

RESEARCH ARTICLE

The Role of Physiological Regulation in Understanding the Influence of Child Abuse Potential on Children's Behavioral Problems

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The current project investigated the role of toddlers' physiological regulation at 24 months in the relationship between prenatal child abuse potential and internalizing and externalizing problems at age 3 using a sample of 285 primiparous mothers and their first-born children. Regression analyses were used to explore physiological regulation, indexed by sleeping, eating, sensory sensitivity and negative emotionality, as a mediator of the relationship between abuse potential, measured by a brief version of the Child Abuse Potential Inventory, and children's problematic behaviors. Findings revealed direct effects between child abuse potential and internalizing and externalizing problems and child abuse potential and dysregulation. Further analyses highlighted regulation as a mediator of the relationship between child abuse potential and internalizing problems, whereas both child abuse potential and children's dysregulation were important in determining externalizing problems. Self-regulation appears to be a key target for intervention programs for toddlers to halt the progression of behavioral problems often found in maltreated children.

Keywords: maltreatment risk; physiological regulation; behavioral problems

Research has shown that maltreated children are at heightened risk for behavioral problems and emotional maladjustment (Aber, Allen, Carlson, & Cicchetti, 1989; Egeland, Yates, Appleyard, & van Dulmen, 2002). Explorative studies on the multi-faceted impact of maltreatment have highlighted children's self-regulation as the major link between abuse and later developmental dysfunction such that maltreatment is related to children's compromised self-regulation skills which in turn contribute to behavioral and emotional problems (Egeland, et al., 2002; Maughan & Cicchetti, 2002; Schatz, Smith, Keogh, Borkowski, & Whitman, 2008). For instance, emotion

regulation has been found to mediate the relationship between maltreatment and child outcomes, including externalizing behaviors (Egeland, et al., 2002), internalizing symptoms (Maughan & Cicchetti, 2002), and social adjustment (Shields & Cicchetti, 1998; 2001). Recent work has begun to explore another component of regulation – physiological – and its role in the development of maltreated children’s later dysfunction (Bruce, Fisher, Pears, & Levine, 2009; Cicchetti & Rogosch, 2002; Dobrova-Krol, van Ijzendoorn, Bakermas-Kranenburg, Cyr, & Juffer, 2008). The current study builds on the previous body of research and extends it by examining the relationships among early child abuse potential, toddlers’ physiological regulatory difficulties, and emotional and behavioral problems within a prospective, longitudinal framework.

Emotional and behavioral problems are among the most frequently reported consequences of abuse and neglect with a growing body of evidence supporting elevated rates of depression and externalizing behaviors among maltreated children (Aber et al., 1989; Cicchetti & Rogosch, 2001; Kim & Cicchetti, 2004). In comparison to a group of non-maltreated children, Aber and colleagues (1989) found that maltreated children had significantly more behavioral problems and depression. In a similar study, Kim and Cicchetti (2003) reported a higher incidence of internalizing behaviors in a group of maltreated children aged 5 to 12 than in a non-maltreated comparison group. The relationship between maltreatment and emotional and behavior problems is well-established; a growing body of research, however, has focused on exploring how children’s deficient self-regulation may be the process variable responsible for the effects of abuse and neglect on all domains of children’s development (Egeland, et al., 2002; Maughan & Cicchetti, 2002; Heim, Newport, Mletzko, Miller, & Nemeroff, 2008; Murray-Close, Han, Cicchetti, Crick, Rogosch, 2008).

Child Abuse Potential

Different methods have been used to assess child maltreatment including measures that assess potential for abuse, self-reports of abuse and neglect, and information gathered from Child Protective Services (CPS). Utilizing reports from CPS, however, has proven to create multiple difficulties, chief among them underestimating actual maltreatment instances (Chaffin & Valle, 2003). Self-report measures of instances of abuse and neglect also can be inaccurate due to parental concern about the repercussions of an affirmative response. For this reason, measures that assess potentiality, or likelihood for abuse, have often been utilized in research (Moreland Begle, Dumas, & Hanson 2010). Among the most frequently used is the Child Abuse Potential Inventory (CAPI) due to its strong correlation with actual abuse perpetration (Milner, 1986).

