

ORIGINAL ARTICLE

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The accumulated impact of critical incident exposure on correctional officers' mental health

Joseph A. Schwartz¹  | Bradon Valgardson² |
Christopher A. Jodis¹  | Daniel P. Mears¹  | Benjamin Steiner³

¹College of Criminology and Criminal Justice, Florida State University, Tallahassee, Florida, USA

²Centre for Teaching and Learning, University of Alberta, Edmonton, Alberta, Canada

³School of Criminology and Criminal Justice, University of Nebraska at Omaha, Omaha, USA

Correspondence

Joseph A. Schwartz, College of Criminology and Criminal Justice, Florida State University, Criminology and Criminal Justice Building, 112 S. Copeland Street, Tallahassee, FL 32306-1273, USA.
Email: jaschwartz@fsu.edu

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Abstract

Despite compelling arguments that prison work influences officer mental health, little attention has been devoted to directly and rigorously assessing this relationship. Even less attention has been attributed to the potential impact of critical incident exposure on mental health outcomes among officers. Drawing from a longitudinal sample of correctional officers from three prisons in Minnesota, the current study develops and then tests a resiliency-fatigue model by examining the impact of the accumulation of work-related critical incident exposures on symptoms related to posttraumatic stress disorder, depression, and anxiety. As critical incident exposures accumulate, mental health symptoms are found to become more pronounced. The analyses also reveal evidence that mental health symptoms only increase to problematic levels once the accumulation of critical incidents reaches or surpasses an inflection point. The results underscore the importance of understanding the diverse groups affected by prisons and have downstream implications for incarcerated persons, as well as for prison systems more broadly.

KEYWORDS

correctional officers, mental health, critical incidents, prisons

development of the current study. His absence not only impacts the many friends and family members who miss him dearly but also the broader fields of criminology and criminal justice. This project was supported by Award No. 2017-R2-CX-0032, awarded by the National Institute of Justice, Office of Justice Programs, U.S. Department of Justice. The opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect those of the Department of Justice.

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1 | INTRODUCTION

Although incarceration rates in the United States have decreased by approximately 24 percent since their peak in 2009 (Carson, 2020; Carson & Kluckow, 2023), many consequences stemming from increasingly punitive policies persist (Gottschalk, 2011; Lynch & Sabol, 2004; Simon, 2012; Western & Wildeman, 2009). One such consequence is an increased need for, and reliance on, correctional officers (COs). Indeed, COs were the most common category of state employee during 2020 (U.S. Bureau of Labor Statistics, 2024), and yet, even with the decline in incarceration rates, prison systems struggle to hire and retain them.

Officers have long been featured prominently in research on prisons. They are, for example, central to theories of social order (Bottoms, 1999; Garland, 1993; Liebling et al., 2011; Lombardo, 1989; Sparks et al., 1996; Tyler, 2010) and accounts, including organizational cultural frameworks (Liebling & Kant, 2018; Schoenfeld & Everly, 2023), that seek to understand the nature and impacts of prisons. Scholarship has, therefore, recognized the role of officers in maintaining control in prisons (Bucerus et al., 2023; Crewe, 2009; Rubin & Reiter, 2018; Schultz et al., 2021). It also has focused on the impacts of prisons on incarcerated persons and the reentry process (e.g., Gottschalk, 2011; Steiner & Wooldredge, 2018).

A related but distinct focus is to consider the potential impacts of prison systems on officers. This focus stems from the insight, supported by research, that the larger prison environment can and does have meaningful, and deleterious, impacts on officers (Dowden & Tellier, 2004; Ferdik & Smith, 2017; Harvey, 2014; Morgan, 2009; Ricciardelli & Power, 2020). A recent meta-analysis, for example, revealed that organizational factors, such as perceived workplace adversity, perceived workplace justice, and occupational subcultures that promote unhealthy coping, are negatively associated with officer well-being (Miller et al., 2022).

Notably, one unique aspect of prison work, exposure to work-related critical incidents and its effects on officer mental health, has received less attention (but see, for example, Carleton et al., 2019). Indeed, one systematic review, focused on the most commonly examined outcomes among COs in research undertaken between 1980 and 2017, identified only nine studies (out of a total of 172 peer-reviewed publications that met the inclusion criteria) that examined mental health

outcomes (Butler et al., 2019). Furthermore, many of the studies examining such outcomes have been descriptive, focusing primarily on identifying the prevalence of mental health diagnoses or symptomatology rather than on theorizing or identifying how prison work contributes to mental health outcomes. In addition, these studies typically have relied on cross-sectional data, thereby making it difficult to assess temporal order and changes over time.

In short, the effects of accumulated exposures of one of the most salient aspects of contemporary prison work—incidents involving dangerous, violent, or otherwise challenging interactions with, and infractions by, incarcerated persons—on officer mental health need more rigorous examination. Such research could provide greater insights into the ways the prison environment impacts officers, along with the downstream impacts on prison systems. Environmental influences on officer well-being, for example, may shape how officers perceive and interact with incarcerated individuals (Lambert, Barton-Bellessa, et al., 2015; Ulmer, 1992).

The current study, therefore, is aimed at examining the impact of accumulated exposures to work-related critical incidents on officer mental health. To this end, we rely on a longitudinal, multisite study of COs from Minnesota. Critical incidents across two observation periods spanning nearly 2 years were assessed using administrative disciplinary data augmented with responding officer narrative reports that recorded: 1) exposure to a given incident and 2) the intensity of each exposure (coded as each officer's level of involvement in each incident). This information is used to examine the association between the accumulation of critical incident exposure and symptoms of three mental health disorders: 1) posttraumatic stress disorder (PTSD), 2) depression, and 3) anxiety. Implications for understanding the impact of prison work on officers and implications for prison system order and safety are also discussed.

2 | OFFICERS AND THE PRISON ENVIRONMENT

Despite recent decreases in the overall prison population in the United States (Carson, 2020; Carson & Kluckkowitz, 2023), demand for COs has continued to outpace hiring as many correctional departments report being critically understaffed (Santo & Neff, 2020). The inability to recruit and retain officers has substantial “downstream” effects on the prison environment, often resulting in more punitive, harsh, and inequitable conditions for incarcerated individuals. For example, institutions that do not have an adequate number of officers to supervise the movement of incarcerated individuals rely more heavily on institution-wide lockdowns and are less likely to offer programming, activities, and education (Blakinger et al., 2021). In addition to operational changes that directly affect incarcerated individuals, increased levels of officer stress and job burnout may result in more punitive attitudes and in an increased reliance on force among COs (Griffin, 2002; Lambert, Barton-Bellessa, et al., 2015; Ulmer, 1992). Similarly, chronic and prolonged stress exposure may compromise decision-making and job performance among officers during critical situations, increasing the risk of harm or death to incarcerated persons and to themselves (Brower, 2013; Spinaris et al., 2012; Steiner & Wooldredge, 2015).

The salience of these observations lies in the implications that they have not only for understanding the experiences and impacts of prison work on officers but also for appreciating their impacts on prison systems. Factors that influence personnel—the primary focus of this study—have the potential to influence prison order and safety. Exposure to incidents that harm personnel, for example, may undermine work performance, consistency of rule enforcement, and willingness to exercise discretion in ways helpful to incarcerated persons. This broader context is central to appreciating the need to understand personnel experiences. As emphasized by Sykes (1958),

and many scholars since (see, e.g., Bottoms, 1999; DiIulio, 1987; Hepburn, 1985; Crewe 2009; Wooldredge & Steiner, 2016; Bucerius et al., 2023), prison systems are fundamentally interactive institutions. When personnel act in ways that undermine their own or prison system legitimacy, the end result can be greater security issues (see, e.g., Schultz & Ricciardelli, 2023). A critical question, then, centers on how exactly officers are affected by their work.

3 | THE PRISON ENVIRONMENT'S IMPACT ON OFFICERS

Given the nature of their work, exposure to occupational stressors among COs—including violence—is substantial. COs experience higher rates of workplace violence (Brower, 2013; Spinaris et al., 2012; Steiner & Wooldredge, 2015) and higher nonfatal injury rates (Konda et al., 2012; U.S. Bureau of Labor Statistics, 2023) compared with those in other occupations. For example, in 2022, COs experienced the fifth highest incidence rate of nonfatal occupational injury (approximately 11.3 injuries per 100 full time employees) and the third highest incidence rate of injuries that required days away from work (8.5 injuries per 100 full time employees; U.S. Bureau of Labor Statistics, 2023). COs are also more likely to experience negative work-related outcomes, including increased levels of burnout and work stress, as well as lower retention rates (Schaufeli & Peeters, 2000; Steiner & Wooldredge, 2015). Such patterns even persist when comparing COs with other prison staff, such as wellness services employees (Fusco et al., 2021). Importantly, however, research has also demonstrated that some forms of law enforcement exhibit increased levels of resiliency after exposure to traumatic events (Regehr et al., 2021), including the development of *posttraumatic growth* (Tedeschi et al., 2018).

Few studies, however, have examined whether increased exposure to occupational stressors, along with the unique challenges that stem from working in a prison, contribute to long-term and deleterious stress-related outcomes. In direct contrast to other forms of law enforcement like policing, COs work up to 16 hours a day in a total institution with direct and close contact with individuals who have been convicted of criminal behavior. These unique aspects of prison work underscore the importance of research on its effects, yet as one review commissioned by the National Institute of Justice found, studies of the impacts of CO exposure to violence are anemic (Steiner & Cain, 2016; see also Aranda-Hughes & Mears, 2023). The review's conclusion stands: A need remains for research focused on critical incident exposure and mental health problems among correctional personnel.

A focus on mental health seems to be warranted as research has revealed a consistent link between exposure to traumatic stressors—including violence—and mental health problems within the general population (Brewin et al., 2000; Clements et al., 2008; Fowler et al., 2009). This link has been observed in other populations regularly exposed to violence, including other types of law enforcement (Cain et al., 2016; Hartley et al., 2013; Meade et al., 2017; Meade & Steiner, 2013; Steiner & Meade, 2016). For example, Carleton et al. (2019) examined more than 4,000 public safety personnel in Canada, including COs, and found that trauma exposure was a potent risk factor for a wide variety of mental disorders.

Although few studies have examined the impact of work-related stressor exposure on the development of mental health problems, ample evidence suggests that COs suffer from mental health problems at an increased rate compared with the general population (Brower, 2013; Denhof & Spinaris, 2013; Regehr et al., 2019; Spinaris et al., 2012). Some studies have even reported a prevalence rate of PTSD among COs resembling that of military veterans who have experienced active combat (James & Todak, 2018). Additional studies have reported increased levels of other mental health problems among COs, including depression, suicide ideation, substance use problems, and

anxiety disorder (Brower, 2013; Denhof & Spinaris, 2013; James & Todak, 2018; Regehr et al., 2019; Spinaris et al., 2012). Furthermore, qualitative work examining COs from Canada revealed that officers identified work-related stressors, including exposure to violence, as significant sources of mental health problems (Ricciardelli & Power, 2020).

