The Impact of Perinatal Life Stress on Infant Temperament and Child Development: A 2-Year Follow-Up Cohort Study

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ABSTRACT: ***Background:*** **Accumulating evidence suggests a persistent impact of perinatal exposure to maternal stress on the infant. In utero, the fetus is particularly vulnerable to maternal stress and mental health complications with various long-term consequences. This study examines the prospective relationship of subclinical maternal perinatal life stress based on individual responses to stressful life events and infant temperament and child development.** ***Methods:*** **Data were derived from the Akershus Birth Cohort, a longitudinal cohort study including 3,752 women scheduled to give birth at Akershus University Hospital, Norway. Psychometric measures pertained to perinatal life stress, maternal perinatal depression (Edinburgh Postnatal Depression Scale), difficult infant temperament at 8 weeks (Infant Characteristics Questionnaire), and child development 2 years after birth (Ages & Stages Questionnaire).** ***Results:*** **Perinatal life stress predicted difficult infant temperament at 8 weeks and challenges in social-emotional development at 2 years above and beyond demographics, pregnancy, and childbirth-related and postpartum factors.** ***Conclusion:*** **Life events perceived as severely distressing in the peripartum period pose a burden on mothers and may have potentially detrimental long-term effects on neurobiological and social-emotional child development. Our findings highlight the need for person-centered perinatal care and support of mothers facing difficult life events. Clinical awareness of in utero development and its relationship to maternal psychological health is warranted to intervene effectively. Future research should consider the timing of in utero exposure and neurobiological and environmental mechanisms pertaining to the relationship between maternal perinatal life stress and child development.**

(*J Dev Behav Pediatr* 00:1–8, 2020) **Index terms:** perinatal life stress, negative life events, infant temperament, child development.

The perinatal period represents a time of considerable infant development while being highly dependent on parental behavior and well-being. This early life development is affected by genetic factors and hormonal processes related to maternal stress responses and postpartum experiences.[1] The relationship between maternal perinatal psychopathology and adverse child outcomes has been widely documented.[1–5]

Accumulating evidence suggests a persistent impact of in utero exposure to maternal stress on the infant. For instance, maternal stress in the prenatal period is associated with preterm labor, reduced infant health, and increased behavioral, cognitive, and interpersonal issues in young children.[6] Furthermore, infants and toddlers exposed to maternal distress during pregnancy may be at an increased risk of fearful behavior and difficult temperament.[7] Persistent adversities in early temperament and emotion regulation may in turn reinforce later behavioral difficulties,[1,8] creating long-lasting adverse effects. Although positive influences, such as mother-infant bonding and social support, may protect against the adverse outcomes of in utero exposure to maternal stress,[1,4,8] the potentially detrimental effects on mother and child warrant further scientific investigation.

The developmental model of fetal programming posits that in utero exposure to maternal stress can prompt long-term fetal developmental responses and permanent changes in neuroendocrine regulation,

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The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Declaration of Helsinki of 1975, as revised in 2008.

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affecting prenatal and early life neurobiological development and later infant behavior.[9] To this end, increased maternal hypothalamic-pituitary-adrenal (HPA) axis production of stress hormones may interfere with the development of fetal structural and functional neural systems involved in emotional and behavioral responses in infancy.[9] This process may be mediated by placental functioning because stress-related down-regulation of the placental barrier enzyme 11β-HSD2 may increase fetal exposure to maternal cortisol.[10] Maternal stress during pregnancy has been associated with alterations in the infant amygdala and prefrontal and lateral temporal cortices, key structures for social processing and emotional self-regulation.[11] In addition, increasing evidence supports the notion that in utero exposure to maternal stress can prompt stable, long-term epigenetic alterations in the offspring.[12] To this end, maternal stress during pregnancy may be linked to offspring DNA methylation, which in turn may mediate the relationship between maternal stress and infant health outcomes.[13]

In utero, the fetus is particularly vulnerable to maternal stress and mental health complications with various long-term consequences. Maternal depression during pregnancy puts offspring at an increased risk for future depression,[14] and maternal exposure to adverse life events has been linked to offspring autism and schizophrenia in animal models.[15] Similarly, maternal post-traumatic stress disorder during pregnancy affects the offspring's HPA axis regulation[16] and can yield long-term consequences such as physical and mental health adversities.[15] In addition, maternal anxiety during pregnancy has been linked to difficult infant temperament[5] and social-emotional development at 2 years.[1]