Using the CAPI also offers advantages over CPS information and self-reports including: (1) abuse potential can be considered a proxy measure, conceptualizing maltreatment as a continuum of behaviors and attitudes versus a dichotomous conceptualization (present or absent), and (2) abuse potential can be assessed during pregnancy, serving as an early screening tool to identify those at risk for abuse and identify who to target for prevention efforts.

Physiological Regulation

Several regulatory abilities (e.g. effortful control, affect management, hormonal levels) have been explored, however, these abilities can be placed into four more general types of regulation: cognitive, emotional, behavioral, and physiological, with physiological regulation intricately interlaced and supporting each of the aforementioned components. Generally considered to include modulation (i.e. inhibition or activation) of physical processes such as hormone levels, heart rate, vagal tone, and sleep patterns, physiological regulation has been assessed in a variety of manners. The majority of research with maltreated children has assessed a short term physiological response of the sympathetic and parasympathetic branches of the autonomic nervous system indexed by cortisol levels, obtained with a saliva sample, or respiratory sinus arrhythmia, measured with a heart monitor.

Findings from this line of research support the deleterious impact of maltreatment on physiological regulation. For instance, Bruce and colleagues (2009) explored the effects of maltreatment on foster children's morning cortisol levels. The cortisol levels, assessed as indicators of SNS arousal and more specifically hypothalamic-pituitary-adrenocortical system (HPA axis) activity, were differentially influenced by type of maltreatment. Foster children with severe emotional maltreatment experiences had higher cortisol levels, whereas those with severe physical neglect backgrounds had low levels. It appears that when the caregiving environment is characterized by abuse and neglect, all types of regulation become severely compromised, especially physiological (Maughan & Cicchetti, 2002; Pollak, Cicchetti, Hornung, & Reed, 2000). Less is known, however, about a broader, long-term conceptualization of physiological regulation including sleeping, eating, and sensory reactivity patterns, of children at risk for abuse.

Growing evidence suggests that physiological regulation, especially the hormonal and neurological domains of development, may play an even greater role in victimized children's development – researchers have begun to examine regulation as a process variable responsible for maltreatment's multi-faceted impact on child functioning, particularly emotional and behavioral outcomes (Heim et al., 2008; Murray-Close et al., 2008). Heim and colleagues (2008) summarized a series of studies examining physiological regulatory indicators, childhood history of trauma, and depression. Across all studies, childhood trauma was consistently associated with alteration of the stress responses (evidenced through endocrine functioning) and problems with the HPA axis which was then subsequently related to depression symptoms (Heim, et al., 2008). Murray-Close and her research team (2008) examined neuroendocrine regulation, as indexed by cortisol levels, and aggression in samples of maltreated and non-maltreated children. Findings supported the role of physiological regulation in two types of aggression, relational and physical, with more pronounced effects for children with histories of maltreatment. Structural and functional neurological differences have also been noted among victimized children. Taken together, the findings suggest that maltreatment impacts physiological regulation, which in turn fosters maladaptive development; however, little research has investigated these effects in early toddlerhood, particularly within a prospective longitudinal study and used a more comprehensive conceptualization of physiological regulation as a process variable within a sample of at-risk toddlers.

Current Study

The current study addresses three gaps in the research base. First, little is known about child abuse during infancy (when its consequences are often most severe) and the implications of early victimization for development in toddlerhood. Second, because the most common techniques for examining physiological regulation involve short term assessments, less is understood about longer-term indicators of physiological regulation of infants and toddlers, such as sleeping and eating patterns, when regulatory abilities are particularly vulnerable. Third, the majority of research has examined the relationship between abuse and regulatory development in documented maltreatment cases; however, many infants and toddlers are missed due to their lack of exposure to the most common reporting sources (schools, friends, etc.).

