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CONDITIONAL RISK FOR PTSD IN A TRAUMATICALLY INJURED LATINX  
SAMPLE: CULTURAL X BIOLOGICAL MODEL

by

Claire M. Bird, M.S.

A Dissertation submitted to the Faculty of the Graduate School, Marquette University, in  
Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

Milwaukee, Wisconsin

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ABSTRACT  
CONDITIONAL RISK FOR PTSD IN A TRAUMATICALLY INJURED LATINX  
SAMPLE: CULTURAL X BIOLOGICAL MODEL

Claire M. Bird, M.S.

Marquette University, 2022

Posttraumatic stress disorder (PTSD) is a debilitating disorder that develops in some people following a traumatic event. Latinx communities in the U.S. are at greater risk of developing this disorder and experiencing more severe and chronic symptomology. This population has also been found to experience greater levels of dissociative experiences – possibly explaining the increased conditional risk for PTSD in this ethnic group. It remains unclear what may be connecting the experience of peritraumatic dissociation to heightened PTSD risk.

The current study sought to address this gap in the literature by examining peritraumatic dissociation and the interplay between sociocultural and biological factors acutely following a traumatic injury. A sample of 52 Latinx, traumatically injured patients were recruited. In the acute aftermath of the trauma, participants provided blood samples, HRV measurements, and completed self-report measures assessing peritraumatic dissociation, PTSD symptoms, acculturative stress, fatalism, and familism.

Moderated-mediational analyses were conducted to examine the ability of biological variables to mediate the relationship between peritraumatic dissociation and PTSD symptoms, while also considering the moderating influence of each cultural factor on the biological variable – PTSD symptoms pathway. After adjusting for psychiatric history and time of cortisol collection, results were non-significant. However, post-hoc analyses revealed notable findings regarding peritraumatic dissociation and acculturative stress.

Results extend previous research by contributing to the understanding of unique cultural experiences and how this may be underlying greater risk for PTSD in Latinx populations. The current study is the first to examine risk for PTSD from an integrative perspective in a Latinx sample.

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## Conditional risk for PTSD in a traumatically injured Latinx sample: Cultural x biological model

In the United States, 90% of people will experience a traumatic event in their lifetime, with approximately 8% of the general population developing posttraumatic stress disorder (PTSD; Kilpatrick et al., 2013) and approximately 20% of traumatically injured samples reporting chronic PTSD (deRoos-Cassini et al., 2010). As described in the Diagnostic and Statistical Manual – 5 (DSM-5), PTSD falls under the category of Trauma- and Stress-Related Disorders (American Psychiatric Association, 2013). This diagnosis necessitates exposure to a traumatic or stressful event as a diagnostic criterion, which is defined as exposure to actual or threatened death, serious injury, or sexual violence through direct experience, witnessing an event, or learning about an event happening to a loved one. A traumatic event may span various experiences including, but not limited to, community violence, sexual assault or abuse, exposure to combat, motor vehicle accidents, or physical assault (National Center for PTSD, 2018). In addition to exposure to a trauma, a PTSD diagnosis requires symptomology from each of four symptom clusters: intrusive thoughts, avoidance, negative alterations in cognitions and mood, and alterations in arousal and reactivity.

According to the 2018 United States Census population estimates, Latinx individuals compose approximately 18% of the U.S. population and experience persistent health disparities in comparison to non-Latinx groups (U.S. Census Bureau, 2019). In particular, the Latinx population has been consistently found to have a greater conditional risk for PTSD than non-Latinx populations (Alcántara, & Lewis-Fernández, 2016; Breh & Seidler, 2007; Pole, Best, Metzler, & Marmar, 2005). Conditional risk is defined as a

greater vulnerability to developing a PTSD diagnosis, endorsing more severe symptoms, or experiencing more chronic PTSD over the lifetime following a traumatic event (Alcántara, & Lewis-Fernández, 2016). It has been demonstrated that Latinx populations have higher rates of conditional risk for this disorder, specifically in the form of persistent or chronic PTSD, as well as experiencing more severe symptomology (Fortuna et al., 2008; Pietrzak et al., 2014). This greater risk for PTSD has been shown in Latinx samples of police officers (Pole et al., 2005) and military personnel (Kaczurkin et al., 2016), among people exposed to the September 11th terrorist attacks (Pietrzak et al., 2014), and physical trauma survivors (Marshall et al., 2009).

Peritraumatic dissociation is prevalent within the Latinx population and has been suggested as an explanation for the greater conditional risk in this ethnic group (Alcántara et al., 2013). Peritraumatic dissociation is defined as dissociative experiences during or immediately following a traumatic event and has been consistently linked to poorer psychological health outcomes subsequent to a trauma (Benzakour et al., 2021; Demarble et al., 2020; Lensvelt-Mulders et al., 2008; McCanlies et al., 2017; Ozer et al., 2008). However, possible underlying mechanisms of the relationship between peritraumatic dissociation and PTSD remain unclear. Particularly, possible biological underpinnings may be at play. Dysfunction in biological systems such as the autonomic nervous system (ANS) and hypothalamic-pituitary-adrenal (HPA) axis have been found to be associated with greater peritraumatic dissociation as well as negative long-term outcomes, such as PTSD (Hetzl-Riggin, 2010; Morris & Rao, 2013). Furthermore, specific cultural variables, such as, beliefs regarding familism and fatalism and stress associated with the acculturation process, may interact with the aforementioned

biological systems contributing to heightened conditional risk for PTSD among the Latinx community.

In psychological research, biological and cultural investigations have historically been conducted separately. In fact, traditionally marginalized groups, such as racial/ethnic minorities, have benefitted less from the scientific advancements of biological and physiological research (Clingerman & Brown, 2012). This artificial division disregards a holistic view of the human condition resulting in a myopic understanding of critical experiences, such as a traumatic event. To overcome this schism of study, Causadias and colleagues (2017) proposed the framework of cultural neurobiology which centers the interplay between biological and cultural processes and their simultaneous and joint evolution influencing behavior, cognition, and development to better understand health outcomes. Cultural and biological processes do not function independent of one another and specifically, it is known that our environment influences our health (Williams et al., 2010). Thus, the field of cultural neurobiology has been born and grown in popularity in recent years emphasizing the impact this interplay has on health outcomes. Of particular interest, cultural neurobiology has focused on transactions and interactions between cultural factors and stress-sensitive biological systems including the ANS and HPA axis.

While existing research is informative regarding PTSD development and risk factors, the overwhelming majority of the current literature focuses on White American populations. Further research is needed to examine biologic responses to trauma in the Latinx population in concert with sociocultural variables specific to this community. Given that our environment and biological processes interact, it is imperative to examine

the sociocultural factors that interact with the body's stress response systems to influence PTSD symptom severity, which is largely absent in the literature for the Latinx population. Currently, there are no empirical studies that have investigated the biological x cultural interaction in relation to peritraumatic dissociation within this population, and its link to PTSD.

The current study assessed peritraumatic dissociation as a predictor of acute PTSD symptomology in Latinx individuals who presented to the hospital following a traumatic injury. The overall goal of the present study was to investigate mechanisms linking peritraumatic dissociation to increased PTSD risk among a high-risk population. This was approached using the framework of cultural neurobiology, assessing the interplay between unique Latinx cultural factors and biological stress response systems. Specifically, a theoretical model (Figure 1) was tested examining the interactions of biological and cultural factors as possible underlying mechanisms connecting peritraumatic dissociation to acute PTSD symptom severity in Latinx individuals following a traumatic event.

## **BACKGROUND**

### **Peritraumatic Dissociation**

Risk factors for this greater conditional risk are not well understood, however, peri-traumatic experiences have been suggested as a critical consideration particularly when understanding this risk in the Latinx population. Peritraumatic dissociation has been theorized to serve as a coping mechanism in the face of a traumatic experience as a means of protection from a highly disturbing, emotionally aversive event. It has been

posited as an immediate adaptive reaction to a trauma due to its reduction in pain, intense emotion, and/or humiliation (Candel & Merckelbach, 2004; Horowitz, 1986; van der Kolk and Fisler, 1995). As laid out by van der Kolk and colleagues (1996), dissociation refers to an altered state of consciousness or a compartmentalization of an experience in which memories of an event are not integrated as a whole, but are isolated, fragmented memories consisting of sensory perceptions or affective states. Dissociation may manifest in a variety of ways, including, but not limited to, an altered sense of time, bewilderment, confusion, altered pain, tunnel vision, depersonalization, and/or derealization (Marmar et al., 1994; van der Kolk et al., 1996). According to the DSM-5 (American Psychiatric Association, 2013), depersonalization refers to an individual feeling as though they are outside of their body, watching themselves as a third person. Derealization is the experience of feeling as though one's surroundings are unreal, like they are in a movie or a dream. Theory underlying the negative consequences of peritraumatic dissociation purports that dissociating during a trauma prevents an individual from fully integrating the experience into their memory and/or consciousness. This then obstructs one's ability to successfully integrate the memory of the event and in turn hinders their ability to process the experience, creating a susceptibility to psychopathology, particularly PTSD (Bryant, 2007).

Alcántara and colleagues (2013) found peritraumatic responses, particularly, peritraumatic dissociation to be a consistent correlate of PTSD, particularly among Latinx groups. Pole and colleagues (2001) provide further evidence for this in their study comparing ethnic differences of retrospective, self-reported peritraumatic dissociation in a sample of 655 urban police officers (28% Latinx). Latinx participants reported

significantly more peritraumatic dissociation in comparison to both African American and White American participants. Furthermore, Vasquez and colleagues (2012) examined the relationship between peritraumatic dissociation and PTSD in Latinx youth in a retrospective, cross-sectional study, most of whom had an index trauma of experiencing community violence. Results showed that peritraumatic dissociation was a robust predictor of a PTSD diagnosis, such that those who reported peritraumatic dissociation were more than twice as likely to be diagnosed with PTSD than those who did not. Furthermore, Greenwell and Cosden (2009) found similar results in a sample of Latinx individuals demonstrating that peritraumatic dissociative experiences were significantly associated with posttraumatic stress symptoms, such that, it accounted for 21% of variance in symptom severity.

There is strong evidence for the association between peritraumatic dissociation and PTSD symptomology. However, less is known regarding underlying mechanisms of this association. Reviews on racial/ethnic variation in PTSD prevalence and course have suggested various cultural influences that may serve as important influential factors for this relationship (Alegria et al., 2013; Pole et al., 2008). Additionally, there is a robust body of literature emphasizing the importance of the body's stress response systems in reaction to a trauma that may interact with pre-existing sociocultural factors influencing psychological outcomes (Causadias et al., 2017).

### **Biological Stress Response**

While the human body is full of complex interactions between various systems, the ANS and HPA-axis are two of the most studied stress response systems. A cursory overview of the body's biological stress response system can be described as beginning

with a cascade of hormone events occurring in the brain leading to the activation of the ANS and triggering the HPA-axis, preparing the body for its reaction to perceived danger. Assessing proxy measurements of these systems, such as heart rate variability and cortisol levels, particularly in the aftermath of a trauma can inform our understanding of the body's acute stress response and this influence on mental health outcomes.

### ***Heart Rate Variability.***

Heart rate variability (HRV) is a proxy measurement for the interplay between the parasympathetic nervous system (PNS) and the sympathetic nervous system (SNS) functioning. It provides an indication of the dynamic interaction between these two branches of the ANS, with parasympathetic activity of primary interest. Sympathetic influences on the heart may take seconds to minutes to occur, however, PNS activity can influence the heart nearly instantaneously, indicating that PNS activity is much more responsive and sensitive to changes in environment (Hill & Hoggard, 2018). HRV is evaluated by recording, quantifying, and transforming variations in beat-to-beat intervals of the heart (Causadias et al., 2018). Broadly speaking, high HRV is considered a good sign of adaptability within the ANS, allowing an individual to adjust to environmental changes and challenges (Schneider & Schwerdtfeger, 2020; Schwerdtfeger et al., 2020), while low HRV has been associated with poorer health and risk for disease (Hill & Hoggard, 2018; Thayer & Lane, 2007).

