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Regular Article

The influence of early childhood education and care on the relation between early-life social adversity and children's mental health in the environmental influences for Child Health Outcomes Program

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Abstract

Early adversity increases risk for child mental health difficulties. Stressors in the home environment (e.g., parental mental illness, household socioeconomic challenges) may be particularly impactful. Attending out-of-home childcare may buffer or magnify negative effects of such exposures. Using a longitudinal observational design, we leveraged data from the NIH Environmental influences on Child Health Outcomes Program to test whether number of hours in childcare, defined as 1) any type of nonparental care and 2) center-based care specifically, was associated with child mental health, including via buffering or magnifying associations between early exposure to psychosocial and socioeconomic risks (age 0–3 years) and later internalizing and externalizing symptoms (age 3–5.5 years), in a diverse sample of $N = 2{,}024$ parent–child dyads. In linear regression models, childcare participation was not associated with mental health outcomes, nor did we observe an impact of childcare attendance on associations between risk exposures and symptoms. Psychosocial and socioeconomic risks had interactive effects on internalizing and externalizing symptoms. Overall, the findings did not indicate that childcare attendance positively or negatively influenced child mental health and suggested that psychosocial and socioeconomic adversity may need to be considered as separate exposures to understand child mental health risk in early life.

Keywords: Early childhood; psychosocial risk; socioeconomic risk; childcare; mental health

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Introduction

Promoting children's well-being is a priority for parents, educators, and clinicians (Bethell, Solloway, et al., 2017), but the United States consistently lags behind other developed countries on a range of well-being indicators, including children's mental health (Gromada et al., 2020). Nearly one-quarter of US children and adolescents have at least one mental health-related condition (e.g., anxiety, depression, attention-deficit/hyperactivity disorder [ADHD]) (Bethell, Garner, et al., 2022); 40% will meet diagnostic criteria for a mental health disorder by 18 years of age (Jaffee et al., 2005; Merikangas et al., 2010), half of which are diagnosed by age 14 (Kessler et al., 2005). As rates of pediatric mental health problems continue to increase and are further compounded by the residual effects of social and economic disruptions from the COVID-19 pandemic (Lebrun-Harris et al., 2022), understanding effective strategies to not only treat but prevent pediatric psychopathology is a national public health priority (US Surgeon General's Advisory, 2021).

Peak onset for psychopathology occurs in the early teen years (Solmi et al., 2022), such that interventions in adolescence are often prioritized. However, indicators of psychopathology emerge as

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*See acknowledgments for full listing of Environmental influences on Child Health Outcomes program collaborators.

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early as the first year of life (Biedzio & Wakschlag, 2019; Egger & Angold, 2006; Luby, 2010). While genetic vulnerability partially explains an individual's predisposition to mental health problems, notable contributions from the early social environment confer risk, with long-lasting consequences through adulthood (Boyce et al., 2012; Evans et al., 2013; Hughes et al., 2017; McLaughlin et al., 2010). The World Health Organization found that 30% of all mental health disorders are attributable to childhood adversity (Kessler et al., 2010), with odds increasing as exposure to early adversity increases (Anda et al., 2006; Green et al., 2010; Hughes et al., 2017; Kessler et al., 1997; McLaughlin et al., 2010, 2012). Much of the research on the impact of early-life adversities remains focused on retrospective reports, which may be limited by inaccurate recall, and outcomes in adulthood (Baldwin et al., 2019), far too long after the prime period of intervention to prevent the onset of negative health outcomes has passed. To address the current pediatric mental health crisis, a developmentally informed life span approach is necessary. Scalable strategies to protect against adversity effects early in a child's development may reduce lifelong mental health risk. The current study investigates the utility of one such strategy – early childhood education and care (ECEC) – to understand prospectively whether and to what extent ECEC may buffer or magnify the negative influence of early adversity on young children's mental health.

Early adversity and child mental health outcomes

The first three years of life reflect a period of increased susceptibility to the influences of environmental exposures (Britto et al., 2017; Huttenlocher, 2009). Safe, stable, and supportive early-life experiences promote positive mental health (Bethell, Blackwell, et al., 2022; Fritz et al., 2018; Han et al., 2023). Exposure to adverse experiences can have long-lasting detrimental impacts (Blankenship et al., 2019; Evans et al., 2013; Holz et al., 2023; Oh et al., 2018; Repetti et al., 2002), with childhood adversity explaining a large proportion of psychopathology onset (Green et al., 2010; Kessler et al., 2010; McLaughlin et al., 2012).

Adversities need not be traumatic experiences that involve harm or threat of harm, such as maltreatment, abuse, or being a victim of or witnessing violence (Anda et al., 2006; McLaughlin & Lambert, 2017). Socioeconomic status (SES) factors, such as low income and parental educational attainment (Conger et al., 2010; Klass, 2016; Masarik & Conger, 2017), as well as single parent status (Amato, 2005; Heckman, 2008) and young maternal age at childbirth (Gao et al., 2023; McGrath et al., 2014), are well-studied characteristics that have been shown to increase risk for child mental health problems (Huston & Bentley, 2010). Similarly, family environmental stressors, such as parental depression (Goodman & Gotlib, 1999; Goodman et al., 2011), parental history of exposure to adverse childhood events (ACEs; (Folger et al., 2018; Moog et al., 2023; Schickedanz et al., 2018), and family chaos and instability (Coldwell et al., 2006; Glascoe & Leew, 2010; Repetti et al., 2002), are also risk factors (Orendain et al., 2023; Shonkoff & Phillips, 2000). Moreover, recent work suggests that these family stressors may be more influential to youth mental health problems compared to other types of childhood adversities (McLaughlin et al., 2012). For example, a recent population-based prospective study found that parental psychopathology and household dysfunction were the strongest predictors of clinically significant child internalizing and externalizing problems, even after adjusting for sociodemographic characteristics (Orendain et al., 2023). Furthermore, parental psychopathology was the single greatest risk factor for children's experience of early-life adversity.

Relatedly, parental history of ACEs increases risk for psychopathology not only for parents themselves but also for their offspring. Recent work on the intergenerational transmission of ACEs suggests that children of parents who experienced ACEs are at greater risk for a range of mental health problems (e.g., depression, anxiety, conduct problems, ADHD) (Buss et al., 2017; Moog et al., 2022, 2023; Noroña-Zhou et al., 2023). One large-scale study showed that children and adolescents whose mothers experienced ACEs were at three times increased risk of having clinically significant internalizing problems (Moog et al., 2023). Further, parents with a history of ACEs often have a lower ability to regulate their own stress responses, which can lead to suboptimal parenting behaviors (Szilagyi et al., 2016) that directly contribute to children's internalizing and externalizing problems (Carneiro et al., 2016; Choe et al., 2013). These regulation challenges may also create a chaotic home environment that further places children at risk for developing mental health difficulties (Carneiro et al., 2016; Coldwell et al., 2006; Deater-Deckard et al., 2009; Evans et al., 2005; Repetti et al., 2002).

Notably, although the potential adversities described above have been associated with greater likelihood of child mental health problems, many exposed children do not develop such difficulties. Several factors may contribute to a child's vulnerability or resilience to such exposures. First, single factors alone may have limited impact, with risk increasing with cumulative exposures. Second, risk factors may be interactive, with some factors only contributing to child vulnerability when in the context of other risk factors. Finally, protective, buffering characteristics in the environment may mitigate the potentially negative effects of adversity exposures.

Moderating effects of early childhood education and care (ECEC)

ECEC as a potential protective factor

As most US children ages 5 and under spend at least part of their time in nonparental childcare (National Center for Education Statistics, 2019), ECEC is uniquely suited to have large-scale impact on children's health and well-being. Here we define ECEC as childcare provided by nonparental caregivers, either home-based in the child's or caregiver's home, or in a formal childcare setting (e.g., preschool program, Head Start). A body of work on the positive influence of ECEC suggests that children who attend formal childcare settings are better prepared for kindergarten, have higher standardized achievement test scores, are more likely to attend college, have greater earnings, and are less likely to be arrested (Campbell et al., 2002; Duncan & Magnuson, 2013; Heckman et al., 2013; Mashburn et al., 2008; Muennig et al., 2009; Parkes et al., 2021; Wustmann Seiler et al., 2022). Such findings are generally more robust for children from disadvantaged backgrounds. Formal ECEC settings can be a social support structure for at-risk families through both formal and informal parent education and mentoring opportunities (Chase-Lansdale & Brooks-Gunn, 2014; Piña et al., 2022; Shonkoff & Fisher, 2013). Home-based and formal ECEC may also indirectly protect against adversity by reducing parenting stress, as ECEC provides a safe place for children and time for parents to focus on work and other responsibilities without needing to care for their children at the same time (Mooney et al., 2023; Ong et al., 2023). In many situations, ECEC also provides quality meals and health services

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for the child (Ritchie et al., 2012), which decrease the financial strain on the family and promote healthy development.

