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Getting under the skin: Physiological stress and witnessing paternal arrest in young children with incarcerated fathers

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Abstract

U.S. jails see nearly 11 million annual admissions, rates that disproportionately affect men of color—more than half of whom are fathers. An estimated 7% of U.S. children experience the incarceration of a parent, increasing their risk for poor developmental and health outcomes. Although stress processes are often suggested as an underlying mechanism linking paternal incarceration to child well-being, few studies have examined such links. To study how witnessing a father's arrest prior to incarceration in jail relates to children's stress processes, we collected data on 123 individuals from 41 families with young children whose father was in jail, including collecting hair from 41 children, and analyzed their cumulative stress hormones, cortisol, and cortisone. Results indicate that children had higher cumulative stress hormone concentrations when they witnessed their father's arrest. Moreover, there was evidence of a blunted stress reaction in children who witnessed the arrest and who also had high levels of ongoing behavioral stress symptoms, similar to findings in Post-Traumatic Stress Disorder studies. Long-term exposure to stress can have deleterious effects on children's brain development, further increasing risk for developmental psychopathology. Findings have implications for criminal justice approaches that safeguard children during parental arrest.

KEYWORDS
arrest, child, cortisol, parental incarceration, stress

1 | INTRODUCTION

Children with incarcerated parents face numerous risks in their proximal and distal environments, contexts emphasized in bioecological models of development (Bronfenbrenner & Ceci, 1994). Although some proximal risks are general in nature (e.g., poverty and residential instability), other risks involve experiences directly related to the parent's criminal justice involvement, such as witnessing their arrest (e.g., Dallaire & Wilson, 2010). The emerging evidence for negative reactions to witnessing a parent's arrest is alarming given the growing number of children touched by parental criminal justice involvement and paternal incarceration in particular. Recent estimates show that between 5 and 8 million children (or 7% of all U.S. children) have ever had a resident parent go to jail or prison, rates that have increased 79% over the last three decades (Murphey & Cooper, 2015). The vast majority of incarceration occurs in jails (correctional facilities that are locally operated and hold individuals awaiting sentencing or those with a sentence of 1 year or less), with more than 10.7 million annual admissions in 2018 (Zeng, 2020). Incarcerated individuals are disproportionately young, low-income, men of color—over half of whom are fathers (Sawyer & Wagner, 2020). Indeed, about 65% of people in jail have minor children (Shanahan & Agudelo, 2012), many of whom are young (Murphey & Cooper, 2015). Children of color who come from households affected by poverty, too, are overrepresented in the population of those with fathers in jail, and they are likewise at increased risk for other adverse childhood experiences (Murphey & Cooper, 2015). In particular, young children with

incarcerated parents are more likely to experience adversity than similarly situated older children (Turney, 2014).

Pointedly, parental incarceration has been identified as a uniquely stressful experience that can be detrimental for childhood health and development (Turney, 2014). Exposure to certain incarceration-related events, such as witnessing parents' arrest, can be traumatic for children (Dallaire & Wilson, 2010). Although numerous scholars have cited stress processes as potential mechanisms of effect (e.g., Haskins & McCauley, 2019; Poehlmann-Tynan et al., 2020; Turney, 2018), no evidence to date in the literature on children with incarcerated parents documents how these events may "get under the skin" or influence children's physiological stress responses. By examining children's cortisol and cortisone concentrations after witnessing their fathers' arrest, and controlling for other potentially traumatic events such as witnessing the parent's crime or domestic violence, we can begin to identify underlying processes that help us understand the well-being of children with incarcerated fathers, while also considering practices that may protect children from such exposures.

1.1 | Background

1.1.1 | Paternal incarceration

Upon paternal arrest, detainment, and conviction, many households experience a decrease in financial stability due to loss of income (Schwartz-Soicher et al., 2011), are at heightened risk for involvement in other systems (Andersen & Wildeman, 2014), and face a host of hardships for children that extend beyond the father–child dyad (Geller et al., 2012). During the father's incarceration, families also take on added caregiving stress and responsibilities (Arditti, 2012), and even after an incarcerated father is released, father–child relationships remain altered through reduced co-residence, financial support, and joint activities (McKay et al., 2018). In short, separation from fathers due to incarceration can be a catalyst for disruption in children's lives.

When a father is incarcerated, their children are more likely to experience elevated externalizing and internalizing behavior problems (Geller et al., 2012), lower academic achievement (Turney & Haskins, 2014), and adverse childhood experiences (Murphey & Cooper, 2015) compared to children who have never experienced paternal incarceration. Additional hardships for children with incarcerated parents include residential instability (Muentner et al., 2019) and decreases in social support (Nesmith & Ruhland, 2008). Certainly, in instances of domestic violence, abuse, or neglect, the removal of a father from the home may have benefits that ameliorate risk (e.g., Wakefield & Wildeman, 2013; Wildeman, 2010), but overall, incarceration is more likely to harm than help children (Eddy and Poehlmann-Tynan, 2019). There is evidence to suggest that children's well-being remains impaired even after the father's release (Yaros et al., 2018) and extends into adulthood (e.g., Mears & Siennick, 2016). Although the evidence regarding negative implications of paternal incarceration on children's well-being are strong and other work has begun to identify family processes as mechanisms for these outcomes (e.g., Arditti & Savla, 2015; Besemer & Dennison, 2019), we are only beginning to understand how witnessing a parent's arrest may be a uniquely stressful experience for children.

1.1.2 | Parental arrest

Exposure to fathers' arrest, in particular, has received limited attention in the field examining the collateral consequences that incarceration has for children despite U.S. law enforcement carrying out approximately 12 million arrests each year (Harmon, 2016). Evidence from more general populations depict the complexities at play in these situations. For instance, police officers must navigate a number of fast paced decision-making processes that attend to the safety, protection, and cooperativeness of all individuals involved (Phillips & Sobol, 2010). The challenges herein may be exacerbated in instances of mental health crises (Wood & Watson, 2017), domestic violence (Johnson, 2010), and substance use (Swartz & Lurigio, 2007), for example. However, the distribution of these experiences is not equal. Black adults are arrested at rates seven times that of their White counterparts (Schleiden et al., 2020), and arrests involving Black and Hispanic individuals are 50% more likely to involve the use of force (Fryer, 2019). While no two arrests or interactions with law enforcement are the same, what holds true is how this initial phase of justice involvement can lead to the removal of an individual from the community, and in the case of some fathers, from children's lives.

