

# Breast fluctuations are associated with oestradiol and progesterone changes across the menstrual cycle

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## Summary

This study examined breast volume changes across the menstrual cycle and the relationship to hormones and women's perceptions of breast volume change. Fifteen women underwent 3D breast scans and hormone testing throughout one cycle. Results showed an average breast volume increase of 7.3%, with individual variations up to 41.7%. Volume changes correlated strongly with oestradiol and progesterone levels, but with a delay. Women with typical volume patterns showed a 13.3% decrease in oestradiol, while those with atypical patterns had a 14.2% increase. Notably, perceived breast volume changes did not align with actual fluctuations. The study highlights significant inter-individual variability in breast volume changes, with differences up to one bra cup size difference. These findings have implications for sports performance and participation where unrecognised breast volume changes across menstrual cycle may affect biomechanics and comfort during exercise.

## Introduction

Breast volume changes across the menstrual cycle [1], which may alter bra size and fit [2]. Research indicates that as breast volume increases in the luteal phase, so does breast water volume [3]. Oestradiol and progesterone may impact breast volume through the hormonal and neural systems which control water and sodium balance and glandular breast tissue morphology [4]. It is unknown whether all women conform to the typical changes in breast volume or if changes can be perceived across the menstrual cycle and inform associated behavioral changes.

## Methods

Fifteen women (N = 10 fitted to a UK bra size of 34C, and n = 5 fitted to a 36B) with regular menstrual cycles, not on hormone treatment attended six laboratory appointments (day 2, ovulation-2, ovulation, ovulation+7, menses-3, day 2 of next cycle) and provided bidaily saliva samples for hormone testing during one menstrual cycle. At each appointment 3D surface scanning measured breast volume whilst perceptions of volume change and associated behavior modifications were recorded. Bare-breasted breast kinematics was also measured during each appointment (results not presented in this abstract). ANOVA were run to assess changes in breast volume and hormones across the menstrual cycle and Pearson correlation coefficients implemented to distinguish relationships between measured variables.

## Results

Average left breast volume changed by +7.3% ( $p < 0.05$ ) between ovulation and predicted menses-3 days. Individual variations in breast volume change ranged from 0-41.7%. Volume asymmetry peaked around ovulation (5.1%). Mean oestradiol ranged from 2.1 pg/mL to 11.2 pg/mL across the menstrual cycle, peaking two days before ovulation. Mean progesterone ranged from 17.6 pg/mL to 350.2 pg/mL across the menstrual cycle, peaking seven days after ovulation. Large variability was observed across hormone data. Breast volume changes strongly correlated with oestradiol and progesterone levels, but with a delay of three appointments (left  $r=0.85$ ; right  $r=0.95$ ) and one appointment (left  $r=0.84$ ; right  $r=0.84$ ), respectively. Women exhibiting typical volume patterns ( $n=11$ ) showed a 13.3% decrease in oestradiol, compared to 14.2% increase in atypical patterns ( $n=4$ ). Notably, perceived breast volume changes did not align with actual volume fluctuations.

## Discussion and Conclusion

While average breast volume increases (~one-third bra cup) may seem minimal, substantial inter-individual variability was observed, with changes up to ~1 bra cup size. Volume peaked ~13 days after oestradiol and ~4 days after progesterone peak. However, the combination of high variability, the inability for women to accurately perceive changes and discrepancies between hormonal peaks and breast volume changes, emphasises the need for individualized measurements within and between multiple menstrual cycles. These unrecognised breast volume changes, paired with other physiological impact of hormone changes with menstrual cycle, will likely impact breast kinematics and comfort during exercise and have implications for bra design, physical activity participation and sports performance.

## References

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