HRV is an important biomarker to examine in the context of psychological health as it provides insight into the relationship between mental and physical health through understanding the connectivity between the heart and brain. Atypical HRV has been consistently linked to negative health outcomes such as cardiovascular disease,

hypertension, and immune dysfunction (Hill & Hoggard, 2018; Palatini & Julius, 2009). It has also been associated with negative mental health outcomes such as heightened anxiety due to a deficit in the inhibitory activity of the PNS (Porges, 2007; Pyne et al., 2016). Various theories have been put forth to understand this connection between physiological functioning and psychosocial stressors, some of which consider HRV a marker of the functional pathway between the autonomic and central nervous systems (Friedman, 2007), others broadly considering it an index of biopsychosocial well-being (Kemp & Quintana, 2013).

**HRV and peritraumatic dissociation.** Given the nature of peritraumatic dissociation and its consequences, discussed previously, it is sensible that dissociating during a traumatic event may lead to more severe hyperarousal or intense physiological responses to trauma reminders due to the lack of integrated memories or fear of experiencing dissociation again. Therefore, it is possible that biomarkers, such as HRV, may help explain the relationship between peritraumatic dissociation and PTSD symptomology. There is a dearth of research examining the relationship between HRV and peritraumatic dissociation, however, there is some research that has examined heart rate alone in relation to peritraumatic dissociation. While not as robust a predictor as HRV, heart rate alone is useful to review in this context given that it is an alternative biomarker often used as a proxy measurement of the ANS. It is important to note before discussing existing literature examining heart rate alone that increased heart rate would theoretically indicate *decreased* HRV, such that as the heart is beating faster, time intervals between each beat would be reduced.



Kuhn and colleagues (2006) measured heart rate upon admission to the Emergency Department in a sample of motor vehicle collision survivors. Heart rate was significantly, positively correlated with self-reported peritraumatic dissociation. Similarly, Kaufman and colleagues (2002) found increased heart rate during a trauma recall task was also significantly and positively associated with peritraumatic dissociation in veterans. On the other hand, one study examining assault survivors reported no significant association between retrospective self-report of peritraumatic dissociation and heart rate when presented with trauma-related stimuli (Halligan et al., 2006).

Given these inconsistencies, measurement of HRV, a more robust indicator of autonomic functioning, may enlighten understanding of the relationship between physiological reactions and peritraumatic dissociation. Of note, each of the studies discussed reported majority White samples and included no greater than 5% Latinx participants. Therefore, due to cultural norms and expressions, it is unknown what relationship HRV may have to peritraumatic dissociation for Latinx individuals subsequent to a trauma.

**HRV and PTSD.** A prominent aspect of PTSD is physiological reactivity to trauma cues, such that, individuals who develop PTSD exhibit an increase in sympathetic reactivity and decrease in parasympathetic activity (Van der Kolk, 2004). Therefore, much prior research has examined the direct relationship between physiological reactions and PTSD development and have found that trauma exposed individuals tend to have impaired autonomic function. In fact, a recent meta-analysis demonstrated that ANS dysregulation, as measured by HRV, is associated with PTSD (Schneider & Schwerdtfeger, 2020).

Combat veterans with a PTSD diagnosis were found to have significantly lower HRV in comparison to veterans without PTSD, indicating a dysfunction of parasympathetic activity (Tan et al., 2011). These findings have been demonstrated across various studies in both prospective and cross-sectional designs (Pyne et al., 2016; Rissling et al., 2016; Shaikh al arab et al., 2012). Of note, one study assessed a small sample ( $n = 21$ ) of road traffic accident victims examining the predictive ability of HRV on PTSD at 2- and 6-month time points. HRV was measured acutely post-trauma as participants were admitted to the hospital. Using area under the curve analyses, results showed that HRV measures yielded 0.92 predictive value of PTSD at 6-month assessment. Furthermore, findings revealed a sensitivity of 85.7% and a specificity of 81.8% for PTSD. This study suggests that not only is HRV strongly associated with PTSD development and severity, but it is also one of few studies providing longitudinal data to suggest the strong predictive ability of HRV dysregulation for PTSD development. To the writer's knowledge, there are no existing studies that have examined the role of HRV in relation to acute PTSD symptoms following a trauma or peritraumatic experiences in a Latinx population.

In summary, while ANS activity appears to be related to peritraumatic dissociation, there is inconsistency regarding the nature of these relationships. However, in relation to PTSD, there is evidence to suggest that lower HRV is related to PTSD symptomology (Pyne et al., 2016; Rissling et al., 2016; Schneider & Schwerdtfeger, 2020; Tan et al., 2011). It has been posited that in addition to trauma exposure, other chronic stressors such as community violence, poverty, and racism may also play a role in ANS reactivity (Lepore et al., 2006). Therefore, this provides merit for considering

other preexisting stressors or resiliency factors that could provide context for physiological responses post-trauma, such as culturally specific stressors or beliefs within the Latinx population.

### ***Cortisol.***

Upon the brain perceiving threat in the environment, activation of the HPA axis is initiated by the release of the corticotropin-releasing hormone (CRH) from the hypothalamus, leading to the release of the adrenocorticotrophic hormone (ACTH) from the pituitary gland, resulting in the release of glucocorticoids, primarily cortisol in humans, from the adrenal gland (Saxbe, 2008; Lovallo & Buchanan, 2017).

Glucocorticoids play an interesting role in the body's stress response. Cortisol initiates various effects in the body to enable the stress response, including enhancing glucose availability, reducing the release of insulin, and regulating immune functions (Myers et al., 2014). However, cortisol also acts as a negative feedback signal within the HPA axis to indicate a reduction in CRH and ACTH is needed, thus inhibiting ongoing HPA axis activity, and bringing the body back to rest (Dunlop & Wong, 2019). However, under extreme and/or chronic stress, glucocorticoids can become dysregulated by becoming either elevated or blunted, resulting in a multiplicity of adverse outcomes, including hypertension, cardiovascular disease, dysregulation in immune processes and deficits in cognitive functioning (Saxbe, 2008; Wang & Campos, 2018). Dysregulation of the HPA axis can result from chronic overactivation of this system due to chronic stress or trauma (McEwen, 1998; Wang & Campos, 2018). The vast majority of research examining this system has utilized the measurement of its end product, cortisol, often as a mediator between stressful experiences and health outcomes (Saxbe, 2008). Due to this system's

relationship to stressors in the environment, it has also been implicated in trauma research, which has yielded inconsistent findings.

**Cortisol and peritraumatic dissociation.** Little research has examined the relationship between cortisol levels and peritraumatic dissociative experiences. Some studies have suggested that peritraumatic dissociation is indicative of blunted cortisol responses, resulting in overactivation of sympathetic activity. This excessive activation and lack of released cortisol has been hypothesized to enhance fear conditioning and memory consolidation subsequently leading to hyperarousal symptoms characteristic of PTSD (Inslicht et al., 2011; Yehuda, 2009). Therefore, it is believed that deficits in HPA axis functioning (i.e., decreased secretion of cortisol hormone) during the peritraumatic period contributes to PTSD development. Inslicht and colleagues (2011) conducted a prospective study with police officers during academy training to examine the ability of cortisol awakening response prior to trauma exposure to predict peritraumatic dissociation and PTSD symptoms post-trauma exposure. Findings revealed that greater increase in salivary cortisol after awakening significantly predicted greater peritraumatic dissociation, however, was not related to PTSD development at 12-, 24-, or 36-month follow-up.

This suggests that greater cortisol response pre-trauma may create a susceptibility to peritraumatic dissociation during a trauma, and subsequently creating an overactivation of this system and vulnerability to PTSD. However, some existing research supports the theory that individuals experiencing greater peritraumatic dissociation may constitute a sub-group of trauma victims who are biologically less reactive to trauma. Evidence for this can be found from a study conducted by Delahanty

and colleagues (2003) examining the relationship between peritraumatic dissociation and urinary hormone levels in a sample of motor vehicle crash survivors admitted to the hospital. Various biological specimens were gathered and tested in this study, including urinary cortisol, heart rate, and blood pressure. No relationship was found between any of these biomarkers and peritraumatic dissociation.

**Cortisol and PTSD.** While a dysregulation of cortisol secretion has been consistently found in individuals with PTSD, there are conflicting empirical findings as to the characterization of this dysregulation contributing to increased risk for disorder development (Meewisse et al., 2007; Morris et al., 2012). For example, many studies have reported lower cortisol levels in individuals with PTSD compared to non-clinical samples (Galatzer-Levy et al., 2014; Steudte-Schmiedgen et al., 2015), while others have reported greater cortisol levels in patients with PTSD (Elzinga et al., 2003). Additionally, some research has suggested that dysregulation of the HPA axis may simply be a result of trauma exposure rather than PTSD development. For example, a study with military veterans diagnosed with PTSD found lower cortisol levels in those with a diagnosis, when compared to non-trauma-exposed controls. However, no differences were found between the clinical sample and a control group with a history of deployment related trauma (De Kloet et al., 2007).

A meta-analysis examining only studies that employed analysis of basal cortisol levels through plasma samples revealed lower levels of cortisol in people with PTSD in comparison to non-trauma exposed controls (Meewisse et al., 2007). Additional differences examined in this review included lower cortisol in studies with physical or sexual abuse survivors and in plasma samples collected in the afternoon. In a separate

study, traumatic injury patients had serum cortisol samples gathered within hours following injury and demonstrated that patients with lower cortisol output were at greater risk for PTSD development at 6-weeks and 6-months post injury (Mouthaan et al., 2014). Further support for this is found in a recent prospective study demonstrating blunted cortisol following traumatic injury was related to PTSD development (Jayan et al., 2021). These findings suggest that blunted cortisol release may be characteristic of those with PTSD in comparison to healthy controls.

Galatzer-Levy and colleagues (2017) utilized machine learning predictive modeling in order to develop sophisticated predictive algorithms considering complex trajectory models. Analyses revealed multiple trajectories resulting in PTSD development following a traumatic event. One trajectory indicated that blunted cortisol response, following admission to the Emergency Department (ED), together with a history of childhood trauma resulted in non-remitting PTSD at 6-months post-trauma. A second trajectory indicated that individuals without a history of childhood trauma and heightened cortisol response, upon admittance to the ED, also resulted in non-remitting PTSD. This study exemplifies the complex pathways in which an individual may develop PTSD following a traumatic event. This also offers a reiteration of the importance of considering contextual factors such as prior lifetime trauma and stress as suggested in the previous section regarding the ANS. Furthermore, researchers have suggested mediating and/or moderating factors, such as previous trauma history, socioenvironmental factors, and peritraumatic experiences among others, to understand inconsistent findings (Morris et al, 2016).

In summary, there are mixed findings regarding the relationship between cortisol levels and PTSD. Specifically, there is evidence to suggest that the role of cortisol may change over time following a traumatic event. In the acute aftermath of a trauma, higher levels of circulating cortisol would be expected as the body is still in the acute response phase. Therefore, it is plausible to predict that individuals with blunted, or lower, cortisol levels in the acute period following a traumatic event may be at greater risk for PTSD symptoms, as supported by the findings discussed above (Galatzer-Levy et al., 2017; Jayan et al., 2021).

According to various studies reviewed, the relationship of cortisol and PTSD development is not static and consistent across groups. This provides strong support for the consideration of contextual factors in understanding the dysregulation of cortisol levels following a trauma. Of the studies reviewed, racial/ethnic breakdown of participants was either not provided or composed of a majority White sample. Therefore, little to nothing is known about the reactivity of the HPA axis following a trauma in the Latinx population. Due to high levels of stress experienced by Latinxs (e.g. acculturative stress), it is expected that these adverse experiences may serve as a vulnerability to HPA dysregulation.

### ***HRV and Cortisol.***

As described earlier, heart rate variability and cortisol are biomarkers indicating functionality of closely interconnected stress response systems – ANS and HPA-axis. Therefore, it is to be expected that these two markers may be related. As described already, each of these systems have been extensively studied in relation to stress response and regulation, however, a burgeoning area of research is emphasizing the importance of

understanding the interaction between these two systems. For example, a recent study assessed the impact of HPA axis manipulation (cortisol suppression or stimulation) on ANS function, as measured by HRV (Agorastos et al., 2019). Findings demonstrated that HPA-axis stimulation (heightened cortisol secretion) was associated with significantly reduced HRV. Further, through fusion analyses, it has been found that HRV and cortisol measurements considered together are significantly more accurate in their sensitivity and specificity of detailing the stress response system functioning than either of these indicators alone (Aimie-Salleh et al., 2019).

