



Short-term changes in mental health help-seeking behaviors following exposure to multiple social stressors and a natural disaster



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ABSTRACT

In 2020, unprecedented circumstances led to significant mental health consequences. Individuals faced mental health stressors that extended beyond the devastating impact of the COVID-19 pandemic, including widespread social unrest following the murder of George Floyd, an intense hurricane season in the Atlantic, and the politically divisive 2020 election. The objective of this analysis was to consider changes in help-seeking behavior following exposure to multiple social stressors and a natural disaster. Data from Crisis Text Line (CTL), a national text-based mental health crisis counseling service, was used to determine how help-seeking behavior changed in the wake of each event. Wilcoxon rank sum tests assessed changes in help-seeking behavior for each event in 2020 as compared to the same period in 2019. AutoRegressive Integrated Moving Average (ARIMA) models examined if changes in crisis conversation volumes following each event differed. Higher median conversation volumes noted for the COVID-19 pandemic (+1 to +5 conversations), Hurricane Laura (+1 to +7 conversations) and the 2020 Election (+1 to +26 conversations). ARIMA models show substantial increases in help-seeking behavior following the declaration of a national emergency for the COVID-19 pandemic (+4.3 to +38.2%) and following the 2020 election (+3 to +24.44%). Our analysis found that the mental health response following social stressors may be distinct from natural events, especially when natural disasters occur in the context of multiple social stressors. This analysis adds to the growing body of literature considering the mental health impact of exposure to multiple co-occurring societal stressors, like police violence and a global pandemic.

1. Introduction

Climate stressors (e.g., hurricanes, flooding) and social stressors (e.g., war, riots, pandemics) are linked to poor mental health outcomes (Espinel et al., 2019; Fernandez et al., 2015; Fix, 2021; Ni et al., 2020a; Ni et al., 2020b). Climate-related disasters, including hurricanes and extreme weather events (e.g., flooding, winter weather events) are expected to become more common as the climate changes (US EPA, 2021). Similar trends are expected with social stressors (e.g., police violence, political elections), as political and social tensions are also predicted to increase (Dimock and Wike, 2020). Given the projected increase in the prevalence of both social and climate stressors, these events are likely to co-occur in the context of one another, which can result in compounded or aggregated impacts and place excess strain on emergency responders, community resources, and mental health support infrastructure (Hahn

et al., 2022; Sansom et al., 2022). More knowledge about the impact of exposure to concurrent social stressors and climate events on mental health is needed to prepare for future co-occurring stressors (Massazza et al., 2022).

1.1. Mental health and climate stressors

Climate stressors can be broadly defined to include extreme weather events and environmental change or degradation that can be linked to the climate crisis. Research investigating the mental health impact of climate disasters and extreme weather events has identified high mental health burdens among exposed populations in the days and weeks following exposure (Runkle et al., 2021; Wertis et al., 2023), and up to years after exposure (Begum et al., 2022). Higher mental health burdens have been identified for numerous climate-related events, including

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following hurricane exposure (Charlson et al., 2021; Runkle et al., 2021; Wertis et al., 2023), during heatwaves (Liu et al., 2021; Thompson et al., 2018), in the aftermath of an extreme winter weather event (Sugg et al., 2023), and after extreme flood events (Charlson et al., 2021).

Experts hypothesize climate events can negatively impact mental health both directly and indirectly, with the chances of experiencing or developing poor mental health outcomes in the aftermath of a climate disaster linked to a complex, interconnected network of biological, psychosocial and social pathways (Thoma et al., 2021). Notably, the vulnerability stress model (Engel, 1977; Thoma et al., 2021) posits that the development of poor mental health outcomes is tied to how an individual perceives a stressor. An individual's sensitivity to a certain stressor is tied to their physical health (i.e., biologic pathway), their emotional, behavioral, and cognitive functioning (i.e., psychosocial pathway), and their social support network (i.e., social pathways). Negative impacts of climate change, including environmental degradation and changing climate patterns, can increase stress by inhibiting cultural practices and avenues for social cohesion, destroying homes and infrastructure, limiting economic opportunities, and worsening physical health due to water pollution and changing food resources, among others (Cunsolo Wilcox et al., 2013; Thoma et al., 2021).

Furthermore, an individual's likelihood of experiencing mental distress after an extreme climate event is tied to the nature of the event itself (Thoma et al., 2021). Specifically, if the event is acute (e.g., extreme weather event) versus chronic (e.g., sea level rise), and whether the individual experienced the effects directly (e.g., home flooded) or indirectly (e.g., media exposure) (Thoma et al., 2021). Direct and indirect exposure to acute climate events is tied with post-traumatic stress disorder, anxiety, depression, increased substance use, and an increase in suicide-related outcomes, while fear and sadness are more often associated with exposure to chronic climate stressors, such as sea-level rise and dramatic environmental change (Thoma et al., 2021). Prior trauma, which could include interpersonal trauma or prior climate-related trauma, increases the likelihood of mental health distress following exposure (Seon et al., 2024). Other at-risk demographics include those with prior experiences of deprivation or mental health issues (Lin et al., 2016; Sullivan et al., 2013). In general, while progress has been made in recognizing the mental health impacts of climate change, more work is needed as the psychological trauma from disaster exposure exceed those of physical injury by 40 to 1 (Hayes et al., 2018; Links, 2017), and climate change related disasters continue to rise worldwide (Watts et al., 2018).

1.2. Mental health and social stressors

Social stressors can be broadly defined to capture extreme events characterized by political and social unrest (e.g., racism, riots, elections), or those characterized as a public health emergency (e.g., pandemic). Past evidence suggests that social stressors, including racism (Chae et al., 2021), police violence (Galovski et al., 2016), and political unrest (Ni et al., 2016, 2017) negatively impact population mental health. Furthermore, many social stressors receive substantial media coverage, which can increase perceived stress among populations not directly exposed, leading to an increase in poor mental health outcomes among both directly exposed populations and those indirectly exposed through media coverage (Ni et al., 2016; Ni et al., 2020b).

Past research has identified a "spillover effect", such that individuals who were not directly exposed experience heightened mental distress in the aftermath (Ni et al., 2016). Furthermore, past research highlights that even the notion of a social stressor, such as the proposal of restrictive laws aimed at LGBTQ+ individuals, can heighten mental distress among the targeted population (Parris et al., 2021). Poor mental health outcomes attributed to social stressors can also develop as a result of media interactions, particularly social media interactions with individuals of opposing views, leading to interpersonal conflict, which elevates stress (Ni et al., 2020a). The mass media coverage of many

social stressors could increase an individual or community's perception of stress, contributing to an increased prevalence of poor mental health outcomes in the aftermath of an extreme social stressor.

1.3. Mental health and Co-occurring stressors

Emerging evidence suggests there is a cumulative mental health burden on populations exposed to multiple co-occurring or compound stressors, including climate stressors (e.g., hurricanes, recurrent flood events), and social stressors (e.g. COVID-19, civil unrest, racism). Recent work hypothesizes that an individual's perception of stress related to a climate stressor increases in the context of a co-occurring social stressor (Seon et al., 2024). Results indicate compound stressor exposure (e.g., exposure to civil unrest and COVID-19, exposure to flooding and COVID-19) exacerbates poor mental health outcomes, increasing community health burdens (Callender et al., 2022; Hou et al., 2021; Seon et al., 2024). Results also suggest this association is complex, with an individual's circumstances, including socioeconomic status (Ettman et al., 2021; Hawrilenko et al., 2021; Hou et al., 2021), race (Eboigbe et al., 2023), prior exposure to compound stressors (Callender et al., 2022; Raker et al., 2019; Zacher et al., 2023), and pre-existing health concerns (Lewis et al., 2022), moderating the likelihood of experiencing this cumulative mental health burden.

1.4. Co-occurring events in 2020 for Louisiana

The year 2020 was unprecedented, with the emergence of the COVID-19 pandemic and subsequent lockdowns and financial downturn, widespread social unrest following the murder of George Floyd by the Minneapolis Police, an intense hurricane season in the Atlantic, and the 2020 presidential election. Past studies have examined the mental health response to the COVID-19 pandemic (Chen et al., 2020; Larson and Bergmans, 2022; Runkle et al., 2021) and the pandemic in conjunction with exposure to a climate disaster (Sugg et al., 2022; Wertis et al., 2023). Yet, to our knowledge, no studies have examined how exposure to multiple co-occurring social stressors and a climate disaster impacts a population's mental health. Each of these events have long-lasting and differential impacts on mental health for exposed populations.

We examined Louisiana (LA), located along the Gulf Coast of the southern United States, as a case study. Louisiana is home to about 4.5 million residents; roughly 33% of residents identify as Black, and 23% are under 18 years old (US Census, 2021). Louisiana is subject to multiple climate hazards, including hurricanes, heatwaves, and flood and drought events, which are projected to become more extreme and frequent with climate change (EPA, 2016). Additionally, LA is considered one of the most socially vulnerable states when referencing the Social Vulnerability Index, with more than 50% of parishes designated as 'High Vulnerability', and the majority considered 'Medium High' to 'High Vulnerability' (CDC, 2018), making it an important state in which to consider the mental health impacts of co-occurring climate and social stressors.

Louisiana was subject to lockdown and stay-at-home orders due to the COVID-19 pandemic, and on several occasions throughout 2020, LA received national attention for high COVID-19 case counts (The New York Times, 2020). Furthermore, protests erupted throughout the state following the murder of George Floyd by Minneapolis police (Social Explorer, 2020), accompanied by widespread media coverage. A few weeks later, Louisiana experienced Hurricane Laura in August 2020, the strongest hurricane to hit LA in over 50 years (Pasch et al., 2020), bringing 18-foot storm surges to coastal LA, and hurricane-force-winds more than one hundred miles inland (Pasch et al., 2020). All of these stressors were on voters' minds weeks later during the 2020 Presidential Election; in Louisiana, voter turnout in the 2020 election was higher compared to recent presidential elections (la.gov, 2020).

1.4.1. COVID-19 pandemic

The COVID-19 pandemic has been linked to a global mental health crisis (Hamza Shuja et al., 2020; Kumar and Nayar, 2021; Nochaiwong et al., 2021; Torales et al., 2020). The COVID-19-related mental health crisis has been most pronounced amongst historically marginalized communities, with Black, Hispanic, and Asian Americans more likely to report poor mental health outcomes than white Americans but less likely to receive care (Thomeer et al., 2022), and amongst LGBTQ+ youth and adolescents (Hawke et al., 2021; Ormiston and Williams, 2022). While studies found that mental health diagnoses (Chen et al., 2020), and suicides (Larson and Bergmans, 2022) initially decreased following the onset of the COVID-19 pandemic before increasing later in the pandemic (Chen et al., 2020), help-seeking behavior spiked in the initial months of the pandemic, especially among historically marginalized populations, children, and adolescents (Runkle et al., 2021).

The COVID-19 pandemic disrupted almost every aspect of daily life, contributing to increases in financial stress (Codagnone et al., 2020; Zajacova et al., 2020), and school-related stress (Hawrilenko et al., 2021; Viner et al., 2022), and increased racist sentiment and race-based violence and harassment, particularly among Asian Americans (Chae et al., 2021; Cheah et al., 2020; Shi et al., 2022), and Black Americans (Chae et al., 2021; Shi et al., 2022), all of which are associated with increased mental health burdens. Furthermore, the pandemic has been linked to an epidemic of loneliness and isolation among U.S. residents (U.S. Surgeon General, 2021). Isolation can contribute to numerous mental and behavioral health concerns, including depression, anxiety, and increased substance use (Christiansen et al., 2021).

1.4.2. Murder of George Floyd

Amidst the backdrop of the COVID-19 pandemic, the murder of George Floyd by the Minneapolis Police ignited nationwide outrage with protests relating to police brutality and the Black Lives Matter movement occurring throughout the country, in both rural and urban communities, in the days and weeks following the incident (Social Explorer, 2020). George Floyd's murder has been linked to increased reports of poor mental health, especially among Black Americans (Eichstaedt et al., 2021; Howard et al., 2022), with an estimated 50% of Black Americans reporting feeling angry and sad in the days following (Eichstaedt et al., 2021).

Many Black Americans reported higher incidence of racism during the COVID-19 pandemic (Chae et al., 2021; Shi et al., 2022), contributing to increased rates of poor mental health outcomes. Furthermore, many Black communities also reported higher rates of COVID-19 and were more likely to die from COVID-19, compared to white communities, which is due to historic systemic injustices that create and amplify health disparities (Holmes et al., 2020; Millett et al., 2020). Few studies have analyzed real-time mental health data in the wake of George Floyd's murder or considered its mental health impact relative to the pandemic and other external social and climatic stressors.

