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Maternal Dietary Quality During Pregnancy and Risk of Neurodevelopmental Disorders in Offspring: A Systematic Review and Meta-Analysis

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Abstract

Introduction: Maternal diet during pregnancy has profound effect on brain and cognitive development of the child and thus an important risk factor in the occurrence of childhood neurodevelopmental disorders. **Objectives:** To our knowledge very few studies examined the association between maternal dietary quality during pregnancy and neurodevelopmental outcomes (ADHD and ASD) posing a need for a comprehensive review of the complex synergies among nutrients and foods and relation with ADHD and ASD to enable evidence-based recommendation on dietary patterns. **Method:** To achieve this, a systematic review and meta-analysis was conducted in accordance with the general recommendations of the PRISMA and MOOSE guidelines with an inverse variance-weighted random-effects model. Results are presented as odds ratio (OR) and 95% confidence intervals (CIs). Statistical heterogeneity was assessed by the Higgins I^2 statistic. Interpretation followed Cochrane Handbook guidance and was based on the magnitude of I^2 statistics alongside the direction and consistency of the estimates. The review protocol was preregistered on PROSPERO with an ID CRD420251137377. The risk of bias (RoB) for all included studies was independently assessed using the ROBINS-E tool. The GRADE framework was used to assess the overall certainty and accuracy of evidence. **Result:** The study included 9 studies and 22 cohorts studies. On pro-inflammatory dietary patterns for ADHD (8 studies including 17,114 samples), no significant association was observed between higher pro-inflammatory dietary patterns and the risk of offspring ADHD (OR = 1.07, 95% CI 0.96 to 1.20; p =) with substantial heterogeneity (I^2 = 79%, Q = 13.87, p = 0.0077) while For ASD (3 studies including 6,511 samples), no significant association was observed (OR 1.55, 95% CI 1.10 to -2.19; p = 0.57), with low heterogeneity (I^2 = 20%, Q = 7.29, p = 0.12). Anti-inflammatory healthy dietary patterns for ADHD (n = 6, samples 17,028), higher maternal adherence was associated with reduced risk (OR 0.97, 95% CI 0.95 to -0.99; p = 0.002), with low heterogeneity (I^2 = 21%, Q = 5.87, p = 0.32). For ASD (n = 5, samples 100,908), higher adherence was associated with reduced risk (OR 0.79, 95% CI 0.69 to -0.91; p = 0.003), with no observed heterogeneity (I^2 = 0%, Q = 4.08, p = 0.54). **Conclusion:** Across the included studies, anti-inflammatory dietary patterns were associated with lower odds of neurodevelopmental disorders, while pro-inflammatory dietary patterns were associated with increased odds of ASD. These findings suggest that the inflammatory profile and quality of the maternal diet may be relevant to offspring neurodevelopment. Maternal diet at the level of dietary patterns may provide clearer insights than nutrient-specific analyses alone.

Keywords: attention-deficit hyperactivity disorder; autism spectrum disorder; pro-inflammatory dietary patterns; maternal diet; neurodevelopmental disorders

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Introduction

Attention-deficit/hyperactivity disorder (ADHD) and Autism Spectrum Disorder (ASD) are chronic neurodevelopmental conditions that occur mostly in children and may persist into adulthood. Although most cases are underreported, particularly in the low- and middle-income countries, global pooled prevalence of ADHD and ASD in children are 3.4% and 1%, respectively [1,2]. These two neurodevelopmental disorders share characteristics bordering on problems with attention, impulsivity, communication, and frequently occur concurrently [3,4], with collective prevalence rate at 6-14% [5]. These neurodevelopmental conditions negatively affect children's self-esteem, academic performance and relationships with others [6]. Among the myriads of genetic, physiological and environmental factors that contribute to ADHD and ASD, a significant focus has been on the impact of maternal diet during pregnancy [7–10]. Most of the reviews focused mainly on single nutrient relationship with either of the disorders. There is limited synthesised information on the influence of dietary patterns on both disorders.

Maternal diet during pregnancy has profound effect on brain and cognitive development of the child and thus an important risk factor in the occurrence of childhood neurodevelopmental disorders [11–14]. A high-quality diet and multivitamin supplementation among women with low quality diet were associated with improved cognitive and language scores in the offspring [15]. Adequate maternal diet is very essential during the rapid phase of cell differentiation, myelination and DNA methylation of the developing fetal brain [16]. Protein supplies the building blocks for the optimal growth and development of the central nervous system and brain [17], particularly during the third trimester when the structure of the brain becomes more complex. In addition, long chain polyunsaturated fatty acid (LC-PUFA), zinc, iron, B-vitamins, and folate [18] including docosahexaenoic acid (DHA), choline, Lutein, sphingomyelin are very vital for brain growth [19]. Insufficient amounts of the macro and micronutrients during this critical period may result in irreversible neurodevelopmental defects [20]. Some studies have suggested that maternal diet in pregnancy influences offsprings' neurodevelopmental disorders via processes involving maternal immune activation (MIA), oxidative stress (OS), and fetal programming [21,22], neuroinflammation [12,14] and gut-microbiome [23].

Evidence from research has mostly focused on associations between maternal intake of specific foods and nutrients including multivitamins, iron, vitamin D [24], vitamin B12, folate, calcium, magnesium, omega 3 fatty acids, fish [25] and ADHD and ASD in children [26,27]. While these findings are significant and plausible, their impact and applicability are however undermined. This is because the human diet does not consist of one or two single nutrients but rather a plethora of nutrients, complementing each other and providing tailored benefits to the body. In a randomised controlled trial, conducted in the University of Kansas Medical Centre, it was found that maternal intake of eggs had associations with fetal neurodevelopment [19]. This was attributed to the synergistic actions of choline, lutein, docosahexaenoic acid (DHA) in egg. In France, a study on the effects of prenatal diet on children's trajectories of hyperactivity-inattention and conduct problems revealed significant associations between later development of high levels of hyperactivity-inattention in children and low Healthy and high Western dietary patterns during pregnancy [8].

A study among large Norwegian pregnant women in 2021 reported that composite maternal diet quality during pregnancy related to a small decrease in ADHD symptom score at 8 years and lower risk for ADHD diagnosis [9]. Western dietary patterns during pregnancy were associated with increased behavioural problems in children, with slightly higher externalizing behaviours in girls and an increased likelihood of ADHD in boys [28], ADHD and ASD diagnoses in children [29]. Healthy dietary pattern was linked with decreased risk of offspring autism [30]. [31] in their review, concluded that diets high in salt, sugar, fat, ultra processed foods and low in dietary fiber deficiency including alcohol consumption, negatively impact fetal and neonatal gut microbiota, increasing risk of ASD in infants.

The Developmental Origins of Health and Disease (DOHaD) postulates that exposure to specific environmental influences during the crucial phase of foetal growth and development may

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significantly contribute to the long-term health status of offspring [32]. Within this body of research, a significant focus has been on the impact of maternal diet during pregnancy on neurodevelopmental disorders such as Attention-deficit Hyperactivity Disorder (ADHD) and Autism Spectrum Disorder (ASD) [1,8–10]). These are two chronic and devastating neurodevelopmental conditions that occur in children which negatively affect their self-esteem, academic performance and relationships with others [6].

To our knowledge very few reviews exist on the synthesis of influence of maternal dietary quality on offspring ADHD and ASD, simultaneously. There is a need for a comprehensive review of the complex synergies among nutrients and foods and relation with ADHD and ASD thereby enabling the recommendation of evidence-based dietary patterns [33]. Thus, this systematic review proposes a synthesization of observational studies on the association between prenatal dietary quality and offspring ADHD and ASD.

Current Evidence and Gaps

Emerging evidence suggests that the intrauterine environment plays a critical role in shaping neurodevelopmental trajectories. Maternal nutrition during pregnancy represents a key modifiable exposure within this environment, yet the extent to which prenatal dietary quality influences neurodevelopmental outcomes in children remains incompletely understood. Although several systematic reviews have synthesised aspects of the literature, most have focused on individual nutrient exposures rather than dietary patterns, resulting in a fragmented understanding of how maternal diet as a whole may influence neurodevelopment.