Being present for paternal arrest may be particularly stressful for a young child, especially when law enforcement agencies do not have protocols in place that safeguard children during the arrest (Poehlmann-Tynan et al., 2020). Siegel (2011) describes the variation in how parental arrest procedures may play out differently for children dependent upon their presence, and even participation. In these situations, when law enforcement forcibly intruded into the home, visibly handcuffed and detained parents in the back of cars, and had no alternative caregiving placements, children were particularly distressed (Siegel, 2011). Though there is no systematic way of knowing how many U.S. children are present for their parents' arrest, it may not be all that uncommon. In fact, estimates indicate that between 22% and 41% of children who were involved with child protective services or had incarcerated parents saw their parents arrested and detained (Dallaire & Wilson, 2010; Phillips & Zhao, 2010). Witnessing this process can be particularly traumatic for children when it occurs suddenly or involves violence (Thurau, 2015). When children are exposed to the parent's arrest, and witness the parent being handcuffed and removed, they often feel frightened, distressed, or at fault, and some think that they will also be arrested (Poehlmann-Tynan et al., 2017; Puddefoot & Foster, 2007). Many of these children face immediate and long-term emotional, social, and health consequences, including sleep disruptions and irritability (Puddefoot & Foster, 2007), worry and anxiety (Phillips & Zhao,

2010), and behavior impairments (Roberts et al., 2014). Notably, children who witness a parent's arrest are also more likely to show signs of post-traumatic stress (Phillips & Zhao, 2010; Roberts et al., 2014), which has implications for their health and development (Poehlmann-Tynan et al., 2020). These findings suggest that exposure to paternal arrest is highly stressful, potentially altering children's physiological stress responses and influencing the ways in which their bodies can cope with stress and trauma, even long after the arrest occurs (Puddefoot & Foster, 2007).

1.1.3 | Physiological stress

The consequences of prolonged exposure to stress hormones in early childhood have implications for child psychopathology and health, and also brain development (Shonkoff et al., 2012). The glucocorticoid hormone cortisol and the cortisol metabolite cortisone are released by the neuroendocrine system when the body experiences stress. These indicators of hypothalamic–pituitary–adrenal (HPA) axis activity play a significant role in stress-related outcomes. Whereas acute physiological stress reactions reflect the body's normative adaptation to stressors, long-term changes under conditions of toxic stress are linked to elevated risk for physical and mental health problems (Loman & Gunnar, 2010). Toxic stress, defined as strong or prolonged activation of the body's system that manages stress, can be set in motion by chronic uncontrollable or unsupported negative events (i.e., trauma, such as witnessing a parent's arrest) (National Scientific Council on the Developing Child, 2005/2014). Toxic stress can have adverse impacts on developing brain architecture, especially when extreme events occur during early childhood, subsequently dysregulating brain circuits and stress response systems (McEwen, 2012). The behavior of the HPA axis in response to toxic stress can result in hypercortisolism or hypocortisolism (i.e., blunting) due to changes in the negative feedback system of the HPA axis, the latter of which has been shown in studies of Post-Traumatic Stress Disorder (PTSD) and chronic stress (Yehuda, 2001).

The implications of chronically high or blunted cortisol on young children's brain development are particularly concerning. Indeed, when under extreme and persistent stress, children can show either a prolonged elevation with little to no recovery to baseline or a blunted cortisol response to the stressor (Van Ryzin et al., 2009). For example, studies that examine stress markers on children living in poverty find that elevated cortisol contributes to poor executive function development and less optimal regulation of emotion and attention (Blair et al., 2011), thereby influencing activity in and development of brain structures and neural circuitry that are crucial for behavior, health, and development (Blair & Raver, 2016). Even still, studies of children who experience trauma (e.g., Harkness et al., 2011; Ouellet-Morin et al., 2011) and other life stressors (Pagliaccio et al., 2014) find trends for the negative effects of blunted glucocorticoid output. This has been found to be linked to lower memory function (Raffington et al., 2018), PTSD, and externalizing psychopathology (McLaughlin et al., 2016). The extent to which a child demonstrates elevated or blunted glucocorticoid levels may in fact depend upon exposure to traumatic events; indeed, as children experience more stressful events, their glucocorticoid levels rise, whereas those who experience both early and recent stressful contexts are more likely to show blunted responses (Jaffee et al., 2015). These findings contribute to calls for additional work examining how stressful experiences influence neurobehavioral development in children (Doom & Gunnar, 2013), specifically blunting effects (Gunnar & Vazquez, 2006) and ties to subjective distress (Miller et al., 2007).

Altered physiological stress responses can be measured in various ways (e.g., in blood, saliva, or urine) but capturing longer-term cortisol and cortisone secretion with these methods measures acute levels, which may be unstable and influenced by situations immediately prior. In contrast, using scalp hair to measure glucocorticoids is a reliable estimate of longer-term cortisol and cortisone output—particularly important when assessing prolonged and toxic stress, which, in the case of children with parents in jail, can also capture the time when their parents' arrest occurred. Indeed, hair cortisol and cortisone are established noninvasive measures of central HPA activity that represent cortisol and cortisone in the blood (Kapoor et al., 2018), reflecting months rather than hours of neuroendocrine activity. One mechanism of incorporation of glucocorticoids into the hair is by diffusion from circulation into the dividing hair follicle. The hormone is contained in the hair shaft and grows externally, indicating what was circulating in the body while the hair grew. The hair follicles are also able to synthesize cortisol, known as the peripheral HPA axis. This is thought to be a secondary mechanism of incorporation of cortisol into the hair and regulates responses to local stressors, including trauma (Ito et al., 2005). Thus, analysis of physiological stress response in hair cortisol is a reliable approach to studying basal HPA axis function and stress-reactive activity for previous months, evidenced by changes in stress levels following traumatic events (Stalder et al., 2017).

1.1.4 | Current study

Prior research has found that witnessing a parent's arrest prior to parental incarceration can interact with children's ongoing behavioral symptoms on their health and development (Poehlmann-Tynan et al., 2020; Roberts et al., 2014). Consistent with diathesis-stress models (Zuckerman, 1999), existing vulnerabilities can amplify the effects of new trauma exposure on child outcomes. In other words, adverse life experiences and the ways in which one copes with those challenges have implications for a child's psychopathology (Cicchetti & Toth, 1998; Lazarus, 1993). As discussed above, parental incarceration can be stressful for many children, but there is heterogeneity in children's responses to parental incarceration (Turney, 2017). On top of this, other potentially present environmental stressors, such as witnessing domestic violence or being present for parental criminal behavior, may also induce physiological stress responses for children in situations where an arrest may be at some point inevitable. To further explore this and parse out the influential role of witnessing

arrest, we examine children's ongoing behavioral symptoms of stress in addition to physiological measures of stress hormones.

