

RESEARCH ARTICLE

Maternal depressive symptoms, poverty, and young motherhood increase the odds of early depressive and anxiety disorders for children born prematurely

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ABSTRACT

Children born preterm, compared to term, are at risk for behavioral problems. However, the prevalence and predictors of internalizing disorders among children born preterm are unclear. The purpose of this study was to identify the prevalence of depressive and anxiety disorders at 2 years of age among children born preterm and determine the extent to which poverty, maternal depressive symptoms, or young motherhood increase the likelihood of these disorders. Mothers and their infants ($N = 105$) were recruited from two neonatal intensive care units affiliated with a major U.S. university. A sociodemographic questionnaire, the Patient Health Questionnaire-9, and the Diagnostic and Statistical Manual of Mental Disorders, 5th Edition scale scores from the Preschool Child Behavior Checklist were used to measure primary variables. We examined mothers' family satisfaction and quality of caregiving as well as children's degree of prematurity, morbidity, gender, cognitive functioning, and motor function as covariates. Fifteen percent of children met criteria for an anxiety disorder and another 15% for depression. Maternal depressive symptoms increased the odds of children developing both anxiety and depression, whereas young motherhood was associated with child anxiety and poverty with child depression. Results indicate the need for mental health assessment of children born preterm during their first 2 years of life and the importance of early therapeutic and tangible support to vulnerable mothers and children.

KEYWORDS

adolescent, anxiety, depression, internalizing, parenting, preschool child, preterm

1 | INTRODUCTION

Preterm births (<37 weeks gestation) have increased over the past 20 years, making up about 12% of all births in low-income countries and 9% in high-income countries (World Health Organization, 2018). Preterm births affected 10% of infants born in the United States in 2018

(Centers for Disease Control and Prevention, 2019). With recent improvements in neonatal intensive care, infants born underweight and/or premature have a higher chance of survival, shifting the research to a focus on morbidity (Mathewson et al., 2017). With decreasing gestational age, risks for low birth weight, recurrent hospitalizations, growth impairments, impaired lung function, and poorer

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neurodevelopmental outcomes increase (Mandy, 2020). Mental health problems also escalate. Utilizing data from the 2011–2012 National Survey of Children's Health, Singh et al. (2013) reported that 22.9% of children born preterm experience mental disorders between 2 and 17 years of age, as opposed to 15.5% of term children. Janssens et al. (2009) found that 1-year-old infants born preterm (25–35 weeks) had a higher risk for regulatory, emotional functioning, and developmental disorders. In their study of children born preterm (<35 weeks), Poehlmann et al. (2011) reported that only children with more distressed temperaments and intrusive parenting experienced externalizing behaviors at 2 years of age. Reasons for poorer mental health and development are multifaceted and likely due to differences in brain maturity and development, perinatal factors, and environmental exposures (Chung et al., 2020).

1.1 | Internalizing problems and degree of prematurity

Internalizing disorders, characterized by internal distress such as depression or anxiety, are of particular concern for children born preterm. However, children born at different gestational ages (i.e., extremely preterm, very preterm, and moderate to late preterm) may have different risks for internalizing problems.

1.1.1 | Extremely and very preterm

Most studies comparing groups born at different gestational ages have examined children born extremely preterm (<28 weeks) or very preterm (28–31 weeks) (Linsell et al., 2016; Montagna & Nosarti, 2016; Ritchie et al., 2015), with fewer focusing on the moderate to late preterm stage (32–36 weeks) (Arpi & Ferrari, 2013). Stoelhorst et al. (2003) reported slightly higher scores for anxiety and depression of 2- to 3-year-old children who were born very premature compared to children not born preterm. Other research has found lower emotional regulation scores, negative emotionality, and other behavioral symptoms for children born very preterm (Jones et al., 2013; Spittle et al., 2009; Wolf et al., 2007). Delobel-Ayoub et al. (2006) reported that 3-year-old children born very preterm, as compared to term, had higher scores on all behavioral scales, including emotional symptoms that continued through 5 years of age. Persistence of internalizing problems was also reported by Reijneveld et al. (2006) in their study of 5-year-old children born very preterm, an age when emotional problems may begin to affect academic performance.

Key Findings

- At age 2, approximately 25% of children born preterm met the criteria for an anxiety disorder, a depressive disorder, or both. Results indicate the importance of early assessment of children born preterm for potential anxiety and depression.
- Maternal depressive symptoms and poverty increased the odds of children developing a depressive disorder at 2 years of age. Findings reinforce the need for augmented emotional and tangible support of mothers who are depressed and living in poverty.
- Both children with young mothers and children whose mothers had more depressive symptoms had greater odds of meeting criteria for an anxiety disorder. Because young mothers are grappling with the angst of their own developmental tasks, public policies that facilitate parenting guidance and effective coping for these young mothers are essential.

Relevance to infant and early childhood mental health

Indicators of emerging internalizing disorders often go unrecognized during the first 2 years of life, especially among children born preterm whose medical and developmental challenges are frequently the focus of clinicians. Our findings indicate the need to initiate mental health assessment of children born preterm during infancy and reinforce the importance of providing early therapeutic support to vulnerable mothers and infants during the first 2 years after birth.

1.1.2 | Moderate to late preterm

Utilizing data from a large national cohort, Stene-Larsen et al. (2016) reported that 3-year-old children born late preterm (34–36 weeks), specifically girls in their gender-stratified analysis, had increased risk for emotional problems. In another study consisting of children 2–16.3 years of age admitted to a neuropsychiatric unit, Palumbi et al. (2018) reported that 30.8% of the children born late preterm had internalizing problems. Similarly, research with preschool children indicates significantly higher rates

of anxiety disorders for children born late preterm versus term (Rogers et al., 2013). We found no studies focused specifically on internalizing problems among children classified as being born “moderate preterm” (32–33 weeks of gestation).