To date, four systematic reviews examining maternal dietary quality or dietary patterns in relation to child neurodevelopment have been published between 2017 and 2024, including three meta-analyses [13,24,26] and one narrative review [34]. Across these reviews, the prevailing conclusion is that poorer prenatal dietary quality may be associated with adverse neurodevelopmental outcomes in offspring. However, this evidence base remains limited by methodological heterogeneity, inconsistent conceptualisation of dietary quality, and the relatively small number of studies examining dietary patterns as holistic exposures.

The current evidence suggests that maternal dietary quality during pregnancy may influence neurodevelopmental outcomes in children. However, several important limitations remain. First, the majority of studies focus on individual nutrient exposures rather than holistic dietary patterns, despite increasing recognition that diet functions as a complex system of interacting components. Second, there is substantial heterogeneity in how dietary quality is measured, with studies employing a wide range of indices and pattern derivation approaches. Notably, the scarcity of studies examining prenatal dietary quality as a holistic exposure has been repeatedly highlighted across existing reviews. Across the four systematic reviews discussed above, only fourteen studies examined prenatal dietary quality in relation to neurodevelopmental outcomes among over one hundred studies synthesised. These studies are yet to be systematically synthesised.

Given that relevant studies remain dispersed across multiple systematic reviews and emerging primary research, a comprehensive synthesis of the available evidence is needed. The present study therefore undertakes an updated systematic review and meta-analysis of the association between prenatal dietary quality and neurodevelopmental outcomes in children, integrating previously reviewed studies with more recent evidence to provide a clearer and more comprehensive assessment of this relationship.

Methodology

Protocol and Registration

This systematic review and meta-analysis were conducted in accordance with the general recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and Meta-analysis Of Observational Studies in Epidemiology (MOOSE) guidelines [35].

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The review protocol was preregistered on PROSPERO with an ID: CRD420251137377. Title and abstract screening and full-text review were conducted on Covidence, a web-based software designed to organise and manage systematic review workflows. Data extraction was conducted on Microsoft Excel.

Search Strategy

A preliminary scoping search was conducted to identify relevant keywords and synonyms related to maternal diet and offspring ADHD and ASD outcome. These keywords were utilised in the development of the initial search string. The search string was executed on Embase, MEDLINE, PsycINFO and Google scholar from inception to November 2025. The search strategy combined terms for maternal exposure, dietary factors, neurodevelopmental outcomes, and observational study designs using Boolean operators (AND, OR), with truncation (*) applied where appropriate. The search strategy included: maternal OR prenatal OR pregnancy OR gestational OR mother) AND (diet* OR nutri* OR "dietary pattern*" OR "dietary quality" OR "dietary habit*" OR "dietary status") AND (neurodevelopment* OR autism OR ASD OR ADHD OR "attention deficit" OR "developmental disorder*" OR "cognitive impairment" OR "cognitive function" OR IQ OR "intelligence quotient" OR "academic achievement" OR literacy OR numeracy) AND (cohort OR "case-control" OR longitudinal OR prospective OR retrospective OR "cross-sectional" OR epidemiologic). Records retrieved from all searches were combined and deduplicated prior to screening.

Eligibility Criteria and Study Selection

To be eligible for inclusion in the review (Table 1), studies were required to be empirical observational studies employing study designs commonly used in aetiological research, including longitudinal, case-control and cohort study designs [36]. Eligible studies were qualified if they focused on pregnant women with singleton pregnancies and recorded or analysed maternal dietary quality any time before the last menstrual period (LMP) and childbirth. Maternal dietary quality was defined by holistic dietary pattern rather than intake of specific food. Only studies with offspring ASD or ADHD outcomes ascertained through diagnoses retrieved from validated health register records, clinical diagnoses based on formal diagnostic criteria, or parent report of medical diagnosis [13]. Studies published in English and assessing offspring outcome at any age were included, while studies comprising of multiple pregnancies, animal models, and preterm populations were excluded. In total, 9 studies met the inclusion criteria and were included in the systematic Review and meta-analysis.

Table 1. Guideline for the systematic literature search based on Population, Exposure and Outcome (PEO) framework.

PEO	DESCRIPTION
Population	Pregnant women
Exposure	Maternal dietary quality defined by holistic dietary pattern rather than intake of specific food
Outcome	Attention deficit hyperactivity disorder (ADHD) and Autism spectrum disorders (ASD) in offspring
Study design	Studies of cohort, cross-sectional and case-control design

Data Collection Process

All records retrieved from the database searches were exported into the Zotero bibliographic software package 2022 for deduplication. The deduplicated records were then uploaded into Covidence, a web-based systematic review manager. Title and abstract screening were undertaken

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blinded by two reviewers independently. Discrepancies were addressed through discussion and consensus. Articles satisfying the inclusion criteria progressed to full-text screening, where assessed blindly by another two reviewers for eligibility. Data extraction was performed using a data extraction form piloted in Excel. Extracted data includes study author names, article titles, publication year, sample size, study design, country, region, age range and mean age of participants, maternal dietary quality, exposure measurement tool, offspring outcome and measurement method.

Variable Extraction and Classification

Dietary exposures were classified a priori according to expected inflammatory potential. Proinflammatory dietary patterns included higher Dietary Inflammatory Index (DII), Energy adjusted DII (E-DII), Empirical Dietary Inflammatory Pattern (EDIP), and Western or processed food patterns characterised by high intake of refined carbohydrates, saturated fats, and ultra-processed foods. Anti-inflammatory healthy dietary patterns included higher adherence to Dietary Approaches to Stop Hypertension (DASH), Mediterranean-style diets, and other validated dietary quality indices such as Alternative Healthy Eating Index (AHEI), characterised by greater consumption of fruits, vegetables, whole grains, legumes, and unsaturated fats. Separate random-effects meta-analyses were conducted for ADHD and ASD within each dietary classification.

Risk of Bias Assessment

The risk of bias (RoB) for all included studies was independently assessed by two reviewers using the ROBINS-E (Risk of Bias in Non-randomized Studies - of Exposure) tool which was piloted prior to formal assessment. In contrast to commonly used tools such as the Newcastle-Ottawa Scale and Joanna Briggs Institute checklists which primarily assess study quality, ROBINS-E was specifically designed to evaluate bias risk across broad domains in non-randomised studies of exposure. With its domain-specific judgement, ROBINS-E supports causal inference by capturing bias arising from confounding, exposure measurement, outcome measurement, missing data and selective reporting. The ROBINS-E tool offers a more rigorous risk of bias evaluation compared to other tools employed in previous studies. Across the seven ROBINS-E domains, studies were rated as having low, moderate, serious or critical risk of bias. Overall judgement of critical or serious risk was categorised as high risk of bias, moderate risk as some concerns, and low risk as low risk of bias. Discrepancies between reviewers were resolved through discussion and consensus.

Data Analysis

First, a narrative synthesis was conducted to provide a summary of study characteristics and findings across all included studies (n=9) and study cohorts (n=22). Following this, a meta-analysis was conducted to quantitatively synthesise all eligible studies according to exposure and outcome definitions including.

1. Maternal pro-inflammatory diet and offspring ADHD
2. Maternal pro-inflammatory diet and offspring ASD
3. Maternal anti-inflammatory and offspring ADHD
4. Maternal anti-inflammatory diet and offspring ASD

The meta-analysis was undertaken in R version 4.4.2 (2024-10-31 ucrt) and RStudio (version 2024.12.0+467), Quarto (version 1.5.57) with inverse variance-weighted random-effects models. Results are pooled and presented as odds ratio (OR) and 95% confidence intervals (CIs). Statistical heterogeneity was assessed by the Higgins I^2 statistic [37]. Interpretation followed Cochrane Handbook guidance and was based on the magnitude of I^2 statistics alongside the direction and consistency of the estimates. Results from the meta-analysis are visually presented using forest plots. Funnel plots and formal assessment of publication bias were not undertaken because each subgroup meta-analysis included approximately five or fewer studies. As such, assessment of publication bias was considered unreliable and was therefore not conducted. The "Grading of Recommendations

Assessment, Development, and Evaluation (GRADE)" framework was used to assess the overall certainty and accuracy of evidence. The GRADE ratings generally range from high, moderate, low to very low. Since all included studies were observational, certainty of evidence for each outcome was initially rated as low in accordance with GRADE guidance.

