**Perinatal Risk and Protective Factors Associated with Diagnosis of Mental Health Disorders in Children by Age 9 Years**

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**Abstract**

**Background:** Early identification of children who are at risk of developing mental health disorders is essential for implementing prevention and intervention approaches. The perinatal period offers a unique period to identify these risks, as well as protective factors, due to the high frequency of contact with healthcare professionals.

**Methods:** The current study linked longitudinal cohort data from the All Our Families study (Canada) with administrative health records up to age 9 years (n=2,814), to identify risk and protective factors from the perinatal period (pregnancy through to first year of life) that are associated with common mental health diagnoses, specifically ADHD and emotional disorders. Parents also reported via surveys whether their child had received a mental health diagnosis prior to age 9 years.

**Results:** For a diagnosis of ADHD via administrative health records or parent report by age 9 years, risk factors included maternal post-partum mental health difficulties, difficulty meeting basic financial needs, an unwanted pregnancy, infant feeding and sleeping problems, and the presence of the child experiencing a physical health condition prior to 12 months, whereas high parent self-efficacy was associated with a decreased odds of a child ADHD diagnosis. For diagnosis of an emotional disorder, maternal postpartum mental health difficulties, single parenthood, an unwanted pregnancy, difficulty soothing the infant, and a maternal history of child abuse were risk factors, whereas parent optimism and partner relationship satisfaction were associated with a decreased odds of diagnosis.

**Conclusions:** Both shared and disparate perinatal factors are associated with the diagnosis of ADHD versus an emotional disorder The perinatal period may represent a critical window for identifying both risk and protective factors, enabling healthcare professionals to deliver tailored prevention or intervention strategies that could reduce the likelihood of future mental health problems in children.

**Key Words:** infancy; early identification; attention deficit hyperactivity disorder; emotional disorder; early childhood.

**Abbreviations:** ADHD-attention deficit hyperactivity disorder.

**Introduction**

Child and adolescent mental health difficulties represent a significant public health challenge, with 14% of children and adolescents between 10 and 19 years experiencing a mental health disorder globally.1 In Canada, an estimated 1.6 million children and youth have a mental health disorder, with higher rates among those experiencing greater health inequality, including racialized people and those who identify as sexual and gender diverse.2 More than one quarter of mental disorders have their onset when children are younger than 14 years3, with even earlier peak onset for anxiety disorders and neurodevelopmental disorders, such as ADHD (i.e., < 6 years of age).4 Indeed, a systematic review of 21 studies found that 18.4% of children between two and six years of age seen in a primary healthcare setting had a psychiatric diagnosis5, pointing to the need for prevention and intervention approaches for this population.

Identifying risk and protective factors present in the perinatal period may help orient resources towards those who present at greater or reduced risk for future mental health difficulties.6 Additionally, early childhood is an opportune time to identify children at risk for mental disorders, as the present lifetime cost of a cohort of children suffering from an emotional disorder (i.e., anxiety or depression) is close to $1 trillion Canadian, or $3,100 per person in the United States.2 Investments in the early years are more cost effective than later remediation7,8, and could save up to $28 billion dollars annually for the Canadian economy.2

Despite considerable research examining factors in childhood associated with mental health difficulties in children and youth (e.g. low socio-economic status, developmental difficulties, difficult temperament)9, few have focused on factors that can be identified in pregnancy and the first year postpartum, when parents and children have the greatest number of contacts with medical professionals. In Canada, children have up to 18 physician visits in the first year10, which is approximately 180% higher than at any other time prior to school entry.10 Most women also receive frequent prenatal care during pregnancy.11 The perinatal period therefore provides a unique opportunity to identify early risk and protective factors that may be associated with the development of mental health disorders in early and middle childhood. Identification of these factors could inform clinical decision making related to monitoring and follow-up concerning child mental health in the early years.12

There are several risk factors for children’s mental health difficulties that have been identified in infancy and early childhood. Specifically, maternal mental health difficulties13,14, poverty15,16, whether pregnancy was wanted17, poor child sleep18,19, child feeding difficulties20, and physical or developmental delays21 have been identified as risk factors for poor child mental health. A maternal history of adverse childhood experiences (ACEs) has also emerged as a predictor of children’s early mental health difficulties. 14,22-24 In addition, several factors have also been identified as being protective against the development of mental health challenges in childhood, including attending childcare14, maternal optimism14, parental relationship satisfaction25,26, parent self-efficacy27, community engagement14, and social support14. However, limited research has explored these risk and protective factors simultaneously and most research has looked at symptom outcomes rather than likelihood of disorder diagnosis.

Large prospective cohort studies offer a valuable opportunity to identify early risk and protective factors for the development of children’s mental health disorders by capitalizing on rich longitudinal measurement. However, one limitation of large prospective cohorts is the reliance on parent-reported outcome data, which may introduce bias due to subjective reporting. The value of cohort studies can be enhanced through linkage with administrative health records, which provide objective health information assessed by healthcare professionals. This combination of parent-reported data with risk factor data and linked administrative health data for diagnostic outcomes allows researchers to address and mitigate biases inherent in single-informant studies. By integrating these complementary data sources, it is possible to ascertain a more comprehensive and reliable understanding of the early childhood factors associated with children’s mental health development.

**The Current Study**

The goal of the current study was to identify risk and protective factors from the perinatal period that are associated with mental health disorders in early childhood, prior to 9 years of age. We focus specifically on ADHD and emotional disorders diagnoses, as these are among the most diagnosed mental health disorders in children. By linking a longitudinal pregnancy cohort with administrative health data, we sought to identify the individual, family, and social-environmental risk and protective factors that are predictive of diagnosis of mental disorders prior to 9 years of age. Our research has the potential to contribute to the development of early childhood mental health “risk calculators”, which estimate the probability of a child receiving a mental illness diagnosis and are instrumental in guiding clinical care with regards to identifying who may need prevention strategies.28

**Methods**

**Study Sample and Data Linkage**

Data for the current study comes from the All Our Families (AOF) study, which is a prospective birth cohort study focused on understanding factors associated with maternal-child health and child development over time.29,30 Participants (n=3,388) were recruited into the study during pregnancy starting in 2008 in Calgary, Alberta, Canada. Participants completed questionnaires twice in pregnancy, at 4-months, and 12-months post-partum. Maternal reports of child mental health diagnoses were completed when the child was 5 and 8 years of age.