Although prison work may have a pronounced impact on individual officers, some systemic implications also flow from adverse work-related effects on officers' mental health. For example, officers exposed to more occupational stressors and who experience more mental health problems are more likely to experience burnout and absenteeism (Schaufeli & Peeters, 2000). Understaffing, in turn, can lead to the use of more punitive strategies to control institutionalized populations (Blakinger et al., 2021). This problem is further exacerbated when officers who experience mental health problems demonstrate increased levels of cynicism, are more likely to hold punitive attitudes, and are less supportive of treatment of incarcerated individuals (Lambert, Griffin, et al., 2015; Ulmer, 1992). Such changes can contribute to lower perceived levels of institutional legitimacy and officers' authority (Steiner & Wooldredge, 2018). In sum, officers play a central role in contributing to order in prisons, including how they respond to incarcerated individuals' needs, their willingness to transcend "us"/"them" boundaries, and their ability to enforce rules fairly (Bottoms, 1999; Bucerius et al., 2023; Crewe, 2009; Sykes, 1958).

4 | A RESILIENCY-FATIGUE MODEL

To this point, we have focused on the immediate impact of occupational critical incident exposure on mental health problems among COs. A related focus is whether such exposures can accumulate in a problematic manner over time, potentially contributing to more serious mental health disorders after reaching a given threshold. One possible response is resiliency followed by fatigue, what we term a *resiliency-fatigue model*. Specifically, officers may exhibit a pattern of resilience to occupational stressors, but as exposures continue to rapidly accumulate over a short period of time, individuals become overwhelmed, resulting in a greater likelihood of experiencing mental health problems.

This possibility aligns with prisonization processes among incarcerated persons, including reactions to the deprivations of prison (Clemmer, 1940; Sykes, 1958). For example, ethnographic studies of new prison officers have identified a "newjack" or transitional period in which officers are exposed to and acclimate to prison conditions (Conover, 2001; Crawley, 2004; Liebling et al., 2011). During this time, officers learn official rules and regulations along with informal norms that guide interactions with incarcerated persons and other staff. As Schoenfeld and Everly (2023) emphasized, officers learn "through formal informational cues and informal observational cues about how to act or feel in a specific situation" (p. 228). In this way, officers may develop resilience to occupational stressors, such as critical incidents, because they work within an organizational structure and culture that provides a foundation for understanding and navigating them, at least so long as those stressors accumulate in a general and expected pattern. In situations in which stressors, such as critical incident exposures, accumulate more rapidly and over a short period of time, however, associated fatigue may substantially increase. In such situations, the ability of officers to navigate and respond to incidents may be inadequate, greatly increasing the subsequent likelihood of experiencing mental health problems.

This hypothesized resiliency-fatigue model was anticipated by work demonstrating a link between workplace safety and the psychological dimension of work stress among COs (Cullen et al., 1985; Lambert et al., 2007; Schaufeli & Peeters, 2000). Psychological stress occurs when occupational requirements or conditions exceed an employee's available coping resources (National

Institute for Occupational Safety and Health, 1999; Schaufeli & Peeters, 2000), leading to increased emotional and fearful responses along with increased levels of hypervigilance and anxiety (Bandura, 1976; Dodge et al., 1990; Luthra et al., 2009). Studies have shown that as occupational requirements continue to increase, officers' emotional resiliency significantly decreases, further exhausting coping resources and potentially contributing to the development of mental health problems (Denhof & Spinaris, 2013; Dollard & Winefield, 1998; Steiner & Wooldredge, 2015). This line of work has provided evidence that continued exposure to the prison environment, and the short-term, rapid accumulation of critical incident exposures more specifically, may be an important and influential factor in the development of mental health problems among officers.

The resiliency-fatigue model is similar to, but also departs from, existing theoretical models by highlighting the salience of a category of experiences—critical incidents—that do not clearly align with dimensions specified in these models. For example, the concept of work stress (or strain) has featured prominently in the job–demand–control (JDC; Karasek, 1979) and the job–demand–control–support (JDCS; Johnson & Hall, 1988) theoretical models that some scholars have used to examine sources of occupational stress among COs (Finney et al., 2013). These models conceptualize job demands, such as workload, insufficient staffing, work overload (e.g., forced overtime), and time pressures, as organizational stressors (Demerouti et al., 2001). In Karasek's (1979) classic paper, examples of job demands included customer demands that employees were unable to control, close supervision under heavy workloads, and heavy workloads performed under rigid rule structures with limited decision-making autonomy.

These types of job demands may play an important role in the development of burnout and other negative outcomes among COs (Schaufeli & Peeters, 2000). Critical incident exposure, however, differs markedly from this conceptualization of job demands. It constitutes a distinct potential influence on work stress, one that operates through physiological and psychological pathways and that is not reducible to predictable job “demands.” As with aspects of policing, some experiences, like work overload, may be viewed as typical, or “normal,” aspects of the job. Other experiences, however, such as incidents involving extreme acts of violence or danger, may be understood to constitute potential, but not typical or “normal,” aspects. They constitute extreme events that differ from routine work demands and, importantly, entail physical risk. Empirical support for this theoretical argument comes in part from Ellison and Caudill (2020), who examined the independent contributions of job demands, job control, support, and exposure to safety risks (including experiencing threats from incarcerated persons, witnessing violence at work, and perceived dangerousness) on work stress in a sample of jail COs. The results revealed unique paths of influence on work stress stemming from all four domains. Such findings provide preliminary support for a theoretical framework that views critical incident exposure accumulations and other safety risks as contributing to work stress through pathways related to, but distinct from, those specified in the JDC and JDCS models.

5 | THE CURRENT STUDY

Against this backdrop, this study examines the impact of the accumulated exposure to work-related critical incidents on officer mental health both to gain insight into the effects of such exposure and to test the resiliency-fatigue model. Although prison officers are differentially exposed to occupational stressors (Brown et al., 1999; Finn, 2000; Haslam & Mallon, 2003; Kop et al., 1999; Revicki & Gershon, 1996; Spinaris et al., 2012)—and violent stressors in particular—and exhibit increased levels of mental health problems (Brower, 2013; Denhof & Spinaris, 2013; James & Todak, 2018; Regehr et al., 2019; Ricciardelli & Power, 2020; Spinaris et al., 2012), to our

knowledge, a rigorous and direct analysis has not been conducted of the association between the accumulation of critical incident exposures and mental health problems within this population. Given these observations, the first objective of the current study aims to more closely examine this association among a sample of COs from Minnesota. To do so, the current study relies on a combination of administrative data, narrative reports, and self-report data to effectively examine the potential impact of critical incident exposure accumulation on mental health problems.

The second objective of the study is to test the resiliency-fatigue model by examining whether mental health problems become more prevalent as the short-term accumulation of critical incident exposures increases to a threshold that outpaces individual levels of resilience. Importantly, the resiliency-fatigue model distinguishes the short-term, rapid accumulation of critical incident exposures from long-term, general accumulation (i.e., the expected accumulation that occurs as officer service time increases). As evidenced by heterogeneity in mental health problems among officers across almost all years of service, the general accumulation of critical incidents may not result in mental health problems with certainty. Rapid, short-term accumulations that occur during a more condensed timeframe, however, can be expected to overwhelm officers and their ability to navigate and recover from the incidents, resulting in resiliency fatigue and, as a result, a greater likelihood of mental health problems. The current study investigates the resiliency-fatigue model by examining mental health problems across levels of critical incident exposure accumulation over a limited timeframe to identify potential thresholds at which such problems may be more likely to occur.

6 | METHODOLOGY

6.1 | Data

The current study analyzes data from a prospective, longitudinal study of COs from three Minnesota Department of Corrections (MnDOC) correctional facilities. The institutions were strategically selected, with input from MnDOC administration, to provide a representative cross section of all facilities in the overall correctional system. Collectively, the three facilities included in the current study constitute between 40 and 45 percent of Minnesota's prison population and likely a similar proportion of the Department's officers, increasing the likelihood that the resulting sample is representative of the overall population of COs in MnDOC. The first facility houses approximately 1,600 incarcerated individuals and is the largest close-security institution for men in the state, with an additional minimum-security unit outside its perimeter. The second is a medium-security facility and the largest institution in the MnDOC system, housing approximately 2,000 men, with two minimum-security units located outside its perimeter. The third is the only female facility in the state, which houses approximately 650 incarcerated females at all custody levels. The study design was approved by the appropriate Institutional Review Board.

Data collection was split into two cohorts¹ and four data collection periods with the first data collection period (i.e., time 1, wave 1) completed in July 2018. Subsequent data collection periods

¹ The two-cohort design was necessitated by a critical incident that occurred at one study site during the first wave of data collection but before the first day of data collection at that particular site. Data collection had commenced at the other sites and was scheduled to start later in the same week for the third study site. As a result of the incident, time 1 data collection was postponed, necessitating the addition of a fourth collection period, as specified in figure 1. To ensure that the two cohorts did not systematically vary in ways that may impact the examined hypotheses, all analyses were estimated with a cohort dummy identifier included as a control.

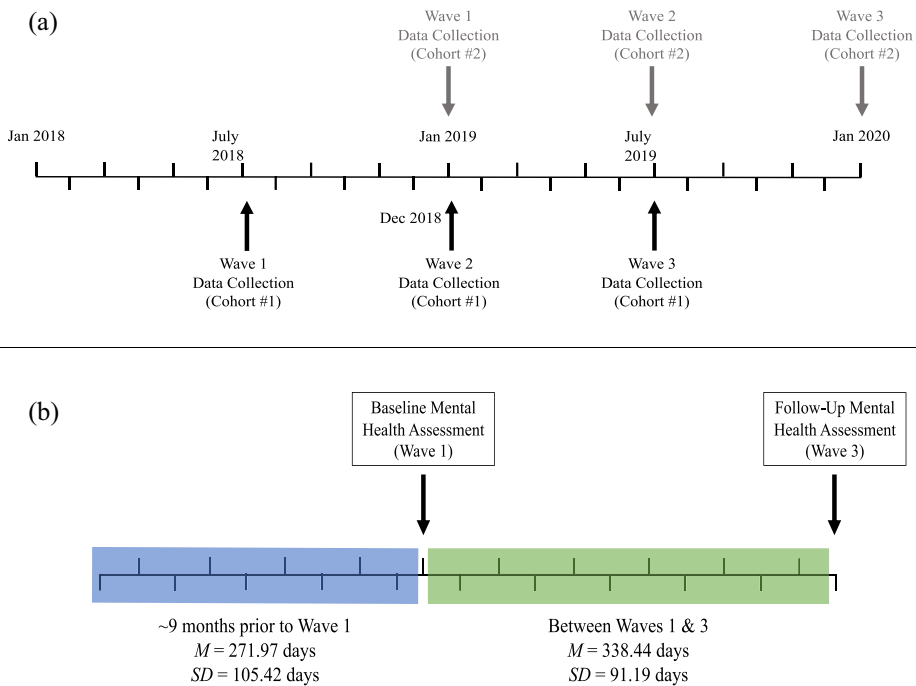


FIGURE 1 Study measurement occasions.