1.2 | Potential risk factors for internalizing disorders

Early problems in regulating mood and affect increase the risk for many adverse outcomes as the child develops, including school drop-out, substance abuse, major depressive disorder, and suicide (Tandon et al., 2009). However, internalizing disorders in early childhood often go unrecognized in clinical settings. Detecting anxiety and depression can be challenging when children have limited capacity to describe or understand internal feeling states, and their verbal skills are minimally developed (Lyons-Ruth et al., 2017; Tandon et al., 2009). Because of these challenges, identification of factors that may help in predicting risk is vital. There is some evidence that poverty, maternal depression, and young motherhood (i.e., becoming a mother during adolescence) may be factors that increase the probability of developing varied mental health problems in childhood. However, the salience of these factors for (a) internalizing disorders, (b) the first 2 years of life, or (c) children born preterm is not clear.

1.2.1 | Poverty

Chronic material deprivation and poverty have been associated with worse child mental health (Gupta et al., 2007) and poorer adaptive behavior for children born preterm (De Battista et al., 2016). Poverty places children at risk for exposure to environmental stressors, including violence, family separation, and instability (Mazza et al., 2017). These stressors have been linked to behavioral and mental health problems from middle to late childhood (Flouri et al., 2014). Additionally, research indicates that children living in poverty receive less social support and cognitive stimulation compared to children of higher socioeconomic status (SES; Brito & Noble, 2014). The pressures of poverty can increase parental risk for mental health problems and substance abuse, which, in turn, may diminish the parent's capacity to provide sensitive care or effective supervision, and increase the potential for child abuse or neglect (Hodgkinson et al., 2017; Pelton, 2015). These parenting approaches can lead to mood problems for high-risk children (Madigan et al., 2015; Weiss & St. John-Seed, 2002). However, it is not known whether poverty per se leads to

development of internalizing disorders for children born preterm during their first few years of life.

1.2.2 | Maternal depressive symptoms

Women who have a child born prematurely are at high risk for depression (Carson et al., 2015; Vigod et al., 2010). Elevated depressive symptom levels in mothers have been associated with more negative, coercive behaviors, less positive behavior, and more disengagement by mothers with their infants (Lovejoy et al., 2000). Mothers with depression may also form insecure attachments with their child, thereby affecting the quality of maternal caregiving (Santona et al., 2015).

There is a robust literature showing that maternal depression is associated with poorer child mental health outcomes (Bernard-Bonnin et al., 2004; Cummings & Kouros, 2009; Goodman, 2007; Priel et al., 2019; Wagner & Valdez, 2020). Research indicates a specific relationship between maternal postpartum depression and children having anxious/depressed behavior at age 2 (Letourneau et al., 2019), greater emotional negativity at age 2 (Prenoveau et al., 2017), and increased odds of separation anxiety disorder at age 3 (Kingston et al., 2018). However, one study found that postpartum depression did not predict internalizing problems for 3-year-old children (Sidor et al., 2017). In addition, studies examining maternal depression are often confounded by SES. Research has shown that maternal depression may mediate or moderate associations between poverty and childhood behavioral problems (Mazza et al., 2017; Petterson & Albers, 2001; Riley et al., 2009). These findings support the need to examine poverty and maternal depressive symptoms concurrently. It is also not clear whether results for children in the general population generalize to children born preterm, or whether maternal depressive symptoms are associated specifically with their development of internalizing disorders in early childhood.

1.2.3 | Young motherhood

Adolescent mothers are more likely to deliver an infant prematurely than mothers who are not adolescents (Khashan et al., 2010; Ogawa et al., 2019). Young parenthood has been associated with less responsiveness and affective availability in mothers' interactions with their infants (Mayers et al., 2008) and the potential for increased infant mental health problems (Morinis et al., 2013; Tomlin & Viehweg, 2003). In addition, a British cohort study reported that older maternal age was associated with fewer

behavioral, social, and emotional difficulties in children at 9 months, and 3 and 5 years of age (Sutcliffe et al., 2012).

The reasons for more adverse child outcomes among young mothers are not entirely clear. Studies have suggested that adolescent mothers themselves have poorer mental health than other mothers (Hodgkinson et al., 2014). Birkeland et al.'s (2005) study examining 149 adolescent mothers reported that 29% had clinical depression within the first year of giving birth. Other research suggests that early motherhood is related to financial difficulties and lower education attainment (Pinzon & Jones, 2012). As a group, these varied studies suggest the importance of clarifying how young motherhood may affect internalizing problems of children born preterm, while distinguishing its effects from those of maternal depression and poverty.

1.3 | Study purpose and aims

Findings to date indicate that children born preterm have a greater prevalence of overall behavioral problems than do children born term. However, there is limited evidence regarding the risk of children born preterm for symptoms specifically associated with anxiety and depression at 2–3 years of age. In addition, based on studies with children of varied ages and no known health risks, there is preliminary evidence that poverty, maternal depressive symptoms, and young motherhood may contribute to development of children's mental health problems. Although some studies of children born preterm have accounted for SES and maternal age, with one controlling for maternal depression (Poehlmann et al., 2011), the degree to which poverty, maternal depressive symptoms, and young motherhood may affect early development of internalizing problems of children born preterm and the differential strength of their effects have not been examined. The aims of this study were twofold: (1) to identify the prevalence of depressive and anxiety disorders at 2 years of age among a sample of children born preterm, and (2) to determine the extent to which poverty, maternal depressive symptoms, or young motherhood increase the likelihood that they will develop symptoms of an internalizing disorder in early life.