1.4.3. Hurricane Laura

Like the COVID-19 pandemic and murder of George Floyd, hurricanes and extreme weather events are associated with heightened mental health burdens (Espinel et al., 2019; Milojevic et al., 2017; Weisler et al., 2006); specifically increased rates of anxiety (Fernandez et al., 2015; Munro et al., 2017), PTSD and depressive symptoms (Bistricky et al., 2019; Fernandez et al., 2015; Munro et al., 2017), and thoughts of suicide (Runkle et al., 2021). The southern United States experienced an intense hurricane season in 2020, adding extra stress to already overstrained emergency responders and medical services (Shultz et al., 2022). Early warnings were made for the U.S. Gulf Coast and Southeast to prepare for an intense Atlantic hurricane season while navigating rapidly changing COVID-19 restrictions and resurgence of cases (Shultz et al., 2020). Hurricane warnings and COVID-19 protective measures often contradict one another; with Hurricane measures encouraging evacuation and taking shelter in designated safe places,

which inherently leads to gathering large groups in confined spaces, while COVID-19 measures discourage gathering and encourage physical and social distancing (Shultz et al., 2022). These inherently contradictory measures can exacerbate negative impacts from both the pandemic and hurricanes (Shultz et al., 2022).

Hurricane Laura touched ground in Louisiana on August 27th, 2020, and was the most devastating hurricane to hit the state in over 50 years (Pasch et al., 2020). The category 4 hurricane caused widespread flooding and damage, with every parish in the state receiving emergency funding and FEMA declarations (FEMA, 2022; Pasch et al., 2020). Hurricane Laura destroyed at least 10,000 homes in LA, left hundreds of thousands without power, was directly responsible for four deaths, and contributed to an additional 26 deaths, throughout the state (Pasch et al., 2020). Climate change is contributing to a higher quantity and frequency of destructive hurricanes, with warming ocean temperatures creating hurricanes that produce more intense rainfall and have higher storm surges as a result of rising sea-levels (Colbert, 2022). Past research has identified increases in depression (Bevilacqua et al., 2020; Taioli et al., 2018; Weisler et al., 2006), stress or anxiety (Begum et al., 2022; Runkle et al., 2021; Wertis et al., 2023), and suicide-related outcomes (Begum et al., 2022; Runkle et al., 2021) in the aftermath of hurricane exposure. Despite the catastrophic nature of Hurricane Laura and early warnings of the compound impacts of hurricanes and COVID-19, little is known of the mental health response following this event.

1.4.4. Presidential election

Past research suggests exposure to multiple compounding or co-occurring stressors can lead to cumulative mental health burdens (Hou et al., 2021). The COVID-19 pandemic, climate change, and police brutality were all considerations at the United States general election polls in November 2020. Americans reported feeling more stressed about the 2020 election compared to the 2016 presidential election (APA, 2020; Canady, 2020). Studies on the mental health response after the 2016 presidential election found that mental health plummeted, especially among marginalized communities and Americans of color in conservative states, as these groups were not well represented by former President Trump's platform (Morey et al., 2021). In the wake of the 2020 presidential election, delayed election results due to former President Trump's claims of widespread voter fraud and demands for recounts, the continuation of the COVID-19 pandemic, and the capital riots all caused additional stress among the American people (APA, 2020). However, at the time of this publication, no studies have documented the immediate mental health response following the 2020 election.

1.5. Current analysis

This analysis seeks to understand the mental health response among individuals in Louisiana, USA, following exposure to four distinct yet co-occurring events in 2020—the COVID-19 pandemic, the murder of George Floyd, Hurricane Laura, and the 2020 presidential election. Real-time data from the largest non-profit, national crisis text platform was used to measure before and after changes in mental health distress and help-seeking behaviors for each event. This study adds new knowledge of how both a climate event (i.e., hurricane) and social stressors (i.e., political events, social unrest, pandemic) can contribute to immediate changes in population mental health, providing information that can guide future policy decisions and post-disaster mental health care.

2. Methods

2.1. Crisis Text Line data

Mental health data was obtained from Crisis Text Line (CTL), a not-for-profit organization that provides free, 24/7, confidential, text-based mental health-related crisis counseling services across the United States (Crisis Text Line, 2019). Trained volunteer Crisis Counselors provide

texters with immediate crisis support via digital messaging (Crisis Text Line, 2019). Information on crisis-related issues is coded after every conversation by trained volunteer Crisis Counselors using crisis tags (i.e., whether the conversation mentioned specific concerns like depression, isolation, thoughts of suicide, etc.). A conversation can be tagged with one or multiple crisis topics.

For this analysis, we elected to include six crisis topics in addition to all conversations (aggregate of all crisis conversations on CTL's platform regardless of the issue topic): (1) Depression, (2) Thoughts of suicide, (3) Isolation, (4) Stress and anxiety, (5) Eating and body image concerns, and (6) Abuse (which includes emotional, physical, sexual, and unspecified abuse). We elected to include these specific crisis topics because depression, suicide-related outcomes, and stress/anxiety are commonly assessed when investigating the mental health impacts of extreme weather events (e.g., Begum et al., 2022; Dass-Brailsford et al., 2022; Runkle et al., 2021; Sugg et al., 2022), and social stressors (e.g., Chae et al., 2021; Ni et al., 2016), and recent literature noted substantial increases in eating and body image concerns (J Devoe et al., 2023; Taquet et al., 2022), abuse (Ivandic et al., 2020; Kourt et al., 2021; Piquero et al., 2021; Rengasamy et al., 2022), and isolation (U.S. Surgeon General, 2021) during 2020.

This analysis restricted CTL conversations to Louisiana-based area codes (225, 504, 985, 337, and 318). Demographic information was acquired through an optional, post-conversation survey that Crisis Text Line offers all individuals to fill out, and roughly 22.5% of all CTL texters complete the survey (Gould et al., 2022). Geographic location is derived from the texter area code, which is estimated to correspond to the texter's actual state of residence 70% of the time (Crisis Text Line, 2019).

To create a pre-event baseline that is robust to seasonal changes in help-seeking behaviors, crisis conversations were selected for one year prior to each event (Schaffer et al., 2021). Post-event time periods were restricted to the four weeks following each event to assess the immediate, short-term impact on crisis behaviors.

- (1) The declaration of a national emergency in response to the COVID-19 pandemic (event: March 13th, 2020, data: March 13th, 2019 to April 12, 2020);
- (2) The murder of George Floyd by Minneapolis Police (event: May 25th, 2020, data: May 25th, 2019 to June 22nd, 2020),
- (3) Hurricane Laura (event: August 27th, 2020, data: August 27th, 2019 to September 24th, 2020); and
- (4) The 2020 presidential election (event: November 3rd, 2020, data: November 3rd, 2019 to December 1st, 2020).

For each extreme event, CTL conversations were distinguished as 'before,' which includes conversations in the one year preceding the event, and 'after,' which includes conversations in the four weeks following the event, to create the four datasets (one for each event studied) used in the subsequent analyses (Table 1).

2.2. Digital mental health data and extreme events

Digital crisis messaging services, such as Crisis Text Line (CTL) and the 988 Suicide Hotline, provide users in crisis with immediate and anonymous counseling services. Many individuals seeking help via crisis messaging often do not seek care through other means (e.g., therapy) due to existing barriers, such as cost or feelings of shame. Furthermore, crisis lines differ from many other forms of mental health care, often operating 24/7, with the individual in crisis choosing to seek help in that immediate moment (Pisani et al., 2022). Unlike survey data, data from digital crisis messaging services provides daily, line-level information to conduct longitudinal analyses that assess and characterize changes in help-seeking behaviors over time. Furthermore, CTL data has been shown to better represent mental distress and help-seeking behaviors among underrepresented populations, including sexual and gender

Table 1
Sample size and median daily conversation volume before and after exposure to each event. Wilcoxon-rank sum tests were conducted to derive significance.

	COVID-19 National Emergency						Hurricane Laura						2020 Presidential Election											
	Before (3/13-19/3/13/20)			After (3/14/20-4/10/20)			Before (5/25-19-5/25/20)			After (5/26/20-6/22/20)			Before (8/27-19/8/27/20)			After (8/28/20-9/25/20)			Before (11/3-19/11/3/20)			After (11/4/20-12/1/20)		
	Total Texts	Median Daily Texts	Median Daily Texts	Total Texts	Median Daily Texts	Median Daily Texts	Total Texts	Median Daily Texts	Median Daily Texts	Total Texts	Median Daily Texts	Median Daily Texts	Total Texts	Median Daily Texts	Median Daily Texts	Total Texts	Median Daily Texts	Total Texts	Median Daily Texts	Total Texts	Median Daily Texts	p		
All Conversations	7986	20.00	738	24.00	<0.001	8595	22.00	870	30.50	<0.001	8933	23.00	742	27.00	0.03	8555	25.00	1177	40.00	<0.001				
Thoughts of Suicide	2138	5.00	145	5.00	0.260	2113	6.00	179	6.00	0.39	2107	6.00	156	5.50	0.73	2180	6.00	248	9.00	<0.001				
Depression	3455	9.00	206	7.00	0.010	3550	9.00	304	10.50	0.07	3441	9.00	268	10.00	0.61	3658	9.00	470	15.00	<0.001				
Isolation	1805	4.00	139	5.00	0.620	1947	5.00	200	7.00	<0.001	2022	5.00	136	5.00	0.30	2083	5.00	251	8.00	<0.001				
Stress/Anxiety	2692	7.00	270	9.00	0.004	2929	7.00	293	10.00	<0.001	3024	8.00	271	10.00	0.01	3208	8.00	384	12.00	<0.001				
Eating	193	0.00	25	1.00	0.015	218	0.00	22	1.00	0.16	244	0.00	19	1.00	0.71	253	1.00	34	1.00	0.001				
Abuse ^a	559	1.00	80	2.00	0.050	628	1.00	79	2.00	0.04	711	2.00	57	1.00	0.26	730	2.00	93	3.00	0.07				

^aTotal text volumes are for conversations from Louisiana-based area codes.

^aAbuse is an aggregated category and contains emotional, physical, sexual, unspecified and abuse-related conversations.

minorities and individuals who identify as more than one race (Pisani et al., 2022), compared to other mental health datasets.

Data from digital crisis messaging services can be used both to illustrate increases in mental distress and poor mental health outcomes and changes in help-seeking behaviors. While increases in help-seeking behaviors can be a positive indicator (e.g., individuals overcoming stigma, fewer barriers to care, etc), the vast majority of CTL users, about 80%, are above the clinical cutoff for depression and anxiety, suggesting increases in help-seeking behaviors are also indicative of increases in mental distress (Pisani et al., 2022). Furthermore, CTL data has been shown to better represent mental distress and help-seeking behaviors among underrepresented populations, including sexual and gender minorities, and individuals who identify as more than one race (Pisani et al., 2022), compared to other mental health datasets. Previous analysis has found a strong association between CTL data and emergency department visits for mental health outcomes, highlighting the potential for CTL as a proxy for the mental health of the population (Runkle et al., 2021).

CTL's anonymized and de-identified data has been used in multiple studies; including an analysis of concurrent wildfire risk and mental health (Sugg et al., 2022), the mental health response following exposure to Hurricane Ida and the COVID-19 pandemic (Wertis et al., 2023),

and research characterizing the mental health concerns of frontline workers, their children (Sugg et al., 2021), and young people in response to the COVID-19 pandemic (Runkle et al., 2021).

2.3. Statistical analysis

2.3.1. Pre-post demographics

Pre/post-chi-square-test analysis was conducted to assess if total crisis conversation volume changed significantly before versus after each event based on age, gender identity, race/ethnicity, or sexual identity using the 'tableone' package (Yoshida, 2020) in RStudio 2022.02.3 (RStudio Team, 2022). Standardized mean differences (SMDs), which convey effect size, are included in the supplemental information (Supplemental table 1). An SMD of about 0.2 is considered a small effect size, 0.5 is considered a medium effect size, and 0.8 is considered a large effect size (Cohen, 2013; Faraone, 2008).