Participants in the AOF study were asked for consent to link to their medical records (n = 2824 consented), and a waiver of consent was subsequently obtained to link to their child’s records. The linkage was conducted by an analyst at Alberta Health Services. Linkage accuracy was 99.6% for maternal records. Using maternal personal health numbers and child date of birth, child personal health numbers were obtained using Alberta vital statistics (birth) records, and linked to inpatient (Discharge Abstract Data, or DAD), outpatient (National Ambulatory Care Reporting System, or NACRS), and practitioner claims data to identify mental health disorder diagnoses prior to age 9 years. Within the administrative health data, diagnostic information was entered using the International Classification of Disease (ICD) 9 or 10 format. Although administrative health data provides information about several diagnostic categories, we focus on ADHD and emotional disorders (i.e., anxiety and depression) as they are the most common disorders in childhood.31 A total of 2814 children were identified as having at least one health service contact beyond their delivery record and were included in the final sample for this study. Permission to access the administrative health data was provided by Alberta Health and Alberta Health Services. Ethics approval for this study was received from the Conjoint Health Research Ethics Board, University of Calgary (ID: 130868).

**Risk and Protective Factors**

We were interested in exploring risk and protective factors in the perinatal period for the diagnosis of mental health disorders, specifically ADHD and emotional disorders in early childhood (prior to 9 years of age). Risk and protective factors were obtained from self-report questionnaires completed by mothers in the All Our Families cohort during pregnancy, at 4 and 12 months postpartum. Factors measured in pregnancy included an unwanted pregnancy (yes/no), maternal history of child maltreatment (yes/no), and maternal optimism (yes/no). Factors measured at 4 months postpartum included experiencing maternal postpartum mental health difficulties (yes/no), difficulty meeting basic needs (yes/no), and feeding difficulties (yes/no). A maternal mental health difficulty was indicated if a mother exceeded the designated clinical cut-offs on measures of depression (Edinburgh Postnatal Depression Scale)32 or anxiety (Spielberger State Anxiety Scale)33 when the infant was 4 months of age. Factors measured at 12 months postpartum included being a single parent (yes/no), infant sleeping difficulties (yes/no), infant soothing difficulties (yes/no), infant physical health conditions (yes/no), infant delay in any developmental milestones (yes/no), infant attends childcare (yes/no), high relationship satisfaction with their partner (yes/no), high parenting self-efficacy (yes/no), community engagement (yes/no), and adequate social support (yes/no). Operational definitions including the standardized scales used to operationalize the exposure variables can be found in Supplementary Table 1.

**Outcome Variables**

The outcome variables included whether the child had received an ADHD diagnosis, emotional disorder diagnosis, or either of the two. These variables were operationalized from two sources: administrative health data, where inpatient, outpatient, or physician claims data identified children with a recorded ADHD and/or emotional disorder diagnosis (e.g., anxiety, depression) and parent reports that their child received a diagnosis on the All Our Families surveys at 5 and 8 years of age. This combined approach was used because administrative health data does not capture all mental health diagnoses for children. For example, many individuals may receive a mental health diagnosis from a mental health practitioner in the school or community setting.34￼ Thus, this approach is more comprehensive. With regards to missing data, if a participant was identified as having a diagnosis in any data source, this was carried forward to the outcome variable regardless of any other missing data.

**Parent reported mental health diagnoses.**In 5-year and 8-year AOF surveys, parents were asked to report whether their child had experienced or been diagnosed with ADHD or a mental health problem.If yes for a mental health problem, the parent specified details in an open text field and only details pertaining to anxiety and depression were retained. The 5- and 8-year parent reports were combined, and a new variable was generated to indicate if the child had been diagnosed (yes = 1, no = 0) with ADHD, an emotional disorder (e.g., anxiety disorders, depressive disorders, bipolar disorder) or either disorder prior to age 9 years.

**Administrative data***.* The ICD-9 and ICD-10 codes that were used for this study are presented in Supplementary Table 2. An existing case definition adopted by the Canadian Institutes of Health Information (CIHI) for the surveillance of child mental health disorders was used to identify the relevant diagnostic codes for child emotional disorder.35 The case definitions for ADHD and emotional disorders have been used previously in research and are published elsewhere.36 To operationalize diagnoses within administrative health data, we used the 1 hospitalization (inpatient or outpatient), 2 physician claims (1H2P) method over a 12 month period, which is a validated algorithm for depression and ADHD in Canada.37, 38 Children were coded as either having received a diagnosis prior to age nine years (1) or not (0) for ADHD, emotional disorders, or either.

**Confounding Variables**

We conducted bivariate analyses between our exposure variables and the following sociodemographic variables: maternal age, parity, household family income, child gestational age, racial/ethnic minority status, maternal education, being born in Canada, and child sex. Supplementary Tables 3 and 4 depict the results of the bivariate analyses. Variables identified as significantly associated with the risk and protective factors in this study were included as covariates for all adjusted regression models, to reduce potential confounding.39

**Statistical Analysis**

Frequencies and proportions were calculated for the demographic characteristics of the full sample and for those who did and did not receive a mental disorder diagnosis prior to age 9 years. Frequencies and proportions were also estimated for the prevalence of ADHD diagnosis, emotional disorder diagnosis, or receiving either diagnosis.