2 | METHODS

2.1 | Recruitment and enrollment

Mothers were recruited from two neonatal intensive care units (NICUs) in two major teaching hospitals affiliated with a large university medical center on the West Coast

of the United States. The Clinical Research Coordinators (CRC) at the hospitals identified infants from the clinical roster who were born prior to 37 weeks. Mothers of these infants were given a flyer about the study when they were visiting their infants in the NICU as well as a brief overview of the research by the CRC. If mothers were interested in participation, a research assistant (RA) contacted them to discuss the research in more detail and provide informed consent. Mothers provided proxy consent for their infants to participate. The study was approved by the Institutional Review Board of the University of California, San Francisco.

Mothers who were 16 years of age and older were recruited into the study. The only exclusion criterion for women was evidence of cognitive or other impairment that would make it difficult for them to accurately complete questionnaires or participate in clinical assessments involving interaction with their infants. Exclusion criteria for infants included birth at >37 weeks gestational age, chromosomal or other genetic anomalies, or other major neonatal illness such as sepsis. In addition, if nurses or physicians who were working with the mothers and infants considered them too psychologically or physically fragile to participate, mothers were not approached regarding the study. Participants could speak either English or Spanish, with measures being available in both languages and research staff who spoke both languages.

2.2 | Data collection procedures

We collected data from mothers and their infants at two time points: during the first 2 weeks of life and when the child was 2 years of age. Gestational age was based on the week confirmed in the medical record and corrected to account for weeks of prematurity in scheduling the 2-year assessments. After consent to participate, mothers completed a sociodemographic questionnaire. Prior to infant discharge from the NICU, an RA reviewed the medical record to identify gestational age, medical complications contributing to neonatal morbidity, gender, and any anomalies or major neonatal illnesses that would require exclusion from the study.

At 2 years of child age, a home visit was made at which mothers completed the Patient Health Questionnaire-9 (PHQ-9) to measure their depressive symptoms, the Family Satisfaction Scale (FSS) to assess perceptions of their family functioning, and the Preschool Child Behavior Checklist (CBCL) to identify behavioral and emotional problems of their child. In addition, mother and child participated in two standardized assessments at a clinic site to acquire information regarding important covariates we wanted to control for in our analyses. These included assessments

of the quality of mothers' caregiving using the NCAST Parent-Child Interaction Teaching Scale and the children's level of cognitive function and gross motor function with the Mullen Scales of Early Learning (MSEL).

2.3 | Measures of primary predictors

2.3.1 | Sociodemographic questionnaire

This questionnaire acquired information regarding variables such as age, education, income, and government assistance. The information was used to describe sample characteristics and to determine poverty level of the family as well as young motherhood. Poverty was defined as being below the federal poverty level designated by the poverty guidelines of the Department of Health and Human Services. Poverty level is considered inadequate financial resources to meet basic needs based on the number of persons in a family's household. Young motherhood was defined as a mother being below the age of 20 at the time the infant was born (i.e., ages 16 through 19 in our sample).

2.3.2 | Patient Health Questionnaire-9

The PHQ-9 (Kroenke et al., 2001) is a nine-item self-report questionnaire based on the Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria for major depression. This measure was used to assess mothers' depressive symptoms. Respondents rated how frequently they had experienced symptoms over the past 2 weeks on a scale ranging from 0 = *not at all* to 3 = *nearly every day*. Scores range from 0 to 27, with higher scores indicating more severe depressive symptoms. A cutoff score of 10 is considered clinically significant, moderate depression but not necessarily warranting treatment. Treatment is recommended if the score is 15 or greater, indicating more severe depressive symptoms. The measure's established internal consistency is very good (ranging from $\alpha = .86-.89$) as well as its test-retest reliability. Internal consistency for its use in our sample was $\alpha = .88$. The PHQ-9 has also shown criterion, discriminant, and construct validity (Kroenke et al., 2001). Meta-analyses of validity findings for the PHQ-9 have concluded that it has excellent sensitivity and specificity for detecting depressive disorders and is equal or superior to other depression measures (Kroenke et al., 2010). Effective performance of the PHQ-9 has been supported across sex, age, and racial/ethnic groups, including its use with women in the first few years after birth (Flynn et al., 2018).

2.3.3 | Child Behavior Checklist for 1.5- to 5-year olds

The CBCL 1½-5 is part of the Preschool Package of the Achenbach System of Empirically Based Assessment (ASEBA), a set of measures to assess the emotional and behavioral functioning of children (Achenbach, 2009; Achenbach & Rescorla, 2000). The CBCL has 99 items that ask the parent how true each item has been for their child over the last 6 months. From these items, a number of possible scale scores can be determined. One set of scales is aligned with criteria for specific disorders in the DSM-5. We used the CBCL items to create DSM-5 scale scores for Affective (Depressive) Disorder and Anxiety Disorder. Validity of the initial CBCL preschool items was based on epidemiologic findings, consultation with practitioners, researchers, and parents as well as on reviews of published research (Achenbach & Rescorla, 2000). The scales were derived from factor analysis of the 99 CBCL items within a sample of approximately 2000 children aged 1.5-5 who had been referred to clinical settings (McConaughy, 2001). The Preschool DSM-5 Scales were developed from the 99 items by experienced psychiatrists and psychologists from many cultures who were knowledgeable about psychopathology at ages 1.5-5 (Achenbach, 2013). Items constituting the Affective Disorder and Anxiety Disorder DSM-5 Scales have shown significant test-retest reliability, stability over time, and the ability to discriminate and predict children identified through clinical interviews as needing referral for treatment (Achenbach & Rescorla, 2000). In our sample, alpha reliability for items in the Affective Disorder Scale and the Anxiety Disorder Scale was .82 and .84, respectively.