Although the positive impact of ECEC on child cognitive and academic functioning is consistently reported in the literature, findings are inconsistent as to whether and to what extent ECEC impacts children's mental health. Numerous factors suggest ECEC may enhance children's mental health and serve as a protective buffer for children experiencing adversity. First, ECEC can provide increased stability, predictable routines, stimulating learning and play experiences, and opportunities for quality social interactions with peers and nonparental caregivers – all of which are important factors that can promote children's positive development in the face of adversity (Fabes et al., 2003; Howes & Smith, 1995; Votruba-Drzal et al., 2004). ECEC also can help young children learn strategies to cope with adversity and build resiliency-promoting skills (e.g., self-regulation and self-efficacy capabilities) that can buffer against mental health problems (Masten & Barnes, 2018; Rutter, 2012; Traub & Boynton-Jarrett, 2017). Further, ECEC may offer an alternative safe, stable, and supportive environment for children who do not have such experiences at home. For example, Berry and colleagues (2016) found that children from highly disorganized homes who spent more hours in nonparental care had fewer social problems, whereas no influence of childcare was found for children from non-disorganized homes. Others have shown that high-quality early learning environments with emotionally responsive educators are associated with fewer child social-emotional and behavioral problems (von Suchodoletz et al., 2023). Such environments also have been shown to mitigate the risk of early adversity, including maternal depression (Charrois et al., 2017, 2020; Goelman et al., 2014), on children's internalizing and externalizing behaviors (Burchinal et al., 2006; Larose et al., 2021; Wilhelmsen et al., 2023; Wustmann Seiler et al., 2022). Finally, ECEC may help prevent parental burnout by providing some respite from the demands of caregiving, ultimately contributing to more healthy parental psychological functioning and sensitive parenting behaviors that promote child socioemotional functioning (Mooney et al., 2023).

ECEC as a potential risk factor

Despite the extensive increase in use of non-parental care in the United States in the past several decades and evidence for potential benefits of ECEC, there is still considerable concern that ECEC may increase risk for poor child developmental outcomes (Waters et al., 2021). Some suggest that spending more time in nonparental care can disrupt early maternal–child attachment and, subsequently, result in worse child mental health outcomes (Belsky, 1986; Vandell et al., 2010). Early studies suggested that amount of time spent in non-parental care, particularly center-based care, is associated with increased risk of an insecure mother–child attachment relationship (e.g., Belsky & Rovine, 1988; Sagi et al., 2002); however, these findings were not replicated in later studies (NICHD Early Child Care Research Network, 1997, 2001; Waters et al., 2021). In fact, Waters and colleagues (2021) found that higher quality, but not quantity nor type (home-based vs. center-based), of childcare in early life was weakly associated with more secure attachment states of mind in a large study of adolescents. However, numerous studies have reported that long hours spent in nonparental care, including center-based care, lead to worse child outcomes in the short and long term (Côté et al., 2007; Loeb et al., 2007; NICHD Early Child Care Research Network, 2003; Vandell et al., 2010). Specific concerns have been raised that greater time spent in ECEC, particularly center-based care, increases risk for child externalizing problems (Rey-Guerra et al., 2023). Results here have been mixed, with some observing such effects and others finding no increased risk (NICHD Early Child Care Research Network, 2003; Rey-Guerra et al., 2023). Similarly, there is inconsistent evidence as to whether time spent in ECEC interacts with child risk: Some studies suggest children experiencing multiple early adversities have increased behavior problems if they attend more childcare (Parkes et al., 2021; Watamura et al., 2011), whereas others suggest nonparental care decreases problem behaviors, especially among children in socially disadvantaged families (Rey-Guerra et al., 2023).

Limitations of relevant research

The inconsistency of findings regarding the role of ECEC on child mental health, including whether it protects against or magnifies the negative impact of adversity (Burchinal et al., 2006; Dearing & Zachrisson, 2017; Vandell et al., 2010), may be due, in part, to limitations of prior studies. Such limitations may include examining individual risk factors separately, as research suggests that the impact of individual risk factors on child outcomes may be limited and poorly reflective of the child's true risk. Risk may be measured more accurately via cumulative risk indices that account for various types of adversities (Bethell, Blackwell, et al., 2022; Evans et al., 2013). Other limitations include utilization of small sample sizes and inconsistency in the consideration of types of childcare attended. Additionally, most prior work has focused on how ECEC buffers the impact of adversity on cognitive outcomes, with less attention to mental health outcomes (Dearing & Zachrisson, 2017; Wilhelmsen et al., 2023). More research is needed to understand how ECEC may mitigate or exacerbate the negative effects of early adversity on early childhood mental health.

Current study

The current study seeks to address the described gaps and limitations by examining whether participation in ECEC moderates the impact of early exposure to adversity on child mental health by age 5 years in a large, diverse multicohort sample. We leveraged data from the NIH Environmental influences on Child Health Outcomes (ECHO) Program, which aims to study the effects of a broad range of early environmental exposures on child health and development across diverse participating observational longitudinal cohort study sites (Knapp et al., 2023). We specifically tested whether the number of hours in childcare, both in any type of nonparental care and also specifically in center-based childcare, modified associations of child exposure to adversity, assessed in the first three years of life, with child internalizing and externalizing symptoms, assessed between 3 and 5.5 years of age. We hypothesized that greater attendance in childcare would attenuate associations of greater exposure to adversity with higher internalizing and externalizing symptoms in childhood. We further considered whether childcare attendance, regardless of adversity history, was associated with child mental health outcomes.

To operationalize child adversity exposure, we implemented a cumulative risk score approach, given strong evidence that multiple exposures, relative to single exposures, predict significantly worse mental health outcomes (Evans et al., 2013). Cumulative risk scores offer several advantages over other approaches (e.g., considering each risk factor separately), including decreased measurement error; enhanced validity; and a reduction in the number of independent variables, which enhances the stability of estimates and statistical power. Moreover, cumulative

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risk scores are parsimonious, statistically sensitive, avoid extreme higher-order interaction terms, and do not depend on assumptions about the relative strengths of the contributing individual risk scores or their collinearity (Evans et al., 2013). Cumulative risk scores can have disadvantages, including sample-specific or arbitrary assignment of the cutoff score used to determine what constitutes risk exposure for a given measure; loss of information on risk severity; and the inability to test for statistical interactions among risk factors (Evans et al., 2013). We attempted to minimize any undesirable effects here by (a) using established a priori non-sample-specific thresholds when determining dichotomous cutoffs to avoid sample-specific biases and (b) intentionally developing two risk indices, rather than a single index, in acknowledgment that different types of risks may be differentially associated with early childhood mental health outcomes. This approach is responsive to calls for better characterization of risk domains that allow for examination of the contribution of different types of risks (Bethell, Blackwell, et al., 2022; Evans et al., 2013) while accounting for the compounding detrimental impact of the accumulation of multiple risks (Evans et al., 2013; Huston & Bentley, 2010; McLaughlin et al., 2012).

Consequently, a second aim of this study was to develop and test an approach to incorporating multiple risk factors into two cumulative risk domain indices that considered psychosocial risk factors and socioeconomic risk factors separately. As there is no agreed-upon set of adversities that characterize early risk, we selected specific risks based on existing work examining vulnerability for childhood mental health problems (Evans et al., 2013; McLaughlin & Lambert, 2017; Wilhelmsen et al., 2023). We operationalized psychosocial risk as an index that considered parental exposures to adverse events in their own childhood, parent depressive symptoms, and low enrichment in the child's home caregiving environment. We operationalized socioeconomic risk as an index that considered parental educational attainment, maternal age at childbirth, and parent relationship status. Based on a large extant literature, we assumed and expected that greater exposure to adversity would be associated with higher risk for child mental health concerns. What was unknown was (a) how the domains of psychosocial risk and socioeconomic risk together might contribute to child mental health and (b) how exposure to these risk domains may be mitigated or exacerbated by childcare attendance. Therefore, as a second aim, we explored how these psychosocial and socioeconomic risk domain scores together (e.g., interactive effects, additive effects) contributed to the prediction of child internalizing and externalizing symptoms. Thus, in the current analyses, we considered both how these risk domains contribute to child mental health and whether such associations may be modified by childcare attendance.

Method

Participants

Data came from the NIH ECHO Program (Knapp et al., 2023), which comprises longitudinal cohort studies across the United States. All participants consented to participate in their local ECHO cohort study site and share their information with the ECHO consortia. Both a central and site-specific Institutional Review Board monitored human subject activities at each cohort study site and the centralized ECHO program.