The present project used regression analyses to investigate the relationship between early maltreatment risk and the development of preschoolers' internalizing and externalizing problems as mediated by physiological regulation (Baron & Kenny, 1986; Preacher & Hayes, 2004). The current project utilized data from a longitudinal study designed to understand low-levels of neglectful parenting among mothers and their first-born children. The multi-site design included a racially diverse sample with variability in participants' ages, economic status, and educational backgrounds. Maternal child abuse potential, conceptualized as a continuum of likelihood for maltreatment, was measured prenatally by an abbreviated version of the Child Abuse Potential Inventory. Children's physiological regulation was indexed by sleeping and eating patterns, and sensory and emotional reactivity at 24 months by maternal reports based on the last 2 months of the infants' lives. Children's externalizing and internalizing behaviors were reported on by mothers when children were 3. It was expected that mothers evidencing higher abuse potential would have children exhibiting greater internalizing and externalizing problems. It was also hypothesized that toddlers' physiological regulation would mediate the relationship between maternal abuse potential and both externalizing and internalizing behaviors.

METHOD

Participants

The current study's sample was drawn from a larger, longitudinal study designed to understand the effects of sub-threshold neglect on child development, with a focus on the antecedents associated with neglectful parenting. Mothers and their first born children were recruited from 5 cities: South Bend, Indiana; Washington, DC; Birmingham, Alabama; and Kansas City, Kansas or Missouri. Each site's Internal Review Board independently approved the study protocol and reviewed it annually. At the prenatal interview, each participant was asked to sign the study consent form provided by project interviewers. If the mother was a minor, her guardian was also asked to sign a consent form.

In the present study, participants with data at each of the three time points (prenatal, 24, and 36 months) were included resulting in a subsample of 285 mother-child dyads (682 mothers completed the prenatal, but only 470 completed the 4 month). The most common reasons for nonparticipation included moving more than an hour away, dropping out of the study, or being unreachable during the data collection window which was generally one month before and after

each time point. The current sample varied considerably in education, age, and economic status. First-time mothers were recruited if they were adolescents (less than 19 years of age at the time of child's birth); low-resource adults (older than 21 years but less than 2 years of college education), or high-resource adults (over 21 years with at least 2 years of college completed). Adolescent mothers were slightly oversampled. A significant difference was found between the present study's sample and the larger longitudinal project participants not included in the study in age: Mothers not in the study tended to be slightly younger ($M = 20.61$, $SD = 4.71$) than mothers in the study ($M = 21.85$, $SD = 5.43$), $t(680) = 3.17$, $p < .05$. However, no significant differences were noted regarding maternal and child race or target child gender.

At the time of the child's birth, average maternal age was 21.95 years ($SD=5.43$). Forty percent of mothers had not completed high school (75% of these were adolescents) and 28.9% had completed postsecondary education. Only 25.5% of mothers were employed at the time of the prenatal interview, compared to 51.6% who were working when they learned they were pregnant. Additional mother and child characteristics data can be found in Table 1.

TABLE 1
Characteristics of Mother and Child Characteristics (n=285)

Variable	
<i>Household characteristics (reported 6 months after the birth of the child)</i>	
Average yearly income	\$22,379.69
Average number of individuals in household excluding participant	3.35
<i>Child characteristics</i>	
Child gender, male, %	50.9
Race, non-white, %	83.0
<i>Mother characteristics</i>	
Race, non-white, %*	77.2

Procedure

As mentioned above, assessments began prenatally (during the last trimester of pregnancy) and included a laboratory visit when the target child was 24 and 36 months old. Interviews generally lasted one to two hours and included a variety of questions related to family characteristics; mother characteristics, history, resources, and mental status; and child characteristics and outcomes.

Analytic Plan

Analyses were conducted based on current mediational recommendations (Baron & Kenny, 1986; Preacher & Hayes, 2004). A series of regression analyses were employed to examine children's physiological regulation as a mediator of the relationship between child abuse potential and children's internalizing problems. In a separate series, the same equations were utilized to examine regulation as a mediator of child abuse potential and children's externalizing problems. Bootstrapping estimates were also conducted as a follow-up assessment of the indirect

effects of the proposed relationships (Preacher & Hayes, 2004).