Similar adverse effects of maternal postpartum mental health complications on infant development have been documented. Symptoms of maternal postpartum depression have been linked to reduced social-emotional and cognitive development[1,4] and communication skills, partly mediated by maternal avoidance and care. Furthermore, maternal symptoms of post-traumatic stress are related to higher parental stress, child maltreatment, psychological aggression toward the child, and social-emotional child development.[2,17] These findings lend support to developmental theories proposing mother-infant attachment and maternal care as crucial for offspring survival and development.

Although previous studies have used a variety of methodologies to assess maternal prenatal or perinatal stress, the conceptualization of stress should be considered. From a psychological perspective, stress can be defined as a stimulus (viz., stressor), a response (viz., stress response), or the product of a stimulus-response interaction.[8] Stress may thus be defined as a "person-environment transaction" pertaining to balancing environmental demands with personal capacity to cope with them using available resources.[8,18] The present study sets forth to examine the prospective relationship of maternal perinatal life stress based on individual *responses to potentially stressful life events* (viz., the individual emotional impact of potentially stressful life events and rather than assessing whether certain events took place) and child development.

METHODS

Design and Participants

Data were derived from the Akershus Birth Cohort, a prospective cohort study that targeted all women scheduled to give birth at Akershus University Hospital, Norway. Recruitment took place from November 2008 to April 2010. Expectant mothers were recruited during their routine fetal ultrasound examination at gestational week 17. Of the eligible women (able to complete a questionnaire in Norwegian), 80% (n = 3,752) agreed to participate and returned the first set of questionnaires.

Further self-report assessments were conducted at pregnancy week 32 (T2), 8 weeks postpartum (T3), and 2 years postpartum (T4). Owing to women moving away or being withdrawn from the study because of severe obstetric complications, eligibility rates decreased somewhat over the study course. Detailed information regarding dropout and participation is provided in a flow chart (see Supplementary Material, Supplemental Digital Content 1, http://links.lww.com/JDBP/A278).

To analyze attrition, we used multiple logistic regression analyses, including relevant demographic and mental health variables [i.e., maternal age, education, and symptoms of depression, anxiety, and post-traumatic stress disorder (PTSD)] assessed at gestational week 17 and the hospital's birth record as predictors of dropout within 2 years after birth. The results indicated that women with higher age [odds ratio (OR) = 0.97, 95% confidence interval (CI) = 0.96–0.99, $p < 0.001$] and education (OR = 0.57, 95% CI = 0.50–0.65, $p < 0.001$) were less likely to drop out of the study. Women with symptoms of depression (OR = 1.05, 95% CI = 1.02–1.07, $p < 0.001$) were somewhat more likely to drop out. Symptoms of anxiety and PTSD were not significantly related to drop out ($p > 0.05$).[2]

The Akershus Birth Cohort study received ethical approval from the Regional Committees for Medical and Health Research Ethics in Norway and was conducted in accordance with the Declaration of Helsinki.

Measures

Perinatal life stress was conceptualized based on 10 items drawn from established life event scales, assessed 8 weeks after birth. The life events included can be found in Table 1. At 8 weeks after birth, women indicated whether each of these events happened to them during the past 12 months and reported their reaction to the event on a 3-point scale, ranging from 1 (emotionally not so difficult) to 2

(difficult) to 3 (very difficult). The sum of scores from each item was used as a negative life event indicator. For the conceptualization of perinatal life stress, a score of 0 indicates low stress, scores between 1 and 5 indicate moderate stress, and scores above 5 indicate high levels of stress.[19]

Difficult infant temperament was measured using an adapted version of the "fussy/difficult" subscale of the Infant Characteristics Questionnaire (ICQ) 8 weeks after birth. Mothers rated their infants on 10 items from 1 ("completely disagree") to 7 ("completely agree") with higher scores illustrating more difficult infant temperament. The "fussy/difficult" subscale of the ICQ has good psychometric properties[20] starting at as young as 8 weeks,[21] and in this study, the internal consistency of the 10-item adapted subscale was $\alpha = 0.83$.