To be included in the current analysis, study sites had to have available data on (a) the type and frequency of childcare attendance from birth to age 3 years; (b) parental exposure to ACEs; (c) parental depressive symptoms assessed at least once between birth and age 3 years; (d) the Home Observation for Measurement of the Environment (HOME), assessed between birth and age 3 years; (e) maternal age at the child's birth; (f) at least one assessment of child internalizing and externalizing problems between ages 3 years and 5.5 years; and (g) at least one assessment of parental educational attainment and marital status at or before the assessment of child internalizing and externalizing problems.

Three ECHO study sites collected the data required for the current study, with a total of $N = 2{,}024$ parent–child dyads across sites meeting study inclusion criteria. The Family Life Project (FLP) is a population-based longitudinal study designed to assess young children and their families recruited at birth from seven hospitals in central Pennsylvania and eastern North Carolina between September 2003 and September 2004 (Vernon-Feagans & Cox, 2013). Sampling was based on an epidemiological design to recruit a representative sample of children from six counties in these areas at the time of the child's birth.

The Conditions Affecting Neurocognitive Development and Learning in Early childhood (CANDLE) cohort, a prospective pregnancy cohort study in Shelby County, Tennessee, originally initiated to identify early-life factors affecting neurocognitive development, comprises mother–child dyads enrolled during pregnancy between 2006 and 2011 from four Memphis, TN hospitals (LeWinn et al., 2020; Sontag-Padilla et al., 2015; Steine et al., 2020). Pregnant women with low-medical risk pregnancies were recruited from prenatal clinics between 16 weeks and 29 weeks of gestation; women with known chronic conditions (e.g., hypertension, diabetes) were excluded.

The Early Growth and Development Study (EGDS) is a longitudinal study of domestically adopted children and their biological and rearing parents, recruited from adoption agencies across the United States between 2003 and 2009 following the birth of the child (Leve et al., 2019). Participants were recruited through 45 adoption agencies in 15 states across the United States. Participants were eligible for participation in EGDS if (1) the adoption was domestic, (2) the infant was placed with a non-relative adoptive family, (3) the infant was placed prior to 3 months of age ($M = 7.11$ days, $SD = 13.28$), (4) the infant had no known major medical conditions, and (5) the birth mother and adoptive parents could read or understand English at an eighth-grade level or higher. As the current analyses focused on postnatal risk exposures, we only included adoptive parent and not birth parent data, given that placement occurred soon after birth.

Table 1 provides detailed information about the demographics of each of the three site samples separately and of the current combined study sample as a whole.

Procedures

Available measures were selected across study sites to create scores for child early-life risk exposure assessed during the first three years of life (exposure), childcare attendance between birth and age 3 years (moderator), and child internalizing and externalizing problems assessed between 3 to 5.5 years (outcome). As noted above, for the risk exposure construct, we created two cumulative risk indices, one to quantify psychosocial risk exposure and one to quantify socioeconomic risk exposure, to examine the independent and dual influences of these different types of risk factors on child mental health. When different measures were utilized across study sites to assess the same construct, data that were harmonized across measures as part of the ECHO extant data harmonization effort were used, as described below (Vandenberg & Lance, 2000; Zheng et al., 2024).

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Table 1. Participant characteristics

	Combined Study Sites ($N = 2024$)	FLP ($n = 529$)	CANDLE ($n = 1077$)	EGDS ($n = 418$)
Child Age at Outcome, years *M (SD) [range]*	4.47 (0.55) [3.0-5.5]	4.96 (0.33) [3.01-5.5]	4.12 (0.46) [3.0-5.41]	4.74 (0.26) [4.35-5.47]
Child Sex (Male) *n* (%)	1,041 (51.43%)	267 (50.47%)	540 (50.14%)	234 (55.98%)
Child Race, *n* (%)				
American Indian or Alaska Native	5 (0.26%)	<5	<5	<5
Asian	9 (0.46%)	0 (0.00%)	<10	<5
Black/African American	997 (49.26%)	281 (53.12%)	658 (61.1%)	58 (13.88%)
Native Hawaiian or Other Pacific Islander	<5	0 (0.00%)	<5	<5
White	745 (36.81%)	206 (38.94%)	282 (26.18%)	257 (61.48%)
Multiracial	180 (8.89%)	38 (7.18%)	48 (4.46%)	94 (22.49%)
Other Race	9 (0.46%)	<5	<5	<5
Missing	75 (3.71%)	<5	74 (6.87%)	<5
Child Ethnicity (Hispanic or Latino/not Hispanic or Latino), *n* (%)				
Hispanic	95 (4.69%)	<10	31 (2.88%)	55 (13.16%)
Missing	74 (3.66%)	<5	73 (6.78%)	<5
Parental ACEs, *n* (%)[a]				
0	546 (26.98%)	103 (19.47%)	347 (32.22%)	96 (22.97%)
1	280 (13.83%)	76 (14.37%)	148 (13.74%)	56 (13.40%)
2	148 (7.31%)	34 (6.43%)	77 (7.15%)	37 (8.85%)
3	116 (5.73%)	31 (5.86%)	65 (6.04%)	20 (4.78%)
4	89 (4.40%)	22 (4.16%)	55 (5.11%)	12 (2.87%)
≥ 5	158 (7.81%)	27 (5.10%)	120 (11.14%)	11 (2.63%)
Missing	687 (33.94%)	236 (44.61%)	265 (24.61%)	186 (44.5%)
Parental Depressive Symptoms, *n* (%)[a]				
T-score<55	1325 (65.46%)	126 (23.82%)	860 (79.85%)	339 (81.1%)
T-score 55-59	426 (21.05%)	238 (44.99%)	127 (11.79%)	61 (14.59%)
T-score 60-64	173 (8.55%)	107 (20.23%)	51 (4.74%)	15 (3.59%)
T-score 65-69	71 (3.51%)	39 (7.37%)	<30	<5
T-score 70+	29 (1.43%)	19 (3.59%)	<15	<5
Missing	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)
HOME Scores[a]				
Responsivity, *M (SD) [range]*	9.57 (1.64) [0-11]	9.57 (1.67) [2-11]	9.36 (1.72) [0-11]	9.92 (1.39) [5-11]
Acceptance, *M (SD) [range]*	6.92 (1.20) [0-8]	6.88 (0.99) [3-8]	6.49 (1.40) [0-8]	7.7 (0.50) [6-8]
Low score, *n* (%)	121 (5.98%)	36 (6.81%)	75 (6.96%)	10 (2.39%)
Missing, *n* (%)	498 (24.59%)	17 (3.21%)	437 (40.58%)	44 (10.53%)

(*Continued*)

Table 1. (*Continued*)

	Combined Study Sites ($N = 2024$)	FLP ($n = 529$)	CANDLE ($n = 1077$)	EGDS ($n = 418$)
Psychosocial Risk Index Score, *n* (%)				
0	354 (17.49%)	42 (7.94%)	206 (19.13%)	106 (25.36%)
1	444 (21.94%)	139 (26.28%)	215 (19.96%)	90 (21.53%)
≥2	181 (8.94%)	102 (19.28%)	65 (6.04%)	14 (3.35%)
Missing	1045 (51.63%)	246 (46.50%)	591 (54.87%)	208 (49.76%)
Parental Educational Attainment, *n* (%)[b]				
Less than High School Degree	99 (4.89%)	49 (9.26%)	50 (4.64%)	0 (0.00%)
High School Degree or GED	469 (23.17%)	12 (2.27%)	424 (39.37%)	33 (3.89%)
Some College, Associate's Degree, or Trade School Degree	317 (15.66%)	133 (25.14%)	138 (12.81%)	46 (11%)
Bachelor's Degree	623 (30.78%)	175 (33.08%)	275 (25.53%)	173 (41.39%)
Masters, PhD, Professional Degree	483 (23.86%)	140 (26.47%)	183 (16.99%)	160 (38.28%)
Missing	33 (1.63%)	20 (3.78%)	7 (0.65%)	6 (1.44%)
Maternal Age at Child's Birth[b]				
<21yrs, *n* (%)	401 (19.81%)	121 (22.87%)	145 (13.46%)	135 (32.3%)
Missing, *n* (%)	7 (0.35%)	0 (0.00%)	0 (0.00%)	7 (1.67%)
Parental Relationship Status, *n* (%)[b]				
Married or Living with Partner	1256 (62.06%)	212 (40.08%)	636 (59.05%)	408 (97.61%)
Missing	13 (0.64%)	20 (3.78%)	0 (0.00%)	0 (0.00%)
Socioeconomic (SES) Risk Index Score, *n* (%)				
0	651 (32.16%)	173 (32.70%)	263 (24.42%)	215 (51.44%)
1	802 (39.62%)	171 (32.33%)	474 (44.01%)	157 (37.56%)
2	429 (21.20%)	119 (22.50%)	277 (25.72%)	33 (7.89%)
3	101 (4.99%)	46 (8.70%)	55 (5.11%)	0 (0.00%)
Missing	41 (2.03%)	20 (3.78%)	8 (0.74%)	13 (3.11%)
Childcare Attendance				
In any non-parental childcare, *n* (%)	1847 (91.25%)	506 (95.65%)	954 (88.58%)	387 (92.58%)
In center-based childcare, *n* (%)	1348 (66.60%)	329 (37.81%)	657 (61.00%)	362 (86.60%)
Hours/week in any non-parental care, *M (SD) [range]*	26.19 (17.53) [0-134]	33.81 (15.45) [0-134]	23.49 (17.96) [0-99]	23.49 (16.02) [0-80]
Hours/week in center-based care, *M (SD) [range]*	16.64 (16.41) [0-77]	16.80 (16.75) [0-52.5]	15.98 (16.81) [0-77]	18.13 (14.77) [0-75]
Child Internalizing Symptoms T-Score, *M (SD) [range]*	47.65 (12.07) [29-95.4]	52.54 (14.29) [31.6-95.4]	44.98 (10.8) [29-92]	48.34 (9.88) [29-87]
Child Externalizing Symptoms T-Score, *M (SD) [range]*	45.10 (9.83) [28-88]	41.58 (7.15) [28.1-61.9]	45.07 (10.43) [28-88]	49.63 (9.35) [28-85]