As the first study to directly link witnessing a parent's arrest to glucocorticoid levels in children with incarcerated parents, we address four primary questions: (1) What proportion of young children in our sample witnessed their fathers' arrest and how distressing was this experience for them? (2) How does witnessing paternal arrest (and distress related to witnessing the arrest) relate to children's cumulative hair cortisol and cortisone levels? (3) When children's ongoing behavioral stress symptoms are high, is the relation between witnessing the father's arrest (and distress related to witnessing the arrest) and children's cumulative hair cortisol and cortisone strengthened? (4) Controlling for exposure to other potentially traumatic events, including witnessing the parent's crime and witnessing domestic violence at home, how does witnessing paternal arrest relate to physiological stress concentrations either directly or indirectly (i.e., in interaction with existing behavioral stress symptoms)? Children's age and race were entered as covariates in each analysis because of age-related sensitive periods of stress system development in children (Doom & Gunnar, 2013) and established links between racial discrimination and cortisol output (Korous et al., 2017).

2 | METHODS

2.1 | Participants

Data for this study come from a larger project with 165 incarcerated parents (both fathers and mothers), 86 caregivers, and 86 children (e.g., Muentner et al., 2019; Poehlmann-Tynan et al., 2017). Our subsample includes children who had a father in jail and hair cortisol and cortisone data (a proportion of children had missing data on these variables because their home visit occurred before hair data collection procedures were approved by the IRB, because they did not assent, or because they had shaved heads). Thus, data for this study come from a total of 123 individuals within 41 families: 41 jailed fathers, 41 children, and 41 at-home caregivers, as displayed in Table 1. All of the fathers identified as male and reported the following racial/ethnic backgrounds: 58.5% Black, 19.5% White, 4.9% Latino, and 17.1% multiple or other races. Incarcerated fathers ranged in age from 21 to 46 years (M = 31.76; SD = 6.53). Nearly half had a GED or high school diploma, with about one fifth not having a high school education. Half were employed prior to their current incarceration and had a mean annual income of just under $12,000. Fathers had an average of three children (SD = 1.85), and more than three quarters (n = 31) lived with the focal child before their current incarceration; the other fathers were engaged with the focal child and had lived with the child at some point. All but one father had been incarcerated before, and the average length of time in jail was slightly over 2 months (SD = 99.2 days). Jailed parents were incarcerated for disorderly conduct (34.1%), technical violations (19.5%), drug-related offense (17.1%), operating while intoxicated (12.2%), and unpaid child support (9.8%).

All of the caregivers in the sample were women who ranged in age from 20 to 53 years (M = 29.68; SD = 7.41), and the majority were the child's mother (n = 37, 90.2%). Nearly 80% of children's caregivers reported high school graduation or higher. More than half of the caregivers were employed, and most were receiving public assistance. Focal children ranged from 2 to 6 years of age, with an average of 3.76 years (SD = 1.31); children in this age range were chosen because it is among the most common age for children experience their first parental incarceration (Murphey & Cooper, 2015) and it is also a sensitive period for environmental influences on brain development (Shonkoff et al., 2012). Of the focal children 18 (43.9%) were boys and 23 (56.1%) were girls; 18 were Black, 8 White, 6 Latinx, and 9 were multiple or other races.

2.2 | Procedure

Three jails in three Midwestern counties participated, all of which were overseen by county sheriff's departments who had not implemented arrest protocols related to safeguarding children. Details about the jails can be found in Poehlmann-Tynan et al. (2017). Recruitment began with jail administrative staff identifying parents who had children between 2 and 6 years of age. Interested parents were screened to ensure they (1) were at least 18 years old, (2) had a child who lived in the same or adjacent county, (3) had retained legal rights to the child and had not committed a crime against the child, (4) had played a parenting role in some way prior to incarceration, (5) could understand and read English, and (6) had already been sentenced to or likely would serve jail (rather than prison) time. If the father had more than one child in the age range, one was randomly selected as the focal child. Incarcerated fathers who met inclusion criteria were invited to participate, consented, and interviewed in a private area within their cell block. Jailed fathers were not compensated for participation. Fathers signed release forms to contact the child's caregiver and consented to the focal child's participation.

Caregivers who consented were assessed at home by trained researchers in visits that lasted 2–3 hours. Researchers used stainless steel scissors to cut hair from four sampling areas on the scalp within the child's posterior vertex which displays the least variability in hair growth rate. Recognizing that approximately 1 cm of hair most proximal to the scalp represents, on average, about 1 month's growth (Stalder & Kirschbaum, 2012), up to 3 cm was measured, cut, and stored in aluminum foil at room temperature. The scissors were wiped with ethanol swabs before and immediately following to diminish cross contamination. Caregivers were paid $50 following the home visit, and children were given an age-appropriate book.

Hair samples were taken to the Wisconsin National Primate Research Center at the University of Wisconsin-Madison for analysis using a liquid chromatography-tandem mass spectrometry approach (Kapoor et al., 2014, 2016). Hair samples were placed into tubes and washed twice with 2-propanol, dried, and then ground into a powder. The hair was precisely weighed and placed into a glass culture tube and stored in the dark at room temperature until extraction. For extraction

TABLE 1 Demographic characteristics of the jailed fathers, caregivers, and children in the current study

