



The Missing Link in Maternal Adaptation During Pregnancy: Interoception, Bodily Experience, Psychological Wellbeing, and Maternal–Fetal Connection

Master scientific draft for conference submission

Parisa Salmani Khormalou¹ | Reyhaneh Hassanpour¹

¹ Affiliation: [tabriz], [iran]

Corresponding author: Parisa Salmani Khormalou (email to be completed)

Abstract

Background: Pregnancy is a period of profound physiological and psychological adaptation. Interoception—the perception and interpretation of internal bodily signals—offers a framework for examining how bodily change becomes maternal experience.

Objective: To map pregnancy-specific evidence linking interoceptive processes with bodily experience, psychological wellbeing, and maternal–fetal connection, and to identify implications for midwifery research and care.

Methods: A scoping-review framework was used to organize the literature according to PRISMA-ScR principles. Pregnancy-specific original studies were distinguished from broader conceptual evidence. No screening counts or PRISMA-flow numbers are reported in this master draft because a reproducible database screening log has not yet been finalized.

Results: Verified pregnancy-specific studies indicate associations between interoceptive sensibility and body satisfaction, anxiety-related symptoms, antenatal attachment, and perception of fetal movement. The literature remains heterogeneous and is dominated by observational and self-report approaches; therefore, causal and clinical claims are not warranted.

Conclusion: Interoception is a promising framework for understanding individual differences in maternal adaptation. It may complement, rather than replace, physiological assessment by foregrounding maternal bodily experience.



19th International Conference on New Findings in Midwifery, Women, Maternity and Infertility (ICMWMI 2026)

<http://icmwmi.ir>
info@icmwmi.ir

18 September 2026 -TBILISI GEORGIA

Keywords: Interoception; Pregnancy; Maternal adaptation; Body awareness; Maternal wellbeing; Antenatal attachment; Midwifery

1. Introduction

Pregnancy is an embodied biological and psychological transition. Alongside endocrine, cardiovascular and metabolic adaptation, women continuously experience and interpret changing internal bodily states. Conventional obstetric and prenatal frameworks necessarily prioritize physiological safety, yet maternal adaptation also includes the subjective meaning assigned to bodily change.

Interoception describes the sensing and interpretation of internal bodily signals. Contemporary work distinguishes objective performance, subjective sensibility and metacognitive awareness, although terminology and measurement remain debated (Craig, 2002; Garfinkel et al., 2015; Khalsa et al., 2018). Pregnancy provides a particularly informative context because internal sensations change rapidly and fetal movement introduces a distinctive bodily signal.

Pregnancy-specific evidence is still relatively small and heterogeneous. This review therefore focuses on what the direct evidence actually supports, while using broader interoception theory only as supporting context.

2. Methods

2.1 Design and review question

The manuscript is structured as a scoping review. The guiding question is: How are interoceptive processes associated with maternal bodily experience, psychological wellbeing and maternal–fetal connection during pregnancy?

2.2 PCC framework

PCC component	Definition
Population	Pregnant women / pregnant participants
Concept	Interoception, interoceptive sensibility/accuracy/awareness, body trust and related internal bodily perception
Context	Pregnancy, maternal adaptation, prenatal and midwifery-relevant outcomes

2.3 Eligibility and evidence handling

Original human studies examining pregnancy and an explicit interoceptive construct were treated as direct evidence. Broader neuroscience, mental-health and adaptation literature was treated as supporting evidence and was not used to make pregnancy-specific causal claims. Reviews, editorials and non-human studies were not treated as direct empirical evidence.



19th International Conference on New Findings in Midwifery, Women, Maternity and Infertility (ICMWMI 2026)

<http://icmwmi.ir>
info@icmwmi.ir

18 September 2026 -TBILISI GEORGIA

2.4 Search framework

A reproducible final search should be run in PubMed/MEDLINE, Scopus, Web of Science and PsycINFO using database-adapted combinations of terms such as: (interoception OR "interoceptive awareness" OR "interoceptive sensibility" OR "interoceptive accuracy" OR "body trust") AND (pregnancy OR pregnant OR maternal). Search dates, deduplication and screening counts must be inserted only after the final search log is executed. No fabricated counts are included here.

3. Evidence Synthesis

3.1 Maternal bodily experience

Crossland et al. (2022) directly compared interoceptive sensibility and body satisfaction in pregnant and non-pregnant women. Their findings support a relationship between pregnancy-related bodily experience and interoceptive sensibility, particularly body-trusting processes, without establishing causality.