2.4 | Measures of covariates

Covariates were included to control for their potential effects on infant depression and anxiety. Two maternal variables were examined because they have been linked to child internalizing problems in previous research: quality of the mother's interaction with her child and the mother's satisfaction with her family's interactions (e.g., Brock & Kochanska, 2015; Kok et al., 2013). Similarly, there is previous evidence of a potential association between the following infant variables and child internalizing problems: gestational age, preterm status (extremely, very, or moderate-to-late preterm), neonatal morbidity, the infant's level of cognitive and gross motor development, and infant gender (e.g., Edwards & Hans, 2016; Gerstein et al., 2017; Scott et al., 2018; Serdarevic et al., 2017; Wang & Yan, 2019). Information about infant gestational age,

preterm status, and gender was derived from the medical record. Measures of other covariates are described below.

2.4.1 | NCAST Parent–Child Interaction Teaching Scale

Evaluation of the quality of the mother's interaction with her child was assessed during a standardized situation where she taught the child two tasks (building a tower of cubes and drawing both vertical and horizontal lines). This teaching situation was video-recorded and scored later for maternal interaction using the NCAST Parent–Child Interaction Teaching Scale (Oxford & Findlay, 2013). The scale consists of four distinct subscales: Sensitivity to Cues, Response to Distress, Social–Emotional Growth Fostering, and Cognitive Growth Fostering. These subscales are combined to yield a total score, with a higher score indicating more optimal quality of interaction. The possible total score can range from 0 to 50. One individual rated all video records. She was trained by the NCAST training center and certified at a level of 90% for interobserver reliability. The coder was blind to study aims and any information about the mother–infant pairs. Empirical support is substantial for use of the measure with racially and ethnically diverse, community-based populations (Bryne & Keefe, 2003; Letourneau et al., 2018; Panagiota et al., 2016; Tryphonopoulos et al., 2016; White-Traut et al., 2013).

2.4.2 | Mullen Scales of Early Learning

We used the MSEL to evaluate the child's level of cognitive development and gross motor function (Dumont et al., 2000; Mullen, 1995). The MSEL provides scores in five domains including gross motor, visual reception, fine motor, expressive language, and receptive language. Each domain is composed of interactive tasks that are completed by the child or with assistance from a parent. The scale items are presented in hierarchical order of difficulty, and scale administration is discontinued after three consecutive attempts if the child fails to achieve the tasks at a particular level. The MSEL was administered by a developmental psychologist who was certified in its use. Based on instructions in the MSEL manual, the scores of four domain scales (without gross motor) are combined to create a composite measure of cognitive functioning that we used in this study. The average score for the composite measure is 200. The cutoff for 2 standard deviations (*SDs*) below the norm for cognitive function is a score of 160 or less, indicating function well below average. The average for gross motor function is a score of 50. The cutoff for 2 *SDs* below the norm for gross motor function is 30.

The MSEL has very good psychometric properties with interrater reliability between .91 and .99, and test–retest correlations at .82 or above (Burns et al., 2013; Carlson et al., 2018; Koura et al., 2013; Swineford et al., 2015).

2.4.3 | Perinatal Complications Scale

We used the Perinatal Complications Scale (PCS) as our measure of neonatal morbidity. This scale involves a structured template for review of medical records to identify medical or surgical problems incurred by infants during delivery or in the first month postnatal (Littman & Parmelee, 1978; Wyly, 2018). Items are rated as present or not for various medical/surgical complications, with a total sum score ranging from 0 to 10. Items include problems such as respiratory distress, need for assisted ventilation, convulsions, noninfectious illness, and hyperbilirubinemia. Content validity for the measure stemmed from a series of studies by a panel of expert clinicians. Predictive and discriminant validity have been supported through association of scale scores with identified risk groups and varied clinical outcomes (Wyly, 2018). Internal consistency of the items for our sample was $\alpha = .77$.

2.4.4 | Family Satisfaction Scale

The FSS measures the degree of cohesion, flexibility, and communication of a family, as indicated by satisfaction with these family processes by the individual completing the questionnaire (Olson, 2018). We used the 14-item version, with each item on a 5-point Likert scale and a total possible score ranging from 14 to 70. The measure was developed as part of the “Family Adaptability and Cohesion Scales,” a package of measures to assess family functioning (Olson, 2011; Olson & Gorall, 2003). The FSS has shown internal consistency ranging from .92 to .95 as well as test–retest reliability, construct validity, convergent validity, and predictive validity (Johnson, Resch et al., 2010; Olson, 2011; Oshri et al., 2015). We found an $\alpha = .90$ for internal consistency of the scale in our study.

2.5 | Data analysis

2.5.1 | Testing of assumptions and Aim 1

All continuous variables were examined for their linearity and normality. Only one variable (mothers' quality of caregiving) did not meet acceptable criteria, showing a slight negative skew in its distribution. However, normality was achieved after performing a log transformation that

included a constant from which each score was subtracted. No outliers were removed for any variable. Descriptive statistics were used to identify sample characteristics. For Aim 1, frequencies and percentages were computed for children receiving scores that identified them as meeting criteria for an affective (depressive) disorder or an anxiety disorder based upon the CBCL DSM-5 Scale scores.

2.5.2 | Testing for covariates and Aim 2

Two steps were involved for analysis of Aim 2. First, preliminary chi square tests and Pearson correlation coefficients were used to determine which covariates should be included in the final regression analyses based upon their relationship to children's anxiety and depressive symptoms. The following covariates were assessed: the quality of the mother's interaction with her child, the mother's satisfaction with interactions among her family members, infant gestational age, preterm status (extremely, very, or moderate-to-late preterm), neonatal morbidity, the infant's level of cognitive and gross motor function at 2 years of age, and infant gender. Covariates showing a significant relationship ($p \leq .05$) to either children's anxiety or depressive symptoms in preliminary analyses were included in logistic regression models to test Aim 2. Significant covariates were entered at the first step to control for their potential confounding effects. Scores for maternal depressive symptoms, categorization as meeting criteria for poverty or not, and categorization as a young mother or not were entered at the second step of the logistic regression model. Separate models were computed for child depression and anxiety, with the dependent variable being classification as meeting criteria (or not) for Affective (Depressive) Disorder or Anxiety Disorder based on the DSM-5 Scale scores of the CBCL.