Unadjusted and adjusted odds ratios were calculated to examine the association between risk and protective factors and diagnosis of a mental disorder prior to age 9 years. For the adjusted models, variables that were significantly associated with the predictor variable were included as covariates. For example, household family income and child gestational age were significantly associated with maternal mental health and were those included in the maternal mental health models. Given the exploratory nature of the analyses, statistical significance was set at p<0.05. All analyses were conducted in SPSS Version 2940 and using MPlus version 8.8.41

**Missing data.** Attrition among participants enrolled in longitudinal cohort studies is well documented. In the All Our Families study, response rates were approximately 71% at the 5-year and 8-year time points. These attrition rates are in line with completion rates in other longitudinal parent and child cohorts.42,43 In the current study, overall missingness across all variables ranged from 0.1% to 59.1%. Approximately 59.1% of the data was missing for the developmental delay questionnaire using the Ages and Stages questionnaire at the one-year timepoint due to a delay in securing funding and ethics for that timepoint, which resulted in a smaller number of children being eligible.29 Thus, only 1573 women had completed the study questionnaires at the one-year time point . Given that most data were likely missing at random36, full information maximum likelihood (FIML) was used to model the missing data, which uses all observed data without imputing missing values. FIML has been shown to estimate unbiased parameters by maximizing the likelihood function based on the observed data and model parameters44 and to perform as well as multiple imputation.45 As such, between 2,778 and 2,812 participants were included in the adjusted odds ratio models.

**Results**

**Sample Characteristics**

Descriptive statistics for the sample of women and their children linked to administrative health data are presented in Table 1. On average, women were 31 years of age when their child was born, with the majority being less than 35 years of age. Most women had a household family income >$80,000 per year, had a term baby, were White, had more than a high-school education, were married, did not have a history of mental illness, and were born in Canada. Approximately half (50.7%) of women had a previous child and half (47%) of the babies born in this study were female. Participants whose children had been diagnosed with any mental disorder before age 9 years had higher odds of having a lower income, have a child born preterm, be single, have a history of mental health difficulties, be born in Canada, and have a male child.

**Descriptive Statistics**

The prevalence of mental health disorder diagnoses in administrative health data and via parent report using AOF cohort data is presented in Table 1.

Risk factors co-occurred in the current study (See Supplementary Table 3). For example, families who had difficulty meeting their basic needs had higher odds of having mothers who were younger, identified as a racial/ethnic minority, have lower household income, have lower education, and not be born in Canada. Protective factors also co-occurred in the current sample. For example, children whose mothers who had adequate social support had higher odds of having mothers who were younger, have higher household income, had a term child, identify as White, and have mothers born in Canada (See Supplementary Table 4). Phi coefficients among risk and protective factors are also presented in Supplementary Table 7. Therefore, all identified covariates were adjusted for in the multivariable analyses.

**Multivariate Analysis**

**Risk factors for mental disorders.** After adjusting for covariates, significant risk factors for ADHD included maternal postpartum mental health difficulties (aOR:1.67, 95%CI: 1.13-2.47), difficulty meeting basic needs (aOR:3.15, 95%CI:1.83-5.42), an unwanted pregnancy (aOR: 2.05, 95%CI:1.38-3.04), infant feeding (aOR: 3.41, 95%CI: 1.69-6.85) and sleeping difficulties (aOR: 1.64, 95%CI: 1.08-2.48), and an infant with a physical health condition (aOR: 2.07, 95%CI:1.10-3.93).

After adjusting for covariates, risk factors for an emotional disorder included a maternal postpartum mental health difficulties (aOR:2.19, 95%CI: 1.36-3.53), a single parent (aOR: 5.53, 95%CI: 1.12-18.41), an unwanted pregnancy (aOR:2.02, 95%CI: 1.21-3.36), infant soothing difficulties (aOR:2.10, 95%CI: 1.02-4.34), and a maternal history of child maltreatment (aOR:2.01, 95%CI: 1.26-3.20). Risk factors for any disorder (ADHD or an emotional disorder) after adjusting for covariates included maternal history of mental illness, single parent status, difficulty meeting basic needs, an unwanted pregnancy, infant feeding difficulties, infant sleeping difficulties, a physical health condition, and a history of maternal child maltreatment. Odds ratios adjusted for covariates are presented in Table 2. Unadjusted analyses are presented in Supplementary Table 5.

**Protective factors for mental disorders.** Parenting self-efficacy was a protective factor for ADHD after adjusting for covariates (aOR: 0.50, 95%CI: 0.31-0.81). Maternal optimism (aOR: 0.57, 95%CI: 0.34-0.96) and relationship satisfaction (aOR: 0.36, 95%CI: 0.19-0.71) were protective factors for emotional disorders after adjusting for covariates. Odds ratios adjusted for covariates are presented in Table 3. Unadjusted analyses are presented in Supplementary Table 6.

**Discussion**

Epidemiological research has demonstrated that the peak onset of common mental disorders, including ADHD and emotional disorders, often occurs well before adolescence. This highlights the need to identify factors that put children at risk for mental health problems during early childhood.4 The current study sought to identify whether risk and protective factors in the perinatal period are associated with the diagnosis of a mental health disorder before age 9. To examine this comprehensively, we linked longitudinal cohort data with administrative health records data. When examining risk factors for a diagnosis of ADHD in early childhood, we found that maternal postpartum mental health difficulties, difficulty meeting basic needs, unwanted pregnancy, and infant feeding, sleeping, and health difficulties were associated with a two to three times greater likelihood of an ADHD diagnosis by age 9 years. In comparison, for emotional disorders, maternal postpartum mental health difficulties, single parenthood, an unwanted pregnancy, difficulty soothing the infant, and a maternal history of child maltreatment were associated with two times the odds of having a child that received such a diagnosis by 9 years of age. Our findings suggest that multiple factors are associated with mental health disorders in early childhood and both similar but also disparate mechanisms may be at play for these two disorders.