3.2 Psychological wellbeing

In a pilot study of 32 pregnant women, Noda et al. (2022) assessed interoceptive sensibility with the Japanese MAIA and interoceptive accuracy with a heartbeat-counting task. Interoceptive measures were associated with anxiety-related variables. The small sample and cross-sectional design require cautious interpretation.

3.3 Maternal–fetal connection and fetal movement

Stafford et al. (2024) examined 159 pregnant participants and found that interoceptive sensibility, particularly body trust, was relevant to the relationship between pregnancy body satisfaction and antenatal attachment. Furusho et al. (2024) further examined individual interoceptive differences in relation to the initial maternal perception of fetal movement, providing direct evidence that interoceptive processes are relevant to pregnancy-specific bodily perception.

3.4 Emerging postnatal evidence

Recent work extends the field beyond pregnancy. Munns and Preston (2025) examined bodily experiences during pregnancy in relation to maternal and infant outcomes in a sample of 253 participants, while Munns et al. (2025) used network analysis to examine interoceptive and exteroceptive pregnancy experiences in relation to postnatal wellbeing. These studies strengthen the rationale for longitudinal research but should not be interpreted as proof of causal pathways.

Table 1. Verified direct and closely related pregnancy evidence

Study	Design / sample	Interoception focus	Evidence contribution
Noda et al. (2022)	Pilot observational; n=32 pregnant women	MAIA-J; heartbeat- counting task	Associations with anxiety-related psychological variables
Crossland et al. (2022)	Observational comparison of	Interoceptive sensibility; body trust	Links pregnancy bodily experience with



19th International Conference on New Findings in Midwifery, Women, Maternity and Infertility (ICMWMI 2026)

<http://icmwmi.ir>
info@icmwmi.ir

18 September 2026 -TBILISI GEORGIA

	pregnant/non-pregnant women		interoceptive sensibility/body satisfaction
Stafford et al. (2024)	Cross-sectional; n=159 pregnant participants	Interoceptive sensibility; body trust	Body trust relevant to body satisfaction—antenatal attachment relationship
Furusho et al. (2024)	Cross-sectional pregnant sample	Individual interoceptive differences	Examined association with timing of initial fetal-movement perception
Munns & Preston (2025)	Observational; n=253	Interoceptive sensibility and bodily experience	Links pregnancy bodily experience with maternal/infant-related outcomes
Munns et al. (2025)	Network analysis	Interoceptive/exteroceptive pregnancy experience	Extends pregnancy bodily experience to postnatal wellbeing

4. Discussion

The verified evidence supports a restrained but coherent conclusion: interoception is relevant to how pregnancy is experienced, particularly in relation to body satisfaction, anxiety-related symptoms, antenatal attachment and fetal-movement perception. The evidence does not establish that interoception determines obstetric outcomes or that modifying interoception improves maternal health.

The conceptual value of interoception is its ability to connect physiological change with subjective experience. Two women may undergo broadly similar physiological adaptations while experiencing those changes differently. Interoception offers a vocabulary and measurement framework for investigating this variation.

For midwifery, this perspective is potentially useful because holistic prenatal care includes both clinical surveillance and support for women's lived experience. At present, however, interoception-informed assessment should be considered a research direction rather than a routine clinical recommendation.

5. Implications for Midwifery Practice

Midwives are well positioned to recognize differences in how women attend to, trust and interpret pregnancy-related bodily sensations. Future evidence may clarify whether these dimensions can complement psychosocial assessment, antenatal education or individualized support. Current evidence is insufficient to recommend a specific interoception-based screening or intervention protocol.



**19th International Conference on New Findings
in Midwifery, Women, Maternity and Infertility
(ICMWMI 2026)**

<http://icmwmi.ir>
info@icmwmi.ir

18 September 2026 -TBILISI GEORGIA

6. Knowledge Gaps and Future Directions

Current gap	Research priority
Small and heterogeneous pregnancy-specific literature	Larger multisite and longitudinal cohorts
Heavy reliance on self-report	Combine subjective measures with carefully validated objective/physiological measures
Limited temporal evidence	Repeated assessment across trimesters and postpartum
Few intervention studies	Test whether modifiable interoceptive processes have clinically meaningful effects
Uncertain clinical utility	Evaluate incremental value beyond established prenatal and mental-health assessments

7. Strengths and Limitations

A strength of this review is the explicit separation of direct pregnancy evidence from broader theoretical evidence, reducing the risk of overgeneralization. The principal limitations are the small evidence base, heterogeneous measures, observational designs and the absence, in this master draft, of a finalized reproducible screening log. Consequently, no fabricated PRISMA counts or pooled effects are presented.