Results

Study Selection

The predefined database search string identified 211 eligible records which were retrieved and uploaded to Covidence. After duplicates were automatically removed, 210 studies proceeded to the title and abstract screening which was handled by two independent reviewers. Out of these, 196 were deemed ineligible thereby leaving 14 studies eligible for inclusion in the full text screening. Following the full text screening, 5 studies were excluded leaving a total of 9 studies which proceeded to the data extraction phase. From all 9 studies in the systematic review, we retrieved a total of 22 effect estimates as some studies contributed multiple effect estimates from different cohort studies. This was primarily driven by different dietary quality indices or multiple cohorts within the same study. All nine studies included in the systematic review have been narratively synthesised (Section 4.4 below). Figure 1 provides a summary of all eligible studies included at each screening stage.

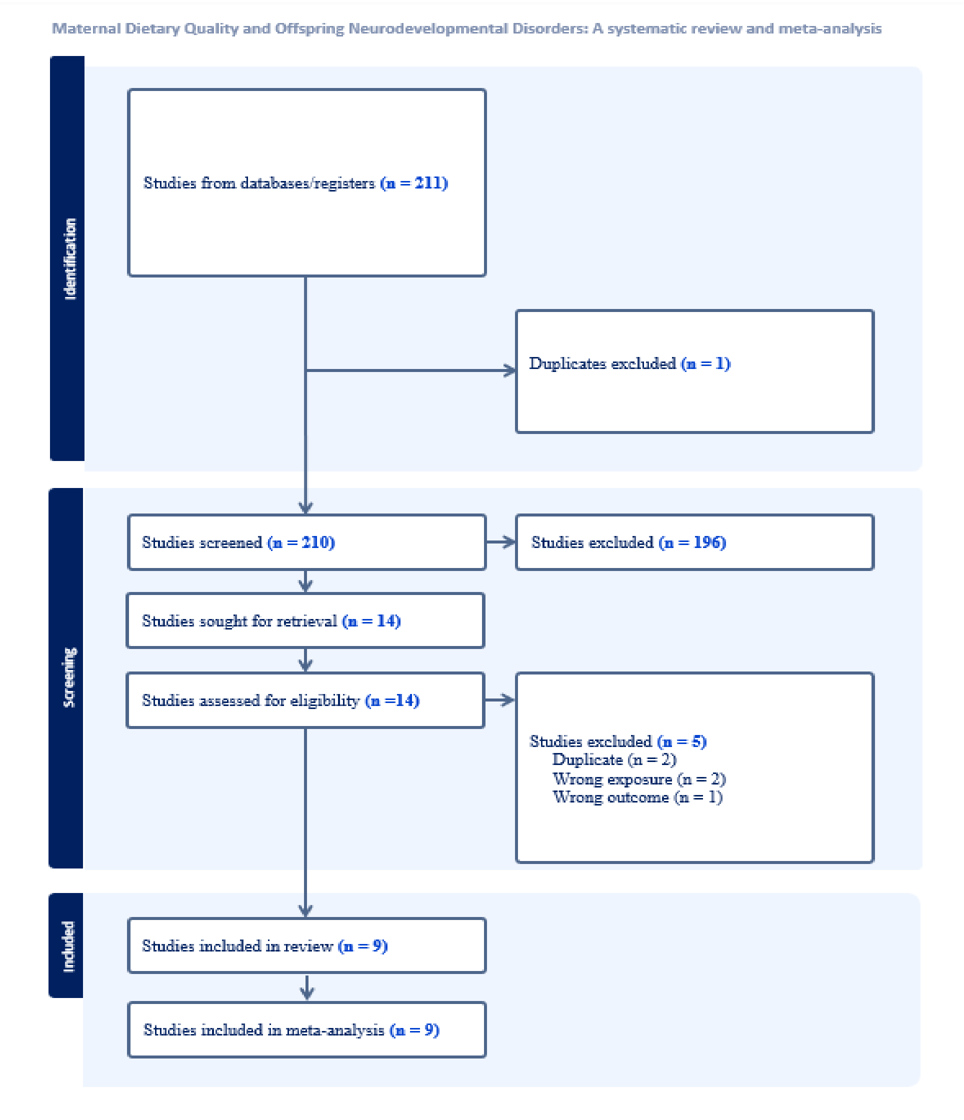

Figure 1. Flowchart of study selection.

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Study Characteristics

Table 2 summarises the characteristics of all included studies, all published between 2021 and 2025. Of all included studies, four studies evaluated the effect of maternal dietary quality on ASD, three studies on ADHD and two on both ASD and ADHD. All of the included studies were prospective cohort studies except one retrospective cohort study. As some studies included multiple cohorts (n=22), study geographical location differed across studies and was based on individual cohort location. Seven cohorts were conducted in Europe (Denmark n =1, United Kingdom n=1, Italy n=1, France n=1, Netherlands = 1, Poland = 1, Spain and Greece n=1), five cohorts were conducted in the Americas (United States n =4), and one study in the Western Pacific Region (China, n=1). Overall, all 9 included studies were conducted across 14 cohorts from 10 countries, yielding 22 effect estimates. They comprised approximately of 124,129 participants, with individual sample sizes ranging from 316 to 84,548.

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Table 2. Overview of studies included in the systematic review.

Study author	Country	Study design	Study data source	Study sample	Exposure definition	Outcome type	ROB
Che 2023 [38]	USA	Prospective cohort study	Boston Birth Cohort (BBC)	3165	Mediterranean-style diet score (MSDS)	ASD ADHD	Low
Friel 2024 [30]	USA	Prospective cohort study	Norwegian Mother, Father, and Child Cohort Study (MoBa), Avon Longitudinal Study of Parents and Children (ALSPAC)	84,548 and 11,760	Healthy Prenatal Dietary Pattern (HPDP)	ASD	Low
Horner 2025 [29]	Denmark	Prospective cohort study	COPSAC2010 mother–child cohort	700	Western Dietary Pattern	ASD and ADHD	Low
Leccese 2025 [39]	Italy	Prospective cohort study	Piccolipiù Italian birth cohort	2006	Processed and High-Fat Foods and Fresh food and fish	ADHD	Some concerns
Lertxundi 2022 [40]	Spain and Greece	Prospective cohort study	INMA and RHEA	2541	Dietary Inflammatory Index	ADHD	Some concerns
Li 2018 [41]	China	Retrospective cohort study	Autism Clinical and Environmental Database (ACED)	728	Balanced dietary pattern (Mostly vegetable)	ASD	Some concerns
Polanska 2021 [42]	Poland	Prospective cohort study	ALSPAC, EDEN, Generation R, and REPRO_PL	7177, 806, 3571, and 316	Healthy dietary quality according to DASH score, Dietary Inflammatory potential (E-DII score)	ADHD	Some concerns
Vecchione 2022[43]	USA	Prospective cohort study	NHSII	727	Empirical dietary inflammatory pattern (EDIP), Alternative Healthy Eating Index (AHEI)-2010, Alternative Healthy Eating Index (AHEI)-P, Western dietary patterns, Prudent dietary patterns, and alternative Mediterranean Diet (aMED) score	ASD	Some concerns
Vecchione 2024[10]	USA	Prospective cohort study	ECHO	6084	Empirical dietary inflammatory pattern (EDIP), Alternative Healthy Eating Index (AHEI)-P, Healthy Eating Index (AHEI)	ASD	Low

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Narrative Synthesis of All Included Studies

Substantial variability was observed across studies, attributable to exposure definition and study sample size (Table 3). Sample sizes ranged from 316 participants in smaller cohorts like the Polish Mother and Child Cohort Study (REPRO_P) study in [42] to over 84,000 participants in larger cohorts like the MoBa in [30].

