1.6 percentage points (Column 5). Taken together, Table 2 suggests that lockdowns could potentially worsen individuals' mental well-being through aggravating their concerns over food sufficiency.

[Table 2 near here]

Housing Security Concerns - In the second group of channels, the financial burden related to housing security is reflected by whether the individual paid mortgage or rent on time last month (Last Payment on Time). The pessimistic expectation of future housing security is captured by an indicator for whether the individual is confident of his/her ability to pay mortgage or rent next month (Next Payment Confidence). As shown in Columns 1 and 2 of Table 3, lockdowns tend to deteriorate individuals' ability to afford for housing security. In particular, Column 1 suggests that individuals exposed to lockdowns are 0.6 percentage points less likely to report on-time payment for last month's mortgage or rent. According to Column 2, lockdowns also decrease individuals' confidence in their next mortgage or rent payment

by 1.7 percentage points. The reporting estimates are all statistically distinguishable from zero. Collectively, the presenting results suggest that lockdowns could aggravate individuals' mental well-being through raising their concerns over housing security.

Employment Security Concerns - Finally, the financial burden related to employment prospects is captured by an indicator for whether the individual reports a recent job loss in his/her household (Recent Unemployment). Individual pessimistic expectation of future job prospects is reflected by whether the individual expects a job loss in his/her household next month (Expected Unemployment). Evident from Columns 3 and 4 of Table 3, lockdown exposure is negatively associated with job prospects. Those subject to lockdowns are more likely to report a recent incidence of joblessness in their households, although the estimate falls short of conventional statistical significant levels (Column 3). Exposure to lockdowns induces individuals to expect to have at least one member in their households to become unemployed in the next four weeks by 0.7 percentage points (Column 4). Besides food and housing security concerns, there is some evidence that concerns about employment security could be one of the potential channels transmitting the psychological consequences of lockdowns.

[Table 3 near here]

4.3 *Heterogeneity Analyses*

In this section, we explore how the psychological impacts of lockdowns differ across racial and gender groups. The estimating results (i.e. β_1 coefficient from the DiD specification) are reported in Table 4. Heterogeneity analyses along the line of race and gender are presented in Panel A and B, respectively. Each column consists of four separate regressions where the column headings indicate the dependent variables. In Panel A, the upper row provides estimates for white individuals and the lower row includes estimates for African American individuals. In Panel B, the upper row presents estimates for men and the lower row provides estimates for women.

White and African American - First, we examine whether there exist any heterogeneous impacts of lockdowns between white and African American individuals. Evident from Panel A, we find that African American individuals tend to suffer more severe consequences of lockdowns than their white counterparts. African American individuals experiencing lockdowns are 0.3 percentage points more likely to report poor general health condition while the effect on white is 0.2 percentage points (Column 1). Exposure to lockdowns raises the incidences of worry, disinterest, and depression among African American individuals by 1.3, 1.7, and 2.0 percentage points, respectively, whereas the impacts on white are approximately 60% smaller in magnitude. These findings suggest that the African American community is especially vulnerable to lockdowns during the global pandemic, which could further perpetuate the racial gap in the U.S society. Given the underrepresentation of African Americans in the data (Section 3.1), our estimates might be the lower bounds of the true impacts of pandemic lockdowns, since a fraction of this disadvantaged population could be unreachable for surveys.

[Table 4 near here]

Male and Female - Next, we proceed to investigate whether men and women are differentially affected by lockdowns. As shown in Panel B, women tend to be more susceptible than men. Specifically, lockdowns raise the incidence of poor general health perception among women by 0.4 percentage points whereas the estimate for the men sample carries the opposite sign and is statistically indistinguishable from zero. Lockdowns make women more likely to be anxious, worried, disinterested, and depressed by 0.7, 0.9, 0.9, and 1.1 percentage points, respectively while the impacts on men are much weaker in both economic (22% to 125% smaller in magnitude) and statistical sense.

Taken together, the disproportionate adverse psychological consequences on African Americans and women suggest that they are especially vulnerable to lockdowns during the COVID-19 global pandemic. If no measures were taken to protect these populations, pandemic lockdowns could potentially perpetuate the racial and gender gaps in the U.S. society.