	Jailed fathers (*n* = 41)		Caregivers (*n* = 41)		Children (*n* = 41)	
	M, *N*	Range (SD), %	*M*, *N*	Range (SD), %	*M*, *N*	Range (SD), %
Age	31.76	21–46 (6.53)	29.68	20–53 (7.42)	3.76	2–6 (1.31)
Gender						
Male	41	100%	—	—	18	43.9%
Female	—	—	41	100%	23	56.1%
Number of children[a]	3.21	1–10 (1.85)	2.63	0–15 (2.41)	—	—
Days of current sentence served[a]	61.56	6–600 (99.21)	—	—	—	—
Number of previous arrests[a]	11.29	0–50 (13.07)	—	—	—	—
Public assistance[a]	17	43.59%	39	95.12%	—	—
Employed[a]	22	56.41%	21	51.22%	—	—
Annual income (<$20,000)	31	75.61%	30	73.17%	—	—
Highest level of education[a]						
Less than high school	6	15.38%	9	21.95%	—	—
High school graduation (or equiv.)	15	38.46%	13	31.71%	—	—
More than high school	18	46.15%	19	46.34%	—	—
Race/ethnicity[a]						
White	7	17.95%	19	46.34%	8	19.51%
Black	23	58.97%	18	43.90%	18	43.90%
Latinx	2	5.13%	3	7.32%	6	14.63%
Other race(s)	7	17.95%	1	2.44%	9	21.95%
Marital status[a]						
Never married	28	71.79%	31	75.61%	—	—
Currently married	7	17.95%	5	12.20%	—	—
Legally separated	4	10.26%	4	9.76%	—	—
Divorced	4	10.26%	4	9.76%	—	—
Widowed	—	—	1	2.44%	—	—
Lived with child prior to jail time[a]	31	79.49%	—	—	—	—
Child witnessed arrest	—	—	—	—	11	26.8%
Child witnessed criminal activity	—	—	—	—	12	29.3%
Child witnessed domestic violence	—	—	—	—	16	39.0%
Hair cortisol	—	—	—	—	175.45	0.07–573.77 (224.41)
Hair cortisone	—	—	—	—	64.57	0.07–290.76 (74.61)

[a]Not all jailed fathers *n* values add to 41 because of missing data on *n* = 2 demographic surveys.

of steroid hormones from hair, methanol and internal standard were added to the tube of ground hair and incubated overnight. Following incubation, tubes were vortexed and centrifuged, the supernatant was removed and run through solid-phase, followed by liquid-phase extraction. The organic phase was placed in a clean test tube, evaporated to dryness, and then resuspended in mobile phase. All samples were analyzed using a QTRAP 5500 quadrupole linear ion trap mass spectrometer (Sciex). Chromatographic separation was performed using a Kinetex C18 column. All data were processed with Analyst software. Intra- and inter-assay coefficients of variation for this method are 4.3, 9.2, and 3.7, 11.3 for cortisol and cortisone, respectively.

The University of Wisconsin-Madison's Institutional Review Board approved the study, and a National Institutes of Health Certificate of Confidentiality was used.

2.3 | Measures

2.3.1 | Children's physiological stress responses

Cortisol and cortisone concentrations within children's scalp hair were analyzed as biomarkers of physiological stress response

over several months since the father's arrest (Stalder et al., 2012). Paternal arrest had occurred an average of 60 days before the hair collection but with much variability. Positive correlations between hair cortisol concentration and salivary cortisol have been validated in studies with humans as a method of physiological stress measurement (D'Anna-Hernandez et al., 2011). Sample hair weights ranged from 3.8 to 110.4 mg. Except for the smallest hair sample (3.8 mg), all other hair samples weighed over 5 mg (the smallest weight in which hormones are detectable in hair using mass spectrometry) and produced valid estimates of systemic cortisol and cortisone. Often, undetectable values are the result of hair sample weights below 5 mg; although in this study the samples weighed more than this threshold, seven cortisol values and two cortisone values of the hair samples contained hormone levels that were too low to be analyzed within a range of detection. In cases such as these, when undetectable values are present and hair sample weights exceed 5 mg, standard procedure with this method is to use the lowest detectable hormone value for each individual hair sample based on weight. Because cortisol and cortisone values tend to have skewed distributions (Stalder et al., 2012), we examined the distribution of the sum of standardized cortisol and cortisone in this sample. It was a skewed distribution, and a log transformation was attempted, but did not ameliorate the problem. Thus, we created six clusters that were nearly equal in size to represent combined cortisol and cortisone ranging from extremely low to extremely high, and we used this variable in analyses.

2.3.2 | Witnessing arrest and distress about the arrest

Both the incarcerated father and the caregiver reported on the child's experience with incarceration-related risks, based on Dallaire and Wilson (2010). These included whether the child witnessed the parent's arrest and crime, each coded "yes" (1) or "no" (0) and how much distress the child experienced because of witnessing each event (scale ranging from 0 = *not at all upsetting* to 5 = *extremely upsetting*). Children's exposure to incarceration-related risks was counted as "yes" if either adult reported it. In instances where just one of the adults reported on the child's distress, that value was used, otherwise the higher of the two values were used, as in Poehlmann-Tynan et al. (2020).

To represent both witnessing the event and distress about it, the witness arrest variable was combined with the distress variable: 0 = *did not witness the event*, 1 = *witnessed the event but no distress was reported*, and 2–8 = *witnessed the event and child distress ranged from mild to extreme distress*.

2.3.3 | Children's behavioral stress

To assess children's ongoing behavioral stress responses, caregivers completed the Child Behavior Checklist (CBCL, either Preschool or School-Age form; Achenbach & Rescorla, 2000). The CBCL is a standardized behavior rating completed by a parent or caregiver, with high internal consistency ranging from 0.93 to 0.94. Caregivers rated each child behavior on a scale of 0 (*not true*), 1 (*somewhat or sometimes true*), or 2 (*very true or often true*) in reference to the last 6 months, with higher scores indicating more problematic behaviors. We operationalize behavioral stress symptoms as the stress problems subscale (caregiver report of children's concentration, nausea, nervousness, stomach aches, stubbornness, mood changes, and sadness). *T*-scores for children's behavioral stress symptoms ranged from 50 to 96, with a mean of 59.21 (SD =12.03); however, raw scores were used in analyses.

2.4 | Plan of analysis

Figure 1 displays the approximate timing of data collection and the temporal ordering of key variables, as well as the moderator model that we tested. First, we report descriptive statistics about children witnessing their parent's arrest and crime. Second, we evaluate a moderation model using the PROCESS macro v3.5 (Hayes, 2017), executed in SPSS v.26. We evaluate the path from the predictor (children witnessing the father's arrest, X), to the outcome (hair cortisol and cortisone, Y), and test if the strength of the relation was altered by children's existing stress symptoms (W). The covariates in the model are child age and race (coded as Black = 1, not Black = 0); because there were no statistical differences in witnessing the arrest of a parent by child gender, we do not include this in our presented models. In the PROCESS macro, continuous variables used in the construction of interaction terms are mean centered and regression coefficients for all paths with continuous variables are estimated using ordinary least squares regression. Interactions significant below the $p < .05$ level are examined at multiple levels of the moderator and tested for significance. The macro generates 10,000 bootstrapped samples to calculate 95% bias-corrected confidence intervals. Third, we assess the model with additional covariates: child witnessed the father's crime and child witnessed domestic violence (coded 1 = *witnessed*, 0 = *did not witness*). Reported effects were characterized as small ($r = .10$), moderate ($r = .30$), or large ($r = .50$) using Cohen's benchmarks (Cohen, 1988).