Note. Panel A: Presents the full study timeline with all data collection periods designated. The black arrows represent data collection periods for cohort #1, whereas the gray arrows on top represent data collection periods for cohort #2. Panel B: The blue section of the timeline represents the critical incident assessment period that occurred prior to wave 1 and consisted of 9 months of critical incidents. The blue section ends before the baseline mental health assessment at wave 1 as this measurement period started at the earliest point that data were available for each participant but ended the day before the wave 1 survey was completed. The green section of the timeline represents the 12 months between the completion of each participant's wave 1 and wave 3 surveys. Importantly, the green section does not include the days in which the surveys were completed as this measurement period was limited to the day after each participant completed the wave 1 survey and ran through the day before the completion of the wave 3 survey.

[Color figure can be viewed at wileyonlinelibrary.com]

were spaced across approximately 6-month intervals and completed during January 2019 (time 2, wave 1 and time 2, wave 2), July 2019 (time 3, wave 2 and time 3, wave 3), and January 2020 (time 4, wave 3). Figure 1 provides a more detailed study timeline, with information pertaining to the primary data collection periods for both cohorts and the key study occasions examined in the current study. Prior to wave 1 data collection, a solicitation e-mail was sent to all officers listed on active-duty rosters at the selected study sites. During wave 1, officers were recruited as they entered a general briefing room to receive their preshift briefing. A total of 488 COs agreed to participate in the study, resulting in a response rate of approximately 69 percent.² The initial wave of data collection included a survey tapping a range of constructs related to work within a

² Response rates were calculated using scheduling rosters provided by MnDOC for each of the three facilities included in the final study; 703 officers were present at some point during the recruitment period. The response rate for the current study exceeds commonly reported rates from previous CO studies (~40 to 60 percent; see, e.g., Aranda-Hughes & Mears, 2023; Lerman et al., 2022), and aligns with studies reporting the highest response rates among this population

corrections institution, individual perceptions of workplace danger and safety, and self-reported symptoms of mental health problems.

Wave 2 of the study occurred approximately 6 months after wave 1 and included a shorter survey aimed at documenting any important work or life changes. Approximately 71 percent ($n = 344$) of wave 1 participants also participated in wave 2 of the study. Wave 3 was completed approximately 6 months after wave 2 and ~1 year after initial recruitment in the study. Once again, a more detailed survey was administered that was similar to the one completed during wave 1, using many of the same constructs. Approximately 79 percent of the officers who completed the wave 1 survey (and 89 percent of officers who completed the wave 2 survey; $n = 381$) completed the wave 3 survey. Study attrition was also examined in relation to the examined mental health measures and all other study measures in multiple ways, with additional information presented in the online supporting information.³ Collectively, the findings suggest that individuals with the most pronounced mental health problems were more likely to prematurely leave the study, effectively truncating variability in the examined outcomes. As a result, the standard errors from the resulting multivariate models estimated in the primary analysis are likely inflated or overly conservative, making it more difficult to reach statistical significance.

In addition to the survey, information related to all disciplinary incidents that occurred within the three facilities were obtained from MnDOC for two time periods—approximately 9 months prior to wave 1 data collection (approximately 272 days) and during the study period (approximately 338 days). These data were provided in the form of basic summary information, with general information about each incident, including the date and time the incident occurred, the location of the incident, the specific type of violation, and the officers that were involved. A total of 72 disciplinary categories were included in the provided data. These categories were further collapsed into the following seven broader categories: 1) nonviolent (e.g., gambling; destruction, damage, or alteration of property); 2) violent (e.g., assault another inmate [with or without weapon]; assault staff [with or without weapon]; fighting); 3) noncompliance (e.g., being in an unauthorized area; disobeying a direct order); 4) drug (e.g., misuse of prescribed medications; possession or use of illegal drugs); 5) contraband (e.g., possession of weapons; smuggling in or out of a facility); 6) security violations (e.g., interference with security procedures; obstructing cell bars); and 7) sexual (e.g., sexual harassment; sexual abuse of an inmate). A more detailed summary of the categories, the disciplinary infractions organized within each category, and the accompanying descriptive statistics across both observation periods are presented in table S1 of the online supporting information.

In addition to this summary information, detailed reports written by responding officers were also provided. These narratives were written by one or more of the officers who were exposed to the incident and provided a more detailed summary of 1) the context surrounding each incident, 2) each officer's individual involvement in the incident, and 3) the sequence of events that unfolded during the incident. Narratives were coded to augment the disciplinary data and provide more detailed information surrounding officers' involvement in each incident. Research team members reviewed the corresponding narratives for each disciplinary incident and coded each named

(e.g., Lambert et al., 2007; St. Louis et al., 2023). The retention rate for the current study also resembles or exceeds what has been reported in the few longitudinal studies examining COs (e.g., Jaegers et al., 2021).

³ Additional supporting information can be found in the full text tab for this article in the Wiley Online Library at <https://onlinelibrary.wiley.com/doi/full/10.1111/1745-9125.12379>.

officer's overall level of involvement for each critical incident exposure, resulting in three possible levels of involvement.⁴

Primary involvement was defined as exposures in which the target officer was the first officer to discover the infraction, was the primary target of an assault or other form of misconduct, or was the first officer to discover contraband during a search. *Secondary involvement* was defined as exposures in which officers responded to a previously identified critical incident or situation, during which they may have responded to calls for back up or been part of a team responding to an identified threat. Similarly, situations with officers who were responsible for applying restraints and escorting incarcerated individuals away from an incident were coded as secondary involvement. Finally, *tertiary involvement* was defined as the lowest level of involvement. It typically characterized exposures in which the officer responded to an incident after the fact, providing cell pack ups, reviewing video evidence, or removing restraints from an incarcerated individual after they had already been escorted away from the scene of the incident. Although officers could have multiple levels of involvement in complex situations in which multiple incidents occurred—for example, an officer-involved assault that then triggered a cell search—such incidents were rare. Narratives were coded by a team of trained research assistants who received extensive training and were familiar with the organizational structure of the facilities included in the study. In total, narratives for 66,766 infractions and 7,381 unique incidents were coded. Approximately 8 percent of all narratives (5,260 infractions) were coded by multiple raters to assess agreement, which exceeded 90 percent. Additional information regarding training and coding procedures is presented in the [online supporting information](#).

6.2 | Mental health measures

6.2.1 | Posttraumatic stress disorder (PTSD)

PTSD was measured at waves 1 and 3 using the PTSD Checklist for DSM-5 (PCL-5), a 20-item self-report measure tapping the presence and severity of PTSD symptoms in the past month (Weathers et al., 2013). The PCL-5 is a psychometrically sound and reliable measure of PTSD symptoms (Blevins et al., 2015) that has been employed in a variety of populations, including those that regularly experience traumatic events (Bovin et al., 2015). Participants were asked to indicate how much each of the noted symptoms (e.g., repeated, disturbing, and unwanted memories of a stressful experience) bothered them in the past month, with the possible response categories measured on a five-point scale and ranging between 0 (not at all) and 4 (extremely). Responses to all 20 questions were summed separately for wave 1 ($\alpha = .96$) and wave 3 ($\alpha = .96$). Previous studies have suggested that scores greater than or equal to 33 on the resulting summed measure indicate the presence of PTSD (Weathers et al., 2013), allowing for the creation of a diagnostic PTSD indicator that was coded such that 0 = a resulting score < 33 and 1 = a resulting score $\geq$ 33. Descriptive statistics for the waves 1 and 3 PTSD measures, along with all other study measures, are provided in table 1.

⁴ Since, at least to our knowledge, no previous studies have relied on official records to assess officer exposure to, or involvement in, critical incidents, a data-driven approach was used to develop the employed coding strategy. A broader set of categories was initially considered, but after piloting this coding scheme in a random sample of narratives, the research team realized that some of the categories selected a priori were overly narrow and would only be relevant for a small proportion of overall cases. Eventually, after multiple iterations and pilots, the coding scheme outlined here was selected to balance parsimony and comprehensiveness.

TABLE 1 Univariate statistics for all study measures.

Measures	Mean/%	SD/n	Min	Max
Mental Health Measures				
PTSD (mean)				
Wave 1	28.544	20.258	0	80
Wave 3	26.718	19.806	0	80
Diagnostic Indicators (%)				
Wave 1			0	1
No diagnosis	59.746%	282		
Diagnosis	40.254%	190		
Wave 3				
No diagnosis	66.488%	248		
Diagnosis	33.512%	125		
Depression (mean)				
Wave 1	10.789	6.576	0	30
Wave 3	10.647	6.216	0	30
Diagnostic Indicators (%)				
Wave 1			0	1
No diagnosis	77.186%	362		
Diagnosis	22.814%	107		
Wave 3			0	1
No diagnosis	77.089%	286		
Diagnosis	22.911%	85		
Anxiety (mean)				
Wave 1	55.370	11.246	37.100	83.100
Wave 3	54.071	11.416	12.571	83.100
Diagnostic Indicators (%)				
Wave 1			0	1
No diagnosis	66.525%	312		
Diagnosis	33.475%	157		
Wave 3			0	1
No diagnosis	69.542%	258		
Diagnosis	30.458%	113		
Critical Incident Exposure				
Overall Incidents (mean)				
Before wave 1	54.101	80.042	0	536
Between waves 1 and 3	51.117	69.902	0	456
Level of Involvement (mean)				
Before wave 1	.074	.085	0	.459
Between waves 1 and 3	.064	.076	0	.431
Weighted Cumulative Index of Exposure (mean)				
Before wave 1	21.164	31.310	0	190.306
Between waves 1 and 3	15.880	21.391	0	127.376

(Continues)

TABLE 1 (Continued)

Measures	Mean/%	SD/n	Min	Max
Control Variables				
Shift (%)				
Wave 1			1	4
1st watch	11.227%	54		
2nd watch	40.956%	197		
3rd watch	43.659%	210		
Other	4.158%	20		
Wave 3			1	4
1st watch	11.286%	43		
2nd watch	42.520%	162		
3rd watch	38.583%	147		
Other	7.612%	29		
Study Site (%)				
Wave 1			1	3
Site 1	41.060%	186		
Site 2	42.384%	192		
Site 3	16.556%	75		
Wave 3			1	3
Site 1	41.732%	159		
Site 2	41.732%	159		
Site 3	16.535%	63		
Service Time (wave 1, years; mean)	9.499	7.557	.083	30.750
Age (wave 1, years; mean)	38.739	10.513	19	67
Race (wave 1; %)				
			1	4
White/Caucasian	88.248%	413		
African American	3.419%	16		
Latino(a)	3.419%	16		
Other	4.915%	23		
Sex (wave 1; %)				
			0	1
Female	30.621%	143		
Male	69.379%	324		
Exposure to Violence (mean)				
Wave 1	2.798	2.128	0	6
Wave 3	2.126	1.790	0	6
Supervisor Status (wave 1; %)				
			0	1
Not a supervisor	88.773%	427		
Supervisor	11.227%	54		
Military Service (wave 1; %)				
			1	3
Currently serving	3.846%	18		
Never served	78.846%	369		

(Continues)

TABLE 1 (Continued)

Measures	Mean/%	SD/n	Min	Max
Previously served	17.308%	81		
Family Situation (%)				
Wave 1			1	4
Not married/no children	31.974%	149		
Married/no children	13.090%	61		
Married/children	40.987%	191		
Not married/children	13.948%	65		
Wave 3			1	4
Not married/no children	27.913%	103		
Married/no children	12.195%	45		
Married/children	44.173%	163		
Not married/children	15.718%	58		
Cohort (wave 1; %)			1	2
Cohort #1	51.760%	250		
Cohort #2	48.240%	233		
Exposure Time (mean)				
Before wave 1	271.965	105.423	196	376
Between waves 1 and 3	338.441	91.188	201	423

6.2.2 | Depression

Depression was measured at waves 1 and 3 using the 10-item short form of the Center for Epidemiologic Studies-Depression scale (CES-D; Radloff, 1977), a valid and reliable self-report instrument that has been widely used to assess depressive symptoms in a wide variety of populations. Participants were asked to report the frequency they experienced each of the provided 10 symptoms (e.g., “I was bothered by things that usually don’t bother me”) in the past week, with possible responses measured on a four-point scale ranging between 1 (rarely/none) and 4 (all of the time). All 10 items were then summed separately for wave 1 ($\alpha = .88$) and wave 3 ($\alpha = .87$). A score of 16 or greater on the resulting index indicates the presence of depression (Radloff, 1977), allowing for the creation of a diagnostic depression indicator at each wave, where 0 = a resulting score < 16 and 1 = a resulting score ≥ 16 .

