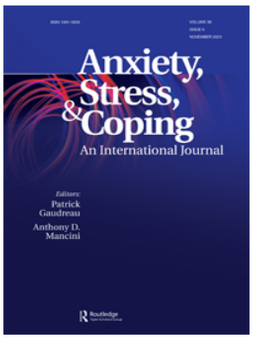

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Associations between mindfulness and mental health after collective trauma: results from a longitudinal, representative, probability-based survey

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ABSTRACT

Background/objectives: Trait mindfulness (TM) may protect against post-trauma mental health ailments and related impairment. Few studies have evaluated this association in the context of collective traumas using representative samples or longitudinal designs.

Design/method: We explored relationships between TM and collective trauma-related outcomes in a prospective, representative, probability-based sample of 1846 U.S. Gulf Coast residents repeatedly exposed to catastrophic hurricanes, assessed twice during the COVID-19 outbreak (Wave 1: 5/14/20–5/27/20; Wave 2: 12/21/21–1/11/22). Generalized estimating equations examined longitudinal relationships between TM, COVID-19-related fear/worry, hurricane-related fear/worry, global distress, and functional impairment; ordinary least squares regression analyses examined the cross-sectional association between TM and COVID-19-related posttraumatic stress symptoms (PTSS) at Wave 1. Event-related stressor exposure was explored as a moderator.

Results: In covariate-adjusted models including pre-event mental health ailments and demographics, TM was negatively associated with COVID-19-related fear/worry, hurricane-related fear/worry, global distress, and functional impairment over time; in cross-sectional analyses, TM was negatively associated with COVID-19-related PTSS. TM moderated the relationship between COVID-19 secondary stressor exposure (e.g., lost job/wages) and both global distress and functional impairment over time.

Conclusions: Results suggest TM may buffer adverse psychosocial outcomes following collective trauma, with some evidence TM may protect against negative effects of secondary stressor exposure.

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Introduction

Residents of the United States Gulf Coast, such as those living in Florida and Texas, experienced a cascade of collective traumas in recent years. In 2017, Hurricane Harvey (a Category 4 storm) and Hurricane Irma (a Category 5 storm) made landfall in Texas and Florida, respectively. One year later, Hurricane Michael (a Category 5 storm) made landfall in Florida. The impact of these storms

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was profound and widespread. Losses were estimated at $125 billion for Hurricane Harvey (NOAA National Centers for Environmental Information, 2023); 6.5 million were under evacuation order during Hurricane Irma (Feng & Lin, 2021); and an estimated 60,000 homes were damaged by Hurricane Michael (Schneider, 2019). Shortly thereafter, Gulf Coast residents faced the co-occurring threats posed by the 2020 COVID-19 pandemic and the annual hurricane season, which typically starts in June (National Weather Service, 2022). Texas and Florida residents were exposed to news reports of neighboring states grappling with devastating storms including hurricanes Laura and Ida (both Category 4 storms), while facing numerous smaller hurricanes (e.g., hurricanes Sally, Hanna, and Nicholas) in their own states.

Such broad, community-wide events exemplify collective traumas, which impact individuals through direct (e.g., physical proximity), indirect (e.g., knowing someone affected) and media-based exposure (Goldmann & Galea, 2014; Holman et al., 2020). Unfortunately, many estimates suggest collective traumas including climate-related disasters and viral pandemics have been increasing, and will continue to increase in frequency and severity in the years to come (Fernandez et al., 2020; Keesing & Ostfeld, 2021; Ting et al., 2019). A robust body of research has documented the relationships between exposure to both hurricanes and COVID-19 and mental health ailments and impairment in work and social functioning (Gallagher et al., 2020; Garfin, Thompson, Holman, et al., 2022; Holingue et al., 2020; Holman et al., 2020). Many studies have focused on risk factors associated with adverse psychosocial outcomes (e.g., Gallagher et al., 2020). Yet fewer studies have examined factors associated with resilience to these threats (e.g., First & Houston, 2022), particularly using representative samples and longitudinal designs (e.g., Bennett et al., 2023).

Mindfulness and stress exposure

Mindfulness is defined as a mental state of non-judgmental attentive awareness toward the present moment (Kabat-Zinn, 2003). Considerable evidence suggests that mindfulness is associated with improved psychological well-being and decreased levels of psychopathological symptoms in the general population (Brown & Ryan, 2003; Carpenter et al., 2019; Tomlinson et al., 2018). Mindfulness helps individuals accept their present thoughts, feelings, and experiences as impersonal and ephemeral, and may foster non-ruminative observation of these phenomena (Bishop et al., 2004; Thompson et al., 2011; Ostafin, 2015). Indeed, mindfulness helps regulate under- and over-modulation of emotional response symptoms, hallmarks of traumatic stress responses (Boyd et al., 2018). Concurrently, mindfulness may help lower propensity for negative cognitions (Kiken & Shook, 2014) and downregulate anxiety symptoms (Hou et al., 2015). Taken together, findings suggest mindfulness may be discordant with many symptoms of psychopathology and may be associated with resilience following stressful events.

Mindfulness can be measured as both an inherent personality-like trait and as an intentionally induced state (Brown & Ryan, 2003; Lau et al., 2006). Trait mindfulness (TM; also referred to as dispositional mindfulness) is the characteristic inclination toward present moment non-judgmental attentive awareness (Brown & Ryan, 2003), reflecting an individual's intrinsic tendency to be mindful in everyday life (Lau et al., 2006). A growing body of literature suggests TM may be negatively associated with adverse psychosocial outcomes after trauma exposure (Boelen & Lenferink, 2018; Harper et al., 2022; Thompson et al., 2011). For example, in research with first responders in the United States, TM was negatively associated with posttraumatic stress symptoms (PTSS) and depressive symptoms (Smith et al., 2011). TM was negatively correlated with a range of psychopathological symptoms including anxiety, depression, and PTSS in adults who experienced childhood trauma (Fitzgerald, 2022) and with depression and anxiety in a sample of trauma-exposed cancer patients (Omid et al., 2017). Moreover, a few studies have found evidence TM may moderate the relationship between traumatic stress exposure and

psychosocial outcomes (e.g., Nassi et al., 2019), yet such results have been inconsistent (e.g., Cutright et al., 2019).

Mindfulness and exposure to collective trauma

While evidence suggests TM may predict post-trauma distress and impairment, little research has evaluated this association in the specific context of collective trauma. This deficit is consequential as collective traumas represent unique community-wide exogenous stressors, often without a clear endpoint (Silver et al., 2021). Moreover, exposure to *multiple* collective traumas may have a cumulative dose–response effect on psychosocial well-being (Harville et al., 2018), with each subsequent exposure increasing the severity of negative outcomes such as acute stress, PTSS, depression, and anxiety (Garfin et al., 2015; Lowe et al., 2019). Adverse outcomes may also be exacerbated and prolonged by secondary stressors such as injury, financial burden, and displacement from one's home (Cerdá et al., 2013; Williams et al., 2021). Given these risks, it is critical to identify factors associated with resilience after collective trauma exposure to enhance well-being and protect against adverse outcomes.

COVID-19-related studies

Most studies examining TM in the context of collective trauma have focused on the COVID-19 pandemic. One of the largest ($N = 6412$) was conducted during the early stages of the outbreak in Italy (Conversano et al., 2020). Cross-sectional analyses indicated a moderate negative correlation between TM and global distress. While large, this study was limited by its use of non-random snowball sampling and a skewed representation of gender (75% of participants identified as women). Smaller studies conducted during the COVID-19 pandemic found similar negative associations between TM and symptoms of psychosocial distress (e.g., Belen, 2021; Dillard & Meier, 2021). For example, Dillard and Meier (2021) found TM was negatively associated with depression, anxiety, and COVID-19-related worry in small samples of students ($N = 251$) and adults ($N = 300$). Yet lack of demographic representativeness limits generalizability: most participants in this study reported their race/ethnicity as White (89% in the student sample and 80% in the adult sample). Relatedly, a cross-sectional study of 355 Turkish university students found TM mediated the relationship between COVID-19 fear and anxiety and depressive symptoms (Belen, 2021), although its sample of predominantly female college students again limits generalizability.

Several limitations of the current COVID-19-related research exist. Survey research during COVID-19 has underrepresented racial/ethnic minoritized groups and people with lower income or education (Pierce et al., 2020). Additionally, most previous research on responses to COVID-19 and TM did not control for COVID-19 exposure, which is positively associated with negative psychosocial outcomes (First & Houston, 2022). Further, most studies have examined the relationship between TM and one type of stressor (e.g., COVID-19), rather than multiple types of co-occurring stressors (e.g., COVID-19 and hurricanes), which may exhibit independent and cumulative effects (Callender et al., 2022; Garfin et al., 2014).

