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The role of social adversity on emotional dysregulation during infancy and early childhood

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ABSTRACT

Purpose: The purpose of this study was to investigate if social adversity is associated with mother reported emotional dysregulation behaviors and trajectories during infancy and early childhood.
Design & methods: A secondary data analysis from the Durham Child Health and Development study study included 206 child-mother dyads. Three models were used to explore the relationship between social adversity and mother reported emotional dysregulation during infancy (Infant Behavior Questionnaire-Revised) and early childhood (Child Behavior Checklist - Dysregulation Profile). Linear mixed effects models were adopted to investigate if social adversity was associated with mother reported emotional dysregulation longitudinally. Regression analysis was conducted to explore if social adversity was associated with maternal reported emotional dysregulation trajectory slope scores and maternal reported emotional dysregulation trajectory class. Maternal psychological distress and the child's sex assigned at birth were included as covariates in each analysis.
Results: Infants with greater social adversity scores had significantly higher maternal reported fear responses across the first year of life. Social adversity was associated with maternal reported distress to limitations trajectory, dysregulated recovery class, and dysregulated distress to limitations class. During early childhood social adversity was significantly associated with maternal reported emotional dysregulation but not trajectories which showed little variability.
Conclusion & practical implications: Our results indicate that social adversity is associated with maternal reported emotional dysregulation during infancy and early childhood. Nursing and other professionals can participate in early screening to determine risk and provide intervention.

Introduction

Emotional regulation, the ability to manage attention, affect, and behavior, has been found to influence long term child health and development (Beauchaine & Cicchetti, 2019; Sloan et al., 2017). Emotional regulation has been implicated as a transdiagnostic mechanism in the development of adverse physical and mental health outcomes such as pediatric obesity (Graziano et al., 2010), cardiovascular disease, and type II diabetes (Appleton et al., 2011; Kiecolt-Glaser et al., 2002) as well as increased risk, symptoms, and early onset of psychopathology across multiple disorders including depression, anxiety, bipolar disorder, anorexia nervosa, and schizophrenia (Berking & Wupperman, 2012; Cole et al., 2008; Dvir et al., 2014; Henderson et al., 2021; Larøi et al., 2010; Thomson et al., 2019; Tsypes et al., 2013; Whitney et al., 2013).

Emotional regulation is a process that develops from the start of life (Thomas et al., 2017). Infants exhibit behaviors reflective of both reactivity and regulation at birth (Gartstein & Rothbart, 2003). Reactivity includes responses such as distress (fussing, crying) and fear (startle to changes in stimulation) while regulation is measured as falling reactivity (rate of recovery from distress, ease of falling asleep) and soothability (reduction in reactivity when caregivers use soothing techniques) (Enlow et al., 2016). Individual differences in reactivity and regulation are partially due to infant temperament (Calkins et al., 2002). Infant temperament refers to biologically based reactions that occur in response to environmental stimuli (Rothbart, 1981). Temperament is an important precursor to emerging emotional regulation skills (Leerkes et al., 2017). The developing capacity to regulate one's own

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emotions shifts over time from dependent co-regulation processes with parents and caregivers to more independent means (McIntosh et al., 2021). For example, over the first year of life infants transition from relying on innate reflexive behaviors such as sucking, rooting, and head turning as means to self-regulate (Kopp, 1982, 1989) to more self-directed soothing behaviors at three months of age which include thumb sucking and self-touch to self-regulate. Ongoing interactions with caregivers transition over time from caregivers providing help and support for infants to infants regulating their own emotions allowing them increasing autonomy and control of their own responses (Morris et al., 2017). As children develop, emotional regulation rapidly becomes more integrated with emerging cognitive and behavioral strategies rather than reactionary or co-dependent sources of external co-regulation (McIntosh et al., 2021). Children gain increased ability throughout development to implement top-down emotional regulation strategies including voluntary shifts in attention and affect to manage distressing stimuli and control their emotional state (Calkins, 1994; Calkins & Bell, 2010).

Poor emotional regulation, defined as emotional dysregulation, is linked to negative child social well-being due to difficulties with peer relations, stress management, and increased risk-taking behaviors (Kim & Cicchetti, 2010; Thomson et al., 2019). Socioemotional problems, which include emotional dysregulation, are prevalent in pre-school aged children with estimates as high as 26% (Brown et al., 2012). These rates are higher among children who experience social adversity (Li-Grining et al., 2010; Noroña-Zhou & Tung, 2020). There has been an increase in the use of multilevel measurement of social adversity indices to simultaneously explore multiple risk factors on emerging child development outcomes (Evans et al., 2013; Gutman et al., 2019; Holochwost et al., 2016). Thus, social adversity includes exposure to both psychosocial and socioeconomic hardship (Nuru-Jeter et al., 2018) and adversities across multiple levels. These hardships include household income, parental education, or caregiver psychological distress or mental illness; all of which have been associated with long term socioemotional functioning and emotional dysregulation (Ding et al., 2018; Hurt & Betancourt, 2017; St John et al., 2019; van Oort et al., 2011; Wehby & McCarthy, 2013). Although income status, education, and parental mental health are the most common measures of social adversity, other multilevel factors have also been implicated including material hardship (food, housing insecurity) (Robinson et al., 2017), insurance status (Newacheck et al., 2003), dietary quality (Metwally et al., 2016; O'Neil et al., 2014), neighborhood conditions (Robinson et al., 2017; Singh & Ghandour, 2012), rurality (Robinson et al., 2017), and single parent households (Chad-Friedman et al., 2020). In addition, these factors may interact leading to increased risk for emotional dysregulation. For this reason, we rely on the Social-Ecological Model to guide the current study (McLeroy et al., 1988). This model suggests that health and disease are influenced through multiple factors across individual, organizational, community, and societal levels (Lopez et al., 2021; McLeroy et al., 1988; Shonkoff et al., 2012), and that these levels interact in various ways to predict outcomes. Within the present study we will examine social adversity across individual and family levels in order to explore its association with emotional regulation as a significant developmental outcome.