2.5.3 | Testing for moderating effects

We also examined interaction terms in a third step of each model to determine potential interactions of predictors with one another. In general, only variables retained in the models after preliminary tests (described above) were examined for their interactions. There were two exceptions to this approach; we assessed the moderating effects of both gender and gestational age in each model, even if these variables had no significant main effect on child depression or anxiety in preliminary testing. In view of power constraints, each possible interaction term was tested individually in a separate model to determine whether it should be included in the final model. However, none of these interactions were significant so

they were not retained in the final models, including all interactions with gender and gestational age.

Predictors that were retained after preliminary testing were examined for potential collinearity. The tolerance of all items was .90 or above and their Variance Inflation Factors were all close to 1, indicating little correlation among predictors. Data were analyzed using SPSS Version 27.

3 | RESULTS

3.1 | Sample characteristics

The sample included 105 mothers and their children. Table 1 presents information regarding demographic and clinical characteristics of the sample. Mean age of the mothers was 29 years and they had a high school education on average. For the group as a whole, mothers had mean scores on the PHQ-9 indicating they were moderately depressed, although there was a wide range across women in depressive symptoms. Approximately one fourth of the mothers were adolescents at the time of the baby's birth and 40% of the mothers met the federal guidelines for poverty. Forty-five percent ($n = 47$) of the mothers had a European/White heritage; 22.4% ($n = 24$) of the sample was African American/Black; and 26.6% ($n = 28$) were Hispanic/Latina. Four percent ($n = 4$) were Asian and the remainder of the sample identified themselves as having another or mixed background (2%; $n = 2$).

There were more boys in the sample than girls by 14%. Children were almost equally split between being born moderate to late preterm and very preterm, with only 13% of the children born extremely preterm. On average, infants had approximately four medical complications during the first month of life, ranging from no complications to 10 different morbidities. The most common complications were respiratory distress syndrome and hyperbilirubinemia. Fifty-five percent ($n = 58$) of the infants achieved a cognitive score of average or better on the MSEL, whereas 20% ($n = 21$) were 2 *SDs* below the norm for their corrected age. Fifty-four percent ($n = 57$) had an average or better gross motor score, whereas 29% ($n = 30$) of the infants were at 2 *SDs* or below for gross motor skills.

3.2 | Testing of Aim 1

Table 1 provides data regarding the prevalence of depressive and anxiety disorders for children (Aim 1). CBCL DSM-5 scores indicated that the prevalence of disorders was low. A small percent of children who met the criteria had both depression and anxiety, whereas the majority met criteria for one but not the other.

TABLE 1 Descriptive data for mothers and children in the sample

		Maternal variables	
		Mean (SD)	Range
Depressive symptoms		12.57 (3.81)	0–21
Age		29.35 (7.16)	16–44
Education (years)		12.52 (3.88)	1–20
Caregiving quality		43.26 (4.57)	29–49
Family satisfaction		50.89 (8.97)	28–68
		Yes: n (%)	No: n (%)
Poverty		42 (40)	63 (60)
Adolescent parent		22 (21)	83 (79)
Depression status	Mild depression	Moderate depression	Severe depression
	n (%)	n (%)	n (%)
	54 (51)	42 (40)	9 (9)
		Child variables	
		Mean (SD)	Range
Gestational age (weeks)		31.94 (3.48)	24–36
Birthweight		1694.97 (532.03)	650–3271
		Mean (SD)	Range
Neonatal morbidity		4.20 (2.28)	0–10
Gross motor function		39.33 (8.88)	25–56
Cognitive function		157.48 (33.12)	100–230
Preterm status	Extremely preterm	Very preterm	Moderate–late preterm
	n (%)	n (%)	n (%)
	14 (13)	46 (44)	45 (43)
		Yes: n (%)	No: n (%)
Gender: Girl		45 (43)	60 (57)
Anxiety disorder		16 (15)	89 (85)
Depressive disorder		16 (15)	89 (85)
Anxiety and depression		6 (6)	99 (94)

3.3 | Testing of Aim 2

3.3.1 | Covariates for inclusion in final regression models

Tables 2 through 4 present data regarding Aim 2 of the study. Preliminary bivariate correlations between predictors, covariates, and symptoms of anxiety and depression are shown in Table 2. Family income and mothers' satisfaction with family processes were both inversely associated with children's depressive symptoms. Maternal age, maternal depressive symptoms, and family income were significantly associated with children's symptoms of anxiety. Family income was also examined for the primary cutoff of interest in our analysis (i.e., meeting the poverty threshold). Analysis of variance indicated that children whose family's income was under the poverty threshold had significantly more symptoms of depression ($F = 13.44$, $p < .001$) and a trend toward more symptoms of anxiety ($F = 2.236$, $p = .075$) than children whose family was above

the poverty threshold. Our analysis of variance for comparison of children having young versus adult mothers indicated that children whose mothers were young (i.e., adolescents when their infant was born) had significantly more symptoms of anxiety than children whose mothers were adults ($F = 6.911$, $p = .010$). However, there were no differences between these groups of children for depressive symptoms ($F = .094$, $p = .760$). These group comparisons for our primary predictors of interest supported the correlations found for continuous variables (Table 2). Although gestational age showed no relationship to children's depressive or anxiety symptoms, we examined differences in these symptoms across groups of children born extremely preterm, very preterm, and moderate to late preterm to assure that we were not missing potential effects of gestational status. There were no differences across these groups in either symptoms of depression ($F = .305$, $p = .738$) or anxiety ($F = .203$, $p = .817$). Similarly, as shown in Table 2, children's degree of neonatal morbidity and cognitive function at age 2, as well as the quality of mothers'