Non-COVID-19-related studies

Few studies have examined the relationship between TM and psychosocial outcomes (e.g., psychological distress and impairment) after non-COVID-19-related collective traumas (e.g., natural disasters or terrorism), with existing studies finding mixed results and many lacking in methodological rigor. One study employing probability-based sampling to study survivors of a violent attack (which resulted in many deaths and widespread property damage) by an armed group of Fulani herdsmen in a Nigerian community found that TM was negatively associated with both PTSS and depressive symptoms (Aliche et al., 2021). Despite the use of a rigorous, probability-based sampling design, generalizability was limited due to the ethnically homogeneous sample, and the cross-sectional design

precluded inferences regarding relationships over time. A smaller ($N = 125$) longitudinal study of Israelis affected by the Mount Carmel forest fire found a similar negative relationship between TM and both PTSS and depression over time (Nitzan-Assayag et al., 2015). While longitudinal, that study was limited by a small sample size and the use of convenience sampling.

Other studies of TM and responses to collective trauma demonstrated mixed or inconsistent results. For example, a small sample ($N = 25$) of survivors of the 2004 South Asian tsunami did not find a relationship between PTSS and TM (Hagen et al., 2016), although the study was likely underpowered. A convenience sample of college students ($N = 725$) assessed after the 2018 Camp Fire (the deadliest California wildfire to date) found a negative relationship between anxiety and depression symptoms and TM (Silveira et al., 2021). However, an association between TM and PTSS was not indicated and the potential buffering effect of exposure and TM on psychological outcomes was not explored.

In summary, few studies have explored the association between TM and psychosocial outcomes after collective trauma. The existing literature is methodologically limited and findings are mixed. Further, threat exposure (including both direct exposure and secondary stress exposure) has been inconsistently assessed. Given that co-occurring threats (e.g., hurricanes and COVID-19) may have both separate and cumulative psychosocial impacts, it is important to account for exposure to each (First & Houston, 2022; Hammen et al., 2009). A more methodologically rigorous study using a probability-based, longitudinal design with assessments of exposure across multiple threats could help clarify these relationships.

The present study

Herein, we examine, using pre-registered analyses, the relationship between TM and post-event psychosocial outcomes among a representative probability-based sample of individuals exposed to multiple collective traumas. Study participants were Texas and Florida residents repeatedly exposed to Gulf Coast hurricanes, assessed longitudinally during the COVID-19 outbreak in the United States. Our primary hypothesis was that individuals with higher levels of TM would report lower levels of COVID-19-related PTSS, COVID-19-related fear/worry, hurricane-related fear/worry, global distress, and functional impairment. Our secondary hypothesis was that TM would moderate the relationship between stress exposure and all observed outcomes. Key covariates (age, gender, race/ethnicity, income, education, and prior mental health history) shown to be predictive of post-event psychosocial distress (Silver & Garfin, 2016) were accounted for in analyses.

Method

Procedure

Data collection occurred in the context of an ongoing, five-wave, longitudinal cohort study. Individuals were recruited from the GfK (now Ipsos) KnowledgePanel, a large probability-based survey panel designed to be demographically representative of the United States. The panel employs Address Based Sampling (ABS) and the Delivery Sequence File (DSF) of the United States Postal Service to randomly recruit participants from nearly 100% of United States households. This methodology improves geographic representation compared to conventional random-digit-dialing (RDD) and facilitates recruitment of traditionally underrepresented groups in survey research (e.g., rural households, underrepresented racial/ethnic groups). Study protocol has been detailed in prior research (Garfin, Thompson, Holman, et al., 2022; Garfin, Thompson, and Wong-Parodi, 2022).

The sample was first assessed between 9/8/17 and 9/11/17 (during Hurricane Irma and shortly after Hurricane Harvey). All 5940 qualified panelists residing in Florida and Texas were invited to participate; 2774 participants completed the survey (46.7% participation rate). The sample was assessed

again one month later (10/12/17–10/29/17; 2960 participants completed the survey, 86.6% response rate) and again a year later after Hurricane Michael (10/22/18–11/6/18; 1879 participants completed the survey, 70.2% response rate).

Two waves of data were collected during the COVID-19 pandemic; the present analyses draw primarily from these final two waves of data collection, hereafter denoted as Waves 1 and 2 for clarity. Participants were assessed during the early stages of the COVID-19 pandemic ("Wave 1"; 5/14/20 to 5/27/20; 1846 participants completed the survey, 73.6% response rate) and again during the Omicron surge of the COVID-19 pandemic in the United States ("Wave 2"; 12/21/21 to 1/11/22; 1479 participants completed the survey, 83.7% response rate). Participants were provided $15-$20 for each survey completed. All procedures were approved by the Institutional Review Board at the University of California, Irvine. Participants consented to participate in surveys upon enrollment in the KnowledgePanel and were provided a Study Information Sheet prior to taking the surveys.

Measures

Key independent variable

Trait mindfulness (TM). At Wave 1, present moment attention and awareness was assessed using a 6-item short scale of the Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003). The MAAS measures TM on a 6-point scale. (Endpoints: 1 = *almost always* to 6 = *almost never*). The original measure development study reported very good reliability ($\alpha = .87$) in a general adult sample (Brown & Ryan, 2003). The short form uses items 7, 8, 9, 10, 13, and 14 from the full 15-item measure and has strong psychometric properties, including very good reliability ($\alpha = .89$), with reduced participant burden (Black et al., 2012). Prior work shows that five of the six items from the short scale supply the bulk of the information assessed in the full-length MAAS (van Dam et al., 2010). In our sample, reliability was excellent ($\alpha = .90$). Items were reverse coded for ease of interpretation.

Dependent variables

COVID-19-related posttraumatic stress symptoms (PTSS). At Wave 1, a modified version of the Primary Care PTSD Screen for DSM-5 (PC-PTSD-5; Prins et al., 2016) was used to assess COVID-19-related PTSS. After reading the question stem "With respect to the COVID-19 outbreak, during the past week or so, how often have you experienced the following … " participants responded to items including: "Have you had nightmares about the COVID-19 outbreak or thought about it when you did not want to?" and "Have you tried hard not to think about the COVID-19 outbreak or gone out of your way to avoid situations that reminded you of it?" (Endpoints: 1 = *never*, 5 = *all the time*). Responses were averaged, and reliability was good ($\alpha = .79$). Similar measures have been used in prior work during COVID-19, demonstrating very good reliability ($\alpha = .83$) (Thompson et al., 2022). We note that a substantial body of literature has explored which COVID-19-related exposures, if any, meet the Criterion A requirement for a posttraumatic stress disorder (PTSD) diagnosis (e.g., Norrholm et al., 2021). Our study took a broader approach by focusing on assessing posttraumatic stress *symptoms* (PTSS) experienced by community members during the COVID-19 pandemic rather than assessing PTSD per se, which requires a Criterion A exposure. Given this objective, participants provided responses to the PC-PTSD-5 without referencing a specific COVID-19-related exposure.

COVID-19-related fear/worry. At Waves 1 and 2, participants responded to the items "How often in the past week have you had fears about the COVID-19 outbreak affecting your community?" and "I worry that the COVID-19 outbreak will personally affect me or someone in my family in the

future." (Endpoints: 1 = *never*, 5 = *all the time*). Items were averaged. Reliability was adequate at Wave 1 ($\alpha = .69$) and excellent at Wave 2 ($\alpha = .91$). Similar measures have shown good reliability ($\alpha = .81$) in prior research with a distinct sample (Garfin, Djokovic, et al., 2022).

Hurricane-related fear/worry. At Waves 1 and 2, participants responded to the items "How often in the past week have you had fears about hurricanes affecting your community?" and "I worry that hurricanes will personally affect me or someone in my family in the future." (Endpoints: 1 = *never*, 5 = *all the time*). Items were averaged; reliability was very good at Wave 1 ($\alpha = .87$) and good at Wave 2 ($\alpha = .73$). A similar measure demonstrated very good reliability ($\alpha = .88$) in a distinct representative sample (Sweeting et al., 2020).

Global distress. At Waves 1 and 2, a nine-item version of the Brief Symptom Inventory (BSI; Derogatis, 1983) assessed global distress (a composite of anxiety, depression, and somatization). Participants responded to items including: "During the past 7 days, how much were you distressed by feelings of worthlessness?" (Endpoints: 0 = *not at all*, 4 = *extremely*). Reliability was very good at Waves 1 ($\alpha = .87$) and 2 ($\alpha = .88$). In measure development, the anxiety ($\alpha = .81$), depression ($\alpha = .85$), and somatization ($\alpha = .80$) subscales demonstrated very good reliability (Derogatis, 1983).