Child development was screened regarding 4 areas using the Ages & Stages Questionnaire (ASQ-3) and the Ages & Stages Questionnaire: Social–Emotional (ASQ:SE) at the 2-year follow-up. Using the ASQ-3, mothers reported on their children's gross motor (i.e., arm, leg, and body movements), fine motor (i.e., hand and finger movements), and communication development (i.e., babbling, vocalizing, listening, and understanding).[22] Each of these domains includes 6 items pertaining to whether a child is able to perform a certain task or behavior, coded "10" (yes), "5" (sometimes), or "0" (not yet). Total scores for each domain represent the sum of all domain items, ranging from 0 to 60, with higher scores indicating better development. The Norwegian version of the ASQ-3 has been validated,[23] and the internal consistency in the present study was $\alpha = 0.80$ for communication development and $\alpha = 0.61$ and $\alpha = 0.42$ for gross and fine motor development, respectively.

In addition, mothers completed the ASQ:SE, reporting on their children's social-emotional development (e.g., self-regulation, compliance, and interaction with people). The ASQ:SE comprises 26 items each rated on a 3-point scale specifying whether the child performs a behavior "most of the time" (0), "sometimes" (5), or "never or rarely" (10).[24] Furthermore, mothers indicate whether a behavior is concerning to the parents; checked concerns score 5 additional points. Item scores are summed into an overall score ranging from 0 to 390. In contrast to the ASQ-3, higher scores on the ASQ:SE are indicative of potential difficulties regarding social-emotional development. The Norwegian version of the ASQ-SE has been validated,[25] and the internal consistency in the present study was $\alpha = 0.52$. It should further be noted that the ASQ-3 and ASQ:SE represent screening tools, designed to identify children at risk for potential developmental concerns rather than continuous measures of developmental functioning.

Maternal depression during pregnancy and at the 2-year follow-up was evaluated using the Edinburgh Postnatal Depression Scale (EPDS).[26] The EPDS is a 10-item self-report measure commonly used to screen women for depressive symptoms relating to the past 7 days. Items are scored from 0 to 3, yielding total scores between 0 and 30.[26] The EPDS has good psychometric properties,[26] and the internal consistency was $\alpha = 0.83$ at gestational week 32, $\alpha = 0.85$ at 8 weeks after birth, and $\alpha = 0.87$ at the 2-year follow-up.

Maternal anxiety during pregnancy and postpartum was evaluated using the Anxiety Scale (SCL-A) of the Hopkins Symptom Checklist (SCL-25). The SCL-A is a 10-item self-report measuring dimensional general anxiety symptoms relating to the past 7 days. Items are scored from 1 to 4, yielding total scores between 10 and 40. The SCL-A presents good psychometric properties,[27] and the internal consistency was $\alpha = 0.78$ at gestational week 32, $\alpha = 0.80$ at 8 weeks after birth, and $\alpha = 0.84$ at the 2-year follow-up.

Prenatal attachment was measured at gestational week 32 via a 9-item short version of the Prenatal Attachment Inventory.[28] Response categories range from 1 (almost never) to 4 (almost always), with higher scores indicating greater prenatal attachment. Items 1, 4, 7, 9, 10, 12, 14, 16, and 18 from the original measure were included for the short version, yielding sum scores from 9 to 36. The Prenatal Attachment Inventory has good psychometric properties,[28] and in the present study, the internal consistency was $\alpha = 0.82$.

Social support was assessed 8 weeks after birth using the 3-item Oslo Social Support Scale.[29] The 3 items pertain to the number of close friends, the perceived concern from others, and the relationship with neighbors with a focus on the accessibility of practical help. Sum scores range from 3 to 14 with higher scores indicating stronger social support. The internal consistency was $\alpha = 0.55$.

Sociodemographic and childbirth-related information was derived from hospital birth records, including education, employment and marital status, smoking and alcohol consumption, and use of antidepressants or antianxiety medication during pregnancy, maternal age at delivery, parity, premature birth, mode of delivery, child sex, and obstetric complications (e.g., uterine rupture, eclampsia, and infections). Severe infant health complications at birth were conceptualized as admission to the neonatal intensive care unit as reported by the mother at 8 weeks after delivery. Current child health complications at the 2-year follow-up (e.g., nutritional issues, diabetes, and injuries) were reported by the mother.