6.2.3 | Anxiety

Anxiety was also assessed at waves 1 and 3 using the short-form of the Patient Reported Outcomes Measurement Information System (PROMIS)-Anxiety scale, an eight-item self-report measure of anxiety symptoms (Cella et al., 2010). The scale has been validated with a wide range of populations, including those frequently exposed to violent or traumatic events (Hadlandsmayth et al., 2020). Participants reported how often in the past week they had experienced each of the provided symptoms (e.g., “my worries overwhelmed me”) on a five-point scale ranging between 1 (never) and 5 (always). Responses were summed separately for wave 1 ($\alpha = .96$) and wave 3 (α

= .96). Following procedures outlined previously, the resulting summed scores were converted to *T*-scores using the *T*-score map developed by the National Institutes of Health (Rothrock et al., 2020). *T*-scores greater than 60 (indicating +2 standard deviations [SD] above the mean) have been identified as indicating moderate-to-severe levels of anxiety (Cella et al., 2010), allowing for the creation of a diagnostic anxiety indicator at each wave, which was coded into a binary measure, where 0 = a *T*-score > 60 and 1 = a *T*-score ≥ 60.

6.3 | Critical incident exposure

Critical incident exposure was measured using the combination of disciplinary data and accompanying narratives, as described above. This measurement led to the creation of two person-day data sets that contained information on the total number of daily critical incident exposures for each officer during two timeframes: 1) the 9-month period prior to wave 1 data collection ending on the day before the wave 1 survey was completed ($N = 142,598$ person-days); and 2) the study period spanning from the day after the completion of the wave 1 survey and ending the day before the completion of the wave 3 survey ($N = 177,297$ person-days). Narrative data were used to identify the overall level of involvement coded as 1 = *tertiary involvement*, 2 = *secondary involvement*, and 3 = *primary involvement* for each incident. Since officers could experience more than one incident each day, a daily average level of involvement was calculated, with higher scores indicating greater average levels of daily involvement. Importantly, and as discussed in detail above, the use of disciplinary data allowed for the inclusion of a wide variety of incidents, ranging from disciplinary infractions up to extremely violent events. This conceptualization of critical incidents flows from the recognition that officer work entails daily exposure to a spectrum of incidents, and collectively constitute operational stressors that officers face and that may negatively impact mental health.

6.4 | Statistical controls

To better isolate the associations of interest, several statistical controls were included in the final models. First, at all three waves, officers were asked to report the shift they worked most often in the past year (or 6 months at waves 2 and 3), with responses coded as follows: 1 = first watch (10 PM to 5 AM); 2 = second watch (5 AM to 2 PM); 3 = third watch (2 PM to 10 PM); and 4 = other (any other shift). The shifts reported at waves 1 and 3 were included in the final analytic models. Second, a categorical variable for study site was recorded at each wave of data collection, with the site recorded at waves 1 and 3 included in the primary analysis. Third, a measure of service time was created using self-reported responses from wave 1 in which officers reported the total number of years and months they had been employed by MnDOC. Fourth, at wave 1, officers were asked to report their overall age in years. Fifth, also at wave 1, officers were asked to report their race/ethnicity; responses were coded as 1 = White, 2 = Black, 3 = Latino, 4 = other. Sixth, also at wave 1, officers were asked to report their sex, with the resulting responses coded dichotomously: 0 = female and 1 = male.

Seventh, to distinguish work-related critical incidents from stressful experiences that occurred outside of work, a six-item exposure to violence index was included from wave 1 and 3 surveys. Participants were asked whether six stressful incidents occurred outside of work within the past year: 1) someone threatened you, 2) you witnessed someone threaten to hurt someone else, 3) someone you know threatened to commit suicide or self-harm, 4) someone assaulted you, 5) you

witnessed someone assault someone else, and 6) someone you know committed suicide or self-harm. Responses were coded as 0 = did not occur within the past year and 1 = occurred at least once in the past year and then summed (wave 1: $\alpha = .82$; wave 3: $\alpha = .73$).

Eighth, at wave 1, participants reported whether they were currently a supervisor of any staff. Responses were coded as 0 = not a supervisor and 1 = current supervisor. Ninth, at wave 1, participants were asked whether they currently or had ever served in the military. Responses were coded categorically where 1 = currently serving (3.69 percent), 2 = never served (75.61 percent; reference category), and 3 = previously served (16.60 percent). Tenth, during waves 1 and 3, respondents reported whether they were currently married and the number of children that lived with them at home. The responses were used to create a categorical family situation measure: 1 = not married/no children, 2 = married/no children, 3 = married/children, and 4 = not married/children. Eleventh, to eliminate potential systematic differences between the two cohorts, a dummy indicator identifying participants from each cohort (0 = cohort #1; 1 = cohort #2) was included. Finally, because the number of days in both observation periods varied across individuals (before wave 1: $M = 271.97$ days; $SD = 105.42$ days; between waves 1 and 3: $M = 338.44$ days; $SD = 91.19$ days), time at risk for incident exposure varied. The total number of days that elapsed during each observation period was also included as a statistical control.

6.5 | Plan of analysis

6.5.1 | Estimation of the weighted cumulative exposure index

The first step in the analysis involved the estimation of a weighted cumulative index of exposure (WCIE; Abrahamowicz et al., 2006; Sylvestre & Abrahamowicz, 2009; Wagner et al., 2021). More specifically, a WCIE was used to approximate the overall accumulation of critical incident exposures during both observation periods for each officer. A WCIE represents the weighted sum of the cumulative exposures experienced before a given assessment (i.e., landmark), with specialized weights that represent the relative importance of each exposure based on 1) *when it occurred* and 2) *the relative intensity* in which it was experienced (or *dosage*). In contrast to an unweighted cumulative index of exposure (i.e., the raw sum of all exposures during the examined timeframe), which equally weights each exposure regardless of when it occurred and its relative intensity, a WCIE will upweight those exposures that were more recent (i.e., closer to the end of the examination period or landmark assessment) and more intense, while downweighting exposures that are more distal (i.e., closer to the beginning of the examination period and further away from the landmark assessment) and less intense (i.e., lower dosage). Therefore, for a specified time interval $u - t$, the accompanying WCIE can be defined as:

$$WCIE(u) = \sum_t^u w(u-t)X(t) \quad (1)$$

where u is the end of the observation period (e.g., the day before the wave 3 survey was completed within the context of the current study) and $t \leq u$ represents each day of exposure preceding u (e.g., all days after the completion of the wave 1 survey up to u). $X(t)$ is the individual *exposure intensity or dose* accompanying each exposure. Within the context of the current study, $X(t)$ is the *exposure intensity* measured using the average daily level of involvement. Finally, $w(u-t)$ represents a weight function that assigns appropriate weights to past exposures based on the amount of

time that has elapsed since the exposure occurred ($u - t$). For the current study, exposures were defined as the daily count of critical incident exposures.

The weight function in equation 1 can be specified directly from the data using flexible functions of time across the study period such as a basis of splines (Abrahamowicz et al., 2006; Sylvestre & Abrahamowicz, 2009). When no a priori specification of the expected functional form of the weight function exists, cubic regression splines are recommended (Danieli et al., 2020; Sylvestre & Abrahamowicz, 2009; Wagner et al., 2021) and can be specified as:

$$w(u - t) = \sum_{j=1}^m \theta_j B_j(u - t) \quad (2)$$

where B_j , $j = 1, \dots, m$, is the m function in the cubic spline basis and θ_j , $j = 1, \dots, m$, represents the coefficients of the linear combination of the basis of splines. The flexibility of the estimated spline function is directly related to the number of knots selected. Although a larger number of knots allows for more flexibility, the inclusion of more knots also increases the chances of overfitting. For this reason, Sylvestre & Abrahamowicz (2009) recommended between three and five equidistant knots, with the most parsimonious model selected via inspection of the resulting Akaike information criteria (AICs) and/or likelihood ratio tests (LRTs) of nested models. Based on these suggestions, and additional procedures outlined by Wagner et al. (2021), the weight function in equation 2 was estimated using a standard linear mixed-effects model:

$$\begin{aligned} U_{il} &= U_i^*(t_{Uil}) + \varepsilon_{il} U_{il} \\ &= X_i(t_{Uil})^T \beta + Z_i(t_{Uil})^T b_i + \varepsilon_{il} \end{aligned} \quad (3)$$

where U_{il} are exposure values for individual i ($i = 1, \dots, N$) at measurement time t_{Uil} ($l = 1, \dots, m_i$) before the wave 1 or 3 survey date. Importantly, the total number m_i can vary between subjects, allowing for between-individual differences in exposure time. $U_i^*(t_{Uil})$ is the observed exposure value at time t_{Uil} , $X_i(t_{Uil})$ is a vector of fixed effects (β) and $Z_i(t_U)$ is an accompanying vector of random effects (b_i), respectively, for the included basis of splines representing time. The resulting weights were then used to calculate a WCIE score for each participant across the two observation periods using equation 1.

The resulting WCIE, treated as the primary independent variable in the subsequent multiple variable models discussed below, is effectively a count of all critical incident exposures during the two observation periods, weighted by how close they occurred to the end of each observation period and the intensity or dosage of the experiences (i.e., overall level of involvement). Therefore, a critical incident exposure that occurred closer to the end of the observation period and had higher intensity would be weighted more heavily than an exposure experienced at the beginning of the observation period that had a lower level of intensity.

6.5.2 | Generalized estimating equations

Given the nested nature of the examined data—two observation periods nested within individuals—the second step in the analysis involved the estimation of a series of generalized estimating equations (GEEs; sometimes also referred to as “population averaged models”) to examine the association between the accumulated critical incident exposure and mental health outcomes.

Previous simulation studies have reported limited bias in coefficients resulting from the analysis of clustered data with ordinary least-squares regression (Clarke, 2008), but the resulting standard errors may be inefficient (Raudenbush & Bryk, 2002). For this reason, a wide range of statistical methods that better account for systematic clustering have been developed (Singer & Willett, 2003). Arguably, the most common of these specialized methods are multilevel models (MLMs), which provide a flexible modeling solution that not only addresses clustering but also provides many additional options suitable for research questions involving nested data. Another related, but distinct, class of models also appropriate for clustered or nested data are GEEs (McNeish, 2014; Muth et al., 2016). Similarities exist between MLMs and GEEs along with important differences between both classes of models. MLMs directly incorporate the source of clustering through the estimation of a cluster-specific random effect, which is specified by the user and can be modified to address cluster-specific research questions.