Functional impairment. At Waves 1 and 2, four items modified from the Medical Outcomes Study 36-Item Short-Form Health Survey (SF-36) assessed occupational and social impairment resulting from physical and mental health (Ware & Sherbourne, 1992). Participants responded to items such as: "During the past week, how much of the time has your emotional health interfered with your social relationships (like connecting with friends, relatives, etc.)?" (Endpoints: 0 = *none of the time*, 4 = *all of the time*). Reliability was very good at Waves 1 ($\alpha = .83$) and 2 ($\alpha = .86$). Validation literature reports very good reliability ($\alpha > .85$; Brazier et al., 1992).

Independent variables and covariates

Exposure to COVID-19 and hurricanes. At Wave 1, both direct COVID-19 exposure (e.g., having the virus, or being in a close relationship with someone who had the virus) and secondary stressors associated with COVID-19 exposure (e.g., losing a job, losing wages) were assessed through 13 dichotomous items (0 = *did not occur*; 1 = *occurred*). This measure has been used in prior research (Holman et al., 2020). Prior hurricane exposure was assessed before and after Hurricane Irma and after hurricanes Harvey and Michael. A count score of six dichotomous items (0 = *did not occur*; 1 = *occurred*) assessed both direct exposure (property loss, home destruction, injury) and indirect exposure (knowing someone killed, knowing someone injured, losing a pet). Participants could report multiple exposures over time. This measure has been used in prior research (Garfin, Thompson, Holman, et al., 2022).

Physician diagnosed anxiety or depression disorder. Prior to initial study enrollment in 2017, Ipsos collected data on mental health ailments (i.e., anxiety disorder, depression disorder) by asking participants: "Have you been diagnosed by a doctor or other qualified medical professional with any of the following mental health conditions?" Comparisons between responses to the National Health Interview Survey item and the KnowledgePanel survey supported data validity (<1.5% difference; Baker et al., 2003). Missing values were imputed using sequential Hotdeck imputation (Andridge & Little, 2010; Cox, 1980).

Demographics. Demographics on all panelists are collected upon entry to the KnowledgePanel and updated regularly. Demographic covariates for the present analyses were age, gender, ethnicity, education, and income.

Statistical analysis

Stata 17 (StataCorp LLC., 2021) was used to conduct all statistical analyses. Descriptive statistics were calculated for all variables of interest and a covariance matrix was constructed to present interrelationships between key variables. Predictors of COVID-19-related PTSS were examined cross-sectionally using ordinary least squares (OLS) regression analysis. Then, using a repeated-measures approach, four generalized estimating equations (GEE; Ballinger, 2004) examined longitudinal relationships between TM and (1) COVID-19-related fear/worry, (2) hurricane-related fear/worry, (3) global distress, and (4) functional impairment over time. GEE coefficients represent the average population-level effect of predictors on outcome variables over time, accounting for the correlation between observations at different time points. Direct exposure and secondary stress exposure to COVID-19 were included in analyses examining COVID-19-related outcomes (i.e., COVID-19-related PTSS [cross-sectional] and COVID-19-related fear/worry [longitudinal]); hurricane-related exposure was included in longitudinal analyses examining hurricane-related fear/worry. Finally, moderation was tested by including interaction terms (event exposure X TM). Interactions between TM and event-specific exposures were examined for COVID-19 and hurricanes; interactions between TM and exposure to both hurricanes and COVID-19 were included in longitudinal analyses of global distress and functional impairment.

In the interests of transparency and accountability, all analyses were preregistered on the Open Science Framework, accessible at the following link: https://osf.io/xqejw/?view_only=c785a3e284f24feeb118aba7b6438dc6. We note one deviation from the registered plan. After conducting initial analyses, we collected an additional wave of data (Wave 2). Thus, we employed a repeated-measures approach (i.e., GEE) to analyze variables assessed at both Wave 1 and Wave 2.

Statistical weights

Study-specific post-stratification weights were applied to all statistics. This procedure adjusted the final sample to reflect the demographic profile of Florida and Texas residents aged 18 and above, according to United States Census benchmarks from The American Community Survey (2018). Demographic cells employed to compute post-stratification weights were: gender (male, female), age (18–29, 30–44, 45–59, 60+), race/ethnicity (White/Non-Hispanic, Black/Non-Hispanic, Other/Non-Hispanic, Hispanic, 2+Races/Non-Hispanic); household income (Under $25,000, $25,000–$49,999, $50,000–$74,999, $75,000–$99,999, $100,000–$149,999, $150,000 and over); metro/non-metro areas, and education (less than high school/high school, some college, Bachelor's or higher). Descriptive statistics for cross-sectional variables (measured only at Wave 1) used weights from Wave 1. Descriptive statistics for longitudinal variables (measured at both Waves 1 and 2) used weights from Wave 2. The amount of missing data was very small (< 2% for any one item) and the inclusion of wave-specific survey weights accounted for attrition over time.

Results

Descriptive statistics

The final Wave 1 weighted sample ($N = 1846$) was representative of United States Census benchmarks for Texas and Florida. A demographic comparison of the weighted sample with United States Census benchmarks for Texas and Florida is provided in Table S1. The sample was 53.2% female ($n = 982$). Mean age was 51.00 years ($SD = 16.75$). Race/ethnic identification was reported as 54.8% non-Hispanic White, 11.9% non-Hispanic Black, 28.1% Hispanic, and 5.2% other/multiracial, non-Hispanic. Of the sample, 4.4% did not complete high school, 34.1% were high school graduates, 31.9% completed some college, and 29.5% held a Bachelor's degree or higher.

Median income was between $50,000 and $74,999. Prior to the initial wave of the parent study, 10.88% ($n = 201$) were diagnosed with anxiety or depression by a physician. Prior direct hurricane exposure was reported by 28.7% (range = 0–11, $M = 0.57$, $SD = 1.28$). During the early phase of the COVID-19 outbreak (Wave 1, May 2020), 17.8% of the sample reported direct exposure to COVID-19. Means and standard deviation (SD) for dependent variables were: TM ($M = 4.62$, $SD = 1.11$); COVID-19-related PTSS ($M = 1.63$, $SD = 0.73$), COVID-19-related fear/worry ($M = 2.30$, $SD = 1.08$), hurricane-related fear/worry ($M = 1.99$, $SD = 0.91$), global distress ($M = 0.43$, $SD = 0.63$), and functional impairment ($M = 0.50$, $SD = 0.77$).

Inferential statistics

Table 1 presents a covariance matrix of key study variables. Covariate-adjusted associations between predictors and dependent variables are presented in Tables 2–4. Cross-sectional analyses revealed PTSS was negatively associated with TM and positively associated with COVID-19 exposure (direct and secondary stressor), prior mental health ailments, reporting Hispanic ethnicity, lower income, and older age (see Table 2). Longitudinal analyses demonstrated that, over time, COVID-19-related fear/worry was negatively associated with TM and positively associated with direct exposure to COVID-19, female gender, older age, and obtaining a Bachelor's degree or higher (see left side of Table 3). Over time, hurricane-related fear/worry was negatively associated with TM and positively associated with prior hurricane exposure, reporting Hispanic ethnicity, female gender, and older age (see right side of Table 3). Over time, global distress was negatively associated with TM and reporting other/multiracial identity and positively associated with prior mental health ailments (see left side of Table 4). Over time, functional impairment was negatively associated with TM and positively associated with prior mental health ailments and lower income (see right side of Table 4).

Two interaction terms were statistically significant. TM moderated the relationship between COVID-19 secondary stress exposure and global distress over time ($b = -0.10$, $p = .01$; see Figure 1) and functional impairment over time ($b = -0.11$, $p = .001$; see Figure 2).

Discussion

Herein, we explored the relationships between TM and psychosocial responses to catastrophic hurricanes and the COVID-19 pandemic in a longitudinal, representative, probability-based sample of Texas and Florida residents. We evaluated the associations between TM and event-specific and general mental health outcomes and functional impairment and explored whether TM moderated the potential deleterious effects of event-related stressor exposure. Our findings demonstrated that TM was negatively associated with adverse psychosocial outcomes following two collective traumas, with some evidence TM may buffer the effects of secondary stress exposure over time.

Primary hypotheses

We hypothesized that TM would be negatively associated with adverse psychosocial outcomes (i.e., COVID-19-related PTSS [cross-sectional], and COVID-19-related fear/worry, hurricane-related fear/worry, global distress, and functional impairment [longitudinal]) while accounting for event-related exposure, demographics, and pre-event physician diagnosed anxiety and depression disorders. Results supported this hypothesis across all dependent variables (i.e., COVID-19-related PTSS [cross-sectional], and COVID-19-related fear/worry, hurricane-related fear/worry, global distress, and functional impairment [longitudinal]); longitudinal analyses suggested relationships were significant over time. These findings are consistent with previous research indicating TM may protect against negative psychosocial outcomes after a collective trauma (e.g., Aliche et al., 2021; Conversano et al., 2020; Nitzan-Assayag et al., 2015).