Measures

Measures given to the participants included demographic information assessment, the Child Abuse Potential Inventory – Short Form (CAPI-SF), and the Infant-Toddler Social and Emotional Assessment (ITSEA).

Mother and child demographics. During in-person interviews, demographic information was collected about the mother, child, and family by trained interviewers. Information included self-reported race, age, household income, and number of individuals in the household. Mothers also reported the target child's age and race.

Child Abuse Potential Inventory – Short Form (CAPI-SF). During the prenatal assessment, mothers completed a shortened version of the second edition of the CAPI, which was created to help child protective service workers identify potentially physically abusive caregivers (Milner, 1986). The 25 item short form measures the mother's self-reported rigidity (i.e., A child needs very strict rules; Children should stay clean) and her unhappiness (i.e., I have several close friends in my neighborhood; I do not laugh very much). The CAPI-SF had good internal consistency ($\alpha=.781$) and has been shown to have predictive validity (Dukewich, Borkowski, & Whitman, 1999).

Infant Toddler Social Emotional Assessment (ITSEA). The ITSEA was designed to measure young children's social and emotional functioning as well as competencies (Carter, Briggs-Gowan, & Jones, 2003). The full measure consists of 156 items that are rated on a 3-point scale according to how often the child exhibits the specified behavior with (0) for not true/rarely, (1) somewhat/sometimes true, or (2) very true/often. Intra-class correlations for test-retest reliability have been found to range from .74 to .88. Inter-rater reliabilities comparing the parents' scores ranged from .43 to .78.

Physiological Dysregulation. At the 24 month assessment, mothers completed the Dysregulation Domain on the ITSEA (Carter, Briggs-Gowan, & Jones, 2003). The Dysregulation Domain is 34 items and asks each mother to rate her child's negative emotionality (i.e., Hard to soothe when upset; Wakes up in a bad mood), her child's sleeping (i.e., Trouble falling asleep; Must be held to sleep), her child's eating (Refuses certain food for two days or more; Gags/chokes on food), and her child's sensory sensitivity (i.e., Bothered by certain odors; Bothered by how things feel on skin). The Dysregulation Domain had good internal consistency ($\alpha=.821$). No item overlap was allowed among any of the 3 subscales drawn from the ITSEA: dysregulation, internalizing, and externalizing.

Internalizing behaviors. At the 36 month assessment, mothers completed the Internalizing Domain of the ITSEA. The Internalizing Domain includes 30 items which rate the child's internalizing behaviors. Subscales of internalizing behavior include: 1) depression (i.e., Unhappy; Does not make eye contact); 2) general anxiety (i.e., Nervous or fearful; Puts things in a special order over and over again); 3) separation distress (i.e., Demands a lot of attention; Cries when you try to leave), and 4) inhibition to novelty (i.e., Shy with new children; Takes a while to

speak in unfamiliar situations). The Internalizing Domain had good internal consistency ($\alpha=.857$).

Externalizing behaviors. The Externalizing Domain of the ITSEA completed at the 36 month assessment has 24 items that rate externalizing behavior problems. Children are assessed on three sub-areas: 1) activity/impulsivity (i.e., Constantly moving; Very loud); 2) aggression/defiance (i.e., Hides misbehavior; Purposely tries to hurt you); and 3) peer aggression (i.e., Bullies; Won't let other children play with group). The Externalizing Domain had good internal consistency ($\alpha=.867$).

RESULTS

The current project investigated the relationships among early child abuse potential, physiological regulation, and children's emotional and behavioral development at age 3. The descriptive data are presented first, followed by the series of regression models and follow-up tests for internalizing problems, and concludes with the series of regression models and follow-up analyses for externalizing behaviors.

Descriptive Data

Means and standard deviations for each of the variables can be found in Table 2. Each of the variables evidenced considerable variability and no apparent significant skewing. Only the important descriptive results are highlighted below.

