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**“To Live in the Body of a Survivor<sup>1</sup>”: Unique and Cumulative Disaster Exposure and Mental Health in a Sample of Hurricane Katrina Survivors**

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A Thesis Submitted in Partial Fulfillment of the  
Requirements for the Degree of Master of Public Health (MPH)

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May 2023

*Key words:* Disaster exposure, hurricanes, COVID-19, posttraumatic stress, psychological distress, social and behavioral sciences

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<sup>1</sup> Baird, B. (2019). *To live in the body of a survivor* [Video]. YouTube.  
[https://www.youtube.com/watch?v=Sf0FcGi\\_9bM&t=2s](https://www.youtube.com/watch?v=Sf0FcGi_9bM&t=2s)

## Abstract

**Introduction:** Fueled by the escalation of climate change, weather-related disasters are increasing in frequency and severity. Existing research has documented the extensive harm induced by such disasters, yet few studies have examined how individuals' psychological well-being fares when exposed to multiple, diverse threats, including other weather-related and public health disasters (e.g., COVID-19). As such, the present study explores posttraumatic and psychological distress in the context of unique and cumulative disaster exposure.

**Methods:** The data utilized for this study came from the Resilience in Survivors of Katrina (RISK) Project. The sample was comprised of 381 predominantly Non-Hispanic Black (84.5%) women who experienced varied levels of exposure to Hurricanes Katrina, Laura, and Sally, as well as the COVID-19 pandemic. Multiple linear regression models explored associations between unique and cumulative disaster exposures and three outcomes: Katrina-related posttraumatic stress (PTS), pandemic-related PTS, and psychological distress (PD), controlling for socio-demographic factors and pre-event mental health.

**Results:** The unique disaster model revealed experiencing more stressors related to Hurricane Katrina was significantly associated with higher pandemic-related PTS and PD, Hurricane Sally with higher PD, and the COVID-19 pandemic with higher pandemic- and Katrina-related PTS and PD. The cumulative disaster model found significant positive associations between experiencing "high" exposure to one disaster and PD, as well as two and three or more disasters with all three mental health outcomes, relative to experiencing no "high" exposures.

**Conclusion:** These results reveal novel findings about the relationship between unique and cumulative disaster exposure and adverse mental health outcomes and provide insight into future investment in resource allocation efforts and post-disaster initiatives.

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## Table of Contents

<b>Introduction .....</b>	<b>6</b>
<b>Methods .....</b>	<b>10</b>
Participants and Procedure .....	10
Measures .....	12
Analytical Approach.....	15
<b>Results.....</b>	<b>15</b>
Preliminary Analyses.....	15
Discussion.....	22
Recommendations .....	25
Limitations.....	26
<b>Conclusion .....</b>	<b>27</b>
<b>References .....</b>	<b>28</b>

## **List of Tables**

1. Table 1. Description of the sample (N = 381)
2. Table 2. Pearson's correlation (N = 381)
3. Table 3: Multiple linear regression model, unique disaster exposure (N=381)
4. Table 4: Multiple linear regression model, cumulative disaster exposure (N=381)

## Introduction

Fueled by the escalation of climate change, weather-related disasters are increasing in frequency and severity (IPCC, 2022). The average number of annual weather-related disasters in the United States has risen from three in the 1980s to 13 in the 2010s, with damage costs and household economic deficits rising in tandem (National Centers for Environmental Information, 2023; World Meteorological Association, 2021). Among those regions most vulnerable to the effects of weather-related disasters is the Gulf Coast of the United States (i.e., Texas, Louisiana, Mississippi, Alabama, and Florida) as a result of its geographic susceptibility to warmer temperatures and intense storm surges (Bathi & Das, 2016; Hotez, 2011). The harmful effects of hurricanes are well-known and far-reaching, including financial, material, and familial losses, as well as adverse impacts on physical health (e.g., communicable, cardiovascular disease) and mental health (e.g., depression, posttraumatic stress [PTS]) both in the immediate post-disaster context and long-term aftermath (Beaglehole et al., 2018; Galea et al., 2007; Harville et al., 2018; Mandavia, 2019; Rhodes et al., 2010; Waddell et al., 2021).

Among the costliest and deadliest hurricanes in the Gulf Coast and U.S. history was Hurricane Katrina, which amassed \$108 billion in damages and led to a loss of 1,833 lives. Making landfall in late August of 2005 off the coast of Florida, the initially category 1 hurricane evolved into a category 5, sweeping across Louisiana and Mississippi over a four-day period (National Weather Service, 2022). Since Hurricane Katrina, 28 hurricanes have struck the United States; Hurricanes Laura and Sally are among the 75% that affected the Gulf Coast (Atlantic Oceanographic & Meteorological Laboratory, 2022).