A power analysis was conducted using G*Power 3. For a sample of 41 triads for multiple regression with four predictors, power was 0.92 to detect large effects, 0.82 to detect moderate effects, and 0.42 to detect small effects. Thus, the study was only adequately powered to detect moderate to large effects, the size documented in a previous study focusing on witnessing parental arrest in relation to child health and development (Poehlmann-Tynan et al., 2020).

3 | RESULTS

3.1 | Descriptive

In this sample of children age 2–6 years, 27% witnessed their father's arrest, 29% witnessed their father's crime, and 6 (15%) witnessed both the arrest and crime. Ratings of children's distress

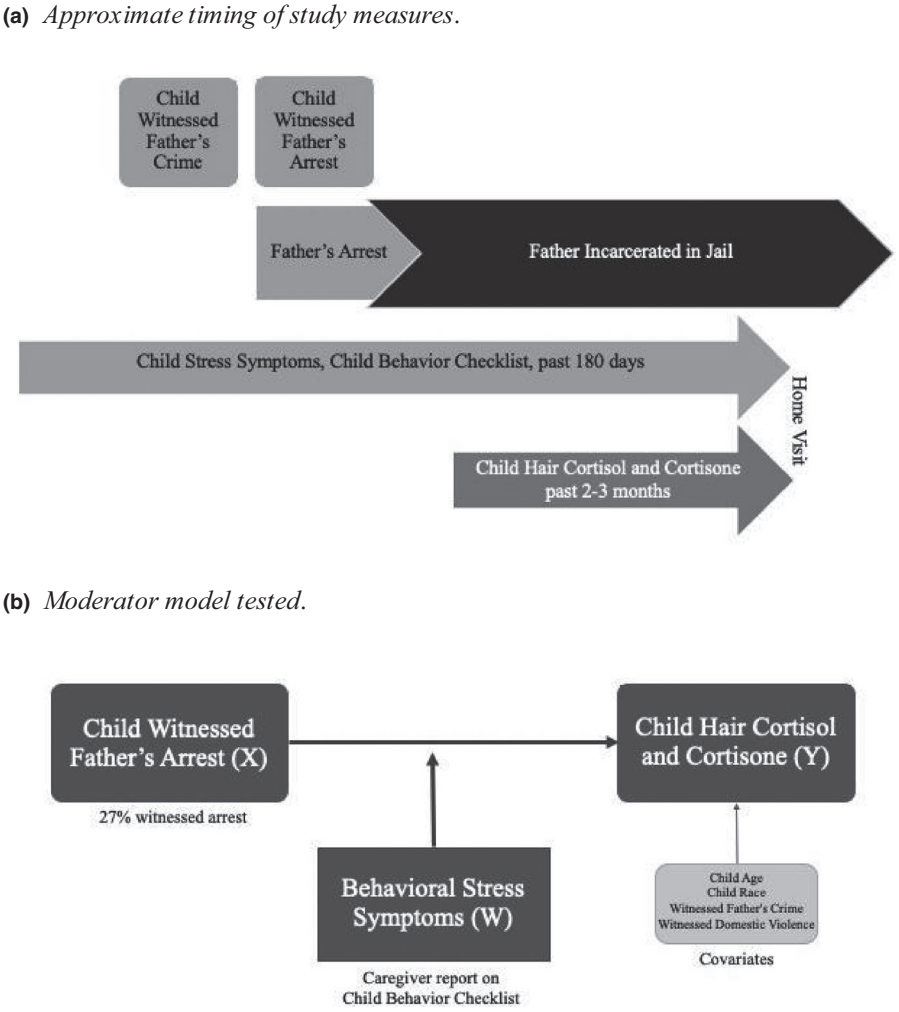

FIGURE 1 Study overview. (a) This panel overviews the temporal ordering of data collection and study measures. (b) This panel displays the conceptual model of the current study, examining how behavioral stress symptoms present before/throughout the arrest and incarceration may moderate children's physiological stress responses after witnessing the arrest, controlling for basic demographics and exposure to other potentially stressful events

when witnessing the father's arrest ranged from 1 to 5, with a mean of 4.09 (SD = 1.30), whereas ratings of distress when witnessing the father's crime ranged from 0 to 5, with a mean of 2.75 (SD = 2.01).

3.2 | Children witnessing their father's arrest in relation to child physiological stress

To assess this hypothesis, we conducted two analyses in PROCESS. In the first model, we used the binary witnessing the father's arrest variable as the key predictor, and in the second, we used the variable that combined witnessing the father's arrest and exhibiting distress about it as the key predictor (Table 2). In both models, there was a moderate effect size. The witnessing paternal arrest variable was statistically significant, as was the stress symptoms scale, with higher scores on each variable associated with higher cortisol and cortisone. In addition, the interaction between stress symptoms and witnessing the father's arrest was significant, supporting a moderator interpretation. Tests of the interaction indicated that at low, moderate, and high levels of the moderator, witnessing the father's arrest was statistically significant. At low and moderate levels of stress symptoms, witnessing the father's arrest was associated with higher cortisol and cortisone. However, when stress symptoms were high, witnessing the father's arrest was associated with lower hair cortisol and cortisone, suggesting a blunting effect (Figure 2). Finally, Black children showed higher cortisol and cortisone compared to other children in the sample.

3.3 | Controlling for other possible trauma from witnessing negative events

To assess this hypothesis, we again conducted two analyses in PROCESS as described above but this time adding witnessing the father's crime and witnessing domestic violence as covariates (Table 3). Results of both analyses were similar to that reported above, with the effects of witnessing parental arrest, the interaction term, and child race still statistically significant. The main effect of behavioral stress symptoms dropped from statistical significance, however. Notably, the potentially stressful or traumatic experiences of witnessing the father's crime and witnessing domestic violence were not associated with children's hair cortisol or cortisone in this sample.

In sum, children had higher cumulative hair cortisol and cortisone concentrations when they had witnessed the father's arrest prior to his incarceration, regardless of how distressed they appeared at the time. There was a diathesis-stress or dual risk effect for all models. When children exhibited low or moderate behavioral stress symptoms and they witnessed the parent's arrest, they had higher hair cortisol and cortisone concentrations. However, at high levels of behavioral stress, witnessing the parent's arrest was associated with lower cortisol and cortisone, suggesting a blunted stress reaction. Witnessing the father's crime or domestic violence did not significantly add to the models.