TABLE 2 Pearson correlations for child depressive and anxiety symptoms, key maternal predictors, and covariates included in model testing

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Maternal variables																
Depressive symptoms (1)																
Age (2)	-.31**															
Young motherhood (3)	.30**	-.73***														
Family income (4)	-.11	.24*	-.26**													
Poverty (5)	.02	-.06	-.02	-.53***												
Caregiving quality (6)	-.07	.43**	-.28**	.16	-.11											
Family satisfaction (7)	.01	-.06	.03	.21*	-.27**	-.03										
Child variables																
Gender (8)	.12	-.05	.12	-.06	.10	.08	.06									
Gestational age (9)	.09	.14	-.08	-.07	-.14	.06	-.06	-.04								
Preterm group (10)	-.03	.06	-.07	-.00	-.04	.00	-.05	-.00	.89***							
Neonatal morbidity (11)	-.01	-.14	.10	.05	.07	.04	.07	.12	-.49***	-.44***						
Cognitive function (12)	.07	-.05	.28**	.09	.06	.04	.06	.27**	.15	.10	-.19					
Gross motor function (13)	.10	-.21*	.16	-.05	.16	.05	.13	.39**	.08	.05	.01	.52***				
Depressive symptoms (14)	.18	-.16	.19	-.24*	.34**	.10	-.30**	.08	.10	.11	.02	.09	.05			
Anxiety symptoms (15)	.37**	-.33**	.27**	-.33**	.34**	-.18	-.14	.23*	.14	.07	.09	.19	.33**	.70***		
Depressive disorder (16)	.02	-.10	.03	-.19	.35**	-.04	-.17	.00	.03	.05	-.02	.09	.01	.82***	.56**	
Anxiety disorder (17)	.23*	-.34**	.25*	-.18	.18	-.18	-.06	.18	.06	-.04	.10	.03	.15	.53**	.81***	.49**

*Significant at $p < .05$.**Significant at $p < .01$.***Significant at $p < .001$.**TABLE 3** Logistic regression model for the relationship of selected predictors to classification of children as meeting criteria for a depressive disorder

	<i>B</i>	<i>SE</i>	<i>OR</i>	<i>p</i>	<i>95% CI</i>
Step 1					
Family satisfaction	-0.022	0.04	0.978	.576	[0.905, 1.057]
Step 2					
Young motherhood	0.801	0.74	2.229	.280	[0.105, 1.920]
Family poverty	1.682	0.78	5.379	.032	[0.040, 0.863]
Maternal depressive symptoms	0.875	0.44	2.400	.048	[1.001, 1.417]

 $\chi^2 = 9.415$ ($df = 3$), $p < .024$.**TABLE 4** Logistic regression model for the relationship of selected predictors to classification of children as meeting criteria for an anxiety disorder

	<i>B</i>	<i>SE</i>	<i>OR</i>	<i>p</i>	<i>95% CI</i>
Step 1					
Child gender	1.343	0.93	3.831	.149	[0.042, 1.618]
Step 2					
Young motherhood	2.173	0.79	8.781	.006	[0.024, 0.538]
Family poverty	1.395	0.77	4.035	.071	[0.054, 1.128]
Maternal depressive symptoms	1.651	0.57	5.210	.003	[1.115, 1.736]

 $\chi^2 = 20.518$ ($df = 3$), $p < .001$.

caregiving, was not associated with children's depression or anxiety. Lastly, results of chi square tests for comparison of boys and girls on prevalence of internalizing disorders indicated no gender difference for depressive disorders (chi square = 0.014, $p = .910$). However, boys did have a higher proportion of anxiety disorders (21%) than girls (7%; chi square = 4.193, $p = .040$). Based on these preliminary analyses, family satisfaction was included as a covariate in the logistic regression model for children's depressive disorders and child gender was built into the model for children's anxiety disorders to control for their effects.

3.3.2 | Predictors of childhood depression

Table 3 provides data for the relationship of predictors to the child's likelihood of having a depressive disorder at age 2. Although both family poverty and maternal depressive symptoms were significant predictors of having a depressive disorder, young motherhood was not significant in this logistic regression. The odds ratio for poverty suggests that the odds of children meeting criteria for depression by age 2 were 5.4 times greater for children living in poverty than the odds for children not living in poverty. In addition, children whose mothers had more depressive symptoms had approximately 2.5 times greater odds of developing a depressive disorder than children whose mothers had fewer depressive symptoms. When considered with other variables in the model, neither mothers' satisfaction with family processes nor young motherhood made significant contributions to children developing a depressive disorder. The Nagelkerke R square for the model was .220, indicating that the factors in the model account for approximately 22% of the variance in children developing a depressive disorder by age 2.

3.3.3 | Predictors of childhood anxiety

Results of the logistic regression for predictors of an anxiety disorder are shown in Table 4. Young motherhood and maternal depressive symptoms were significant predictors. Children with young mothers had 8.8 times greater odds of developing an anxiety disorder than did children of adult mothers. The odds ratio for maternal depressive symptoms suggested that this factor put a child at approximately five times greater risk of developing an anxiety disorder. Neither poverty nor child gender was a significant predictor of the development of child anxiety disorders. The Nagelkerke R square for this model was .431, suggesting that factors in the model accounted for approximately 43% of the variance in a child's likelihood of meeting criteria for an anxiety disorder by age 2.