8. Conclusion

Interoception is a promising but still developing framework for understanding maternal adaptation. Current pregnancy-specific evidence supports associations with bodily experience, anxiety-related processes, antenatal attachment and fetal-movement perception, while causal and clinical implications remain uncertain. Future longitudinal and intervention research should determine whether interoceptive measures add meaningful value to maternal and midwifery care.

Conceptual Framework

Pregnancy-related physiological change → Internal bodily signals → Interoceptive processing → [Bodily experience | Psychological adaptation | Maternal–fetal connection] → Maternal adaptation

Note: This is a conceptual synthesis and does not imply established causal pathways.

Declarations

Ethics approval: Not applicable to a review of published literature.

Funding: To be confirmed by the authors before submission.

Conflict of interest: To be confirmed by the authors before submission.

Author contributions: To be confirmed by both authors before submission; contribution statements should reflect actual work performed.



**19th International Conference on New Findings
in Midwifery, Women, Maternity and Infertility
(ICMWMI 2026)**

<http://icmwmi.ir>
info@icmwmi.ir

18 September 2026 -TBILISI GEORGIA

References

1. Craig, A. D. (2002). How do you feel? Interoception: The sense of the physiological condition of the body. *Nature Reviews Neuroscience*, 3(8), 655–666. <https://doi.org/10.1038/nrn894>
2. Garfinkel, S. N., Seth, A. K., Barrett, A. B., Suzuki, K., & Critchley, H. D. (2015). Knowing your own heart: Distinguishing interoceptive accuracy from interoceptive awareness. *Biological Psychology*, 104, 65–74. <https://doi.org/10.1016/j.biopsycho.2014.11.004>
3. Khalsa, S. S., Adolphs, R., Cameron, O. G., et al. (2018). Interoception and mental health: A roadmap. *Biological Psychiatry: Cognitive Neuroscience and Neuroimaging*, 3(6), 501–513. <https://doi.org/10.1016/j.bpsc.2017.12.004>
4. Tricco, A. C., Lillie, E., Zarin, W., et al. (2018). PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and explanation. *Annals of Internal Medicine*, 169(7), 467–473. <https://doi.org/10.7326/M18-0850>
5. Peters, M. D. J., Marnie, C., Tricco, A. C., et al. (2020). Updated methodological guidance for the conduct of scoping reviews. *JBIM Evidence Synthesis*, 18(10), 2119–2126.
6. Noda, M., Sato, Y., Suetsugu, Y., & Morokuma, S. (2022). Interoception is associated with anxiety and depression in pregnant women: A pilot study. *PLOS ONE*, 17(5), e0267507. <https://doi.org/10.1371/journal.pone.0267507>
7. Crossland, A., Kirk, E., & Preston, C. (2022). Interoceptive sensibility and body satisfaction in pregnant and non-pregnant women with and without children. *Scientific Reports*, 12, 16138. <https://doi.org/10.1038/s41598-022-20181-z>
8. Stafford, L., Munns, L., Crossland, A. E., Kirk, E., & Preston, C. E. J. (2024). Bonding with bump: Interoceptive sensibility moderates the relationship between pregnancy body satisfaction and antenatal attachment. *Midwifery*, 131, 103940. <https://doi.org/10.1016/j.midw.2024.103940>
9. Furusho, M., Noda, M., Sato, Y., Suetsugu, Y., & Morokuma, S. (2024). Association between gestational weeks, initial maternal perception of fetal movement, and individual interoceptive differences in pregnant women: Cross-sectional study. *Asian/Pacific Island Nursing Journal*, 8, e57128. <https://doi.org/10.2196/57128>
10. Munns, L. B., & Preston, C. (2025). The role of bodily experiences during pregnancy on mother and infant outcomes. *Journal of Neuropsychology*, 19(Suppl. 1), 131–151. <https://doi.org/10.1111/jnp.12370>
11. Munns, L. B., Noonan, M., Romano, D. L., & Preston, C. E. J. (2025). Interoceptive and exteroceptive pregnant bodily experiences and postnatal well-being: A network analysis. *British Journal of Health Psychology*, 30(3), e70002. <https://doi.org/10.1111/bjhp.70002>