Statistical Analysis

Analyses were performed in IBM SPSS version 25. Multiple imputation was used to treat missing data. First, we investigated potential differences regarding sociodemographic and childbirth-related information between those with and without perinatal life stress (dichotomous variable; score 0 = low life stress and

Table 1. Pearson Correlations

	Difficult Temperament	Gross Motor	Fine Motor	Communication	Social-Emotional
Study outcomes					
Difficult temperament T3	—	−0.08**	−0.09***	−0.06*	0.22***
ASQ-3 gross motor development T4		—	0.39***	0.32***	−0.16***
ASQ-3 fine motor development T4			—	0.30***	−0.24***
ASQ-3 communication development T4				—	−0.28***
ASQ:SE social-emotional development T4					—
Study predictor					
Perinatal life stress	0.06**	−0.01	−0.07**	−0.06*	0.20***
Demographics					
Maternal age	−0.06**	0.003	0.02	0.03	−0.09***
Marital status	−0.01	−0.03	0.03	0.03	−0.08*
Employment status	−0.04	−0.01	0.01	0.08**	−0.10***
Education	0.001	−0.01	0.04	0.07**	−0.17***
Pregnancy related					
Primiparity	0.11***	−0.02	−0.02	−0.03	−0.01
Smoking during pregnancy	0.03	0.03	0.02	−0.02	0.12***
Alcohol during pregnancy	0.02	−0.01	−0.06	−0.01	0.03
Prenatal attachment	0.01	0.03	0.06**	0.05*	−0.02
Prenatal depression	0.15***	−0.07**	−0.09***	−0.07**	0.23***
Childbirth related					
Prematurity	0.05	−0.05*	−0.05*	−0.02	0.07**
Emergency caesarean	0.05	0.002	−0.02	−0.02	0.03
Male child sex	0.10***	−0.03	−0.07**	−0.16***	0.08**
Obstetric complications	0.08***	0.04*	0.01	0.04*	0.01
Severe infant health complications	0.03	−0.03	0.01	−0.02	0.05
Postchildbirth					
Social support	−0.15***	0.08***	0.12***	0.07**	−0.19***
Continued breastfeeding 12 mo	−0.02	−0.02	0.03	0.02	−0.08**
Depression 8 wk postpartum	0.30***	−0.05*	−0.09***	−0.07**	0.23***
Depression 2 yr postpartum	0.12***	−0.08***	−0.13***	−0.10***	0.26***
Anxiety 8 wk postpartum	0.19***	−0.05*	−0.07**	−0.05*	0.20***
Anxiety 2 yr postpartum	0.13***	−0.08***	−0.11***	−0.08***	0.25***
Child health complications at 2 yr	0.08**	−0.12***	−0.05	−0.07**	0.08**

Difficult Infant Temperament measured with *Infant Characteristics Questionnaire*. Gross and Fine Motor, Communication, and Social-Emotional Development measured with the *ASQ:3* and *ASQ:SE*. Prenatal Attachment measured with *Prenatal Attachment Inventory*. Prenatal Depression and Depression 2 years postpartum assessed with the *Edinburgh Postnatal Depression Scale*. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$. ASQ-3, Ages and Stages Questionnaire, third edition; ASQ:SE, Ages and Stages Questionnaire: Social–Emotional.

scores ≥1 = at least moderate perinatal life stress) using t, χ^2, and Fisher exact tests. Second, we used bivariate Pearson correlations to examine associations between perinatal life stress, difficult infant temperament (ICQ), child development (ASQ-3 and ASQ:SE), and sociodemographic, childbirth-related, and postpartum information.

Given significant bivariate associations between the measures, multiple hierarchical regression was used to investigate whether perinatal life stress predicts difficult infant temperament at 8 weeks after birth and child development at the 2-year follow-up, when accounting for potential confounders (viz., variables significantly associated with difficult infant temperament or child development). Pregnancy-related variables were entered in the first step. Next, childbirth-related variables were entered in the second step. Postchildbirth variables were entered in the third step, and perinatal life stress was entered in the last step.