Note. If percent missing data is not reported for a given variable, then no data were missing for that variable. [a]Contributor to Psychosocial Risk Index. [b]Contributor to Socioeconomic (SES) Risk Index. CANDLE = Conditions Affecting Neurocognitive Development and Learning in Early childhood; EGDS = Early Growth and Development Study; FLP = Family Life Project.

Measures

Child risk exposures

To address calls for better characterization of risk domains that allow for examination of different types of risks while accounting for the compounding impact of multiple risks (Bethell, Blackwell, et al., 2022; Evans et al., 2013; Huston & Bentley, 2010; McLaughlin et al., 2012), we created two risk domain indices, each of which comprised multiple individual risk factors. Our choice of risk factors was informed by the extant child mental health literature (Evans et al., 2013; McLaughlin & Lambert, 2017; Wilhelmsen et al., 2023).

Cumulative Psychosocial Risk Index (Exposure). We created a cumulative risk index quantifying psychosocial risks comprising parental ACEs, parental depressive symptoms, and low enrichment of the home caregiving environment.

Parental ACEs. Two study sites administered the CDC-Kaiser ACE Study questionnaire (Felitti et al., 1998), which was harmonized with data from the third site, which used a modified version of the ACEs module of the Behavioral Risk Factor Surveillance System (BRFSS) (Merrick et al., 2018). Both the 10-item CDC-Kaiser ACE Study questionnaire and the 9-item module from the BRFSS inquire about whether the parent experienced a range of adversities between birth and age 18 years. Nine ACEs could be harmonized across the three study sites: (1) verbal abuse and neglect; (2) physical abuse; (3) sexual abuse; (4) economic hardship; (5) parental separation/divorce; (6) witnessing physical abuse; (7) living with someone who had a problem with drugs or alcohol; (8) living with someone who was depressed, mentally ill, or suicidal; and (9) having a household member go to prison. We computed composite scores (range: 0–9) reflecting the number of adverse childhood exposures the parent experienced during their own childhood.

Parental Depressive Symptoms. Each study site used one or more of the following measures to assess parental depressive symptoms: Edinburgh Postnatal Depression Scale (EPDS) (Blackwell et al., 2021), Brief Symptom Inventory (BSI) (Kaat et al., 2017), Short Form (36) Health Survey (SF-36) (Choi et al., 2012a), and Center for Epidemiological Studies Depression Scale (CES-D) (Choi et al., 2014).

The ***EPDS*** is a 10-item self-report questionnaire specifically designed to measure the presence of depressive symptoms in mothers during the perinatal period, although it has been used in both mothers and fathers and across a range of child ages (Blackwell et al., 2021; Edmondson et al., 2010). The EPDS inquires about depressive symptoms over the previous 7 days. Each item is scored for severity from 0 to 3 and then summed to provide a total score (possible range 0–30), with higher scores indicating greater severity of depressive symptoms. The EPDS has demonstrated high internal consistency and validity across diverse cultures for detecting major depression in the perinatal period (Gibson et al., 2009; Sambrook Smith et al., 2022), and showed good internal reliability in this sample ($\alpha = 0.79$).

The ***BSI*** is a 53-item self-report questionnaire assessing psychopathology across nine dimensions, including a 6-item depression subscale meant to screen for depression. Items ask about the past 7 days and use a 5-point Likert response scale ranging from 0-*Not at all* to 4-*Extremely*. Item scores are summed to provide a total score. Subscale raw scores are calibrated and normed to the general US population; normed scores are expressed as the standard T-score metric (mean = 50, SD = 10). Higher scores indicate greater severity of depressive symptoms. The BSI has high internal consistency and has been validated across a range of ages and populations (Derogatis & Melisaratos, 1983; Derogatis, 1993) and had excellent internal reliability in the current sample ($\alpha = 0.91$).

The ***SF-36*** is a 36-item self-report survey assessing general quality of life, including a 5-item mental health domain asking individuals to report how often they felt nervous, down, calm (reverse-coded), downhearted and blue, and happy (reverse-coded) over the past 4 weeks using a 6-point Likert response scale ranging from 1-*All of the time* to 6-*None of the time*; higher scores indicate more positive mental health indicators. The SF-36 is normed for the general US population, and raw scores are converted to T-scores. The SF-36 has been widely used and validated across clinical and non-clinical populations, with high internal consistency and robust test–retest reliability (Ware et al., 2000; Ware, 2000; Ware & Sherbourne, 1992). Internal reliability for the current sample was adequate ($\alpha = 0.65$).

The ***CES-D*** is a 20-item self-report survey assessing depressive symptoms over the past week on a 4-point Likert response scale ranging from 0-*Rarely or none of the time (less than 1 day)* to 3-*Most or all of the time (5–7 days)*. A total sum score is computed (possible range 0–60), with higher scores reflecting greater depressive symptoms. The CES-D has high internal consistency and has been clinically validated in diverse populations to identify individuals at risk for clinical depression (Radloff, 1977). Internal consistency was excellent for this sample ($\alpha = 0.90$).

Due to variations in site data collection schedules, we included parental depression data collected between child ages 0 to 3 years. In cases where parental depression was assessed more than once, the highest score was selected. Scores from these validated depression instruments were harmonized to the standard PROMIS v1.0 Depressive Symptoms T-score metric (mean = 50, SD = 10) using the existing crosswalk conversion tables developed using the validated PROsetta Stone score linking methodology (Choi et al., 2012b, 2021; Schalet et al., 2021). Prior validation work establishing these links (i.e., EPDS: Blackwell et al., 2021; BSI: Kaat et al., 2014; SF-36: Choi et al., 2012a; CES-D: Choi et al., 2014) shows high reliability of the combined PROMIS v1.0 Depressive Symptoms and legacy measure (i.e., EPDS, BSI, SF-36, CES-D) item sets ($\alpha \geq 0.95$, $\omega \geq 0.85$) and high correlations between linked and observed scores (≥ 0.80). We defined a positive depression screen as a T-score ≥ 55 (i.e., 0.5 SD above the mean) based on existing work suggesting that this threshold captures individuals with, at minimum, mild depressive symptoms (Kroenke et al., 2020).

Home Caregiving Environment. We used the Infant/Toddler-Home Observation for the Measurement of the Environment (IT-HOME) (Bradley, 1989; Caldwell & Bradley, 2001; Totsika & Sylva, 2004), administered during the child's first three years, to characterize the quality of the child's early caregiving environment. The IT-HOME is a 45-item checklist with six subscales. Each endorsed item is scored as a 1, with higher subscale and total scores reflecting a more enriched home environment. Because some study sites only administered certain subscales, we selected the two common subscales across the three sites: *responsivity*, an 11-item subscale assessing the parent's emotional and verbal

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responsiveness and interactions with the child, and *acceptance*, an 8-item subscale assessing the parent's discipline practices (Caldwell & Bradley, 2001; Totsika & Sylva, 2004). The measure has been widely used and validated and has demonstrated moderate stability across time (Bradley, 1989; Rijlaarsdam et al., 2012). In our sample, subscale reliability was moderate to acceptable (responsivity: $\alpha = 0.71$; acceptance: $\alpha = 0.62$), consistent with subscale reliability from existing work (α = 0.3–0.8) (Bradley, 1993).