It is critical to understand the influence of social adversity on emotional regulation development because the ability to regulate emotion has been implicated as a key driver of disparities in school readiness and academic achievement (Duncan & Magnuson, 2012; Li-Grining et al., 2010). When children enter school they often experience new challenges that may influence effective emotional regulation as they experience novel interactions with the school environment including teachers, caregivers, and peers (Harrington et al., 2020). These new challenges may lead to activation of bottom-up processes (McRae et al., 2012), or involuntary neurophysiological activation in response to emotional properties of a stimulus, that may be maladaptive in the classroom (for example, when the teacher announces that recess is over, a child's quick and automatic response to this frustration may be an emotional outburst, increased heart rate, difficulty settling down, or lashing out at friends). In order to be successful in the classroom, children must effectively integrate top-down volitional processes to regulate these emotions (Gross, 2014) - in other words, they must use voluntary cognitive appraisals and behavioral responses in order to guide and modify their responses (for example, when a child is instructed by the teacher to finish playing at recess to join a story circle, the child must focus on the teacher's instructions, shift their attention from recess to the story circle, and manage potential frustrations of no longer being able to play). Children must manage these parallel processes to effectively regulate their emotions and meet the present demand in early care and education settings (Holochwost et al, 2021). Effective emotional regulation sets the stage for children's abilities to manage long term health behaviors and reach their full social, vocational, and economic potentials (Lê-Scherban et al., 2014; Luecken et al., 2013; Polderman et al., 2010; Van Lieshout & Krzeczkowski, 2016). Understanding the development of emotional regulation throughout infancy and early childhood is essential for early identification and intervention (Waxmonsky et al., 2021). School entry is a critical time point for caregivers, teachers, psychologists, and nurses to support children who experience emotional dysregulation (Harrington et al., 2020).

Although the importance of emotional dysregulation is clear, there are still gaps in the literature regarding its changes in development over time and whether variations in these trajectories (e.g., stable, increasing, decreasing levels of dysregulation) may predict future maladaptive social-emotional, cognitive, or health outcomes (Nagin, 1999; Noroña-Zhou & Tung, 2020). For example, it may be the case that emotional dysregulation early in life may not be problematic for children who demonstrate improvement over time, however, for children who continue to be dysregulated, or get worse over time, poor outcomes may be more likely. Longitudinal explorations of the link between social adversity and these trajectories can inform prevention by helping to identify, as early as possible, children who are at high risk and to discover the most critical periods for screening and intervention. Given the disparities associated with emotional dysregulation in health, school readiness, and academic achievement, this work has important implications for the promotion of optimal health and well-being. This study, guided by the Social-Ecological Model, addresses some of the challenges described above by taking advantage of available data from the Durham Child Health and Development study to explore the role of social adversity on emotional dysregulation trajectories using developmentally appropriate measures of emotional dysregulation during infancy and early childhood. The purpose of the current study was to explore the extent to which social adversity is related to emotional dysregulation behaviors and trajectories during infancy (three-12 months) and early childhood (18–84 months).

Design and methods

Participants

This study utilizes data from the Durham Child Health and Development study (IRB #21–0231). This longitudinal cohort study began in 2002 and explored early child development in mother-child dyads through multiple in-home, laboratory, and mail in school questionnaires from infancy into early childhood. All families from the original cohort were recruited from Durham, a medium-sized city in the southern United States with population consisting of mostly White (50.9%) and Black or African Americans (39.5%) (U.S. U.S. Census Bureau, 2000). The parent study used a stratified sampling design in order to recruit approximately equal numbers of Black or African American and White families from high and low income groups resulting in a cohort of 206 dyads (Moore et al., 2009). Within the present study dyads were included in the current analyses if they had complete data on

relevant social adversity and infant or early childhood emotional dysregulation measures. If a dyad had missing data at any timepoint across the trajectory they were not included in the present analyses. This resulted in a final sample of $n = 127$–144 for the infant emotional dysregulation measure and $n = 102$ for the early childhood emotional dysregulation measure.

Procedure

Families were recruited via fliers and postings at birth and parenting classes and phone contact via birth records. The initial baseline visit was conducted when the child was three months of age. Data was collected in two waves; Wave One included assessments at three, six, 12, 18, 24, 30, and 36 months of age and Wave Two included assessments at 60, 72, and 84 months of age. Within the parent study, infants who were premature, had serious post-natal health complications or chromosomal, genetic, metabolic, or congenital abnormalities, or defects evident at birth were excluded from the study.

Measures

Demographics

Demographic data collected at baseline (three-month visit) included maternal, paternal, family, and child level demographics. Maternal and paternal demographics measures included age (years), education level (<high school (HS), HS, Some College, four-year degree), marital status (married, non-married). Family level demographics included income, household size (total number of individuals in family), and number of children in household. Child level demographics included race/ethnicity and sex assigned at birth.