Although MLMs produce standard errors that are properly adjusted for clustering, such models are not well suited for sparse data, or data comprising a small number of observations (i.e., level 1 units) or groups (i.e., level 2 units). For example, simulations have indicated that variance components can be overestimated when examining data with fewer than a few hundred clusters and five observations per cluster (Clarke, 2008; McNeish, 2014). For this reason, previous studies have suggested the use of GEEs for sparse clustered data (Bell et al., 2008; Hox & McNeish, 2020; McNeish, 2014). Briefly, GEEs are similar to MLMs in that they estimate pooled regression equations but differ since they rely only on the population-level equation and account for dependency in repeated measures through the specification of a residual correlation structure and, ultimately, averaging over random effects. This procedure does not directly estimate random effects, but the resulting coefficients and standard errors are properly adjusted for the clustered nature of the data. In addition, GEEs have been found to be accurate and efficient when examining a variety of outcomes, including continuous, binary, and count measures (McNeish, 2014). McNeish (2014), therefore, suggested that GEEs be employed over MLMs in situations when 1) data are clustered, 2) regression coefficients (rather than random effects) are of primary interest, and 3) data are sparse.

The current study meets all these criteria. The employed data are clustered as the examined mental health outcomes were assessed during waves 1 and 3 of the study. Furthermore, the critical incident exposure periods, and many of the key control measures, are also organized into two observation periods. The primary objective of the current study is to examine the impact of accumulated critical incident exposures on the development of mental health outcomes among correctional officers, providing direct emphasis on coefficients rather than random effects. Finally, the data are sparse, in that the key independent (i.e., accumulated critical incident exposures) and dependent variables (i.e., mental health measures) are measured at only two occasions, resulting in a limited number of observations per cluster (i.e., officer). Based on these observations, GEEs seem particularly well suited for the current study.

A total of three sets of GEEs were estimated for the primary analysis. The first was a baseline set of models in which each examined mental health measure (i.e., PTSD, depression, and anxiety) was individually regressed on the WCIE and controls. The examined outcomes were continuous and approximately normally distributed. Accordingly, all models were estimated using an identity link function. The results of these models provide a more intuitive understanding of the underlying association between the accumulation of critical incident exposure and mental health problems. Second, to examine the potential contribution of accumulated critical incident exposure on the development of mental health diagnoses, the previous models were estimated a second time but rather than examining an index of mental health symptoms, binary indicators of mental

health diagnoses are examined. To better accommodate these binary outcome measures, all models were estimated using a logit link function. Finally, the primary objective of the current study is focused on the impact of accumulated critical incident exposure, but the longitudinal nature of the data also allows for the examination of within-individual changes in accumulated exposures. The third set of GEEs were aimed at examining the extent to which within-individual changes in critical incident exposures between the two observation periods resulted in mental health problems. To isolate within-individual changes in critical incident exposures, the accumulated critical incident exposure measures were group mean centered (Singer & Willett, 2003) and the examined mental health outcomes were then regressed on these mean-centered terms along with all covariates. As with the first set of models examining the mental health outcomes, an identity link function was employed.

All analyses were performed in Stata 17 (StataCorp, 2021). All three sets of GEEs were estimated with all control variables and an exchangeable residual correlation structure.⁵ To facilitate ease of interpretation, the WCIE and mental health measures (with the exception of binary mental health diagnostic measures) were z-transformed prior to the estimation of the GEEs. Finally, to more closely investigate the resiliency-fatigue hypothesis, the predicted values from each GEE were calculated with all covariates held to their means and then plotted with accompanying 95 percent confidence intervals. All model coefficients and accompanying 95 percent confidence intervals are presented in the [online supporting information](#).

7 | RESULTS

7.1 | Weighted cumulative exposure index estimation

The first step of the analysis involved the estimation of a series of linear mixed-effects models specified in equation 3 and aimed at identifying the weight function used to calculate a WCIE for each measurement occasion (i.e., prior to wave 1 and between waves 1 and 3). The first set of models examined critical incident exposures that occurred prior to wave 1 (see figure 1). A series of equidistant knots were used to represent the resulting linear combination of splines (Sylvestre & Abrahamowicz, 2009; Wagner et al., 2021). Since the spline function is estimated directly from the data, the most appropriate number of knots is unknown. To avoid model overfitting but maintain optimal model flexibility, a series of linear mixed effects models with a varying number of knots—ranging between three and five—were estimated and then compared using the AIC and LRTs.

The summarized results from the estimated models are presented in table 2, with the first set of columns corresponding to the models examining the timeframe prior to wave 1. As can be seen in the table, the AIC increased as the number of knots increased. The results of the LRTs, however, indicated that the additional model constraint of moving from five knots to four knots did not significantly improve overall fit ($X^2(2) = .01, p = .982$). Similarly, the added constraint of moving from five to three knots resulted in a nonsignificant improvement in fit ($X^2(2) = .01, p = .982$). These findings indicate that even though the addition of model constraints via fewer knots may result in a reduced AIC, the improvement was nonsignificant. Therefore, in the interest of model parsimony, the linear mixed model for the study occasion before wave 1 was estimated as a

⁵ Because the data only include two occasions per participant, an exchangeable correlation structure would be synonymous with an unstructured structure, which freely estimates correlations over time (Muth et al., 2016).

TABLE 2 Weighted cumulative index of exposure model fit.

Statistic	Before Wave 1			During Study Period		
	3 Knots	4 Knots	5 Knots	3 Knots	4 Knots	5 Knots
Log-likelihood	−237,546.036	−237,551.296	−237,551.278	−265,355.048	−265,353.875	−265,347.788
AIC	475,106.071	475,120.593	475,124.557	530,724.096	530,725.751	530,715.576
N	142,598	142,598	142,598	177,297	177,297	177,297
Likelihood Ratio						
Test	$X^2(df)$	P-Value		$X^2(df)$	P-Value	
5 knots vs. 3 knots	−10.49(4)	1.000		14.52(3)	.002	
5 knots vs. 4 knots	.01(2)	.982		12.17(1)	.001	
4 knots vs. 3 knots	−10.52(2)	1.000		2.34(2)	.310	

Note. Results from linear mixed-effects models are presented. Models compare fit for time modeled as a basis of cubic regression splines with three, four, or five equidistant knots. Models were compared using Akaike Information Criteria (AIC) and likelihood ratio tests (LRTs).

basis of cubic splines with five knots (using equation 3). Once the weight function was specified, equation 1 was used to calculate the WCIE for the period prior to wave 1.

The second set of columns in table 2 present the results from a similar set of linear mixed-effects models but reflect critical incident exposures that occurred between waves 1 and 3. The results indicate that the AIC increased within more restricted models (i.e., as the number of included knots decreased). The results of LRTs, however, indicated that the added constraint of moving from five to four ($X^2(1) = 12.17, p = .001$) or three ($X^2(3) = 14.52, p = .002$) knots significantly improved overall fit, whereas constraining the four-knot model to only three knots significantly worsened fit ($X^2(1) = 2.34, p = .310$). These findings suggest that the four-knot model provided the most parsimonious fit and, therefore, was used to estimate the weight function using equation 3. Once the weight function was specified, equation 1 was used to calculate the WCIE for each participant for the period between waves 1 and 3.

7.2 | Critical incident exposure accumulation and mental health outcomes

The analysis here involved the estimation of a series of GEEs aimed at examining the underlying association between critical incident exposure (i.e., the WCIE scores calculated in the previous step) and mental health outcomes. The first set of models examined the association between the accumulation of critical incident exposure and the three mental health measures. The results of the estimated models are presented as predicted values in figure 2, with the accompanying coefficients and 95 percent confidence intervals presented in table S5 of the online supporting information.

For the GEE model examining the association between critical incident exposure accumulation and PTSD, a significant association was found ($b = .086$; 95 percent CI [.026, .146]), such that each standard deviation increase in accumulated critical incident exposure resulted in an approximately .09 standard deviation unit increase in PTSD symptoms. The results also indicated that officers at site 2 experienced significantly greater levels of PTSD symptoms relative to officers working at site 1 ($b = -.453$; 95 percent CI [−.816, −.089]) and site 3 ($b = -.493$; 95 percent CI [−.889, −.097]). In addition, officers with more service time ($b = .023$; 95 percent CI [.006, .039]), who were

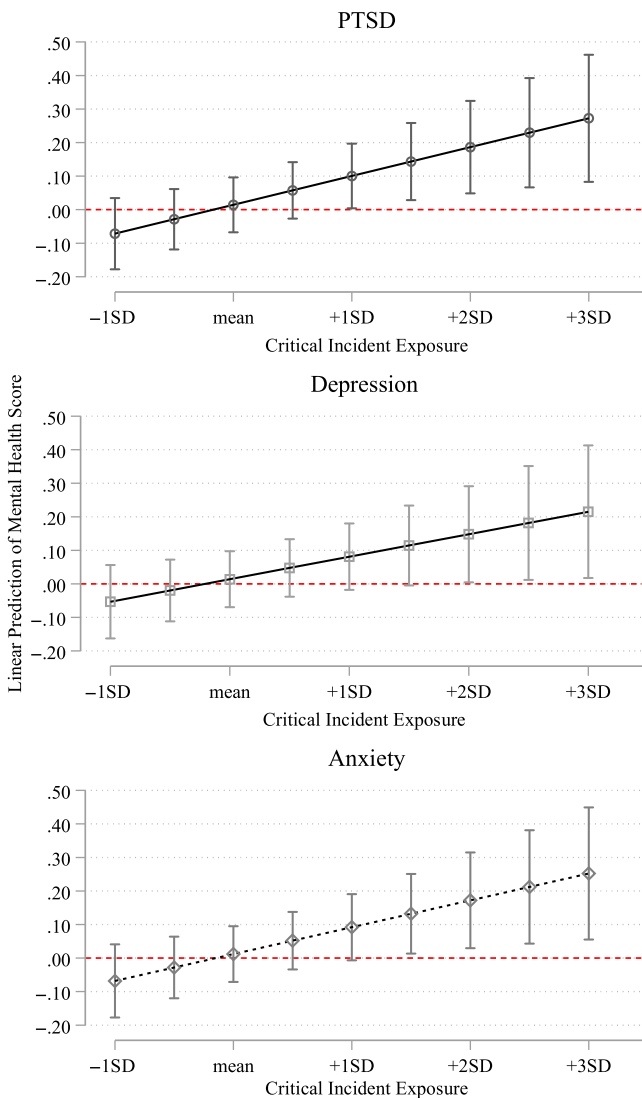


FIGURE 2 Predicted mental health scores across critical incident exposure accumulation.