Maternal dietary quality was defined based on inflammation in seven studies, based on DASH diet in 4 studies, based on mediterranean style diet in 4 studies, based on healthy dietary pattern in 4 studies, based on western diet in 4 studies and based on AHEI in 2 studies. Due to the variability, two exposure variables derived based on the exposure definitions provided across all studies. First was the pro-inflammatory dietary pattern and the anti-inflammatory dietary pattern. Classification method is described in 4.5 below.

Across all 6 cohorts in the anti-inflammatory group for ADHD, reported effect estimates ranged from 0.86 to 1.05. Most confidence intervals included null value, indicating little consistent evidence of a strong association between maternal anti-inflammatory diet and offspring ADHD. Across all 6 cohorts in the anti-inflammatory group for ASD, reported effect estimates ranged 0.51 to 1.20. Although two studies reported statistically significant protective associations, other estimates either included null value or had wide confidence interval. This suggests limited consistency across studies in this group.

Across all 7 cohorts in the pro-inflammatory group for ADHD, reported effect estimates ranged from 0.85 to 1.66. Most studies reported odds ratios above 1, with several statistically significant associations suggesting a modest increased risk of ADHD with pro-inflammatory maternal diet. Across all 3 cohorts in the pro-inflammatory group for ASD, reported effect estimates ranged from 0.36 to 2.22. While one study reported a strong positive association and another a significant inverse association, most estimates were imprecise and crossed the null value indicating considerable heterogeneity in the direction and magnitude of the effect.

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Table 3. Overview of studies included in meta-analysis.

Study Author	Outcome	Study Cohort	Exposure definition	Derived exposure variable code	Effect estimate
Che 2023 [38]	ASD	Boston Birth cohort	Highest adherence to Mediterranean-style diet score (MSDS)	Anti-inflammatory dietary pattern	0.608 (0.255 – 1.398)
Che 2023 [38]	ADHD	Boston Birth cohort	Highest adherence to Mediterranean-style diet score (MSDS)	Anti-inflammatory dietary pattern	0.856 (0.534 – 1.364)
Che 2023 [38]	ASD	Boston Birth cohort	Lowest adherence to Mediterranean-style diet score (MSDS)	Pro-inflammatory dietary pattern	0.961 (0.488-1.932)
Che 2023 [38]	ADHD	Boston Birth cohort	Lowest adherence to Mediterranean-style diet score (MSDS)	Pro-inflammatory dietary pattern	1.012 (0.676 – 1.52)
Friel 2024[30]	ASD	Norwegian Mother Child Cohort (MoBa)	Highest adherence to Healthy Prenatal Dietary Pattern (HPDP)	Anti-inflammatory dietary pattern	0.78 (0.66 – 0.920
Friel 2024[30]	ASD	ALSPAC dataset	Highest adherence to Healthy Prenatal Dietary Pattern (HPDP)	Anti-inflammatory dietary pattern	0.74 (0.55 – 0.98)
Horner 2025 [29]	ASD	COPSAC2010 mother–child cohort	Western dietary pattern	Pro-inflammatory dietary pattern	2.22 (1.33 – 3.74)
Horner 2025 [29]	ADHD	COPSAC2010 mother–child cohort	Western dietary pattern	Pro-inflammatory dietary pattern	1.66 (1.21 – 2.27)
Leccese 2025 [39]	ADHD	Piccolipiù Italian birth cohort	Processed and High-Fat Foods	Pro-inflammatory dietary pattern	1.1 (1.01 – 1.2)
Leccese 2025 [39]	ADHD	Piccolipiù Italian birth cohort	Fresh food and fish	Anti-inflammatory dietary pattern	1.06 (0.96 – 1.18)
Lertxundi 2022 [40]	ADHD	INMA and RHEA	Dietary Inflammatory Index	Pro-inflammatory dietary pattern	0.85 (0.74 – 0.97)

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Li 2018 [41]	ASD	Autism Clinical and Environmental Database (ACED)	Balanced dietary pattern (Mostly vegetable)	Anti-inflammatory dietary pattern	2.234 (1.009 – 4.946)
Polanska 2021[42]	ADHD	ALSPAC	Healthy dietary quality according to DASH score	Anti-inflammatory dietary pattern	0.98 (0.96 – 1)
Polanska 2021[42]	ADHD	EDEN	Healthy dietary quality according to DASH score	Anti-inflammatory dietary pattern	0.95 (0.9 – 1)
Polanska 2021[42]	ADHD	Generation R	Healthy dietary quality according to DASH score	Anti-inflammatory dietary pattern	0.95 (0.93 – 0.98)
Polanska 2021[42]	ADHD	REPRO_PL	Healthy dietary quality according to DASH score	Anti-inflammatory dietary pattern	0.98 (0.91 – 1.04)
Polanska 2021[42]	ASD	ALSPAC	Dietary Inflammatory potential (E-DII score)	Pro-inflammatory dietary pattern	1.05 (1 – 1.09)
Polanska 2021[42]	ASD	EDEN	Dietary Inflammatory potential (E-DII score)	Pro-inflammatory dietary pattern	1.19 (1.05 – 1.36)
Polanska 2021[42]	ASD	Generation R	Dietary Inflammatory potential (E-DII score)	Pro-inflammatory dietary pattern	1.07 (0.96 – 1.18)
Polanska 2021[42]	ASD	REPRO_PL	Dietary Inflammatory potential (E-DII score)	Pro-inflammatory dietary pattern	0.97 (0.8 – 1.17)
Vecchione 2022[43]	ASD	NHSII	Empirical dietary inflammatory pattern (EDIP)	Pro-inflammatory dietary pattern	1.41 (0.76 – 2.62)
Vecchione 2024[10]	ASD	ECHO	Western dietary patterns	Pro-inflammatory dietary pattern	1.29 (0.89 – 1.86)

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Risk of Bias Rating for All Studies

The risk of bias assessment, as displayed in Figure 2, was conducted using the ROBINS-E risk of bias tool. Most of the studies were judged at moderate risk of bias (n=9) with three studies being judged at low risk of bias.

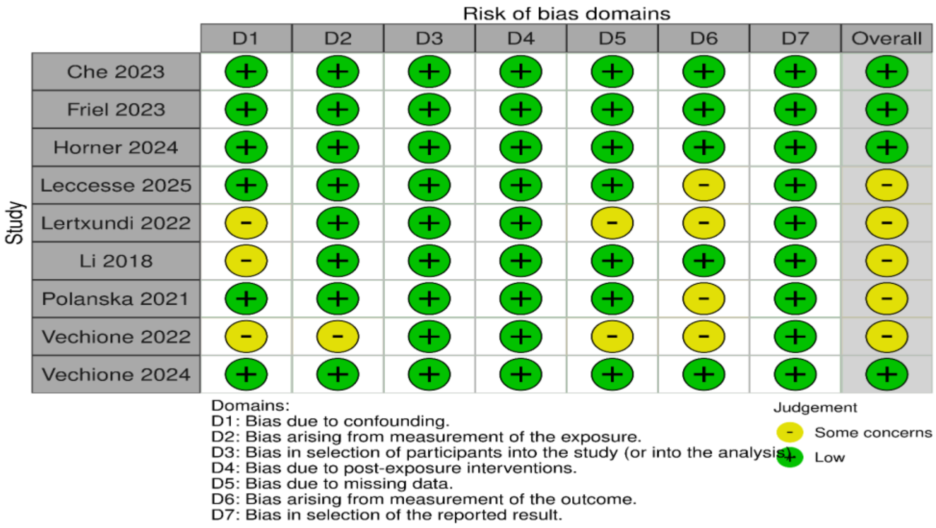

Figure 2. The ROBINS-E risk of bias tool for risk of bias assessment.