5 Discussion, Limitation, and Direction for Future Research

5.1 *Discussion*

Our main findings indicate that lockdowns are associated with a variety of mental health problems. In particular, individuals experiencing lockdowns are 0.5, 0.8, and 0.8 percentage points more likely to feel worried, disinterested, and depressed on a daily basis, respectively. They are also more likely to have poor general health perception by 0.2 percentage points. Our findings are in line with the theoretical framework by [Hall and Soskice \(2001\)](#) where individuals in a liberal and highly deregulated economic system are left in vulnerable states during economic hardships. Our mechanism analyses provide evidence that lockdowns could potentially worsen individuals' mental well-being through aggravating both their current conditions and future expectations of food, housing, and employment security. In this respect, our results are consonant with [Higginbottom, Barling, and Kelloway \(1993\)](#) and [Brenner \(1990\)](#) where a societal economic change can create distress by imposing financial burdens and generating pessimistic expectations, respectively. Furthermore, guided by theories on racial and gender discrimination ([Brewer, Conrad, and King 2002](#), [Bjomholt and McKay 2014](#)), we conduct the heterogeneity analyses along the lines of race and gender. We find disproportionate negative psychological effects on African American individuals and women. Given substantial disadvantages already faced by African Americans and women, their psychological well-being might be more acutely impacted by lockdowns compared to other racial and gender groups. Empirically, our heterogeneity results are consistent with [Fairlie, Couch, and Xu \(2020\)](#) and [Alon et al. \(2020\)](#) who also detect worsening employment outcomes for the African American and female populations in response to the COVID-19 epidemic, respectively.

Given the psychological costs of COVID-19 pandemic lockdowns, interventions intended to alleviate mental health burden should be implemented in accompany with lockdowns. Policies should be directed toward ensuring food, housing, and employment security to mitigate the

psychological strain. Extra attention should be directed toward disadvantaged groups, such as African Americans and women, to avoid deepening racial and gender inequalities. It is also important to raise awareness about various sources of public support for psychological needs. In the US, federal agencies such as the Substance Abuse and Mental Health Services Administration (SAMHSA), Health Resources and Services Administration (HRSA), and Centers for Medicare & Medicaid Services (CMS) can provide useful information on treatment services and mental health care providers. Agencies at the state and county level can offer details on mental health services within a particular administrative area. Besides, there are advocacy and professional organizations such as the National Alliance on Mental Illness (NAMI) and Mental Health America (MHA) devoted to addressing the needs of those with mental health problems and improving the overall psychological well-being of the public. These organizations are also helpful in locating mental health practitioners.

5.2 Limitations and Directions for Future Research

Using the HPS-PUF which focuses on individual experiences during the COVID-19 pandemic, we investigate the extent to which lockdowns affect individuals' mental well-being in the context of the U.S. There remain three major limitations to our study. First, although the DiD model strengthens the internal validity of our results, the focus on one liberal market economy might compromise the external validity of our estimates. It could be difficult for the estimated psychological impacts of lockdowns presented in our paper to be generalized to coordinated market economies such as Germany and Japan where employees are better protected with stronger labor unions and more generous social welfare ([Hall and Soskice 2001](#)). Therefore, future studies on the relationship between lockdowns and mental health for individuals in coordinated market economies are needed. Second, due to data limitation, we are unable to analyze the role of public spending in mitigating the psychological repercussions of lockdowns. Future works might empirically examine this relationship. Finally, the study only covers financial burdens and pessimistic expectations over food, housing, employment

as potential mechanisms through which lockdowns aggravate individuals' mental health while it is likely that other mechanisms are also at work. To effectively respond to future circumstances, it is necessary to have a comprehensive evaluation of all possible pathways to the psychological impacts of lockdowns.