In August 2020, almost exactly 15 years after Hurricane Katrina, Hurricane Laura, developing from a tropical wave off the coast of Africa in mid-August, escalated into a category

4 hurricane by the time it made its way to Louisiana and moved towards Texas, ultimately claiming seven lives (Pasch et al., 2021). Less than one month after Hurricane Laura, in September 2020, Louisiana and Texas were struck by category 2 Hurricane Sally, which led to extensive flooding in western Florida and southern Alabama, and four reported deaths (Berg & Reinhart, 2020). The proximal succession of these two hurricanes reflect the escalating threats posed by climate change and the mounting damages that are a product of weather-related disasters.

Complicating the increasing occurrence and intensity of weather-related disasters is the ongoing devastation wrought by the COVID-19 pandemic. With the loss of more than 1.1 million lives, economic fallout induced by job loss, and consequent inability to access vital resources, such as medication and shelter, and exacerbation of the already deeply embedded health inequities in the U.S., the country continues to reel from the effects of virus (Center on Budget and Policy Priorities, 2021; World Health Organization, 2023). Widespread experiences with such stressors have undermined health and well-being, with studies documenting the pandemic as a source of depression, anxiety, substance misuse, and burnout as well as having compromised physical health by reducing physical activity and impeding access to care associated with chronic conditions (Allen et al., 2022; Dubey et al., 2020; Hacker et al., 2021; Salanti et al., 2022). The effects of the COVID-19 pandemic are complicated in vulnerable settings, including the conditions offered during hurricane evacuation. The highly mobile and overcrowded nature of post-disaster evacuation and relocation efforts increase the risk of COVID-19 transmission, among other highly virulent communicable diseases (Price et al., 2020; Tracey et al., 2022).



Emergent research conveys how the harms induced by disaster survivorship are compounded by cumulative disaster and traumatic event exposure, positing that each additional disaster experienced increases the risk of poor mental and physical health outcomes among those exposed, including generalized anxiety disorder, major depression, and poorer overall health (Fernandez et al., 2005; Leppold, 2022; Lowe et al., 2019). One outcome commonly explored by researchers in the post-disaster context is PTS, which is characterized by intrusion, avoidance, and alterations in mood, cognition, and arousal tied to a direct, witnessed, indirect, or vicarious experience involving threatened death, serious injury, or sexual violation (American Psychiatric Association, 2013; Goldmann & Galea, 2014). Another frequently assessed measure is psychological distress (PD), which encompasses a wider scope of adverse mental health outcomes than those captured by PTS, defined broadly as heightened cognitive, behavioral, emotional and psychophysiological symptoms (e.g., depressed mood, alterations in dietary habits, inability to concentrate) that are common to a range of mental health conditions (Kessler et al., 2002).

Further study of mental health outcomes such as PTS and PD reveal stark disparities in general as well as post-event health and well-being among communities of color and Black women in particular. It is well-documented that stressors and inadequate access to resources that facilitate elevated socioeconomic status, acquisition of medical care, and stable housing in a safe geographic location perpetuate racial and ethnic health disparities for women throughout the U.S., undermining their resilience and recovery post-disaster (Williams, 2002). Existing research has shown that African American survivors of weather-related disaster exposure face elevated diagnosis of adverse mental health outcomes, including depression and posttraumatic stress disorder (PTSD) (Davidson et al., 2013; Sibrava et al., 2019). Further evidence of this is the

extensive amount of data collected in the wake of Hurricane Katrina. Amidst a significant decline in the health of the adult population in New Orleans, Louisiana was a rise in stressors that fostered worse health outcomes among middle-aged Black females, such as destruction of homes, loss of material belongings, and household separations, with negative mental health outcomes persisting as a result in the years after Hurricane Katrina (Sastry & Gregory, 2012; Zacher et al., 2023). Fifteen years later, history has repeated itself, with studies indicating that female sex, financial insecurity, living with preexisting physical and psychological ailments, and being subject to discrimination and social abuse worsened outcomes associated with COVID-19 infections, facilitating the deterioration of mental health among this population (Gibson et al., 2021; Seedat, 2021).

As evidenced above, today's political climate – complicated by events such as the COVID-19 pandemic, acts of violence against Black civilians, and the escalation of climate change – reflect intensified experiences of stress on a global scale, providing a unique context to explore how resilience fares when multiple threats to health and well-being are involved (Silver et al., 2021). Recent studies exploring PTSD and PD in the COVID-19 and social unrest landscapes have found increases in diagnoses of PTSD, depressive, and anxiety disorders (Bo et al., 2021; First et al., 2020; Karatzias, 2020; Miller, 2021; Morabito, 2021; Pitron et al., 2022).

However, largely missing from extant literature is cumulative disaster exposure in the context of the COVID-19 pandemic. To date, four studies have been published on multiple disaster exposures amidst the COVID-19 pandemic, three of which focused on weather-related disasters. These studies revealed that multiple weather-related exposures (e.g., hurricanes, floods, droughts, bushfires) were associated with heightened levels of PTSD, depressive, anxiety, and stress-related symptoms, in part largely attributed to income loss that was predicted by severity

of disaster-related damage (Callender et al., 2022; First and Houston, 2022; Podubinski & Glenister, 2021). Despite the promise of improving public understanding of multiple traumatic exposure on mental health, the findings of the studies were limited by small sample sizes, minimal attention paid to populations facing health disparities, and lack of prospective data on pre-disaster mental health and wellness. With the Biden administration announcing the end of the public health and national emergency declarations associated with the COVID-19 pandemic on May 11<sup>th</sup>, 2023, the longer-term effects of the COVID-19 pandemic on mental health across the nation remains largely unknown (Cox et al., 2023; H.J. Res. 7, 2023).