4 | DISCUSSION

Fifteen percent of the children met criteria for having an anxiety disorder and another 15% as having a depressive disorder, although not necessarily the same children. On average, depressive symptoms reported by mothers indicated that they were moderately depressed. Forty percent met the criteria for poverty and 21% were young (adolescent) mothers at the time of enrollment into the study. Children whose families met the threshold for poverty and those whose mothers had more depressive symptoms had greater odds of having a depressive disorder than children not living in poverty or whose mothers had fewer depressive symptoms. Although young motherhood did not significantly increase the probability of children developing a depressive disorder, children of young mothers and children of mothers who had more depressive symptoms did have greater odds of having an anxiety disorder than children whose mothers were adults or who were less depressed. In the final regression models, there were no associations of child gender, gestational age, stage of prematurity, neonatal morbidity, cognitive function, or gross motor function at 2 years of age with the occurrence of internalizing disorders at age 2. For mothers, neither the quality of their caregiving nor their satisfaction with the family's functioning predicted children's development of anxiety or depressive disorders in the final models.

4.1 | The prevalence of internalizing disorders

Our results show a prevalence of 15% for children who met criteria for a depressive disorder and another 15% who met criteria for an anxiety disorder. These rates are much higher than those found for a general sample of 3- to 5-year-old children in the National Survey of Children's Health (Ghandour et al., 2019). In that sample, only 0.08% of children were diagnosed with depression and 1.3% with anxiety. In a study of children aged 4–5 years, those at risk for motor delays showed a rate of 6.3% for depressive disorder and 7.0% for anxiety disorder, whereas typically developing children had rates of 2% and 3.4%, respectively (Rodriguez et al., 2019).

Considering children who met criteria for either a depressive or anxiety disorder, approximately 25% of our sample met the criteria for one or both. This prevalence is higher than the 14%–15% prevalence for internalizing disorders found by Gerstein et al. (2017) in their U.S. study of prematurely born children between 16 and 36 months of age. That study did not distinguish between anxiety and depressive disorders and reported a sample of children whose gestational ages were overall higher than ours. In

a U.K. sample, Johnson et al. (2010) reported a 9% prevalence of “emotional disorders” in extremely preterm children versus 2% in children born at term. They noted that separation anxiety and generalized anxiety disorder were the most frequent disorders within this diagnostic group. Although children’s ages and gestational characteristics differ across these various studies, our sample (consisting of children who were “very preterm” and “moderate to late preterm” primarily) had higher rates of both anxiety and depressive disorders than what has been previously observed for children who were typically developing, were experiencing motor delays, or were born preterm.

In a review of studies examining psychiatric problems associated with prematurity, Johnson and Marlow (2011) described a “preterm behavioral phenotype” that emerged, characterized by increased risk for symptoms and disorders associated with inattention, anxiety, and social difficulties. Depressive disorders were not indicated in that phenotype. In light of the fact that an identical number of children in our study met criteria for a depressive disorder as did those for anxiety, our results suggest that any behavioral phenotype of preterm children should include risk for depressive disorders as well. As noted by Johnson and Marlow (2011), many studies have combined symptoms of anxiety and depression, making it difficult to differentiate specific types of emotional or mood problems that emerge and persist over time.

4.2 | Predictors of internalizing problems

Of the three predictors we examined, maternal depressive symptoms had the most consistent impact on risk for child internalizing disorders, including both anxiety and depression. Our results regarding the effects of maternal depression are consistent with previous research that has shown a relationship between mothers’ depression and children’s internalizing disorders in the general population (Kingston et al., 2018; Letourneau et al., 2019; NRC/IOM, 2009; Prenoveau et al., 2017). Our research extends these findings to children born preterm and to DSM-related scales that are closely aligned with development of actual anxiety and depressive disorders. It will be important for future research to determine whether the relationship between maternal depression and toddler’s vulnerability to internalizing disorders is the result of a common genetic profile transmitted across generations or whether effects of maternal depression are the result of a mother’s challenges in providing engaged, sensitive care that supports the child’s emotional well-being. There is evidence for both mechanisms (Hammen, 2017; Mikkoenen et al., 2016; Sawyer et al., 2019). However, our finding that quality of maternal care was not associated with either

maternal depressive symptoms or child internalizing problems suggests that other factors may influence effects of maternal depression. Unique mechanisms may explain associations between maternal depression and early development of children’s internalizing disorders among children born preterm, including potential biological exposures during gestation that should be studied (Moisiadis & Mathews, 2014; Sawyer et al., 2019).

Family poverty had the strongest impact on risk for child depressive disorders and showed a trend ($p = .07$) toward also predicting development of anxiety disorders. Previous research suggests that exposure to stress and adversity in the family environment may explain much of the relationship between poverty and childhood depressive symptoms (Tracy et al., 2008). Other research indicates that preschool children living in poverty have alterations in their brain connectivity in regions that are critical for emotion regulation (Barch et al., 2016). Barch and colleagues found that these changes in functional brain connectivity were associated with greater negative mood and risk of clinical depression as children developed. These and other mechanisms associated with the impact of poverty need urgent attention in research, especially for children born preterm. The already vulnerable brain architecture of children born preterm (Nosarti et al., 2014; Tolsa et al., 2004) may place them at further elevated risk for internalizing disorders when living in low-resource environments.

There are no simple explanations for the associations we found between young motherhood and development of anxiety disorders among children born preterm. Young mothers are more likely to live in poverty, have low educational and employment attainment, have poor interpersonal relationships, experience higher rates of depression, and have limited social support (Hodgkinson et al., 2014). In fact, our own correlational findings show that younger mothers had significantly lower incomes, more depressive symptoms, and less optimal caregiving quality. Such factors may interact in complex ways to reduce the young mother’s ability to provide sensitive, comforting care when the child is experiencing distress; this may influence the child’s ability to regulate emotion and foster development of anxiety in children. In addition, because of their stage in life, young mothers are grappling with their own developmental tasks, which may unconsciously take emotional and social precedence over their responsibilities as a parent (Savio Beers & Hollo, 2009; SmithBattle & Freed, 2016). All these factors may reduce the capacity of young mothers to manage the more challenging temperaments reported for children born preterm (Weiss et al., 2004).

