

Maternal Stress and Mental Health Impacts on Infant EEG Outcomes

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ADMINISTRATIVE INFORMATION

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Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 13 August 2025 and was last updated on 13 July 2026.

INTRODUCTION

Review question / Objective The overall objective of this systematic review is to synthesize the literature examining impacts of maternal stress and stressors on infant EEG measures in the first year of life. It will address the following research question: What is the pattern of association between maternal stress and stressors and infant EEG activity?

Rationale Early exposure to adversity has been linked to long-term behavioral and emotional dysregulation. One often-overlooked source of early adversity is maternal stress, to which infants are especially sensitive due to their close biological and emotional connection with their mothers. While research on maternal stress and infant brain development is growing, most studies have focused on prenatal distress and its impact on structural brain outcomes. Far less is known about how maternal stress - particularly postnatal stress - relates to infant brain function as measured by

EEG. This gap is partly due to heterogeneity in how maternal stress is conceptualized and assessed (e.g., psychological, socioeconomic, physiological), and how these measures are linked to diverse EEG outcomes. The use of varying EEG paradigms and analytic approaches (e.g., power, asymmetry, aperiodic slope) further limits comparability across studies. Moreover, few studies have examined how distinct types of maternal stress and/or stressor may differentially impact infant EEG profiles. A deeper understanding of how specific EEG metrics, namely EEG power and asymmetry as they are the most commonly reported on, uniquely capture infant brain function in the context of maternal stress is critical for identifying early neurobiological markers of risk and resilience.

Condition being studied This review focuses on infants exposed to maternal postnatal stress and stressors in the first 12 months of life. Infant EEG brain activity will be the main outcome of interest with maternal stress and stressors being the

predictor. A narrative review of factors (e.g., type of maternal stress, sample characteristics) that may contribute to the pattern of findings will be conducted.

METHODS

Search strategy A search strategy has been developed in collaboration with an academic librarian. The following databases were searched: Medline (Ovid), Embase, CINAHL, and PsycINFO (Ovid). An initial search of these databases was conducted on March 13th 2025 using the following search strategy:

