TRACKING MENSRUAL CYCLES VIA BODY TEMPERATURE AND HEART RATE MEASUREMENTS USING NOVEL WEARABLE TEXTILE SENSORS.

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Background: Clinical visits for cycle monitoring including blood draws to monitor the reproductive cycle is uncomfortable and inconvenient. Wearable technology has been proposed as an accurate and non-invasive solution to this clinical challenge.

Objective: This study aimed to track menstrual cycle phases by measuring body temperature (BT) and heart rate (HR) using innovative textile-based wearable sensors. The objective was to demonstrate the capability of these wearables to continuously and non-invasively monitor physiological changes associated with the menstrual cycle, offering a seamless and user-friendly solution for patients seeking fertility treatment.

Materials and Methods: Data was collected from nine participants over a month-long trial. Participants tracked their days of menstruation and luteinizing hormone (LH) test results via personal spreadsheets. Skiin monitoring platform with textile-based sensors integrated into a garment was used for continuous measurement of ECG and activity along the trial. The system also provides an estimated body temperature without requiring direct contact with the skin. BT and HR were calculated from temperature and ECG data recorded between 1 AM and 5 AM, averaged over 5-minute windows. Trend plots of BT and HR were generated for the follicular, fertile, and luteal phases to visualize physiological changes across the cycle.

Result(s): Generated plots revealed distinct patterns in both BT and HR throughout the menstrual cycle phases. During the follicular phase of the menstrual cycle, BT remains in the lower range, generally between 36.1°C to 36.7°C, until approximately one day before ovulation (LH surge), when BT reaches its lowest point (nadir). After ovulation, BT rises by 0.28°C to 0.6°C and remains elevated, plateauing throughout the luteal phase. In the late luteal phase, BT returns to the lower range within 1–2 days before, or just at, the onset of menstrual bleeding. HR is higher during the fertile phase compared to the follicular phase, with HR peaking in the luteal phase. BT, HR, and LH results for one participant over a period of 22 days are shown in Figure 1. These results align with trends observed in the literature, further confirming the physiological changes that occur throughout the menstrual cycle.

Conclusion(s): This study demonstrates the potential of the Skiin platform for personalized menstrual health tracking. Unlike conventional wearables that provide intermittent data, Skiin

enables continuous, real-time monitoring of multiple physiological markers, such as ECG, activity, and BT, directly integrated into garments. This 24/7 monitoring capability offers a comprehensive and accurate picture of the wearer's health, helping detect subtle physiological changes across menstrual cycle phases. The innovation lies in embedding the monitoring technology into everyday clothing, revolutionizing the management of fertility and reproductive health. Notably, the ability to distinguish between the different phases of the menstrual cycle holds great potential for reliably detecting ovulation. This non-invasive method could serve as a valuable tool for individuals seeking to predict fertile windows, thereby supporting reproductive health and family planning efforts. This user-friendly solution offers a promising future for wearable health technologies.

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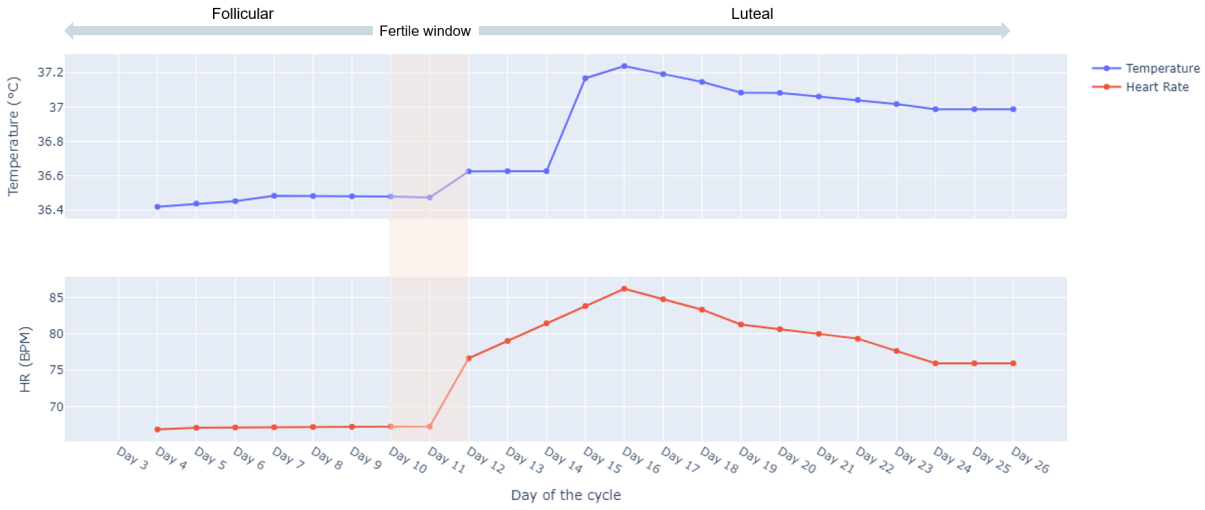

Figure 1: Body temperature (BT) and heart rate (HR) trends for one participant over a 22-day period. The LH surge occurred on day 11 of the cycle, marking the fertile window (highlighted on the plot), which includes the day of the surge, the day before, and the day after. BT and HR values were averaged over 5-minute intervals between 1 a.m. and 5 a.m. daily.