2.3.2. Wilcoxon rank sum

Wilcoxon rank sum tests were conducted to investigate how help-seeking behavior changed in 2020 compared to the same period in 2019. This methodology allows for consideration of how each distinct event may be associated with changes in help-seeking behavior without

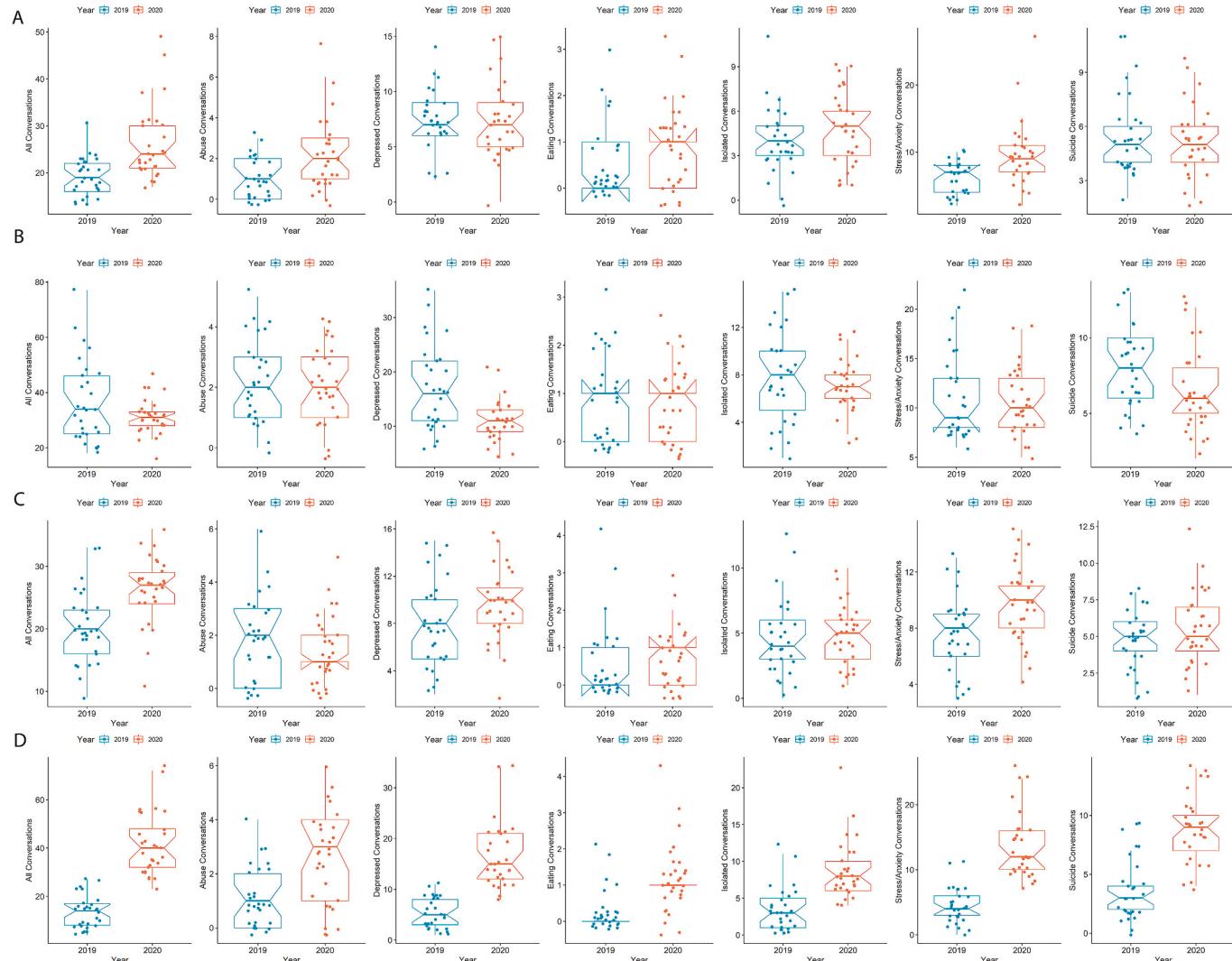


Fig. 1. Wilcoxon-Rank Sum Box Plots illustrating changes in median crisis conversation volume for the COVID-19 pandemic (March 13th - April 10th, 2019 and March 13th - April 10th, 2020), the murder of George Floyd (May 25th - June 22nd, 2019 and May 25th - June 22nd, 2020), Hurricane Laura (August 27th - September 24th, 2019 and August 27th - September 24th, 2020) and the election (November 3rd - December 1st, 2019 and November 3rd - December 1st, 2020).

consideration of the context in which these events occurred. Daily median conversation volumes were compared between the two time periods (Holland et al., 2021). For this analysis, the median daily conversation volume from Louisiana texters in 2019 was compared to the median daily conversation volume from Louisiana texters in 2020. Pre-event crisis conversations were selected for the COVID-19 pandemic (March 13th - April 10th, 2019 and March 13th - April 10th, 2020), the murder of George Floyd (May 25th - June 22nd, 2019 and May 25th - June 22nd, 2020), Hurricane Laura (August 27th - September 24th, 2019 and August 27th - September 24th, 2020) and the 2020 Presidential election (November 3rd - December 1st, 2019 and November 3rd - December 1st, 2020) (SM Fig. 1). Wilcoxon tests are ideal for small sample sizes and non-parametric data and allow for comparisons between two groups (Hogg et al., 2015). Wilcoxon rank sum tests were conducted in base RStudio 2022.02.3, results with a two-tailed p-value < 0.05 were considered statistically significant.

2.3.3. ARIMA

Interrupted time-series, AutoRegressive Integrated Moving Average (ARIMA) modeling was implemented to examine the causal relationship between each event and daily CTL text volumes for the six crisis topics four weeks after each event. This methodology allowed for the investigation of pre- and post-changes in help-seeking behaviors in the immediate aftermath of each event. ARIMA models account for autocorrelation within the time series data (Schaffer et al., 2021) and have been applied to forecast mental health and identify causal relationships with explicit events and mental health responses (e.g., de la Rosa et al., 2022; McClellan et al., 2017; L. K. Thompson et al., 2019).

ARIMA models contain autoregressive (AR) and/or moving average (MA) terms, depending on model selection (Supplemental table 2). ARIMA models include a forecast component and can be specified to determine if case counts change after the event compared to before the event. Observed case counts are compared to forecasted case counts; any observed case counts that fall outside of the forecasted 95% confidence interval are considered significantly different than expected. For this analysis, the interventions are defined as the day each event began, and each event is considered in a separate ARIMA model, comparing

forecasted CTL conversation volumes to observed volumes four weeks after each event.

The ARIMA model parameters: p (number of autoregressive terms, AR term), d (seasonal stationarity), and q (number of lagged forecast errors, MA term) were determined by running multiple ARIMA models for each event and crisis topic and selecting the one with that best fit across all crisis outcomes for that event, by comparing (1) residual ACF, (2) Ljung-Box statistics and (3) residual normality (Schaffer et al., 2021) (SM Fig. 2). Models can also be run with step (sudden sustained change), ramp (immediate change in slope), and pulse (sudden temporary change) functions, which can help characterize the change following an intervention (i.e., extreme event). However, for this analysis the base model (i.e., gradual change) was the best fit ARIMA model for all four events: COVID-19 (1,0,2), Murder of George Floyd (1,1,1), Hurricane Laura (2,1,1) and the 2020 Election (2,1,1) (Fig. 2). ARIMA forecasting and modeling were conducted using the 'forecast' package Hyndman et al. (2022); RStudio 2022.02.3.

As a supplement to ARIMA models, we also conducted Interrupted Time Series Analysis (ITSA) using the ITSA package (English, 2021), which was designed for a shorter base-line period (i.e., starting January 1st, 2020). This method uses a variance-centric approach by using a Type-2 Sum Squares ANCOVA Lagged Dependent Variable model, which estimates the difference in means between interrupted and uninterrupted time periods while accounting for the lag of crisis conversations over time. For the most part, both methods showed similar results; ARIMA model results are more robust to seasonality and both long-term and short-term health trends (Schaffer et al., 2021); as such ITSA results are included in the supplemental materials (Supplemental table 3).

3. Results

3.1. Pre-post demographics

Table 2 summarizes the demographics of CTL users before and after each event for Louisiana-based area codes. Among individuals who provided their age, more individuals 13 or younger sought help from CTL after the murder of George Floyd (0.3% increase), Hurricane Laura

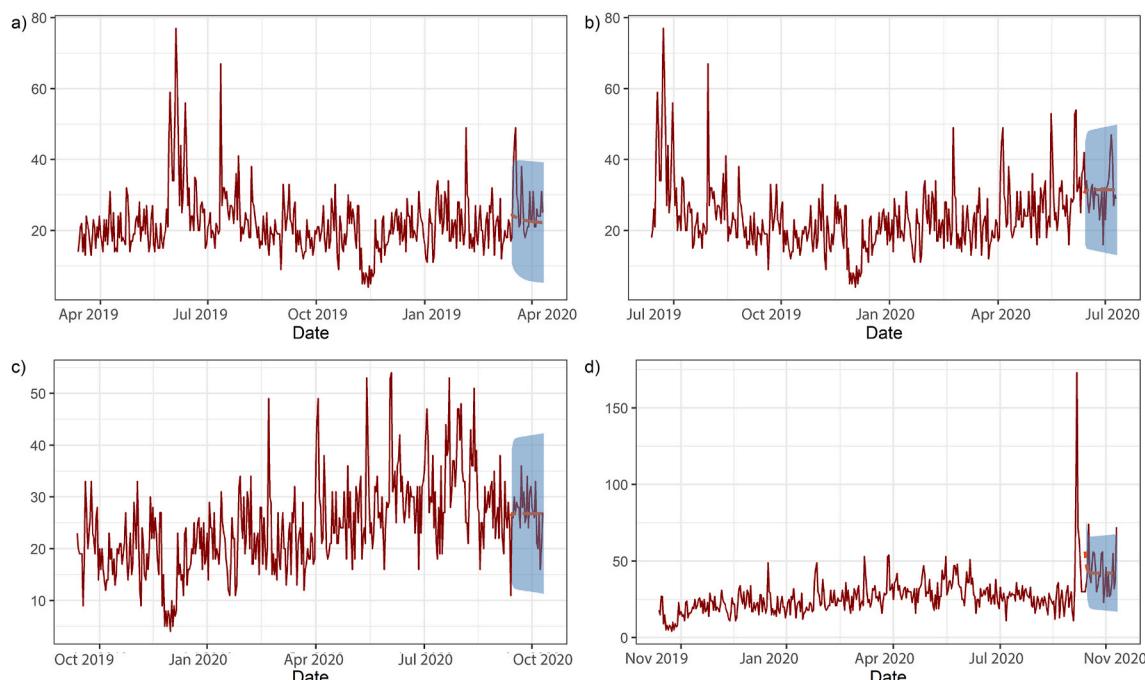


Fig. 2. Forecast total crisis conversation volume for each event. The forecast volume is indicated with the dotted red line, and the light blue illustrates the 95% Confidence Interval. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

Table 2

Summary of pre/post-chi-square-test analysis to assess if total crisis conversation volume changed significantly before versus after each event based on age, gender identity, race/ethnicity, or sexual identity. Conversations are from texters with Louisiana-based area codes.