Calculation of Cumulative Psychosocial Risk Index. A psychosocial risk index score was computed by assigning one point to each of the following criteria: parent reported two or more ACEs, given prior reported thresholds (Bethell, Carle, et al., 2017); parent had a positive depression screen for mild depressive symptoms or greater, using the established PROMIS clinically meaningful cut point of T-score ≥ 55 (Kroenke et al., 2020); and HOME responsivity and/or acceptance subscale score was in the lowest quartile provided in the HOME scoring manual (Caldwell & Bradley, 2001), as scores in this range have been shown to indicate an environment that may pose risk to child development (Totsika & Sylva, 2004). Possible scores on the psychosocial risk index ranged from 0 risks to 3 risks. Given the small number of participants with 3 psychosocial risks ($n = 10$), we collapsed the two highest categories so that the final index reflected 0 risks, 1 risk, and 2 or more risks.

Cumulative Socioeconomic Status (SES) Risk Index (Exposure). We created a cumulative risk index capturing socioeconomic risks experienced in the first three years of life across three domains, each obtained from parental report: ***parental highest educational attainment*** (less than high school degree, high school degree, GED, or equivalent; some college, an associate's degree, or trade school degree; bachelor's degree; and master's, professional, or doctorate degree*);* ***maternal age (in years) at childbirth***; and ***parental marital/partner status*** (married or living with a partner; widowed, divorced, or separated; or single or never married). A SES risk index score was computed by assigning one point to each of the following criteria: parent education less than a bachelor's degree; maternal age at childbirth younger than 21 years; and parent neither married nor living with a partner. Possible scores ranged from 0 risks to 3 risks.

Childcare (ECEC) attendance (Moderator)

Each study site collected information on the amount of time that children spent in various types of nonparental care. To assess childcare attendance, we computed a variable representing the *total average hours per week in any nonparental care* ("***total hours in nonparental care***"), which was the sum of the average hours per week in center-based care (e.g., Head Start, prekindergarten program, nursery school, preschool, program in a center, program in an organized facility), home-based non-relative care (i.e., daycare in the provider's home with a group of children), and relative care (i.e., care provided by an adult relative of the child, either in the child's home or in the relative's home). Given that type of nonparental care may differentially impact young children's mental health and that there are conceptual differences between center-based care and other nonparental care (Rey-Guerra et al., 2023), we derived a variable describing the average hours per week the child spent specifically in center-based care ("***total hours in center-based care***"). This variable enabled testing of whether any effect modification of childcare was specific to hours spent in center-based care, specifically, versus hours spent in any type of nonparental care.

Child internalizing and externalizing problems (Outcome)

To maximize sample size and account for different assessments used across study sites, we used data on child internalizing and externalizing problems from the Child Behavior Checklist for ages 1½ -5 (CBCL/1½ -5) (Achenbach & Rescorla, 2000; Achenbach & Ruffle, 2000) and the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 2001), assessed when children were 3 to 5.5 years old. If a child had multiple assessment time points of internalizing and externalizing problems on both measures, the CBCL was prioritized given the more robust reliability of linked scores (described below); if multiple assessments were still available, we selected the earliest available assessment for chronological proximity to our exposure and moderator variables.

The ***CBCL/1½-5***, one of the most well-established, empirically supported questionnaires to assess child mental health symptoms (Achenbach et al., 2008), is a 99-item questionnaire that has been validated for the assessment of emotional and behavioral problems in young children (Achenbach & Ruffle, 2000). The respondent is asked to assess how often particular child behaviors occurred over the past 6 months on a 3-point scale (0 = not true, 1 = somewhat or sometimes true, 2 = very true or often true). Two broadband scales, *Internalizing Problems* and *Externalizing Problems*, can be computed. The Internalizing Problems score is composed of the following syndrome scales: Anxious/Depressed, Emotionally Reactive, Withdrawn, and Somatic Complaints. The Externalizing Problems scores is composed of the following syndrome scales: Attention Problems and Aggressive Behavior. Both broadband scales showed excellent internal consistency in the current sample (internalizing: $\alpha = 0.88$; externalizing: $\alpha = 0.91$).

The ***SDQ*** is a 25-item parent report survey asking respondents to rate their children's emotional and behavioral problems over the past 6 months on a 3-point Likert scale (0 = not true, 1 = somewhat true, 2 = certainly true) (Goodman, 2001). Study sites used either the SDQ 2-4, which is appropriate for 2- to 4-year-olds, or the SDQ 4-10, which is appropriate for 4- to 10-year-olds. All but three items are identical (paraphrased items: argues with adults vs. lies/cheats; stops and thinks before acting vs. thinks before acting; and spiteful of others vs. steals), and both forms have the same five subscales, same two broadband scales, and same overall total score. We utilized the *Internalizing Problems* score, which comprises the 5-item emotional problems and peer problems subscales (possible range: 0–20), and the *Externalizing Problems* score, which comprises the 5-item hyperactivity and conduct problems subscales (possible range: 0–20). Both broadband scales showed good internal reliability in the current sample (internalizing: $\alpha = 0.72$; externalizing: $\alpha = 0.80$).

Data from the CBCL/1½-5 and the SDQ were harmonized to the CBCL metric using the validated equipercentile score linking approach to produce harmonized Internalizing and Externalizing T-scores (Mansolf et al., 2022). The two measures are highly comparable (Achenbach et al., 2008), and validation evidence described in Mansolf et al. (2022) shows high reliability of the combined CBCL and SDQ item sets ($\alpha > 0.95$, $\omega > 0.94$) and high correlations between linked and observed scores (> 0.82), suggesting minimal measurement bias and robust harmonization. As reported in Mansolf et al. (2022), although SDQ versions have

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some items with slightly different wording, the forms are essentially measurement invariant, and crosswalk tables can be used with nonstandard conversions (i.e., converting SDQ 4–10 to CBCL/1½-5). We therefore used crosswalk conversion tables to convert SDQ 2-4 and SDQ 4-10 scores to CBCL/1½-5 scores (see Mansolf et al., 2022 Supplemental Tables S1a and S1b). We used the CBCL/1½-5 T-score thresholds to describe borderline clinical significance (T-score = 60–63) and clinical significance (T-score ≥ 64) (Achenbach & Rescorla, 2000).

Data analyses

We performed descriptive analyses to assess sample characteristics. To test our first hypothesis that greater attendance in childcare attenuates associations of greater exposure to psychosocial and SES risks with heightened internalizing and externalizing symptoms in early childhood, we conducted a separate series of linear regression models for each outcome (i.e., internalizing problems, externalizing problems) and childcare attendance variable (i.e., total hours in nonparental care, total hours in center-based care). In these models, psychosocial risk and SES risk (predictors) and childcare attendance (moderator) were included as the independent variables, and internalizing problems and externalizing problems were the dependent variables. All models were adjusted for child age (in years) at the time of the outcome assessment and for child sex assigned at birth (hereafter "sex," female = reference) as well as for study site fixed effects to control for any unobserved differences in the relation between exposures and outcomes of interest across the three study sites. We also included an interaction between the two risk indices to account for the potential of non-linear cumulative risks, addressing the second aim of our analyses.

To minimize unnecessary testing of simpler models and to begin with a direct test of our first hypothesis, we began with the most complex models (i.e., including all risk and childcare terms and interaction terms) and then removed nonsignificant (i.e., $p > .05$) higher-order terms in subsequent reduced models until we had a parsimonious model that remained hierarchically well defined (i.e., we retained lower-order terms regardless of significance if a higher-order term was significant). Specifically, we first tested the three-way interaction among psychosocial risks, SES risks, and childcare attendance to investigate whether childcare attendance modified any combined effects of psychosocial risk and SES risk with respect to internalizing and externalizing symptoms. If this three-way interaction was not significant, subsequent reduced models were run to test two, two-way interactions involving risk and childcare (psychosocial risks by childcare, SES risks by childcare) to examine the extent to which childcare attendance moderated the effects of each type of risk on child internalizing and externalizing problems. If these two-way interaction terms were not significant, we then removed them and examined associations of the two-way risk interaction term (psychosocial risks by SES risks) on child mental health outcomes to allow us to fully address our second aim – examination of the combined effects of the two risk domains on child internalizing and externalizing symptoms. If the interaction term was not statistically significant, models were further reduced to those without interactions. We used passive, multiple imputation in the mice R package (van Buuren & Groothuis-Oudshoorn, 2011) for missing data on all variables except the outcomes (CBCL/SDQ) and childcare attendance, which required complete data for inclusion in analyses.