Social adversity index

Social adversity included five measures of the five commonly cited distal risk factors on child developmental outcomes including income (Income Needs Ratio (INR)) (200% below the poverty line = 1, above 200% the poverty line =0), maternal age at first childbirth (≤20 = 1, >20 = 0), number of children in the household (≥ three children =1, < three children = 0), marital status (non-married = 1, married = 0), and maternal educational level (<HS = 1, ≥HS =0). A risk score from 0 to 5 was calculated based on the sum score of each individual social adversity risk factor (see Holochwost et al., 2016).

Maternal psychological distress

The Brief Symptom Inventory (BSI) is a 53 item self-report measure of psychopathology and psychological distress (Derogatis & Melisaratos, 1983). Participants were asked to rate the relevance of each distress symptom to their personal experience on a five-point Likert scale (0 = not at all, 4 = extremely) based on the last seven days. The current study uses the global distress score calculated from the average of the 53 items to reflect generalized psychological distress which includes somatization, obsessive–compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism. For this study the BSI-Global Severity Index (BSI-GSI) adjusted t scores were used because they are nationally normed and account for the gender of the parent. Individuals with an adjusted t-score of ≥63 indicate clinical significance (Derogatis, 1992). The BSI has been normed in both clinical and community settings and has strong internal consistency (α = 0.71–0.95) (Aroian & Patsdaughter, 1989; Croog et al., 1986; Derogatis & Melisaratos, 1983). Mothers completed the BSI during the baseline three month visit, and within our sample the internal reliability for the BSI-GSI was α =0.93.

Infant behavior questionnaire

The Infant Behavior Questionnaire-Revised (IBQ-R) is a widely used caregiver self-report measure that assesses perceived child temperament in infants between the ages of three-12 months (Gartstein & Rothbart, 2003). The IBQ-R is a 191-item questionnaire with items derived from a definition of temperament which includes individual differences in reactivity (arousability, emotional, motor, and attentional processes) and self-regulation (Gartstein & Rothbart, 2003). Mothers responded to each item by rating the frequency with which their infant engaged with specific behaviors in the last two weeks using a seven-point Likert scale with one indicating '*Never*' and seven indicating '*Always*'. Higher scores indicate greater levels of that temperament dimension. In addition to a total score (global index), four subscales were derived which indicate reactivity (distress to limitations, fear) and regulation (soothability and falling reactivity from distress) using the average response of subscale items (Enlow et al., 2016). Furthermore, falling reactivity from distress will be referred to as recovery. The IBQ-R has demonstrated strong internal consistency (alpha 0.70–0.90) among socioeconomically diverse community samples as well as substantial reliability and validity testing (Gartstein et al., 2009; Gartstein & Marmion, 2008; Goldsmith & Campos, 1990; Parade & Leerkes, 2008). Within the present study the IBQ-R was administered at three time points (three, six, and 12 months). Dyads were included within the present analyses if they completed all relevant social adversity and IBQ-R measures at each time point resulting in a sample of global index ($n = 144$), distress to limitations (n = 144), fear ($n = 127$), recovery ($n = 129$), and soothability ($n = 132$). The internal reliability for the IBQ-R subscales were Global Index (α =0.75–0.83), distress to limitations (α =0.73–0.83), fear (α =0.88–0.92), soothability (α =0.77.-0.83), and recovery (α =0.82–0.83).

Child behavior checklist dysregulation profile

The Child Behavior Checklist $1^1/_2$–5 (CBCL) is a nationally normed measurement tool and one of the most widely used caregiver report checklists that assesses perceived generalized psychopathology including emotional and behavioral problems of preschool aged children (Achenbach, 2015; Achenbach & Rescorla, 2001; Rescorla, 2005). The CBCL includes 99 items in which caregivers were asked to rate their child's behavior over the past two months on a three-point Likert Scale (not true of the child, somewhat true, very true or often true) with higher scores indicating greater prevalence of that behavior. The CBCL has demonstrated strong reliability with reported internal consistency (α = 0.78 to 0.94), test-retest reliability (rs = 0.82 to 0.92), and inter-rater agreement (rs = 0.65 to 0.85) (Achenbach & Rescorla, 2001).

The CBCL Dysregulation Profile (CBCL-DP) is a composite score of three syndrome scales of the CBCL that address three aspects of regulation including emotional (anxious/depressed), cognitive (attention problems), and behavioral (aggressive behavior) components (Althoff et al., 2010; Hudziak et al., 2005). The sum of the three syndrome scale t-scores indicate a total dysregulation score with a score of ≥180 indicating moderate dysregulation and ≥ 210 indicating severe dysregulation (Biedermann et al., 2009). Within community samples a CBCL-DP total score greater than or equal to 180 is commonly used to denote dysregulation (Carlson et al., 2016; Kim et al., 2012; Meyer et al., 2009). Within the present study the CBCL-DP was administered at six time points. Dyads were included within the present analyses if they completed all relevant social adversity and CBCL-DP measures at each time point which resulted in a sample of 102 dyads. Within our sample the internal reliability for the CBCL-DP subscales were Anxiety/Depression (α =0.41–0.73), Attention Problems (α =0.70–0.75), and Aggressive Behaviors (α =0.86–0.90).