We found that having difficulty meeting basic needs was associated with a diagnosis of ADHD before age 9 years. Socioeconomic disadvantage, such as food insecurity, has been identified as fundamental determinant of mental health across development.46 Indeed, this finding is in line with results from a meta-analysis of 42 studies demonstrating that children in families of low socioeconomic status have twice the odds of having ADHD than their peers in families of higher socioeconomic status.47 This literature is limited by the fact that whether or not parents have ADHD is not always considered, which is important given the heritability of ADHD. Additionally, children who demonstrate multiple regulatory problems, including feeding and sleeping difficulties, had higher odds of receiving a diagnosis of ADHD in childhood and adulthood, compared to children without regulatory difficulties.48 Early regulatory problems in infancy may be a precursor for child behavioral difficulties as well as parenting difficulties. As such, parenting support and strategies could be provided to parents whose children are facing early regulatory difficulties to help them in addressing their child’s physiological and behavioral regulation.

With regards to risk factors for the diagnosis of emotional disorders in children, maternal postpartum mental health difficulties were a salient predictor. This finding is in line with previous research that has pointed to the importance of identifying49 and addressing maternal postpartum mental health difficulties to mitigate poor outcomes for offspring.50 There are several mechanisms by which postpartum mental health difficulties may impact children’s mental health, including shared genetics and environmental factors such as the severity and timing of the exposure to maternal mental health difficulties, and the presence of protective factors (e.g., a supportive co-parent). Individual child vulnerabilities, such as the infant’s temperament, including being difficult to soothe, are also important considerations. We found that parent-reported difficulty soothing their infant was associated with an increased likelihood of an emotional disorder. There is likely interplay between maternal postpartum mental health characteristics and her child’s difficulty being soothed whereby the child’s characteristics further reinforces depressive symptoms and vice versa.51 Previous research has shown that a positive parenting relationship and social support can help address maternal postpartum mental health challenges52, as such these are important intervention targets.

Interestingly, an unwanted pregnancy as reported by the mother was associated with both ADHD and an emotional disorder diagnosis. Children of mothers who were unsure or unhappy about their pregnancy have twice the odds of developing a mental health disorder prior to age 9 years. Previous research has shown that mothers who report their pregnancy as unwanted had greater odds of experiencing challenges in their lives, such as relationship difficulties or stress, which could predispose a child to having mental health difficulties. For example, maternal stress and psychopathology in pregnancy has been associated with the development of both externalizing and internalizing challenges in offspring.53 An unwanted pregnancy and the context in which this experience occurs may be associated with cascading effects that contribute to mental health difficulties in offspring and is consistent with the notion of multifinality54, whereby exposure to one risk factor predicts the development of various mental health difficulties in children. An unwanted pregnancy may also be a proxy for caregiver life stressors or mental health difficulties that can also have an impact on children’s mental health.

We found that parent-reported relationship optimism and satisfaction in the perinatal period, which are modifiable factors, were protective for the development of an emotional disorder in young children. A positive life outlook and support that is provided in the context of an intimate relationship may buffer against mental health challenges experienced by the mother.50,55 High relationship satisfaction may also be a proxy for a home environment and parenting practices that are conducive to positive emotional development for young children.56 Increased emphasis on co-parenting relationships and social support provided by partners in the perinatal period may be critical for fostering optimal child mental health. Additionally, parents who reported higher levels of parenting self-efficacy in the first year had lower odds of having children diagnosed with ADHD, which is in line with previous research.57 Research that disentangles directionality of this association is needed.

**Strengths and Limitations**

The current study has several strengths and limitations. A key strength is that, to the best of our knowledge, this is one of the first studies to link a large prospective pregnancy cohort with administrative health records data to specifically explore whether early infancy predictors are associated with later child mental health disorders. The study’s longitudinal design and comprehensive collection of both risk *and* protective factors during the perinatal period allow us to make inferences about very early predictors of childhood mental health disorders. Additionally, by incorporating both administrative health data and parent reports of diagnoses, the current study was able to capture diagnoses that may have occurred outside the healthcare system.

There are also limitations to the current study. First, potential bias may arise from differences in the characteristics of mothers included in the current study as compared to those in the Canadian population, those who discontinued, and those wwho were not linked. Women who participated in the All Our Families Study had higher incomes and more likely to be married than women in the Canadian population, however, the age, education level, and number of women who were foreign born was comparable to the Canadian population.29 Additionally, women who were retained in the study were older, in a relationship, had higher education, had higher family income, and were born in Canada.29 A previous study by Premji et al., 2019 and colleagues also found that women who were not linked to administrative data in the All Our Families Cohort had lower levels of education, income and were less likely to be partnered.49 These differences may limit the generalizability of the findings to higher risk samples or other demographic groups. Second, due to the exploratory nature of the current study, the significance level was set at p<-.05, which may have inflated the chance of Type I error. Nevertheless, this paper provides a first examination of factors from the perinatal period associated with common childhood diagnoses prior to age 9 years. Lastly, although the current study examined several factors from the perinatal period that are associated with child mental health diffculties, there are additional factors that were not included that should be considered in future research, namely paternal factors and parental psychopathology beyond the perinatal period. Although paternal factors are often under-emphasized in child mental health research, paternal mental health history and maltreatment history are known determinants of children’s mental health. 58,59 Additionally, previous research has shown that parental mental health beyond the perinatal period plays an important role in the development of childhood mental illness.60 As such, future research that considers broader familial factors as predictors of child mental illness is needed.

**Conclusion**

This study established that risk and protective factors for diagnosis of ADHD and emotional disorders can be identified in the perinatal period. During this critical period, healthcare providers have the most frequent contact with families, which presents an important “window of opportunity” to identify these factors and offer resources and supports where appropriate. This approach has the potential to be both preventative and cost-effective in reducing individual and public costs associated with childhood mental health disorders.