Generally, across studies assessing these relationships within the context of stress, heightened cortisol levels are associated with decreased HRV (Hansen et al., 2012; La Marca et al., 2011; Weber et al., 2010). These findings are indicative of dysregulation within these intertwined stress response systems. Importantly, these findings were overwhelmingly discovered among White, male samples, severely limiting the generalizability and applicability to other populations, particularly those that are historically exposed to multiple forms of chronic stress.

### **Cultural Factors**

Culture can be defined as a shared information system, including behavioral norms and cognitive patterns, shared by a group of people that is distinct from other populations (Lehman et al., 2004; Matsumoto & Juang, 2013). There are numerous cultural factors unique to Latinx populations that have been the subject of extensive research in relation to psychological outcomes (Arellano-Morales & Sosa, 2013; Grey & Hall-Clark, 2015). Furthermore, there have been cultural factors put forth that may be of particular interest when examining outcomes, such as PTSD, following a trauma.



Specifically, acculturative stress, fatalism, and familism have been implicated in influencing the conditional risk for PTSD among Latinx groups (Alcántara & Lewis-Fernández, 2016).

***Acculturative Stress.***

As Latinx individuals settle in the United States, they are met with the task of acclimating, or not, to a new culture. This process has been described as acculturation, which can be defined as the process of navigating multiple cultures, customs, practices, and values (Berry, 1997; Schwartz et al., 2010). Acculturation itself has been associated with the mental health and well-being of Latinx individuals (Lara et al., 2005). The process of acculturation may be difficult, and place added stress on individuals navigating the balance between Latinx and American culture). It is important to note acculturation and acculturative stress as closely related, but separate concepts, with acculturation indicating the process of navigating one's heritage culture and dominant culture and acculturative stress being the stress resulting from the burden of the acculturation process.

Furthermore, the process of acculturation may place added burden on individuals of Latinx ethnicity regardless of immigration status or generation level (Cervantes et al., 2013; Crockett et al., 2007). For instance, Latinx immigrants may experience the most typical acculturation process of learning a new language and having to learn new cultural norms of the dominant society (Dawson & Panchanadeswaran, 2010; Bekteshi & Kang, 2018). However, second and third generation Latinx individuals may also experience acculturative stress by having to broker between their Latinx culture and the mainstream American culture in which they have been raised, for themselves and family members

that may be less acculturated as well as having both their American and Latinx identity questioned and challenged (Cervantes et al., 2013). Therefore, Latinx individuals of varying nativity status and time lived in the U.S. may be subject to the stress of navigating their ethnic cultural heritage and the dominant American culture. While there is a vast amount of research focusing effects of general stress, examining acculturative stress provides the opportunity to understand a culturally specific stressor to much of the Latinx population.

**Acculturative stress and PTSD.** Acculturative stress has been associated with various negative mental health outcomes, such as, depression, anxiety, substance use, and general psychological distress (Bekteshi & Kang, 2018; Wang et al., 2010). Acculturative stress has also been linked with increased traumatic stress symptoms and PTSD diagnosis. For instance, Ehlers and colleagues (2016) examined acculturative stress and its relationship to a PTSD diagnosis in a predominately second-generation or greater Mexican American population. Findings revealed that greater acculturative stress was related to more trauma exposure as well as a PTSD diagnosis. This may suggest that acculturative stress creates a vulnerability to trauma and, subsequently, the development of PTSD. Additionally, Zvolensky and colleagues (2018) found acculturative stress to significantly predict PTSD symptom severity in a large sample of Latinx college students, all of whom had experienced at least one traumatic event in their lifetime. While the research examining this relationship in Latinx populations is limited, acculturative stress has also been linked to PTSD symptoms among various refugee samples (Ellis et al., 2008; Kartal et al., 2018; Kartal & Kiropoulos, 2016).

**Acculturative stress and biological stress response.** Regarding biomarkers, studies examining the influence of acculturative stress on the body's stress response systems are scarce. To this author's knowledge, there are currently two studies examining this relationship. Torres and colleagues (2018) examined these factors among a sample of Latinx women using salivary cortisol samples at three timepoints over a 24-hour period. The sample was divided into high and low acculturative stress groups. Findings revealed that participants who scored in the high acculturative stress group showed lower levels of cortisol at the post-waking and bedtime time-points, indicating a flatter diurnal cortisol slope in comparison to the low acculturative stress group (Torres et al., 2018). The second study consisted of 105 participants of Mexican descent to examine the relationship between acculturative stress, cortisol levels, and self-reported health (Garcia et al., 2017). Significant associations were found between acculturative stress and health, as well as, with cortisol levels, such that, higher acculturative stress was associated with poorer health and lower cortisol levels. Through further analyses, a mediational model indicated that a significant proportion of the relationship between acculturative stress and appraised health was mediated by cortisol.

Interestingly, there are currently no existing studies that have examined the relationship between acculturative stress and ANS functioning or response. However, given the sensitivity of this system, it is plausible that acculturative stress may influence the body's nervous system functioning as well. For instance, a systematic review examining the relationship between work stress and ANS functioning found that increased work stress was associated with decreased ANS functioning via HRV measurements (Jarczok et al., 2013). Specifically, decreased HRV was associated with

increased stress, indicating ANS dysfunction. It is conceivable to expect similar results in the context of acculturative stress.

### ***Fatalism***

A common Latinx cultural belief that has been theorized to influence PTSD development post-trauma is fatalism. Fatalism can be defined as a deterministic notion that external forces have greater causal power than that of individual forces (Alcántara & Lewis-Fernández, 2016). There is little consensus on the appropriate measurement or definition of fatalism throughout the literature as it has been operationalized and defined in various ways. For example, Gutierrez and colleagues (2017) defined fatalism as the belief that “one’s health and health outcomes are determined by fate and are outside of one’s control”. It has also been defined as the acceptance of one’s situation (Futa, Hsu, & Hansen, 2001). A review of fatalism definitions found that fatalism has been variously characterized as an external locus of control, predetermined beliefs, acceptance of reality, or a form of coping (Esparza et al., 2015).

**Fatalism and PTSD.** While research relating trauma and fatalistic beliefs needs further examination, in the context of a traumatic experience, one’s endorsement of fatalistic beliefs is thought to influence their coping style (Alcántara & Lewis-Fernández, 2016; Neff & Hoppe, 1993). Two main theories have been purported as to whether greater fatalism may be protective or may put an individual at higher risk for psychopathology. One theory suggests that fatalistic beliefs are associated with passive coping strategies that may result in maladaptive thinking patterns (i.e. wishful thinking, hopelessness; Pole et al, 2005). Following a traumatic event, individuals with passive coping styles may subsequently engage in various maladaptive behaviors or thinking

patterns, as well as have lower inclination to engage in help-seeking behaviors, which could in turn result in continuation or intensifying of symptoms. Findings from a study conducted by Pole and colleagues (2005) may be evidence for this. Latinx police officers endorsed greater self-blame and wishful thinking coping strategies which was in turn associated with greater PTSD severity in this group. Alternatively, fatalism may indicate adaptive coping manifesting through mindful acceptance, leading to less negative outcomes (Markowitz et al., 2009). However, these competing theories have yet to be explicitly tested.

To the author's knowledge, there have been two studies examining the relationship between fatalism and PTSD symptoms. Perilla and colleagues (2002) examined differences in PTSD development across ethnic groups (134 Latinx, 135 non-Latinx Black, and 135 non-Latinx White) six months following a natural disaster. Results suggested a significant relationship between fatalism and PTSD within Latinx individuals, however, this study did not expand upon mechanisms underlying this association (Perilla et al., 2002). A second study assessed fatalistic beliefs in the context of the COVID-19 pandemic and psychological outcomes and demonstrated that greater fatalism was predictive of greater endorsement of PTSD symptomology among a large, international sample (Bogolyubova et al., 2021). There are currently no studies that have examined the relationship between fatalism and biological stress response systems.

While there is little research regarding fatalistic beliefs among trauma-exposed samples, fatalism has been examined and conceptualized as a risk factor for negative health outcomes among other disease prone samples. For example, Gutierrez and colleagues (2017) found greater fatalism beliefs to be associated with greater odds of

hypertension in a sample of Latinx adults. Moreover, greater fatalistic beliefs have also been associated with lower likelihood of participating in cervical cancer screenings (Marván, Ehrenzweig, & Catillo-López, 2016). These findings suggest that fatalism may serve as a risk factor when examining trauma-exposed individuals who already have a greater vulnerability to negative health outcomes.

### ***Familism***

Lastly, familism is a cultural construct that may influence Latinx mental health outcomes following a traumatic event. Familism can be defined as a cultural value emphasizing the prioritization of strong family connectedness among immediate and extended family members, and placing family priorities above individual priorities (Alcántara, Casement, & Lewis-Fernandez, 2013; Alcántara and Lewis- Fernández, 2016). While close relationships with family may be present among various other ethnic groups, familism has shown to be a central part of Latinx culture and endorsed at greater levels by Latinx individuals in comparison to other ethnic groups (Perilla et al., 2002). Familism is often considered a protective factor within this population, indicating increased social support and promoting healthy coping strategies (Stein et al., 2019). However, some studies have found familism values to be detrimental to mental health. For example, a cross sectional study examining a sample of Latinx emerging adults, found higher familism scores to be associated with binge drinking (Escobedo et al., 2018). Furthermore, a qualitative study was conducted with Latinx emerging adult women with and without a history of suicide attempts to understand the way in which familism is expressed in their lives. Findings revealed that these women understood and expressed familism in the form of self-sacrifice; most shockingly, women who had

actively attempted suicide in the past expressed a desire to kill themselves in order to make things better for their families (Nolle et al., 2012).

While these studies exemplify the complexity of familism within Latinx culture, it is unclear in what contexts familism may be protective or create greater vulnerability to negative outcomes for Latinx individuals. Specifically, existing empirical research has not provided enough support as to whether strong familial relationships and obligations to one's family may serve as a protective or risk factor in the context of stressful or traumatic events (Alcántara and Lewis- Fernández, 2016). However, given the common occurrence of interpersonal difficulty as well as the importance of social support networks during and after traumatic events, familism is an important cultural value to examine in this context (Frías and Agoff, 2015).

**Familism and biological stress response.** Regarding relationships between familism and biological markers of the body's stress response systems, recent research has examined the relationship between familism and cortisol levels in youth populations. Chiang and colleagues (2019) examined associations between familism values and behaviors with inflammatory processes, as measured by cortisol and interleukin (IL)-10, a biomarker of immune system functioning, among an ethnically diverse sample. While no significant associations were found between familism and cortisol levels in Latinx youth, greater familism was associated with greater sensitivity to IL-10. This indicates that for Latino youth, familism values may be protective against risk for poor health and may be influencing the inflammatory response in the body which is critical to healing. A similar study examining Latino youth found no association between cortisol responsivity to an experimental stress task and familism (Gonzales et al., 2018). Lastly, Doane and

colleagues (2018) revealed more nuanced findings in their examination of familism, perceived parental support and diurnal cortisol levels in Latino youth. Results did not indicate significant association of familism and cortisol, however, greater perceptions of parental support by participants was associated with greater average cortisol awakening response. It is suggested that greater cortisol awakening response aids an individual in effectively coping with anticipated stressors in the upcoming day (Adam et al., 2006; Doane et al., 2018). While parental support may function differently in youth than in Latinx adults, these findings provide support for the possibility that individuals high in familism would value familial and parental support, which could confer protection against dysregulation of stress response systems in the context of a significant stressor. No studies currently exist examining familism and physiological measurements/ANS functioning.

There are mixed findings as to whether familism serves as a protective or risk factor for mental health outcomes among Latinx adults, particularly in the context of a traumatic event. However, given the reviewed literature demonstrating familism as a protective factor in relation to biological stress response systems, it is expected that familism may similarly serve as a protective factor when considering its interaction with other biological systems and psychological outcomes, namely PTSD.

In summary, there is a lack of empirical research testing the relationships between these various cultural beliefs and experiences in relation to a traumatic event. Given the reviewed evidence and theory, it is likely that these variables interact with the body's stress response systems to influence PTSD outcomes post-trauma.



## Current Study

Previous research demonstrates a strong relationship between peritraumatic dissociation and PTSD (Alcántara et al., 2013; Demarble et al., 2020; Lensvelt-Mulders et al., 2008; Ozer et al., 2008). Latinx populations have been found to experience greater levels of dissociative experiences – possibly explaining the increased conditional risk for PTSD in this ethnic group (Alcántara and Lewis-Fernández, 2016). It is unclear, however, what may be connecting the experience of peritraumatic dissociation to heightened PTSD symptomology. The current study sought to address this gap in the literature utilizing the framework of cultural neurobiology (Causadias et al., 2017).