Our study expands on the existing literature in several ways. Using a large and representative probability-based sample offers increased generalizability and external validity compared to prior studies

Table 1. Covariances among study variables.

Variable	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
Wave 1 variables ($N = 1846$)													
1. Global distress	1.00***	0.73***	0.56***	0.32***	0.30***	0.76***	0.23***	0.18***	0.15**	0.73***	0.35***	0.26***	0.53***
2. COVID-19-related PTSS[a]		1.00***	0.50***	0.44***	0.38***	0.62***	0.28***	0.23***	0.19***	0.49***	0.38***	0.30***	0.34***
3. Trait mindfulness			1.00***	0.26***	0.26***	0.48***	0.20***	0.14***	0.19***	0.48***	0.25***	0.20***	0.41***
4. COVID-19-related fear/worry				1.00***	0.38***	0.28***	0.09*	0.11***	0.07*	0.16***	0.44***	0.25***	0.13***
5. Hurricane-related fear/worry					1.00***	0.27***	0.27***	0.11***	0.14***	0.21***	0.32***	0.43***	0.21***
6. Functional impairment						1.00***	0.24***	0.16***	0.14**	0.58***	0.25***	0.18***	0.61***
7. Prior hurricane exposure							1.00***	0.25***	0.33***	0.26***	0.16***	0.23***	0.25***
8. Direct exposure to COVID-19								1.00***	0.14***	0.15**	0.15***	.016***	0.15***
9. COVID-19 secondary stressors									1.00***	0.17*	0.07*	0.13***	0.14*
Wave 2 variables ($N = 1479$)													
10. Global distress										1.00***	0.36***	0.31***	0.77***
11. COVID-19-related fear/worry											1.00***	0.36***	0.31***
12. Hurricane-related fear/worry												1.00***	0.24***
13. Functional impairment													1.00***

Note: Wave 1 weights were used when both variables were measured at Wave 1. Wave 2 weights were used when either variable was measured at Wave 2.
[a]PTSS = posttraumatic stress symptoms.
*$p < .05$; **$p < .01$; ***$p < .001$.

Table 2. Multiple regression analysis of the associations between trait mindfulness, event exposure, and COVID-19-related posttraumatic stress symptoms at Wave 1 (5/14/20–5/27/20), $N = 1839$.

	COVID-19-related Posttraumatic Stress Symptoms			
Variable	b[a]	95% CI	p	Beta
Trait mindfulness[b]	−0.29	−0.34, −0.23	<.001	−0.43
Prior mental health ailments[c]	0.20	0.11, 0.28	<.001	0.16
Race/ethnicity[d]				
Black, non-Hispanic	0.02	−0.14, 0.17	0.84	0.01
Other/2+ races, non-Hispanic	0.14	−0.04, 0.31	0.14	0.04
Hispanic	0.15	0.03, 0.27	0.01	0.09
Income	−0.04	−0.06, −0.01	0.002	−0.10
Female gender	0.10	−0.002, 0.19	0.06	0.07
Age	0.01	0.003, 0.01	<.001	0.13
Bachelor's degree or higher[e]	0.06	−0.04, 0.15	0.23	0.04
Direct exposure to COVID-19	0.24	0.11, 0.37	<.001	0.12
Secondary stressors related to COVID-19	0.10	0.03, 0.16	.003	0.12
Constant	2.55	2.20, 2.89	<.001	–
Model statistics		F (11, 1827) = 26.33, $p < .001$, $R^2 = 0.34$		

[a]Unstandardized coefficient.
[b]Trait mindfulness was reverse coded (higher numbers = more mindful).
[c]Prior mental health ailments: 0 = none, 1 = anxiety or depression, 2 = anxiety and depression.
[d]White is the reference group.
[e]Less than a Bachelor degree is the reference group.
N varies due to missing data. Analyses are cross-sectional. Prior mental health ailments were collected prior to Wave 1.

with small sample sizes and/or less rigorous sampling methods that can result in biased samples. We bolster prior cross-sectional research by evaluating several dependent variables over time. Our analyses controlled for pre-event physician diagnosed anxiety and depression disorders, which are established predictors of post-event distress (Garfin & Silver, 2016) and may correlate with TM (Curtiss & Klemanski, 2014). Parceling out this variability allows our analyses to better isolate the association between TM and

Table 3. Generalized estimating equations for associations between trait mindfulness, event exposure, and fear/worry regarding COVID-19 and hurricanes over Wave 1 (5/14/20–5/27/20) and Wave 2 (12/21/21–1/11/22), $N = 1479$.

	COVID-19-related Fear/Worry					Hurricane-related Fear/Worry				
Variable	b[a]	95% CI	SE[b]	z	p	b[a]	95% CI	SE[b]	z	p
Time	−0.64	−0.75, −0.52	0.06	−10.80	<.001	−0.06	−0.14, 0.02	0.04	−1.55	0.12
Trait mindfulness[c]	−0.26	−0.34, −0.18	0.04	−6.15	<.001	−0.15	−0.22, −0.08	0.04	−4.29	<.001
Prior mental health ailments[d]	0.12	−0.04, 0.29	0.08	1.44	0.15	0.09	−0.02, 0.20	0.06	1.63	0.10
Race/ethnicity[e]										
Black, non-Hispanic	0.09	−0.22, 0.39	0.15	0.56	0.58	0.20	−0.01, 0.40	0.10	1.88	0.06
Other/2+ races, non-Hispanic	0.30	−0.08, 0.69	0.20	1.53	0.13	0.27	−0.06, 0.60	0.17	1.61	0.11
Hispanic	0.19	−0.03, 0.41	0.11	1.70	0.09	0.40	0.23, 0.57	0.09	4.56	<.001
Income	−0.02	−0.07, 0.02	0.02	−0.97	0.33	0.02	−0.02, 0.06	0.02	0.84	0.40
Female gender	0.21	0.03, 0.38	0.09	2.33	0.02	0.16	0.03, 0.28	0.06	2.44	0.02
Age	0.01	0.003, 0.01	0.003	2.87	.004	0.01	0.004, 0.01	0.002	3.89	<.001
Bachelor's degree or higher[f]	0.20	0.02, 0.39	0.09	2.15	0.03	−0.12	−0.26, 0.02	0.07	−1.70	0.09
Direct exposure to COVID-19	0.20	0.01, 0.39	0.10	2.06	0.04	–	–	–	–	–
Secondary stressors related to COVID-19	0.03	−0.08, 0.14	0.06	0.59	0.55	–	–	–	–	–
Prior hurricane exposure	–	–	–	–	–	0.13	0.09, 0.18	0.02	5.94	<.001
Constant	4.10	3.50, 4.69	0.31	13.42	<.001	2.01	1.54, 2.47	0.24	8.45	<.001
Model statistics		Wald X^2 (12) = 238.83, $p < .001$					Wald X^2 (11) = 121.57, $p < .001$			

[a]Unstandardized coefficient.
[b]Robust standard error.
[c]Trait mindfulness was reverse coded (higher numbers = more mindful).
[d]Prior mental health ailments: 0 = none, 1 = anxiety or depression, 2 = anxiety and depression.
[e]White is the reference group.
[f]Less than a Bachelor degree is the reference group.
N varies due to missing data. Analyses are longitudinal. Prior mental health ailments and prior hurricane exposure were collected before Wave 1.

Table 4. Generalized estimating equations for associations between trait mindfulness, event exposure, and global distress and functional impairment over Wave 1 (5/14/20–5/27/20) and Wave 2 (12/21/21–1/11/22), $N = 1479$.

