The interplay between prenatal health behaviours, neurodevelopmental diagnoses and alterations in the gut microbiome

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The interplay between prenatal health behaviours, neurodevelopmental diagnoses and alterations in the gut microbiome: An umbrella review

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Background

Neurodevelopmental diagnoses (NDDs) include Autism and Attention Deficit/ Hyperactivity Disorder (ADHD).

Recently, a role of the gut microbiome in the aetiology of NDDs has been discussed due to its communication with the brain via the immune system (Cenit, Sanz & Codoñer-France, 2017). In line with that, children with NDDs have a high prevalence of gastrointestinal problems (Mannion & Leader, 2014).

Microbial colonisation of the infant gut by maternal gut microbes occurs during birth (Korpela, 2021).

The composition of the maternal microbiome can be impacted by health behaviours and lifestyle factors such as smoking and stress (Conlon & Bird, 2014).

Aims:

- To conduct a systematic review of systematic reviews and meta-analyses across the three domains:
  1. Association between prenatal health behaviours and NDDs
  2. Association between prenatal health behaviours and offspring gut microbiome composition
  3. Association of NDDs and gut microbiome composition
- To summarise the overlap between the three domains in a developmental framework.

Methods

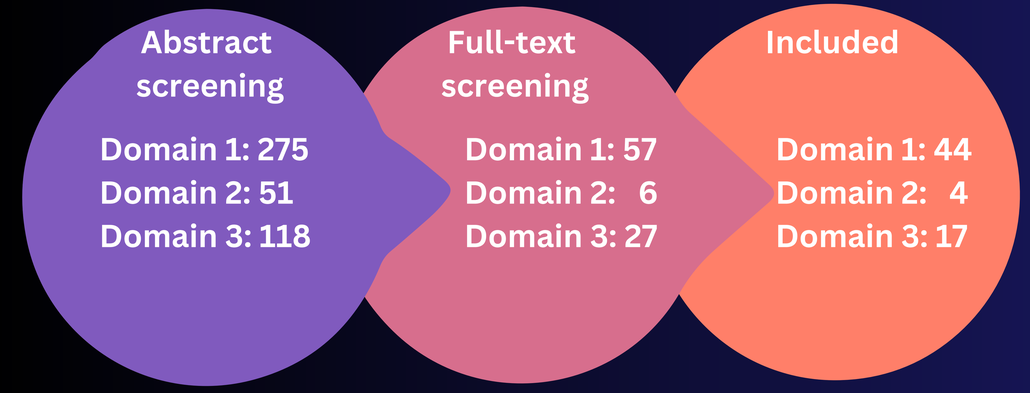
The search strategy was pre-registered on Prospero (CFR42021292394) and can be accessed here:

Inclusion criteria: Publication in a peer-reviewed journal, English abstract, systematic review with or without a meta-analysis, human participants.

Specific criteria for the three domains:

1. Inclusion of studies on negative prenatal health behaviours & neurodevelopmental diagnoses or symptoms in offspring (i.e., maternal smoking, diet, gestational weight gain or pre-pregnancy obesity, maternal stress).
2. Inclusion of studies on prenatal health behaviours and the composition of the offspring's gut microbiome.
3. Inclusion of studies on NDDs and gut microbiome composition.

Results



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Subjective stress
- ADHD: Pos. association, potentially larger for more severe experiences. Familial confounding should be considered.
- Autism: Pos association, but driven by case-control designs and lower quality studies.

Smoking
- ADHD: Association with dimensional, but not categorical measures.
- Autism: No evidence.

Obesity/ GWG
- *ADHD: Positive association, potentially due to familial confounding.*
- *Autism: Association may be stronger for GWG, familial confounding should be considered.*

Prenatal Health Behaviours & Neurodevelopmental Diagnoses/ Symptoms

3

Most Consistent Findings

Autism

Lower abundance of:
- *Bifidobacterium*
- *Proteobacteria*
- *Streptococcus*
- *Dialister*

Higher abundance of:
- *Firmicutes/ Bacteroidetes ratio*
- *Bacteroides*
- *Clostridium*

ADHD

Lower abundance of:
- *Faecalibacterium*

Higher abundance of:
- *Odoribacter*
- *Eggerthella*
- *Bacteroides uniformis*
- *Prevotellaceae*

Prenatal Health Behaviours & Offspring Gut Microbiome Composition

Overlap
Stress and obesity/ GWG are associated with NDDs & gut microbial composition

Overlap
Autism and prenatal stress are associated with a lower abundance of Bifidobacteria

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Obesity/ GWG
- Slightly lower alpha diversity

Stress

Lower abundance of:
- *Lactobacillus*
- *Bifidobacteria*

High-fat diet

Lower abundance of:
- *Bacteroides*

Prenatal Health Behaviours & Offspring Gut Microbiome Composition

Preliminary conclusion

The umbrella systematic review is still in progress.

Domain 1: There is a positive association between some prenatal health behaviours and NDDs. There is however a need for high-quality longitudinal studies that control for familial confounding.

Domain 2: Few replicated results across studies. Some factors examined in domain 1 have not been sufficiently examined regarding their impact on offspring gut microbiome composition.

Domain 3: Convincing evidence for an association between NDDs and gut microbiome composition but with few replicated findings. Future studies should utilise metagenomic sequencing techniques that allow for an analysis of functional profiles (i.e., shallow shotgun).

No effects for...

Domain 2: No evidence for most maternal dietary factors.
No evidence for a persistent alteration of the infant gut microbiome following the cessation of pro-/ prebiotic supplementation.

References

Cenit, M. C., Sanz, Y., & Codoñer-Franch, P. (2017). Influence of gut microbiota on neuropsychiatric disorders. World journal of gastroenterology, 23(30), 5486.

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Korpela, K. (2021). Impact of delivery mode on infant gut microbiota. Annals of Nutrition and Metabolism, 77(Suppl. 3), 11-19.

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