As time progresses, it will be critical to engage in research that examines the unique and cumulative effects of such traumatic events to elucidate the state of health and well-being in the 21<sup>st</sup> century. One such area of study is the longitudinal implications of unique and multiple traumas on event-specific PTS and PD – particularly, the ways in which exposure to such events can augment risk for poor mental health outcomes among previously-traumatized populations. In the current study, I therefore explore event-specific PTS and PD in the context of unique and cumulative disaster exposure to Hurricanes Katrina, Laura, and Sally as well as the COVID-19 pandemic.

## **Methods**

### *Participants and Procedure*

The data utilized for this analysis were from the Resilience in Survivors of Katrina (RISK) Project, a longitudinal Harvard and Princeton University IRB-approved cohort study of Hurricane Katrina survivors. The project, which originated as the Opening Doors study, began as a data collection effort from community colleges across the United States (Richburg-Hayes et al.,

2009). Participants were selected from two community colleges in New Orleans, Louisiana – Delgado Community College and Louisiana Technical College – in 2004. To be eligible for participation, students had to be a single parent between the ages of 18 and 34 years old, a high school graduate or GED recipient, and have an income less than 200% of the federal poverty level. A total of 1,019 eligible community college students ultimately participated in the study (i.e., Pre-Katrina), completing a brief survey that included socio-demographic characteristics (e.g., age, race/ethnicity, marital status, number of public benefits received), perceived social support, and PD (Pre-Katrina [PK]). Among said participants, 942 (92.4%) were female and 85% were African American with an average monthly income of \$993.21 (SD = \$536.46) (Lowe et al., 2020). Participation in the project was intended to help eligible students acquire further education and employment post-graduation through services and resources such as financial aid and student support (Richburg-Hayes et al., 2009).

After follow-up for the Opening Doors study was interrupted by Hurricane Katrina's landfall on August 29<sup>th</sup>, 2005, the trajectory of the study was reconfigured. A follow-up approximately one-year post-Hurricane Katrina (Follow-up 1 [F1]) initiated the study's transformation to focus on tracking low-income mothers' outcomes after the storm. To date, there have been four rounds of post-Katrina questionnaire data collection efforts. Following the first wave of data collection, in which surveys were conducted via telephone surveys (F1), data was collected in 2009-2010 (Follow-up 2 [F2], approximately 4 years post-Katrina) via telephone surveys and in 2016-2018 (Follow-up 3 [F3], approximately 12 years post-Katrina). Most recently, an additional wave of data was collected during the COVID-19 pandemic in 2021-2022 (Follow-up 4 [F4], approximately 16 years post-Katrina) via a combination of telephone and online surveys. Due to limited funding available during F4, efforts were focused

on surveying those who completed F3 and the target sample size was set a priori at 500 participants. A total of 467 individuals (49.6% of the baseline sample of 942 mothers) completed F4; of these, 381 (81.6%) had complete data on all variables in the current study and comprised the final analytic sample.

### *Measures*

Hurricane-related stressors: Katrina-related stressors were measured at F1, and for those who did not complete F1, at F2. Participants indicated whether they had experienced the following potentially traumatic or stressful experiences associated with surviving Hurricane Katrina: belief their life was in danger, lacked access to medications and/or medical care, did not know whether their child/children and/or relative(s) were safe, had a relative that could not access medical care, lacked access to food, and whether their neighborhood flooded as a result of the storm (Raker et al., 2020). A total number of affirmative responses was included, ranging from 0 to 8.

At F4, participants were also asked to report whether they were living in an area affected by Hurricane Laura in August of 2020 and/or Hurricane Sally the following month at the time each hurricane made landfall. Those who answered affirmatively were then asked to indicate their exposure to stressors related to the respective hurricane, using the same items used to assess exposure to Hurricane Katrina. For each hurricane, a count of affirmative responses was computed, ranging from 0 to 8.

Pandemic-related stressors: Pandemic exposure was measured by a count of affirmative responses to 13 questions about personal experiences with COVID-19. Questions included whether the respondent had or likely had COVID-19, whether they were seriously ill and/or hospitalized because of their diagnosis, and whether a relative or friend was diagnosed with

COVID-19, were seriously ill and/or hospitalized, and/or died because of the virus. Two questions assessed fears surrounding COVID-19: that they were very or extremely worried that themselves or that a friend or family member would become seriously ill and/or die from COVID-19. The final questions centered health care access and exposure among respondents, family, and friends (e.g, whether they had access to medical care when needed, whether they had access to prescriptions) (Zacher et al., 2023).