Identification of early risk and protective factors has the potential to inform our understanding of variables from the perinatal period that are association with the development of mental illness in children and youth. Moreover, it provides an opportunity to support families facing social determinants of health and to provide selected primary prevention approaches for children at particularly high risk.46 Clinical applications and translations of this work are essential to guide the efforts of clinicians and healthcare providers who work directly with young children and their caregivers.

**References**

1. World Health Organization. 2024. <https://www.who.int/news-room/fact-sheets/detail/adolescent-mental-health> (accessed October 21, 2024.

2. The Conference Board of Canada. Nurturing Minds for Secure Futures, 2023.

3. Giaconia RM, Reinherz HZ, Silverman AB, Pakiz B, Frost AK, Cohen E. Ages of onset of psychiatric disorders in a community population of older adolescents. *J Am Acad Child Adolesc Psychiatry* 1994; **33**(5): 706-17.

4. Solmi M, Radua J, Olivola M, et al. Age at onset of mental disorders worldwide: large-scale meta-analysis of 192 epidemiological studies. *Molecular Psychiatry* 2022; **27**(1): 281-95.

5. Charach A, Mohammadzadeh F, Belanger SA, et al. Identification of Preschool Children with Mental Health Problems in Primary Care: Systematic Review and Meta-analysis. *J Can Acad Child Adolesc Psychiatry* 2020; **29**(2): 76-105.

6. Costello EJ. Early Detection and Prevention of Mental Health Problems: Developmental Epidemiology and Systems of Support. *Journal of Clinical Child &amp; Adolescent Psychology* 2016; **45**(6): 710-7.

7. Doyle O, Harmon CP, Heckman JJ, Tremblay RE. Investing in early human development: timing and economic efficiency. *Econ Hum Biol* 2009; **7**(1): 1-6.

8. Campbell F, Conti G, Heckman JJ, et al. Early Childhood Investments Substantially Boost Adult Health. *Science* 2014; **343**(6178): 1478-85.

9. Koning NR, Büchner FL, Vermeiren RRJM, Crone MR, Numans ME. Identification of children at risk for mental health problems in primary care—Development of a prediction model with routine health care data. *EClinicalMedicine* 2019; **15**: 89-97.

10. Premji S, McNeil DA, Santana MJ, Spackman E. Examining the Relationship Between Screening for Postpartum Depression and Associated Child Health Service Utilization and Costs: A Study Using the All Our Families Cohort and Administrative Data. *Matern Child Health J* 2024; **28**(3): 567-77.

11. Debessai Y, Costanian C, Roy M, El-Sayed M, Tamim H. Inadequate prenatal care use among Canadian mothers: findings from the Maternity Experiences Survey. *Journal of Perinatology* 2016; **36**(6): 420-6.

12. Luby J, Allen N, Estabrook R, et al. Mapping infant neurodevelopmental precursors of mental disorders: How synthetic cohorts & computational approaches can be used to enhance prediction of early childhood psychopathology. *Behav Res Ther* 2019; **123**: 103484.

13. Hentges RF, Graham SA, Plamondon A, Tough S, Madigan S. Bidirectional associations between maternal depression, hostile parenting, and early child emotional problems: Findings from the all our families cohort. *Journal of Affective Disorders* 2021; **287**: 397-404.

14. Hetherington E, McDonald S, Racine N, Tough S. Risk and Protective Factors for Externalizing Behavior at 3 Years: Results from the All Our Families Pregnancy Cohort. *J Dev Behav Pediatr* 2018; **39**(7): 547-54.

15. Roos LL, Wall-Wieler E, Lee JB. Poverty and Early Childhood Outcomes. *Pediatrics* 2019; **143**(6): e20183426.

16. Peverill M, Dirks MA, Narvaja T, Herts KL, Comer JS, McLaughlin KA. Socioeconomic status and child psychopathology in the United States: A meta-analysis of population-based studies. *Clin Psychol Rev* 2021; **83**: 101933.

17. Saleem HT, Surkan PJ. Parental Pregnancy Wantedness and Child Social-Emotional Development. *Maternal and Child Health Journal* 2014; **18**(4): 930-8.

18. Sivertsen B, Harvey AG, Reichborn-Kjennerud T, Torgersen L, Ystrom E, Hysing M. Later Emotional and Behavioral Problems Associated With Sleep Problems in Toddlers. *JAMA Pediatrics* 2015; **169**(6): 575.

19. O'Callaghan FV, Al Mamun A, O'Callaghan M, et al. The link between sleep problems in infancy and early childhood and attention problems at 5 and 14years: Evidence from a birth cohort study. *Early Human Development* 2010; **86**(7): 419-24.

20. Ammaniti M, Lucarelli L, Cimino S, D'Olimpio F, Chatoor I. Feeding disorders of infancy: A longitudinal study to middle childhood. *International Journal of Eating Disorders* 2012; **45**(2): 272-80.

21. Pant SW, Skovgaard AM, Ammitzbøll J, Holstein BE, Pedersen TP. Motor development problems in infancy predict mental disorders in childhood: a longitudinal cohort study. *European Journal of Pediatrics* 2022; **181**(7): 2655-61.

22. Cooke JE, Racine N, Plamondon A, Tough S, Madigan S. Maternal adverse childhood experiences, attachment style, and mental health: Pathways of transmission to child behavior problems. *Child Abuse Negl* 2019; **93**: 27-37.

23. McDonald SW, Madigan S, Racine N, Benzies K, Tomfohr L, Tough S. Maternal adverse childhood experiences, mental health, and child behaviour at age 3: The all our families community cohort study. *Prev Med* 2019; **118**: 286-94.