Results

Descriptive analyses

Participant characteristics are presented in Table 1. Children were $M = 4.47$ years old ($SD = 0.55$, range: 3.0–5.5 years) at the time of the outcome assessment. Most caregivers were biological ($n = 1{,}589$, 78.5%) or adoptive ($n = 405$, 20%) mothers; the remaining 1.5% identified as the child's biological ($n < 5$) or adoptive father ($n < 15$) or other relative, such as a grandparent ($n < 15$). The sample was sociodemographically diverse. Approximately 49% of the sample were identified by their parent as Black/African American, 37% as White, and 9% as multi-racial. Half of the sample are female. Parents' educational attainment varied, with 28% having a high school degree or less, 16% some college or an associate's or trade school degree, 31% a college degree, and 24% a postgraduate degree. Parental relationship status also varied, with approximately two-thirds married or living with a partner; 20% of the children were born to mothers younger than 21 years old.

Two-thirds of the sample had at least one psychosocial risk (63.8%) or SES risk (67.2%). Most children (91.3%) attended some type of nonparental childcare, spending on average 26.19 h per week ($SD = 17.53$) in any type of nonparental care setting. Two-thirds of children (66.6%) attended center-based childcare, spending on average 16.64 h per week ($SD = 16.41$) in this care setting. On average, children's internalizing T-scores were 47.65 ($SD = 12.07$), and externalizing T-scores were 45.10 ($SD = 9.83$). For internalizing problems, 6.4% ($n = 130$) and 11.0% ($n = 222$) met borderline clinical levels (T-score = 60–63) and clinical levels (T-score ≥ 64), respectively; for externalizing problems, 3.1% ($n = 63$) and 3.7% ($n = 75$) met borderline clinical levels and clinical levels, respectively.

Regression analyses

Early adversity, childcare attendance, and child mental health

The three-way interaction terms among childcare attendance (total hours in nonparental care or specifically in center-based care) by psychosocial risk by SES risk were not significant in relation to child internalizing or externalizing problems. Thus, the analyses did not provide evidence of effect modification of childcare attendance, either total hours in nonparental care or specifically in center-based care, on the interactive effects of psychosocial risk and SES risk on child internalizing or externalizing problems (Supplementary Tables 1 and 2).

Given their lack of significance, we removed three-way interaction terms from subsequent models, which next focused on testing two-way interactions involving childcare attendance. In these models, childcare attendance did not moderate the association of the psychosocial risk index or the SES risk index with internalizing or externalizing problems; this result was consistent across total childcare hours and hours specifically in center-based care (Supplementary Tables 3 and 4). Thus, we did not observe evidence that childcare attendance modified any effects of psychosocial risk exposures or socioeconomic risk exposures on child mental health outcomes.

Combined effects of psychosocial risk and socioeconomic risk on child mental health

To address our second aim, we then tested models that did not include effect modification of psychosocial risk or SES risk by childcare variables (i.e., removed two-way interaction terms of risk

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Table 2. Primary models evaluating the association of early psychosocial risks and socioeconomic risks and childcare attendance with early childhood internalizing problems

	Results when Hours/Week in Any Non-Parental Childcare is Included					Results when Hours/Week in Center-Based Care is Included				
Parameter	*b*	*se*	*95% CI*		*p*	*b*	*se*	*95% CI*		*p*
Psychosocial Risk	0.80	0.61	−0.40	2.00	.193	0.81	0.61	−0.39	2.00	.187
Socioeconomic (SES) Risk	0.70	0.51	−0.30	1.71	.172	0.71	0.51	−0.29	1.72	.164
Psychosocial Risk*SES Risk	1.56	0.47	0.64	2.48	.001	1.56	0.47	0.64	2.48	.001
Childcare (hours/week)	0.00	0.01	−0.03	0.03	.915	−0.02	0.02	−0.05	0.01	.238
Child Age	0.31	0.65	−0.96	1.58	.632	0.31	0.65	−0.96	1.57	.637
Child Sex (Male)	−0.12	0.51	−1.12	0.87	.809	−0.14	0.51	−1.13	0.86	.788
CANDLE Cohort	−5.70	0.86	−7.38	−4.02	<.001	−5.70	0.85	−7.37	−4.02	<.001
EGDS Cohort	−1.34	0.85	−3.00	0.32	.114	−1.43	0.82	−3.04	0.18	.083
(Intercept)	46.90	3.43	40.17	53.62	<.001	47.17	3.42	40.46	53.87	<.001

Note. CANDLE = Conditions Affecting Neurocognitive Development and Learning in Early childhood; EGDS = Early Growth and Development Study. Referent site = FLP (Family Life Project).

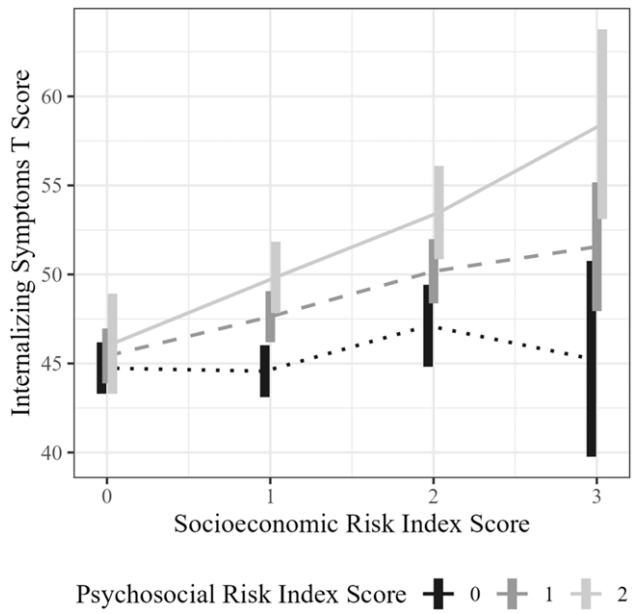

Figure 1. Internalizing symptoms T-score by socioeconomic risk across different levels of psychosocial risk. *Note.* Figure from regression model including hours per week in any non-parental childcare setting as a main effect term. There was a significant interaction between psychosocial risk and socioeconomic risk in predicting child internalizing problems.

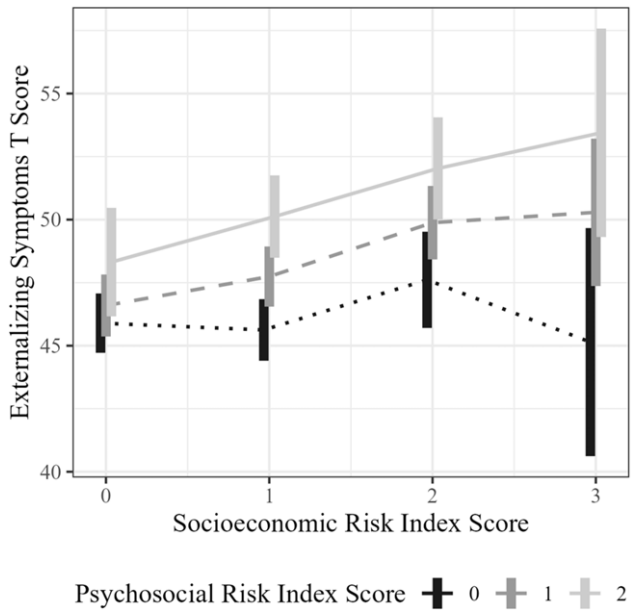

Figure 2. Externalizing symptoms T-score by socioeconomic risk across different levels of psychosocial risk. *Note.* Figure from regression model including hours per week in any non-parental childcare setting as a main effect term. There was a significant interaction between psychosocial risk and socioeconomic risk in predicting child externalizing problems.

variable by childcare variable) but retained the two-way interaction term of psychosocial risk by SES risk. For internalizing problems, there was a significant interaction between psychosocial risk and SES risk, such that the impact of higher levels of psychosocial risk on child internalizing problems was greater among children with higher levels of SES risk (Figure 1). Findings were similar across models with total hours spent in any nonparental care ($b = 1.56$, $SE = 0.47$, 95% CI: 0.64–2.48, $p = .001$) and total hours spent in center-based care ($b = 1.56$, $SE = 0.47$, 95% CI: 0.64–2.48, $p = .001$; Table 2). There was no main effect for time spent in nonparental childcare or time spent specifically in center-based care on child internalizing problems in these models (Table 2).

For externalizing problems, similar to internalizing problems, there was a significant interaction between psychosocial risk and SES risk, such that the impact of higher levels of psychosocial risk on child externalizing problems was greater among children with higher levels of SES risk (Figure 2). Findings were similar across models with total hours spent in any nonparental care ($b = 0.76$, $SE = 0.37$, 95% CI: 0.03–1.50, $p = .042$) and total hours spent in center-based care ($b = 0.76$, $SE = 0.37$, 95% CI: 0.03–1.50, $p = .042$; Table 3). There was no main effect of time spent in nonparental childcare or in time spent specifically in center-based care on externalizing problems (Table 3).