6 Conclusion

This paper quantifies the psychological consequences associated with COVID-19 pandemic lockdowns in the U.S. Our study utilizes the Household Pulse Survey Public Use File which contains individual responses to survey questions on experiences during the pandemic. Our identification strategy exploits the differential timing of lockdown implementation across the U.S. states within a DiD framework. We uncover adverse impacts of the lockdowns on a variety of psychological outcomes, namely anxiety, worry, disinterest, depression, and general health perception. The results are in line with [Hall and Soskice \(2001\)](#) on the vulnerable states of individuals in a liberal and highly deregulated economic system during economic hardships. Exploring the potential pathways, we show that the negative consequences could be attributed to individual concerns towards food, housing, and employment security, which is consistent with [Higginbottom, Barling, and Kelloway \(1993\)](#) and [Brenner \(1990\)](#). Finally, guided by theories on racial and gender discrimination ([Brewer, Conrad, and King 2002](#), [Bjomholt and McKay 2014](#)), we conduct the heterogeneity analyses along the lines of race and gender. We find that African American and female individuals are disproportionately affected by the pandemic lockdown.

The findings imply that lockdowns should be supplemented with policies intended to prevent mental health burden and deepening inequality. For example, it is important to develop interventions that aim to ensure food, housing, and employment security as they are potential channels through which lockdowns aggravate mental health. Extra attention should be directed toward vulnerable groups, such as African Americans and women, to avoid deepening racial and gender inequalities in the U.S society. It is also important to raise awareness about

various sources of public support for psychological needs.

Data availability statement: The data underlying this study can be obtained from the U.S. Census website: [census.gov/programs-surveys/household-pulse-survey/datasets.html](https://www.census.gov/programs-surveys/household-pulse-survey/datasets.html)

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TABLES

Table 1: The Psychological Impact of Lockdowns: Main Results

	Poor General Health Perception (1)	Anxiety Every Day (2)	Worry Every Day (3)	Disinterest Every Day (4)	Depression Every Day (5)
Lockdowns	0.002** (0.001)	0.005 (0.004)	0.005** (0.002)	0.008*** (0.003)	0.008*** (0.002)
Controls					
Ind. Characteristics	✓	✓	✓	✓	✓
State & Week FE	✓	✓	✓	✓	✓
Observations	317,950	317,592	317,445	317,296	317,594

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Individual Characteristics include age, age-squared, marital status, race, gender, occupational sector, and educational attainment. Robust standard errors are clustered at the State-by-Week level.

Table 2: Potential Mechanism - Food Concerns

	Afford More Food (1)	Get Out to Buy Food (2)	Get Food Delivered (3)	Food Availability (4)	Food Sufficiency Confidence (5)
Lockdowns	-0.005* (0.003)	-0.003*** (0.001)	-0.002 (0.001)	-0.012*** (0.004)	-0.016*** (0.004)
Controls					
Ind. Characteristics	✓	✓	✓	✓	✓
State & Week FE	✓	✓	✓	✓	✓
Observations	343,929	343,929	343,929	343,929	321,099

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Individual Characteristics include age, age-squared, marital status, race, gender, occupational sector, and educational attainment. Robust standard errors are clustered at the State-by-Week level.

Table 3: Potential Mechanism - Housing and Employment Concerns

	Housing Concerns		Employment Concerns	
	Last Payment on Time (1)	Next Payment Confidence (2)	Recent Unemployment (3)	Expected Unemployment (4)
Lockdowns	-0.006** (0.003)	-0.017*** (0.004)	0.001 (0.004)	0.007* (0.004)
Controls				
Ind. Characteristics	✓	✓	✓	✓
State & Week FE	✓	✓	✓	✓
Observations	234,205	234,389	348,507	348,098

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Individual Characteristics include age, age-squared, marital status, race, gender, occupational sector, and educational attainment. Robust standard errors are clustered at the State-by-Week level.

Table 4: The Psychological Impact of Lockdowns: Heterogeneity Analysis

	Poor General Health Perception (1)	Anxiety Every Day (2)	Worry Every Day (3)	Disinterest Every Day (4)	Depression Every Day (5)
Panel A: Impact of Lockdowns by Race					
Lockdowns on White	0.002* (0.001)	0.006 (0.004)	0.005** (0.002)	0.007** (0.003)	0.007*** (0.002)
Observations	265,059	264,777	264,670	264,568	264,773
Lockdowns on African American	0.003 (0.005)	0.000 (0.009)	0.013* (0.008)	0.017** (0.008)	0.020** (0.009)
Observations	23,752	23,717	23,702	23,680	23,727
Panel B: Impact of Lockdowns by Gender					
Lockdowns on Male	-0.001 (0.002)	0.002 (0.005)	0.000 (0.003)	0.007** (0.003)	0.004* (0.002)
Observations	130,603	130,428	130,351	130,292	130,422
Lockdowns on Female	0.004*** (0.001)	0.007 (0.005)	0.009*** (0.003)	0.009** (0.003)	0.011*** (0.003)
Observations	187,347	187,164	187,094	187,004	187,172
Controls					
Ind. Characteristics	✓	✓	✓	✓	✓
State & Week FE	✓	✓	✓	✓	✓

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Individual Characteristics include age, age-squared, marital status, race, gender, occupational sector, and educational attainment. Robust standard errors are clustered at the State-by-Week level.