4 | DISCUSSION

This is the first study to explore how stress associated with incarceration-related events "gets under the skin" of young children with incarcerated parents. By assessing children's biological reactions to environmental risk factors, and characterizing stress in relation to these hardships, we can begin to understand how children cope with paternal incarceration and delineate possible intervention points that may support children in the face of adversity.

Children responding to witnessing paternal arrest with distressing emotions and behaviors are consistent with previous studies (e.g., Dallaire & Wilson, 2010; Poehlmann-Tynan et al., 2017). This may be in part due to the lack of protocols in place when making an arrest with children present (International Association of Chiefs of Police, 2014; Thurau, 2015). Typically, such stressful events trigger a release of hormones from the adrenal glands, and the spikes of cortisol reflect the body's acute activation of the HPA axis reaction to the events, normal response to stress that promotes adaptation and survival. The response is terminated through negative feedback inhibition by the glucocorticoids at the level of the hypothalamus, pituitary, and other higher brain regions. When stress is chronic or severe, however, the stress system activation might be prolonged or fail, resulting in stress mediators that are no longer protective. In such situations, children may react to repeated stressors with increases in basal cortisol, making them more sensitive to stressors in the future.

Under extreme or sustained exposure to stress, children's stress regulation systems may become less sensitive and show blunted physiological responses to stress, similar to previous findings with other highly stressed samples (Stalder et al., 2017). This is precisely the type of physiological responses seen in young children with high behavioral stress symptoms who also witnessed their father's arrest. In other words, our findings depict this complex association between witnessing incarceration-related events and HPA axis functioning, with children witnessing the father's arrest showing increases in hair cortisol and cortisone levels when exhibiting low to moderate behavioral stress but having a blunted effect when behavioral stress was high. This effect is in line with other work that finds that when children experience chronic stress and traumatic events, their glucocorticoid responses are blunted, whereas those who experience

TABLE 2 Witnessing paternal arrest and behavioral stress symptoms as predictors of hair cortisol and cortisone concentrations ($N = 41$)

Hair cortisol and cortisone (Y)	Model with witnessing father's arrest						Model with witnessing arrest and distress					
				95% CI						95% CI		
	B	*SE*	*t*	LL	UL	*p*	*B*	*SE*	*t*	LL	UL	*p*
Constant	2.165	0.748	2.895	0.647	3.683	.006	2.443	0.723	3.381	0.976	3.910	.002
Child witnessed father's arrest (X)	2.106	0.431	4.882	1.231	2.982	.000	0.393	0.069	5.695	0.253	0.533	.000
Behavioral stress symptoms (W)	0.164	0.070	2.349	0.022	0.306	.025	0.138	0.057	2.430	0.023	0.254	.020
X × W	−0.363	0.085	−4.291	−0.535	−0.191	.000	−0.078	0.013	−5.887	−0.105	−0.051	.000
Child age	−0.301	0.176	−1.711	−0.658	0.056	.096	−0.322	0.173	−1.859	−0.674	0.030	.071
Child race	1.369	0.412	3.326	0.533	2.205	.002	1.133	0.396	2.862	0.330	1.937	.007
Model summary statistics	$F(5,35) = 8.143$, $p < .001$, $R^2 = .364$						$F(5,35) = 19.679$, $p < .001$, $R^2 = .377$					

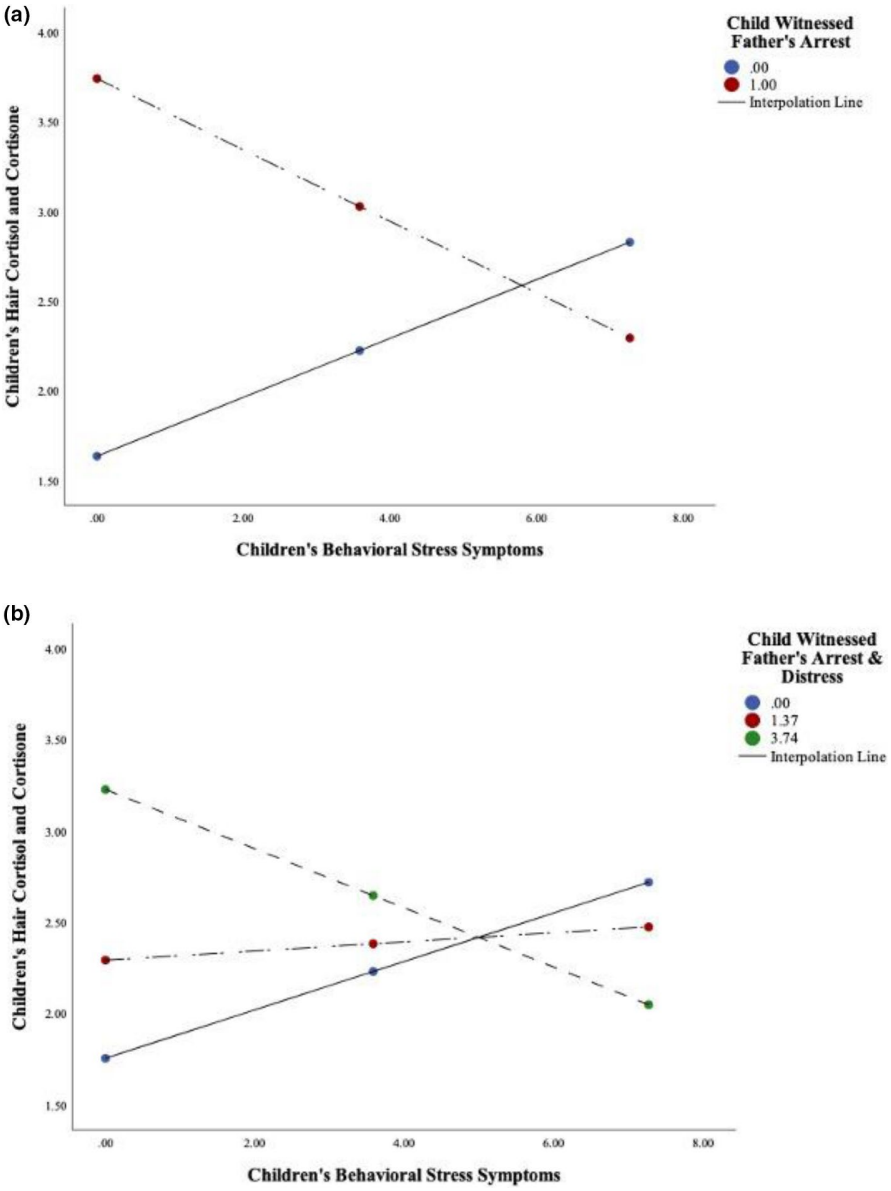

FIGURE 2 Interaction of witnessing paternal arrest and behavioral stress symptoms on children's hair cortisol and cortisone concentrations. The figure displays the associations between children's behavioral health symptoms and physiological stress responses, as measured by both a binary witnessing arrest predictor (a) and the combined measure of witnessing arrest and exhibited distress (b). Both of these trends demonstrate how children with low levels of behavioral stress symptoms see elevated cortisol and cortisone levels after witnessing their fathers' arrest but that those with already high behavioral stress symptoms see blunted physiological stress response levels