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Table 3. Primary models evaluating the association of early psychosocial risks and socioeconomic risks and childcare attendance with early childhood externalizing problems

Parameter	Results when Hours/Week in Any Non-Parental Childcare is Included					Results when Hours/Week in Center-Based Care is Included				
	b	*se*	*95% CI*		*p*	*b*	*se*	*95% CI*		*p*
Psychosocial Risk	1.21	0.49	0.25	2.17	.014	1.21	0.49	0.24	2.17	.014
Socioeconomic (SES) Risk	0.51	0.41	−0.3	1.32	.216	0.5	0.41	−0.3	1.31	.221
Psychosocial Risk*SES Risk	0.76	0.37	0.03	1.50	.042	0.76	0.37	0.03	1.50	.042
Childcare (hours/week)	0	0.01	−0.02	0.03	.673	0.01	0.01	−0.02	0.03	.502
Child Age	−0.48	0.53	−1.52	0.55	.361	−0.48	0.53	−1.51	0.55	.364
Child Sex (Male)	−1.13	0.41	−1.95	−0.32	.006	−1.12	0.41	−1.94	−0.31	.007
CANDLE Cohort	4.38	0.7	3.01	5.74	< .001	4.35	0.69	2.99	5.71	< .001
EGDS Cohort	9.93	0.69	8.58	11.29	< .001	9.91	0.67	8.59	11.22	< .001
(Intercept)	42.16	2.8	36.68	47.64	< .001	42.15	2.79	36.68	47.61	< .001

Note. CANDLE = Conditions Affecting Neurocognitive Development and Learning in Early childhood; EGDS = Early Growth and Development Study. Referent site = FLP (Family Life Project).

Secondary analyses

In secondary analyses, we ran parallel regression analyses to those described above, adding (a) all possible covariate interaction terms, as suggested by others to control for any effects of the covariates on the main interaction terms of interest (Keller, 2014) and (b) interaction terms by study site to determine if there were differences in the pattern of associations by site. The main results were unaffected by inclusion of these terms. The site interaction terms were not significant, suggesting a lack of differences across sites in the pattern of associations among the risk, childcare, and child mental health variables. The primary models with these terms (i.e., excluding nonsignificant interaction terms among the risk and childcare variables) are presented in the Supplemental Materials (Supplementary Tables 5 and 6).

Discussion

The overall objective of the current study was to test whether attendance in childcare moderates the effects of early exposure to adversity on child mental health by age 5 years. Exposure to adversity in the first years of life is a documented risk factor for a range of poor developmental, mental health, and physical health outcomes across the life span; exposures in the home environment are particularly impactful (Britto et al., 2017; McLaughlin & Lambert, 2017; Orendain et al., 2023; Shonkoff & Phillips, 2000). Time spent in childcare may mitigate such exposure effects by providing the child with an alternative, supportive caregiving environment. Alternatively, time spent in childcare may exacerbate such exposure effects by decreasing the child's time spent with their primary caregivers. We tested our hypotheses in a large sample of parent–child dyads, comprising multiple longitudinal study sites participating in the ECHO Program. The findings indicated that neither time spent in any nonparental childcare nor time spent specifically in center-based childcare attenuated or magnified the effects of early psychosocial risk and socioeconomic risk on child mental health. Additionally, childcare attendance did not show a positive or negative effect on child mental health as a main effect.

Thus, although we did not find that time spent in childcare buffered the negative effects of psychosocial or socioeconomic risk on child mental health, we also did not find evidence that childcare attendance magnified the effects of early adversity on child mental health or that childcare attendance had a detrimental effect on child mental health more generally. Previous studies have documented conflicting findings as to whether attendance in childcare is associated with increased risk for child emotional and behavioral problems, particularly externalizing behaviors (Belsky et al., 2007; Côté et al., 2007; Crosby et al., 2010; Huston et al., 2015; NICHD Early Child Care Research Network, 2003; Orri et al., 2019; Rey-Guerra et al., 2023; Zachrisson et al., 2013). Moreover, findings also have been inconsistent as to whether time spent in childcare has greater impact on children with specific adversity profiles. Some studies suggest that greater time in nonparental care may be associated with decreased externalizing behaviors, particularly among children of socially disadvantaged families (Côté et al., 2007; Crosby et al., 2010; Orri et al., 2019). Others have found that the association between hours spent in center-based care and externalizing problems is strongest among families with high incomes or low risk of exposure to adversity (Blair et al., 2014; Huston et al., 2015). Our findings are consistent with a recent meta-analysis that demonstrated no associations between hours spent in center-based care and child externalizing problems (Rey-Guerra et al., 2023). Moreover, this meta-analysis found no evidence of moderating effects by family income or maternal education despite the considerable socioeconomic variability represented across the studies included in the analysis (Rey-Guerra et al., 2023). Our study expands upon these findings by considering potential effects on the development of child internalizing problems.

The goal of our second aim was to apply a more nuanced approach to examining early-life adversity effects on child mental health outcomes. We found that psychosocial risk and socioeconomic risk in early life had interactive effects on child internalizing and externalizing symptoms. Specifically, the effects on child symptoms of increasing psychosocial risk exposure were magnified in the context of greater socioeconomic risk exposure. Future work may explore the pathways and mechanisms by which different forms of adversity affect child mental health risk. Such work may also consider whether any effects differ by sex. We included sex as a covariate in analyses, finding main effects for externalizing problems, with boys having higher scores than girls. Given well-

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documented sex differences in the effects of various risk factors in early life on a range of developmental outcomes (An et al., 2022; Cameron et al., 2017; Hodes & Epperson, 2019; Letourneau et al., 2019; Ma et al., 2022), consideration of potential sex-specific effects on the development of internalizing and externalizing symptoms in future studies is warranted.

Our findings are consistent with the extant literature regarding the negative impact of exposure to adversities in early life on child mental health. In the current study, we used cumulative risk composite indices instead of individual risk variables to examine adversity exposure effects on child mental health, given the number of risk variables and our sample size. Consequently, our analyses do not indicate if specific risk factor(s) may be driving any associations. However, prior work has shown that the accumulation of risks is more strongly associated with child outcomes compared to any individual risk, driving our decision not to focus on analysis of individual risk factors (Evans et al., 2013). Further, we extended this work by using domain-level risk composites to help identify whether type of risk (psychosocial, socioeconomic) had differential influence on child mental health outcomes. This approach is responsive to calls by others to create risk scores that combine singular risk factors into cumulative risk domains scores (rather than a singular cumulative risk score) to allow for the testing of main and interactive effects of risk domains (Evans et al., 2013). In doing so, we identified an interactive effect between psychosocial and socioeconomic risks on child mental health in the first years of life. An important next step will be to identify whether specific exposures, either alone or in combination, are more strongly associated with children's emotional and behavioral functioning and if childcare attendance moderates the association between specific risks and child mental health. The current findings suggest that the overarching domains of psychosocial risk and socioeconomic risk exert effects on child mental health, with their combined effects more nuanced than a simple additive effect. Thus, there may be value in using a combination of approaches in assessing child risk that utilizes cumulative risk scores *within domains of risk* but maintains *separate scores for different domains of risk*.

Of potential relevance, our sample overall had relatively low levels of child internalizing and externalizing symptoms. Samples enriched for clinical risk or who demonstrate evidence of clinical levels of psychopathology may show a different pattern of results. The hypotheses should be tested in samples with greater and more varied types of adversity and clinical risk to determine if the pattern of findings vary by risk profiles.

Strengths, limitations, and future directions

This study offers a number of strengths. We were able to leverage the ECHO Program to derive a large, diverse US-based sample. The study sites provided parental and child mental health data, data typically not available in childcare-focused longitudinal cohort studies. Similarly, more detailed childcare data were available than is typical in childhood mental health studies. The study is innovative in that there has been limited research on how ECEC may moderate the relation between early-life exposure to adversity and child mental health. Moreover, our adversity measure included multiple indicators across different forms of adversity (psychosocial exposures, comprising parental exposure to adversity in their own childhood, parental depressive symptoms, and low enrichment of the home caregiving environment; socioeconomic exposures, comprising low parental educational attainment, young maternal age at childbirth, and parent neither married nor living with a partner). Examining adversity in this manner elucidated effects of psychosocial risk and socioeconomic risk on child mental health, with evidence for interactive effects between these two types of adversity on internalizing and externalizing problems in early childhood. This approach combined the documented benefits of utilizing cumulative risk indices in predicting mental health outcomes (Evans et al., 2013), while allowing for the examination of potential differential and interactive effects of distinct types of exposures on child mental health in early life. Moreover, because of the longitudinal nature of the study design, we were able to show evidence of a temporal relation between the risk exposure predictor variables and the child mental health outcome variables. That being said, we acknowledge that many of the risk factors we assessed between birth and age 3 years were likely to be chronic or fixed and thus may have continued past age 3 years.