APPENDIX TABLES

Table A1: Response Rate by State and Survey Week

State	W1	W2	W3	W4	Average	State	W1	W2	W3	W4	Average
AL	3	1	2	2.8	2.2	MT	4.2	1.5	2.2	3	2.7
AK	8.4	2.7	3.8	5.2	5.0	NE	4.1	1.4	2.3	3.2	2.8
AZ	4.2	1.4	2.4	3.2	2.8	NV	3.7	1.3	2.3	3	2.6
AR	3	1.1	1.9	2.6	2.2	NH	4.6	1.7	2.3	3.1	2.9
CA	3.8	1.3	2.5	3.3	2.7	NJ	3.7	1.3	2.4	3.2	2.7
CO	4.9	1.8	3	4	3.4	NM	4.5	1.6	2.4	3.1	2.9
CT	3.5	1.3	2.5	3.7	2.8	NY	3.9	1.5	2.4	3	2.7
DE	4.5	1.7	2.7	3.6	3.1	NC	3.7	1.2	2.1	2.7	2.4
DC	5.6	2	3.3	4.7	3.9	ND	3.8	1.2	1.9	2.5	2.4
FL	3.7	1.3	2.2	3.9	2.8	OH	3.6	1.1	1.9	2.7	2.3
GA	3.6	1.2	2	2.6	2.4	OK	3.2	1.1	1.9	2.7	2.2
HI	3.2	1.3	2.4	3.3	2.6	OR	4.9	1.8	3.1	4.3	3.5
ID	5	1.7	2.7	3.6	3.3	PA	3.8	1.3	2.2	2.8	2.5
IL	3.6	1.3	2.4	3.3	2.7	RI	3.4	1.1	2.1	2.8	2.4
IN	3.7	1.3	2.4	3.3	2.7	SC	3.7	1.2	1.8	2.5	2.3
IA	3.7	1.3	2.2	2.8	2.5	SD	3.2	1	1.9	2.7	2.2
KS	3.6	1.3	2.5	3.5	2.7	TN	3.4	1.3	2.1	2.8	2.4
KY	3.7	1.2	2	2.7	2.4	TX	3.6	1.2	2.1	3	2.5
LA	2.9	0.9	1.8	2.5	2.0	UT	5.8	2.1	3.7	4.8	4.1
ME	4	1.4	1.9	2.4	2.4	VT	4.8	1.9	2.7	3.4	3.2
MD	4.8	1.7	4.6	2.5	3.4	VA	4.6	1.6	2.6	3.3	3.0
MA	4.3	1.7	2.9	3.8	3.2	WA	4.9	1.7	2.7	3.6	3.2
MI	3.9	1.4	2.2	2.8	2.6	WV	3.5	1.2	1.8	2.3	2.2
MN	4.2	1.5	2.7	3.6	3.0	WI	3.7	1.3	2.2	2.8	2.5
MS	2.9	1	1.6	2.1	1.9	WY	4	1.4	2.3	2.1	2.5
MO	3.6	1.1	2	2.9	2.4						

Note: The table presents the response rate across states. W1, W2, W3, and W4 stand for Week 1 (April 23 - May 5), Week 2 (May 7 - May 12), Week 3 (May 14 - May 19), and Week 4 (May 21 - May 26) surveys, respectively. Average is the mean response rate over four weeks for each state. Source: [U.S. Census Bureau \(2020\)](#).