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(
exp Infant/
OR neonat*.ti,ab,id,kw.
OR (baby OR babies).ti,ab,id,kw.
OR newborn*.ti,ab,id,kw.
OR "first year* of life".ti,ab,id,kw.
OR ((preterm* OR prematur* OR pre-term* OR pre-matur*) adj2 (infant* OR neonat* OR bab* OR birth*)).ti,ab,id,kw.
)
AND
(
(postnatal* adj3 (stress* OR distress* OR psychopatholog* OR anxiety* OR anxious* OR depress* OR trauma* OR posttrauma* OR post-trauma* OR internalizing* OR "mental health" OR advers* OR cortisol* OR PTSD)).mp.
OR (post-natal adj3 (stress* OR distress* OR psychopatholog* OR anxiety* OR anxious* OR depress* OR trauma* OR posttrauma* OR post-trauma* OR internalizing* OR "mental health" OR advers* OR cortisol* OR PTSD)).mp.
OR (postpartum* adj3 (stress* OR distress* OR psychopatholog* OR anxiety* OR anxious* OR depress* OR trauma* OR posttrauma* OR post-trauma* OR internalizing* OR "mental health" OR advers* OR cortisol* OR PTSD)).mp.
OR (post-partum* adj3 (stress* OR distress* OR psychopatholog* OR anxiety* OR anxious* OR depress* OR trauma* OR posttrauma* OR post-trauma* OR internalizing* OR "mental health" OR advers* OR cortisol* OR PTSD)).mp.
OR (perinatal* adj3 (stress* OR distress* OR psychopatholog* OR anxiety* OR anxious* OR depress* OR trauma* OR posttrauma* OR post-trauma* OR internalizing* OR "mental health" OR advers* OR cortisol* OR PTSD)).mp.
OR (peri-natal* adj3 (stress* OR distress* OR psychopatholog* OR anxiety* OR anxious* OR depress* OR trauma* OR posttrauma* OR post-trauma* OR internalizing* OR "mental health" OR advers* OR cortisol* OR PTSD)).mp.
OR (maternal* adj3 (stress* OR distress* OR psychopatholog* OR anxiety* OR anxious* OR
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depress* OR trauma* OR posttrauma* OR post-trauma* OR internalizing* OR "mental health" OR advers* OR cortisol* OR PTSD)).mp.
OR (mother* adj3 (stress* OR distress* OR psychopatholog* OR anxiety* OR anxious* OR depress* OR trauma* OR posttrauma* OR post-trauma* OR internalizing* OR "mental health" OR advers* OR cortisol* OR PTSD)).mp.
OR "maternal allostatic load".mp.
OR (maternal* adj3 affect* adj3 disord*).mp.
OR (maternal* adj3 mood* adj3 disord*).mp.
OR Edinburgh postnatal depression scale:.mp.
OR parenting stress index:.mp.
OR parental stressor scale:.mp.
OR Maternal Postnatal Attachment Scale:.mp.
OR exp Depression, Postpartum/
OR (State-Trait Anxiety Inventory.mp. AND exp Mothers/)
OR (Posttraumatic Stress Disorder Checklist:.mp. AND exp Mothers/)
OR (beck depression inventory:.mp. AND exp Mothers/)
OR (family adj3 income*).ti,ab,id,kw.
OR poverty.ti,ab,id,kw.
OR SES*.ti,ab,id,kw.
OR (socioeconomic adj2 status).ti,ab,id,kw.
OR Poverty/
OR exp Socioeconomic Factors/
OR exp employment/
OR exp housing instability/
OR exp income/
OR exp Low Socioeconomic Status/
OR exp Educational Status/
OR (hollingshead* adj2 ind*).mp.
OR (hollingshead* adj5 SES).mp.
OR (education* adj3 attain*).ti,ab,id,kw.
OR (education* adj3 level*).ti,ab,id,kw.
)
AND
(
exp Electroencephalography/
OR exp Magnetic Resonance Imaging/
OR exp Neuroimaging/
OR Functional Neuroimaging/
OR Spectroscopy, Near-Infrared/
OR exp Magnetoencephalography/
OR exp Diffusion Tensor Imaging/
OR exp Diffusion Magnetic Resonance Imaging/
OR exp White Matter/
OR exp Brain Mapping/
OR exp Neural Pathways/
OR exp electroencephalography phase synchronization/
OR exp alpha rhythm/
OR exp beta rhythm/
OR exp delta rhythm/
OR exp gamma rhythm/
OR exp theta rhythm/
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OR exp cortical excitability/
 OR exp evoked potentials/
 OR exp brain waves/
 OR (frontal adj3 asymmetr*).mp.
 OR (resting adj3 brain adj3 activ*).mp.
 OR (resting adj3 cortical adj3 activ*).mp.
 OR (resting adj3 neural adj3 activ*).mp.
 OR (event* adj3 related* adj3 potential*).mp.
 OR (brain adj3 activ*).mp.
 OR (neural adj3 activ*).mp.
 OR (cortical adj3 activ*).mp.
 OR (neural adj3 correlate:).mp.
 OR EEG*.ti,ab,id,kw.
 OR fMRI*.ti,ab,id,kw.
 OR fNIRS*.ti,ab,id,kw.
 OR MRI*.ti,ab,id,kw.
 OR MEG*.ti,ab,id,kw.
 OR (EEG* adj3 frequenc*).mp.
 OR (EEG* adj3 activ*).mp.
 OR (EEG* adj3 power*).mp.
 OR (EEG* adj3 asymmetr*).mp.
 OR (brain adj3 frequenc*).mp.
 OR (brain adj3 wave*).mp.
 OR (cortical adj3 frequenc*).mp.
 OR (power* adj3 (theta OR gamma OR delta OR alpha OR beta)).ti,ab,id,kw.
 OR microstate*.ti,ab,id,kw.
)
 AND Humans/

While screening full text, it was concluded that the included studies (which included structural and functional brain outcomes) were too broad, rendering the review unmanageable. Thus, at the full text screening stage, any paper that examined non-EEG infant brain outcomes was excluded at the full text screening stage.

Participant or population The review will focus on all infants in the first 12 months of life and their mothers.

Intervention All infant samples exposed to maternal stress and/or stressors will be included. For RCTs or experimental studies investigating the effects of an intervention on mothers' stress or stressors and its subsequent impacts on infant EEG outcomes will be considered.

Comparator N/A.

Study designs to be included Any original empirical article will be considered eligible for inclusion. Review articles, commentaries, conference proceedings, case studies, and dissertations will not be included.