TABLE 2
Descriptive Statistics for Child Abuse Potential, Physiological Regulation, and Internalizing and Externalizing Outcomes

	Mean	SD	Range	N
Maternal Maltreatment Risk				
Child Abuse Potential	9.11	4.10	1, 21	285
Children's Regulation				
ITSEA - Dysregulation	.56	.25	.05, 1.46	284
Children's Outcomes				
ITSEA - Internalizing	.58	.25	0, 1.55	281
ITSEA – Externalizing	.60	.32	0, 1.54	284

ITSEA – Infant-Toddler Social and Emotional Assessment

Child Abuse Potential. Total scores for the CAPI - SF ranged from 1 to 21 with a mean of 9.11. A weighted transformation of the CAPI – SF total score allowed comparison with the

frequently used full length CAPI total score's cut-point of 215 to identify high risk for abuse: 7% of mothers scored at or above this level.

Toddlers' Physiological Regulation. Children's dysregulation scores ranged from .05 to 1.46 with a mean of .56. Using t-score cutoffs, 7.1% of the children scored in the range of concern and 6.3% scored in the clinical range.

Children's 3 Year Internalizing and Externalizing Behaviors. Scores for children's internalizing problems ranged from 0 to 1.55, with a mean of .58 and externalizing problems ranged from 0 to 1.54, with a mean of .60. Using t-score cutoffs indicating concern and clinical levels, 12.5% scored in the range of concern and 7.7% evidenced clinical levels of internalizing problems; 12.5% scored in the range of concern with another 12.4% evidencing clinical levels of externalizing problems.

Correlations among all variables of interest can be found in Table 3. Significant associations were found among all variables. Maternal abuse potential was correlated with children's greater dysregulation, internalizing and externalizing problems. In addition, physiological dysregulation was positively associated with greater internalizing and externalizing problems.

TABLE 3
Inter-correlations among all variables

	1.	2.	3.
Maltreatment			
1. CAPI-SF			
Regulation			
2. ITSEA-Dysregulation	.19***		
Child Development			
3. ITSEA-Internalizing	.13*	.37***	
4. ITSEA – Externalizing	.24***	.48***	.47***

***p <=.001, **p <=.01, *p <=.05

CAPI-SF = Child Abuse Potential Inventory – Short Form;

ITSEA = Infant-Toddler Social and Emotional Assessment

Abuse Potential, Physiological Regulation and Internalizing Problems

The guidelines set forth by Baron and Kenny (1986) were used as the foundation for the initial series of mediational analyses and four regression equations were employed for each outcome. The first regression equation tested the hypothesis that higher maternal maltreatment risk would be associated with more problematic developmental outcomes for the children. As can be seen from Figure 1, higher maternal child abuse potential was significantly predictive of children's

internalizing problems. More specifically, greater child abuse potential was predictive of higher internalizing problems, $\beta = .13$, $p < .05$ with 2% of the variance explained. In the second regression model, higher levels of child abuse potential were associated with greater physiological dysregulation, $\beta = .19$, $p = .001$, with 4% of the variance was explained. Physiological dysregulation was predictive of internalizing problems, $\beta = .37$, $p < .001$ and nearly 14% of the variance was captured in the third regression model. In the final model that included both child abuse potential and dysregulation in the equation, results revealed a mediational relationship such that the formerly significant path between abuse potential and children's internalizing fell to non-significance, $\beta = .05$, while the dysregulation path remained strong, $\beta = .36$, $p < .001$.