Cumulative hurricane exposure: Cumulative hurricane exposure reflected the number of disasters in which the participant experienced “high” exposure, defined as above the median for that hurricane in the analytic sample, ranging from 0 (i.e., “high” exposure for none of the events) to 4 (i.e., “high” exposure for Hurricanes Katrina, Laura, Sally, and the COVID-19 pandemic). The median exposure count for each disaster was then computed to reflect “high” traumatic exposure to the event. For Hurricane Katrina, this was  $\geq 2$ , for Hurricanes Laura and Sally,  $\geq 0$ , and the COVID-19 pandemic,  $\geq 4$ .

Event-related posttraumatic stress: The Impact of Event Scale-6 (IES-6), a widely used short-form of the Impact of Event Scale-Revised (IES-R), was used to assess PTS associated with Hurricane Katrina at F3 and F4 and with the COVID-19 pandemic at F4 (Jeong et al., 2022; Thoresen et al., 2010). Participants indicated the extent to which they experienced symptoms related to the index event (e.g., avoiding thinking about the event, having trouble concentrating, unintentionally thinking about the event) on a scale from 0 (“Not at all”) to 4 (“Extremely”). Scale scores were computed as the mean of the six items, ranging from 0 to 4. Cronbach’s alpha of internal consistency for the IES-6 scale assessing Katrina-related PTS was 0.92 at F3 and 0.91 at F4, and for COVID-19 related PTS at F4, 0.91.

Psychological distress: PD was assessed at PK as well as at F3 and F4 using the Kessler K6 non-specific distress scale. K6 score is a validated scale based on levels of agreement with a series of six items in the past 30 days from 0 (“None of the time”) to 4 (“All of the time”), including whether participants felt nervous, hopeless, restless or fidgety, so depressed that nothing could cheer them up, that everything was an effort, and worthless, with a total summed score ranging from 0 to 24, with higher scores indicating greater levels of PD (Kessler, 2002). Cronbach’s alpha of internal consistency for the Kessler K6 non-specific distress scale was 0.79 PK, 0.84 at F3, and 0.89 at F4.

Covariates: Covariates in this study included age, race, marital status, receipt of public benefits, and perceived social support. Age was assessed continuously, and race and marital status were coded as binary variables (i.e., 0 = “Other race”; 1 = “Non-Hispanic Black”; 0 = “Not Married”; 1 = “Married or cohabitating with a partner”). Lastly, public benefits received at F4 were included as a count of whether participants received unemployment, social security, welfare, and/or Supplemental Nutrition Assistance Program (SNAP) benefits.

Perceived social support was constructed based on a count of agreement with a series of statements. Participants answered eight questions from the Social Provisions Scale in relation to their feelings about those closest to and the community around them (Cutrona & Russell, 1987). Each item is rated on a four-point Likert scale from 1 = “Strongly disagree” to 4 = “Strongly Agree”. Each of the six subscales were based on Robert Stuart Weiss’s work (1974) – reliable alliance, attachment, nurturance, social integration, reassurance of worth, and guidance – and included two positively- and negatively-framed items about the presence and absence of certain forms of support (e.g., “There are people I know will help me if I really need it,” “There is no

one I feel comfortable talking about problems with”) (Chiu et al., 2016; Cutrona & Russell, 1987). Cronbach’s alpha of internal consistency for the Social Provisions Scale was 0.81 at F4.

### *Analytical Approach*

SAS (version 9.4) was used to analyze the data. Analysis began with calculation of descriptive statistics for all variables in the analysis and a correlation matrix of the relationships between said variables. A series of multivariable linear regression analyses were then run to determine the relationship between unique exposure severity and F4 pandemic-related PTS, Katrina-related PTS, and PD, controlling for covariates, pre-Katrina PD, and the corresponding mental health index from F3 (i.e., F3 Katrina-related PTS was included in the analyses predicting F4 pandemic- and Katrina-related PTS, and F3 PD was included in the analysis predicting F4 PD). The analysis was repeated substituting the unique exposure index for cumulative disaster exposure. Models were first run with zero “high” exposures as the reference group, and then subsequently, the reference groups were revised to include one and two “high” exposures to retrieve all comparisons among the number of exposures and COVID-19 and Katrina-related PTS and PD.

## **Results**

### *Preliminary Analyses*

Table 1 provides a description of the 381 women included within the analysis. Most participants were Non-Hispanic Black (84.5%) with a mean age of 42.05 years old (SD = 4.41). All of the participants in the sample were affected by Hurricane Katrina and the COVID-19 pandemic, and the mean number of stressors experienced for each disaster was 2.84 (SD = 2.25) and 4.29 (SD = 2.63), respectively. Of the 381 participants, 82 (21.5%) experienced Hurricane Laura and 41 (10.8%) experienced Hurricane Sally. For participants who reported living in areas



affected by Hurricanes Laura and Sally, the mean number of hurricane-related stressors experienced was 1.13 (SD=1.68) and 1.27 (SD=1.76) for Hurricanes Laura and Sally, respectively. Of the four events under analysis, the majority of participants had “high” exposure to one disaster (37.3%) and the least with three or more disasters (8.9%).