	COVID-19			George Floyd Murder			Hurricane Laura			2020 Presidential Election			
	National Emergency	Before n = 7986	After n = 738	p <0.001	Before n = 8595	After n = 870	p <0.001	Before n = 8933	After n = 742	p <0.001	Before n = 9595	After n = 1177	p 0.004
Age													
13 or younger	215 (2.7)	14 (1.9)			181 (2.1)	21 (2.4)		204 (2.3)	35 (4.7)		249 (2.6)	48 (4.1)	
14-17	495 (6.2)	20 (2.7)			487 (5.7)	75 (8.6)		577 (6.5)	62 (8.4)		624 (6.5)	69 (5.9)	
18-24	434 (5.4)	25 (3.4)			441 (5.1)	54 (6.2)		480 (5.4)	54 (7.3)		514 (5.4)	44 (3.7)	
25-34	297 (3.7)	15 (2.0)			311 (3.6)	41 (4.7)		285 (3.2)	29 (3.9)		288 (3.0)	32 (2.7)	
35-44	78 (1.0)	3 (0.4)			73 (0.8)	15 (1.7)		73 (0.8)	5 (0.7)		76 (0.8)	13 (1.1)	
45-54	69 (0.9)	6 (0.8)			81 (0.9)	15 (1.7)		107 (1.2)	12 (1.6)		128 (1.3)	11 (0.9)	
55-64	18 (0.2)	0 (0.0)			18 (0.2)	3 (0.3)		19 (0.2)	2 (0.3)		21 (0.2)	0 (0.0)	
65+	23 (0.3)	2 (0.3)			29 (0.3)	4 (0.5)		26 (0.3)	2 (0.3)		33 (0.3)	1 (0.1)	
No Answer	6357 (79.6)	653 (88.5)			6974 (81.1)	642 (73.8)		7162 (80.2)	541 (72.9)		7662 (79.9)	959 (81.5)	
Gender				<0.001			<0.001			<0.001			0.12
Female	1257 (15.7)	52 (7.0)			1239 (14.4)	188 (21.6)		1409 (15.8)	182 (24.5)		1583 (16.5)	195 (16.6)	
Male	214 (2.7)	15 (2.0)			213 (2.5)	31 (3.6)		226 (2.5)	26 (3.5)		248 (2.6)	25 (2.1)	
Diverse	233 (2.9)	18 (2.4)			248 (2.9)	23 (2.6)		295 (3.3)	21 (2.8)		328 (3.4)	26 (2.2)	
No Answer	6282 (78.7)	653 (88.5)			6895 (80.2)	628 (72.2)		7003 (78.4)	513 (69.1)		7436 (77.5)	931 (79.1)	
Race and Ethnicity				<0.001			<0.001			<0.001			0.38
Asian	33 (0.4)	2 (0.3)			31 (0.3)	6 (0.7)		47 (0.5)	6 (0.8)		54 (0.5)	3 (0.3)	
Black	436 (5.5)	13 (1.8)			442 (5.1)	56 (6.4)		494 (5.5)	56 (7.5)		542 (5.6)	72 (6.1)	
Hispanic	133 (1.7)	5 (0.7)			124 (1.4)	19 (2.2)		128 (1.4)	11 (1.5)		139 (1.4)	19 (1.6)	
Indigenous American	20 (0.3)	2 (0.3)			17 (0.2)	2 (0.2)		19 (0.2)	0 (0.0)		27 (0.3)	3 (0.3)	
Other or Mixed Race	239 (3.0)	11 (1.5)			242 (2.8)	29 (3.3)		292 (3.3)	56 (7.5)		364 (3.8)	51 (4.3)	
White	815 (10.2)	51 (6.9)			809 (9.4)	118 (13.6)		895 (10.0)	96 (12.9)		980 (10.2)	96 (8.2)	
No Answer	6310 (79.0)	654 (88.6)			6930 (80.6)	640 (73.6)		7058 (79.0)	517 (69.7)		7489 (78.1)	933 (79.3)	
Sexual Identity				<0.001			<0.001			0.001			0.18
LGBTQ+	701 (8.8)	42 (5.7)			691 (8.0)	93 (10.7)		751 (8.4)	80 (10.8)		822 (8.6)	93 (7.9)	
Straight	876 (11.0)	38 (5.1)			868 (10.1)	128 (14.7)		981 (11.0)	107 (14.4)		1068 (11.1)	113 (9.6)	
No Answer	6409 (80.3)	658 (89.2)			7036 (81.9)	649 (74.6)		7201 (80.6)	555 (74.8)		7705 (80.3)	971 (82.5)	

(2.4% increase), and the 2020 election (1.5% increase). Increases in help-seeking behavior were also noted for any individual under 34 following the murder of George Floyd and Hurricane Laura, with increases ranging from 0.3 to 2.9%, with more substantial increases noted in younger populations (13 or younger and 14 to 17).

Of those who disclosed their gender identity in the voluntary post-conversation survey, fewer females had sought help following the declaration of a national emergency in response to the COVID-19 pandemic (8.7% decrease), and more females had sought help following the murder of George Floyd (7.2% increase) and Hurricane Laura (8.7% increase). Significant increases were also noted for males seeking help following the murder of George Floyd (1.1% increase) and Hurricane Laura (1.0% increase), and a minor decrease following the COVID-19 national emergency (0.7% decrease). Across all four events, fewer gender-diverse individuals sought help from CTL in the post-event period.

Among individuals who provided their racial identity, more Asian

individuals (0.4% increase), Black individuals (1.3% increase), Hispanic individuals (0.8% increase), Other or Mixed individuals (0.5% increase), and White individuals (4.2% increase) had sought help following the murder of George Floyd. Significant increases were also noted following Hurricane Laura among Asian individuals (0.3% increase), Black individuals (2.0% increase), Other or Mixed-Race individuals (4.2% increase), and White individuals (2.9% increase).

Some of the noted changes in help-seeking behaviors may be due to the number of individuals who elected to fill out the optional, post-conversation demographic survey, with more individuals completing this survey in the four weeks following the murder of George Floyd (7–8 percentage point increase) and Hurricane Laura (5.8–9.3 percentage point increase), as compared to before. A decrease in the percent of individuals completing the optional post-conversation survey was observed in the four weeks following the COVID-19 National Emergency (8.9–9.8 percentage point decrease) and 2020 Presidential Election (1.2–2.2 percentage point decrease).

3.2. COVID-19 national emergency

In the year before the COVID-19 national emergency (March 13th, 2019, to March 13th, 2020), there were 7986 total conversations from texters in Louisiana-based area codes, averaging 21.88 conversations per day. In the four weeks after the national COVID-19 emergency, there were 738 total conversations, averaging 26.36 conversations per day. Average daily conversations increased for all conversations, and for conversations related to the following specific issues: stress and anxiety, eating and body image issues, and abuse (Table 1).

Between March 13th and April 10th, 2020, median daily conversations were higher for all conversations, abuse-related conversations, eating and body image conversations, and stress and anxiety related conversations, as compared to the same time period in 2019 (Table 3) (Fig. 1). Results from ARIMA models (p,d,q) showed that the declaration of a national emergency and the COVID-19 pandemic is associated with a 12.9% increase in all conversations, a 23.8% increase in abuse-related conversations, a 38.2% increase in eating and body-image conversations, a 4.3% increase in isolation-related conversations, and a 21.5% increase in stress and anxiety related conversations in the four weeks post-event. In general, increases in help-seeking behaviors were most pronounced for the declaration of the national pandemic, compared to the other events. Decreases in conversation volume were observed for depression (12.3% lower) and thoughts of suicide (13.9% lower) after the COVID-19 lockdown (Table 4).

3.3. George Floyd murder

In the year before the murder of George Floyd, there were 8595 total conversations from texters in Louisiana, averaging 23.55 conversations per day (Table 1); in the four weeks after, there were 807 total

conversations, averaging 31.07 conversations per day. Average daily conversations increased for every crisis topic considered in this analysis for these time periods.

We observed significantly lower median daily conversations between May 25th and June 22nd, 2020, as compared to the same period in 2019 for depression (11, $p = 0.002$) and thoughts of suicide (6, $p = 0.03$) (Table 3) (Fig. 1). However, in the context of the COVID-19 pandemic, ARIMA models detected a marginal increase in the number of conversations relating to eating and body image concerns (1.1% higher), isolation (3.7% higher), and thoughts of suicide (0.37% higher) in the four weeks after exposure (Table 4). Decreases in conversation volume were observed for all conversations (1.1% lower) and conversations relating to abuse (0.92% lower), depression (6.7% lower), and stress and anxiety (1.9% lower) in the four weeks following the murder of George Floyd. However, none of the observed values fell outside the forecasted 95% confidence interval.

3.4. Hurricane Laura

In the year before Hurricane Laura, there were 8933 total conversations from texters in Louisiana, averaging 24.47 conversations per day (Table 1); in the four weeks after Hurricane Laura, there were 742 total conversations, averaging 26.5 conversations per day. Average daily conversations increased for all conversations, with slight increases also noted for conversations related to depression, stress and anxiety, and abuse.

A significantly higher daily median conversation volume was observed for all conversations (27, <0.001), and conversations relating to depression (10, 0.04), and stress and anxiety (10, 0.007) between August 27th and September 24th, 2020, as compared to this time period in 2019 (Table 3) (Fig. 1). In the context of the COVID-19 pandemic and

Table 3

Wilcoxon-rank sum results comparing median crisis conversation volume for the each 28 day event period, COVID-19 pandemic (March 13th - April 10th, 2019 and March 13th - April 10th, 2020), the murder of George Floyd (May 25th - June 22nd, 2019, and May 25th - June 22nd, 2020), Hurricane Laura (August 27th - September 24th, 2019 and August 27th - September 24th, 2020) and the election (November 3rd - December 1st, 2019 and November 3rd - December 1st, 2020).

	2019	2020	Difference	p
	Median Daily Calls (IQR) (3/14/19-4/10/19)	Median Daily Calls (IQR) (3/14/20-4/10/20)		
COVID-19				
All Conversations	19 (6)	24 (9)	5	<0.001
Abuse	1 (2)	2 (2)	1	0.01
Depression	7 (3)	7 (4)	0	0.43
Eating	0 (1)	1 (1)	1	0.04
Isolation	4 (2)	5 (3)	1	0.17
Stress/Anxiety	7 (4)	9 (4)	2	0.001
Thoughts of Suicide	5 (2)	5 (2)	0	0.85
Murder of George Floyd	(5/25/19-6/22/19)	(5/25/20-6/22/20)		
All Conversations	34 (21)	31 (5)	-3	0.49
Abuse	2 (2)	2 (2)	0	0.96
Depression	16 (11)	11 (4)	-5	0.002
Eating	1 (1)	1 (1)	0	0.95
Isolation	8 (5)	7 (2)	-1	0.51
Stress/Anxiety	9 (5)	10 (5)	1	0.84
Thoughts of Suicide	8 (4)	6 (3)	-2	0.03
Hurricane Laura	(8/27/19-9/24/19)	(8/27/20-9/24/20)		
All Conversations	20 (7)	27 (5)	7	<0.001
Abuse	2 (3)	1 (1)	-1	0.52
Depression	8 (5)	10 (3)	2	0.04
Eating	0 (1)	1 (1)	1	0.18
Isolation	4 (3)	5 (3)	1	0.43
Stress/Anxiety	8 (3)	10 (3)	2	0.007
Thoughts of Suicide	5 (2)	5 (3)	0	0.25
2020 Election	(11/3/19-12/1/19)	(11/3/20-12/1/20)		
All Conversations	14 (9)	40 (16)	26	<0.001
Abuse	1 (2)	3 (3)	2	<0.001
Depression	5 (5)	15 (9)	10	<0.001
Eating	0 (0)	1 (0)	1	<0.001
Isolation	3 (4)	8 (4)	5	<0.001
Stress/Anxiety	4 (3)	12 (6)	8	<0.001
Thoughts of Suicide	3 (2)	9 (3)	6	<0.001

Table 4

ARIMA forecasted versus observed crisis text volume in the four weeks following the COVID-19 national emergency (March 13th to April 12, 2020), the murder of George Floyd (May 25th to June 22nd, 2020), Hurricane Laura (August 27th to September 24th, 2020) and the 2020 Presidential Election (November 3rd to December 1st, 2020).

	Forecasted	Confidence (95%)	Observed	Percent Change	p,d,q
COVID-19					1,0,2
All Conversations	642.82	175.41–1065.75	738	12.897	
Abuse	47.25	–28.3–119.66	62	23.790	
Depression	231.43	–14.96–460.02	206	–12.345	
Eating	15.44	–27.54–57.33	25	38.240	
Isolation	133.03	–21.43–277.74	139	4.295	
Stress/Anxiety	211.86	20.88–387.86	270	21.533	
Thoughts of Suicide	165.09	18.89–299.68	145	–13.855	
Murder of George Floyd					1,1,1
All Conversations	879.45	378.81–1317.15	870	–1.086	
Abuse	60.55	–16.99–133.77	60	–0.917	
Depression	324.37	59.03–566.52	304	–6.701	
Eating	21.77	–21.61–63.60	22	1.045	
Isolation	192.7	30.0–341.63	200	3.650	
Stress/Anxiety	298.6	88.87–486.93	293	–1.911	
Thoughts of Suicide	178.33	30.74–313.16	179	0.374	
Hurricane Laura					2,1,1
All Conversations	749.93	320.78–1125.46	742	–1.069	
Abuse	52.97	–29.53–131.66	44	–20.386	
Depression	274.74	59.91–469.96	268	–2.515	
Eating	22.5	–22.76–66.15	19	–18.421	
Isolation	133.59	–18.47–276.09	136	1.772	
Stress/Anxiety	263.54	63.79–444.45	271	2.753	
Thoughts of Suicide	161.84	21.00–291.12	156	–3.744	
2020 Election					2,1,1
All Conversations	1206.2	513.78–1814.04	1177	–2.481	
Abuse	66.54	–22.97–151.31	69	3.565	
Depression	483.91	138.77–795.41	470	–2.960	
Eating	25.69	–20.79–70.32	34	24.441	
Isolation	254.09	67.52–422.61	251	–1.231	
Stress/Anxiety	372.45	110.82–607.88	384	3.008	
Thoughts of Suicide	225.04	61.29–372.70.76	248	9.258	

months of protests following the murder of George Floyd, ARIMA models found marginal increases in conversations relating to isolation (1.8% higher) and stress and anxiety (2.8% higher) in the four weeks following Hurricane Laura. However, every other crisis topic noted decreases, with abuse (20.4% lower) and eating and body image concerns (18.4% lower) seeing the largest decreases (Table 4). Depression (2.5% lower) and all-conversations (1.1% lower) demonstrated the smallest decreases, though none of the observed values fell outside the 95% confidence interval of forecasted values.