Note. Predicted values from generalized estimating equation (GEE) models. Models were estimated with an identity link function and an exchangeable residual correlation structure to account for measurement occasions nested within individuals. Point estimates represent standardized regression coefficients and are presented with accompanying 95 percent confidence intervals (represented as error bars). All controls were included in the estimated model and were held to their means when calculating the presented predicted values. Critical incident exposure accumulation is measured using a weighted cumulative index of exposure (WCIE). The full results, including regression coefficients and corresponding 95 percent intervals for all measures included in the estimated models, are presented in the [online supporting information](#). PTSD = posttraumatic stress disorder. $N = 775$; $N_{\text{groups}} = 444$. [Color figure can be viewed at [wileyonlinelibrary.com](#)]

younger ($b = -.017$; 95 percent CI $[-.027, -.006]$), and who identified as female (relative to male, $b = -.240$; 95 percent CI $[-.433, -.048]$) also experienced significantly greater PTSD symptoms.

To more closely examine the hypothesized relationship between critical incidents and mental health, as well as evidence of the resiliency-fatigue hypothesis, predicted PTSD scores from the estimated GEE are presented in the top panel of figure 2. The predicted values were calculated with all model covariates held at their means. Since the WCIE and PTSD measures were z -transformed prior to the estimation of the GEE, the corresponding predicted values presented in the figure can be interpreted in line with standardized regression coefficients. The predicted values reflect the linear and positive association between the WCIE and PTSD as indicated above. As revealed by a closer examination of the predicted values of PTSD across levels of critical incident exposure accumulation, however, the association is not statistically significant (as evidenced by 95 percent confidence intervals that include zero) until exposure accumulation reaches approximately 1 standard deviation above the mean (predicted value = .100; 95 percent CI $[.004, .197]$). Despite the linear nature of this association, the presented pattern of results can be interpreted

in line with a threshold effect as the association is only statistically significant once accumulated critical incident exposure exceeds an inflection point.

The next estimated GEE model examined the association between the accumulation of critical incident exposure and depressive symptoms across the two observation periods. The results, which are presented in table S5 of the [online supporting information](#), revealed a positive and significant association, such that each standard deviation increase in accumulated critical incident exposure resulted in a .067 standard deviation increase in depression symptoms ($b = .067$; 95 percent CI [.004, .130]). Once again, to further investigate the resiliency-fatigue hypothesis, the predicted values of the depression measure were plotted across levels of accumulated critical incident exposure with the results presented in the second panel of figure 2. The predicted values point to a threshold effect in which the potential impact on depressive symptoms becomes statistically significant only once accumulated critical incident exposure surpasses two standard deviations above the mean (predicted value = .148; 95 percent CI [.005, .291]).

Finally, another GEE model was estimated to examine the association between accumulated critical incident exposure and anxiety symptoms. The results, presented in table S5 in the [online supporting information](#), suggest a positive and significant association, one in which each standard deviation increase in accumulated critical incident exposure resulted in a .080 standard deviation unit increase in anxiety symptoms ($b = .080$; 95 percent CI [.018, .143]). Here, again, to examine the resiliency-fatigue hypothesis, the predicted values of anxiety symptoms were plotted across levels of accumulated critical incident exposure, with the results presented in the third panel of figure 2. As shown, once critical incident exposure surpasses approximately 1.5 standard deviations above the mean, the association becomes statistically significant (predicted value = .132; 95 percent CI [.013, .251]).

7.3 | Critical incident exposure accumulation and mental health diagnoses

The next set of GEE models examined the association between the accumulation of critical incident exposures and mental health diagnoses. We examined measures of mental health symptoms above; here, we focus on binary codings that indicate diagnoses. The first estimated model examined the association between the accumulation of critical incident exposure and meeting the diagnostic criteria for PTSD, with the result presented in table S6 of the [online supporting information](#). The results revealed a positive and significant association, such that a 1 standard deviation increase in the accumulation of critical incident exposure resulted in an 18 percent increase in meeting the diagnostic criteria for PTSD (odds ratio [OR] = 1.181 [i.e., $e^{.166}$]; 95 percent CI [1.016, 1.372]). To examine this association more closely, figure 3 presents the predicted probabilities of PTSD diagnosis across levels of accumulated critical incident exposure. As can be seen in the figure, the probability of PTSD diagnosis increases as the accumulated exposure increases. The probability of diagnosis exceeds 40 percent as accumulated exposures surpass 1 standard deviation above the mean and continues to increase thereafter.

The next GEE model examined the association between accumulated critical incident exposure and depression diagnosis, with the results presented in table S6 of the [online supporting information](#). Again, the results revealed a positive and significant association in which each 1 standard deviation increase in accumulated critical incident exposure resulted in an approximately 18 percent increase in the odds of meeting the diagnostic criteria for depression ($OR = 1.179$; 95 percent CI [1.013, 1.372]). The predicted probability of depression diagnosis is plotted across levels of accumulated critical incident exposure in figure 3, where the probability of diagnosis is approximately

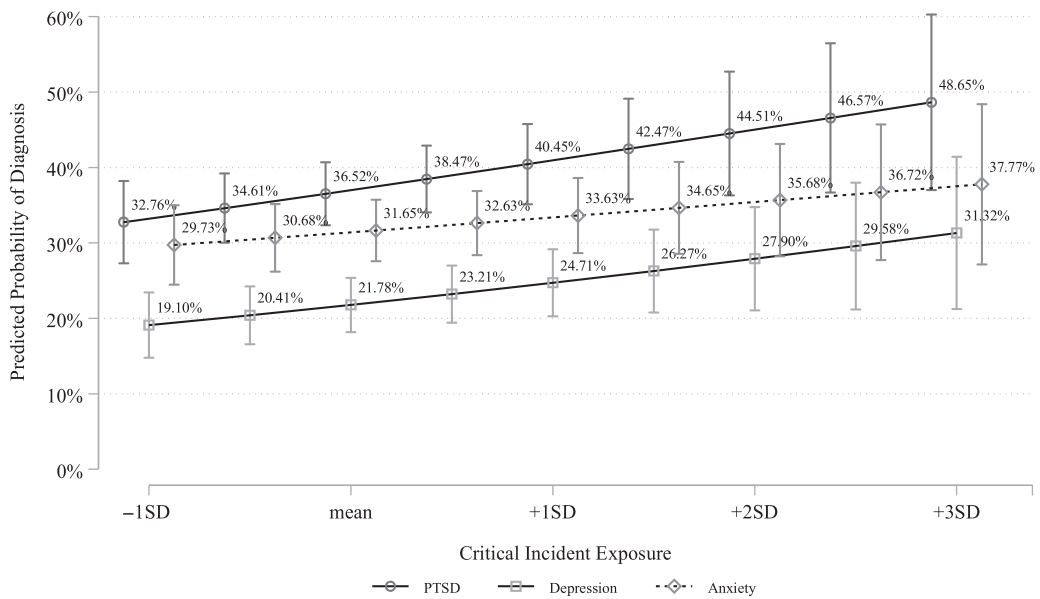


FIGURE 3 Predicted probability of mental health diagnoses across accumulated critical incident exposure. *Note.* Predicted probabilities from generalized estimating equation (GEE) models presented. Models were estimated with a logit link function and an exchangeable residual correlation structure to account for measurement occasions nested within individuals. Point estimates and accompanying 95 percent confidence intervals (represented as error bars) have been converted from probabilities to percentages to ease interpretation. All controls were included in the corresponding mixed model and were held to their means when calculating the presented predicted values. Critical incident exposure accumulation is measured using a weighted cumulative index of exposure (WCIE). The full results, including regression coefficients and corresponding 95 percent intervals for all measures included in the estimated models, are presented in the [online supporting information](#). PTSD = posttraumatic stress disorder. $N = 775$; $N_{\text{groups}} = 444$.

25 percent when accumulated critical incident exposure is 1 standard deviation above the mean and continues to increase as exposures continue to accumulate.

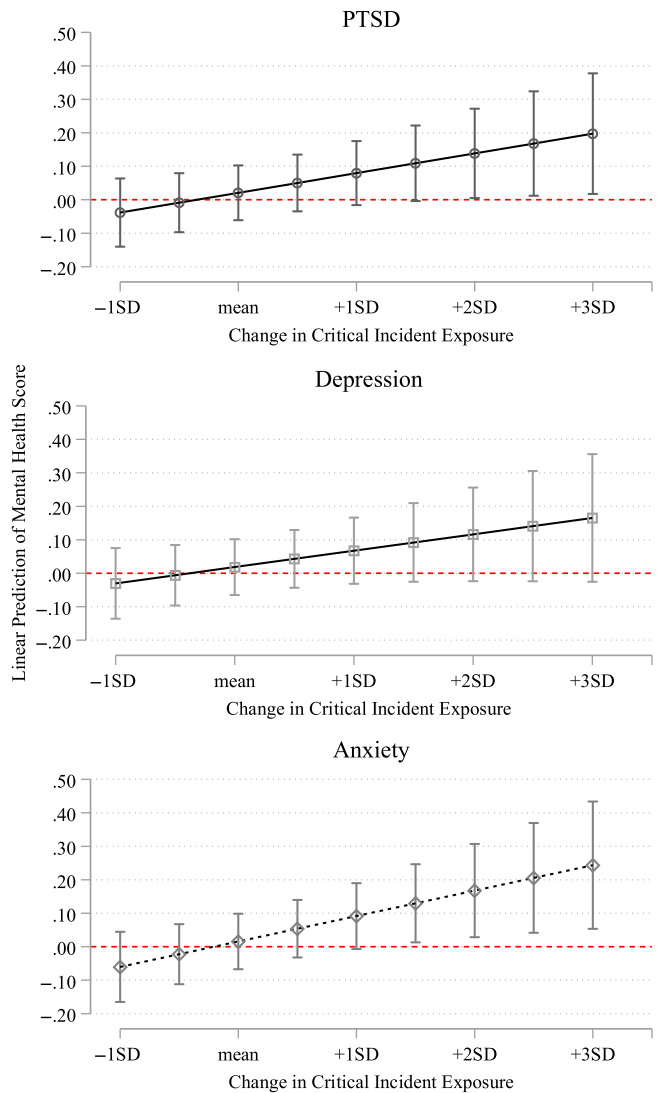
The last model examined the association between accumulated critical incident exposure and anxiety diagnosis. The results are presented in table S6 of the online supporting information and reveal a positive but nonsignificant association ($OR = 1.095$; 95 percent CI [.947, 1.265]). Despite these nonsignificant results, the predicted probability of anxiety diagnosis is still plotted across levels of accumulated critical incident exposure in figure 3 for reference and reveals that the probability of diagnosis exceeds 33 percent when the accumulated exposure is 1 standard deviation above the mean, and it increases as exposures increase.

7.4 | Within-individual changes in critical incident exposure accumulation and mental health outcomes

The third set of GEE models were aimed at better isolating the impact of short-term, rapid increases in critical incident exposures by examining within-individual changes in exposure accumulation between the two observation periods by group mean centering the included WCIE term.

FIGURE 4 Predicted mental health scores across changes in critical incident exposure.