The body's biological stress response in the acute aftermath of a traumatic event may mediate the peritraumatic dissociation and PTSD link. As currently conceptualized, cultural variables of fatalism, familism, and acculturative stress are believed to moderate the relationship between the body's stress response systems and PTSD outcomes (B pathway of Figure 1). While some research has conceptualized cultural factors as a distal influence on PTSD outcomes, the literature reviewed suggests a more proximal role. Such that, acculturative stress may interact with biological stress response systems by compounding negative effects of trauma on the body and mind, creating greater susceptibility to PTSD outcomes post-trauma. Factors such as familism and fatalism, which represent cultural values in the Latinx population, may interact with biological systems by conferring unique resilience or risk factors resulting in the manifestation of psychopathology following a trauma. Furthermore, it is the examination of the interaction between cultural and biological factors that is crucial to be consistent with the cultural

neurobiological theoretical framework (Causadias et al., 2017). As such, the proposed study has three aims:

**Aim 1: Establish the association between peritraumatic dissociation and PTSD symptoms acutely following trauma.**

*Hypothesis 1:* Peritraumatic dissociation will predict acute PTSD symptoms among Latinx traumatically injured adults.

**Aim 2: Establish predictive ability of biological and cultural variables on acute PTSD symptom severity.**

*Hypothesis 2A:* Biological stress response variables (cortisol and HRV) will predict acute PTSD symptom severity. Specifically, lower cortisol and HRV will be associated with greater acute PTSD symptom severity.

*Hypothesis 2B:* Cultural factors (familism, fatalism, and acculturative stress) will predict acute PTSD symptom severity. Specifically, greater acculturative stress and fatalism beliefs will be associated with increased PTSD symptom severity, while lower familism beliefs will be associated with heightened PTSD symptom severity.

**Aim 3: Examine a moderated mediational model that links peritraumatic dissociation to PTSD symptoms via biological stress responses while accounting for moderating role of cultural variables on the indirect effect.**

*Hypothesis 3:* A significant conditional indirect effect will be demonstrated, such that, biological dysregulation will mediate the relationship between peritraumatic dissociation and acute PTSD symptom

severity, while cultural variables (acculturative stress, fatalism, and familism) will moderate this mediational model (as illustrated in Figure 1).

*Hypothesis 3A:* A significant indirect effect will be observed, such that both cortisol and HRV will mediate the relationship between peritraumatic dissociation and PTSD symptoms.

*Hypothesis 3B:* The conditional indirect effect will be stronger for high acculturative stress, such that, greater acculturative stress will interact with biological dysfunction to result in heightened acute PTSD symptoms.

*Hypothesis 3C:* The conditional indirect effect will be stronger for high fatalism beliefs, such that, greater fatalism beliefs will interact with biological dysfunction to result in heightened acute PTSD symptoms.

*Hypothesis 3D:* The conditional indirect effect will be weaker for high familism beliefs, such that, greater familism beliefs will interact with the biological dysfunction to result in lower acute PTSD symptoms.

## **METHOD**

### **Participants**

For the current study, 52 Latinx traumatically injured patients were recruited from the Emergency Department and Trauma Surgery inpatient unit of a level 1 trauma center. Due to the significant obstacles during the recruitment period, a post hoc power analysis

was conducted using a  $p$ -value of 0.05 and an effect size of .35 using power analysis via SPSS software v. 28 for statistical analyses of regressions. Using this method, the current sample size was deemed to have sufficient power for analyses. Participants include Latinx adult patients who sought services at Froedtert Hospital/Medical College of Wisconsin (MCW) for a traumatic injury (e.g., motor vehicle crash, fall, blunt and penetrating assaultive injury, recreational accident, industrial accident, pedestrian vehicle struck). Participants were initially screened for eligibility for the current study if they were (a) seen for traumatic injury, (b) at least 18 years of age, (c) literate in either English or Spanish, and (d) identify as Latinx. Initial exclusions included severe traumatic brain injury and/or inability to communicate verbally. Participants who were deemed eligible based on these screening criteria were then be approached for further screening on the inpatient unit or in the emergency department. Exclusion criteria were as follows: 1) individuals admitted due to self-inflicted injuries, 2) moderate to severe cognitive impairment secondary to trauma-related head injury, 3) active psychosis, 4) Glasgow Coma Scale score <13, indicating more than a mild traumatic brain injury, or 5) post-traumatic amnesia greater than 24 hours following the event.

## **Materials**

***Demographics.*** Participants were asked for demographic information such as age, gender, race and ethnicity, employment status, student status, and mechanism of injury.

***PTSD Symptoms.*** The PTSD Checklist – 5 (PCL-5; Blevins et al., 2015) is a 20-item self-report measure assessing PTSD symptoms in accordance with symptom criteria detailed in the *Diagnostic and Statistical Manual – 5 (DSM-5)*. Participants are asked to rate what degree of distress each item has caused them in the time since the index

traumatic event. Each item is rated on a 5-point Likert scale ranging from 1 (*not at all*) to 5 (*extremely*). Sample items include, “Repeated, disturbing, and unwanted memories of the stressful experience?” and “Avoiding memories, thoughts, or feelings related to the stressful experience?”. All items are summed to generate a total score, with higher scores indicating greater PTSD symptoms. Research in traumatically injured samples has suggested a total score of 30 or higher indicates diagnostic levels of PTSD symptoms (Geier et al., 2019). This measure is available in both English and Spanish. The PCL-5 has been utilized with Latinx samples in previous research and demonstrated good internal consistency ( $\alpha = 0.94$ ; Falgas-Bague et al., 2019; Saucedo, Wiebe, Chan, Kutner, & Simoni, 2018). In line with this, the current sample demonstrated an internal consistency of  $\alpha = 0.94$ .

***Peritraumatic Dissociation.*** The Peritraumatic Dissociative Experiences Questionnaire (PDEQ; Marmar et al., 1997) is a 10-item measure that assesses dissociative or out of body experiences during or immediately following the identified traumatic event. Participants are asked to rate each item on a 5-point Likert scale from 1 (*not at all true*) to 5 (*extremely true*). Sample items include, “What was happening seemed unreal to me, like I was in a dream, or watching a movie or play.” A sum score is calculated using all items. This measure is frequently used throughout the literature and is well validated (Sijbrandij et al., 2012). A modified version of this measure has been used with a young adult Latinx sample that displayed good internal reliability (Marshall & Orlando, 2002). As this measure was not previously available in Spanish, for the current study, the PDEQ was professionally translated and back translated to ensure consistency between languages. The current sample achieved a good internal reliability ( $\alpha = 0.86$ ).

**Fatalism.** The Multidimensional Fatalism Scale (MFS; Esparza, Wiebe, & Quiñones, 2015) is a 30-item measure assessing fatalistic beliefs, comprised of six separate subscales, including helplessness, fatalism, internality, luck, and divine control. The current study only used the 6-item fatalism subscale. Participants are asked to rate each item using a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Sample items include, “Life is very unpredictable, and there is nothing one can do to change the future” and “I have learned that what is going to happen, will happen.” Sum score will be calculated from the 6 subscale items. The MFS was developed simultaneously in English and Spanish with measurement invariance analyses indicating factor structure, loadings, variances, and covariances were invariant between English and Spanish versions (Esparza et al., 2015). In addition to being validated with a Latinx sample, the MFS has been used in various other studies with Latinx participants (Esparza, 2018; Maercker et al., 2019). Internal reliability coefficient for the current sample was good ( $\alpha = 0.84$ ).

**Familism.** The Multiphasic Assessment of Cultural Constructs (MACC; Cuellar et al., 1995) is a 62-item measure of Latinx cultural factors consisting of five subscales: familism, *fatalismo*, *personalismo*, *machismo*, and folk beliefs. The current study utilized only the familism subscale, which is comprised of 12 true/false items. Sample items include, “No matter what the cost, dealing with a relatives’ problems comes first” and “Relatives are more important than friends”. A sum score is calculated from these items, with greater scores indicating greater familism beliefs. This measure is available in both English and Spanish. It has been widely used with Latinx populations (Lorenzo-Blanco et

al., 2012; Ramos-Sánchez & Atkinson, 2009). Internal reliability coefficient for the current sample was good ( $\alpha = 0.72$ ).

***Acculturative stress.*** The Multidimensional Acculturative Stress Inventory (MASI; Rodriguez et al., 2002) is a 36-item measure assessing participant's acculturative stress. Items on this measure assess stress deriving from both American and Latinx sources. Sample items include, "I don't speak English, or I don't speak it well" and "Since I don't speak Spanish well, people have treated me rudely or unfairly". Participants are asked to rate how much stress each item has caused them over the past 3 months on a 6-point Likert scale ranging from 0 (*does not apply*) to 5 (*extremely stressful*). An average score is calculated across all items, with higher scores corresponding to greater acculturative stress. This measure is available in both English and Spanish. Previous studies utilizing the MASI with Latinx individuals have demonstrated excellent internal consistency (Torres et al., 2012). Internal reliability coefficient for the current sample was excellent ( $\alpha = 0.94$ ).

***Heart Rate Variability.*** Heart rate variability (HRV) was measured using the iThlete finger sensor (iThlete Finger Sensor: HRV Fit Pty Ltd, Hampshire, UK; Heathers, 2013). Using a smartphone platform, photoplethysmography (PPG) technology is used via an optical recording of the pulse wave obtained through the silicone finger clip (Heathers, 2013). The finger sensor is attached to the participants finger of choice. Signal from the sensor is transmitted to an interface box, which is connected to a microphone input of an iOS-compliant device (i.e., smartphone or iPad; Heathers, 2013). Once signal is obtained and a pulse detected, HRV measurement was gathered in 55 seconds. Using PPG, the iThlete provides a root mean square of successive R-R intervals (RMSSD). This

measurement tracks the high frequency changes in heart rate rhythm in response to respiration (Flat and Esco, 2013). The iThlete finger sensor has been validated in various samples and has shown the accuracy comparable to the gold standard electrocardiogram (ECG) measurement (Flat and Esco, 2013; Heathers, 2013).

**Cortisol.** Participants provided a blood sample ( $\leq 30$ mL total) obtained by a research coordinator, unit nurse, or hospital phlebotomist to evaluate circulating levels of cortisol acutely post-trauma. For patients admitted to the inpatient trauma service, blood samples were drawn as early in the patient's hospital stay as possible (range of cortisol collection time = 9:30am – 3:49pm,  $M = 1:02$ pm). For those who were recruited from the ED, their initial baseline appointment was scheduled as soon after injury as possible (range of cortisol collection time = 8:55am – 3:35pm,  $M = 1:03$ pm). Blood samples were collected an average of 4 days post-trauma. Time of cortisol collection could not be standardized due to acute nature of injuries, necessity of medical procedures and care, varying sleep-wake cycles, transportation, and scheduling constraints. Blood samples sat at room temperature for 30-60 minutes. Following this timeframe, samples were spun in a centrifuge at approximately 1300 rotations per minute (RPM) for 20 minutes at 4°C. Serum and cells were separated in the MCW Translational Research Unit (TRU). Serum was immediately frozen and stored at -80°C until cortisol measurement assay. Analysis was completed using enzyme-linked immunosorbent assay (ELISA) with commercial kits (Enzo Biochem Inc.) according to manufacturer's instructions. Based on manufacturer's reporting, intra-assay precision varies from 7.3 to 10.5 and interassay precision varies from 8.6 to 13.4 for high-to-low cortisol levels.



## Procedures

Participants were recruited at a level 1 trauma center from both the Emergency Department (ED) and trauma surgery inpatient unit. This setting allowed the unique opportunity to assess trauma patients acutely, as patients were assessed no later than 1-week post-injury. Recruitment from the inpatient trauma unit was facilitated using the trauma patient care list, which is a real-time list of all patients admitted to the trauma service following the index event. Daily trauma pages were also screened as they came in for patients who may have qualified for participation but were discharged that same day. Additionally, patients were recruited who presented to the ED but were not admitted to the inpatient service.