**Table 1: Description of sample (N=381)**

<b>CHARACTERISTIC</b>	<b>N (%)</b>
Age (years), mean $\pm$ SD	42.05 $\pm$ 4.41
Race/ethnicity	
Non-Hispanic Black	322 (84.5)
Other	59 (15.5)
Marital status	
Married/Cohabiting	177 (46.5)
Other	204 (53.5)
Social support, mean $\pm$ SD	3.09 $\pm$ 0.57
Number of benefits, mean $\pm$ SD	0.66 $\pm$ 0.78
Mental health, mean $\pm$ SD	
Pre-Katrina psychological distress (2004)	4.93 $\pm$ 4.10
Post-Katrina psychological distress (2017)	5.49 $\pm$ 4.73
Post-Katrina psychological distress (2021)	8.03 $\pm$ 5.75
Experienced Hurricane Katrina	
Yes	381 (100.0)
No	0 (0.0)
Number of Katrina-related traumas, mean $\pm$ SD	2.84 $\pm$ 2.25
Katrina-related IES-6 score	
W3 posttraumatic stress (2017)	0.68 $\pm$ 0.89
W4 posttraumatic stress (2021)	0.98 $\pm$ 0.99
Experienced Hurricane Laura	
Yes	82 (21.5)
No	299 (78.5)
Number of Laura-related traumas, mean $\pm$ SD	1.13 $\pm$ 1.68
Experienced Hurricane Sally	
Yes	41 (10.8)
No	340 (89.2)
Number of Sally-related traumas, mean $\pm$ SD	1.27 $\pm$ 1.76
Experienced COVID-19 pandemic	
Yes	381 (100.0)
No	0 (0.0)
Number of COVID-19-related traumas, mean $\pm$ SD	4.29 $\pm$ 2.63
COVID-19-related IES-6 score, mean $\pm$ SD	1.46 $\pm$ 1.09
Cumulative disaster exposure	
0	70 (18.4)
1	142 (37.3)
2	135 (35.4)
3+	34 (8.9)

The Pearson's correlation matrix is shown in Table 2. Significant positive correlations were observed among counts of stressors related to Hurricanes Katrina, Laura, and Sally, and the

COVID-19 pandemic. Exposure to all four unique events were significantly associated with PD and PTS, with the exception of Hurricane Sally, which was not positively correlated with COVID-19 PTS. Two and three or more cumulative exposures were associated with PD and Katrina and COVID-related PTS.

**Table 2: Pearson's correlation**

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	
1. Age	--																			
2. Race/ethnicity	-0.04	--																		
3. Marital status	0.04	-0.17	--																	
4. Social support	-0.05	-0.09	0.12	--																
5. # of Benefits	0.05	0.10	-0.14	-0.14	--															
6. Pre-Katrina PD (2004)	-0.07	-0.08	-0.04	-0.12	0.03	--														
7. Post-Katrina PD (2017)	0.05	-0.09	-0.06	-0.22	0.23	0.29	--													
8. Post-Katrina PD (2021)	-0.00	0.07	-0.04	-0.38	0.13	0.26	0.39	--												
9. W3 IES-6	0.09	0.15	-0.07	-0.25	0.25	0.16	0.36	0.32	--											
10. W4 IES-6	0.09	0.18	-0.05	-0.29	0.17	0.16	0.24	0.59	0.43	--										
11. # of Katrina exposures	0.11	0.16	-0.08	-0.26	0.12	0.11	0.09	0.27	0.25	0.26	--									
12. # of Laura exposures	0.05	0.05	0.03	-0.18	0.12	0.01	0.10	0.25	0.25	0.17	0.21	--								
13. # of Sally exposures	-0.02	0.03	0.01	-0.17	0.00	-0.04	0.08	0.27	0.11	0.15	0.08	0.36	--							
14. # of COVID exposures	0.05	0.04	-0.02	-0.21	0.24	0.07	0.26	0.33	0.19	0.30	0.23	0.15	0.14	--						
15. COVID IES-6	0.07	0.09	0.03	-0.30	0.13	0.14	0.26	0.58	0.35	0.61	0.26	0.14	0.03	0.33	--					
16. 0 disasters	-0.06	-0.06	-0.06	0.15	-0.13	-0.05	-0.12	-0.24	-0.12	-0.19	-0.46	-0.13	-0.09	-0.45	-0.25	--				
17. 1 disaster	-0.07	-0.06	0.09	0.11	-0.06	0.01	-0.05	-0.12	-0.13	-0.12	-0.17	-0.20	-0.11	-0.22	-0.15	-0.37	--			
18. 2 disasters	0.09	0.06	-0.05	-0.14	0.11	0.01	0.11	0.15	0.11	0.16	0.38	-0.11	-0.06	0.43	0.24	-0.35	-0.57	--		
19. 3+ disasters	0.04	0.08	0.02	-0.17	0.09	0.03	0.07	0.27	0.20	0.20	0.28	0.71	0.42	0.27	0.19	-0.15	-0.24	-0.23	--	