Table A2: Summary Statistics

	Control			Treatment			All		
	Mean (1)	SD (2)	Obs. (3)	Mean (4)	SD (5)	Obs. (6)	Mean (7)	SD (8)	Obs. (9)
Panel A: Control Variables									
Being White	0.850	0.357	183,971	0.806	0.395	166,614	0.829	0.376	350,585
Being African American	0.078	0.268	183,971	0.078	0.268	166,614	0.078	0.268	350,585
Being Other Races	0.072	0.259	183,971	0.116	0.320	166,614	0.093	0.290	350,585
Age	51.34	15.73	183,971	51.67	15.69	166,614	51.49	15.71	350,585
Being Married	0.587	0.492	183,971	0.562	0.496	166,614	0.575	0.494	350,585
Being Male	0.405	0.491	183,971	0.413	0.492	166,614	0.409	0.492	350,585
Went to College	0.850	0.357	183,971	0.868	0.338	166,614	0.859	0.348	350,585
Work for Government	0.104	0.305	183,971	0.101	0.301	166,614	0.102	0.303	350,585
Panel B: Outcome Variables									
Poor General Health Perception	0.025	0.157	166,224	0.023	0.149	151,726	0.024	0.153	317,950
Anxiety Every Day	0.141	0.348	166,037	0.153	0.360	151,555	0.147	0.354	317,592
Worry Every Day	0.097	0.296	165,961	0.101	0.301	151,484	0.099	0.298	317,445
Disinterest Every Day	0.076	0.265	165,915	0.078	0.269	151,381	0.077	0.267	317,296
Depression Every Day	0.076	0.266	166,055	0.078	0.268	151,539	0.077	0.267	317,594
Food Sufficiency Confidence	0.574	0.495	167,942	0.584	0.493	153,157	0.579	0.494	321,099
Afford More Food	0.882	0.323	180,446	0.894	0.308	163,483	0.887	0.316	343,929
Get out to Buy Food	0.968	0.176	180,446	0.963	0.190	163,483	0.965	0.183	343,929
Get Food Delivered	0.979	0.142	180,446	0.971	0.169	163,483	0.975	0.156	343,929
Food Availability	0.817	0.387	180,446	0.801	0.399	163,483	0.809	0.393	343,929
Next Payment Confidence	0.672	0.469	120,616	0.674	0.469	113,773	0.673	0.469	234,389
Last Payment on Time	0.895	0.306	120,505	0.898	0.303	113,700	0.896	0.305	234,205
Expected Unemployment	0.288	0.453	182,673	0.319	0.466	165,425	0.303	0.460	348,098
Recent Unemployment	0.622	0.485	182,887	0.597	0.491	165,620	0.610	0.488	348,507

Table A3: Outcome Variable Construction

Question	Response	Coding
Would you say your health in general is:	1=Excellent, 2=Very good, 3=Good, 4=Fair, 5=Poor	Poor General Health Perception equals to 1 if Response is 5
Over the last 7 days, how often have you been bothered by the following problems: (i) Feeling nervous, anxious, or on edge, (ii) Not being able to stop or control worrying, (iii) having little interest or pleasure in doing things, and (iv) feeling down, depressed, or hopeless.	1=Not at all, 2=Several days, 3=More than half the days, 4=Nearly every day	(i) Anxiety Every Day, (ii) Worry Every Day, (iii) Disinterest Every Day, and (iv) Depression Every Day equal to 1 if Response is 4
How confident are you that your household will be able to afford the kinds of food you need for the next four weeks?	1=Not at all confident, 2=Somewhat confident, 3=Moderately confident, 4=Very confident	Food Sufficiency Confidence equals to 1 if Response is 4
Why did you not have enough to eat? Choose all that apply: (i) Couldn't afford to buy more food, (ii) Couldn't get out to buy food, (iii) Couldn't get groceries or meals delivered to me, and (iv) The stores didn't have the food I wanted.	1=Category marked	(i) Afford More Food, (ii) Get Out to Buy Food, (iii) Get Food Delivered, and (iv) Food Availability equals to 0 if Response is 1
How confident are you that your household will be able to pay your next rent or mortgage payment on time?	1=No confidence, 2=Slight confidence, 3=Moderate confidence, 4=High confidence, 5=Payment is/will be deferred	Next Payment Confidence equals to 1 if Response is 4
Did you pay your last month's rent or mortgage on time?	1=Yes, 2=No, 3=Payment was deferred	Last Payment on Time equals to 1 if Response is 1
Do you expect that you or anyone in your household will experience a loss of employment income in the next 4 weeks because of the coronavirus pandemic?	1=Yes, 2=No	Expected Unemployment equals to 1 if Response is 1
Have you, or has anyone in your household experienced a loss of employment income since March 13, 2020?	1=Yes, 2=No	Recent Unemployment equals to 1 if Response is 1