If a potential participant qualified for recruitment based on the trauma patient care list, a trained research assistant approached the individual, explained the purpose, risks, study related procedures and conducted the informed consent process if the patient agreed to participate. To increase Latinx enrollment, recruitment occurred in the ED, in addition to inpatient. The ED research team screened patients admitted to the ED following an index event. Emergency department research staff then notified the study team when an eligible patient was screened. If study staff was available, they then approached the potential subject to gauge interest in study participation. Eligible patients were provided with additional study information (i.e., a blank informed consent form and/or a study flyer) and scheduled either in-person or over the phone for an in-person visit that occurred within four days of their injury. If study staff were not available, the ED research team provided a study flyer to the individual, logged patient information, and relayed patient information to the study team for them to contact the identified eligible

patient in the following days over the phone. The potential participants were asked to come back to the hospital in order to complete the same activities as the inpatient participants described below. During this initial appointment, study staff conducted the informed consent process. These scheduled appointments took place in the Adult Translational Research Unit (TRU) at Froedtert Hospital, a staffed research support space sponsored by the Clinical and Translational Science Institute (CTSI) of Southeast Wisconsin.

Once enrolled, participants completed baseline activities, which included, a blood draw, physiological vitals including blood pressure, heart rate, heart rate variability, height and weight, a urine sample, and a series of demographic and psychological questionnaires. Blood sample was collected without experimental manipulation. Heart rate variability measurements were performed with participants in a sitting position in a quiet laboratory room, breathing spontaneously. There were no restrictions on eating, drinking, or smoking in the hours prior to measurement. Participants were encouraged to relax and refrain from movement during data acquisition. All questions are asked in a clinical interview format by a study team member. Participants are compensated \$40 for these activities.

Notably, the current study began recruitment and data collection in October 2019, prior to the SARS-COVID-19 pandemic. Due to the COVID-19 pandemic, in March 2020 research activities were required to completely cease activity and did not resume until July 2020. Additionally, once recruitment began again, many patients presenting to the hospital were skeptical of participating in research due to various life stressors and health concerns related to the pandemic. As a result, recruitment was negatively

impacted, resulting in a smaller sample size than originally planned. Of note, 14 participants were recruited pre-pandemic, with the remaining 38 participants recruited from September 2020 through March 2021.

## RESULTS

### Data Screening

Prior to analyses, main variables of interest (peritraumatic dissociation, post-traumatic stress symptoms, acculturative stress, fatalism, familism, HRV, and cortisol) were examined to determine accuracy of data and assumptions of multivariate analyses.

All statistical analyses were carried out using the SPSS statistical software package, version 27 (IBM, 2021). Pairwise linearity was assessed using within-group scatterplots and deemed satisfactory. To screen for univariate outliers each variable was transformed to its z-score and values  $\pm 3.29$  were considered potential outliers (Howell, 2013; Tabachnick & Fidell, 2013). Cortisol and MASI scores were the only variables to display univariate outliers. Each variable consisted of one outlier which were winsorized to the next highest value under the cut off of 3.29 (Tabachnick & Fidell, 2013). In order to screen for multivariate outliers Mahalanobis distance was utilized to examine the distance each value falls from the centroid. No corrections were necessary given that no cases were determined to be multivariate outliers using a  $p$ -value of 0.0001 and  $\chi^2$  testing.

All variables of interest were examined for normality. Skewness and kurtosis were evaluated in each variable by dividing the value by their respective standard errors. If the value was  $\pm 3.29$ , data were considered significantly kurtotic or skewed. Acculturative stress (MASI) was the only variable that was significantly skewed and

kurtotic. All main analyses were conducted using the transformed and untransformed data. No differences were observed; therefore, all of the analyses reported include original, untransformed data. To examine multicollinearity, a matrix correlation (two-tailed Pearson's  $r$ ) of all variables was created. No two variables were correlated over 0.80, as is an accepted diagnostic cut-off of multicollinearity (P. Vatcheva & Lee 2016). Results can be found in Table 2.

### **Participants and Preliminary Analyses**

The current sample was comprised of 52 Latinx patients. Nine of them chose to complete the study in Spanish, with the remaining 43 completing the study in English. Of the total sample, 61.5% ( $n = 32$ ) were recruited from the Emergency Room, with the remaining 38.5% recruited from the trauma inpatient unit ( $n = 20$ ). Majority of the sample were injured in a motor vehicle collision (46.2%,  $n = 24$ ) with the remaining participants reporting gunshot wound (GSW; 15.4%,  $n = 8$ ), fall (13.5%,  $n = 7$ ), assault (9.6%,  $n = 5$ ), pedestrian struck by vehicle (1.9%,  $n = 1$ ), motorcycle crash (MCC; 1.9%,  $n = 1$ ), and other (11.5%,  $n = 6$ ). Other injury included snowmobile accident, accidental amputation of fingers, and animal bite. The sample was fairly even regarding gender with 51.9% men ( $n = 27$ ) and 48.1% women ( $n = 25$ ). The mean age was 32.33 years ( $SD = 12.25$ ). Sixty-three percent of the sample was employed at the time of injury ( $n = 33$ ). Regarding nativity, 25% ( $n = 13$ ) of the sample was born outside of the U.S., with the remaining 75% ( $n = 31$ ) U.S. born. Twenty-five percent of the sample reported a history of psychiatric disorder. Regarding socioeconomic status, an Area Deprivation Index (ADI; Kind et al., 2014; Singh, 2003) was calculated using the address of each participant. The ADI is a measure of neighborhood socioeconomic disadvantage using a

factor-based index score including poverty, education, housing, and employment (score derived from the 2011-2015 American Community Survey, part of the U.S. Census; Kind et al., 2014). Scores range from 0 to 100, with greater scores indicating greater environmental disadvantage. The current sample had a mean score of 75.25 ( $SD = 21.09$ ) indicating high disadvantage. Descriptive statistics of main study variables are displayed in Table 1, and bivariate associations are provided in Table 2.

*Mean differences.* Independent samples t-tests were conducted to examine potential differences between nativity status, gender, location of recruitment, psychiatric history, and mechanism of injury. Analyses revealed no significant differences across nativity status and location of recruitment. Women ( $M = 73.05$ ,  $SD = 14.49$ ) had significantly higher HRV readings than men ( $M = 67.96$ ,  $SD = 14.99$ ),  $t(43) = .001$ ,  $p = .027$ , while men ( $M = 7.23$ ,  $SD = 4.23$ ) had significantly higher cortisol levels than women ( $M = 4.81$ ,  $SD = 2.74$ ),  $t(50) = 2.41$ ,  $p = .02$ . Additionally, participants with a past psychiatric diagnosis ( $M = 41.92$ ,  $SD = 18.41$ ) reported greater acute posttraumatic stress symptoms than those who did not have a psychiatric history ( $M = 28.24$ ,  $SD = 21.26$ ),  $t(40) = .54$ ,  $p = .052$ . A dummy variable was created for trauma type to group into assaultive (i.e., gunshot, stabbing, or physical assault) and non-assaultive trauma. Participants who suffered an assaultive injury ( $M = 8.10$ ,  $SD = 3.79$ ) had significantly greater cortisol measurements than those who suffered a non-assaultive injury ( $M = 5.37$ ,  $SD = 3.52$ ),  $t(50) = -2.28$ ,  $p = .027$ .

*Correlations.* Gender was significantly associated with HRV ( $r(52) = .33$ ,  $p = .027$ ) and cortisol ( $r(50) = -.33$ ,  $p = .02$ ; point biserial correlations were used for categorical variables). Age was significantly related to psychiatric history ( $r(42) = -.40$ ,  $p$

= .01), HRV ( $r(45) = -.50, p < .000$ ), and familism ( $r(52) = .39, p = .01$ ). Assaultive injury was significantly associated with cortisol ( $r(37) = .34, p = .043$ ). Peritraumatic dissociation was significantly related to ADI ( $r(51) = .32, p = .024$ ), acculturative stress ( $r(50) = .41, p = .003$ ) and PTSD symptoms ( $r(51) = .72, p < .000$ ). HRV was significantly associated with PTSD symptoms ( $r(45) = .30, p = .046$ ). Lastly, acculturative stress was significantly associated with PTSD symptoms ( $r(52) = .33, p = .029$ ).

*Peritraumatic Dissociation and PTSD Symptoms.* The mean PDEQ score was 24.57 (SD = 10.15, minimum = 10, maximum = 50). Using a cut-off score of 15 to signify highly dissociative individuals (Demarble et al., 2020; Civilotti et al., 2015), 77% of participants ( $n = 40$ ) reported scores surpassing this threshold. The mean PCL-5 score was 28.77 (SD = 20.94, minimum = 0, maximum = 80). Using a cut-off score of 30 (Geier et al., 2019), 51% of participants ( $n = 27$ ) screened provisionally positive for PTSD acutely post-trauma. This percentage is greater than previous studies with non-Latinx traumatic injury survivors (Bird et al., 2021).

*Cultural Variables.* Fatalism scores of the current sample ( $M = 22.10, SD = 4.99$ ) appear to be higher in comparison to other racial/ethnic samples in previous research, which demonstrate mean sample scores between 16 (Bachem et al., 2020) and 19.75 (Bogolyubova et al., 2021). Due to lack of previous research with exclusively Latinx samples, direct comparison to other ethnically similar samples is unavailable.

Regarding acculturative stress, the current sample mean score ( $M = .60, SD = .64$ ) was much lower when compared to other Latinx, non-traumatized, samples from past

research which demonstrate mean scores approximately around 1.5 (Driscoll & Torres, 2013; Maya et al., 2021; Torres et al., 2012).

Lastly, familism scores of the current sample ( $M = 7.06$ ,  $SD = 2.59$ ) appear to be slightly greater than previous research using this measure with Latinx samples ( $M = 5.62$ , Keeler et al., 2014;  $M = 6.86$ , DeSantis et al., 2019).

*Biological Variables.* Due to the significant inconsistencies in cortisol measurement and method of collection, comparison across studies is difficult. However, in comparison to similar studies with traumatic injury survivors, serum cortisol measurement mean from the current study appears low (Pandya et al., 2014). For example, Kusmenkov and colleagues (2019) demonstrated a mean score of 13.1  $\mu\text{g/dL}$  total serum cortisol 24 hours post-trauma as compared to the current study's mean score of 6.02  $\mu\text{g/dL}$ .

Regarding HRV, Lee and Theus (2012) report mean HRV RMSSD measurements of participants with PTSD diagnosis at 36.79 and participants without PTSD diagnosis at 52.27. In comparison to previous studies examining HRV in non-traumatized samples using iThlete measurement, RMSSD measurement mean was much higher (i.e.  $M = 86.19$ , Flatt & Esco, 2013) than the mean measurement of the current study ( $M = 67.89$ ).

## **Hypothesis 1**

Hypothesis 1 stated that peritraumatic dissociation would significantly predict PTSD symptoms, such that greater reported peritraumatic dissociation would indicate greater PTSD symptomology. To test this hypothesis, a linear regression was conducted with PCL-5 scores as the outcome. Psychiatric history was covaried and entered into step 1. Peritraumatic dissociation was entered at step 2.

Step 1 explained 20% of the variance in PTSD symptoms,  $F(1, 50) = 7.74, R^2 = .13, p = .008$ . With the addition of peritraumatic dissociation in step 2, the total variance accounted for by the model was 54%,  $F(2,49) = 28.51, R^2 = .54$ . Peritraumatic dissociation explained an additional 40% of variance in PTSD symptoms,  $R^2$  change = .40,  $F$  change =  $F(1,49) = 42.81, p < .000$ . These results indicate full support for hypothesis 1 showing that peritraumatic dissociation does significantly predict PTSD symptoms above and beyond demographic variables. Full results shown in Table 3. This result supports previous research demonstrating this relationship.

## **Hypothesis 2**

Hypothesis 2 consisted of two parts and stated that both biological (HRV and cortisol) and cultural variables (acculturative stress, fatalism, and familism) would contribute significant variance to acute PTSD symptom severity. To test hypothesis 2, two separate hierarchical regressions were conducted with biological and cultural variables. Psychiatric history was covaried in each analysis. For analyses including cortisol measurement, number of days between trauma exposure and post-injury blood sample and the time of blood collection took place were also covaried.