RESULTS

Demographics and Descriptive Statistics

Participants were between 19 and 46 years old (mean = 31, SD = 5). Most were married or living with their

partners (95%) and employed at least part time (91%) with at least 12 years of education (62%). Few women indicated having smoked (7% "daily," 5% "now and then") or consumed alcohol (4%) during pregnancy. Around half of the sample (48%) were primiparous, and most delivered at term (94%; i.e., delivery within 21 days before ultrasound calculated date or at least 258 days after last menstruation), with slightly more than half delivering male infants (52%). A minority underwent emergency cesarean sections (12%). Although only a few infants were admitted to the neonatal intensive care unit (7%), around a third of women reported at least 1 obstetric complication (32%) and child health issues at the 2-year follow-up (33%). More than half indicated at least moderate levels of perinatal life stress (68%).

Women who indicated at least moderate levels of perinatal life stress (n = 2532) were slightly younger (mean = 30.7, SD = 4.9) than those with low perinatal life stress (mean = 31.6, SD = 4.2), $t(1075) = 5.32$, $p < 0.001$, and were less likely to have had 12 years of education (stress: 57% and no stress: 72%). Furthermore, those with perinatal life stress were more likely to be unmarried or separated (stress: 6% and no stress: 2%), unemployed (stress: 11% and no stress: 5%), to have smoked (stress: 15% and no stress: 5%) or consumed alcohol during pregnancy (stress: 6% and no stress: 1%), and less likely to have continued breastfeeding for the first 12 months (stress: 35% and no stress: 40%).

Perinatal Life Stress and Difficult Infant Temperament and Child Development

Maternal perinatal life stress was associated with difficult infant temperament and child fine motor, communication, and social-emotional development, but not with gross motor development. Associations between infant temperament and child developmental dimension with maternal demographics, pregnancy- and childbirth-related, and postchildbirth factors are displayed in Table 1.

The multiple hierarchical regression model examining whether maternal perinatal life stress predicts difficult infant temperament, accounting for maternal age, primiparity, prenatal depression, child sex, obstetric complications, social support, and maternal symptoms of depression and anxiety at 8 weeks after birth, revealed a significant contribution of perinatal life stress to difficult infant temperament. Primiparity, male infant sex, obstetric complications, lower social support, and maternal postpartum depression explained 11% of variance in difficult infant temperament at 8 weeks after birth. Perinatal life stress added 1% of explained variance, resulting in the overall model explaining 12%. Maternal age, prenatal depression, and anxiety at 8 weeks after birth did not contribute significantly to difficult infant temperament (Table 2).

Multiple hierarchical regression models pertaining to maternal perinatal life stress as a predictor of fine motor and communication development at the 2-year follow-up indicated no significant contribution of perinatal life stress to fine motor and communication development above and beyond prechildbirth, childbirth-related, or postchildbirth factors.

The multiple hierarchical regression model for perinatal life stress as a predictor of social-emotional child development at the 2-year follow-up, accounting for maternal age, marital status, employment, education, smoking during pregnancy, prenatal depression, premature birth, child sex, social support, difficult infant temperament, breastfeeding, maternal symptoms of depression and anxiety at 8 weeks and 2 years after birth, child health complications at 2 years of age, and gross motor, fine motor, and communication development, revealed a significant contribution of perinatal life stress to social-emotional development. Lower maternal education, prenatal depression, low social support, difficult infant temperament, no continued breastfeeding for the first 12 months of the child's life, postpartum depression and anxiety at the 2-year follow-up, and lower fine motor and communication development explained 21% of variance in social-emotional development. Perinatal life stress added 1% of explained variance, resulting in the overall model explaining 22%. Maternal age, marital status, employment, smoking during pregnancy, premature birth, child sex, depression and anxiety at 8 weeks after birth, child health complications at 2 years of age, and gross motor development did not contribute significantly to social-emotional development (Table 2).

DISCUSSION

We examined the prospective relationship between maternal perinatal life stress based on individual responses to potentially stressful life events and infant temperament at 8 weeks and child development at 2 years in a sample of 3,572 Norwegian women while controlling for potentially confounding factors. Our main findings pertain to unique contributions of perinatal life stress to difficult infant temperament and challenges in social-emotional development at 2 years of age, but not to gross motor, fine motor, or communication development.