	Global Distress					Functional Impairment				
Variable	b[a]	95% CI	SE[b]	z	p	b[a]	95% CI	SE[b]	z	p
Time	−0.07	−0.10, −0.03	0.02	−3.27	.001	−0.04	−0.10, 0.01	0.03	−1.47	0.14
Trait mindfulness[c]	−0.23	−0.29, −0.17	0.03	−7.77	<.001	−0.24	−0.30, −0.18	0.03	−7.85	<.001
Prior mental health ailments[d]	0.23	0.13, 0.33	0.05	4.42	<.001	0.31	0.19, 0.43	0.06	5.16	<.001
Race/ethnicity[e]										
Black, non-Hispanic	−0.04	−0.18, 0.09	0.07	−0.65	0.52	0.05	−0.13, 0.24	0.09	0.56	0.57
Other/2+ races, non-Hispanic	−0.16	−0.28, −0.04	0.06	−2.69	0.01	−0.01	−0.22, 0.20	0.11	−0.09	0.93
Hispanic	0.09	−0.02, 0.20	0.06	1.57	0.12	−0.03	−0.15, 0.09	0.06	−0.47	0.64
Income	−0.02	−0.05, 0.01	0.01	−1.34	0.18	−0.04	−0.07, −0.01	0.02	−2.58	0.01
Female gender	0.04	−0.05, 0.13	0.05	0.82	0.42	−0.003	−0.11, −0.10	0.05	−0.05	0.96
Age	0.001	−0.003, 0.004	0.002	0.41	0.68	0.002	−0.002, 0.01	0.00	0.93	0.36
Bachelor's degree or higher[f]	−0.07	−0.17, 0.03	0.05	−1.38	0.17	−0.09	−0.19, 0.01	0.05	−1.67	0.10
Direct exposure to COVID-19	0.09	−0.03, 0.21	0.06	1.53	0.13	0.11	−0.01, 0.24	0.07	1.74	0.08
Secondary stressors related to COVID-19	0.03	−0.07, 0.13	0.05	0.52	0.60	0.01	−0.09, 0.12	0.05	0.29	0.77
Prior hurricane exposure	0.03	−0.01, 0.07	0.02	1.32	0.19	0.04	−0.01, 0.10	0.03	1.71	0.09
Constant	1.56	1.19, 1.92	0.19	8.38	<.001	1.68	1.26, 2.10	0.22	7.77	<.001
Model statistics		Wald X^2 (13) = 195.84, $p < .001$					Wald X^2 (13) = 192.83, $p < .001$			

[a]Unstandardized coefficient.
[b]Robust standard error.
[c]Trait mindfulness was reverse coded (higher numbers = more mindful).
[d]Prior mental health ailments: 0 = none, 1 = anxiety or depression, 2 = anxiety and depression.
[e]White is the reference group.
[f]Less than a Bachelor degree is the reference group.
N varies due to missing data. Analyses are longitudinal. Prior mental health ailments and prior hurricane exposure were collected before Wave 1.

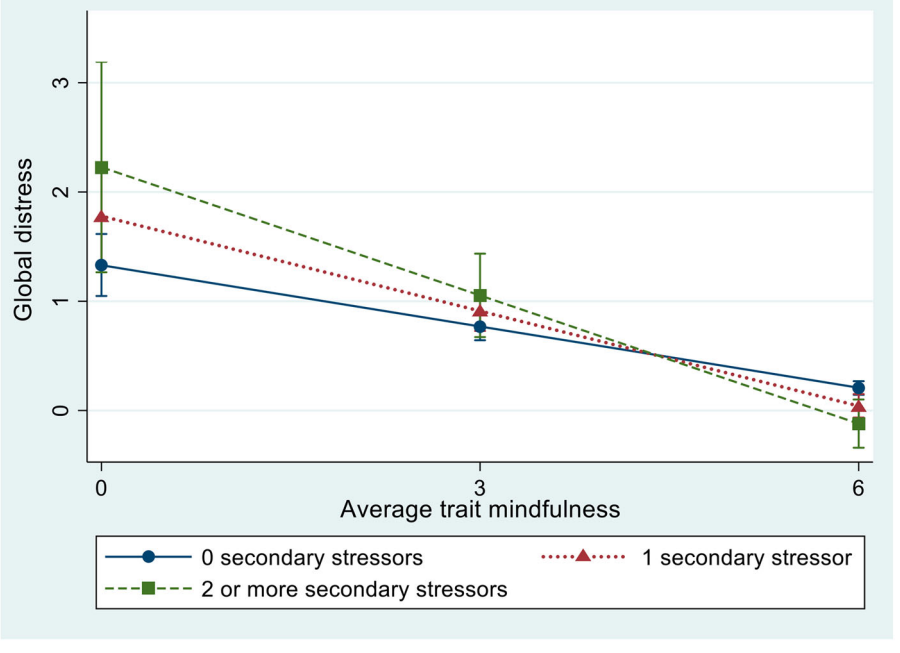

Figure 1. Moderating effect of trait mindfulness on COVID-19.secondary stressor exposure and global distress over Waves 1 (5/14/20–5/27/20) and 2 (12/21/21–1/11/22), adjusted for covariates, using generalized estimating equations, ($N = 1479$).

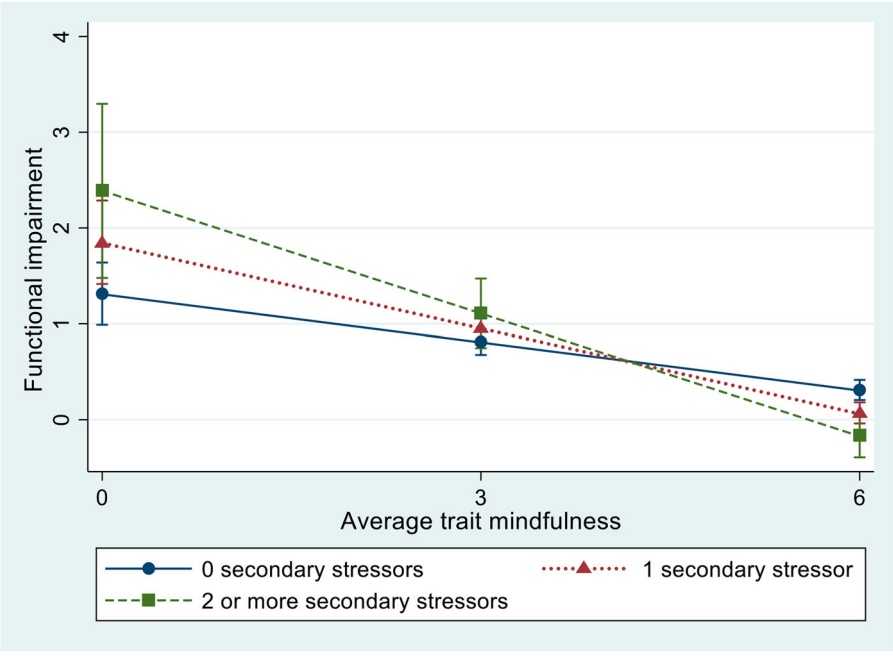

Figure 2. Moderating effect of trait mindfulness on COVID-19 secondary stressor exposure and functional impairment over Waves 1 (5/14/20–5/27/20) and 2 (12/21/21–1/11/22), adjusted for covariates, using generalized estimating equations, ($N = 1479$).

post-event psychosocial outcomes compared to prior work not controlling for these diagnoses. Finally, in cross-sectional analyses we found TM was negatively associated with COVID-19-related PTSS. This is notable as at least two smaller non-representative studies found no association between TM and PTSS among collective trauma exposed persons (see Hagen et al., 2016; Silveira et al., 2021).

Secondary hypothesis

Our secondary hypothesis was that TM would moderate the relationship between exposure and event-related and general psychosocial outcomes. This hypothesis was partially supported. In longitudinal analyses, TM moderated the relationship between COVID-19 secondary stress exposure (e.g., losing a job, losing wages) and global distress and functional impairment over time. The other interactions tested were not statistically significant.

Few prior studies have evaluated the moderating effect of TM on trauma exposure and psychosocial outcomes; those examining such moderation have reported mixed results. Our results align with findings that TM may buffer exposure-related outcomes for general, although not event-specific, symptoms. For example, in prior research, TM moderated the relationship between combat exposure and functional impairment among a sample of United States veterans (Nassi et al., 2019) and trauma exposure and internalizing symptoms in a small sample ($N = 108$) of hurricane-exposed children in the Caribbean (Cutright et al., 2019). Given that the effects of COVID-19 secondary stress exposures may persist for years and predict long-term adverse psychosocial outcomes (Cerdá et al., 2013; Galea et al., 2007), it is important to understand factors that build resilience against these stressors in the general populace. Our finding that TM may aid secondary stress-exposed individuals in buffering global distress and functional impairment suggests TM may be a target for interventions addressing adverse psychosocial outcomes in a post-event environment. Importantly, we note that in our sample PTSS (as well as event-related fear/worry) was relatively low. Thus, it is plausible that moderation effects may occur in samples with greater variability in response, at higher levels of PTSS and fear/worry, or with more highly exposed samples.

Public health and clinical applications

It is well established that collective trauma exposure is associated with increased psychosocial distress throughout the populace (see Goldmann & Galea, 2014; Silver et al., 2021). Given the potential adverse effects of such exposure, establishing TM as a potential construct to target could inform public health and clinical interventions to increase resilience and recovery. Indeed, evidence suggests it is possible to *increase* TM through mindfulness-based interventions (e.g., Jiménez-Gómez et al., 2022). For example, a recent study found participation in both Mindfulness-Based Stress Reduction (MBSR) and Mindful Self-Compassion were associated with large gains in TM compared to a control condition (Jiménez-Gómez et al., 2022). Longitudinal research suggests gains in TM associated with participation in MBSR may be maintained up to one-year post-intervention (Shapiro et al., 2011). This suggests TM may be a malleable, yet durable factor, which, once increased through an intervention, may help build psychological resilience relevant to future threats.

