



A new metric to understand the association between heart rate variability and menstrual regularity



Cardiovascular disease is underdiagnosed and undertreated in women compared to men. Wearable technologies (wearables) help shed light on women's cardiovascular by collecting continuous cardiovascular data and correlating it with hormonal fluctuations across the menstrual cycle. In this context, Jasinski et al. propose that the new metric, cardiovascular amplitude, enables non-invasive monitoring of female physiology and health across the menstrual cycle.

Background

Cardiovascular disease (CVD) is the leading cause of death for women¹. Compared to men, women receive lower quality care in relation to cardiovascular concerns and are consistently underrepresented in cardiovascular research^{2–4}. Accordingly, current understanding of the impacts of the menstrual cycle on female cardiovascular health remains limited⁵. For example, women experiencing irregular menstrual cycles have a higher risk of coronary heart disease, cancer, and osteoporosis, yet the causes of these associations are unclear^{6–8}. An important contributor to this knowledge gap is a limited understanding of the biological differences between women and men surrounding how CVD manifests itself in puberty, pregnancy and menopause⁹. Addressing heart health at every life stage can improve a woman's overall health and quality of life. Expanding women's CVD research by 2040 could lead to at least 1.6 million years of higher-quality life and boost the US economy by \$28 billion annually¹⁰. More importantly, researching and caring for cardiovascular health should be a priority across a woman's lifespan, not just at older ages when acute symptoms are most prevalent and most expected by women themselves.

Thus far, multidisciplinary approaches and remote monitoring are being implemented to improve women's cardiovascular care and outcomes¹¹. One such recent approach is demonstrated by Jasinski et al. in their study titled "A Novel method for quantifying fluctuations in wearable derived daily cardiovascular parameters across the menstrual cycle." Citing existing research, Jasinski et al. first establish that heart rate variability (a measure of the fluctuation of time between each heartbeat) varies across the menstrual cycle. Jasinski et al. aim to describe the significance of these variations using a novel metric, cardiovascular amplitude. Cardiovascular amplitude is a metric that quantifies that magnitude of heart rate variability and can be routinely measured by wearable technology (wearables)¹². Since heart rate variability is a standard feature in most wearables, abstracting the cardiac amplitude is feasible. The authors propose that cardiovascular amplitude may mirror hormonal fluctuations across the female menstrual cycle. They found that cardiovascular amplitude follows a predictable pattern across the menstrual cycle, and they hypothesize that significant fluctuations in cardiovascular amplitude in naturally cycling participants may be due to progesterone increases in the late luteal phase, which are attenuated in individuals who are older or on hormonal birth control. The paper's results are consistent with existing studies that have shown in anovulatory women with polycystic ovary syndrome, heart rate variability fluctuation is different from normovulatory women throughout the ovulation induction cycles¹³.

Innovation

Since wearables are currently used for autonomic tracking of fertility and pregnancy status, extending their utility to monitoring cardiovascular variability across the menstrual cycle offers an opportunity to monitor women's cardiovascular health across the reproductive lifespan and to rapidly identify menstrual irregularities¹⁴. The association between cardiovascular amplitude and hormonal fluctuations is useful insofar that it provides a non-invasive way to monitor women's

hormone levels. That can contribute to better cardiovascular health for women by making possible earlier detection of cardiovascular abnormalities. While the data derived from this new metric is promising, more studies are needed to further understand the association between the cardiovascular amplitude values derived in the study and direct measures of hormonal health. On the condition that increasing research validates the accuracy of this new metric and its reliability as a proxy for hormonal fluctuation, access to cardiovascular amplitude on wearables could help users monitor the regularity of their menstrual cycles and take more control of their health.

Challenges

A pressing challenge lies in securing data privacy while also encouraging data interoperability among different wearable brands. The bioethicist Stephanie Morian, in a 2020 study of the terms of service and privacy policies for 15 popular menstruation-tracking applications, found that information about data-sharing practices is often neither easily accessible nor understandable to users^{15,16}. To date, standardized, national regulatory oversight of privacy and data protection policies of menstruation-tracking applications lags behind technological advancements¹⁷. While the federal trade commission regulates these applications, the extent of its oversight is not well-defined¹⁷. Additionally, as evidenced by a Pew Research Center survey conducted June 3–17, 2019, since approx. 20% of Americans use wearables, higher standards for data privacy, sharing, and security are ethically and legally necessary¹⁶.

Conclusion

Jasinski et al. derive a new metric, cardiovascular amplitude, for wearables and suggest that one of its uses could be as a proxy for hormonal fluctuations across the menstrual cycle. That innovation offers clinicians and researchers a window to observe variations in cardiac output at different stages of the menstrual cycle and probe reasons underlying such variations. Equally for users, the novel metric may improve preventive care by way

of increasing personal health monitoring. Future studies that substantiate the reliability of this new metric, alongside improved standards for privacy and security of wearables, may bolster the impacts that those technologies can have on women's cardiovascular health.

Data availability

No datasets were generated or analysed during the current study.

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Competing interests

J.C.K. is the editor-in-chief of npj Digital Medicine. All other authors declare no competing interests.

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