relatively normative stress show elevated levels in response to life stressors (Jaffee et al., 2015). Such findings suggest that witnessing a father's arrest is a stressful or even traumatic experience for children, but that there is heterogeneity in their responses which dictate the extent to which the experience "gets under their skin."

We already know that children who witness the arrest of their parents are likely to show PTSD symptoms (Phillips & Zhao, 2010). In physiological studies, individuals who display PTSD symptoms as a result of chronic stress experience blunting due to enhanced negative feedback of the HPA axis (e.g., Stalder et al., 2017; Yehuda et al., 1995), the same effect that was found in our study for children who witnessed the father's arrest and showed ongoing stress symptoms. These findings in tandem demonstrate how the level of distress experienced by children with hair hypocortisolemia can be particularly severe. It is important to note that the direction of this effect and the intensity of incarceration-related stressors on children's HPA axis may be affected by many factors, including the accumulation and intensity of stressors (even those not related to the parent's incarceration) and personality or temperament differences that contribute to how children cope. However, even when controlling for child demographics and other potentially traumatic events, such as witnessing fathers' crime or domestic violence, the findings still hold.

Chronic stress, as documented in both elevated and blunted levels of cortisol, can affect the morphology and chemistry of brain regions such as the hippocampus, prefrontal cortex, and amygdala. These changes are largely reversible if the chronic stress only lasts for weeks. However, it is unclear whether prolonged stress for many months, as reflected by these hair cortisol data, may have irreversible effects on the brain (McEwan, 2009), compounded by the vulnerability of the developing brain in young children. Long-term exposure to stress and both elevated and blunted levels of cortisol and cortisone have deleterious effects on many bodily processes, increasing the risk of experiencing health issues, from heart disease and obesity to anxiety and depression (Ranabir & Reetu, 2011), effects that may

TABLE 3 Witnessing paternal arrest, behavioral stress symptoms, and witnessing other trauma as predictors of hair cortisol and cortisone concentrations (N = 41)

	Model with witnessing father's arrest						Model with witnessing arrest and distress					
				95% CI						95% CI		
Hair cortisol and cortisone (Y)	*B*	*SE*	*t*	LL	UL	*p*	*B*	*SE*	*t*	LL	UL	*p*
Constant	2.111	0.738	2.860	0.609	3.613	.007	2.445	0.644	3.797	1.135	3.755	.001
Child witnessed father's arrest (X)	2.125	0.457	4.656	1.197	3.054	.000	0.394	0.072	5.488	0.248	0.540	.000
Behavioral stress symptoms (W)	0.161	0.079	2.037	0.000	0.321	.050	0.133	0.068	1.951	−0.006	0.271	.060
X × W	−0.399	0.099	−4.047	−0.600	−0.198	.000	−0.079	0.013	−5.963	−0.106	−0.052	.000
Child age	−0.288	0.175	−1.645	−0.643	0.068	.109	−0.323	0.167	−1.933	−0.663	0.017	.062
Child race	1.386	0.428	3.239	0.516	2.257	.003	1.145	0.446	2.568	0.238	2.052	.015
Child witnessed father's crime	0.571	0.421	1.357	−0.285	1.427	.184	0.021	0.101	0.210	−0.185	0.228	.835
Child witnessed domestic violence at home	−0.295	0.531	−0.555	−1.376	0.786	.582	−0.009	0.495	−0.019	−1.017	0.998	.985
Model summary statistics	$F(7,33) = 6.558$, $p < .001$, $R^2 = .384$						$F(7,33) = 13.440$, $p < .001$, $R^2 = .377$					

be particularly profound in young children. This evidence is particularly salient given recent findings of poor health and developmental delays demonstrated in children who witness their parents' arrest (Poehlmann-Tynan et al., 2020).

These findings stress the importance of accounting for trauma histories that may put children with incarcerated fathers at risk for altered stress responses. For example, children with incarcerated fathers are commonly found to have elevated externalizing, internalizing, and antisocial behaviors compared to their peers who have never experienced paternal incarceration (e.g., Geller et al., 2009). When under stress, children are often more disorganized emotionally and behaviorally and may be prone to react with confusion, withdrawal, rage, or helplessness (Teicher et al., 2002); thus, behavior problems may reflect a child's stress levels. As such, our findings fill an important gap in the literature that confirms physiological stress processes as one mechanism that can help us understand links between paternal incarceration and child well-being (e.g., Turney, 2014), consistent with bioecological models of development (Bronfenbrenner & Ceci, 1994). By documenting stress using physiological measures, this work moves the field beyond parent-reported child distress or perceived stress. Notably, while some children may react with observable distress, others may "shut down" and not exhibit observable responses. Conflating exhibited distress with physiological stress responses may miss a significant component of children's adaptation and perpetuate an idea that more overt responses matter more than internal responses.

Lastly, our analyses provide initial evidence that race may be a significant predictor of physiological stress, with young Black children with incarcerated parents showing higher cortisol and cortisone levels than other young children. Prior evidence establishes the disproportionate systemic risk which makes Black children and other children of color subject to parental arrest and incarceration at significantly higher rates than other children (Murphey & Cooper, 2015). Given the racial disparities seen in arrest and incarceration rates in the United States (e.g., Zeng, 2020), as well as racial discrimination and systemic oppression, it is likely that Black children with incarcerated parents may experience more system-induced stress than children with incarcerated parents of other races. Additionally, knowing that Black individuals experience force from law enforcement at significantly higher rates than other racial groups (Fryer, 2019), this finding may suggest the uniquely traumatic example of systemic risk that witnessing the arrest of a parent may be for these children. For instance, the recent police-involved shootings of Black men, Philando Castile in Minnesota and Jacob Blake in Wisconsin, both occurred in the presence of their children. With documented evidence of race-related trauma stemming from the criminal justice system for Black men (Aymer, 2016), this current study provides initial evidence calling for future work that explores variation in children's stress responses to justice-involvement that may be dependent upon race. Indeed, because these analyses are based on a small sample specific to children with incarcerated parents, more research is needed to understand the mechanisms behind this association that may structurally make some children more at risk for physiological stress than others.