Data Synthesis

A total of 13 study cohorts from 9 eligible studies were included in the quantitative synthesis and were analysed using a random effect meta-analysis. Characteristics of all 13 study cohorts yielding 22 effect estimates have been detailed in Table 3. Overall pooled effect estimates were calculated across all 22 studies within four predefined subgroups:

1) The association between maternal pro-inflammatory diet and offspring ADHD
2) The association between maternal pro-inflammatory diet and offspring ASD
3) The association between maternal anti-inflammatory and offspring ADHD
4) The association between maternal anti-inflammatory diet and offspring ASD

Influence analysis could not be conducted for all subgroups and publication bias was not explored due to insufficient number of studies (<10).

The Effect of Maternal Pro-Inflammatory Diet on Offspring ADHD

Across eight cohorts, no significant association was observed between higher pro-inflammatory dietary patterns and the risk of offspring ADHD (OR = 1.07, 95% CI 0.96 to 1.20) (Figure 3). There was substantial between-study heterogeneity (I^2 = 79%) indicating strong variation in effect estimates across cohort studies. The pooled estimate suggests a very small increase in odds, about 3 percent, but the confidence interval includes 1 and ranges from a small decrease to a small increase. The meta-analysis shows no evidence of an overall association between pro-inflammatory maternal diet and ADHD in this subset of seven studies. However, heterogeneity is high, indicating substantial variability in effect estimates across studies. Influence analysis was performed and no study was identified.

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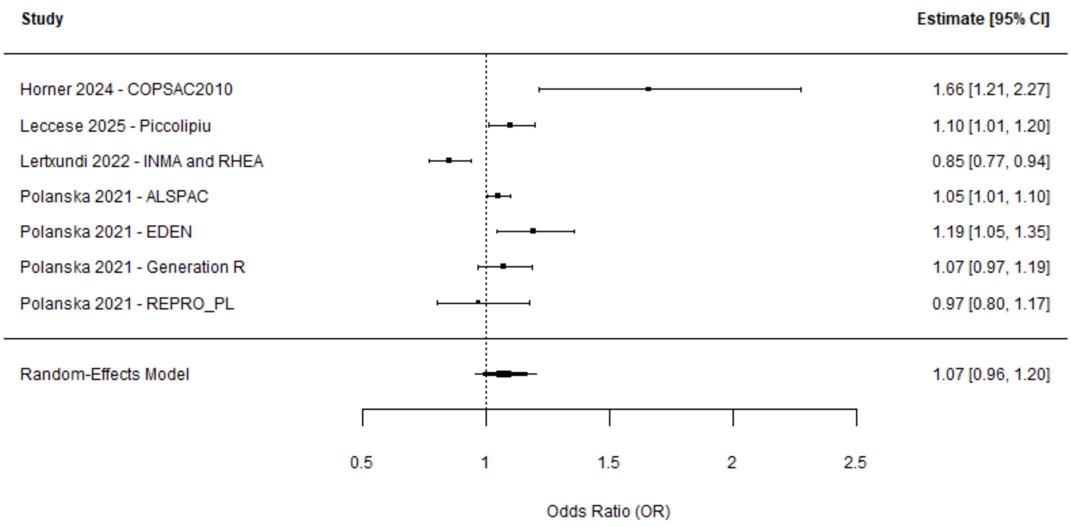

Figure 3. Forest plot of maternal pro-inflammatory diet on offspring ADHD.

The Effect of Maternal Pro-Inflammatory Diet on Offspring ASD

Across three cohorts, random-effects meta-analysis including three cohorts showed a statistically significant association between pro-inflammatory dietary patterns and ASD (OR = 1.55, 95% CI 1.10 to 2.19) (Figure 4). There was moderate between-study heterogeneity ($I^2 = 33\%$) indicating mild variation in effect estimates across cohort studies. The pooled estimate indicates about 55% higher odds of ASD associated with more pro-inflammatory dietary patterns. Heterogeneity observed was modest and not statistically significant. However, given the small number of contributing cohorts, the precision and generalisability of this estimate remain limited.

Influence diagnostics suggested individual studies exerted notable influence on the pooled estimate, which is expected given the small number of studies. Leave-one-out analyses showed the direction of effect remained consistent. Leave-one-out analyses indicated that the direction of association remained consistent across all models; however, statistical significance was attenuated when individual studies were removed, reflecting the limited number of available cohorts.

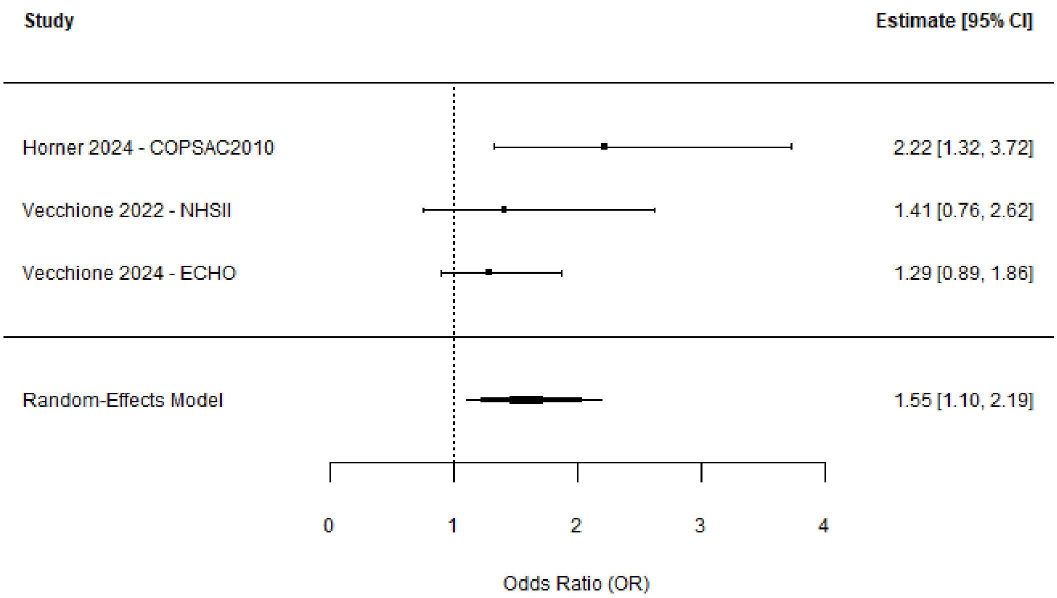

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Figure 4. Forest plot of maternal pro-inflammatory diet on offspring ASD.

The Effect of Maternal Anti-Inflammatory Diet on Offspring ADHD

Across six cohorts, random-effects meta-analysis found that greater adherence to anti-inflammatory dietary patterns was associated with lower odds of ADHD (OR = 0.97, 95% CI 0.95 to 0.99) (Figure 5). There was moderate between-study heterogeneity (I^2 = 29%) indicating mild variation in effect estimates across cohort studies. The pooled estimate indicates about 3% lower odds of ADHD associated with more anti-inflammatory dietary patterns. Heterogeneity observed was modest and not statistically significant.