***Hypothesis 2A.*** For the first hierarchical regression predicting PTSD symptoms, psychiatric history, days between trauma exposure and post-injury blood sample, and the time of blood collection were entered at step 1, HRV and cortisol were entered into step 2. Results demonstrated that neither HRV nor cortisol were predictive of PTSD symptoms. Step 1 explained 32% of variance in PTSD symptoms,  $F(3, 39) = 5.98, R^2 = .32, p = .002$ . Step 2 explained an additional 7% of variance in PTSD symptoms,  $F(2, 37) = 1.99, R^2$  change = .07,  $p = .150$ . Results displayed in Table 4.



**Hypothesis 2B.** For the second hierarchical regression predicting PTSD symptoms, psychiatric history was entered in step 1 and fatalism, familism, and acculturative stress were entered in step 2. Results demonstrated that cultural variables were not significantly predictive of PTSD symptoms. Step 1 explained 13% of variance in PTSD symptoms,  $F(1, 49) = 7.23, R^2 = .13, p = .010$ . Step 2 explained an additional 16% of variance,  $F(3, 46) = 3.38, R^2 \text{ change} = .16, p = .026$ . While the overall model in Step 2 reaches the statistically significant threshold, no individual predictor in Step 2 significantly predicted PTSD symptoms. Both fatalism and acculturative stress were trending significant but did not reach the significance threshold, with  $p = .061$  and  $p = .086$ , respectively. Results displayed in Table 5.

### **Hypothesis 3**

Hypothesis 3 stated that a moderated mediational model would indicate that cortisol and HRV would mediate the relationship between peritraumatic dissociation and PTSD symptoms, and that each cultural variable would moderate this relationship through the B pathway. To test Hypothesis 3A, a mediation analysis was conducted. For hypotheses 3B-3D, moderated mediational analyses were conducted.

Instead of using traditional procedures for mediation analyses as proposed by Barron and Kenny (1986), a more recent approach developed by Hayes (2012) was used. The PROCESS macro is a SPSS add-on which simplifies moderated mediation to a one-step input procedure and offers expanded information on analyses. PROCESS assesses the conditional indirect effects using bootstrapping methods. Bootstrapping is a non-parametric test that conducts several iterations resulting in reduced type 1 error in addition to providing estimates of standard errors and confidence intervals. Significance

testing examines confidence intervals by examining if the confidence interval includes the value of 0. Inclusion of 0 indicates non-significance. Psychiatric history was covaried in each analysis. For analyses including cortisol measurement, number of days between trauma exposure and post-injury blood sample and the time of day the blood collection took place were also covaried.

**Hypothesis 3A.** Two meditation analyses were conducted using the PROCESS macro to examine the ability of HRV and cortisol to mediate the relationship between peritraumatic dissociation and PTSD symptoms. Regarding cortisol, results demonstrated a significant direct effect between peritraumatic dissociation and PTSD symptoms, however, the indirect effect through cortisol was non-significant (index =  $-.02$ ,  $SE = .05$ ,  $CI = -.14, .05$ ). Results displayed in Table 6. Regarding HRV, similar results were revealed, such that, HRV did not mediate the relationship between peritraumatic dissociation and PTSD symptoms (index =  $.07$ ,  $SE = .10$ ,  $CI = -.08, .32$ ). Results are displayed in Table 7.

**Hypothesis 3B.** A moderated-mediational analysis was conducted to examine conditional indirect effects by testing cortisol and HRV as separate mediators between peritraumatic dissociation and PTSD symptoms, while considering acculturative stress as a moderator in the biological variable-PTSD symptoms link. As shown in Table 8a, the moderated mediational analysis examining *cortisol* as the mediator, revealed a non-significant conditional indirect effect with acculturative stress (index =  $-.04$ ,  $SE = .08$ ,  $CI = -.21, .10$ ).

Similarly, the model examining *HRV* in the mediation role, findings demonstrated a non-significant conditional indirect effect with acculturative stress (index = .25, *SE* = .28, *CI* = -.07, .96). Results displayed in Table 8b.

**Hypothesis 3C.** A moderated-mediational analysis was conducted to examine conditional indirect effects by testing cortisol and *HRV* as separate mediators between peritraumatic dissociation and PTSD symptoms, while considering fatalism as a moderator in the biological variable-PTSD symptoms link. As shown in Table 9a, the moderated mediational analysis examining *cortisol* as the mediator, revealed a non-significant conditional indirect effect with fatalism (index = .00, *SE* = .01, *CI* = -.02, .03).

Similarly, the model examining *HRV* in the mediation role, findings demonstrated a non-significant conditional indirect effect with fatalism (index = .02, *SE* = .03, *CI* = -.05, .07). Results displayed in Table 9b.

**Hypothesis 3D.** A moderated-mediational analysis was conducted to examine conditional indirect effects by testing cortisol and *HRV* as separate mediators between peritraumatic dissociation and PTSD symptoms, while considering familism as a moderator in the biological variable-PTSD symptoms link. As shown in Table 10a, the moderated mediational analysis revealed a non-significant conditional indirect effect with through *cortisol* (index = .01, *SE* = .02, *CI* = -.03, .04).

Similarly, the model examining *HRV* in the mediation role, findings demonstrated a non-significant conditional indirect effect with familism (index = -.01, *SE* = .04, *CI* = -.10, .06). Results displayed in Table 10b.

## Post Hoc Analyses

Post-hoc analyses were conducted in an attempt to elucidate any possible underlying mechanisms or associations, not originally proposed, that may be explaining the relationship between peritraumatic dissociation and PTSD symptoms in the current sample.

Guided by previous literature and the cultural neurobiological framework, cultural factors were conceptualized as moderating the biological variable-PTSD symptoms link (B pathway; Figure 1), however, there is some research to suggest that cultural factors may serve a more distal role in predicting PTSD symptomology (Alcántara & Lewis-Fernández, 2016). With hypotheses 2 and 3 not supported, each moderated-mediational model was re-run to examine the role of the cultural factors in moderating the peritraumatic dissociation-biological variables link (A pathway; Figure 1). With acculturative stress as the moderator, results demonstrated an insignificant conditional indirect effect through both cortisol (index =  $-.12$ ,  $SE = .14$ ,  $CI = -.41, .17$ ) and HRV (index =  $-.11$ ,  $SE = .21$ ,  $CI = -.60, .29$ ). Models examining fatalism as the moderator demonstrated similar results with cortisol (index =  $.01$ ,  $SE = .01$ ,  $CI = -.01, .02$ ) and HRV (index =  $-.01$ ,  $SE = .02$ ,  $CI = -.01, .05$ ). Lastly, with familism as the moderator, both models with cortisol (index =  $.01$ ,  $SE = .02$ ,  $CI = -.03, .05$ ) and HRV (index =  $.02$ ,  $SE = .03$ ,  $CI = -.04, .08$ ) were insignificant.

While bio-variables were considered as mediators in the original hypothesized model, post hoc analyses explored whether cultural variables may be better suited in a mediation role. Each cultural variable was found to not mediate the relationship between peritraumatic dissociation and PTSD.

Moreover, in reviewing the initial bivariate correlations, positive associations among peritraumatic dissociation, acculturative stress, and PTSD symptoms are apparent. Further post hoc analyses were examined in order to investigate the nature of these relationships in greater depth. Therefore, a mediation analysis was conducted examining peritraumatic dissociation as a mediator between acculturative stress and PTSD symptomology. A mediation analysis with acculturative stress as the predictor was deemed appropriate given the temporal nature of each of the measures. Acculturative stress was assessed retrospectively, asking the participant to report their levels of stress over the past three months, therefore, higher levels of acculturative stress may be seen as the more chronic stressor already at play at the time of trauma, therefore, possibly increasing peritraumatic dissociation and consequently PTSD symptoms. These results were significant, demonstrating that peritraumatic dissociative experiences links acculturative stress to PTSD symptoms (index = 7.67,  $SE = 2.42$ ,  $CI = 3.63, 13.11$ ).

To further probe this finding, another mediation analysis was conducted with acculturative stress functioning as a mediator, peritraumatic dissociation as a predictor, and PTSD symptoms as the outcome. This model was non-significant. In summary, peritraumatic dissociation was found to link acculturative stress to acute PTSD symptoms, such that greater acculturative stress was associated with greater reported peritraumatic dissociation which was in turn associated with more PTSD symptoms. Notably, the relation of these variables was unique, such that when the placement of acculturative stress and peritraumatic dissociation were reversed in the mediation model, results were no longer significant.

## DISCUSSION

Posttraumatic stress disorder (PTSD) is a debilitating disorder that will affect approximately 20% of those who have experienced a traumatic injury (deRoon-Cassini et al., 2010). Latinx individuals display greater rates of conditional risk for this disorder following a trauma in comparison to other non-Latinx ethnic groups (Asnaani & Hall-Clark, 2017; Alcántara et al., 2013; Kaczurkin et al., 2016; Marshall, Schnell, & Miles, 2009; Pietrzak et al., 2014). The current study is novel in numerous ways, including, that it is one of few studies that attempt to explicate the underlying mechanisms leading to this greater risk. Further, the current study attempted to unearth these mechanisms utilizing a holistic framework, centering the interplay of culture and biology and its connection to health outcomes. Lastly, findings from the current study are each the first to be demonstrated among a sample of Latinx, traumatically injured adults. Therefore, not only do these findings shed light on the experiences of this population but also lay important groundwork for future study.

Prior to discussing main study hypotheses, preliminary analyses revealed notable findings regarding gender. Women exhibited significantly greater HRV and lower cortisol levels in comparison to men. Broadly speaking, greater HRV and lower cortisol would indicate adaptive function at rest. Given that the current study attempted to capture the acute time frame following a traumatic event, this finding, that women exhibited a profile indicative of rest, rather than arousal, is somewhat surprising. However, it is important to keep in mind that these measurements were taken within 1 week following injury. It is possible then, that these results may indicate the acute *recovery* period following the trauma and that women are displaying a quicker biological and

physiological recovery than are men, therefore, demonstrating a healthier trauma recovery profile.

These findings replicate and extend previous research in various ways. First, regarding gender, differences in relation to HRV have been consistently demonstrated, such that women are found to have better autonomic adaptive functioning, or higher HRV, in comparison to men (Alyahya et al., 2021, Ramalho et al., 2017; Zachariah et al., 2019). Second, regarding serum cortisol in the context of traumatic injury, previous research offers interesting findings regarding timing of measurement and risk profiles. Specifically, a past study demonstrated that *blunted* cortisol levels immediately following trauma (2-4 hours) was indicative of greater risk for PTSD (Mouthaan et al., 2014). Additional studies have also replicated the identification of blunted cortisol levels following a trauma leading to increased PTSD symptomology and diagnosis prospectively (Jayan et al., 2021). A separate study found that *greater* cortisol levels in the aftermath of injury (30-60 days) was indicative of PTSD risk (Pacella et al., 2017). These studies indicate the importance of timing in cortisol measurement and how this may differentially indicate risk for psychopathology. Given the cortisol profile of men and women in the current study, the timing of recovery following trauma may be implicated and suggests that men could be displaying a biological profile that confers greater risk for PTSD. While the present study did not demonstrate a relationship between gender and acute PTSD symptomology, it is possible that this risk profile may put the Latinx men in this sample at greater risk for PTSD development longitudinally that is not reflected in their baseline report of PTSD symptoms. This warrants further research. Lastly, these findings are notable for future studies to determine what point the

body transitions from acute biological response to recovery response and what this may mean for measurement of both cortisol and HRV in understanding risk for negative outcomes following injury.

The main objective of the current study was to understand greater conditional risk for PTSD among Latinx individuals by examining possible underlying mechanisms connecting peritraumatic dissociation and acute PTSD symptoms through the framework of cultural neurobiology. Results demonstrated mixed support for study hypotheses. Hypothesis 1 was supported. Peritraumatic dissociation was a robust predictor of acute PTSD symptoms. This is in line with an abundance of past research demonstrating this relationship (Alcántara et al., 2013; Demarble et al., 2020; Lensvelt-Mulders et al., 2008; Massazza et al., 2021). The current study is the first to confirm this relationship in a Latinx, traumatically injured sample. Due to previous research using inconsistent measures to examine peritraumatic dissociation, it is difficult to make comparisons regarding the level of peritraumatic dissociation reported among this sample in relation to other Latinx samples. However, in comparison to non-Latinx samples, the current study demonstrated similar (Massazza et al., 2021) or lower levels (Demarble et al., 2020; Jones et al., 2018; Thompson-Hollands et al., 2020) of peritraumatic dissociation. This is surprising given previous literature that has indicated higher levels of dissociation among this ethnic group (Alcántara et al., 2013), however, this may be due to methodological differences such as retrospective reporting and types of dissociation assessed.