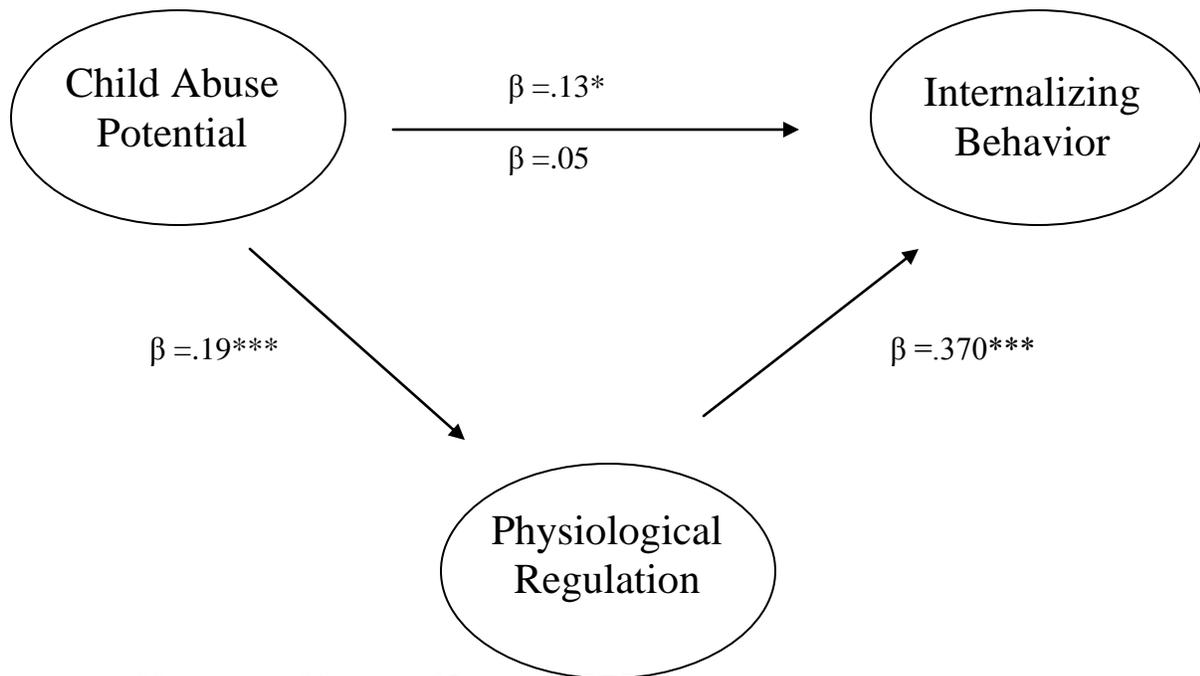


Figure 1. Children's physiological regulation at age 24 months as a mediator of the relationship between prenatal child abuse potential and 36 months internalizing behavior

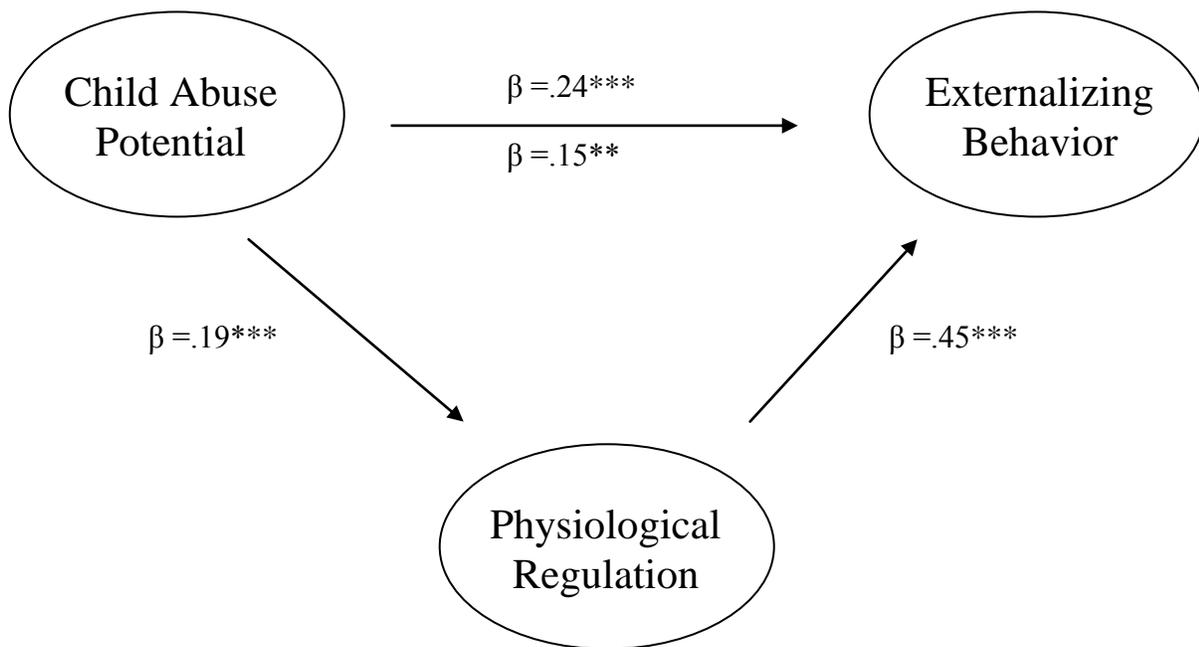
Although frequently employed, Baron and Kenny's (1986) recommendations have been criticized on the grounds of low power and parameter estimation (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002; Preacher & Hayes, 2004). Additional post hoc tests to assess mediation have been suggested with bootstrap resampling at the forefront (Preacher & Hayes, 2004). Bootstrap resampling, generating multiple independent distributions of the data, provides a confidence interval of an estimated effect and a statistically powerful confirmation to the original methods of mediational assessment.