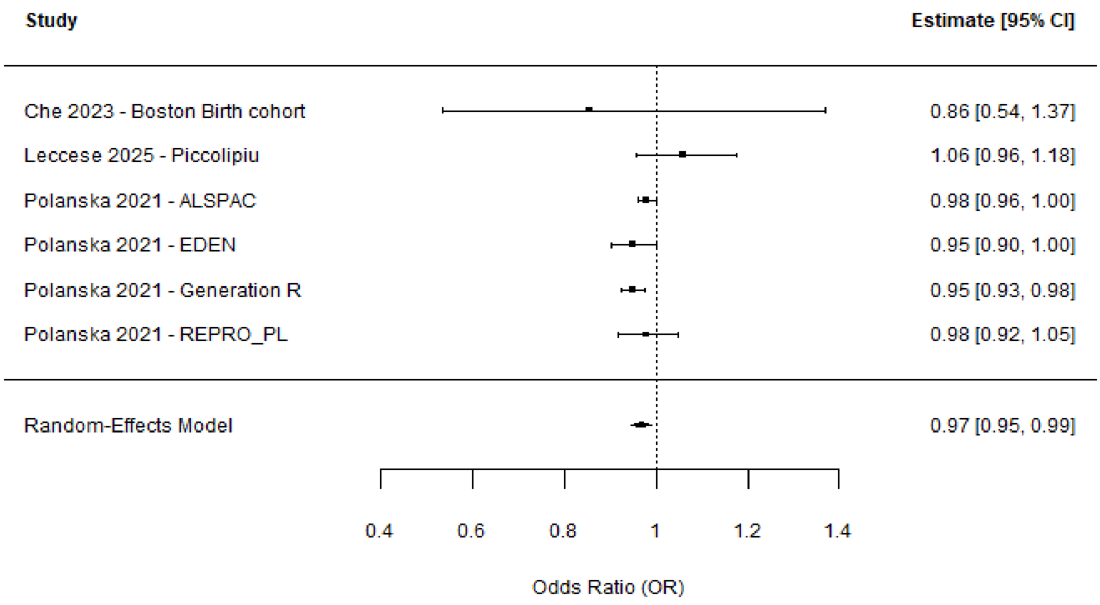

Figure 5. Forest plot of maternal anti-inflammatory diet on offspring ADHD.

The Effect of Maternal Anti-Inflammatory Diet on Offspring ASD

Across five cohorts, random-effects meta-analysis found that greater adherence to anti-inflammatory dietary patterns was associated with lower odds of ASD (OR = 0.79, 95% CI 0.69 to 0.91) (Figure 6). There was zero between-study heterogeneity (I^2 = 0.00%) indicating no variation in effect estimates across cohort studies. The pooled estimate indicates about 21% lower odds of ASD associated with more anti-inflammatory dietary patterns. Heterogeneity observed was low and not statistically significant.

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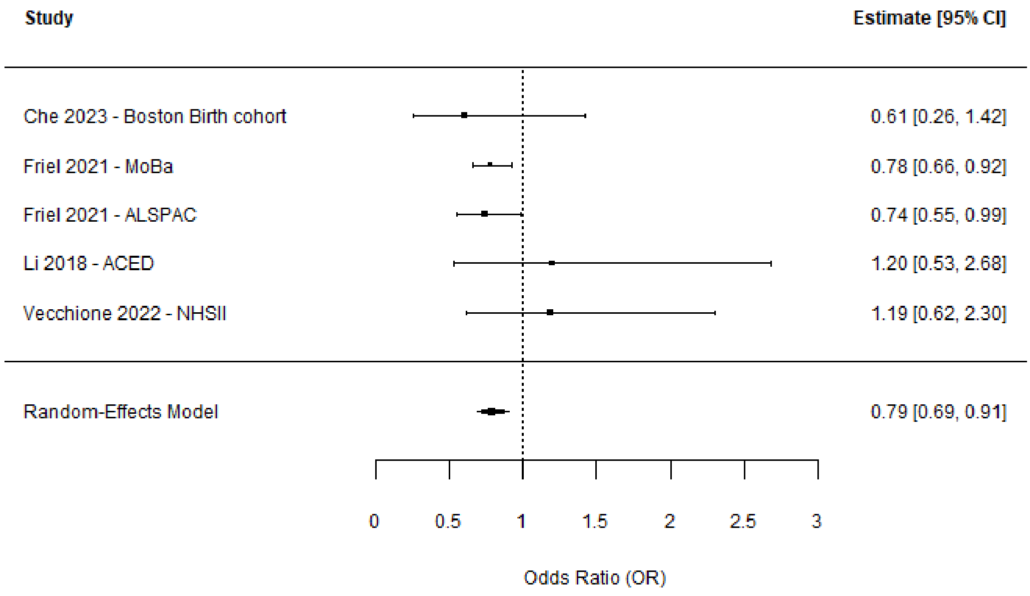

Figure 6. Forest plot of maternal anti-inflammatory diet on offspring ASD.

GRADE Certainty of Evidence

Across all outcome groups, the certainty of evidence was rated as very low (Table 4). Downgrading was primarily driven by inconsistency due to moderate between-study heterogeneity and by imprecision due to paucity of studies. While the direction of association is significant and consistent, the low certainty of evidence limits confidence in the reported effect estimates.

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Table 4. GRADE Certainty of evidence.

Outcome	Exposure	Number of studies	Participants	Pooled OR (95% CI)	Certainty of evidence	p-value	Q-test (p-value)	τ^2	Publication Bias (Egger's p)	Reasons for downgrading
ASD	Anti-inflammatory diet	5	100,908	0.79(0.69 - 0.91)	Low	0.001	<0.0001	0.0187	0.094	No serious concerns for risk of bias, inconsistency, indirectness, or imprecision.
ASD	Pro-inflammatory diet	3	6,511	1.55(1.10 - 2.19)	Low	0.001	0.542	0.0000	0.414	No serious concerns for risk of bias, inconsistency, indirectness, or imprecision.
ADHD	Anti-inflammatory diet	6	17,028	0.97(0.95 - 0.99)	Low	0.004	0.206	0.0002	0.717	No serious concerns for risk of bias, inconsistency, indirectness, or imprecision.
ADHD	Pro-inflammatory diet	8	17,114	1.07(0.96 - 1.20)	Very low	0.232	0.542	0.0000	—	Downgraded due to imprecision and for inconsistency due to moderate between-study heterogeneity.

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Table 5. Influence Analysis of Included Studies.

Outcome	Exposure	Influential Study	Interpretation
ADHD	Pro-inflammatory	Multiple (notably Study 3)	Results unstable; heterogeneity-driven
ASD	Pro-inflammatory	Study 2	Moderate influence on pooled estimate
ADHD	Anti-inflammatory	Minor influence	Results robust despite small variation
ASD	Anti-inflammatory	None	Highly robust findings

Discussion

This meta-analysis of 22 effect estimates from 9 observational studies examined the association between maternal dietary quality during pregnancy and neurodevelopmental outcomes in children, focusing on ASD and ADHD. Overall, evidence suggested that prenatal dietary pattern characterised by maternal anti-inflammatory diet was associated with lower odds of both ASD and ADHD in offspring, while prenatal dietary pattern characterised by maternal pro-inflammatory diet was associated with increased odds in ASD and not ADHD.

These findings are broadly consistent with previous systematic reviews [13,24,26], which have reported associations between maternal diet and child neurodevelopment. Recent evidence suggests that higher-quality prenatal diets are associated with improved cognitive and behavioural outcomes, while Western or processed dietary patterns are linked to adverse neurodevelopmental profiles. However, existing reviews are limited by substantial heterogeneity in dietary assessment methods and outcome definitions, as well as the predominance of nutrient-focused analyses.

Importantly, our findings extend the existing literature by quantitatively synthesising studies examining overall dietary patterns, thereby addressing a key gap identified in earlier reviews. While prior work has highlighted the potential importance of maternal diet, the limited number of studies examining dietary quality as a holistic exposure has constrained inference. By integrating these studies, this meta-analysis provides more robust evidence that maternal dietary patterns, particularly those characterised by inflammatory potential, may play a role in shaping neurodevelopmental risk.

Nevertheless, the observed associations should be interpreted cautiously. Variability in dietary assessment approaches, outcome measurement, and residual confounding across studies may influence effect estimates. In addition, the relatively small number of studies for certain analyses, particularly for ADHD, limits the strength of conclusions that can be drawn.

Our findings suggest that prenatal dietary quality may play a role in shaping neurodevelopmental risk, with anti-inflammatory dietary patterns potentially offering protective effects and pro-inflammatory dietary patterns associated with increased risk, particularly for ASD.

Strengths and Limitations

Compared with previous meta-analyses with mixed effect estimates from varying exposure definitions, our meta-analysis is the first to provide a systematic synthesis of studies measuring maternal dietary quality. One key distinction in our meta-analysis is the extraction of effect estimates from all eligible cohorts within each study. Another key distinction in our meta-analysis is the synthesis of effect estimates indicative of both anti-inflammatory dietary pattern and pro-inflammatory dietary pattern, resulting in four pooled estimates in total for both ASD and ADHD. This provided a more refined understanding of previously nuanced prenatal dietary exposures obscured in previous systematic reviews.

