Journal of Cancer Research and Reports

Editorial

Fact File Observations of Structural Brain Alterations in Indian Women during the Menstrual Cycle

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Abstract

Some Indian women report a culturally grounded intuitive awareness regarding the timing and characteristics of childbirth, which may reflect traditional knowledge systems related to fertility, reproduction, and maternal health. Within certain Indian cultural and spiritual traditions, interpretations of conception and childbirth are often informed by astrological or metaphysical frameworks. While these perspectives are not empirically validated by contemporary science, they hold significant cultural relevance and influence reproductive health practices in these communities.

Keywords

Menstrual Cycle, Structural Brain Alterations, Indian Women.

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Received: October 11, 2025; **Accepted:** November 13, 2025; **Published:** November 24, 2025

Citation: Rahul Hajare. Fact File Observations of Structural Brain Alterations in Indian Women during the Menstrual Cycle. J Can Res Rep. 2025; 1(1):1-3.

Editorial

Approximately 95% of Indian women do not monitor their brain hormone fluctuations across the menstrual cycle, despite the fact that cyclic variations in hypothalamic–pituitary–gonadal (HPG) axis hormones exert significant behavioral, structural, and functional effects on the mammalian central nervous system. However, the specific ways in which these hormonal fluctuations influence the structural nodes and connectivity pathways of the human brain remain poorly understood. In this study, we investigated whether cyclical changes in HPG-axis hormone concentrations are associated with alterations in brain structure across the menstrual cycle. We recruited 30 naturally cycling women and conducted multidimensional diffusion and T1-weighted magnetic resonance imaging (MRI) during three estimated phases of the menstrual cycle: menses, ovulation, and the mid-luteal phase. Our primary focus was to examine whether hormone fluctuations co-vary with changes in white matter (WM) microstructure, cortical thickness (CT), and total brain volume. Predict birth child physics in India perspective 17β-estradiol and luteinizing hormone (LH) levels were positively associated with increased diffusion anisotropy, suggesting enhanced white matter integrity during phases of elevated hormonal concentration [1]. Follicle stimulating hormone (FSH) and progesterone exhibited divergent associations with mean diffusivity (MD) and cortical thickness (CT) across several brain regions, indicating distinct and potentially opposing roles in microstructural and cortical remodeling. Progesterone levels showed a positive correlation with total brain tissue volume and a negative correlation with cerebrospinal fluid (CSF) volume, suggesting a hormone-linked modulation of intracranial composition.

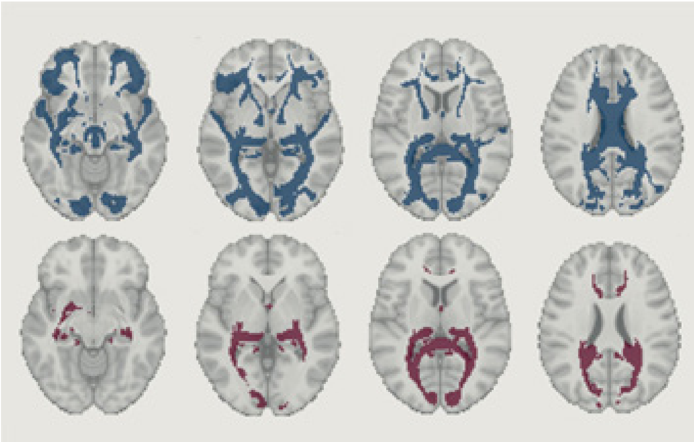
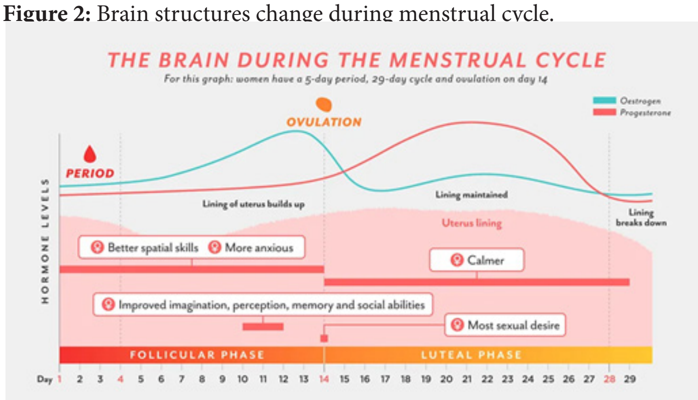


Figure 1: Structural variations in the brain occur in association with different phases of the menstrual cycle.