The results from the posthoc bootstrapping analyses supported the findings from the internalizing series of regression analyses. The test of the indirect effect using a 95% confidence

interval with 5000 resamples of the data did not include zero (CI = .0017 to .0075). Taken together, the two tests support the mediational role of physiological regulation in the relationship between maternal abuse potential and children's internalizing problems.

Abuse Potential, Physiological Regulation, and Externalizing Problems

Another series of regression analyses was employed to examine the relationships among child abuse potential, regulation, and children's externalizing behaviors. Mothers with higher child abuse potential had children with significantly greater externalizing problems, $\beta = .24$, $p < .001$ with 6% of the variance explained. As mentioned earlier, higher levels of child abuse potential were associated with greater physiological dysregulation, $\beta = .19$, $p = .001$. Physiological dysregulation was predictive of externalizing problems, $\beta = .48$, $p < .001$ and 23% of the variance was captured. In the final model, the inclusion of both child abuse potential and dysregulation provided support for the influential roles they both have on externalizing behaviors, $\beta = .15$, $p < .01$ and $\beta = .31$, $p < .001$, respectively.



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

Figure 2. Children's physiological regulation at age 24 months as a mediator of the relationship between prenatal child abuse potential and 36 months externalizing behavior

The results from the posthoc bootstrapping analyses supported the findings from the series of regression analyses. The 95% confidence interval with 5000 resamples of the data did not include zero (CI = .0024 to .0118). Coupled together, the regression analyses and bootstrapping results suggest that physiological regulation does play a role in the relationship between child

abuse potential and externalizing problems; however, there is also a strong, direct relationship between abuse potential and externalizing behaviors.

To summarize the regression analyses, children with mothers evidencing greater abuse potential evidenced greater dysregulation and more internalizing and externalizing behaviors. The mediational model testing supported physiological regulation as a mediator of the relationship between child abuse potential and internalizing behaviors. Externalizing behaviors, however, were strongly influenced by both child abuse potential and children's physiological regulation.

DISCUSSION

The current study extended the previous research base in several ways. First, the majority of physiological research with maltreated children has been with older children and utilizes a single measure such as cortisol or vagal tone. Our findings provided support for the role that physiological regulation plays in translating abuse potential's effects to maladaptive development in a sample of young children, offering important targets for intervention. The current project also employed multiple indicators of biological regulation, including sleep, eating, sensory sensitivity, and negative emotionality, versus previous studies utilizing a solitary physiological indicator, providing a more comprehensive view of toddler regulatory abilities. Finally, our utilization of a non-referred sample and a proxy measure of child abuse, versus a substantiated report, supported the conceptualization of maltreatment as a continuum of parenting behaviors and allowed us to draw our findings from a more diverse sample allowing for greater generalizability, and again provides another target for early interventions.

A large body of research has consistently identified the link between maltreatment and emotional and behavioral problems (Aber et al., 1989; Eigsti & Cicchetti, 2004). The current study supports the previous research with 20.2% of our sample evidencing at-risk internalizing problems and 24.9% showing at-risk externalizing problems. Moreover, these findings have not been consistently replicated in samples of very young children, thus the current results are important in terms of contributing to the growing body of evidence on maltreatment and its detrimental influence at all ages.