Limitations of the current study are worth considering. Many of the measures relied on parental report, which may have inflated associations between affected variables. The harmonization required to combine data across the study sites meant that some variables lost granularity and that there was an increase in potential measurement error. In particular, each study site measured childcare attendance at different time points and frequencies and with different survey methodologies (e.g., concurrent vs. retrospective) and items. Data reduction was required to develop a common metric of childcare type and timing, which may have compromised variability and could not account for potential stops and starts of childcare across the first three years of life. Relatedly, due to site differences in the manner in which questions were worded regarding childcare attendance history, we were unable to account for the age at which childcare began or the "dosage," that is, how much of the first three years were spent in childcare. Additionally, because childcare type was not mutually exclusive, with many different potential combinations of care within and across time (i.e., a child could be in multiple types of nonparental care at the same time or at different times between birth to 3 years), we could not evaluate every single type of care combination; instead, we could only assess total hours per week in nonparental care and in center-based care specifically, both of which could be harmonized across all three study sites. Similarly, we were unable to examine potential differences in effects of attendance in different types of center-based care. For parental depressive symptoms and the child internalizing and externalizing outcomes, some additional measurement error was introduced through the score-linking process. However, the robust item response theory (IRT)-based score-linking methodology reduces error to the extent possible. Moreover, validation studies for adult depression (Blackwell et al., 2021; Choi et al., 2012a; Choi, et al., 2014; Kaat et al., 2017) and the CBCL/SDQ (Mansolf et al., 2022) harmonization show low bias and high reliability of the harmonized metrics.

We believe the noted limitations were offset by several benefits afforded by harmonization. By combining data from multiple diverse cohorts, we could characterize the associations among ECEC, psychosocial and socioeconomic risk, covariates, and child internalizing and externalizing symptoms across a broader region of the predictor space with a greater sample size, increasing power and generalizability. Further, harmonization allows the comparison of the same constructs across sites despite the sites using different measures to assess the constructs. Examining the study questions within site without harmonizing the data would have impeded interpretations of findings across studies, particularly any differences. We would not be able to disentangle true differences in

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associations among study variables by site versus differences attributable to variations in measures/protocols used to assess the same underlying construct. Notably, we tested for and did not observe any site differences in the pattern of associations among the risk, childcare, and child mental health variables using harmonized data.

Although our risk variables had noted strengths, they also had limitations. First, the risk variables were largely, although not exclusively, focused on maternal characteristics/respondents due to the nature of the available data in the study sites eligible to be included in the current analyses. This focus on maternal risk factors, common in the extant developmental literature, does not take into account the potentially critical contributions of other primary caregivers, such as fathers, parental partners, and grandparents. More attention needs to be given to the roles of other caregivers who have extensive contact with the child in early life. Second, the current analyses did not consider prenatal adversity, which is known to influence child mental health risk, including in interaction with postnatal exposures (Van den Bergh et al., 2017). Relevant prenatal risk variables were not consistently available across study sites, limiting our ability to consider prenatal characteristics. Finally, there are other psychosocial risk factors (e.g., interparental violence/conflict, parental substance use, experiences of racism) and socioeconomic risk factors (e.g., financial instability, poor housing quality, neighborhood inequity) that may have influenced child mental health in our sample but were not available for inclusion in the current analyses. Future work may consider assessment of a wider array of adversity exposures and explore how they differentially influence child mental health risk and are amenable to amelioration by childcare attendance.

Although our sample was sociodemographically diverse, it may not be reflective of the general US population, which may influence the generalizability of the findings. For example, the current sample, as a whole, endorsed greater educational attainment than the general US population (US Census Bureau, 2022). Although parental (primarily maternal) educational attainment was included in our socioeconomic risk index, which was associated with increased child internalizing and externalizing symptoms, the average higher educational attainment may have been associated with unmeasured factors relevant for our analyses (e.g., environmental protective conditions and other resources that may have buffered early adversity effects). Consequently, childcare attendance may have had less ability to influence the effects of adversity on child mental health. Also, although parental educational attainment is a commonly used and robust indicator of a family's SES (Steptoe et al., 2011), household income and related variables (e.g., income relative to number of household members; financial instability or insecurity) may be important risk indicators. However, we were not able to include income in our socioeconomic risk index due to the large number of participants who did not have income data over the period of interest. Notably, education has been described as a measure of an individual's likely long-term SES trajectory and thus may represent a cumulative, robust measure of SES across time compared to a "snapshot" measure such as current income (Steptoe et al., 2011). Thus, parental education may provide a more reliable indicator of long-term socioeconomic stress on child outcomes relative to income measured at a point in time in the child's life (e.g., at the child's birth).

We recognize that race, or more accurately systemic racism, likely played a significant role in children's exposure to psychosocial and socioeconomic risk. Racially and ethnically minoritized (REM) children may experience elevated exposure to psychosocial and socioeconomic risks, including economic instability and insecurity, reduced access to neighborhood/community resources (e.g., health facilities, green spaces), increased exposure to toxins (e.g., air pollution, lead), and heightened parental stress, as the downstream consequences of systemic racism (Iruka et al., 2022). Moreover, evidence indicates that REM communities experience significant barriers (financial, geographic, logistical) to accessing high quality childcare (Iruka et al., 2022). Additionally, REM children are more likely to experience biased and harsh treatment by childcare providers (Iruka et al., 2022). Future work should address (a) how systemic racism differentially influences exposure to early psychosocial and socioeconomic risk and access to early childcare among REM children, and (b) how resilience practices that REM families engage to cope with the effects of racism (e.g., family kinship bonds, social support) influence the associations studied here (Iruka et al., 2022).

Finally, another limitation of the current study is that we did not have data available regarding childcare quality. Childcare quality has been shown to be an important factor in determining the influence of nonparental care on child outcomes (Bustamante et al., 2023; Charrois et al., 2020; Rey-Guerra et al., 2023). Involvement in childcare may only buffer negative effects of early adversity on child mental health if it is of high quality (e.g., low child-to-provider ratio, small group sizes, well-trained staff, age-appropriate curriculum, supportive environment). Exposure to poor quality childcare may not only fail to mitigate early adversity effects but also compound such effects by contributing additional risk to children's emotional and behavioral functioning. Future research should consider the role of childcare quality in mitigating adversity effects on short- and long-term child mental health outcomes. Although the current study did not observe protective effects of childcare attendance on the impact of early adversity on child mental health, it is possible that a more nuanced approach would reveal important associations that could have major implications for public policy. For example, future research should examine whether specific aspects of the early childcare environment affect child mental health and whether such aspects have greater impact on children with different risk profiles/vulnerabilities. Ultimately, such findings could inform the development of future interventional trials to identify components that have the highest potential to promote positive child mental health outcomes. Evidence that childcare can protect or optimize child mental health would support federal and state policies to expand availability of quality childcare.

Conclusion

Exposure to adversity in early life has major implications for child long-term mental health. Participation in childcare may mitigate these effects, potentially through multiple routes, including by reducing the time the child spends in a home environment where they may be experiencing compromised caregiving and heightened stress, exposing the child to additional, sensitive caregivers and positive, stimulating environments, and providing the family with respite and educational, instrumental, and/or emotional support. Conversely, prior conflicting evidence has suggested that participation in childcare in the first years of life may increase child mental health risk, particularly among vulnerable children. The current study leveraged the ECHO Program to examine, in a large sample of harmonized study sites, the potential moderating effects of time spent in childcare on the negative impact of psychosocial

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and socioeconomic adversity on child mental health. The findings suggest that psychosocial risks and socioeconomic risks exerted interactive effects on internalizing and eternalizing symptoms in early childhood. Childcare attendance neither moderated these effects nor had a positive or negative main effect on child mental health. Thus, although participation in childcare did not buffer the negative effects of adversity on child mental health, it also did not exacerbate such effects. Further, there was no evidence that childcare attendance was positively or negatively associated with child mental health outcomes generally. Future work should continue to pursue this line of research, including examining the role of childcare on child mental health in families with a greater range of adversity exposures and exploring the influence of childcare quality indicators on disrupting the negative effects of early adversity on child mental health.

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Data sharing statement. Select de-identified data from the ECHO Program are available through NICHD's Data and Specimen Hub (DASH). Information on study data not available on DASH, such as some Indigenous data sets, can be found on the ECHO study DASH webpage.

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