Analytic strategy

Descriptive analysis

Descriptive analyses including means and standard deviations were conducted for the demographic variables at baseline, outcome variables across time, and the trajectory regulation slope scores. Regression analyses were conducted to obtain the partial correlation between the social

adversity index and the two regulation outcome variables during infancy (IBQ-R) and early childhood (CBCL-DP).

Emotional regulation trajectories

Infant emotional regulation trajectories were derived as the rate of change using the IBQ-R (three, six, 12 months) and the CBCL-DP (18, 24, 30, 36, 60, 84 months). A trajectory slope score was calculated as the rate of change over time for each subject for the IBQ-R total score as well as its four subscales (distress to limitations, fear, soothability, and recovery) if a subject had complete observations between three-12 months. The trajectory slope scores were dichotomized into upward regulation trajectories (+ slope) and downward trajectories (− slope), which were further defined into a dysregulation trajectory class. For the infancy regulation measures we differentiated the outcome between IBQ-R reactivity subscales (fear, distress to limitations) which defined upward slope indicating emotional dysregulation class while the IBQ-R regulation subscales (global index, soothability, recovery) defined downward slope as indicating emotional dysregulation class.

Trajectories were calculated as the CBCL-DP rate of change over time for each subject with complete data from 18 to 84 months. The trajectory slope scores were dichotomized into upward regulation trajectories (+ slope) and downward trajectories (− slope). For the early childhood maternal reported regulation measure we defined the dysregulation class based upon an upward regulation trajectory, which indicated worsening dysregulation over time.

For both the infancy and early childhood measures three regression models were adopted to explore the effect of social adversity on emotional dysregulation. First, a linear mixed effects model was adopted to explore if social adversity was related to emotional regulation scores over time. The primary independent variable was the social adversity index and the CBCL-DP or IBQ-R score as the dependent variable. To explore the regulation trajectories, linear regression models were adopted with social adversity as the primary independent variable and the regulation trajectory slope score as the dependent variable. Finally, a logistic regression model was adopted to explore if social adversity was associated with an emotional dysregulation class. Social adversity index was again the primary independent variable, and the dichotomized outcome variable was an emotional dysregulation class.

For all three analyses two covariates, i.e., sex assigned at birth and maternal psychological distress, were included in the model as confounding variables. There are marked gender differences, where boys are more likely to be identified for emotional dysregulation (Mitchison et al., 2020). Within the present study all emotional dysregulation measures are maternally reported and psychological distress symptoms can disrupt a mother's ability to engage, co-regulate, and perceive emotional dysregulation behaviors in their children (Carreras et al., 2019; Leis et al., 2014). Statistical significance was assessed at the significance level of 0.05. Parameter estimates, confidence intervals (CI), and *p*-values are reported for the linear mixed effects models and linear regression models while beta values, odds ratios (OR), CI, and *p*-values are reported for the binomial regression model.

Results

Descriptive analyses

Demographics

At baseline (three-months) our sample consisted of 206 family dyads. The sample had a mean maternal age of 27.9 years old (SD = 5.7) and paternal age of 30.6 (SD = 7.0). About one third of the mothers reported an education level of high-school (19.4%) or less than high-school (15.5%). Fathers indicated similar education levels with slightly over a third of the sample reporting high school (30.9%) and (8.8%) less than high school educations. Children were roughly equal in terms of sex assigned at birth with 51.5% assigned male and 48.5% assigned female. The mean level of reported social adversity index was 1.66 (SD = 1.16) with income level (48.5%) and marital status (41.7%) being more frequently reported as a risk. Mothers reported a mean score of 49.1 (SD = 9.5) on the BSI-GSI indicating a below clinically significant score (≥ 63) of psychological distress. For complete demographic results see Table 1.

Regression analyses

Infant emotional regulation trajectories

The IBQ-R global score reflected increasing levels of maternal reported regulation behaviors across infancy from three (3.9 (SD = 0.4)) to 12 (4.2 (SD = 0.4) months. This pattern of increasing scores was seen within the two regulation subscales (soothability and recovery) as well as the two reactivity subscales (distress to limitations and fear) indicating an increase in both maternal reported reactivity and regulation behaviors. The number of infants with downward and upward trajectories were similar among the two regulation subscales of soothability and recovery with 42.3% and 50% of infants exhibiting an emotional dysregulation trajectory respectively. Among the reactivity subscales there was a similar pattern of increases in maternal reported reactivity behaviors with fear (0.09, SD = 0.13) having a greater slope than distress to limitations (slope = 0.04, SD = 0.09). The fear subscale additionally had a greater number of infants with upward trajectories with 81.1% exhibiting a dysregulated emotional regulation trajectory

Table 1
Descriptive statistics for demographic and social adversity measures at three months.