Communities may consider public health efforts that proactively encourage mindfulness training in efforts to bolster resilience and promote recovery. Such initiatives may buffer the risk of negative psychosocial outcomes in the event of a collective trauma. These efforts could take the shape of public health campaigns, school-based mindfulness trainings, or low-cost, widely available community-based programs. Additionally, mobile app-based interventions may provide a particularly expedient, efficacious, and cost-effective way to offer mindfulness training on a community level (Flett et al., 2019).

Mindfulness-based interventions may also be appropriate to increase TM and address adverse psychosocial outcomes in those presenting with clinically relevant post-event distress (Zhang et al., 2021). Such interventions have been found to be beneficial in treating negative outcomes in trauma-exposed individuals (see review from Taylor et al., 2020). Yet importantly, some studies report potential adverse effects of practicing meditation, including traumatic re-experiencing, as was found in a small minority of participants from a community (i.e., non-clinical) sample (Goldberg et al., 2022). Consequently, clinicians may wish to tailor mindfulness-based interventions for use with trauma-exposed populations to avoid such outcomes (Treleaven, 2018). Clinical trials of trauma-adapted mindfulness-based interventions administered in post-disaster contexts could be a fruitful area for future research, and should aim to identify the most suitable candidates for these interventions.

Limitations and directions for future research

Despite our study's strengths, we acknowledge some limitations. Like all self-report research, some recall bias may exist. Our survey-based approach, while methodologically rigorous, represents a broad snapshot of participants' experiences primarily at two time points. Future work may consider incorporating qualitative interviews or ecological momentary assessment to gain more nuanced insights. TM and COVID-19-related PTSS were only measured at Wave 1, thus we could not assess change in those variables over time. We analyzed our dependent variables in separate analyses to highlight event-specific responses and for consistency with the literature: multivariate approaches could be more parsimonious. While Likert-adapted versions of the PC-PTSD-5 efficiently capture variability in PTSS (Baker & Smith, 2023), more comprehensive assessments could include the Posttraumatic Stress Disorder Checklist for DSM-5, Clinician-Administered PTSD Scale for DSM-5, or both (Blevins et al., 2015; Weathers et al., 2018). All PC-PTSD-5 items were asked in reference to the COVID-19 pandemic, without an option for respondents to report on a Criterion A traumatic event more generally. While our assessment is consistent with prior work evaluating COVID-19 as a collective trauma (Thompson et al., 2022), our lack of Criterion A assessment precludes our ability to assess PTSD relevant to specific COVID-19-related exposures (e.g., sudden loss of a loved one) or the numerous other traumatic events (e.g., interpersonal abuse, serious accident) our participants may have experienced. Subsequent work may wish to explore the associations between TM and DSM-5 criterion PTSD.

Conclusion

Given the frequency and expected increase in collective traumas, establishing factors that promote mental health and functioning in the populace is critical. Using a methodologically rigorous design, this study demonstrated a consistent negative association between TM and adverse psychosocial outcomes after exposure to multiple collective traumas (i.e., repeated Gulf Coast hurricanes and COVID-19) and indicates TM may buffer the relationship between exposure to secondary stressors and some outcomes. Results suggest TM may help protect against post-event distress and may be a useful psychological resource to target in public health and clinical interventions after collective traumas.

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Data availability statement

The data that support the findings of this study are available at https://doi.org/10.17605/OSF.IO/TYRJQ.

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References

Aliche, C. J., Ifeagwazi, C. M., Yankouskaya, A., Comoretto, A., Wezyk, A., Ventouris, A., & Panourgia, C. (2021). Post-traumatic stress disorder and depressive symptoms following a Herdsmen attack: The role of life meaning in mediating trait mindfulness. *Stress and Health*, *37*(3), 528–537. https://doi.org/10.1002/smi.3012

Andridge, R. R., & Little, R. J. A. (2010). A review of hot deck imputation for survey non-response. *International Statistical Review*, *78*(1), 40–64. https://doi.org/10.1111/j.1751-5823.2010.00103.x

Baker, L. C., Bundorf, M. K., Singer, S., & Wagner, T. H. (2003). *Validity of the survey of health and Internet and Knowledge Network's panel and sampling*. http://www.knowledgenetworks.com/ganp/safe/aapor%202001%20nonresponse.pdf

Baker, L. D., & Smith, A. J. (2023). Adapting the Primary Care PTSD Screener for firefighters. *Occupational Medicine*, *73*(3), 142–147. https://doi.org/10.1093/occmed/kqad019

Ballinger, G. A. (2004). Using generalized estimating equations for longitudinal data analysis. *Organizational Research Methods*, *7*(2), 127–150. https://doi.org/10.1177/1094428104263672

Belen, H. (2021). Fear of COVID-19 and mental health: The role of mindfulness in during times of crisis. *International Journal of Mental Health and Addiction*, *20*(1), 607–618. https://doi.org/10.1007/s11469-020-00470-2

Bennett, K. M., Panzeri, A., Derrer-Merk, E., Butter, S., Hartman, T. K., Mason, L., McBride, O., Murphy, J., Shevlin, M., Gibson-Miller, J., Levita, L., Martinez, A. P., McKay, R., Lloyd, A., Stocks, T. V. A., Bottesi, G., Vidotto, G., Bentall, R. P.,

& Bertamini, M. (2023). Predicting resilience during the COVID-19 pandemic in the United Kingdom: Cross-sectional and longitudinal results. *PLoS ONE*, *18*(5), e0283254. https://doi.org/10.1371/journal.pone.0283254

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., Segal, Z. v., Abbey, S., Speca, M., Velting, D., & Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, *11*(3), 230–241. https://doi.org/10.1093/clipsy.bph077

Black, D. S., Sussman, S., Johnson, C. A., & Milam, J. (2012). Psychometric assessment of the Mindful Attention Awareness Scale (MAAS) among Chinese adolescents. *Assessment*, *19*(1), 42–52. https://doi.org/10.1177/1073191111415365

Blevins, C. A., Weathers, F. W., Davis, M. T., Witte, T. K., & Domino, J. L. (2015). The Posttraumatic Stress Disorder Checklist for *DSM-5* (PCL-5): Development and initial psychometric evaluation. *Journal of Traumatic Stress*, *28*(6), 489–498. https://doi.org/10.1002/jts.22059

Boelen, P. A., & Lenferink, L. I. M. (2018). Experiential acceptance and trait-mindfulness as predictors of analogue post-traumatic stress. *Psychology and Psychotherapy: Theory, Research and Practice*, *91*(1), 1–14. https://doi.org/10.1111/papt.12138

Boyd, J. E., Lanius, R. A., & McKinnon, M. C. (2018). Mindfulness-based treatments for posttraumatic stress disorder: A review of the treatment literature and neurobiological evidence. *Journal of Psychiatry & Neuroscience, 43*(1), 7–25. https://doi.org/10.1503/jpn.170021

Brazier, J. E., Harper, R., Jones, B. N. M., Thomas, K. J., Usherwood, T., & Westlake, L. (1992). Validating the SF-36 health survey questionnaire: New outcome measure for primary care. *BMJ*, *305*(6846), 160–164. https://doi.org/10.1136/bmj.305.6846.160

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology*, *84*(4), 822–848. https://doi.org/10.1037/0022-3514.84.4.822

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. *Environmental Research*, *214*(3), 114020. https://doi.org/10.1016/j.envres.2022.114020

Carpenter, J. K., Conroy, K., Gomez, A. F., Curren, L. C., & Hofmann, S. G. (2019). The relationship between trait mindfulness and affective symptoms: A meta-analysis of the Five Facet Mindfulness Questionnaire (FFMQ). *Clinical Psychology Review*, *74*, 101785. https://doi.org/10.1016/j.cpr.2019.101785

Cerdá, M., Bordelois, P. M., Galea, S., Norris, F., Tracy, M., & Koenen, K. C. (2013). The course of posttraumatic stress symptoms and functional impairment following a disaster: What is the lasting influence of acute versus ongoing traumatic events and stressors? *Social Psychiatry and Psychiatric Epidemiology*, *48*(3), 385–395. https://doi.org/10.1007/s00127-012-0560-3

Conversano, C., di Giuseppe, M., Miccoli, M., Ciacchini, R., Gemignani, A., & Orrù, G. (2020). Mindfulness, age and gender as protective factors against psychological distress during COVID-19 pandemic. *Frontiers in Psychology*, *11*, 1900. https://doi.org/10.3389/fpsyg.2020.01900

Cox, B. G. (1980). The weighted sequential hot deck imputation procedure. *Proceedings of the American Statistical Association Section on Survey Research Methods*, 721–726.