3.5. 2020 presidential election

In the year before the 2020 presidential election, there were 8555 total conversations from Louisiana texters, averaging 27.78 conversations per day (Table 1); in the four weeks after, there were 1177 total conversations, averaging 42.04 conversations per day. Average daily conversations increased for every crisis topic considered in this analysis.

Higher daily median volumes were detected for every crisis topic considered in this analysis between November 3rd and December 1st, 2020, as compared to this time period in 2019 (Table 3) (Fig. 1). ARIMA models observed increases for conversations relating to abuse (3.6% higher), eating and body image concerns (24.4% higher), stress and anxiety (3.0% higher) and thoughts of suicide (9.3% higher) in the four weeks following the 2020 election (Table 4). Eating and body image concerns had the largest percent increase (24.4%) following the 2020 presidential election, and thoughts of suicide increased the most for this event (9.3% higher), as compared to the other events.

4. Discussion

This analysis examined short-term changes in help-seeking behaviors among Louisiana residents in response to four critical events in 2020 – the COVID-19 pandemic, the murder of George Floyd, Hurricane Laura,

and the presidential election. Results suggest each event was associated with increases in help-seeking behaviors, with political social stressors: the COVID-19 pandemic and the 2020 election, associated with the most substantial increases in help-seeking behaviors, compared to baseline. Surprisingly, depression was lower than expected after all events; however, increases were noted for stressors that can precede depression, including abuse, isolation, and eating and body image concerns (Araujo et al., 2010; Christiansen et al., 2021; Evans and Fisher, 2022; Puccio et al., 2016; Radell et al., 2021) following the onset of the COVID-19 pandemic, and an increase in thoughts of suicide following the 2020 presidential election, potentially indicating worsening mental distress as the year progressed.

Of the four events, the COVID-19 pandemic saw the largest increases in help-seeking behaviors in the four weeks after the declaration of a national emergency and subsequent stay-at-home orders. Help-seeking behaviors related to abuse, eating and body image concerns, isolation, and stress and anxiety increased considerably. In addition, unlike the other events, total conversation volume (i.e. all crisis conversations) increased among Louisiana texters following the declaration of a national emergency for COVID-19, highlighting higher mental health burdens among users across all crisis concerns. These findings corroborate a growing body of literature suggesting the COVID-19 pandemic served as a risk multiplier for an already existing global mental health crisis (Hamza Shuja et al., 2020; Nochaiwong et al., 2021; Olff et al., 2021; Torales et al., 2020), and for more specific crisis concerns, like eating and body image concerns (J Devoe et al., 2023; Taquet et al., 2022). Contrary to other evidence (e.g., Bueno-Notivol et al., 2021; Ettman et al., 2020), we did not find an association with increasing prevalence of depression after the onset of the pandemic. However, our results did note increases in outcomes that often predicate or can co-occur with depression, including abuse (Radell et al., 2021), isolation (Christiansen et al., 2021; Evans and Fisher, 2022), and eating and body image concerns (Araujo et al., 2010; Puccio et al., 2016). As such, our

analysis may provide context for increases in mental health related concerns that could contribute to higher depression burdens during the pandemic.

Conversations relating to abuse, a crisis concern category that includes physical, sexual, emotional, and unspecified abuse, had notable increases following the COVID-19 national emergency. These results corroborate past research, which found increased abuse during the initial weeks (Kourt et al., 2021) and months of the COVID-19 pandemic (Ivandic et al., 2020; Rengasamy et al., 2022), with many social resources limited and most Americans staying home. Domestic violence also increased after lockdowns, and stay-at-home orders were lifted (Piquero et al., 2021). Isolation also increased dramatically during the initial weeks of the pandemic, with the U.S. Surgeon General declaring an epidemic of loneliness and isolation in the United States (U.S. Surgeon General, 2021). Increases in interpersonal stress, which can include abuse and social isolation, in the context of a major social stressor (i.e., COVID-19 pandemic), can contribute to higher mental health burdens (Ni et al., 2016). As such, the noted increases in abuse and isolation-related conversations in the immediate aftermath of the national lockdown due to the COVID-19 pandemic may help explain higher conversation volumes related to stress and anxiety, and a higher overall conversation volume in the weeks after onset of the COVID-19 pandemic.

Immediately following the murder of George Floyd, we found slight increases in crisis concerns related to eating and body image concerns, isolation, and thoughts of suicide. Likewise, we noted increases in CTL use among Black texters for the event, though our findings could be due to increases in post-crisis conversation survey completion. Police violence and poor mental health are especially pronounced among Black Americans (Alang et al., 2017; NAACP, 2021), who are systematically targeted and disproportionately arrested, harmed, and killed by police (Peeples, 2019, 2020). Mass media coverage of protests and collective action increases the exposure population, such that individuals who did not go to the protests themselves are indirectly exposed via media coverage, creating a 'spillover effect' (Ni et al., 2016). Increased interactions with individuals of opposing views, an increase in racism during the COVID-19 pandemic, and discussion relating to police violence may all have further exacerbated individual's exposure and perception of stress. While our sample of Louisiana residents were likely not directly exposed to the murder of George Floyd, video footage of the murder was shared widely, and Black Lives Matter protests occurred globally (Social Explorer, 2020), suggesting many residents received indirect exposure to this event.

In the four weeks following Hurricane Laura, crisis conversations were slightly higher for stress and anxiety and isolation; however, these increases were marginal compared to other events, like the beginning of the COVID-19 pandemic and the 2020 election. In fact, notable decreases were observed for the other crisis events (e.g., all conversations, depression, abuse, eating and body images). Our observed decreases are supported by conceptual frameworks like the Substance Abuse and Mental Health Services Administration (SAMHSA) Phases of the Disaster Model (DeWolfe, 2000). This model hypothesizes that immediately following a climate disaster, people are less likely to seek mental health care due to the 'heroic' phase, a time in which communities come together and collectively respond to the aftermath of the disaster, likely prioritizing physical needs over emotional and mental needs (DeWolfe, 2000). Decreases may also occur due to widespread power outages (Raphaelson, 2020), which may have limited the ability to seek help via electronic resources, such as CTL.

However, these results are contrary to our other work using CTL data to characterize short-term changes in mental distress after a major climate event, which showed immediate increases in most crisis concerns, including stress/anxiety and thoughts of suicide (e.g., Wertz et al., 2021; Runkle et al., 2021a,b). Past research suggests collective action, such as a community rallying together, can have a protective effect in the context of exposure to multiple social stressors (Ni et al.,

2016). As such, a major hurricane in the context of numerous social stressors that the majority of residents are exposed to, whether directly or indirectly, may have provided the opportunity for community cohesion during a period when many individuals reported feeling socially isolated (U.S. Surgeon General, 2021), buffering the often-associated increase in poor mental health outcomes.

Compared to other events, the 2020 Election resulted in the greatest increase in crisis conversations and the most notable increases in more severe crisis outcomes (i.e., thoughts of suicide). These increases may be due to the election itself, the compounding stress of multiple events among our sample population, resulting in more severe outcomes, or the mass media coverage, which could increase the exposed population and amplify perceived stress (Ni et al., 2016). Preceding the 2020 Election, more Americans reported feeling stressed about this election than prior elections (Canady, 2020). Additionally, past research has found that harmful political policies negatively impact the mental health of the individuals targeted in these policies, even if they are not passed through legislation (Parris et al., 2021), which may help explain increases in help-seeking behavior of more severe health outcomes (i.e., thoughts of suicide) after the election. Furthermore, the increase in help-seeking behaviors for multiple crisis concerns illustrates the wide-reaching mental health impact of the 2020 election. An unexpected finding was an increase in abuse following the 2020 election, which could be indicative of increased interpersonal stress.

4.1. Social stressors vs. climate stressors

Help-seeking behaviors varied among events, with increases in help-seeking behaviors primarily observed for all three social stressors (COVID-19, George Floyd Murder, 2020 Presidential Election) and an overall decrease observed following Hurricane Laura. The SAMHSA model illustrates that following a climate disaster, help-seeking behaviors and reports of poor mental health are expected to decrease in the immediate response period before increasing in the months following (DeWolfe, 2000), which this analysis observed following Hurricane Laura. Interestingly, this same response pattern was not observed following the social stressors, which caused, or were associated with, increased help-seeking behaviors immediately following exposure. This suggests that the mental health response following social stressors is distinct from the response following climate stressors, particularly in the context of multiple social stressors. This important finding illustrates that the mental health response, and therefore mental health care needed, following social stressors, may be distinct from climate disasters.

This analysis considered immediate changes in help-seeking behaviors following exposure to multiple social stressors and a climate disaster. Results suggest that exposure to multiple social stressors negatively impacts the population's mental health and is associated with increases in help-seeking behaviors among those seeking digital crisis support. Substantial increases in help-seeking behaviors related to more severe outcomes (i.e., thoughts of suicide) were observed following the 2020 election. In the context of multiple social stressors, help-seeking behaviors primarily decreased following exposure to a climate disaster.

4.2. Strengths and limitations

This study has multiple strengths. The CTL dataset is an objective mental health dataset that continuously provides data for numerous mental health outcomes at high temporal resolution throughout the contiguous United States, allowing for daily time-series analyses. Additionally, the consideration of social stressors and climate disasters in the context of one another allows for further analysis of the mental health response to co-occurring events. The findings from this analysis can be applied to targeted mental health care interventions following extreme events.

This study is also limited. The prevalence of poor mental health

outcomes was discerned from help-seeking behavior data. As such, our results are specific to those who sought help via digital crisis messaging. Digital messaging data may not capture the true mental health burden of a population; however, CTL data has been verified with hospital administration data (Runkle et al., 2021), adding further evidence that this dataset can be used to characterize population-level mental health trends. This analysis was based on the texter area code, which reflects the texter's current state of residence ~70% of the time (Crisis Text Line, 2019). However, given that all four events had national implications and received widespread national media coverage, the trends observed are likely robust, though we can only draw conclusions among those who texted during the study period with a Louisiana-based area code.

Additionally, previous research has illustrated that pre-existing mental health conditions may be exacerbated by exposure to extreme events and compounding disasters (Sansom et al., 2022). This analysis did not consider repeat CTL users and, as such, does not make inferences about pre-existing mental health conditions and help-seeking behavior following extreme events. The authors recommend future research to consider pre-existing mental health conditions and compounding disasters. Sample bias of those who completed the optional post-conversation demographic survey may also influence demographic-related results. Furthermore, this analysis considered the immediate changes in help-seeking behaviors by analyzing crisis text volume before and four weeks after each extreme event and did not consider longer-term mental health impacts. Mental health responses may vary over time, based on the nature and intensity of the event (Clay et al., 2018), complicated by pre-existing vulnerabilities, such as pre-existing mental health conditions (Clay et al., 2018). Thus, this analysis highlights acute changes in help-seeking behaviors in the immediate aftermath of exposure to social stressors and a climate disaster. Finally, this analysis looked at multiple co-occurring stressors; however, we did not include an analytic element that would allow us to ascertain cumulative mental health burden or whether individuals seeking help via CTL were experiencing crises related to these co-occurring or cumulative stressors. We recommend future research continue to grow understanding of the mental health impacts of co-occurring and cumulative stressors.