Table A4: Lockdowns by State and Week of Survey

State	Start	End	W1	W2	W3	W4	State	Start	End	W1	W2	W3	W4
AL	Apr 04	Apr 30	0	0	0	0	MT	Mar 28	Apr 26	0	0	0	0
AK	Mar 28	Apr 24	0	0	0	0	NE	<i>No Lockdown</i>		0	0	0	0
AZ	Mar 31	May 15	1	1	0	0	NV	Apr 01	May 09	1	0	0	0
AR	<i>No Lockdown</i>		0	0	0	0	NH	Mar 27	<i>S.i.E</i>	1	1	1	1
CA	Mar 19	<i>S.i.E</i>	1	1	1	1	NJ	Mar 21	Jun 09	1	1	1	1
CO	Mar 26	Apr 26	0	0	0	0	NM	Mar 24	May 31	1	1	1	1
CT	Mar 23	May 20	1	1	1	0	NY	Mar 22	May 28	1	1	1	1
DE	Mar 24	May 31	1	1	1	1	NC	Mar 30	May 22	1	1	1	0
DC	Apr 01	May 29	1	1	1	1	ND	<i>No Lockdown</i>		0	0	0	0
FL	Apr 03	May 04	0	0	0	0	OH	Mar 23	May 29	1	1	1	1
GA	Apr 03	Apr 30	0	0	0	0	OK	<i>No Lockdown</i>		0	0	0	0
HI	Mar 25	May 31	1	1	1	1	OR	Mar 23	<i>S.i.E</i>	1	1	1	1
ID	Mar 25	Apr 30	0	0	0	0	PA	Apr 01	Jun 04	1	1	1	1
IL	Mar 21	May 29	1	1	1	1	RI	Apr 28	May 08	0	0	0	0
IN	Mar 24	May 04	0	0	0	0	SC	Apr 07	May 04	0	0	0	0
IA	<i>No Lockdown</i>		0	0	0	0	SD	<i>No Lockdown</i>		0	0	0	0
KS	Mar 30	May 03	0	0	0	0	TN	Mar 31	<i>S.i.E</i>	1	1	1	1
KY	Mar 26	<i>S.i.E</i>	1	1	1	1	TX	Apr 02	Apr 30	0	0	0	0
LA	Mar 23	May 15	1	1	0	0	UT	<i>No Lockdown</i>		0	0	0	0
ME	Apr 02	May 31	1	1	1	1	VT	Mar 25	May 15	1	1	0	0
MD	Mar 30	May 15	1	1	0	0	VA	Mar 30	Jun 10	1	1	1	1
MA	Mar 24	May 18	1	1	0	0	WA	Mar 23	May 31	1	1	1	1
MI	Mar 24	Jun 01	1	1	1	1	WV	Mar 24	May 03	0	0	0	0
MN	Mar 27	May 17	1	1	0	0	WI	Mar 25	May 13	1	1	0	0
MS	Apr 03	Apr 27	0	0	0	0	WY	<i>No Lockdown</i>		0	0	0	0
MO	Apr 06	May 03	0	0	0	0	Average			0.58	0.57	0.43	0.39