Variable	n	% or Mean (SD)
Mother Age	206	27.9 (5.7)
Mother Education	206	
<High School	32	15.5%
High School	40	19.4%
Some Higher	43	20.9%
4 Year College Degree	91	44.2%
Mother Marital Status	206	
Married	120	58.3%
Non-Married	86	41.7%
Maternal Psychological Distress (Brief Symptom Inventory- Global Severity Index)	205	49.1 (9.5)
Household Size	206	4.05
Number of Children in Household	206	2.0
Birth Father Age	204	30.6 (7.0)
Father Education	204	
<High School	18	8.8%
High School	63	30.9%
Some Higher	35	17.2%
4 Year College Degree	88	43.1%
Income	206	
Above Poverty Line	100	48.5%
Below Poverty Line	106	51.5%
Child Race/Ethnicity	206	
Black or African American	117	56.8%
White	89	43.2%
Child Assigned Sex at Birth	206	
Male	106	51.5%
Female	100	48.5%
Social Adversity: Maternal age at first childbirth	206	
>20 (0)	142	68.9%
≤20 (1)	64	31.1%
Social Adversity: Maternal Education	206	
≥HS (0)	172	84.5%
<HS (1)	32	15.5%
Social Adversity: Income	206	
Above Poverty Line (0)	100	48.5%
Below Poverty Line (1)	106	51.5%
Social Adversity: Number of Children	206	
<3 children (0)	152	73.8%
≥3 children (1)	54	26.2%
Social Adversity: Marital Status	206	
Married (0)	120	58.3%
Non-Married (1)	86	41.7%
Social Adversity Index	206	1.66 (1.61)

compared to 62% of infants within the distress to limitations subscale (Table 2). See Supplementary Fig. 1 for correlation analysis results between social adversity, the IBQ-R, and maternal psychological distress (BSI) and Supplementary Fig. 2 for infancy emotional regulation trajectories.

Social adversity and infant regulation and reactivity over time. A linear mixed effects model was conducted to examine the relationship between social adversity and IBQ-R scores over time. Our results indicated that social adversity was significantly associated with fear IBQ-R subscale score with every unit increase of social adversity being associated with a 0.13 (95% CI [0.04, 0.22]) increase in fear reactivity score ($p = 0.004$) when controlling for both maternal psychological distress and sex assigned at birth (see Table 3).

Social adversity and infant emotional regulation trajectories. Linear regression was used to examine the relationship between social adversity and infant emotional regulation trajectories. Social adversity was only significantly associated with the distress to limitations IBQ-R subscale with every unit of increase in social adversity being associated with a − 0.015 (95% CI: [−0.025, 0.005]) decrease in the trajectory slope score of distress to limitations $p = 0.005$ when controlling for both sex assigned at birth and maternal psychological distress (see Table 3). A binomial logistic regression model for each IBQ-R subscale was used to examine whether social adversity was related to an increased risk of infant emotional dysregulation class. In the adjusted logistic regression model social adversity was significantly associated with the distress to limitations IBQ-R reactivity subscale and the recovery IBQ-R regulation subscale. The odds of infants having a dysregulated distress to limitations class were 0.72 (95% CI [0.57–0.91], $p = 0.006$), and the odds of infants having a dysregulated recovery class were 1.34 (95% CI [1.05–1.70], $p = 0.02$) for each one-point increase in social adversity score (see Table 3).

Child emotional regulation trajectories

The mean CBCL-DP score at each timepoint was relatively similar over time with average scores ranging 155.8 (SD = 9.1) to 157.8 (SD = 10.0) indicating that dysregulation scores were relatively stable across time. See Supplementary Fig. 1 for correlation analysis results between social adversity, the CBCL-DP, and maternal psychological distress (BSI) and Supplementary Fig. 3 for early childhood emotional regulation trajectories. Within our sample 37.3% of children had an upward CBCL-DP slope indicating a dysregulation trajectory class (Table 4).

Social adversity and child regulation and reactivity over time. A mixed effects model was used to examine the relationship between social adversity and CBCL-DP scores over time. Our results indicated that social adversity was significantly associated with the CBCL-DP with every unit increase of social adversity being associated with a 1.97 (95% CI [1.09–2.86], $p \leq 0.001$) increase in CBCL-DP score when controlling for both maternal psychological distress and sex assigned at birth (see Table 3).

Social adversity and child emotional regulation trajectories. A linear regression model was used to examine how social adversity was related to early child emotional regulation trajectories. Social adversity was not a statistically significant predictor of CBCL-DP trajectory slope score controlling for both maternal psychological distress and sex assigned at birth (Table 3). A binomial logistic regression model was used to examine if social adversity was related to an increased risk of a dysregulation trajectory during early childhood. Our results indicated that social adversity was not associated with a CBCL-DP dysregulation trajectory class (see Table 3).

Discussion

The goal of our study was to examine the role of social adversity on emotional regulation development over time during infancy and early childhood using mother-child dyadic data from the Durham Child Health and Developpment study. Our results indicated that social adversity was related to infant emotional dysregulation behaviors and trajectories, while in childhood it was only related to emotional dysregulation behaviors but not trajectories.

During infancy social adversity was associated with both reactivity and regulation temperament measures, however, the association was stronger with reactivity. Moreover, infants with higher levels of social adversity had significantly higher maternal reported fear responses indicating increased startle and distress to changes in novel stimuli or environment (Enlow et al., 2016; McRae et al., 2012). Infant temperament is an important precursor to emerging regulation skills as reactivity measures the degree to which children express emotional responses to stimuli while regulation indicates the ability to modulate these emotional expressions (Leerkes et al., 2017). Although our analyses used the IBQ-R, a parent reported measure, this relationship is an important one to investigate because of the downstream implications. It is possible that early parent-reported reactivity measures may be a proxy for physiological responses that could be associated with long-term behavioral and health outcomes. Infants with a temperament profile that is more reactive to novel stimuli or environmental changes may have increased stress related neurophysiological activation during infancy. The development of effective emotional regulation is dependent on a child's ability to manage both top-down volitional processes to meet the challenges of their environment as well as involuntary bottom-up stress related neurophysiological activation including the sympathetic nervous system, parasympathetic nervous system, and hypothalamic pituitary adrenal axis (Thompson, 2019). Allostatic load theory describes a primary mechanism in which chronic stressors, including social adversity, may affect child health and development via alterations in neuroendocrine stress hormones that interfere with neuroendocrine, immune, metabolic, and cardiovascular system functioning (Blair et al., 2011; Juster et al., 2010). Our findings provide evidence that during infancy, stress in the environment may interact with individual temperament vulnerabilities and adversely influence the developing capacity to regulate emotion. Although not measured here, this could in theory lead to increased physiological reactivity (i.e., changes in cortisol or respiratory sinus arrhythmia) and wear and tear on the body (i.e., inflammation, oxidative stress) resulting in chronic health issues (Casavant, Cong, Fitch, et al., 2019). Future research should integrate these bottom-up measures of emotional regulation in infants and