24. Madigan S, Browne D, Racine N, Mori C, Tough S. Association Between Screen Time and Children's Performance on a Developmental Screening Test. *JAMA Pediatr* 2019; **173**(3): 244-50.

25. Nicolaus C, Kress V, Kopp M, Garthus-Niegel S. The Impact of Parental Relationship Satisfaction on Infant Development: Results From the Population-Based Cohort Study DREAM. *Frontiers in Psychology* 2021; **12**.

26. Salo SJ, Lipsanen JO, Sourander J, Pajulo M, Kalland M. Parental relationship satisfaction, reflective functioning, and toddler behavioral problems: A longitudinal study from pregnancy to 2 years postpartum. *Front Psychol* 2022; **13**: 904409.

27. Albanese AM, Russo GR, Geller PA. The role of parental self‐efficacy in parent and child well‐being: A systematic review of associated outcomes. *Child: Care, Health and Development* 2019; **45**(3): 333-63.

28. Wakschlag LS, MacNeill LA, Pool LR, et al. Predictive Utility of Irritability “In Context”: Proof-of-Principle for an Early Childhood Mental Health Risk Calculator. *Journal of Clinical Child & Adolescent Psychology* 2024; **53**(2): 231-45.

29. Tough SC, McDonald SW, Collisson BA, et al. Cohort Profile: The All Our Babies pregnancy cohort (AOB). *Int J Epidemiol* 2017; **46**(5): 1389-90k.

30. McDonald SW, Lyon AW, Benzies KM, et al. The All Our Babies pregnancy cohort: design, methods, and participant characteristics. *BMC Pregnancy Childbirth* 2013; **13 Suppl 1**: S2.

31. Sacco R, Camilleri N, Eberhardt J, Umla-Runge K, Newbury-Birch D. A systematic review and meta-analysis on the prevalence of mental disorders among children and adolescents in Europe. *European Child &amp; Adolescent Psychiatry* 2024; **33**(9): 2877-94.

32. Cox J, Holden J, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. *British Journal of Psychiatry* 1987; **150**: 782-6.

33. Spielberger CD GR, Lushene R, Vagg PR, Jacobs GA. Manual for the State-Trait Anxiety Inventory. : Consulting Psychologists Press; 1983.

34. Farmer EM, Burns BJ, Phillips SD, Angold A, Costello EJ. Pathways into and through mental health services for children and adolescents. *Psychiatr Serv* 2003; **54**(1): 60-6.

35. Information CIfH. Hospital Mental Health Database Data Dictionary, 2019-2020 2021. <https://www.cihi.ca/en/hospital-mental-health-database-metadata-hmhdb>.

36. Racine N, Pitt T, Premji S, et al. Prevalence of Common Child Mental Health Disorders Using Administrative Health Data and Parent Report in a Prospective Community-Based Cohort from Alberta, Canada: Prevalence des troubles communs de sante mentale de l'enfant a l'aide des donnees de sante administratives et des rapports des parents dans une cohorte prospective communautaire d'Alberta, Canada. *Can J Psychiatry* 2024; **69**(10): 768-77.

37. Butt D, Jaakkimainen L, Tu K. Prevalence and Incidence Trends of Attention Deficit/Hyperactivity Disorder in Children and Youth Aged 1–24 Years in Ontario, Canada: A Validation Study of Health Administrative Data Algorithms. *The Canadian Journal of Psychiatry* 2023; **0**(0): 07067437231213553.

38. Doktorchik C, Patten S, Eastwood C, et al. Validation of a case definition for depression in administrative data against primary chart data as a reference standard. . *BMC psychiatry* 2019; **19(1)**.

39. Greenland S, Robins JM. Identifiability, exchangeability, and epidemiological confounding. *Int J Epidemiol* 1986; **15**(3): 413-9.

40. IBM Corp. IBM SPSS Statistics for Windows, Version 29.0. Armonk, NY: IBM Corp.; 2020.

41. Muthén L, & Muthén, B. . Mplus statistical modeling software: Release 8.8. Los Angeles, CA: Muthén & Muthén.; 2022.

42. Fraser A, Macdonald-Wallis C, Tilling K, et al. Cohort Profile: the Avon Longitudinal Study of Parents and Children: ALSPAC mothers cohort. *Int J Epidemiol* 2013; **42**(1): 97-110.

43. Piler P, Kandrnal V, Kukla L, et al. Cohort Profile: The European Longitudinal Study of Pregnancy and Childhood (ELSPAC) in the Czech Republic. *Int J Epidemiol* 2017; **46**(5): 1379-f.

44. Enders CK. The Performance of the Full Information Maximum Likelihood Estimator in Multiple Regression Models with Missing Data. *Educational and Psychological Measurement* 2001; **61**(5): 713-40.

45. Lee T, Shi D. A comparison of full information maximum likelihood and multiple imputation in structural equation modeling with missing data. *Psychol Methods* 2021; **26**(4): 466-85.

46. Kirkbride JB, Anglin DM, Colman I, et al. The social determinants of mental health and disorder: evidence, prevention and recommendations. *World Psychiatry* 2024; **23**(1): 58-90.

47. Russell AE, Ford T, Williams R, Russell G. The Association Between Socioeconomic Disadvantage and Attention Deficit/Hyperactivity Disorder (ADHD): A Systematic Review. *Child Psychiatry & Human Development* 2016; **47**(3): 440-58.

48. Bilgin A, Baumann N, Jaekel J, et al. Early Crying, Sleeping, and Feeding Problems and Trajectories of Attention Problems From Childhood to Adulthood. *Child Development* 2020; **91**(1): e77-e91.

49. Premji S, McDonald S, Metcalfe A, et al. Examining postpartum depression screening effectiveness in well child clinics in Alberta, Canada: A study using the All Our Families cohort and administrative data. . *Preventive medicine reports* 2019; **14**.