The hormonal fluctuations that regulate the menstrual cycle influence not only reproductive physiology but also the structure of the human brain. A 2020 study led by University of California, Santa Barbara, provides novel insights into these neurobiological dynamics. By longitudinally tracking 30 naturally cycling women across three key phases of the menstrual cycle, the researchers captured hormone linked structural changes in the brain using advanced neuroimaging techniques. Intention of author to study presents the evidence of simultaneous, brain-wide alterations in white matter microstructure and cortical thickness that co-occur with menstrual cycle related hormonal shifts. Notably, the observed changes were not confined to regions traditionally associated with high densities of hypothalamic pituitary gonadal (HPG) axis hormone receptors [2]. These findings suggest that cyclical hormone fluctuations exert broader effects on neural architecture than previously understood, underscoring the need for more inclusive models of hormone brain interactions in neuroscience research.

Figure 2: Brain structures change during menstrual cycle.



Over the course of a typical reproductive lifespan, menstruation occurs approximately 450 times, making it a significant and recurring physiological process. Despite its widespread prevalence impacting nearly half of the global population for a substantial portion of their lives scientific research on the systemic and neurological effects of the menstrual cycle remains relatively limited. Historically, investigations into hormonal influences on the brain have primarily focused on functional changes, particularly hormone mediated modulation of neural activity during cognitive tasks. In contrast, considerably less attention has been devoted to understanding how endogenous hormonal fluctuations influence brain structure across the menstrual cycle. Cyclic fluctuations in hormones of the hypothalamic pituitary gonadal (HPG) axis exert profound behavioral, structural, and functional effects on the mammalian central nervous system. However, the extent to which these hormonal rhythms influence the structural architecture of the human brain particularly large scale integrative pathways remain incompletely understood. White matter microstructure, comprising the myelinated axonal tracts that facilitate communication between cortical and subcortical gray matter regions, has demonstrated sensitivity to hormonal modulation. Structural alterations in white matter have been observed in association with key hormonal transitions, including puberty, oral contraceptive use, gender-affirming hormone therapy, and postmenopausal estrogen replacement. These findings collectively suggest that the brain's connective infrastructure remains dynamically responsive to endocrine states across the lifespan.

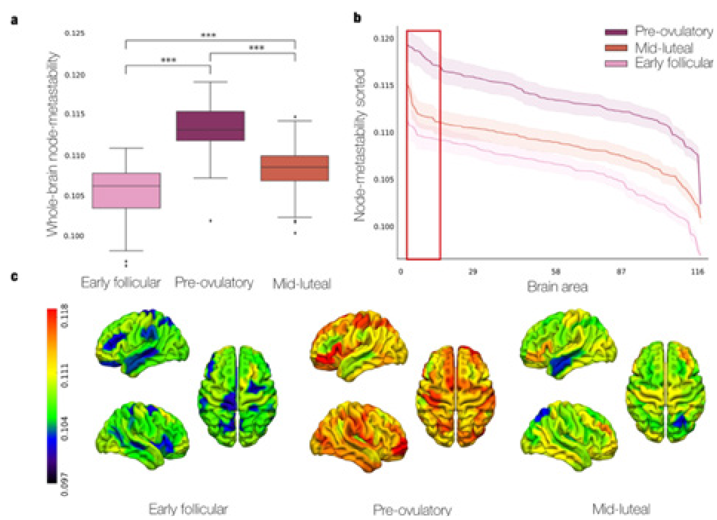


Figure 3: Brain structures undergo dynamic changes across the menstrual cycle.