4.1 | Implications

The study findings can inform future policy, practice, and research for children with incarcerated parents. First, we recommend that law enforcement agencies use best practices for safeguarding children during parental arrest (International Association of Chiefs of Police, 2014; Lang et al., 2013; Thurau, 2015). Such models are intended to be used as templates and customized locally, considering both officer safety and child well-being. Without such protocols in place, the arrest of a parent with children present relates to a number of detrimental outcomes for children, including their stress regulation. Thus, law enforcement agencies must expand procedures and training when making arrests with children present, including implementing pre-arrest planning to assess a child's presence, modifying timing and methods, delaying the arrest, removing the parent from sight, refraining from use of force, allowing the parent to speak with the child prior to detainment, and including the parent in placement decisions in order to reduce children's traumatic responses (International Association of Chiefs of Police, 2014).

Prevention and intervention scientists as well as practitioners agree that law enforcement agencies are in unique positions to limit stress-induced harm for children, as explicated in *First, Do No Harm* (Thurau, 2015). By modifying arrest procedures, adopting protocols to account for the care of children after the arrest, and collaborating with professionals for follow-up services, the clinical framework seeks to prevent negative outcomes for children (Thurau, 2015). This is particularly important for local law enforcement agencies such as county sheriff's departments and city police forces, as most arrests and incarcerations occur locally (Sawyer & Wagner, 2019). Another intervention model REACT (Lang et al., 2013), includes protocols and training recommendations for law enforcement, mobile crisis clinicians, and child welfare workers with the goal of reducing child distress, addressing stigma, and providing wrap-around services.

When children witness parental arrest, additional care must be provided to help them regulate their stress. Stress reduction approaches could include offering a stuffed animal or a parent's sweater, scarf, or blanket to comfort the child, speaking calmly to the child at eye level (i.e., explaining why the police are there, reassuring it is not their fault, and refraining from impossible promises), emotion regulation and mindfulness techniques, and referral to community resources. Our findings, emphasizing both overt and covert stress responses in young children, underscore the need for measures to be taken in every scenario in which children are present, not just when they react with distress. If safeguarding approaches or referral to professionals is absent or incomplete, such as in this study, alteration of the HPA axis can have long-term consequences for young children's health and well-being (Poehlmann-Tynan et al., 2020).

Future research exploring collateral consequences of parental incarceration should use these findings as a springboard for understanding mechanisms to maladjustment in young children. Assessing cumulative cortisol and cortisone as measures of physiological stress is a precise approach to understanding how stressors manifest in

children. Additional details about children's experiences may be helpful, including support in children's lives that may mitigate the effects of stress or trauma related to witnessing a parent's arrest. Lastly, additional work is needed to understand systematic selection in the types of parents who expose their children to criminal justice-involvement and how such exposures are associated with other stressors in the home. For example, in a previous study, Poehlmann-Tynan et al. (2017) found that children with insecure attachments to their caregivers were more likely to witness their father's arrest.

4.2 | Limitations

When interpreting our findings, one should keep in mind the study's limitations, one of which includes the small sample that is not population-based. Although a strength of the study is its use of multiple methods and respondents, the study relies on parent and caregiver retrospective reports of children's exposure to parental arrest, crime, and domestic violence as well as children's behavioral stress symptoms, creating concern for accuracy and shared method variance. This was especially a limitation in knowing when exactly the father's arrest occurred. Although the within-group study design limits bias related to selection into incarceration, there was no longer-term follow-up of children. In future work with larger samples, it may also be necessary to understand how contextual factors, such as experiencing food insecurity, witnessing neighborhood violence, or interactions with the child welfare system, may also have a role in contributing to children's distress at the time of arrest. Additional limitations come with measuring physiological stress through hair. For instance, hair from children of different races may grow at slightly different rates (Cone & Joseph, 1996; Loussouarn et al., 2016) and medication use and seasonal variation can impact findings in children (Slominski et al., 2015), which is important for future research that uses it to analyze stress hormones. Because of this, it remains important to measure cortisol in other ways in children affected by parental arrest and/or incarceration. For example, multiple samples of saliva could be collected to determine diurnal fluctuations as well as differences during important activities such as visiting a parent in jail or prison. In contrast, cortisol measured through blood draws or urine collection as part of pediatric physical exams is another way to examine stress levels in children affected by parental incarceration. One final limitation is the potential for systematic selection bias in the children who witnessed their father's arrest. These children may have parents who are less likely to shield them from general trauma and stress; however, we attempted to control for such bias by including witnessing the father's crime and domestic violence in our models. Further research focusing on stress processes and trauma in children with incarcerated parents is needed to elucidate these issues.

Despite the limitations, the study provides key insights regarding how witnessing a father's arrest has implications for a young child's physiological stress responses, thus reinforcing the idea that children with incarcerated parents are a growing group who require attention and support. The findings can inform research and safeguarding policies that are sensitive to the developmental needs of children and create safe and equitable opportunities for their growth and development when a parent is involved with the criminal justice system. Future work that situates itself in this gap has the power to ultimately enhance the lives of criminal justice-involved families through strengths-based and social justice-oriented approaches that cater specifically to the needs and well-being of children.

5 | CONCLUSION

As the first study to document physiological stress responses for children with incarcerated parents, this work sheds light on the need to reduce system-induced trauma beginning at the time of arrest. Descriptively, parents and caregivers report that children were considerably distressed after witnessing their fathers' arrest. Yet on top of this, the findings point to the significant toll that being present for this can have on children's behavioral health and physiological stress response. Even when controlling for other potentially stressful events, the results show that those with lower behavioral stress see elevated cortisol levels after witnessing the arrest but that those with high behavioral stress see their physiological stress responses become blunted (trends mirrored in studies of PTSD). As further intervention and prevention strategies become introduced, this study calls for evidence-based approaches to law enforcement protocols that mitigate risk and reduce stress for children that may be present. By better understanding how these experiences "get under the skin" of children with incarcerated parents, we take one step closer to viewing their responses holistically and informing effective harm reduction strategies that target the range of coping that comes in the wake of fathers' detainment.

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

DATA AVAILABILITY STATEMENT

The de-identified data file is available in a repository at our university.

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