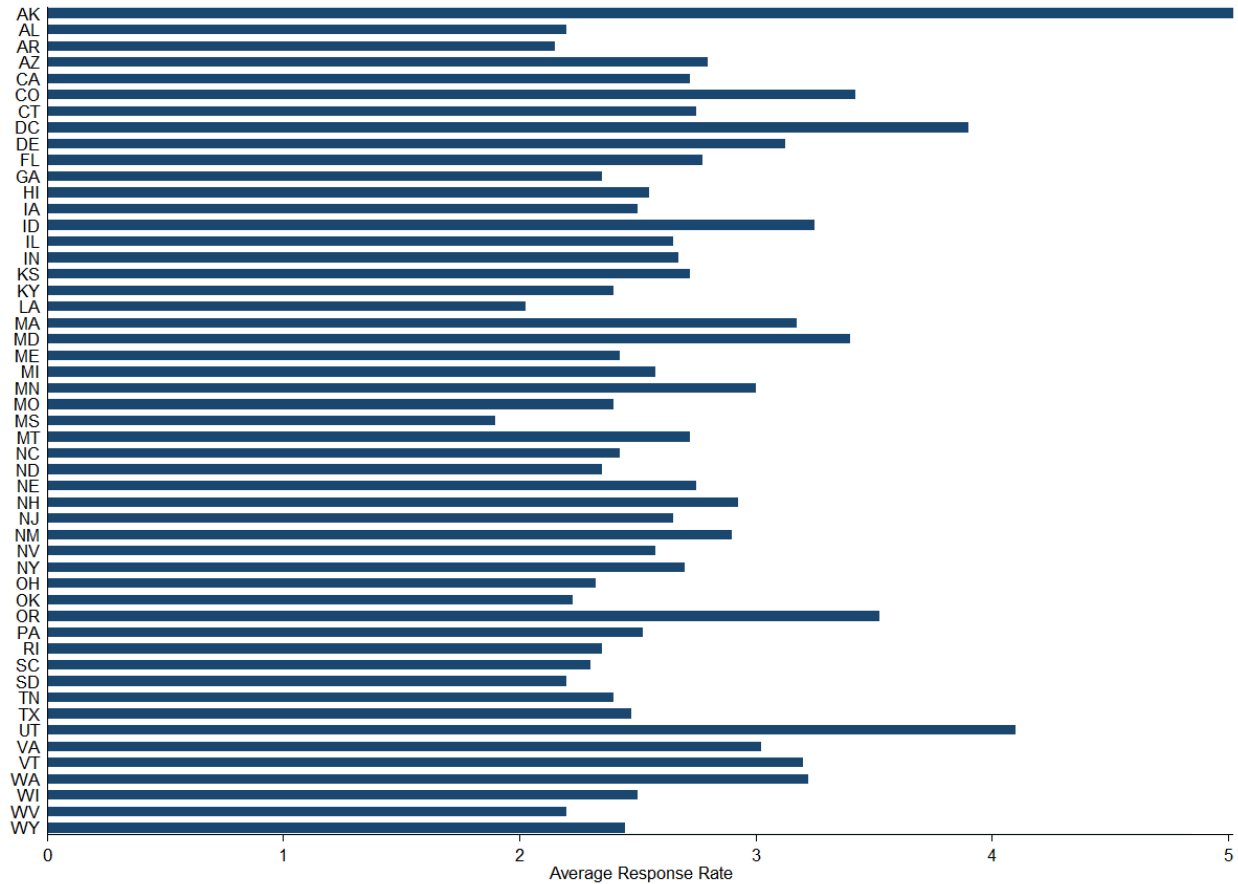
Note: The table presents the timing of lockdowns across states. W1, W2, W3, and W4 stand for Week 1 (April 23 - May 5), Week 2 (May 7 - May 12), Week 3 (May 14 - May 19), and Week 4 (May 21 - May 26) surveys, respectively. They take the value of 1 if the survey was conducted during the lockdown period, and zero otherwise. *S.i.E* means the lockdown has not been lifted yet (still in effect).

Table A5: The Psychological Impact of Lockdowns - Uncoded Measures

	Poor General Health Perception (1)	Anxiety Every Day (2)	Worry Every Day (3)	Disinterest Every Day (4)	Depression Every Day (5)
Lockdowns	0.015** (0.006)	0.017 (0.011)	0.020** (0.009)	0.026** (0.012)	0.030*** (0.010)
Controls					
Ind. Characteristics	✓	✓	✓	✓	✓
State & Week FE	✓	✓	✓	✓	✓
Observations	317,950	317,592	317,445	317,296	317,594

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Individual Characteristics include age, age-squared, marital status, race, gender, occupational sector, and educational attainment. Robust standard errors are clustered at the State-by-Week level.

Figure A1: Average Response Rate by State



Note: The graph presents the average response rate for each state across four survey weeks. The data on response rate are taken from the [U.S. Census Bureau \(2020\)](#)