Although the link between prenatal maternal mental health problems and child outcomes has been well established,[1,2,4,5] in accordance with the developmental model of fetal programming, our findings highlight that even subclinical, nonpathological levels of maternal emotional distress in the perinatal period can prompt long-term developmental responses in the infant. Furthermore, our results stress the importance of examining the individual emotional impact of potentially stressful life events, rather than solely assessing whether certain events took place. Offspring may be affected by the mother's biophysiological stress response, which seems dependent on her individual perception of an event causing emotional distress.

Although it has been documented that maternal stress during pregnancy is linked to alterations in infant amygdala and prefrontal and lateral temporal cortices, key structures for social processing and emotional self-regulation,[11] previous research has largely focused on postpartum factors, such as parental caregiving and maltreatment. Furthermore, it has been established that early life represents a period of extensive brain white matter (WM) volume development and that this development is vulnerable not only to environmental factors but also to glucocorticoids, indicating that elevated stress hormones because of chronic provocation of stress responses may affect brain WM development in infancy and childhood.[30] Our findings, however, suggest that the conceptualization of early life stress should incorporate in utero experiences, a period of extensive fetal brain development, in which exposure to maternal stress hormones may prompt long-term offspring development.

Limitations

Data on maternal perinatal life stress, infant temperament, and child development were based on maternal self-report, representing a methodological limitation. The women's hospital birth records did not provide information related to emotional stress. Nonetheless, previous research has reported associations between self-reported maternal prenatal mental health, such as depression, and child outcomes.[31] In addition, because they were reported retrospectively, we were not able to pinpoint the exact timing of stressful life events. Because some previous evidence suggests the relevance of timing of in utero exposure to maternal stress during pregnancy, as related to different developmental stages, future studies should incorporate assessments of maternal perinatal life stress at several time points during pregnancy and early postpartum. Similarly, although women were able to indicate "other life events," the potential for various other stressogenic life events not covered in the current project should be acknowledged. Nonetheless, because the life events assessed here can be considered major occurrences, they may prompt long-term emotional distress and chronic maternal stress activation, thus affecting fetal development throughout pregnancy. Although the significance and relevance of the difficult infant temperament subscale used here has repeatedly been shown, it should be noted that there are gold standard observational measures for infant temperament and development that should be used in future studies to replicate the findings presented herein.

Despite documenting significant associations between perinatal life stress and difficult infant temperament at 8 weeks and social-emotional development at 2 years, regression coefficients were relatively small, indicating only modest effects. Nonetheless, our results may be clinically significant because we show that perinatal life stress was prospectively linked to difficult infant temperament and lower social-emotional development over a long period of time. Although the Ages & Stages Questionnaire represents one of few recommended screening tools to examine child development,[22,24] internal consistency of communication and fine motor and social-emotional development was rather low. These measures, however, assess broad domains of development. Items assessing such broad constructs tend to correlate less highly than items assessing more tightly defined constructs, in turn resulting in lower reliability estimates. In addition, translation or cultural factors might be at play, yielding lower internal consistency.

Moreover, including Norwegian-speaking women only, with most being White, our sample was somewhat homogeneous. Other ethnic groups may diverge regarding risk factors and the emotional impact of certain life events. Study participation was linked to a slight social gradient,[32] and previous attrition analyses indicated marginally selective attrition over the study course, potentially limiting generalizability of our findings.[33] For instance, as indicated by lower response rates at 32 weeks by women with high Edinburgh Postnatal Depression Scale scores at 17 weeks, attrition analyses showed that women with severe prenatal mental distress may have been more likely to drop out. Nonetheless, the results are not necessarily affected by selection bias when examining associations.[34] In addition, although our sample is fairly psychologically healthy and despite rather small effect sizes, we still document a link between maternal perinatal life stress and difficult infant temperament and social-emotional development with important clinical implications.