Note. Results from generalized estimating equation (GEE) models presented. Models were estimated with an identity link function and an exchangeable residual correlation structure to account for measurement occasions nested within individuals. Point estimates represent standardized regression coefficients and are presented with accompanying 95 percent confidence intervals (represented as error bars). All controls were included in estimated model and were held to their means when calculating predicted values. Critical incident exposure accumulation is measured using a weighted cumulative index of exposure (WCIE). The WCIE was group mean centered to reflect within-individual changes in critical incident exposure accumulation. The full results, including regression coefficients and corresponding 95 percent intervals for all measures included in the estimated models, are presented in the online supporting information. PTSD = posttraumatic stress disorder. $N = 775$; $N_{\text{groups}} = 444$. [Color figure can be viewed at wileyonlinelibrary.com]



The first model examined the association between within-individual changes in accumulated critical incident exposure and PTSD symptoms, with the results presented in table S7 of the online supporting information. The overall effect was attenuated relative to the model that did not consider within-individual changes but remained positive and significant ($b = .059$; 95 percent CI [.004, .114]). Each standard deviation increase in the accumulated exposure to critical incidents resulted in a .06 standard deviation increase in PTSD symptoms. Once again, the predicted values of PTSD symptoms were also plotted across levels of accumulated exposures, with the results presented in figure 4. The association remains nonsignificant until the overall change in accumulated critical incident exposure exceeds 2 standard deviations (predicted value = .139; 95 percent CI [.005, .271]) and then continues to increase.

The next model examined the association between within-individual changes in accumulated critical incident exposure and depression symptoms, with the results also presented in table S7. The association between within-individual changes in the WCIE and depression symptoms was nonsignificant ($b = .049$, 95 percent [-.010, .108]). This pattern was also observed when examining

the predicted values of depression symptoms plotted across levels of within-individual changes in critical incident exposure accumulation, which are presented in the second panel of figure 4. The association between within-individual changes in the WCIE and depression symptoms was non-significant across all presented levels of exposure (as evidenced by 95 percent confidence intervals that include zero across all levels of exposure).

The third and final GEE model examined the association between within-individual changes in accumulated critical incident exposure and anxiety symptoms, with the results presented in table S7. A positive and statistically significant association surfaced; each standard deviation increase in within-individual changes in accumulated critical incident exposure resulted in an estimated .08 standard deviation increase in anxiety symptoms ($b = .076$, 95 percent CI [.017, .135]). The predicted values of anxiety symptoms were plotted in the bottom panel of figure 4 to examine potential threshold effects more closely. The association is nonsignificant until within-individual changes in the WCIE surpasses 1.5 standard deviations above the mean (predicted value = .130, 95 percent CI [.013, .247]), at which point the association is statistically significant and continues to increase in magnitude as changes in exposure accumulate.

7.5 | Supplemental analyses

Four sets supplemental models were also estimated. First, to examine the potential impact of violent critical incident exposures more closely, the WCIE was recalculated such that the weight term reflected the timing of each exposure (as in the primary analysis) and the *daily proportion of all violent exposures* (for a list of infractions coded as violent, see table S1 in the online supporting information). Additional GEE models examining the association between this alternative WCIE and the examined mental health outcomes were estimated with the results presented in table S8. Only the association between the violence weighted WCIE and PTSD was significant ($b = .069$; 95 percent CI [.003, .135]). This result is somewhat expected as violent trauma exposure has been found to be an important risk factor for PTSD among COs (see, e.g., St. Louis et al., 2023).

To further explore the potential role of violent critical incident exposure, the second set of supplemental models estimated the WCIE using the same weight term as in the primary analysis but was limited only to violent incidents. The results of GEE models examining the association between the violence-only WCIE and the examined mental health outcomes are presented in table S9. As shown in the table, the resulting associations between the violence-only WCIE and all three mental health outcomes were nonsignificant.

The third set of supplemental models were aimed at isolating the impact of accumulated incidents with a primary level of involvement. As a result, the WCIE was recalculated using only incidents in which COs were coded at a primary level of involvement. The weight term was still included but limited to exposure timing. The results are presented in table S10 and closely resemble those from the primary analysis in that as incident exposure accumulation increased, both PTSD ($b = .071$; 95 percent CI [.001, .142]) and depression ($b = .077$; 95 percent CI [.003, .150]) symptoms significantly increased. Although the association between the modified WCIE and anxiety symptoms remained positive, however, it was not significant ($b = .069$; 95 percent CI [−.004, .142]).

The fourth set of supplemental models were aimed at examining whether associations between accumulated critical incident exposures and the examined mental health outcomes systematically vary across years of service. This analysis is aimed at better understanding the combined impact of short-term, rapid exposure accumulation and the long-term, general accumulation of exposures. GEEs in which the examined mental health measures were regressed on the WCIE weighted by

exposure timing and exposure intensity (i.e., the first set of GEE models from the primary analysis) were estimated a second time but also included an interaction term between the WCIE and service time. The results are presented in table S11 and revealed a significant moderating effect for both PTSD ($b = .012$; 95 percent CI [.003, .022]) and depression ($b = .012$; 95 percent CI [.002, .022]) but not anxiety ($b = .018$; 95 percent CI [−.104, .140]). The marginal effects of the WCIE on each mental health outcome were also plotted across levels of service time (with all other covariates held to their means) in figure S1. To further investigate whether other officer characteristics may be contributing to this finding, a negative binomial model was estimated in which the overall count of critical incident exposures for the second observation period (i.e., between waves 1 and 3) was regressed on officer service time, officer age, and officer supervisor status (all measured at wave 1). The results are presented in table S12 and indicate that service time and officer age were not significantly associated with the overall count of critical incidents experienced. Supervisors, however, were more likely to experience critical incidents compared with their counterparts (incident rate ratio [IRR] = 1.879; 95 percent CI [1.286, 2.746]).

Collectively, these findings indicate that general or expected accumulations can further exacerbate the impact of short-term, rapid critical incident exposure accumulations on mental health problems. Furthermore, they suggest that senior officers, perhaps supervisors in particular, are more likely to experience resiliency fatigue when faced with a short-term increase in accumulated critical incident exposures, resulting in an enhanced risk of developing mental health problems.

8 | DISCUSSION

COs are deeply connected to the larger prison environment; both influencing and being influenced by it. Research, however, has yet to systematically investigate whether CO exposure to work-related critical incidents—a core feature of working in contemporary prisons—contributes to the development of mental health problems. Scholarship to date has suggested that officers may display resilience when faced with some occupational stressors (Conover, 2001; Crawley, 2004; Liebling et al., 2011; Schoenfeld & Everly, 2023). The short-term, rapid accumulation of exposure to extreme work-related challenges and violence, however, may eventually surpass a given threshold or inflection point, eventually resulting in resiliency fatigue. Against this backdrop, the objectives of the current study were twofold. Relying on a combination of self-report and administrative data, we investigated the association between critical incident exposure accumulation and mental health problems among COs. In addition, we tested whether mental health symptoms increase as critical incident exposures continue to accumulate. Two key findings emerged from the analyses.

First, we found that as critical incident exposures accumulated, PTSD, depression, and anxiety symptoms increased. A similar set of findings were observed for mental health diagnoses—officers who accumulated more critical incident exposures were more likely to meet the diagnostic criteria for PTSD and depression. These findings were further underscored by the results of models that isolated the impact of within-individual changes in the accumulation of critical incidents across the two study periods. As critical incident exposure accumulation increased from one observation period to the next, PTSD and anxiety symptoms also increased.

These findings align with previous research findings indicating that COs have different risks of experiencing mental health problems (Brower, 2013; Denhof & Spinaris, 2013; James & Todak, 2018; Regehr et al., 2019; Spinaris et al., 2012), but they also extend this work by identifying the greater impact of accumulated exposure to critical incidents inherent to prison work. Some

research has found that work-related stressors can contribute to mental health problems among COs (Bourbonnais et al., 2007; Ghaddar et al., 2008; Morgan, 2009; Obidoa et al., 2011), and previous studies have documented the impact of chronic and traumatic stressor exposure on mental health problems in other populations differentially exposed to violence (Cain et al., 2016; Hartley et al., 2013; Meade et al., 2017; Meade & Steiner, 2013; Steiner & Meade, 2016). The current study, to our knowledge, is the first to isolate the impact of critical incident exposure accumulation on CO mental health.

Despite the observed impact of critical incident exposure accumulation on increased levels of mental health symptoms, increased accumulations did not result in a significant increase in meeting the clinical diagnostic criteria for anxiety disorder. This result was unexpected given the observed positive association between critical incident exposure accumulation and anxiety symptoms. One explanation may be the anxiety measure employed. The study relied on the PROMIS-Anxiety scale, which has been validated in a variety of samples (Cella et al., 2010; Hadlandsmyth et al., 2020), including groups differentially exposed to violence and trauma (Schalet et al., 2016). This measure, however, was not originally intended for use as a diagnostic tool (Pilkonis et al., 2011). For this reason, future research would benefit from further investigating whether this pattern of results persists when employing clinical diagnoses.

Similarly, within-individual changes in critical incident exposure accumulation also did not result in increased depressive symptoms. Although this finding, too, was unexpected, it raises an intriguing possibility. Evidence indicates that depressive episodes can persist for an extended amount of time, with some studies reporting an average length of approximately 4 months (Patten & Lee, 2004). Furthermore, supportive environments—including those that afford increased levels of social support—may result in shorter depression duration (Nolen-Hoeksema & Davis, 1999). By contrast, prison settings are likely to entail persistent reinforcement of negative, and perhaps even traumatic, experiences, as well as offer limited support (Cullen et al., 1985; Lambert et al., 2007; Schaufeli & Peeters, 2000). The end result may be depressive episodes that persist for longer periods, resulting in little-to-no change in symptoms for an extended amount of time. Research is needed that investigates this possibility more directly.

The supplemental analyses (provided in the online supporting information) also produced findings that directly relate to the impact of accumulated critical incident exposures and mental health problems. They revealed that the accumulation of critical incident exposures in general, relative to violent exposures more specifically, exert a more consistent negative impact on the examined mental health outcomes. These findings seem to align with those from prior studies, which identify a wide variety of work-related challenges and stressors—not just violent or traumatic exposures—as the primary sources of mental health problems (Carleton et al., 2019; Ricciardelli & Power, 2020).

In addition, even though incidents in which officers are most directly involved play an important role in the development of mental health problems, incidents in which officers are indirectly or tangentially exposed may influence mental health as well. Importantly, these findings align with a recent study by St. Louis and colleagues (2023) who found that both direct and indirect exposures (measured via self-report) to violent incidents were associated with deleterious outcomes among COs. In light of these observations, future research would benefit from evaluating the potential impact of a wide variety of critical incident exposures, as well as varying levels of exposure intensity. Such research would help illuminate how various types of exposures may impact officers' well-being, their perceptions, and their interactions with incarcerated individuals during the course of their careers.

The second finding from the study, which more directly focused on the resiliency-fatigue model, flowed from a closer examination of the predicted values of mental health symptoms across

increasingly accumulated levels of critical incident exposures. Pronounced threshold effects surfaced. When the accumulated exposures remained within a more expected and normative range (i.e., <1 standard deviation from the mean), officers displayed resiliency, preventing mental health symptoms from reaching problematic levels. When faced with a short-term, rapid accumulation of exposures, however, mental health symptoms increased. Although we could not directly test the mediating mechanism, this pattern may stem from fatigue and a corresponding decline in the ability to respond to the challenges of prison work. Although previous studies have implied the potential importance of such resiliency-fatigue thresholds (Denhof & Spinaris, 2013; Dollard & Winefield, 1998; Steiner & Wooldredge, 2015), such studies did not specify thresholds or inflection points directly. The results here reinforce that such thresholds may exist and provide general support for the resiliency-fatigue model.