\*p≤0.05; \*\*p≤0.01; \*\*\*p≤0.001

## *Multivariable Models*

### Unique disaster exposure models

Table 3 shows the results of multivariable linear regression models with unique disaster exposures predicting pandemic and Katrina-related PTS and PD. As shown, exposure to both more Katrina and COVID-related stressors was significantly associated with higher pandemic-related PTS. COVID-19-related stressors were significantly associated with greater Katrina-related PTS. Exposure to more stressors related Hurricanes Katrina and Sally as well as the COVID-19 pandemic were significantly associated with elevated PD. With regards to the socio-demographic covariates included within the analysis, social support was negatively correlated with pandemic and Katrina-related PTS and PD and race/ethnicity and F3 PTS positively with Katrina-related PTS.

### Cumulative disaster exposure models

Table 4 presents the results of multivariable linear regression models substituting unique with cumulative disaster exposures predicting pandemic and Katrina-related PTS and PD. One “high” disaster exposure was positively and significantly associated with higher PD. Experiencing two and three or more “high” disaster exposures, relative to zero “high” exposures, were both significantly associated with higher pandemic and Katrina-related PTS and PD. Additional comparisons of cumulative disaster exposure and PTS and PD revealed significant associations between two “high” disaster exposures and pandemic-related PTS and PD and three or more “high” disaster exposures with all three outcomes compared to one “high” disaster exposure. Additionally, there was a positive significant association between three or more “high” disaster exposures and PD compared to two “high” disaster exposures.

In addition, social support's negative relationship with increased PTS scores and PD persisted from the unique disaster model. Also consistent with the unique disaster model, racial/ethnic identity was associated with elevated Katrina PTS. F3 PTS was associated with higher pandemic and Katrina-related PTS and pre-Katrina and F3 PD was associated with higher F4 PD.

**Table 3a: Multiple linear regression model, unique disaster exposure (N= 381)**

CHARACTERISTIC	PANDEMIC-RELATED PTS		KATRINA-RELATED PTS		POST-KATRINA PSYCHOLOGICAL DISTRESS	
	<i>Adjusted <math>\beta</math> (SE)</i>	<i>p</i>	<i>Adjusted <math>\beta</math> (SE)</i>	<i>p</i>	<i>Adjusted <math>\beta</math> (SE)</i>	<i>p</i>
Age (years)	0.00 (0.01)	0.712	0.01 (0.01)	0.339	-0.05 (0.06)	0.391
Race/ethnicity	0.09 (0.14)	0.509	0.30 (0.13)	0.019	0.92 (0.69)	0.187
Marital status	0.19 (0.10)	0.059	0.03 (0.09)	0.708	0.28 (0.50)	0.572
Social support	-0.33 (0.09)	0.001	-0.22 (0.08)	0.009	-2.12 (0.46)	<0.001
Number of benefits	-0.03 (0.07)	0.688	0.02 (0.06)	0.751	-0.10 (0.33)	0.766
Mental health						
PK psychological distress (2004)	0.01 (0.01)	0.223	0.02 (0.01)	0.085	0.22 (0.06)	0.001
F3 Katrina psychological distress (2017)	---	---	---	---	0.29 (0.06)	<0.001
F3 posttraumatic stress (2017)	0.29 (0.06)	<0.001	0.33 (0.05)	<0.001	---	---
Number of stressors						
Hurricane Katrina	0.05 (0.02)	0.037	0.03 (0.02)	0.117	0.27 (0.12)	0.021
Hurricane Laura	0.02 (0.06)	0.738	-0.00 (0.05)	0.981	0.53 (0.29)	0.069
Hurricane Sally	-0.11 (0.08)	0.151	0.09 (0.07)	0.197	1.31 (0.38)	0.001
COVID-19 pandemic	0.09 (0.02)	<0.001	0.07 (0.02)	<0.001	0.33 (0.10)	0.001

*Note:* Each full model held statistical significance. COVID-related PTS:  $F(11, 369) = 11.14, p < 0.001, R^2 = 0.227$ ; Katrina-related PTS;  $F(11,369) = 13.39, p < 0.001, R^2 = 0.264$ ; Post-Katrina psychological distress:  $F(11, 369) = 18.46, p < 0.001, R^2 = 0.336$ .