Table 2
Descriptive Statistics for Infant Behavior Questionnaire-Revised scores and trajectory slope score across infancy.

	Global Index n = 144	Reactivity: Distress to Limitations n = 144	Reactivity: Fear n = 127	Regulation: Soothability n = 129	Regulation: Recovery n = 132
	Mean (SD) or n (%)	Mean (SD) or n (%)	Mean (SD) or n (%)	Mean (SD) or n (%)	Mean (SD) or n (%)
3 months	3.9 (0.4)	3.4 (0.8)	2.0 (0.8)	5.1 (0.7)	5.2 (0.9)
6 months	4.0 (0.4)	3.6 (0.9)	2.4 (1.0)	5.1 (0.7)	5.2 (0.9)
12 months	4.2 (0.4)	3.7 (0.8)	2.9 (1.1)	5.2 (0.7)	5.3 (0.9)
Trajectory Slope Score	0.04 (0.06)	0.04 (0.09)	0.09 (0.13)	0.01(0.08)	0.00 (0.09)
Dysregulated Trajectory Class	28 (19.4%)	88 (61.1%)	103 (81.1%)	61 (42.3%)	66 (50%)

Note: For regulation measures (Global, Soothability, Recovery) a dysregulated emotional regulation trajectory score has a downward slope and for reactivity measures (distress to limitations, fear) a dysregulated emotional regulation trajectory score has a positive slope.

Table 3
Effects for Infant Behavior Questionnaire-Revised (IBQ-R) (3–12 months) and Child Behavior Checklist - Dysregulation Profile (CBCL-DP) (18–84 months) longitudinal effects, trajectories, and dysregulation trajectory class.

	Longitudinal Effects				Trajectory Effects				Dysregulation Trajectory Class Effects				
	Estimate	95% CI		p-value	Estimate	95% CI		p-value	B	OR	95% CI		p-value
IBQ-R: Global Index													
Time	**0.04**	**0.05**	**0.05**	**<0.001**	–	–	–	–	–	–	–	–	–
BSI	0.00	0.01	0.01	0.412	0.001	<0.001	0.002	0.234	**−0.05**	**0.95**	**0.91**	**1.00**	**0.046**
Sex at Birth	0.06	−0.05	0.17	0.289	0.007	0.010	0.025	0.496	0.27	1.31	0.55	3.10	0.539
Social Adversity	0.03	<0.01	0.07	0.08	−0.005	0.003	0.001	0.090	0.26	1.29	0.98	1.70	0.07
IBQ-R Reactivity: Distress to Limitations													
Time	**0.04**	**0.02**	**0.05**	**<0.001**	–	–	–	–	–	–	–	–	–
BSI	**0.02**	**0.03**	**0.03**	**<0.001**	0.000	−0.002	0.002	0.849	0.01	1.01	0.97	1.05	0.765
Sex at Birth	0.14	−0.08	0.37	0.211	0.014	−0.017	0.044	0.382	−0.23	0.80	0.40	1.62	0.532
Social Adversity	0.06	−0.01	0.14	0.101	**−0.015**	**−0.025**	**−0.005**	**0.005**	**−0.34**	**0.72**	**0.57**	**0.91**	**0.006**
IBQ-R Reactivity: Fear													
Time	**0.09**	**0.11**	**0.11**	**<0.001**	–	–	–	–	–	–	–	–	–
BSI	**0.02**	**0.03**	**0.03**	**0.013**	0.002	−0.001	0.004	0.127	0.04	1.04	0.99	1.09	0.158
Sex at Birth	**0.26**	**0.52**	**0.52**	**0.048**	0.032	−0.013	0.077	0.162	−0.24	0.79	0.32	1.97	0.614
Social Adversity	**0.13**	**0.04**	**0.22**	**0.004**	−0.004	−0.019	0.012	0.654	−0.11	0.90	0.66	1.23	0.501
IBQ-R Regulation: Soothability													
Time	0.01	<0.01	0.03	0.089	–	–	–	–	–	–	–	–	–
BSI	**−0.01**	**−0.02**	**<0.01**	**0.009**	0.000	−0.002	0.002	0.970	−0.01	0.99	0.95	1.03	0.474
Sex at Birth	−0.13	−0.32	0.07	0.196	0.013	−0.017	0.044	0.379	0.19	1.21	0.59	2.46	0.607
Social Adversity	−0.05	−0.12	0.01	0.106	0.001	−0.009	0.011	0.843	−0.08	0.92	0.73	1.17	0.499
IBQ-R Regulation: Recovery													
Time	0.00	−0.01	0.02	0.604	–	–	–	–	–	–	–	–	–
BSI	**−0.02**	**−0.04**	**−0.01**	**0.001**	0.002	<0.001	0.003	0.071	−0.01	0.99	0.95	1.03	0.688
Sex at Birth	−0.18	0.06	0.06	0.137	−0.020	−0.053	0.012	0.222	−0.42	0.66	0.32	1.33	0.244
Social Adversity	−0.06	−0.14	0.02	0.112	−0.007	−0.018	0.004	0.211	**0.29**	**1.34**	**1.05**	**1.70**	**0.02**
CBCL-DP													
Time	−0.01	−0.04	0.01	0.293	–	–	–	–	–	–	–	–	–
BSI	**0.32**	**0.18**	**0.47**	**<0.001**	−0.002	−0.005	0.001	0.268	0.02	1.02	0.98	1.07	0.052
Sex at Birth	−1.57	−4.2	1.02	0.235	0.057	−0.001	0.115	0.056	−0.84	0.43	0.19	1.01	0.353
Social Adversity	**1.97**	**1.09**	**2.86**	**<0.001**	0.006	−0.014	0.025	0.578	0.04	1.04	0.78	1.37	0.806