5. Conclusions

This analysis considered the immediate help-seeking response to co-occurring social stressors and a climate disaster, in the context of one another. Results suggest that exposure to multiple social stressors (i.e. COVID-19 National Emergency, 2020 presidential election) negatively impacts population mental health and is associated with increases in help-seeking behaviors. In the context of multiple social stressors, help-seeking behaviors primarily decreased following Hurricane Laura; suggesting the mental health response, and thus mental health care needed, following exposure to climate disasters may differ from the help-seeking response following exposure to social stressors. Furthermore, substantial increases in help-seeking behaviors related to more severe outcomes (i.e. thoughts of suicide) were observed following the 2020 election. Of the four events considered, the COVID-19 pandemic and 2020 presidential election saw the most substantial immediate increases in help-seeking behavior.

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CRediT authorship contribution statement

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Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing. **Margaret M. Sugg:** Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, Validation, Writing – original draft, Writing – review & editing. **Jennifer D. Runkle:** Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, Validation, Writing – review & editing. **Luke Wertis:** Data curation, Methodology, Writing – review & editing. **Devyani Singh:** Data curation, Resources, Supervision, Writing – review & editing. **Shannon Green:** Data curation, Resources, Supervision, Writing – review & editing.

Data availability

The authors do not have permission to share data.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.socscimed.2024.116843>.

References

Alang, S., McAlpine, D., McCreedy, E., Hardeman, R., 2017. Police brutality and black health: Setting the agenda for public health scholars. *Am. J. Publ. Health* 107 (5), 662–665. <https://doi.org/10.2105/AJPH.2017.303691>.

APA, 2020. Outcome of Presidential Election Offers Little Stress Relief, According to New Survey. <https://Www.Apa.Org>. <https://www.apa.org/news/press/releases/2020/11/post-election-stress>.

Araujo, D.M.R., Santos, G.F. da S., Nardi, A.E., 2010. Binge eating disorder and depression: a systematic review. *World J. Biol. Psychiatr.* 11 (2–2), 199–207. <https://doi.org/10.3109/15622970802563171>.

Begum, T.F., Lin, Z., Primeau, M., Lin, S., 2022. Assessing short-term and long-term mental health effects among older adults after Hurricane Sandy. *Sci. Total Environ.* 825, 153753 <https://doi.org/10.1016/j.scitotenv.2022.153753>.

Bevilacqua, K., Rasul, R., Schneider, S., Guzman, M., Nepal, V., Banerjee, D., Schulte, J., Schwartz, R.M., 2020. Understanding associations between hurricane harvey exposure and mental health symptoms among greater houston-area residents. *Disaster Med. Public Health Prep.* 14 (1), 103–110. <https://doi.org/10.1017/dmp.2019.141>.

Bistricky, S.L., Long, L.J., Lai, B.S., Gallagher, M.W., Kanenberg, H., Elkins, S.R., Harper, K.L., Short, M.B., 2019. Surviving the storm: avoidant coping, helping behavior, resilience and affective symptoms around a major hurricane-flood. *J. Affect. Disord.* 257, 297–306. <https://doi.org/10.1016/j.jad.2019.07.044>.

Bueno-Notivol, J., Gracia-García, P., Olaya, B., Lasheras, I., López-Antón, R., Santabarbara, J., 2021. Prevalence of depression during the COVID-19 outbreak: a meta-analysis of community-based studies. *Int. J. Clin. Health Psychol.* 21 (1), 100196 <https://doi.org/10.1016/j.ijchp.2020.07.007>.

Callender, R., Canales, J.M., Avendano, C., Craft, E., Ensor, K.B., Miranda, M.L., 2022. Economic and mental health impacts of multiple adverse events: hurricane Harvey, other flooding events, and the COVID-19 pandemic. *Environ. Res.* 214, 114020 <https://doi.org/10.1016/j.enres.2022.114020>.

Canady, V.A., 2020. 2020 presidential election more stressful than 2016 race. *Ment. Health Wkly.* 30 (39) <https://doi.org/10.1002/mhw.32539>, 7–7.

CDC, 2018. The Social Vulnerability Index (SVI). CDC's Social Vulnerability Index (SVI). <https://svi.cdc.gov/map.html>.

Chae, D.H., Yip, T., Martz, C.D., Chung, K., Richeson, J.A., Hajat, A., Curtis, D.S., Rogers, L.O., LaVeist, T.A., 2021. Vicarious racism and vigilance during the COVID-19 pandemic: mental health implications among asian and black Americans. *Publ. Health Rep.* 136 (4), 508–517. <https://doi.org/10.1177/0033549211018675>.

Charlson, F., Ali, S., Bennmarhnia, T., Pearl, M., Massazza, A., Augustinavicius, J., Scott, J. G., 2021. Climate change and mental health: a scoping review. *Int. J. Environ. Res. Publ. Health* 18 (9). <https://doi.org/10.3390/ijerph18094486>, Article 9.

Cheah, C.S.L., Wang, C., Ren, H., Zong, X., Cho, H.S., Xue, X., 2020. COVID-19 racism and mental health in Chinese American families. *Pediatrics* 146 (5), e2020021816. <https://doi.org/10.1542/peds.2020-021816>.

Chen, S., She, R., Qin, P., Kershenbaum, A., Fernandez-Egea, E., Nelder, J.R., Ma, C., Lewis, J., Wang, C., Cardinal, R.N., 2020. The medium-term impact of COVID-19 lockdown on referrals to secondary care mental health services: a controlled

interrupted time series study. *Front. Psychiatr.* 11. <https://www.frontiersin.org/article/10.3389/fpsy.2020.585915>.

Christiansen, J., Qualter, P., Friis, K., Pedersen, S., Lund, R., Andersen, C., Bekker-Jeppesen, M., Lasgaard, M., 2021. Associations of loneliness and social isolation with physical and mental health among adolescents and young adults. *Perspectives in Public Health* 141 (4), 226–236. <https://doi.org/10.1177/17579139211016077>.

Clay, L.A., Greer, A., Kendra, J., 2018. Learning from historic disaster response: reviewing old lessons on disaster mental health. *Risk Hazards Crisis Publ. Pol.* 9 (3), 303–331. <https://doi.org/10.1002/rhc.3.12137>.

Codagnone, C., Bogliacino, F., Gómez, C., Charris, R., Montealegre, F., Liva, G., Lupiáñez-Villanueva, F., Folkvord, F., Veltri, G.A., 2020. Assessing concerns for the economic consequence of the COVID-19 response and mental health problems associated with economic vulnerability and negative economic shock in Italy, Spain, and the United Kingdom. *PLoS One* 15 (10), e0240876. <https://doi.org/10.1371/journal.pone.0240876>.

Cohen, J., 2013. *Statistical Power Analysis for the Behavioral Sciences*. Academic Press.

Colbert, A., 2022. A Force of Nature: Hurricanes in a Changing Climate. NASA. Retrieved April 1, 2024, from <https://science.nasa.gov/earth/climate-change/a-force-of-nature-hurricanes-in-a-changing-climate>.

Crisis Text Line, 2019. *Crisis Text Line | Text HOME to 741741 Free, 24/7 Crisis Counseling*. Crisis Text Line. <https://www.crisistextline.org/>.

Cunsolo Wilcox, A., Harper, S.L., Ford, J.D., Edge, V.L., Landman, K., Houle, K., Blake, S., Wolfrey, C., 2013. Climatic change and mental health: an exploratory case study from Rigolet, Nunavut, Canada. *Climatic Change* 121 (2), 255–270. <https://doi.org/10.1007/s10584-013-0875-4>.

Dass-Brailsford, P., Thomley, R.S.H., Jain, D., Jarrett, E.S., 2022. The mental health consequences of hurricane matthew on Haitian children and youth: an exploratory study. *J. Child Adolesc. Trauma* 15 (3), 899–909. <https://doi.org/10.1007/s40653-021-00413-6>.

de la Rosa, P.A., Cowden, R.G., de Filippis, R., Jerotic, S., Nahidi, M., Ori, D., Orsolini, L., Nagendrappa, S., Pinto da Costa, M., Ransing, R., Saeed, F., Shoib, S., Turan, S., Ullah, I., Vadivel, R., Ramalho, R., 2022. Associations of lockdown stringency and duration with Google searches for mental health terms during the COVID-19 pandemic: a nine-country study. *J. Psychiatr. Res.* 150, 237–245. <https://doi.org/10.1016/j.jpsychires.2022.03.026>.

DeWolfe, D., 2000. Field Manual for Mental Health and Human Service Workers in Major Disasters. Office of Justice Programs. <https://www.ojp.gov/ncjrs/virtual-library/abstracts/field-manual-mental-health-and-human-service-workers-major>.

Dimock, M., Wike, R., 2020. America Is Exceptional in the Nature of its Political Divide. Pew Research Center. <https://www.pewresearch.org/fact-tank/2020/11/13/america-is-exceptional-in-the-nature-of-its-political-divide/>.

Eboigbe, L.I., Simon, C.B., Wang, Y.S., Tyrell, F.A., 2023. The compounded effect of the dual pandemic on ethnic-racial minority adolescents' mental health and psychosocial well-being. *Current Opinion in Psychology* 52, 101626. <https://doi.org/10.1016/j.copsyc.2023.101626>.

Eichstaedt, J.C., Sherman, G.T., Giorgi, S., Roberts, S.O., Reynolds, M.E., Ungar, L.H., Guntuku, S.C., 2021. The emotional and mental health impact of the murder of George Floyd on the US population. *Proc. Natl. Acad. Sci. USA* 118 (39), e2109139118. <https://doi.org/10.1073/pnas.2109139118>.

Engel, G.L., 1977. The need for a new medical model: a challenge for biomedicine. *Science* 196 (4286). <https://doi.org/10.1126/science.847460>.

English, P., 2021. Package "its.analysis". *Running Interrupted Time Series Analysis, 1.6.0* [R].

EPA, 2016. *What Climate Change Means for Louisiana*. United State Environmental Protection Agency, p. 2. EPA 430-F-16-020.

Espinel, Z., Kossin, J.P., Galea, S., Richardson, A.S., Shultz, J.M., 2019. Forecast: increasing mental health consequences from atlantic hurricanes throughout the 21st century. *Psychiatr. Serv.* 70 (12), 1165–1167. <https://doi.org/10.1176/appi.ps.201900273>.

Ettman, C.K., Abdalla, S.M., Cohen, G.H., Sampson, L., Vivier, P.M., Galea, S., 2020. Prevalence of depression symptoms in US adults before and during the COVID-19 pandemic. *JAMA Netw. Open* 3 (9), e2019686. <https://doi.org/10.1001/jamanetworkopen.2020.19686>.

Ettman, C.K., Abdalla, S.M., Cohen, G.H., Sampson, L., Vivier, P.M., Galea, S., 2021. Low assets and financial stressors associated with higher depression during COVID-19 in a nationally representative sample of US adults. *J. Epidemiol. Community Health* 75 (6), 501–508. <https://doi.org/10.1136/jech-2020-215213>.

Evans, M., Fisher, E.B., 2022. Social isolation and mental health: the role of nondirective and directive social support. *Community Ment. Health J.* 58 (1), 20–40. <https://doi.org/10.1007/s10597-021-00787-9>.

Faraone, S.V., 2008. Interpreting estimates of treatment effects. *Pharmacy and Therapeutics* 33 (12), 700–711.

FEMA, 2022. Designated areas: disaster 4559. <https://www.fema.gov/designated-area#individual-assistance>.

Fernandez, A., Black, J., Jones, M., Wilson, L., Salvador-Carulla, L., Astell-Burt, T., Black, D., 2015. Flooding and mental health: a systematic mapping review. *PLoS One* 10 (4), e0119929. <https://doi.org/10.1371/journal.pone.0119929>.

Fix, R.L., 2021. Mental and physical health consequences of police brutality toward Black community members in the United States. *Public Health in Practice* 2, 100188. <https://doi.org/10.1016/j.puhp.2021.100188>.

Galovski, T.E., Peterson, Z.D., Beagley, M.C., Strasshofer, D.R., Held, P., Fletcher, T.D., 2016. Exposure to violence during ferguson protests: mental health effects for law enforcement and community members. *J. Trauma Stress* 29 (4), 283–292. <https://doi.org/10.1002/jts.22105>.

Gould, M.S., Pisani, A., Gallo, C., Ertefaie, A., Harrington, D., Kelberman, C., Green, S., 2022. Crisis text-line interventions: evaluation of texters' perceptions of effectiveness. *Suicide Life-Threatening Behav.* 52 (3), 583–595. <https://doi.org/10.1111/sltb.12873>.