50. Goodman SH. Intergenerational Transmission of Depression. *Annu Rev Clin Psychol* 2020; **16**: 213-38.

51. Bagner DM, Pettit JW, Lewinsohn PM, Seeley JR, Jaccard J. Disentangling the temporal relationship between parental depressive symptoms and early child behavior problems: a transactional framework. *J Clin Child Adolesc Psychol* 2013; **42**(1): 78-90.

52. Racine N, Plamondon A, Hentges R, Tough S, Madigan S. Dynamic and bidirectional associations between maternal stress, anxiety, and social support: The critical role of partner and family support. *Journal of Affective Disorders* 2019; **252**: 19-24.

53. Madigan S, Oatley H, Racine N, et al. A Meta-Analysis of Maternal Prenatal Depression and Anxiety on Child Socioemotional Development. *Journal of the American Academy of Child & Adolescent Psychiatry* 2018; **57**(9): 645-57.e8.

54. Cicchetti D, Rogosch FA. Equifinality and multifinality in developmental psychopathology. *Developmental psychopathology* 1996; **8**: 597-600.

55. Nagaraja A, Rajamma NM, Reddy SV. Effect of parents’ marital satisfaction, marital life period and type of family on their children mental health status. *Journal of Psychology* 2012; **3**(2): 65-70.

56. Huang CY, Shen ACT, Li X, Feng JY. Happy parents, happy kids: Marital happiness, parenting styles, and children's behavioral outcomes in Chinese societies. *Family Relations* 2024; **73**(3): 1763-80.

57. Primack BA, Hendricks KM, Longacre MR, et al. Parental efficacy and child behavior in a community sample of children with and without attention-deficit hyperactivity disorder (ADHD). *ADHD Attention Deficit and Hyperactivity Disorders* 2012; **4**(4): 189-97.

58. Scarlett H, Moirangthem S, van der Waerden J. The impact of paternal mental illness on child development: an umbrella review of systematic reviews and meta-analyses. *European Child & Adolescent Psychiatry* 2024; **33**(11): 3693-706.

59. Grafft N, Lo B, Easton SD, Pineros-Leano M, Davison KK. Maternal and Paternal Adverse Childhood Experiences (ACEs) and Offspring Health and Wellbeing: A Scoping Review. *Maternal and Child Health Journal* 2024; **28**(1): 52-66.

60. Speyer LG, Hall HA, Hang Y, Hughes C, Murray AL. Within-family relations of mental health problems across childhood and adolescence. *Journal of Child Psychology and Psychiatry* 2022; **63**(11): 1288-96.

## **Table 1.** Sample characteristics

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Characteristic (n=2,814)** | **N (%)** | **No Mental Disorder (n=1362)** | **Mental Disorder (n=275)** | **p-value** |
| **Maternal age in pregnancy** |  |  |  |  |
| <35 years | 2196 (80.2) | 1058 (79.2) | 220 (80.9) | 0.53 |
| ≥35 years | 543 (19.8) | 278 (20.8) | 52 (19.1) |  |
| **Parity** |  |  |  |  |
| No previous baby | 1371 (49.3) | 672 (49.7) | 146 (54.1) | 0.19 |
| Previous baby | 1410 (50.7) | 681 (50.3) | 124 (45.9) |  |
| **Household family income** |  |  |  |  |
| <$80,000 | 808 (29.8) | 342 (26.1) | 91 (34.1) | .01 |
| ≥$80,000 | 1904 (70.2) | 969 (73.9) | 176 (65.9) |  |
| **Child gestational age** |  |  |  |  |
| <37 weeks | 192 (7.3) | 82 (6.2) | 33 (13.0) | <.001 |
| >37 weeks | 2444 (92.7) | 1247 (93.8) | 220 (87.0) |  |
| **Ethnicity** |  |  |  |  |
| White | 2214 (79.2) | 1105 (81.2) | 230 (84.2) | 0.23 |
| Racial/ethnic minority | 583 (20.8) | 256 (18.8) | 43 (15.8) |  |
| **Maternal education** |  |  |  |  |
| High School or Less | 293 (10.5) | 95 (7.0) | 35 (12.8) | <0.001 |
| More than high school | 2505 (89.5) | 1264 (93.0) | 239 (87.2) |  |
| **Marital status** |  |  |  |  |
| Married or Common Law | 2660 (95.1) | 820 (96.8) | 218 (89.0) | .001 |
| Single | 138 (4.9) | 27 (3.2) | 27 (11.0) |  |
| **Maternal history of mental illness** |  |  |  |  |
| No | 1879 (67.1) | 948 (69.6) | 153 (56.0) | <.001 |
| Yes | 920 (32.9) | 414 (30.4) | 120 (44.0) |  |
| **Mother born in Canada** |  |  |  |  |
| No | 606 (21.6) | 265 (19.5) | 37 (13.6) | 0.02 |
| Yes | 2195 (78.4) | 1097 (80.5) | 236 (86.4) |  |
| **Child Sex** |  |  |  |  |
| Male | 1489 (53.0) | 686 (50.4) | 186 (67.6) | <.001 |
| Female | 1323 (47.0) | 676 (49.6) | 89 (32.4) |  |
|  | **Mean (SD)** |  |  |  |
| **Maternal age** |  |  |  |  |
|  | 30.70 (4.5) | 31.01 (4.37) | 30.32 (4.58) | 0.01 |
| **Diagnostic Category** | **N (%)** |  |  |  |
| **ADHD diagnosis in AHD** |  |  |  |  |
| Yes | 143 (5.1) |  |  |  |
| No | 2671 (94.9) |  |  |  |
| **Emotional disorder diagnosis in AHD** |  |  |  |  |
| Yes | 28 (1.0) |  |  |  |
| No | 2786 (99.0) |  |  |  |
| **Parent-reported ADHD diagnosis** |  |  |  |  |
| Yes | 111 (3.9) |  |  |  |
| No | 1439 (51.1) |  |  |  |
| Missing | 1264 (44.9) |  |  |  |
| **Parent-reported emotional disorder diagnosis** |  |  |  |  |
| Yes | 84 (3.0) |  |  |  |
| No | 1459 (51.8) |  |  |  |
| Missing | 1271 (45.2) |  |  |  |
| **ADHD diagnosis reported by parent or AHD** |  |  |  |  |
| Yes | 202 (7.2) |  |  |  |
| No | 1417 (50.4) |  |  |  |
| Missing | 1195 (42.5) |  |  |  |
| **Emotional disorder diagnosis reported by parent or AHD** |  |  |  |  |
| Yes | 107 (3.8) |  |  |  |
| No | 1449 (51.5) |  |  |  |
| Missing | 1258 (44.7) |  |  |  |
| **ADHD or Emotional disorder diagnosis reported by parent or AHD** |  |  |  |  |
| Yes | 275 (9.8) |  |  |  |
| No | 1362 (48.4) |  |  |  |
| Missing | 1177 (41.8) |  |  |  |