Note: Infant Behavior Questionnaire-Revised (IBQ-R), Child Behavior Checklist-Dysregulation Profile (CBCL-DP), Brief Symptom Inventory (BSI), **Bold = $p < 0.05$.**

children as they may contribute to allostatic load and provide more information about biologically embedded risk for distal physical and mental health outcomes develop across the lifespan (Pakulak et al., 2018; Quigley & Moore, 2018).

During infancy social adversity was only associated with the distress to limitations IBQ-R trajectory, which indicates infants who had higher levels of social adversity were less likely to express distress to novelty over time according to their mothers. Infants with higher levels of social adversity were reportedly less likely to fuss, cry, or experience distress when in challenging situations over the first year (Enlow et al., 2016). For example, an infant was less likely to cry or fuss when being involved in caregiving activities such as feeding, changing, or when challenged during routine play. Our results from the binomial logistic regression analysis supported this finding as infants with higher levels of social adversity had lower odds of being in the dysregulated class which was defined as an upward slope trajectory indicating more fear responses over time. On one hand it may appear that these infants were better regulated as they did not express their distress, however, on the other hand this could indicate emotional overregulation given the minimization or suppression of emotional responses indicated when infants express flat, constricted, suppressed affect (DeMartini et al., 2021; Martins et al., 2012). Additionally, our results indicate that infants with higher social adversity had increased odds of a dysregulated recovery trajectory across the first year. A dysregulated recovery trajectory includes slower rates of recovery from peak distress, excitement, arousal, as well as ease of falling asleep over the first year (Enlow et al., 2016).

Table 4
Descriptive statistics for Child Behavior Checklist-Dysregulation Profile scores and slope trajectory score across early childhood.

CBCL-DP (n = 102)	Mean (SD) or n (%)
18 months	157.8 (10.0)
24 months	156.0 (10.4)
30 months	156.1 (8.8)
36 months	157.4 (12.3)
60 months	157.1 (10.9)
84 months	155.8 (9.1)
Trajectory Slope Score	−0.01 (0.15)
Dysregulated Trajectory Class	38 (37.3%)

Note: For the Child Behavior Checklist- Dysregulation Profile (CBCL-DP) a dysregulated emotional regulation trajectory slope score has a positive slope indicating scores were getting higher over time.

Given the infant temperament profile described earlier of increased maternal reports of fear responses, decreased distress to limitations, and slower rates of recovery these infants may be suppressing their responses in order to adapt in the short term by disengaging from negative threat or novel stimuli in attempt to self-regulate (McRae et al., 2012). Expressing less distress could be adaptive in the short term to handle increased physiological activation given the increased fear responses and slower recovery from distress. However, suppression as a long term regulation strategy has been associated with negative mental health outcomes in adulthood including depression, anxiety, and eating disorders (Aldao et al., 2010). Although little research has been conducted exploring overregulation during infancy, links have focused on child maltreatment, caregiver sensitivity, and attachment styles (Martins et al., 2012). Furthermore, an insecure attachment style (which shares similar diminished reactivity responses as seen here) has been linked to long-term maladaptive regulation strategies in adulthood (Girme et al., 2021).

During early childhood social adversity was associated with elevated emotional dysregulation behaviors, but not trajectories. Social adversity was significantly associated with higher levels of dysregulation in children. Regarding our trajectory analyses, early childhood regulation trajectories showed little variability and were roughly stable across time between 18 and 84 months. Other studies which explore CBCL-DP trajectories have found similar stable trajectories from ages 7, 10, to

12 years old (Boomsma et al., 2006), and those who find larger variation have used larger community-based sample sizes (Asmussen et al., 2022). In our results social adversity was not significantly associated with the emotional regulation trajectories nor was it significantly associated with an increased risk for an upward dysregulation trajectory score. Our results further suggest the CBCL-DP is a stable longitudinal measure of emotional dysregulation in community samples across early childhood (18–84 months) and provides evidence of measurement invariance (Putnick & Bornstein, 2016).