Further, the rate of provisional PTSD diagnosis in this sample was quite high in comparison to other traumatically injured samples (Bird et al., 2021; Joseph et al., 2021), with 51% of the sample reporting at or above the clinical cut off (Geier et al., 2019). This



finding further supports previous literature regarding increased conditional risk for PTSD among Latinx individuals (Alcántara & Lewis-Fernández, 2013). Previous research demonstrates that both peritraumatic dissociation and greater acute PTSD symptoms are important predictors of long-term recovery and PTSD diagnosis following a traumatic injury (Birmes et al., 2003; deRoos-Cassini et al., 2010; Gabert-Quillen et al., 2011; Sijbrandij et al., 2013). Findings from the current study provide instrumental groundwork demonstrating rates of peritraumatic dissociation and acute PTSD symptoms among a Latinx traumatically injured sample that may be putting these patients at greater risk for long term consequences.

Aim 2 sought to establish the predictive ability of biological variables (i.e., cortisol and HRV) and cultural variables (i.e., acculturative stress, fatalism, and familism) separately as predictors of acute PTSD symptom severity. The hypothesis that cortisol and HRV would predict PTSD symptoms was unsupported. Regarding cultural factors predicting PTSD symptoms, the overall model did indicate that the inclusion of all cultural variables explained a significant amount of variance above and beyond that of the covariates. In examining the individual cultural factors, no single variable significantly predicted symptomology alone. However, given the overall model's significance, there is support that the combination of these factors may indicate greater risk. Specifically, by observing the coefficients of each variable (displayed in Table 5), it appears that it may be the combination of greater acculturative stress and greater fatalistic beliefs driving greater PTSD symptomology. It is possible that a larger sample size may better extrapolate the relationships among these factors and how they relate to PTSD risk.

Lastly, aim 3 stated that a moderated mediational model would be supported such that the biological variables of cortisol and HRV would independently link peritraumatic dissociation to PTSD symptomology, and that each cultural variable would moderate the link between biological variables and PTSD symptoms. Each hypothesis related to aim 3 was unsupported, such that, neither HRV or cortisol levels mediated the relationship between peritraumatic dissociation and PTSD symptoms and that each of the cultural variables examined demonstrated a non-significant conditional indirect effect. While the cultural neurobiology framework was not supported in current study's findings, this could be due to many other methodological or logistically barriers within this study. First, the sample size collected for the current study was smaller than originally anticipated. It is possible that the current sample was not large enough to detect interactions between main variables of interest in examining such a complex model. While post hoc power analyses indicated sufficient power for the analyses conducted, it is possible that with a larger sample size, the true nature between these variables would be more easily extrapolated or possibly change. Second, the current study examined three specific cultural variables that are well studied and have been linked to trauma and PTSD symptomology in existing literature (Alcántara & Lewis-Fernández, 2016; Zvolensky et al., 2018). However, there is an abundance of other sociocultural specific factors that may better explain the unique conditional risk of this group and/or interact with biological systems, such as, religiosity, discrimination, gender roles, help seeking attitudes, availability of culturally relevant treatment, among others (Amaya & Gray, 2021; Jocson et al., 2020; Sibrava et al., 2019; Valentine et al., 2017). For example, the current study assessed fatalistic beliefs, however, fatalism is often conceptualized within the realm of religiosity, which may have

been a better suited concept to assess in this context. Lastly, it is also possible that other biological markers of stress, such as biological inflammatory markers [i.e., IL-6, (TNF)- $\alpha$ , C-reactive protein; Michopoulos et al., 2017] could reveal more notable findings in relation to PTSD risk within this group and possibly interact with cultural factors in ways not studied in the current project. While the cultural neurobiological framework was not necessarily supported in the present study, the concept purported by this framework, that the interplay of sociocultural factors and biological systems should be centered in research to truly understand human function and risk for disease, remains valuable and necessitates further research.

While the bulk of the main study hypotheses were unsupported, post hoc analyses were conducted to further examine what, if any, factors measured in the current study may serve alternative roles to explain the relationship between peritraumatic dissociation and PTSD symptomology. Interestingly, peritraumatic dissociation was found to mediate the relationship between acculturative stress and PTSD symptoms. This is to say that acculturative stress was linked to greater acute PTSD symptoms by way of increased peritraumatic dissociation.

Acculturative stress is a form of chronic stress that many Latinx individuals experience in the U.S. while attempting to navigate both their heritage culture and the norms of the broader culture, in this case, the United States (U.S.). Existing research has demonstrated acculturative stress as a risk factor for PTSD symptomology and diagnosis following a trauma among Latinx samples (Ehlers et al., 2016; Zvolensky et al., 2018). However, there are currently no studies that have examined the role of acculturative stress in relation to peritraumatic dissociation nor have these factors been observed in the

context of a traumatic injury. Only one previous study demonstrated findings regarding acculturation, a similar but distinct concept, and found a negative relationship between acculturation and peritraumatic dissociation in a sample of Latino traumatically injured young adults (Marshall & Orlando, 2002). The process of acculturation for Latinx individuals can be extremely taxing and stressful, leading to acculturative stress.

This stress theoretically results from the chronic demand of navigating one's personal culture and the culture of the broader society in the U.S., often, if not constantly, having to be aware of the behaviors, attitudes, and beliefs of others, appraising what is safe or accepted by the dominant culture (U.S) or not. It is an insidious process that has been associated with many forms of negative outcomes and poorer health (Bakhshaei et al., 2018; Bekteshi & Kang, 2018; Wang et al., 2010). It is established that various forms of chronic stress, like acculturative stress, put individuals at greater risk for poorer health outcomes, which becomes particularly relevant in the context of an acute trauma. This finding offers critical information regarding greater conditional risk for PTSD among this ethnic group. It is imperative to understand the disproportionate burdens placed on communities of color in the U.S. and how this is related to health inequity. These findings provide evidence that the greater pre-morbid strain placed on Latinx individuals due to acculturative stress, is connected to maladaptive peritraumatic coping mechanisms and consequently greater PTSD symptomology, putting them at greater risk for prolonged symptomology long term.

### **Limitations**

This study had several notable limitations. First, the current study is cross sectional in nature, therefore causal relationships cannot be drawn. Also due to this,

PTSD diagnostic status cannot be assessed, only acute symptomology. This necessitates future research to examine these factors as prospective predictors of PTSD development. Second, method of cortisol measurement employed in this study may be crude in nature due to the one-time sample and minimal restriction around time of sample and food or drink intake prior to draw. As cortisol follows a natural diurnal rhythm in the body, the time in which a serum sample is drawn and measured for cortisol has been indicated as an important factor to consider (Clow et al., 2010; Schumacher et al., 2019). The current study showed no correlation between timing of blood draw and cortisol levels. However, it is possible this may have impacted the lack of findings in relation to cortisol in the current study. It is important to note that while standardization of cortisol measurement is often preferred in empirical study, it is also important for researchers to consider the generalizability of findings. Should the ultimate goal be to understand how these factors may inform prevention and treatment efforts in the acute time frame, it is equally important to understand the heterogeneity and complexity of measuring cortisol levels in the acute time frame following trauma.

Further, traumatic injury is a unique form of trauma that may elicit different psychological and biological profiles in comparison to other traumatized samples, therefore limiting the generalizability of the current findings. The current study employed a heterogeneous sample of Latinx adults. Latinx ethnicity encompasses many different cultures and nationalities within it, which each hold unique belief systems and cultural attitudes that future studies should seek to disentangle. Moreover, this study utilized self-report measures which may introduce bias in responses, including difficulty in remembering and reporting past experiences. Lastly, this study utilized a relatively small

sample size. This was due to complications and barriers inflicted on the world, our research team, and hospital patients, due to the COVID-19 pandemic. While the sample size may have limited the findings of the current study, given the novelty of its design and the exploratory nature of the aims, the current study still lays important groundwork to advance understanding of the biopsychocultural influences on mental health outcomes following a traumatic injury in a traditionally understudied population.

### **Future Studies**

Future studies should continue to assess culturally specific factors that may serve as unique predictors of resilience or disorder following a traumatic event. As the aims of the current study were vastly exploratory, there is enormous room for further study to continue to parse apart the underlying factors of conditional risk for PTSD among Latinxs in the U.S. It is common to examine these disproportionate rates of risk among disadvantaged populations from a narrow perspective of either a cultural or neurobiological framework. Cultural neurobiology offers a context from which to conceptualize these inequities considering the vital interactions between our sociocultural environment and biological stress response systems. Understanding these interactions will provide groundwork for implementing meaningful intervention and prevention efforts.

### **Implications and Conclusion**

While Latinxs appear to develop PTSD at similar rates as their non-Latinx counterparts, this group has been found to have a greater conditional risk for this disorder, resulting in greater severity and chronicity of PTSD (Alcántara, & Lewis-

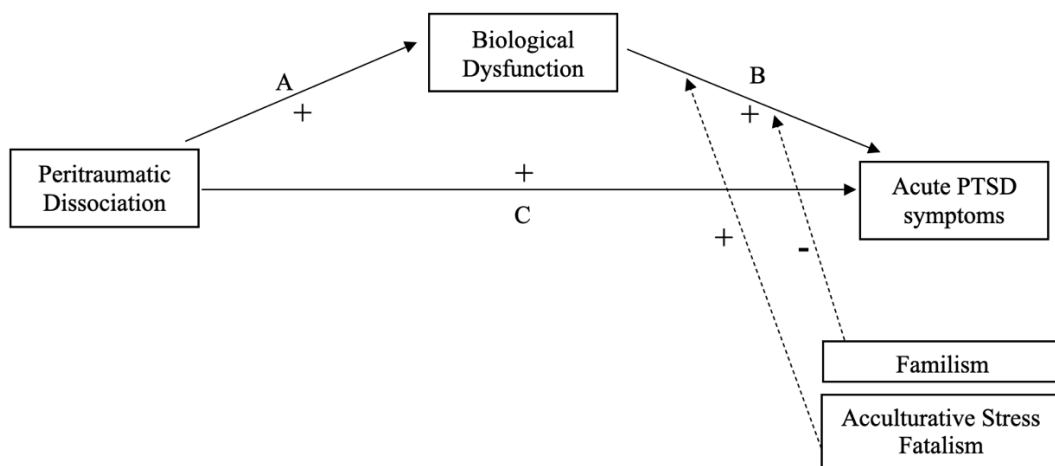
Fernández, 2016; Breh & Seidler, 2007; Pole, Best, Metzler, & Marmar, 2005). With this population comprising the largest ethnic minority group in the United States, understanding the causes of these health disparities is imperative (U.S. Census Bureau, 2019). Peritraumatic dissociation is indeed prevalent within the Latinx population and shows a robust association with subsequent development of PTSD (Pole et al., 2005; Lensvelt-Mulders et al., 2008). The current study revealed multiple notable findings. First, women were found to demonstrate a biological profile indicative of better recovery following injury than did men. This is in line with findings from previous research but is the first to demonstrate this among a sample of Latinx traumatically injured adults. Second, the current study is the first to confirm the relationship between peritraumatic dissociation and greater PTSD symptomology in a traumatically injured Latinx sample. Further, findings revealed acculturative stress as an important risk factor for peritraumatic dissociation and PTSD symptoms.

These findings have extended understanding of the conditional risk for PTSD among an understudied population following a traumatic injury, such that, unique cultural stressors are essential to be considered when conceptualizing risk for this group. Clinically, these findings offer insight into the forms of chronic stress that may be relevant to Latinx patients recovering from trauma. These cumulative burdens are essential to consider in working with disadvantaged communities. They necessitate clinicians and providers to work from a stance of cultural humility, bearing in mind the added risk associated with living in a society and country that often requires assimilation or only palatable expressions of non-White American culture, leaving many Latinx

individuals tasked with navigating ways to maintain dignity and cultural heritage while also remaining acceptable to the broader cultural context of the U.S.