## **Note:** ADHD: Attention deficit hyperactivity disorder; AHD: administration health data.

## **Table 2.** Risk factors associated with mental health diagnoses prior to age 9 years (Adjusted)

|  |  |  |  |
| --- | --- | --- | --- |
| **Risk Factors** | **ADHD aOR (95%CI)** | **Emotional aOR (95%CI)** | **ADHD or Emotional aOR (95%CI)** |
| **Maternal mental health difficulty** |  |  |  |
|  | **1.67 (1.13, 2.47)** | **2.19 (1.36, 3.53)** | **1.78 (1.26, 2.52)** |
| N | 2,807 | 2,807 | 2,807 |
| **Single parent** |  |  |  |
|  | 3.01 (0.71, 12.84) | **5.53 (1.12, 18.41)** | **4.22 (1.10, 16.23)** |
| N | 2,804 | 2,804 | 2,804 |
| **Difficulty meeting basic needs** |  |  |  |
|  | **3.15 (1.83, 5.42)** | 1.35 (0.55, 3.33) | **2.75 (1.64, 4.60)** |
| N | 2,811 | 2,811 | 2,811 |
| **Unwanted pregnancy** |  |  |  |
|  | **2.05 (1.38, 3.04)** | **2.02 (1.21, 3.36)** | **2.08 (1.45, 2.97)** |
| N | 2812 | 2812 | 2812 |
| **Infant feeding difficulties** |  |  |  |
|  | **3.41 (1.69, 6.85)** | 2.30 (0.87, 6.06) | **2.58 (1.30, 5.11)** |
| N | 2811 | 2811 | 2811 |
| **Infant sleeping difficulties** |  |  |  |
|  | **1.64 (1.08, 2.48)** | 1.36 (0.79, 2.32) | **1.56 (1.08, 2.25)** |
| N | 2,803 | 2,803 | 2,803 |
| **Infant difficult to soothe** |  |  |  |
|  | 1.43 (0.72, 2.82) | **2.10 (1.02, 4.34)** | 1.39 (0.77, 2.53) |
| N | 2,803 | 2,803 | 2,803 |
| **Infant has physical health condition** |  |  |  |
|  | **2.07 (1.10, 3.93)** | 2.14 (0.98, 4.66) | **2.22 (1.25, 3.93)** |
| N | 2,812 | 2,812 | 2,812 |
| **Maternal child maltreatment history** |  |  |  |
|  | 1.37 (0.93, 2.01) | **2.01 (1.26, 3.20)** | **1.64 (1.17, 2.28)** |
| N | 2,811 | 2,811 | 2,811 |
| **Delay in any developmental milestones (12 months)** |  |  |  |
|  | 0.81 (0.25, 2.58) | 0.86 (0.20, 3.70) | 1.02 (0.41, 2.55) |
| N | 2,810 | 2,810 | 2,810 |

## **Note:** ADHD: Attention deficit hyperactivity disorder; aOR: Adjusted Odds Ratio.

## **Table 3.** Protective factors associated with mental health diagnoses prior to age 9 years (Adjusted)

|  |  |  |  |
| --- | --- | --- | --- |
| **Protective Factors** | **ADHD aOR (95%CI)** | **Emotional aOR (95%CI)** | **Both aOR (95%CI)** |
| **Infant attends childcare** |  |  |  |
|  | 1.05 (0.66, 1.67) | 1.50 (0.86, 2.61) | 1.16 (0.77, 1.73) |
| N | 2,804 | 2,804 | 2,804 |
| **Maternal optimism** |  |  |  |
|  | 0.76 (0.51, 1.14) | **0.57 (0.34, 0.96)** | **0.64 (0.45, 0.92)** |
| N | 2,811 | 2,811 | 2,811 |
| **Relationship satisfaction** |  |  |  |
|  | 0.64 (0.34, 1.18) | **0.36 (0.19, 0.71)** | **0.47 (0.28, 0.80)** |
| N | 2,778 | 2,779 | 2,779 |
| **Parenting self-efficacy** |  |  |  |
|  | **0.50 (0.31, 0.81)** | 0.66 (0.35, 1.25) | 0.64 (0.41, 1.00) |
| N | 2,778 | 2,779 | 2,779 |
| **Community engagement** |  |  |  |
|  | 1.06 (0.49, 2.28) | 0.74 (0.30, 1.82) | 0.84 (0.44, 1.59) |
| N | 2,803 | 2,803 | 2,803 |
| **Adequate social support** |  |  |  |
|  | 0.96 (0.55, 1.67) | 0.79 (0.40, 1.57) | 0.82 (0.52, 1.31) |
| N | 2,810 | 2,810 | 2,810 |

## **Note:** ADHD: Attention deficit hyperactivity disorder; aOR: Adjusted Odds Ratio.