CONCLUSION

Our study reveals a prospective contribution of maternal perinatal life stress to difficult infant temperament at 8 weeks and challenges in social-emotional development at 2 years of age, even when controlling for comorbid factors such as maternal depression and anxiety. Considering the burden on mothers posed by life events perceived as severely distressing during pregnancy and in early postpartum and potentially detrimental long-term effects on neurobiological and social-emotional child development, our findings highlight the need for person-centered prenatal care and increased support of mothers facing difficult life events in the perinatal period. Routine prenatal care typically focuses on medical and somatic aspects, potentially underestimating the burden of maternal psychological states on both mother and child. Clinical awareness of in utero development and its relationship to maternal psychological health and potential adverse long-term consequences for the child are warranted to intervene and prevent effectively. For instance, expectant mothers facing emotional distress even at nonpathological levels may benefit from support during pregnancy and in adjusting to the parenting role. Future research should consider timing of in utero exposure and neurobiological mechanisms and influential environmental factors

Table 2. Hierarchical Regression Model for Difficult Infant Temperament at 8 Weeks and Social-Emotional Development at 2 Years

	Difficult Infant Temperament at 8 wk				Fine Motor Development at 2 yr				Communication Development at 2 yr				Social-Emotional Development at 2 yr			
Variable	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Step 1: prechildbirth																
Maternal age	−0.03	−0.03	−0.02	−0.04									−0.09	−0.10	−0.04	−0.03
Marital status													−1.34	−1.21	−0.92	−0.70
Employment									2.29*	2.20*	2.06*	2.06*	−2.88*	−2.79*	−1.42	−1.35
Education									1.02*	0.96*	0.50	0.50	−2.45*	−2.41*	−1.80*	−1.67*
Primiparity	−1.88*	−1.57*	−1.45*	−1.43*												
Smoking during pregnancy													1.90*	1.75*	1.63*	1.49
Prenatal attachment					0.09*	0.09	0.05*	0.06*	0.12*	0.12*	0.07	0.07				
Prenatal depression T2	0.32*	0.32*	−0.04	−0.02	−0.15*	−0.15*	0.01	0.01	−0.16*	−0.16*	0.00	0.00	0.74*	0.73*	0.28*	0.26*
Step 2: childbirth related																
Prematurity						−1.17	−0.55	−0.55						2.49	1.47	1.53
Emergency caesarean																
Male child sex		1.60*	1.29*	1.31*		−0.92*	−0.31*	−0.30		−3.27*	−2.61*	−2.61*		2.22*	0.62	0.59
Obstetric complications		0.66*	0.56*	0.55*						0.58*	0.49	0.49				
Step 3: postchildbirth																
Social support			−0.33*	−0.35*			0.19*	0.19			−0.05	−0.05			−0.40*	−0.38*
Difficult infant temperament							−0.01*	−0.01			0.03	0.03			0.23*	0.23*
Continued breastfeeding 12 mo															−1.38*	−1.39*
Depression 8 wk postpartum			0.66*	0.67*			−0.01	−0.01			−0.03	−0.03			0.17	0.16
Depression 2 yr postpartum							−0.09	−0.09			−0.10	−0.10			0.27*	0.25*
Anxiety 8 wk postpartum			−0.07	−0.03			0.04	0.05			0.13	0.13			−0.13	−0.18
Anxiety 2 yr postpartum							−0.01	−0.01			0.09	0.09			0.26*	0.25*
Child health complications T4											−0.32	−0.32			0.23	0.23
Gross motor development							0.32*	0.32*			0.33*	0.33*			−0.04	−0.05
Fine motor development											0.23*	0.23*			−0.25*	−0.24*
Communication development							0.11*	0.11*							−0.28*	−0.28*
Social-emotional development							−0.05*	−0.05*			−0.14*	−0.14*				
Step 4: negative life events																
Perinatal life stress				−0.18*				−0.06				0.01				0.33*
R^2	0.03*	0.05*	0.11*	0.12*	0.02*	0.02*	0.21*	0.21*	0.02*	0.04*	0.20*	0.20*	0.09*	0.09*	0.21*	0.22*

Values represent pooled regression coefficients. Difficult Infant Temperament measured *with Infant Characteristics Questionnaire*. Gross and Fine Motor, Communication, and Social-Emotional Development measured with the *ASQ:3* and *ASQ:SE*. *$p < 0.05$. ASQ-3, Ages & Stages Questionnaire, third edition; ASQ:SE, Ages & Stages Questionnaire: Social–Emotional.

pertaining to the relationship between maternal perinatal life stress and child development.

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