In line with previous studies, the current findings suggest that when the caregiving environment is characterized by abuse, physiological regulation becomes compromised (Maughan & Cicchetti, 2002; Pollak et al., 2000). It is likely that in homes characterized by abuse, many of the key caregiving elements necessary to support optimal self-regulation are absent. Research with maltreating parents suggests that this is the case, with abusive caregivers having greater disorganization in the home and providing less encouragement to their children (Trickett & Susman, 1988). In the present study, 13.4% of the toddlers exhibited problematic levels of physiological dysregulation such that their sleeping, eating, sensory sensitivity, and negative emotionality were maladaptive.

The recent exploration on self-regulation as a mechanism responsible for maltreatment's multi-domain deleterious effects on children's development has advanced understanding of the processes associated with developmental difficulties (Maughan & Cicchetti, 2002; Heim et al., 2008; Murray-Close et al., 2008). Findings from the current study provide additional evidence that early child abuse potential impacts children's physiological regulation, indexed by multiple

indicators of dysregulation, which in turn has implications for internalizing and externalizing outcomes.

Intervention Implications

Most importantly, both the findings and the study's longitudinal, prospective framework lend themselves to intervention implications. The early measurement of abuse potential, prenatally, was predictive of children's physiological dysregulation at 24 months. Moreover, the CAPI – SF consists of only 25 items and can be completed quickly. The findings provide practical support for screening pregnant mothers for abuse potential and offering prevention programming that addresses parenting. Such programming could alter early problematic parenting before it becomes less amenable to change and support children's optimal development.

The connection between dysregulation and later internalizing and externalizing problems also provides insight on another target for intervention. A large body of research highlights regulation's role in social, academic, and emotional development (Blair, 2003; Schatz, Smith, Keogh, Borkowski, & Whitman, 2008; Schmitt, McClelland, Tominey, & Acock, 2014); providing self-regulation supports in early preschool and intervention programming for families with toddlers demonstrating regulation difficulties could prevent the further development of behavioral problems and the cascade of effects seen from problematic regulation, helping the children socially, emotionally, and in Early Head Start.

Limitations and Future Directions

The present findings contribute to the research base on maltreatment risk and physiological consequences, however, several limitations need to be considered. First, although our assessment of physiological regulation included multiple biological regulatory indicators such as sleeping, eating, sensory sensitivity, and negative emotionality, incorporating additional measures would have advanced a more comprehensive picture of children's self-regulation. For instance, utilizing observations of regulatory behaviors or pairing the present study's regulation assessment with a small number of cortisol samples over a short period of time would have provided further validation for our conceptualization of physiological dysregulation and provided additional information about the child's self-regulation beyond maternal reports.

Related, although physiological regulation explained 14% and 23% of the variance in children's internalizing and externalizing problems, respectively, a large proportion was left unexplained. Incorporating additional components of regulation may have accounted for more variance in the outcomes. It is also likely that additional variables (i.e., father abuse potential, protective child factors) may play a role in the relationship between early maternal abuse potential and later children's functioning. Future work should explore these other possible links.

Finally, attrition, although common in longitudinal studies with at-risk participants, nevertheless is an important factor to consider in interpreting the present study's findings. Nearly half of the larger study's full sample did not have complete data and therefore our findings are only representative of the participating families.

Conclusions and Clinical Implications

The findings from the present study highlight the role of physiological regulation in the relationship between early maternal abuse potential and young children's internalizing and externalizing problems lending support to the urgency of early intervention: dysregulation was already apparent by 24 months. Self-regulation interventions have shown efficacy in young children. Schmitt and colleagues (2014) conducted and evaluated a self-regulation intervention for young children at-risk according to demographic factors. The 8-week self-regulation intervention was implemented in Head Start classrooms and proved effective: children receiving the intervention showed greater gains in both self-regulation and academic achievement than those in the control group. The average age of the child, however, was 4 years; the present project suggests that even early intervention programming is needed. Offering self-regulation interventions for families of toddlers in Early Head Start is an important next step in supporting young children's successful development.

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