However, one limitation identified in our meta-analysis is the overall paucity of papers evaluating ADHD and ASD outcomes using overall maternal dietary quality. This limitation meant we did not have sufficient studies to conduct subgroup analyses, sensitivity analyses and meta-regression.

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Research Implication

While causal inference cannot be established from observational evidence, the findings of this meta-analysis suggest that maternal dietary quality during pregnancy may represent a modifiable factor influencing offspring neurodevelopment. In particular, dietary patterns characterised by higher consumption of anti-inflammatory foods appear to be associated with lower odds of ASD, while pro-inflammatory dietary patterns are associated with increased risk.

Dietary quality represents a modifiable exposure and these findings support current public health recommendations encouraging balanced dietary patterns during pregnancy that emphasise whole grains, fruits, vegetables, and healthy fats while limiting highly processed and pro-inflammatory foods. Beyond providing single nutrient recommendation for women of reproductive age, offering holistic dietary guidance and support may therefore represent a potentially important strategy for improving maternal and child health outcomes.

Overall, these findings highlight maternal dietary quality as a potentially important prenatal correlate of neurodevelopmental outcomes. Understanding how maternal diet shapes early neurodevelopment may contribute to the development of more comprehensive nutritional recommendations aimed at supporting both maternal health and optimal neurodevelopment in offspring.

Research Recommendation

Several research gaps remain that warrant further investigation. First, the current evidence base examining maternal dietary quality and neurodevelopment is relatively small, particularly for pro-inflammatory dietary patterns and ADHD outcomes. Future studies should therefore prioritise large prospective cohort designs with repeated dietary assessments across pregnancy to improve exposure measurement and reduce recall bias.

Second, greater consistency in the operationalisation of dietary quality is needed. Existing studies employ a wide range of dietary indices and pattern derivation methods, which limits comparability across studies. The development and adoption of harmonised dietary quality metrics for use in pregnancy research would facilitate more robust cross-study synthesis. Finally, future research should prioritise well-designed intervention studies that evaluate whole dietary patterns rather than isolated nutrients.

Conclusion

This systematic review and meta-analysis examined the association between maternal dietary quality during pregnancy and neurodevelopmental outcomes in offspring. In contrast to previous reviews that largely synthesised evidence on isolated nutrients or specific food components, this study focused specifically on overall maternal dietary patterns. Across the included studies, anti-inflammatory dietary patterns were associated with lower odds of neurodevelopmental disorders, while pro-inflammatory dietary patterns were associated with increased odds of ASD. These findings suggest that the overall inflammatory profile and quality of the maternal diet may be relevant to offspring neurodevelopment.

The present results extend existing evidence by demonstrating that examining maternal diet at the level of dietary patterns may provide clearer insights than nutrient-specific analyses alone. Most previous systematic reviews have pooled studies assessing individual nutrients such as folate, vitamin D, fish intake, or omega-3 fatty acids. While such approaches are valuable, they do not fully capture the cumulative and interactive effects of foods as they are consumed in real-world diets. By focusing specifically on dietary quality and patterns, this review reflects the broader nutritional environment of pregnancy and therefore provides evidence that is potentially more ecologically valid and clinically interpretable.

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Conflict of Interest: Declared None

List of Abbreviations

DOHaD	Developmental Origins of Health and Disease (DOHaD)
ADHD	Attention-deficit Hyperactivity Disorder (ADHD)
ASD	Autism Spectrum Disorder (ASD)
LMP	Last menstrual period (LMP)
AHEI-P	Alternative Healthy Eating Index - Pregnancy
EDIP	Empirical dietary inflammatory pattern
E-DII	Energy-Adjusted Dietary Inflammatory Index
HPDP	Healthy Prenatal Dietary Pattern
MSDS	Mediterranean-style diet score
GRADE	Grading of Recommendations Assessment, Development, and Evaluation
ROBINS-E	Risk Of Bias In Non-randomized Studies of Exposure
DII	Dietary Inflammatory Index (DII)
E-DII	Energy adjusted DII
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
MOOSE	Meta-analysis Of Observational Studies in Epidemiology
LC-PUFA	Long chain polyunsaturated fatty acid
DHA	Docosahexaenoic acid
DASH	Dietary Approaches to Stop Hypertension

References

1. POLANCZYK, G. V., SALUM, G. A., SUGAYA, L. S., CAYE, A. & ROHDE, L. A. 2015. Annual research review: A meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. *J Child Psychol Psychiatry,* 56**,** 345-65.
2. ZEIDAN, J., FOMBONNE, E., SCORAH, J., IBRAHIM, A., DURKIN, M. S., SAXENA, S., YUSUF, A., SHIH, A. & ELSABBAGH, M. 2022. Global prevalence of autism: A systematic review update. *Autism Res,* 15**,** 778-790.
3. LEITNER, Y. 2014. The co-occurrence of autism and attention deficit hyperactivity disorder in children - what do we know? *Front Hum Neurosci,* 8**,** 268.
4. ANTSHEL, K. M. & RUSSO, N. 2019. Autism Spectrum Disorders and ADHD: Overlapping Phenomenology, Diagnostic Issues, and Treatment Considerations. *Curr Psychiatry Rep,* 21**,** 34.
5. SIMONOFF, E., PICKLES, A., CHARMAN, T., CHANDLER, S., LOUCAS, T. & BAIRD, G. 2008. Psychiatric disorders in children with autism spectrum disorders: prevalence, comorbidity, and associated factors in a population-derived sample. *J Am Acad Child Adolesc Psychiatry,* 47**,** 921-9.
6. Harpin V, Mazzone L, Raynaud JP, Kahle J, Hodgkins P. Long-Term Outcomes of ADHD: A Systematic Review of Self-Esteem and Social Function. *J Atten Disord*. 2016;20(4):295-305.
7. Galera C, Heude B, Forhan A, et al. Prenatal diet and children's trajectories of hyperactivity-inattention and conduct problems from 3 to 8 years: the EDEN mother-child cohort. *The Journal of Child Psychology and Psychiatry*. 2018; 59(9): 1003-1011. DOI: 10.1111/jcpp.12898.