Eligibility criteria Studies that meet the following eligibility criteria are being selected for inclusion: 1) original empirical article; 2) study conducted with mother-infant dyads within infants' first 12 months of life; 3) includes a measure of maternal stress or stressor; and 4) infant EEG power and/or asymmetry measures collected and examined in relation to maternal stress or stressors.

Studies are not excluded based on language, time frame, country or setting. Only peer-reviewed published studies will be included.

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Information sources The following databases were searched: Medline (Ovid), Embase, CINAHL, and PsycINFO (Ovid). The reference lists of relevant reviews/chapters were also manually inspected to ensure completeness.

Main outcome(s) The main outcomes of interest will include:

- Infant EEG power and EEG asymmetry across any EEG paradigm.

The main measures of effect will include:

- Primarily association statistics, such as correlations or standardized beta values if available, will be qualitatively examined to describe the association between maternal stress/stressors and infant EEG measures.

Additional outcome(s) N/A.

Data management Four authors (SJ, AL, HH, LH) will be responsible for conducting title/abstract screening and full-text review to identify articles that meet criteria for inclusion. Data extraction was performed by AL, HH, and LH and double screened by SJ using a data extraction template developed in consultation with the senior author (RPR). Inter-rater reliability will be assessed and tracked and disagreements will be resolved via discussion and consultation with the senior author (RPR), as needed.

The following data will be extracted from each study:

- Participant data (postnatal age, infant sex, sample size with usable EEG data, country of recruitment, and inclusion/exclusion criteria, maternal age).
- Type of maternal stress or stressor examined
- Type of infant EEG outcome measure
- Any magnitude statistics on the association between maternal stress or stressor and infant

EEG will also be extracted for a qualitative review where possible.

Covidence software and Microsoft Excel were used to record inclusion/exclusion decisions throughout the systematic review process, as well as for data extraction and risk of bias judgements.

Quality assessment / Risk of bias analysis Four authors (SJ, AL, HH, LH) will independently assess the risk of bias of included studies using an adapted risk of bias tool developed for the current review and informed by the the Risk of Bias in Non-Randomized Studies – of Exposure (ROBINS-E) tool, and published guidelines pertaining to best practices in the measurement and analysis of electroencephalography (EEG) outcome measures. Inter-rater reliability will be assessed, and disagreements will be resolved via discussion and consultation with the senior author (RPR).

Strategy of data synthesis Each study's participant characteristics, study methodology, and study quality will be evaluated, as well as any outcomes and statistical analyses that pertain to the research question (i.e., impact of maternal stress/stressors on infant EEG). Given the heterogeneity in the literature and the likely differential impacts of maternal stress and adversity on infant EEG, findings will be stratified by 1) maternal stress type (i.e., psychological stress and contextual adversity) and 2) EEG outcome measurement.

Given the significant heterogeneity across studies, a systematic narrative review will be undertaken.

Cohen's d or partial eta-squared effect sizes will be computed manually if not reported using the available reported statistics. They will be described qualitatively in-text and a table with a summary of effect size ranges within each subsection will be provided for reference. A formal framework for conducting narrative reviews will be employed to consolidate the relevant studies and draw conclusions that address our research question (Popay et al., 2006).

The most recent PRISMA 2020 guidelines (Page et al., 2021) will be followed when reporting the review findings.

Subgroup analysis Subgroup narrative synthesis will be performed based on the different types of maternal stress and stressors (e.g., maternal physiological stress, maternal mental health symptomatology, maternal perceived stress and maternal contextual stress). Under each section,

we will examine their impact on infant EEG power and asymmetry. Within EEG power, findings will further be stratified based on Absolute Power and Relative Power, where regional and whole-brain power investigations will be described. Within EEG Asymmetry, findings will be further stratified according to Frontal Asymmetry and Non-Frontal Asymmetry.

Sensitivity analysis The authors may conduct qualitative robustness checks by examining whether specific sample characteristics or specific types of maternal stress within each category explain the pattern of findings.

Language restriction No language restrictions were imposed in the search strategy.

Country(ies) involved Canada and UK.

Keywords infant, maternal mental health, maternal postpartum stress, socioeconomic stress, electroencephalography, EEG.

Dissemination plans Review findings will be published in a peer-reviewed journal and presented at academic conferences.

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