**Table 4a: Multiple linear regression model, cumulative disaster exposure (N= 381)**

CHARACTERISTIC	PANDEMIC-RELATED PTS		KATRINA-RELATED PTS		POST-KATRINA PSYCHOLOGICAL DISTRESS	
	<i>Adjusted β (SE)</i>	<i>P</i>	<i>Adjusted β (SE)</i>	<i>p</i>	<i>Adjusted β (SE)</i>	<i>p</i>
Age (years)	0.00 (0.01)	0.751	0.01 (0.01)	0.377	-0.05 (0.06)	0.330
Race/ethnicity	0.08 (0.14)	0.565	0.29 (0.13)	0.022	0.93 (0.70)	0.185
Marital status	0.17 (0.10)	0.090	0.02 (0.09)	0.801	0.23 (0.51)	0.657
Social support	-0.33 (0.09)	<0.001	-0.26 (0.08)	0.002	-2.43 (0.46)	<0.001
Number of benefits	0.01 (0.07)	0.916	0.04 (0.06)	0.494	-0.05 (0.33)	0.872
Mental health						
PK psychological distress (2004)	0.02 (0.01)	0.107	0.02 (0.01)	0.065	0.21 (0.06)	0.001
F3 psychological distress (2017)	---	---	---	---	0.32 (0.06)	<0.001
F3 posttraumatic stress (2017)	0.29 (0.06)	<0.001	0.34 (0.05)	<0.001	---	---
Cumulative disaster exposure						
0	Reference	---	Reference	---	Reference	---
1	0.27 (0.14)	0.056	0.20 (0.13)	0.109	1.40 (0.70)	0.047
2	0.69 (0.15)	<0.001	0.39 (0.13)	0.003	2.70 (0.73)	<0.001
3+	0.76 (0.21)	0.000	0.57 (0.19)	0.003	5.74 (1.04)	<0.001
Additional Comparisons						
1 disaster vs.						
2	0.42 (0.12)	<0.001	0.19 (0.11)	0.079	1.30 (0.58)	0.027
3+	0.49 (0.19)	0.010	0.36 (0.17)	0.033	4.35 (0.93)	<0.001
2 disaster vs.						
3+	0.07 (0.19)	0.707	0.18 (0.17)	0.288	3.05 (0.92)	0.001

Note: Each full model held statistical significance. COVID-related PTS:  $F(10, 370) = 11.14, p < 0.001, R^2 = 0.224$ ; Katrina-related PTS:  $F(10,370) = 13.53, p < 0.001, R^2 = 0.248$ ; Post-Katrina psychological distress:  $F(10, 370) = 18.43, p < 0.001, R^2 = 0.314$ .

### Discussion

This analysis examined associations between exposure to four different disasters – Hurricanes Katrina, Laura, and Sally, and the COVID-19 pandemic – and the mental health of 381 women from the RISK study. Looking at each exposure separately, I found that exposure to unique stressors associated with Hurricanes Katrina and Sally as well as the COVID-19 pandemic displayed links with heightened pandemic and Katrina-related PTS and PD. Specifically, exposure to Hurricane Katrina was associated with pandemic-related PTS and PD, Sally with PD, and COVID-19 with both pandemic and Katrina-related PTS and PD, revealing novel findings about the relationship between traumatic event exposure and alternative event-related adverse mental health outcomes. Looking at cumulative exposure, I found two and three

plus exposures to the disasters under analysis were consistently associated with the three adverse mental health outcomes under study, relative to one disaster exposure with PD. These findings were reinforced by additional comparisons between amounts of “high” disaster exposures.

One of the primary novel findings from this study is that the number of unique disaster exposures associated with a given event served as a predictor of elevated pandemic and Katrina-related PTS and overall PD. While the cumulative effects of traumas have been well-documented, less attention has been paid to event-specific experiences with PTS and how they relate to other traumatic events (i.e., weather-related disaster versus a global pandemic) (Jirek & Saunders, 2018; Johannesson et al., 2017). Statistical significance of the relationship between Katrina-related stressors and COVID-19 PTS and COVID-19 stressors with Katrina-related PTS reinforce that prior, event-specific trauma can serve as a risk factor for future adverse mental health outcomes associated with other traumatic stressors and that subsequent stressors can heighten the risk for PTS tied to an earlier event. Further research into these findings will be critical, given the longitudinal nature and pre-existing, and projectably increasing, encounters with traumatic event exposures of various types (Williams et al., 2007).

Cumulative disaster exposure, to varying extents, was associated with elevated event-specific PTS and PD. Namely, traumatic exposure to two and three-plus events, relative to zero or one disaster exposure, were associated with all three adverse mental health outcomes. The implications of multiple, successive disaster exposures were also captured in the unique exposure model, where the number of Sally-related stressors had three times the effect on PTS and PD compared to those related to Laura just a month prior. It will be critical that future studies explore the complexities of these associations, such as the perpetuating and differentiating



factors between PTS and PD and a variety of traumatic events beyond those weather-related, including manmade and technological disasters.

Additional findings aligned with extant literature, reinforcing the evidence in support of factors that mitigate and exacerbate PTS and PD. In both unique and cumulative disaster models, social support served as a protective factor against PTS and PD. The ability for social support to foster positive mental health outcomes has been well-documented in the context of weather-related disasters and other traumatic events (e.g., serving in the military) through its reduction of symptoms associated with PTSD, depression, and burnout as well as enhancement of overall well-being (Chu et al., 2010; Halbesleben, 2006; Harandi et al., 2017; McGuire et al., 2018; Neria et al., 2008; Rueger et al., 2016; Straus et al., 2019; Wang et al., 2021). These results indicate a need to invest in programs and resources that improve social connectedness amongst disaster prone and traumatized communities, capitalizing upon its ability to mitigate the negative mental health consequences of traumatic event exposure.