8. Rijlaarsdam J, Cecil CA, Walton E, Mesirow MS, Relton CL, Gaunt TR, et al. Prenatal unhealthy diet, insulin-like growth factor 2 gene (IGF2) methylation, and attention deficit hyperactivity disorder symptoms in youth with early-onset conduct problems. *J Child Psychol Psychiatry*. 2017;58(1):19-27.
9. Borge TC, Biele G, Papadopoulou E, Andersen LF, Jack F, Egges M, et al. The associations between maternal and child diet quality and child ADHD findings from a large Norwegian pregnancy cohort study. *BMC Psychiatry*, 2021; 21:139 https://doi.org/10.1186/s12888-021-03130-4
10. Vecchione R, Westlake M, Bragg G. Maternal Dietary Patterns During Pregnancy and Child Autism-Related Traits in the Environmental Influences on Child Health Outcomes Consortium. *Nutrients.* 2024;1:6.
11. Chen, C., Xu, X., and Yan, Y. Estimated global overweight and obesity burden in pregnant women based on panel data model. *PLoS One* 2018;13:e0202183. doi:10.1371/journal.pone.0202183
12. Sauer AK, and Grabrucker AM. Zinc deficiency during pregnancy leads to altered microbiome and elevated inflammatory markers in mice. *Front. Neurosci.* 13:1295. doi: 10.3389/fnins.2019.01295
13. Li M, Francis E, Hinkle SN, Ajjarapu AS, Zhang C. Preconception and prenatal nutrition and neurodevelopmental disorders: a systematic review and meta-analysis. Nutrients, 2019;11:1628. doi: 10.3390/ nu11071628
14. Bordeleau M, Fernández de Cossío L, Chakravarty MM and Tremblay M-È. From Maternal Diet to Neurodevelopmental Disorders: A Story of Neuroinflammation. Front. Cell. Neurosci. 2021;14:612705. doi: 10.3389/fncel.2020.612705
15. Yu Y, Liu H, Feng C, Seguin JR, Hardy IS, Sun W, et al. Maternal Diet Quality and Multivitamin Intake During Pregnancy Interact in the Association with Offspring Neurodevelopment at 2 Years of Age. Nutrients. 2025; 17(12):2020. https://doi.org/10.3390/nu17122020
16. Thapar A, et al. What causes attention deficit hyperactivity disorder? Arch Dis Child. 2012;97(3):260–5.
17. Monk C, Georgieff MK, Osterholm EA. Research review: maternal prenatal distress and poor nutrition–mutually influencing risk factors affecting infant neurocognitive development. J. Child Psychol. Psychiatry, 2013; 54: 115–130. doi: 10.1111/jcpp.12000
18. Prado EL, Dewey KG. Nutrition and brain development in early life. Nutr. Rev. 2014; 72: 267–284.
19. Christifano D. N. Intake of eggs, choline, lutein, zeaxanthin and DHA during pregnancy and their relationship to fetal neurodevelopment. Nutri Neurosci, 2022, p.1-7.
20. Martin JC, Zhou SJ, Flynn AC, Malek L, Greco R, Moran L. Theassessment of diet quality and its effects on health outcomes pre-pregnancy and during pregnancy. Semin. Reprod. Med. 2016;34:83–92. doi: 10.1055/s-0036 1571353
21. Godfrey KM, Reynolds RM, Prescott SL, Nyirenda M, Jaddoe VWV, Eriksson JG, Broekman BFP. Influence of Maternal Obesity on the Long-Term Health of Offspring. Lancet Diabetes Endocrinol. 2017; 5:53–64.
22. Urbonaite G, Knyzeliene A, Bunn FS, Smalskys A, Neniskyte, U. The Impact of Maternal High-Fat Diet on Offspring Neurodevelopment. Front. Neurosci. 2022;16: 909762.
23. Thion MS, Low D, Silvin A, Chen J, Grisel P, Schulte-Schrepping J, et al. Microbiome influences prenatal and adult microglia in a sex-specific manner. Cell, 2018; 172:500–516e16. doi: 10.1016/j.cell.2017.11.042
24. Zhong C, Tessing J, Lee BK, Lyall K. Maternal Dietary Factors and the Risk of Autism Spectrum Disorders: A Systematic Review of Existing Evidence. Autism Res. 2020;13(10):1634-1658. doi: 10.1002/aur.2402.
25. Julvez J, Méndez M, Fernandez-Barres S, Romaguera D, Vioque J, Llop S, et al. Maternal Consumption of Seafood in Pregnancy and Child Neuropsychological Development: A Longitudinal Study Based on a Population with High Consumption Levels. Am. J. Epidemiol. 2016; 183: 169–182.
26. Borge TC, et al. The importance of maternal diet quality during pregnancy on cognitive and behavioural outcomes in children: a systematic review and meta-analysis. BMJ Open. 2017;7(9).
27. Saeeda W, Subuhi A, Sharique A. Attention Deficit Hyperactivity Disorder: The Role of Maternal Health. RJMS 2025;15(2):89-96
28. Leccese L, Nisticò L, Culasso M, Pizzi C, Lastrucci V, Gagliardi L, Brescianini S. Maternal Dietary Pattern in Pregnancy and Behavioral Outcomes at 4 Years of Age in the Piccolipiù Cohort: Potential Sex-Related Differences. Nutrients 2025; 17: 2814. https:// doi.org/10.3390/nu17172814

 doi:10.20944/preprints202604.0924.v1

29. Horner D, Jepsen JRM, Chawes B, Aagaard K, Rosenberg JB, Mohammadzadeh P. A western dietary pattern during pregnancy is associated with neurodevelopmental disorders in childhood and adolescence. Nature Metabolism. 2025; 7: 586–601. https://doi.org/10.1038/s42255-025-01230-z
30. Friel C, Leyland AH, Anderson JJ, Havdahl A, Brantsæter AL, Dundas R. Healthy Prenatal Dietary Pattern and Offspring Autism. JAMA Netw Open. 2024;7(7):e2422815. doi:10.1001/jamanetworkopen.2024.22815
31. Chen Z, Wang X, Hu Y, Zhang S and Han F. Effect of maternal diet on gut bacteria and autism spectrum disorder in offspring. Front. Cell. Neurosci. 2025;19:1623576. doi: 10.3389/fncel.2025.1623576
32. Kyozuka H, Murata T, Fukuda T, Yamaguchi A, Kanno A, Yasuda S, et al. Association between preconception dietary inflammatory index and neurodevelopment of offspring at 3 years of age: The Japan Environment and Children's Study. Nutrition. 2022;102:111708.
33. Mahmassani HA, Switkowski KM, Scott TM, Johnson EJ, Rifas-Shiman SL, Oken E, Jacques PF. Maternal diet quality during pregnancy and child cognition and behavior in a US cohort. The American Journal of Clinical Nutrition. 2022;115(1):128-41
34. ZUPO, R. C. F. B. G. M. E. C. G. P. P. S. R. Processed foods and diet quality in pregnancy may affect child neurodevelopment disorders: a narrative review. *Nutritional neuroscience,* 2024,2**,** 7.
35. Page, M. J., Mckenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., AKL, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., LI, T., Loder, E. W., Mayo-Wilson, E., Mcdonald, S., Mcguinness, L. A., Stewart, L. A., Thomas, J., Tricco, A. C., Welch, V. A., Whiting, P. & Moher, D. 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *Bmj,* 372**,** n71.
36. Moola, S., Munn, Z., Sears, K., Sfetcu, R., Currie, M., Lisy, K., Tufanaru, C., Qureshi, R., Mattis, P. & MU, P. Conducting systematic reviews of association (etiology): The Joanna Briggs Institute's approach. *Int J Evid Based Healthc,* 2015, 13**,** 163-9.
37. HIGGINS, J. P. T., & GREEN, S. (EDS.). 2008. Cochrane Handbook for Systematic Reviews of Interventions (Version 5.0.1). The Cochrane Collaboration.
38. Che X, Gross MS, et al. Impact of consuming a Mediterranean-style diet during pregnancy on neurodevelopmental disabilities in offspring: results from the Boston Birth Cohort. *Precision Nutrition*. 2023.
39. LECCESE, L. N. L. C. M. P. C. L. V. G. L. B. S. Maternal Dietary Pattern in Pregnancy and Behavioral Outcomes at 4 Years of Age in the Piccolipiù Cohort: Potential Sex-Related Differences. *Nutrients,* 2025, 1**,** 7.
40. Lertxundi N, Molinuevo A, Valvi D, Gorostiaga A, Balluerka N, Shivappa N, Hébert JR, Navarrete-Muñoz EM, Vioque J, Tardón A, Vrijheid M, Roumeliotaki T, Koutra K, Chatzi L, Ibarluzea J. Dietary inflammatory index of mothers during pregnancy and attention deficit-hyperactivity disorder symptoms in the child at preschool age: a prospective investigation in the INMA and RHEA cohorts. *European Child and Adolescent Psychiatry*. 2022;31:615–624.
41. Li YM, Shen YD, Li YJ, Xun GL, Liu H, Wu RR, Xia K, Zhao JP, Ou JJ. Maternal dietary patterns, supplements intake and autism spectrum disorders: a preliminary case-control study. *Medicine (Baltimore).* 2018;97:e13902.
42. Polańska K, Kałużny P, Aubert AM, et al. Dietary quality and dietary inflammatory potential during pregnancy and offspring emotional and behavioral symptoms in childhood: an individual participant data meta-analysis of four European cohorts. *Biological Psychiatry.* 2021;89(8).
43. Vecchione R, Wang S, Rando J, Chavarro JE, et al. Maternal dietary patterns during pregnancy and child autism-related traits: results from two US cohorts. *Nutrients*. 2022;14(1).