Curtiss, J., & Klemanski, D. H. (2014). Teasing apart low mindfulness: Differentiating deficits in mindfulness and in psychological flexibility in predicting symptoms of generalized anxiety disorder and depression. *Journal of Affective Disorders*, *166*, 41–47. https://doi.org/10.1016/j.jad.2014.04.062

Cutright, N. L., Padgett, E. E., Awada, S. R., Pabis, J. M., & Pittman, L. D. (2019). The role of mindfulness in psychological outcomes for children following hurricane exposure. *Mindfulness*, *10*(9), 1760–1767. https://doi.org/10.1007/s12671-019-01135-5

Derogatis, L. R. (1983). The Brief Symptom Inventory: An introductory report. *Psychological Medicine*, *13*(3), 595–605. https://doi.org/10.1017/S0033291700048017

Dillard, A. J., & Meier, B. P. (2021). Trait mindfulness is negatively associated with distress related to COVID-19. *Personality and Individual Differences*, *179*, 110955. https://doi.org/10.1016/j.paid.2021.110955

Feng, K., & Lin, N. (2021). Reconstructing and analyzing the traffic flow during evacuation in Hurricane Irma (2017). *Transportation Research Part D: Transport and Environment*, *94*, 102788. https://doi.org/10.1016/j.trd.2021.102788

Fernandez, E., Callen, A., Johnson, S. L., Gaspar, C., Kulhanek, C., & Jose-Bueno, C. (2020). Prevalence, elicitors, and expression of anger in 21st century mass shootings. *Aggression and Violent Behavior*, *55*, 101483. https://doi.org/10.1016/j.avb.2020.101483

First, J. M., & Houston, J. B. (2022). The mental health impacts of successive disasters: Examining the roles of individual and community resilience following a tornado and COVID-19. *Clinical Social Work Journal*, *50*(2), 124–134. https://doi.org/10.1007/s10615-021-00830-y

Fitzgerald, M. (2022). Childhood maltreatment is associated with adult psychopathology through decreased dispositional mindfulness. *Journal of Aggression, Maltreatment & Trauma*, *31*(10), 1263–1278. https://doi.org/10.1080/10926771.2022.2043971

Flett, J. A. M., Hayne, H., Riordan, B. C., Thompson, L. M., & Conner, T. S. (2019). Mobile mindfulness meditation: A randomised controlled trial of the effect of two popular apps on mental health. *Mindfulness*, *10*(5), 863–876. https://doi.org/10.1007/s12671-018-1050-9

Galea, S., Brewin, C. R., Gruber, M., Jones, R. T., King, D. W., King, L. A., McNally, R. J., Ursano, R. J., Petukhova, M., & Kessler, R. C. (2007). Exposure to hurricane-related stressors and mental illness after Hurricane Katrina. *Archives of General Psychiatry*, *64*(12), 1427–1434. https://doi.org/10.1001/archpsyc.64.12.1427

Gallagher, M. W., Zvolensky, M. J., Long, L. J., Rogers, A. H., & Garey, L. (2020). The impact of COVID-19 experiences and associated stress on anxiety, depression, and functional impairment in American adults. *Cognitive Therapy and Research*, *44*(6), 1043–1051. https://doi.org/10.1007/s10608-020-10143-y

Garfin, D. R., Djokovic, L., Silver, R. C., & Holman, E. A. (2022). Acute stress, worry, and impairment in health care and non-health care essential workers during the COVID-19 pandemic. *Psychological Trauma: Theory, Research, Practice, and Policy*, *14*(8), 1304–1313. https://doi.org/10.1037/tra0001224

Garfin, D. R., Holman, E. A., & Silver, R. C. (2015). Cumulative exposure to prior collective trauma and acute stress responses to the Boston Marathon bombings. *Psychological Science*, *26*(6), 675–683. https://doi.org/10.1177/0956797614561043

Garfin, D. R., & Silver, R. C. (2016). Responses to natural disasters. In H. S. Friedman (Ed.), *Encyclopedia of mental health* (2nd ed.,Vol. 4, pp. 35–46). Academic Press. https://doi.org/10.1016/B978-0-12-397045-9.00161-0

Garfin, D. R., Silver, R. C., Ugalde, F. J., Linn, H., & Inostroza, M. (2014). Exposure to rapid succession disasters: A study of residents at the epicenter of the Chilean Bío Bío earthquake. *Journal of Abnormal Psychology*, *123*(3), 545–556. https://doi.org/10.1037/a0037374

Garfin, D. R., Thompson, R. R., Holman, E. A., Wong-Parodi, G., & Silver, R. C. (2022). Association between repeated exposure to hurricanes and mental health in a representative sample of Florida residents. *JAMA Network Open*, *5*(6), e2217251. https://doi.org/10.1001/jamanetworkopen.2022.17251

Garfin, D. R., Thompson, R. R., & Wong-Parodi, G. (2022). Media exposure, threat processing, and mitigation behaviors in Gulf Coast residents facing the co-occurring threats of COVID-19 and hurricanes. *Risk Analysis*, *43*, 1370–1386. https://doi.org/10.1111/risa.14032

Goldberg, S. B., Lam, S. U., Britton, W. B., & Davidson, R. J. (2022). Prevalence of meditation-related adverse effects in a population-based sample in the United States. *Psychotherapy Research*, *32*(3), 291–305. https://doi.org/10.1080/10503307.2021.1933646

Goldmann, E., & Galea, S. (2014). Mental health consequences of disasters. *Annual Review of Public Health*, *35*(1), 169–183. https://doi.org/10.1146/annurev-publhealth-032013-182435

Hagen, C., Lien, L., Hauff, E., & Heir, T. (2016). Is mindfulness protective against PTSD? A neurocognitive study of 25 tsunami disaster survivors. *Journal of Negative Results in BioMedicine*, *15*(13). https://doi.org/10.1186/s12952-016-0056-x

Hammen, C., Kim, E. Y., Eberhart, N. K., & Brennan, P. A. (2009). Chronic and acute stress and the prediction of major depression in women. *Depression and Anxiety*, *26*(8), 718–723. https://doi.org/10.1002/da.20571

Harper, L., Jones, A., Goodwin, L., & Gillespie, S. (2022). Association between trait mindfulness and symptoms of post-traumatic stress: A meta-analysis. *Journal of Psychiatric Research*, *152*, 233–241. https://doi.org/10.1016/j.jpsychires.2022.05.027

Harville, E. W., Shankar, A., Schetter, C. D., & Lichtveld, M. (2018). Cumulative effects of the Gulf Oil spill and other disasters on mental health among reproductive-aged women: The Gulf Resilience on Women's Health study. *Psychological Trauma: Theory, Research, Practice, and Policy*, *10*(5), 533–541. https://doi.org/10.1037/tra0000345

Holingue, C., Badillo-Goicoechea, E., Riehm, K. E., Veldhuis, C. B., Thrul, J., Johnson, R. M., Fallin, M. D., Kreuter, F., Stuart, E. A., & Kalb, L. G. (2020). Mental distress during the COVID-19 pandemic among US adults without a pre-existing mental health condition: Findings from American trend panel survey. *Preventive Medicine*, *139*, 106231. https://doi.org/10.1016/j.ypmed.2020.106231

Holman, E. A., Thompson, R. R., Garfin, D. R., & Silver, R. C. (2020). The unfolding COVID-19 pandemic: A probability-based, nationally representative study of mental health in the United States. *Science Advances*, *6*(42), eabd5390. https://doi.org/10.1126/sciadv.abd5390

Hou, W. K., Ng, S. M., & Wan, J. H. Y. (2015). Changes in positive affect and mindfulness predict changes in cortisol response and psychiatric symptoms: A latent change score modelling approach. *Psychology & Health*, *30*(5), 551–567. https://doi.org/10.1080/08870446.2014.990389

Jiménez-Gómez, L., Yela, J. R., Crego, A., Melero-Ventola, A. R., & Gómez-Martínez, MÁ. (2022). Effectiveness of the Mindfulness-Based Stress Reduction (MBSR) vs. the Mindful Self-Compassion (MSC) programs in clinical and health psychologist trainees. *Mindfulness*, *13*(3), 584–599. https://doi.org/10.1007/s12671-021-01814-2

Kabat-Zinn, J. (2003). Mindfulness-based interventions in context: Past, present, and future. *Clinical Psychology: Science and Practice*, *10*(2), 144–156. https://doi.org/10.1093/clipsy.bpg016

Keesing, F., & Ostfeld, R. S. (2021). Impacts of biodiversity and biodiversity loss on zoonotic diseases. *Proceedings of the National Academy of Sciences*, *118*(7), e2023540118. https://doi.org/10.1073/pnas.2023540118

Kiken, L. G., & Shook, N. J. (2014). Does mindfulness attenuate thoughts emphasizing negativity, but not positivity? *Journal of Research in Personality*, *53*, 22–30. https://doi.org/10.1016/j.jrp.2014.08.002