To address the existing knowledge gap regarding menstruation and brain structure, Rizor, Babenko, and colleagues conducted a longitudinal neuroimaging study that examined structural brain changes across the menstrual cycle. Using high resolution magnetic resonance imaging (MRI), the researchers scanned 30 naturally cycling women during three hormonally distinct phases: menses, ovulation, and mid-luteal. Hormone levels were concurrently assessed at each imaging session to capture dynamic endocrine profiles. The results revealed coordinated fluctuations in gray matter volume, white matter microstructure, and cerebrospinal fluid (CSF) volume in association with endogenous hormonal variation. Notably, during the peri-ovulatory phase when circulating levels of 17β-estradiol and luteinizing hormone (LH) are elevated—participants exhibited white matter alterations suggestive of enhanced axonal integrity and potentially increased efficiency of neural signal transmission. Additionally, higher follicle-stimulating hormone (FSH) levels, which typically precede ovulation and support follicular maturation, were positively associated with increased cortical thickness in several brain regions. Following ovulation, rising progesterone levels were linked to increased total brain tissue volume and a concurrent reduction in CSF volume, indicating cyclical shifts in intracranial compartmentalization. Although the present study did not assess behavioral or cognitive outcomes, these findings provide foundational evidence that endogenous hormonal fluctuations influence neuroanatomical organization on a cyclical basis. The implications of such hormone-driven structural variability remain to be fully elucidated, particularly in the context of menstrual cycle–related mental health vulnerabilities and cognitive fluctuations. Supporting these observations, a separate international study published in 2024 reported that each menstrual phase exerts distinct effects on both global and region-specific brain structure, with additional modulation by participant age. Together, these studies underscore the need for further investigation into hormone–brain interactions at both structural and functional levels [3].

Result

As noted by the authors, although we do not currently report functional consequences or correlates of structural brain changes, our findings may have implications for hormone-driven alterations in behavior and cognition. Investigation of brain-hormone relationships across networks is necessary to understand human nervous system functioning on a daily basis, during hormone transition periods, and across the human lifespan. These findings underscore the importance of integrating endocrine dynamics into models of brain plasticity, particularly in populations traditionally underrepresented in neuroscience research. The observation that structural brain changes align with cyclical hormonal fluctuations suggests a level of neurobiological plasticity that may influence cognitive performance, emotional regulation, and susceptibility to neuropsychiatric conditions across the menstrual cycle. Future research should aim to elucidate the functional significance of these structural shifts by incorporating behavioral assessments, task-based functional MRI, and longitudinal tracking of mood and cognition. Additionally, understanding individual variability such as age, hormonal sensitivity, and reproductive health history—will be crucial for identifying risk factors and protective mechanisms related to hormone-linked brain changes. Ultimately, advancing our knowledge of hormone–brain interactions has the potential to inform personalized approaches to women's brain health, guide clinical interventions for hormone-related mood and cognitive disorders, and reshape how neuroscience approaches sex and gender as biological variables.

Conclusion

While such beliefs are not scientifically validated, they hold cultural and personal significance for many individuals. Indian women, like many globally, often develop a strong somatic awareness of their reproductive cycles, which can contribute to the anticipation of conception or labor onset through recognition of physiological signals.

References

1. Rizor E, Babenko V. Structural Brain Changes Across the Menstrual Cycle: A Longitudinal Neuroimaging Study. Human Brain Mapping. The Times of India. 2023.
2. Thottupattu AJ, Sivaswamy J, Holla B, Saini J. Understanding Brain Aging Across Populations: A Comprehensive Framework for Structural Analysis. arXiv. 2024.
3. Rahul H. Why Men are missing from Fertility Debates. J Gastrointest Disord Liver Func. 2018; 4: 38-39.