Hahn, M.B., Van Wyck, R., Lessard, L., Fried, R., 2022. Compounding effects of social vulnerability and recurring natural disasters on mental and physical health. *Disaster Med. Public Health Prep.* 16 (3), 1013–1021. <https://doi.org/10.1017/dmp.2020.476>.

Hamza Shuja, K., Aqeel, M., Foundation University, Islamabad, Campus, Rawalpindi, Islamabad, Pakistan, Jaffar, A., Shanghai Jiao Tong University, Shanghai, China, Ahmed, A., & Quaid-i-Azam University, Islamabad, Pakistan, 2020. COVID-19 pandemic and impending global mental health implications. *Psychiatr. Danub.* 32 (1), 32–35. <https://doi.org/10.24869/psyd.2020.32>.

Hawke, L.D., Hayes, E., Darnay, K., Henderson, J., 2021. Mental health among transgender and gender diverse youth: an exploration of effects during the COVID-19 pandemic. *Psychology of Sexual Orientation and Gender Diversity* 8 (2), 180. <https://doi.org/10.1037/sgd0000467>.

Hawrilenko, M., Kroshus, E., Tandon, P., Christakis, D., 2021. The association between school closures and child mental health during COVID-19. *JAMA Netw. Open* 4 (9), e2124092. <https://doi.org/10.1001/jamanetworkopen.2021.24092>.

Hayes, K., Blashki, G., Wiseman, J., Burke, S., Reifels, L., 2018. Climate change and mental health: risks, impacts and priority actions. *Int. J. Ment. Health Syst.* 12 (1), 28. <https://doi.org/10.1186/s13033-018-0210-6>.

Hogg, R.V., Tanis, E.A., Zimmerman, D.L., 2015. *Probability and Statistical Inference, ninth ed.* Pearson.

Holland, K.M., Jones, C., Vivolo-Kantor, A.M., Idaikkadar, N., Zwald, M., Hoots, B., Yard, E., D'Inverno, A., Swedo, E., Chen, M.S., Petrosky, E., Board, A., Martinez, P., Stone, D.M., Law, R., Coletta, M.A., Adjemian, J., Thomas, C., Puddy, R.W., et al., 2021. Trends in US emergency department visits for mental health, overdose, and violence outcomes before and during the COVID-19 pandemic. *JAMA Psychiatr.* 78 (4), 1–8. <https://doi.org/10.1001/jamapsychiatry.2020.4402>.

Holmes, L., Enwere, M., Williams, J., Ogundele, B., Chavan, P., Piccoli, T., Chinaka, C., Comeaux, C., Pelaez, L., Okundaye, O., Stalnaker, L., Kalle, F., Deepika, K., Philipcien, G., Poleon, M., Ogungbade, G., Elmhi, H., John, V., Dabney, K.W., 2020. Black–white risk differentials in COVID-19 (SARS-CoV2) transmission, mortality and case fatality in the United States: translational epidemiologic perspective and challenges. *Int. J. Environ. Res. Publ. Health* 17 (12). <https://doi.org/10.3390/ijerph17124322>. Article 12.

Hou, W.K., Lee, T.M.-C., Liang, L., Li, T.W., Liu, H., Ettman, C.K., Galea, S., 2021. Civil unrest, COVID-19 stressors, anxiety, and depression in the acute phase of the pandemic: a population-based study in Hong Kong. *Soc. Psychiatr. Psychiatr. Epidemiol.* 56 (8), 1499–1508. <https://doi.org/10.1007/s00127-021-02037-5>.

Howard, L.C., Krueger, E.A., Barker, J.O., Boley Cruz, T., Cwalina, S.N., Unger, J.B., Barrington-Trimis, J.L., Leventhal, A.M., 2022. Young Adults' Distress about Police Brutality Following the Death of George Floyd. *Youth & Society*, 0044118X221087282. <https://doi.org/10.1177/0044118X221087282>.

Hyndman, R., Athanasiopoulos, G., Bergmeir, C., Caceres, G., Chhay, L., O'Hara-Wild, M., Petropoulos, F., Razbash, S., 2022. *Package "Forecast": Forecasting Functions for Time Series and Linear Models*.

Ivandic, R., Kirchmaier, T., Linton, B., 2020. Changing patterns of domestic abuse during COVID-19 lockdown. *SSRN Electron. J.* <https://doi.org/10.2139/ssrn.3686873>.

J Devoe, D., Han, A., Anderson, A., Katzman, D.K., Patten, S.B., Soumasis, A., Flanagan, J., Paslakis, G., Vyver, E., Marcoux, G., Dimitropoulos, G., 2023. The impact of the COVID-19 pandemic on eating disorders: a systematic review. *Int. J. Eat. Disord.* 56 (1), 5–25. <https://doi.org/10.1002/eat.23704>.

Kourti, A., Stavridou, A., Panagouli, E., Psaltopoulou, T., Spiliopoulou, C., Tsolia, M., Sergentanis, T.N., Tsitsika, A., 2021. Domestic violence during the COVID-19 pandemic: a systematic review. *Trauma Violence Abuse*, 15248380211038690. <https://doi.org/10.1177/15248380211038690>.

Kumar, A., Nayar, K.R., 2021. COVID 19 and its mental health consequences. *J. Ment. Health* 30 (1), 1–2. https://doi.org/10.1080/09638237.2020.1757052_la.gov. <https://www.sos.la.gov/ElectionsAndVoting/Pages/PostElectionStatisticsStatewide.aspx>.

Larson, P.S., Bergmans, R.S., 2022. Impact of the COVID-19 pandemic on temporal patterns of mental health and substance abuse related mortality in Michigan: an interrupted time series analysis. *The Lancet Regional Health - Americas* 10, 100218. <https://doi.org/10.1016/j.lana.2022.100218>.

Lewis, K.J.S., Lewis, C., Roberts, A., Richards, N.A., Evison, C., Pearce, H.A., Lloyd, K., Meudell, A., Edwards, B.M., Robinson, C.A., Poole, R., John, A., Bisson, J.I., Jones, I., 2022. The effect of the COVID-19 pandemic on mental health in individuals with pre-existing mental illness. *BJPsych Open* 8 (2), e59. <https://doi.org/10.1192/bjop.2022.25>.

Lin, S., Lu, Y., Justino, J., Dong, G., Lauper, U., 2016. What happened to our environment and mental health as a result of hurricane sandy? *Disaster Med. Public Health Prep.* 10 (3), 314–319. <https://doi.org/10.1017/dmp.2016.51>.

Links, J., 2017. Predicting Community Resilience and Recovery after a Disaster | Blogs. August 7. CDC. <https://blogs.cdc.gov/publichealthmatters/2017/08/predicting-community-resilience-and-recovery-after-a-disaster/>.

Liu, J., Varghese, B.M., Hansen, A., Xiang, J., Zhang, Y., Dear, K., Gourley, M., Driscoll, T., Morgan, G., Capon, A., Bi, P., 2021. Is there an association between hot weather and poor mental health outcomes? A systematic review and meta-analysis. *Environ. Int.* 153 <https://doi.org/10.1016/j.envint.2021.106533>.

Massazza, A., Teyton, A., Charlson, F., Benmarhnia, T., Augustinavicius, J.L., 2022. Quantitative methods for climate change and mental health research: current trends and future directions. *Lancet Planet. Health* 6 (7), e613–e627. [https://doi.org/10.1016/S2542-5196\(22\)00120-6](https://doi.org/10.1016/S2542-5196(22)00120-6).

McClellan, C., Ali, M.M., Mutter, R., Kroutil, L., Landwehr, J., 2017. Using social media to monitor mental health discussions – evidence from Twitter. *J. Am. Med. Inf. Assoc.* 24 (3), 496–502. <https://doi.org/10.1093/jamia/ocw133>.

Millett, G.A., Jones, A.T., Benkeser, D., Baral, S., Mercer, L., Beyer, C., Honermann, B., Lankiewicz, E., Mena, L., Crowley, J.S., Sherwood, J., Sullivan, P.S., 2020. Assessing differential impacts of COVID-19 on black communities. *Ann. Epidemiol.* 47, 37–44. <https://doi.org/10.1016/j.anepidem.2020.05.003>.

Milojevic, A., Armstrong, B., Wilkinson, P., 2017. Mental health impacts of flooding: a controlled interrupted time series analysis of prescribing data in England. *J. Epidemiol. Community Health* 71 (10), 970–973. <https://doi.org/10.1136/jech-2017-208899>.

Morey, B.N., García, S.J., Nieri, T., Bruckner, T.A., Link, B.G., 2021. Symbolic disempowerment and Donald Trump's 2016 presidential election: mental health responses among Latinx and white populations. *Soc. Sci. Med.* 289, 114417 <https://doi.org/10.1016/j.socscimed.2021.114417>.

Munro, A., Kovats, R.S., Rubin, G.J., Waite, T.D., Bone, A., Armstrong, B., Waite, T.D., Beck, C.R., Bone, A., Amlöt, R., Kovats, R.S., Armstrong, B., Leonardi, G., Rubin, G.J., Oliver, I., 2017. Effect of evacuation and displacement on the association between flooding and mental health outcomes: a cross-sectional analysis of UK survey data. *Lancet Planet. Health* 1 (4), e134–e141. [https://doi.org/10.1016/S2542-5196\(17\)30047-5](https://doi.org/10.1016/S2542-5196(17)30047-5).

NAACP, 2021. Criminal Justice Fact Sheet. May 24. NAACP. <https://naacp.org/resource/s/criminal-justice-fact-sheet>.

Ni, M.Y., Kim, Y., McDowell, I., Wong, S., Qiu, H., Wong, I.O., Galea, S., Leung, G.M., 2020a. Mental health during and after protests, riots and revolutions: a systematic review. *Aust. N. Z. J. Psychiatr.* 54 (3), 232–243. <https://doi.org/10.1177/0004867419899165>.

Ni, M.Y., Li, T.K., Pang, H., Chan, B.H.Y., Kawachi, I., Viswanath, K., Schooling, C.M., Leung, G.M., 2017. Longitudinal patterns and predictors of depression trajectories related to the 2014 occupy central/umbrella movement in Hong Kong. *Am. J. Publ. Health* 107 (4), 593–600. <https://doi.org/10.2105/AJPH.2016.303651>.

Ni, M.Y., Li, T.K., Pang, H., Chan, B.H.Y., Yuan, B.Y., Kawachi, I., Schooling, C.M., Leung, G.M., 2016. Direct participation in and indirect exposure to the occupy central movement and depressive symptoms: a longitudinal study of Hong Kong adults. *Am. J. Epidemiol.* 184 (9), 636–643. <https://doi.org/10.1093/aje/kwv103>.

Ni, M.Y., Yao, X.I., Leung, K.S.M., Yau, C., Leung, C.M.C., Lun, P., Flores, F.P., Chang, W. C., Cowling, B.J., Leung, G.M., 2020b. Depression and post-traumatic stress during major social unrest in Hong Kong: a 10-year prospective cohort study. *Lancet* 395 (10220), 273–284. [https://doi.org/10.1016/S0140-6736\(19\)33160-5](https://doi.org/10.1016/S0140-6736(19)33160-5).

Nochaiwong, S., Ruengorn, C., Thavorn, K., Hutton, B., Awiphan, R., Phosuya, C., Ruanta, Y., Wongpakaran, N., Wongpakaran, T., 2021. Global prevalence of mental health issues among the general population during the coronavirus disease-2019 pandemic: a systematic review and meta-analysis. *Sci. Rep.* 11 (1) <https://doi.org/10.1038/s41995-021-89700-8>. Article 1.

Offl, M., Primasari, I., Qing, Y., Coimbra, B.M., Hovnanyan, A., Grace, E., Williamson, R. E., Hoeboer, C.M., Consortium, the G.-C., 2021. Mental health responses to COVID-19 around the world. *Eur. J. Psychotraumatol.* 12 (1), 1929754 <https://doi.org/10.1080/20008198.2021.1929754>.

Ormiston, C.K., Williams, F., 2022. LGBTQ youth mental health during COVID-19: unmet needs in public health and policy. *Lancet* (London, England) 399 (10324), 501–503. [https://doi.org/10.1016/S0140-6736\(21\)02872-5](https://doi.org/10.1016/S0140-6736(21)02872-5).