Lau, M. A., Bishop, S. R., Segal, Z. v., Buis, T., Anderson, N. D., Carlson, L., Shapiro, S., Carmody, J., Abbey, S., & Devins, G. (2006). The Toronto Mindfulness Scale: Development and validation. *Journal of Clinical Psychology*, *62*(12), 1445–1467. https://doi.org/10.1002/jclp.20326

Lowe, S. R., McGrath, J. A., Young, M. N., Kwok, R. K., Engel, L. S., Galea, S., & Sandler, D. P. (2019). Cumulative disaster exposure and mental and physical health symptoms among a large sample of Gulf Coast residents. *Journal of Traumatic Stress*, *32*(2), 196–205. https://doi.org/10.1002/jts.22392

Nassi, T. H., Start, A. R., Tobln, R. L., & Adler, A. B. (2019). Self-reported mindfulness and soldier health following a combat deployment. *Psychological Trauma: Theory, Research, Practice, and Policy*, *11*(4), 466–474. https://doi.org/10.1037/tra0000413

National Weather Service. (2022). *Gulf Coast hurricane preparedness*. https://www.weather.gov/media/mob/pdf/GulfCoastHurricanePrep.pdf

Nitzan-Assayag, Y., Aderka, I. M., & Bernstein, A. (2015). Dispositional mindfulness in trauma recovery: Prospective relations and mediating mechanisms. *Journal of Anxiety Disorders*, *36*, 25–32. https://doi.org/10.1016/j.janxdis.2015.07.008

NOAA National Centers for Environmental Information. (2023). *U.S. billion-dollar weather and climate disasters*. https://www.ncei.noaa.gov/access/billions

Norrholm, S. D., Zalta, A., Zoellner, L., Powers, A., Tull, M. T., Reist, C., Schnurr, P. P., Weathers, F., & Friedman, M. J. (2021). Does COVID-19 count?: Defining Criterion A trauma for diagnosing PTSD during a global crisis. *Depression and Anxiety*, *38*(9), 882–885. https://doi.org/10.1002/da.23209

Omid, A., Mohammadi, A. S., Jalaeikhoo, H., & Taghva, A. (2017). Dispositional mindfulness, psychological distress, and posttraumatic growth in cancer patients. *Journal of Loss and Trauma*, *22*(8), 681–688. https://doi.org/10.1080/15325024.2017.1384783

Ostafin, B. D. (2015). Taming the wild elephant: Mindfulness and its role in overcoming automatic mental processes. In B. D. Ostafin, M. D. Robinson, & B. P. Meier (Eds.), *Handbook of mindfulness and self-regulation* (pp. 47–63). Springer. https://doi.org/10.1007/978-1-4939-2263-5_5

Pierce, M., McManus, S., Jessop, C., John, A., Hotopf, M., Ford, T., Hatch, S., Wessely, S., & Abel, K. M. (2020). Says who? The significance of sampling in mental health surveys during COVID-19. *The Lancet Psychiatry*, *7*(7), 567–568. https://doi.org/10.1016/S2215-0366(20)30237-6

Prins, A., Bovin, M. J., Smolenski, D. J., Marx, B. P., Kimerling, R., Jenkins-Guarnieri, M. A., Kaloupek, D. G., Schnurr, P. P., Kaiser, A. P., Leyva, Y. E., & Tiet, Q. Q. (2016). The Primary Care PTSD Screen for DSM-5 (PC-PTSD-5): Development and evaluation within a veteran primary care sample. *Journal of General Internal Medicine*, *31*(10), 1206–1211. https://doi.org/10.1007/s11606-016-3703-5

Schneider, M. (2019, October 9). A year after Michael, Florida community still in crisis. *AP News*. https://apnews.com/article/storms-us-news-violence-florida-united-states-0d260a9ec44545458ab1f25b6f969a5a

Shapiro, S. L., Brown, K. W., Thoresen, C., & Plante, T. G. (2011). The moderation of mindfulness-based stress reduction effects by trait mindfulness: Results from a randomized controlled trial. *Journal of Clinical Psychology*, *67*(3), 267–277. https://doi.org/10.1002/jclp.20761

Silveira, S., Kornbluh, M., Withers, M. C., Grennan, G., Ramanathan, V., & Mishra, J. (2021). Chronic mental health sequelae of climate change extremes: A case study of the deadliest Californian wildfire. *International Journal of Environmental Research and Public Health*, *18*(4), 1487–1415. https://doi.org/10.3390/ijerph18041487

Silver, R. C., & Garfin, D. R. (2016). Coping with disasters. In J. C. Norcross, G. R. VandenBos, & D. K. Freedheim (Eds.), *APA handbook of clinical psychology: Psychopathology and health* (Vol. 4, pp. 597–611). American Psychological Association. https://doi.org/10.1037/14862-029

Silver, R. C., Holman, E. A., & Garfin, D. R. (2021). Coping with cascading collective traumas in the United States. *Nature Human Behaviour*, *5*(1), 4–6. https://doi.org/10.1038/s41562-020-00981-x

Smith, B. W., Ortiz, J. A., Steffen, L. E., Tooley, E. M., Wiggins, K. T., Yeater, E. A., Montoya, J. D., & Bernard, M. L. (2011). Mindfulness is associated with fewer PTSD symptoms, depressive symptoms, physical symptoms, and alcohol problems in urban firefighters. *Journal of Consulting and Clinical Psychology*, *79*(5), 613–617. https://doi.org/10.1037/a0025189

StataCorp LLC. (2021). *Stata (Version 17)*. [Computer software]. StataCorp LLC.

Sweeting, J. A., Garfin, D. R., Holman, E. A., & Silver, R. C. (2020). Associations between exposure to childhood bullying and abuse and adulthood outcomes in a representative national U.S. sample. *Child Abuse & Neglect*, *101*, 104048. https://doi.org/10.1016/j.chiabu.2019.104048

Taylor, J., McLean, L., Korner, A., Stratton, E., & Glozier, N. (2020). Mindfulness and yoga for psychological trauma: Systematic review and meta-analysis. *Journal of Trauma & Dissociation*, *21*(5), 536–573. https://doi.org/10.1080/15299732.2020.1760167

Thompson, R. R., Jones, N. M., Freeman, A. M., Holman, E. A., Garfin, D. R., & Silver, R. C. (2022). Psychological responses to U.S. statewide restrictions and COVID-19 exposures: A longitudinal study. *Health Psychology*, *41*(11), 817–825. https://doi.org/10.1037/hea0001233

Thompson, R. W., Arnkoff, D. B., & Glass, C. R. (2011). Conceptualizing mindfulness and acceptance as components of psychological resilience to trauma. *Trauma, Violence, & Abuse*, *12*(4), 220–235. https://doi.org/10.1177/1524838011416375

Ting, M., Kossin, J. P., Camargo, S. J., & Li, C. (2019). Past and future hurricane intensity change along the U.S. East Coast. *Scientific Reports*, *9*(1). https://doi.org/10.1038/s41598-019-44252-w

Tomlinson, E. R., Yousaf, O., Vittersø, A. D., & Jones, L. (2018). Dispositional mindfulness and psychological health: A systematic review. *Mindfulness*, *9*(1), 23–43. https://doi.org/10.1007/s12671-017-0762-6

Treleaven, D. A. (2018). *Trauma-sensitive mindfulness: Practices for safe and transformative healing*. W. W. Norton & Company.
van Dam, N. T., Earleywine, M., & Borders, A. (2010). Measuring mindfulness? An item response theory analysis of the Mindful Attention Awareness Scale. *Personality and Individual Differences*, *49*(7), 805–810. https://doi.org/10.1016/j.paid.2010.07.020
Ware, J. E., & Sherbourne, C. D. (1992). The MOS 36-Item Short-Form Health Survey (SF-36): I. Conceptual framework and item selection. *Medical Care*, *30*(6), 473–483. https://doi.org/10.1097/00005650-199206000-00002
Weathers, F. W., Bovin, M. J., Lee, D. J., Sloan, D. M., Schnurr, P. P., Kaloupek, D. G., Keane, T. M., & Marx, B. P. (2018). The Clinician-Administered PTSD Scale for DSM-5 (CAPS-5): Development and initial psychometric evaluation in military veterans. *Psychological Assessment*, *30*(3), 383–395. https://doi.org/10.1037/pas0000486
Williams, R., Ntontis, E., Alfadhli, K., Drury, J., & Amlôt, R. (2021). A social model of secondary stressors in relation to disasters, major incidents and conflict: Implications for practice. *International Journal of Disaster Risk Reduction*, *63*, 102436. https://doi.org/10.1016/j.ijdrr.2021.102436
Zhang, D., Lee, E. K. P., Mak, E. C. W., Ho, C. Y., & Wong, S. Y. S. (2021). Mindfulness-based interventions: An overall review. *British Medical Bulletin*, *138*(1), 41–57. https://doi.org/10.1093/bmb/ldab005