Implications for practice

Our results indicate that during infancy, social adversity was more frequently associated with reactivity and regulatory measures compared to early childhood. This may be the case because infants are developmentally more dependent on external sources of co-regulation (McIntosh et al., 2021). Within our analyses we controlled for caregiver psychological distress, however, a child develops within the context of many other environmental risk factors which also contribute to emotional dysregulation. In addition to shared genetic vulnerability for emotional dysregulation, prenatal stressors contribute to biological embedding and epigenetic transmission of these parental stressors intergenerationally onto the child (Casavant, Cong, Moore, & Starkweather, 2019; Santos et al., 2019) and shared adversities occur within the family system. Our results highlight the need for parenting-based interventions that address parental efficacy, sensitivity, and emotional awareness which can buffer some of negative influences of social adversity. Future research should consider the effects of social adversity exploring a wider window of susceptibility to include the prenatal period in addition to infancy which may also be a critical time point for parental support and intervention (Havighurst et al., 2020; Vacher et al., 2020). Additionally, our results on the infant level highlight the need for integration of physiological bottom-up regulatory measures to better describe infant regulatory processes than parental self-report alone. Therefore, future research must integrate multilevel parent and child environmental and physiological measures into longitudinal studies assessing emotional dysregulation to better elucidate the relationship between social adversity, biological embedding, and health and well-being across the lifespan.

During early childhood the CBCL-DP was relatively stable which has clinical implications on the timing of screening. Given the stability of the CBCL-DP implementing validated screening tools as early as 18 months may be indicated for identification and early intervention of emotional dysregulation as it has been identified as a transdiagnostic indicator for multiple mental health outcomes across the lifespan (Althoff et al., 2010).

There are several implications that can be derived from our work that impact frontline nurses, teachers and parents role in targeting emotional dysregulation. The IBQ-R and CBCL-DP as parental reports are beneficial as they are easy to administer, cost effective, and are patient centered as they take advantage of the parents' knowledge and ability to observe their children across settings (Leerkes et al., 2017). Nurses in primary care, home visiting, and school nurses have sustained contact with the child and family, and can be key figures in essential prevention efforts including screening, referral, and brief intervention (Gross et al., 2016; Jönsson et al., 2019; Molloy et al., 2021; Ravenna & Cleaver, 2016). An estimated 31% of health referrals made by school nurses were related to child mental health concerns (Stephan & Connors, 2013), highlighting the significant role school nurses play in identifying children's mental health needs. School nurses recognize the growing need to address mental health concerns given the increase in negative child mental health outcomes at school entry, however, they identify significant barriers in their ability to effectively deliver care to children with mental health concerns. These barriers include lack of time, lack of professional confidence, complexity of conditions, lack of training and resources, and large caseloads (Ravenna & Cleaver, 2016). Given appropriate training, staffing, and system level support, frontline nurses can be empowered to promote positive child mental health through individual and school-wide education, screening, early identification, referral to community and professional resources, and brief-interventions to promote child mental health (Bohnenkamp et al., 2019; Gross et al., 2016; Molloy et al., 2021).

Limitations

Some limitations need to be considered when interpreting the results of this study. First, our emotional regulation measures were derived solely by maternal report, which may be influenced by psychological distress. Despite our sample having a low level of clinically significant psychological distress the relationship between social adversity and emotional dysregulation was still evident during infancy and early childhood. The integration of physiological and observational regulation measures in addition to maternal report would have strengthened our results and addressed some of the mechanisms that contribute to long term risk for distal physical and mental health outcomes. Furthermore, although we included five known risk factors of social adversity, a more holistic inclusion of multilevel environmental risk and protective factors including interpersonal, organizational, community, and societal levels should be considered in future research. The Social-Ecological Model is well equipped to theoretically conceptualize these multilevel factors, however, sample size must be carefully considered in order to have adequate power to assess the effect sizes among multilevel relationships. Also of note is the Durham Child Health and Development study which was conducted starting in 2002, and the context of social adversity may be different at this time. Despite these limitations we were able to conduct trajectory analyses for both infancy and early childhood using developmentally appropriate emotional regulation measures using a socioeconomically diverse community-based sample.

Conclusions

Our study is among the few longitudinal explorations of how social adversity is associated with emotional dysregulation trajectories during infancy and early childhood. Social adversity was associated with both maternal reported infant reactivity and regulation measures and trajectories, but only early childhood emotional dysregulation behaviors. Our results further highlight that social adversity enhances infant susceptibility for maladaptive emotional dysregulation and potentially the aforementioned stress-related neuro-physiological processes. Additionally, maternal reported emotional dysregulation during early childhood (18–84 months) was stable within our community sample which has important implications on screening. This information is of great clinical relevance to nurses and other professionals such as teachers and psychologists who can participate in early screening of social adversity to determine risk and deliver interventions for children at high risk for emotional dysregulation. A better understanding of these factors can help identify children at high risk for emotional dysregulation as well as inform the timing of screening and implementation of parenting, early care, and education-based interventions to promote optimal health and well-being across the lifespan.

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Harry Adynski: Conceptualization, Methodology, Data curation, Formal analysis, Writing – original draft, Funding acquisition. **Cathi Propper:** Conceptualization, Resources, Writing – review & editing. **Linda Beeber:** Conceptualization, Writing – review & editing. **John H. Gilmore:** Conceptualization, Writing – review & editing. **Baiming Zou:** Conceptualization, Data curation, Writing – review & editing. **Hudson P. Santos:** Conceptualization, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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