The lack of any effect we found for gestational age or for the child’s status as extremely, very, or late to moderate preterm is congruent with other reports regarding older children and adolescents, suggesting that the child’s

environment after birth may contribute to development of anxiety and depression in more powerful ways than extent of prematurity per se (Burnett et al., 2014; Jaekel et al., 2017). Although there is some evidence that children born extremely preterm are at significantly greater risk for internalizing symptoms than children born at term (Mathewson et al., 2017), we did not find their greater vulnerability than other children of higher gestational age in our sample. However, our subsample of children born extremely preterm was small ($n = 14$), potentially reducing power to detect a difference. Still, our correlational results indicate that neonatal morbidity was not associated with development of internalizing symptoms among the children. Medical risk has often been suggested as the reason for greater mental health problems among children born extremely preterm. Our measure of neonatal morbidity did not look at brain injuries such as white matter abnormalities that have been linked to greater risk for internalizing problems (Andre et al., 2020; Loe et al., 2013). Clarification regarding effects of gestational age or extent of prematurity will require attention to specific morbidities as well as longitudinal research to examine interrelationships and unique contributions of biological and psychosocial variables.

4.3 | Limitations

Our study has a number of limitations. First, the study does not take into account persistence or chronicity of maternal depression over time because we only measured depressive symptoms when the child was 2 years of age. Thus, we have no way of knowing whether the effects of depression are unique to that point in the child's development or have been shaped by maternal depression at points earlier in development.

In addition, both maternal depressive symptoms and child internalizing symptoms were reported by the mother, allowing for potential halo effects of a mother's depression in her reporting about the child. A mother's psychiatric symptoms have been associated with more negative ratings of her child's behavior in previous research (Müller et al., 2011). Ideally, both maternal depression and child internalizing disorders would have been derived from clinician-based assessment and diagnosis. In future research, use of the Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood (DC:0-5™; Zeanah et al., 2017) would enable a clinical diagnostic evaluation of children's Axis I Mood Disorders through a structured play interview with the child and mother. This approach could reduce substantially any effect of maternal perception on assessment of her child and enhance an understanding of the family context within which the child's symptoms may exist.

Third, we did not examine a family's exposure to poverty at various points during the child's first 2 years of life for their differential or cumulative effects on development of anxiety and depressive symptoms nor did our models include all possible variables that might influence children's internalizing problems. Lastly, although we found no effect of gestational age in our models, we did not have a comparison group of children born at term. This group comparison would have enabled a fuller understanding of whether our findings were unique to children born prematurely.

Lastly, issues of generalizability should be considered. Although we had good representation of Black and Hispanic children in our sample, we had a larger percentage of White children than is found among populations of preterm children nationally. In addition, our representation of Asian and Native American populations was inadequate (March of Dimes Foundation, 2020). Also, our sample had a larger percent of extremely and very preterm children than is found among the preterm population nationally. Although these groups make up 57% of our sample, they constitute only 16.9% of infants born preterm nationally (March of Dimes Foundation, 2016). Thus, our sample is of younger gestational age than the norm.

5 | CONCLUSION

Early problems in regulating mood and affect increase the risk for many adverse outcomes as the child develops. However, indicators of emerging internalizing disorders often go unrecognized during the first 2 years of life, especially among children born preterm whose medical and developmental challenges are usually the primary focus of clinicians at regular health visits. Our findings suggest that children as young as 2 years of age experience anxiety and depressive disorders, indicating the need for early and ongoing assessment of children born preterm to allow for time-sensitive interventions.

Although a previous study described the existence of a "preterm behavioral phenotype" characterized by symptoms associated with inattention, anxiety, and social difficulties (Johnson & Marlow, 2011), our results suggest that consideration of any behavioral phenotype of children born preterm should include depressive or mood symptoms as well. In addition, evaluating the mechanisms underlying internalizing problems experienced by children born preterm is essential. Loe et al. (2013) reported decreased white matter in bilateral cingulum bundles widely distributed in the brain as being associated with internalizing symptoms of children born preterm but not those born at term. These and other biological substrates need further study. From a clinical perspective, our

findings indicate the need for initiating mental health assessment of children born preterm during infancy, with ongoing surveillance of potential symptoms associated with internalizing disorders. Regular and systematic assessment of anxiety and depressive symptoms can enable time-sensitive interventions that may preclude development of more advanced internalizing disorders (Weiss & Quides, 2012).

Our results also indicate the need for clinicians to prevent, identify, and treat maternal depression, not only to reduce the mother's suffering but to limit the potential development of anxiety and depression in their children. Similarly, resources should be augmented for families in poverty and for young mothers. Studies of adolescent parents have found that important protective factors include helping parents to complete high school, encouraging active participation in parenting programs, providing basic financial assistance, and maintaining social support to prevent isolation (American Academy of Pediatrics, 2001; Gibb et al., 2014). Early therapeutic and tangible support for vulnerable mothers may be critical in preventing internalizing disorders among children born preterm.

ETHICS AND INTEGRITY

The manuscript has not been submitted or published elsewhere. Both authors have contributed to the conceptualization and writing of this manuscript.

HUMAN RESEARCH APPROVAL

This study was approved by the Institutional Review Board of the University of California, San Francisco. All participants provided informed consent.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Due to the vulnerability of the children participating in this study and potential sensitivity of the information acquired, parents were assured that raw data would remain confidential and would not be shared, even if de-identified. Any questions regarding the data can be directed to Dr. Weiss.

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