While main study hypotheses pertaining to the interaction between cultural and biological factors was unsupported, these findings still play an important role in directing future research and progressing our shared understanding of psychopathology and resilience from a holistic, integrated perspective. Historically, biological and cultural investigations have been conducted separately. This artificial division disregards a holistic view of the human condition. It is imperative to study the interaction of these pathways and understand that neither can exist without the other. The Latinx population continues to grow rapidly within the United States, and it is essential to understand the underlying mechanisms putting Latinx individuals at higher risk for PTSD. This study offers important findings that can be used to improve the care provided to the Latinx population by shedding light on the influence of cultural constructs, such as acculturative stress, in the trajectory mental health following a trauma.



**Figure 1.** Theoretical Model Illustration

*Note.* Solid lines indicate direct and mediational pathways. Dashed lines represent moderation pathways.

**Table 1.** *Descriptive statistics of study measures.*

<b>Measures</b>	<b><i>M</i></b>	<b><i>SD</i></b>	<b><i>Minimum-Maximum</i></b>
<i>PCL-5 Total Symptoms</i>	28.77	20.94	0-80
<i>Peritraumatic Dissociation</i>	24.57	10.15	10-50
<i>Fatalism</i>	22.10	4.99	6-30
<i>Familism</i>	7.06	2.59	1-12
<i>Acculturative Stress</i>	.60	.64	0-5
<i>Cortisol (µg/dL)</i>	6.02	3.74	0.86-14.68
<i>HRV</i>	67.89	15.45	35-97

**Table 2.** *Correlations between study variables.*

Measure	1	2	3	4	5	6	7	8	9	10	11
1. Gender	-	-	-	-	-	-	-	-	-	-	-
2. Age	.01	-	-	-	-	-	-	-	-	-	-
3. Injury Type	-.20	-.04	-	-	-	-	-	-	-	-	-
4. Psychiatric History	-.15	<b>-.40**</b>	-.15	-	-	-	-	-	-	-	-
5. ADI	.10	-.19	.24	.03	-	-	-	-	-	-	-
6. PDEQ	.18	-.09	.05	-.28	<b>.32*</b>	-	-	-	-	-	-
7. Cortisol	<b>-.33*</b>	.09	<b>.31*</b>	.03	-.09	-.09	-	-	-	-	-
8. HRV	<b>.33*</b>	<b>-.50**</b>	-.05	.01	.18	.28	-.26	-	-	-	-
9. Fatalism	-.06	-.23	.10	.18	-.02	.20	.19	.19	-	-	-
10. Familism	-.14	<b>.39**</b>	.20	.09	-.07	-.06	.17	-.15	.09	-	-
11. Acculturative Stress	.10	.20	-.27	-.21	.08	<b>.41**</b>	.13	.06	-.01	-.19	-
12. PCL-5	.25	-.20	.12	-.30	.24	<b>.72**</b>	-.06	<b>.30*</b>	.20	<b>.30*</b>	<b>.33*</b>

*Note.* Two tailed Pearson correlations are reported; correlations with gender, assaultive injury, and psychiatric history are point-biserial correlations; \*\*  $p < .01$ , \*  $p < .05$

**Table 3.** Hierarchical Regression Analysis for Peritraumatic Dissociation Predicting PTSD symptoms

Variables	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Constant	59.46	11.37	-	9.23	11.36	-
Psychiatric History	-17.54	6.30	-.37	-8.16	4.87	-.17
Peritraumatic Dissociation	-	-	-	1.37	.21	.67**
$R^2$	.13			.40		
F for change in $R^2$	7.74			42.81		

Note. \*  $p < .05$ , \*\*  $p < .001$

**Table 4.** Hierarchical Regression Analysis for HRV and Cortisol Predicting PTSD symptoms

Variables	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Constant	49.83	21.35	-	26.23	26.53	-
Days between injury and blood draw	3.22	1.31	.34*	3.10	1.34	.32*
Time of blood collection	.00	.01	-.00	.00	.01	-.00
Psychiatric History	-20.33	6.77	-.41*	-20.08	6.70	-.41*
HRV	-	-	-	.35	.18	.26
Cortisol	-	-	-	-.06	.81	-.01
<i>R</i> <sup>2</sup> change		.32			.07	
F for change in <i>R</i> <sup>2</sup>		5.98			1.99	

Note. \*  $p < .05$ , \*\*  $p < .001$

**Table 5.** Hierarchical Regression Analysis for Cultural Variables Predicting PTSD symptoms

Variables	Model 1			Model 2		
	<i>B</i>	<i>SE B</i>	$\beta$	<i>B</i>	<i>SE B</i>	$\beta$
Constant	58.85	11.32	-	39.04	17.16	-
Psychiatric History	-16.92	6.30	-.36*	-13.89	6.04	-.29*
Fatalism	-	-	-	.99	.52	.24
Familism	-	-	-	-1.70	1.06	-.21
Acculturative Stress	-	-	-	7.44	4.24	.23
<i>R</i> <sup>2</sup>		.13			.16	
F for change in <i>R</i> <sup>2</sup>		7.23			3.38	

Note. \*  $p < .05$ , \*\*  $p < .001$

**Table 6.** Model Summary of the Indirect Effect of Peritraumatic dissociation on PTSD symptoms through Cortisol (N = 50)

Predictor	Outcome					
	<i>M – Cortisol</i>			<i>Y – PTSD symptoms</i>		
	<i>B</i>	<i>SE B</i>	<i>p</i>	<i>B</i>	<i>SE B</i>	<i>p</i>
Peritraumatic Dissociation	.05	.06	.34	1.24	.22	.00**
Cortisol	-	-	-	-.46	.57	.43
Constant	8.57	4.70	.08	1.95	18.62	.92
	$R^2 = .12$			$R^2 = .60$		
	$F(4, 45) = 1.48, p = .23$			$F(5, 44) = 13.34, p < .001$		
				95% Confidence Interval		
Indirect effect		<i>B</i>	<i>SE</i>	Lower limit	Upper limit	
Total indirect effect		-.02	.05	-.14	.05	

Note. \*  $p < .05$ , \*\*  $p < .001$

**Table 7.** Model Summary of the Indirect Effect of Peritraumatic dissociation on PTSD symptoms through HRV (N = 45)

Predictor	Outcome					
	<i>M – HRV</i>			<i>Y – PTSD symptoms</i>		
	<i>B</i>	<i>SE B</i>	<i>p</i>	<i>B</i>	<i>SE B</i>	<i>p</i>
Peritraumatic Dissociation	.48	.25	.057	1.41	.23	.000**
HRV	-	-	-	.15	.14	.291
Constant	50.21	14.06	.001	-2.43	14.48	.868
	$R^2 = .09$			$R^2 = .61$		
	$F(2, 42) = 1.94, p = .157$			$F(3, 41) = 21.39, p < .001$		
				95% Confidence Interval		
Indirect effect		<i>B</i>	<i>SE</i>	Lower limit	Upper limit	
Total indirect effect		.07	.10	-.08	.32	

Note. \*  $p < .05$ , \*\*  $p < .001$

**Table 8a.** *Moderated-mediation Analysis for Peritraumatic Dissociation, Cortisol, Acculturative Stress, and PTSD Symptoms (N = 49)*

	B	SE B	t
Mediator: Cortisol			
Predictor – Peritraumatic Dissociation	.06	.06	.34
Outcome – PTSD Symptoms			
Predictor: Peritraumatic Dissociation	1.22***	.24	5.16
Mediator – Cortisol	.08	.76	.11
Moderator: Acculturative Stress	7.98	6.87	1.16
Interaction: Cortisol X Acculturative Stress	-.79	.68	-1.16
	Boot Ind. Effect	Boot SE	95% CI
Index of Moderated Mediation	-.04	.08	-.21 – .10

\*p < .05. \*\* p < .01. \*\*\*p < .001.

**Table 8b.** *Moderated-mediation Analysis for Peritraumatic Dissociation, HRV, Acculturative Stress, and PTSD Symptoms (N = 44)*

	B	SE B	t
Mediator: HRV			
Predictor – Peritraumatic Dissociation	.44	.25	1.73
Outcome – PTSD Symptoms			
Predictor: Peritraumatic Dissociation	1.44***	.27	5.44
Mediator – HRV	-.15	.22	-.69
Moderator: Acculturative Stress	-37.38	24.72	-1.51
Interaction: HRV X Acculturative Stress	.57	.32	1.79
	Boot Ind. Effect	Boot SE	95% CI
Index of Moderated Mediation	.25	.28	-.07 – .96

\*p < .05. \*\* p < .01. \*\*\*p < .001.



**Table 9a.** Moderated-mediational Analysis for Peritraumatic Dissociation, Cortisol, Fatalism, and PTSD Symptoms ( $N = 50$ )

	B	SE B	t
Mediator: Cortisol			
Predictor – Peritraumatic Dissociation	.05	.06	.96
Outcome – PTSD Symptoms			
Predictor: Peritraumatic Dissociation	1.12***	.23	4.90
Mediator – Cortisol	-2.19	3.11	-.71
Moderator: Fatalism	.46	.76	.61
Interaction: Cortisol X Fatalism	.07	.13	.53
	Boot Ind. Effect	Boot SE	95% CI
Index of Moderated Mediation	.00	.01	-.02 – .03

\* $p < .05$ . \*\*  $p < .01$ . \*\*\* $p < .001$ .

**Table 9b.** Moderated-mediational Analysis for Peritraumatic Dissociation, HRV, Fatalism, and PTSD Symptoms ( $N = 45$ )

	B	SE B	t
Mediator: HRV			
Predictor – Peritraumatic Dissociation	.48	.25	1.96
Outcome – PTSD Symptoms			
Predictor: Peritraumatic Dissociation	1.38***	.24	5.66
Mediator – HRV	-.77	.74	-1.03
Moderator: Fatalism	-3.07	2.36	-1.30
Interaction: HRV X Fatalism	.04	.03	1.26
	Boot Ind. Effect	Boot SE	95% CI
Index of Moderated Mediation	.02	.03	-.05 – .07

\* $p < .05$ . \*\*  $p < .01$ . \*\*\* $p < .001$ .

**Table 10a.** *Moderated-mediational Analysis for Peritraumatic Dissociation, Cortisol, Familism, and PTSD Symptoms (N = 50)*

	B	SE B	t
Mediator: Cortisol			
Predictor – Peritraumatic Dissociation	.05	.06	.96
Outcome – PTSD Symptoms			
Predictor: Peritraumatic Dissociation	1.26***	.21	6.08
Mediator – Cortisol	-1.21	1.87	-.65
Moderator: Familism	-2.94	1.61	-1.83
Interaction: Cortisol X Familism	.13	.22	.57
	Boot Ind. Effect	Boot SE	95% CI
Index of Moderated Mediation	.01	.02	-.03 – .04

\*p < .05. \*\* p < .01. \*\*\*p < .001.

**Table 10b.** *Moderated-mediational Analysis for Peritraumatic Dissociation, HRV, Familism, and PTSD Symptoms (N = 45)*

	B	SE B	t
Mediator – HRV			
Predictor: Peritraumatic Dissociation	.48	.25	1.96
Outcome – PTSD Symptoms			
Predictor: Peritraumatic Dissociation	1.44***	.22	6.57
Mediator: HRV	.19	.40	.47
Moderator: Familism	-1.53	3.75	-.41
Interaction: HRV X Familism	-.01	.06	-.26
	Boot Ind. Effect	Boot SE	95% CI
Index of Moderated Mediation	-.01	.04	-.10 – .06

\*p < .05. \*\* p < .01. \*\*\*p < .001.

**Table 11.** Model Summary of the Indirect Effect of Acculturative Stress on PTSD symptoms through Peritraumatic Dissociation (N = 51)

Predictor	Outcome					
	<i>M – Peritraumatic</i>			<i>Y – PTSD symptoms</i>		
	<i>Dissociation</i>					
	<i>B</i>	<i>SE B</i>	<i>p</i>	<i>B</i>	<i>SE B</i>	<i>p</i>
Acculturative Stress	5.75*	2.08	.008	.91	3.63	.802
Peritraumatic Dissociation	-	-	-	1.33**	.23	.000
Constant	29.64	5.78	.000	9.54	11.66	.417
	$R^2 = .21$			$R^2 = .52$		
	$F(2, 48) = 6.29, p = .004$			$F(3, 47) = 17.20, p < .001$		
Indirect effect		<i>B</i>	<i>SE</i>	95% Confidence Interval		
Total indirect effect		7.67	2.42	Lower limit	Upper limit	
				3.63	13.11	

Note. \*  $p < .05$ , \*\*  $p < .001$

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