Parris, D., Fulks, E., Kelley, C., 2021. Anti-LGBTQ policy proposals can harm youth mental health. <https://www.childtrends.org/publications/anti-lgbtq-policy-proposals-can-harm-youth-mental-health>.

Pasch, R.J., Berg, R., Roberts, D.P., Papin, P.P., 2020. *Hurricane Laura (AL132020; Tropical Cyclone Report)*. National Hurricane Center.

Peeples, L., 2019. What the data say about police shootings. *Nature* 573 (7772), 24–26. <https://doi.org/10.1038/d41586-019-02601-9>.

Peeples, L., 2020. What the data say about police brutality and racial bias—and which reforms might work. *Nature* 583 (7814), 22–24. <https://doi.org/10.1038/d41586-020-01846-z>.

Piquero, A.R., Jennings, W.G., Jemison, E., Kaukinen, C., Knaul, F.M., 2021. Domestic violence during the COVID-19 pandemic—evidence from a systematic review and meta-analysis. *J. Crim. Justice* 74, 101806. <https://doi.org/10.1016/j.jcrimjus.2021.101806>.

Pisani, A.R., Gould, M.S., Gallo, C., Ertefaie, A., Kelberman, C., Harrington, D., Weller, D., Green, S., 2022. Individuals who text crisis text line: key characteristics and opportunities for suicide prevention. *Suicide Life-Threatening Behav.* 52 (3), 567–582. <https://doi.org/10.1111/slth.12872>.

Puccio, F., Fuller-Tyszkiewicz, M., Ong, D., Krug, J., 2016. A systematic review and meta-analysis on the longitudinal relationship between eating pathology and depression. *Int. J. Eat. Disord.* 49 (5), 439–454. <https://doi.org/10.1002/eat.22506>.

Radell, M.L., Abo Hamza, E.G., Daghustani, W.H., Perveen, A., Moustafa, A.A., 2021. The impact of different types of abuse on depression. *Depression Research and Treatment* 2021, e6654503. <https://doi.org/10.1155/2021/6654503>.

Raker, E.J., Lowe, S.R., Arcaya, M.C., Johnson, S.T., Rhodes, J., Waters, M.C., 2019. Twelve years later: the long-term mental health consequences of Hurricane Katrina. *Soc. Sci. Med.* 242, 112610 <https://doi.org/10.1016/j.socscimed.2019.112610>.

Raphaelson, S., 2020. Hurricane Laura Knocks Out Power for Hundreds of Thousands in Louisiana and Texas. August 27. NPR. <https://www.npr.org/sections/hurricane-la-ura-live-updates/2020/08/27/906653006/hurricane-laura-knocks-out-power-for-hundreds-of-thousands-in-louisiana-and-texas>.

Rengasamy, E.R., Long, S.A., Rees, S.C., Davies, S., Hildebrandt, T., Payne, E., 2022. Impact of COVID-19 lockdown: domestic and child abuse in Bridgend. *Child Abuse & Neglect* 130, 105386. <https://doi.org/10.1016/j.chab.2021.105386>.

RStudio Team, 2022. RStudio: Integrated Development Environment for R [PBC]. RStudio. <https://www.rstudio.com/>.

Runkle, J.D., Michael, K.D., Stevens, S.E., Sugg, M.M., 2021a. Quasi-experimental evaluation of text-based crisis patterns in youth following Hurricane Florence in the Carolinas, 2018. *Sci. Total Environ.* 750, 141702 <https://doi.org/10.1016/j.scitotenv.2020.141702>.

Runkle, J.D., Sugg, M.M., Yadav, S., Harden, S., Weiser, J., Michael, K., 2021b. Real-Time Mental Health Crisis Response in the United States to COVID-19. *Crisis*. <https://doi.org/10.1027/0227-5910/a000826>.

Sansom, G.T., Thompson, C., Sansom, L., Fawkes, L., Boerlin, E., 2022. Compounding impacts of hazard exposures on mental health in Houston, TX. *Nat. Hazards* 111 (3), 2809–2818. <https://doi.org/10.1007/s11069-021-05158-x>.

Schaffer, A.L., Dobbins, T.A., Pearson, S.-A., 2021. Interrupted time series analysis using autoregressive integrated moving average (ARIMA) models: a guide for evaluating large-scale health interventions. *BMC Med. Res. Methodol.* 21 (1), 58. <https://doi.org/10.1186/s12874-021-01235-8>.

Seon, Q., Greaves, N., Campbell, M., Anderson, S., Henry, P., Augustus, E., Cummings, E., Kendall, L., Wheeler, E., Vercammen, A., Lawrence, E., Simeon, D., Seemungal, T., Gold, I., Maharaj, S.B., 2024. Exploratory empirical model of combined effects of COVID-19 and climate change on youth mental health. *Nature Mental Health* 2 (2). <https://doi.org/10.1038/s44220-023-00197-8>. Article 2.

Shi, L., Zhang, D., Martin, E., Chen, Z., Li, H., Han, X., Wen, M., Chen, L., Li, Y., Li, J., Chen, B., Ramos, A.K., King, K.M., Michaud, T., Su, D., 2022. Racial discrimination, mental health and behavioral health during the COVID-19 pandemic: a national survey in the United States. *J. Gen. Intern. Med.* 37 (10), 2496–2504. <https://doi.org/10.1007/s11606-022-07540-2>.

Shultz, J.M., Fugate, C., Galea, S., 2020. Cascading risks of COVID-19 resurgence during an active 2020 atlantic hurricane season. *JAMA* 324 (10), 935–936. <https://doi.org/10.1001/jama.2020.15398>.

Shultz, J.M., Trapido, E.J., Kossin, J.P., Fugate, C., Nogueira, L., Apro, A., Patel, M., Torres, V.J., Ettman, C.K., Espinel, Z., Galea, S., 2022. Hurricane Ida's impact on Louisiana and Mississippi during the COVID-19 Delta surge: complex and compounding threats to population health. *The Lancet Regional Health - Americas* 12, 100286. <https://doi.org/10.1016/j.lana.2022.100286>.

Social Explorer, 2020. Black Lives Matter. Social Explorer. <https://www.socialexplorer.com/05374654d9/embed>.

Sugg, M.M., Runkle, J.D., Andersen, L., Weiser, J., Michael, K.D., 2021. Crisis response among essential workers and their children during the COVID-19 pandemic. *Prev. Med.* 153, 106852 <https://doi.org/10.1016/j.ypmed.2021.106852>.

Sugg, M.M., Runkle, J.D., Hajnos, S.N., Green, S., Michael, K.D., 2022. Understanding the concurrent risk of mental health and dangerous wildfire events in the COVID-19 pandemic. *Sci. Total Environ.* 806, 150391 <https://doi.org/10.1016/j.scitotenv.2021.150391>.

Sugg, M.M., Werts, L., Ryan, S., Green, S., Singh, D., Runkle, J., 2023. Cascading disasters and mental health: the February 2021 winter storm and power crisis in Texas. *US. Sci. Total Environ.* 163231 <https://doi.org/10.1016/j.scitotenv.2023.163231>.

Sullivan, G., Vasterling, J.J., Han, X., Tharp, A.T., Davis, T., Deitch, E.A., Constans, J.I., 2013. Preexisting mental illness and risk for developing a new disorder after hurricane Katrina. *J. Nerv. Ment. Dis.* 201 (2), 161–166. <https://doi.org/10.1097/NMD.0b013e31827f636d>.

Taioli, E., Tuminello, S., Lieberman-Cribbin, W., Bevilacqua, K., Schneider, S., Guzman, M., Kerath, S., Schwartz, R.M., 2018. Mental health challenges and experiences in displaced populations following Hurricane Sandy and Hurricane Harvey: the need for more comprehensive interventions in temporary shelters. *J. Epidemiol. Community Health* 72 (10), 867–870.

Taquet, M., Geddes, J.R., Luciano, S., Harrison, P.J., 2022. Incidence and outcomes of eating disorders during the COVID-19 pandemic. *Br. J. Psychiatr.* 220 (5), 262–264. <https://doi.org/10.1192/bjps.2021.105>.

The New York Times, 2020. Louisiana coronavirus map and case count. April 1 The New York Times. <https://www.nytimes.com/interactive/2021/us/louisiana-covid-cases.html>.

Thoma, M.V., Rohleder, N., Rohner, S.L., 2021. Clinical ecopsychology: the mental health impacts and underlying pathways of the climate and environmental crisis. *Front. Psychiatr.* 12. <https://www.frontiersin.org/journals/psychiatry/articles/101389/fpsyg.2021.675936>.

Thomeer, M.B., Moody, M.D., Yahirun, J., 2022. Racial and ethnic disparities in mental health and mental health care during the COVID-19 pandemic. *Journal of Racial and Ethnic Health Disparities*. <https://doi.org/10.1007/s40615-022-01284-9>.

Thompson, L.K., Michael, K.D., Runkle, J., Sugg, M.M., 2019. Crisis Text Line use following the release of Netflix series 13 Reasons Why Season 1: time-series analysis of help-seeking behavior in youth. *Preventive Medicine Reports* 14, 100825. <https://doi.org/10.1016/j.pmedr.2019.100825>.

Thompson, R., Hornigold, R., Page, L., Waite, T., 2018. Associations between high ambient temperatures and heat waves with mental health outcomes: a systematic review. *Publ. Health* 161, 171–191. <https://doi.org/10.1016/j.puhe.2018.06.008>.

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.* 66 (4), 317–320. <https://doi.org/10.1177/0020764020915212>.

US Census, 2021. *U.S. Census bureau QuickFacts: Louisiana*. United states Census QuickFacts. <https://www.census.gov/quickfacts/LA>.

US EPA, 2021. *Climate change indicators: Weather and climate* [reports and assessments]. <https://www.epa.gov/climate-indicators/weather-climate>.

U.S. Surgeon General, 2021. Our Epidemic of Loneliness and Isolation. U.S. Department of Health and Human Services. <https://www.hhs.gov/sites/default/files/surgeon-general-social-connection-advisory.pdf>.

Viner, R., Russell, S., Saulle, R., Croker, H., Stansfield, C., Packer, J., Nicholls, D., Goddings, A.-L., Bonell, C., Hudson, L., Hope, S., Ward, J., Schwalbe, N., Morgan, A., Minozzi, S., 2022. School closures during social lockdown and mental health, health behaviors, and well-being among children and adolescents during the first COVID-19

wave: a systematic review. *JAMA Pediatr.* 176 (4), 400–409. <https://doi.org/10.1001/jamapediatrics.2021.5840>.

Watts, N., Amann, M., Ayeb-Karlsson, S., Belesova, K., Bouley, T., Boykoff, M., Byass, P., Cai, W., Campbell-Lendrum, D., Chambers, J., Cox, P.M., Daly, M., Dasandi, N., Davies, M., Depledge, M., Depoux, A., Dominguez-Salas, P., Drummond, P., Ekins, P., et al., 2018. The Lancet Countdown on health and climate change: from 25 years of inaction to a global transformation for public health. *Lancet* (London, England) 391 (10120), 581–630. [https://doi.org/10.1016/S0140-6736\(17\)32464-9](https://doi.org/10.1016/S0140-6736(17)32464-9).

Weisler, R.H., Barbee, J.G., Townsend, M.H., 2006. Mental health and recovery in the Gulf Coast after hurricanes katrina and rita. *JAMA* 296 (5), 585–588. <https://doi.org/10.1001/jama.296.5.585>.

Wertis, L., Runkle, J.D., Sugg, M.M., Singh, D., 2023. Examining hurricane ida's impact on mental health: results from a quasi-experimental analysis. *GeoHealth* 7 (2), e2022GH000707. <https://doi.org/10.1029/2022GH000707>.

Yoshida, K., 2020. What Is Tableone? [Computer software]. <https://cran.r-project.org/web/packages/tableone/vignettes/introduction.html>.

Zacher, M., Raker, E.J., Meadows, M.-C., Ramírez, S., Woods, T., Lowe, S.R., 2023. Mental health during the COVID-19 pandemic in a longitudinal study of Hurricane Katrina survivors. *SSM - Mental Health* 3, 100198. <https://doi.org/10.1016/j.ssmh.2023.100198>.

Zajacova, A., Jehn, A., Stackhouse, M., Choi, K.H., Denice, P., Haan, M., Ramos, H., 2020. Mental health and economic concerns from March to May during the COVID-19 pandemic in Canada: insights from an analysis of repeated cross-sectional surveys. *SSM - Population Health* 12, 100704. <https://doi.org/10.1016/j.ssmph.2020.100704>.