Also consistently associated across models was pre-existing PD and elevated PTS as a risk factor for future PTS. Extant literature has documented that exposure to life stressors such as the inability to access food or healthcare and previous traumas led to an elevated risk of future traumas, PTS, and PTSD (Kessler et al., 2017; Sareen, 2014). By adding to this evidence base, the present study reinforces the need to track lifetime encounters with stressors and traumas, findings pathways to intervene and interrupt the mounting effects of adverse experiences on mental health.

The previously documented and present association between Black race with Katrina PTS highlights existing sociopolitical and environmental inequities that facilitate disproportionate exposure of communities of color to traumatic experiences such as weather-related disasters.

Hurricane Katrina is a well-documented event in which the Black community suffered the greatest extent of physical damage and traumatic stress associated with the aftermath of the storm, compounded by having the least amount of resources directed towards them during community restoration and redevelopment processes (Alexander et al., 2017; Allen, 2007). In light of the escalation of climate change, paying particular attention to those communities vulnerable to weather-related disasters and their effects is paramount, particularly through bolstering resources offered to them both pre- and post-disaster.

### *Recommendations*

Research in this area is nascent, with the long-term effects of COVID-19 not yet fully understood or realized. With the statistically significant association between disaster exposure and COVID-19 PTS in mind, it will be critical for researchers to conduct future studies on cumulative disaster exposure and severity and pandemic-related mental health outcomes, including and beyond event-specific PTS and PD. Such efforts should particularly focus on how traumatic exposure to the COVID-19 pandemic will be complicated by future traumas, and in turn, impact health and well-being.

As mentioned prior, this study also revealed a significant association when assessing unique and cumulative disaster exposure between social support and PTS and PD. With the present studying adding to the robust evidence base indicating the ways in which social support fosters positive mental health outcomes, further study should be conducted on how social support can be enhanced before, during, and after times of crisis (Chu et al., 2010; Halbesleben, 2006; Harandi et al., 2017; McGuire et al., 2018; Neria et al., 2008; Rueger et al., 2016; Straus et al., 2019; Wang et al., 2021). This will be critical to informing future resource allocation efforts and fostering positive mental health outcomes among both unique and cumulative disaster survivors.

One of the unique facets of this study is that it is among the few that have the capacity to assess the evolution of mental health outcomes endured by participants both pre- and post- event exposure, presenting a critical opportunity to explore other factors that promote mental health post-disaster aside from social support in addition to those that undermine it. The racial justice movement, COVID-19 pandemic, and increases in acts of violence necessitate research into the implications of such stressors on long-term health and whether this diminishes or promotes resilience. This is especially critical in light of present research, which has revealed mixed findings, reporting both a phenomenon coined posttraumatic growth in which stress facilitates improvements in psychological functioning and that traumatic events compromise resilience with the escalating severity and frequency of disaster exposure (Agaibi & Wilson, 2005; Maddi, 2005; Saltzman et al., 2011; Schubert et al., 2016; Veronese et al., 2022). Such determinations can elucidate avenues to promote resilience among traumatized populations post-traumatic event exposure.

The findings of this study also suggest that adverse mental health outcomes, such as PTS, can persist long after encountering a stressor, reinforcing the need to provide ongoing mental health support and resources to survivors. The projected intensification and increased frequency of weather-related disasters undergirds the timeliness and urgency of reimaging resource allocation in the disaster context to include promoting health in the long-term.

### *Limitations*

The first limitation of this study is its sample size. With few participants having experienced either or both Hurricanes Laura and Sally within the sample, the findings suffer from a lack of statistical power, further compounded by limited generalizability (i.e., entirely

female, and largely Black identifying). A second limitation is the reliance on self-report of exposures and outcomes among participants, resulting in variances in interpretations of exposures to given stressors as well as diminishing or overstating one's experience with a given exposure. A final limitation is that of missing data and attrition given the longitudinal nature of the study. Despite these limitations, measure of unique and cumulative disaster exposure in the context of a global pandemic provided insight into how disaster exposure impacted communities amidst the COVID-19 pandemic.

### **Conclusion**

Building upon extant literature, this study explored the relationship between disaster exposure and PTS and PD yet diverged from other research endeavors by focusing on this relationship within the context of the COVID-19 landscape and nearly two decades post-traumatic exposure to Hurricane Katrina. Introducing novel findings, including the significance of the effect of unique and cumulative disaster exposure on Katrina- and pandemic-related PTS and PD in alternative disaster contexts and the receipt of social support in mitigating such adverse mental health outcomes, this study holds promise for further exploration of weather-related disasters in today's sociopolitical climate.

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