Findings from the supplemental analysis have important implications for the resiliency-fatigue model as well. The association between accumulated critical incident exposures and mental health problems seems to be significantly moderated by service time. Although the observed threshold effects persist net of overall service time (and all other included controls), the association between critical incident exposure accumulation and mental health problems seems to increase in magnitude as service time increases (except for anxiety). Furthermore, supervisors were found to have greater exposure to critical incidents relative to nonsupervisory officers, but overall service time and officer age were not associated with increased exposures.

These results suggest that the negative impact of short-term, rapid critical incident exposure accumulations may be more problematic for officers with more years on the job, even if those officers are not necessarily exposed to more incidents, on average, than their counterparts. This pattern implies that lifetime accumulations of critical incident exposures may serve as an important source of vulnerability, resulting in more rapid resiliency fatigue or in a lower tolerance threshold for future exposures. In this way, resiliency fatigue thresholds may vary within individuals over time based on prior experiences and critical incident exposures. These observations, however, remain speculation and require attention from future studies.

Regardless of the underlying mechanisms driving this greater vulnerability among senior officers, this trend is troubling as it suggests that COs with more experience may also be more susceptible to burnout and leaving the force (Finney et al., 2013; Lambert et al., 2018; Schaufeli & Peeters, 2000), further exacerbating overall staffing shortages (Santo & Neff, 2020) and promoting less equitable and harsher correctional institutions (Blakinger et al., 2021; Griffin, 2002; Lambert, Barton-Bellessa, et al., 2015). Based on these observations, future research focused on more effectively mitigating the consequences of prolonged accumulation of occupational stressors among COs across levels of service time would not only advance scholarship on prison systems but also offer more direct benefits to officers, correctional institutions, and incarcerated individuals. Personnel are not the only contributors to institutional order and safety, but adverse effects of work experiences on officer mental health clearly poses a risk to prison systems. In addition to workforce attrition, there is the attendant need to rely on younger and inexperienced officers who may be less equipped and able to exercise control in ways that incarcerated individuals view as legitimate.

The present study is insufficient for determining what interventions are needed or, to the extent that they are, what types of interventions should be implemented. Should future studies identify similar patterns, however, it warrants emphasis that guidance from researchers exists. For example, programming and strategies aimed at managing the negative impact of prolonged stressor exposure have been examined and evaluated in other, related populations such as police officers and other first responders. Several of these programs and strategies, collectively termed “stress

management interventions" (SMIs), were summarized in a recent state-of-the-art review of the literature focused on CO stress (Schwartz et al., 2023). Programming aimed at fostering increased social support, and peer support programs in particular, have been found to promote better mental health outcomes and greater organizational commitment among police officers (Milliard, 2020). Previous research has also indicated that mindfulness-based resilience training can be effective in increasing resilience and mitigating the negative consequences of stress (Chin et al., 2019; Coffey et al., 2010), while promoting significant reductions in mental health problems and hostility among police officers (Chopko & Schwartz, 2013; Kelley & Lambert, 2012). Another promising avenue previously explored among police officers is posttraumatic growth, a phenomena in which the likelihood of stress-related problems after exposure to traumatic events is ultimately reduced (Tedeschi et al., 2018). Targeted institutional interventions or modifications are also expected to limit overall CO stress. Previous recommendations include better pay, more clearly articulated promotion criteria, targeted recruiting, and more stringent supervisor evaluations (Keinan & Malach-Pines, 2007). In addition, others have noted the importance of an active collaboration between administrators and officers with an ongoing and dynamic process that emphasizes data collection, observation, and ongoing modifications (Denhof et al., 2014). Collectively, these interventions are only a cross section of all those available, but they seem to be promising candidates for promoting stress-related resilience and minimizing the consequences of accumulated stressor exposure.

The results of the current study also highlight the need for the systematic and routine capture of information related to 1) the accumulation of critical incident exposures, 2) officers' perceived ability to effectively cope with a greater accumulation of exposures, and 3) officers' current mental health status and overall well-being. Such information, similar to the Prison Social Climate Survey collected annually by the Bureau of Prisons (U.S. Government Accountability Office, 2021), would be beneficial in 1) taking stock of the current state of officers and their ability to perform their jobs in an equitable and productive manner, 2) connecting officers in need with appropriate resources, and 3) formulating staffing decisions based on COs' current status and high-stress work assignments. Collecting better data, and effectively leveraging such data, will result in a more informed administration better equipped to identify current problems, as well as those that may become more problematic in the near future. Such data would also allow for a dynamic investigation of the effectiveness of interventions and programming aimed at improving CO coping strategies, as well as overall wellness.

Several limitations of the study warrant discussion and should be considered when interpreting the results. First, whether the findings extend to other populations of COs remains unknown. For example, the population of Minnesota is less racially diverse (i.e., 82.6 percent vs. 75.5 percent White), exhibits a lower poverty rate (9.6 percent vs. 11.5 percent), and lower incarceration rate (151.13 vs. 369.11 per 100,000 residents) than the U.S. average in 2022 (Carson & Kluckkew, 2023; U.S. Census Bureau, 2024). Therefore, different patterns might be identified with CO populations with different characteristics.

Second, the employed mental health measures have been previously validated (Blevins et al., 2015; Hadlandsmayth et al., 2020; Radloff, 1977), but they still rely on self-reported symptoms and may not capture mental health problems as accurately as alternative methods. Third, the current study focused on PTSD, depression, and anxiety, but previous studies have noted that COs also experience a range of additional mental health problems, including substance use issues and suicide ideation (Crawley, 2004; Ferdik & Smith, 2017; Finney et al., 2013; Lambert, 2001; Liebling et al., 2011; New Jersey Police Suicide Task Force, 2009). Future research would benefit from investigating such sources more thoroughly. Fourth, even though the current study relied on

longitudinal data, the observation periods span less than 2 years, which provides an incomplete snapshot of critical incident exposure accumulation.

Fifth, the current study draws from a sample of COs at various stages in their careers, resulting in variation in the overall accumulation of critical incidents experienced at the beginning of the observation periods. This limitation is especially important when considering the possibility of reverse causality.⁶ We attempted to address this issue in two ways. First, years of service was added as a control variable in all estimated models. As a result, any identified associations persist net of any effect of service time. Second, we isolated the overall impact of within-individual changes in the accumulation of critical incident exposures during the two observation periods on mental health outcomes via group mean-centered terms. Although these efforts likely addressed this issue to some degree, supplemental analyses revealed that the impact of accumulated critical incident exposure on PTSD and depression was greater among officers with more service time. Given these observations, a research design focused on following COs as they initially enter service from the academy, and with a longer observation period, would be helpful. Such a design would isolate the impact of critical incident exposure accumulation on changes in mental health problems during the first few years of service. As discussed in detail, however, identifying the potential sources of increased vulnerability among more senior officers is also an important objective for future research. Investigating that possibility more directly would require following a cohort for extended periods of time, involving substantial resources. Nevertheless, it would offer greater insights into the ways both general and rapid accumulations of critical incident exposures impact officer well-being.

Sixth, the current study focused on the impact of the accumulation of critical incident exposures, but other important sources of occupational stress among COs also likely exist, including those observed in previous studies, such as individual perceptions of job demands and insufficient job control, as well as forced overtime (The Marshall Project, 2023) and insufficient administrative support (Lambert et al., 2023). Additional research focused on all types of stressors, and how they interact, is needed. Seventh, the current study assessed critical incidents using administrative records (as opposed to self-reports), which, due to likely underreporting, represent an underestimate of the total number of incident exposures for each officer. For example, previous research has demonstrated that rule enforcement may be disincentivized through officer subculture (Haggerty & Bucerius, 2021), resulting in fewer reported incidents. Importantly, this limitation would lead to artificially deflated variation in the employed critical incident measures, resulting in inflated or overly conservative standard errors and an increased likelihood of a type II error. Given this possibility, supplementing administrative data with self-report data may result in larger effects and more robust associations than those reported here.

Finally, officers who displayed greater levels of mental health symptoms at wave 1 were more likely to drop out of the study. Few longitudinal studies examining COs currently exist (but see Jaegers et al., 2021). The impact of the examined mental health problems on attrition within the current study, however, seems to be smaller in magnitude than that reported in previous studies examining general population cohorts (de Graaf et al., 2000). Furthermore, these patterns of

⁶ To examine the possible presence of reverse causality more directly, a series of negative binomial regression models were estimated in which the total sum of all critical incident exposures from wave 1 through wave 3 were regressed on the examined mental health measures from wave 1. The results revealed nonsignificant associations for PTSD (IRR = 1.004, $p = .154$), depression (IRR = 1.007, $p = .483$), and anxiety (IRR = 1.003, $p = .607$). Collectively, these results indicate that mental health scores from wave 1 were not substantively or statistically significantly associated with the subsequent accumulation of critical incident exposures.

attrition would be expected to truncate overall variation in the examined outcomes and result in overly conservative standard errors. Here, again, future research is needed and may identify larger effect sizes and more robust associations than those reported in the current study.

This study investigated the impacts of prison work, and exposure to critical incidents in particular, on officer mental health. The results reveal that whereas officers seem able to navigate general, expected exposure to work-related stressors, as stressors continue to rapidly accumulate over a short period of time, they may eventually overwhelm officers and result in substantially increased levels of mental health problems. These findings provide preliminary support for a resiliency-fatigue model of officer adaptation. They highlight the consequential impact of prison work on officers and demonstrate the potential need to understand how such impacts may influence incarcerated persons and prison system effectiveness. Future research would benefit from the continued investigation of these possibilities and the identification of ways to better understand the interactive and dynamic nature of prison systems.

ORCID

Joseph A. Schwartz  <https://orcid.org/0000-0001-5777-0573>

Christopher A. Jodis  <https://orcid.org/0000-0002-8874-7226>

Daniel P. Mears  <https://orcid.org/0000-0001-8594-5350>

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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AUTHOR BIOGRAPHIES

Joseph A. Schwartz is an associate professor in the College of Criminology and Criminal Justice at Florida State University. His current work focuses on the long-term physical and mental health implications of chronic stress exposure, as well as on the role of traumatic brain injury in the development of behavior problems and health outcomes.

Bradon Valgarsdon is the Portfolio Initiatives Manager of Learning Initiatives in the Office of the Provost and Vice-President (Academic) at the University of Alberta. His research interests include biosocial criminology, adverse childhood experiences, and victimization.

Christopher A. Jodis is a PhD student in the College of Criminology and Criminal Justice at Florida State University. His research interests include biosocial and health criminology, social support, and research methods.

Daniel P. Mears is a distinguished professor in the College of Criminology and Criminal Justice at Florida State University. His research interests include theories of crime and punishment, juvenile and criminal justice policy, and systems approaches to understanding crime, punishment, and justice.

Benjamin Steiner was a professor in the School of Criminology and Criminal Justice at the University of Nebraska, Omaha. His research was focused on corrections and juvenile justice.