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Capturing the physiological characteristics of early pregnancy using wrist worn wearables

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Introduction

Using wrist worn wearable sensors, we assessed the differences in temperature, pulse rate, breathing rate and heart rate variability in early pregnancy compared to those of non-conceptive cycle late luteal phase.

Design

This clinical trial is an interventional longitudinal observational study conducted at the University Hospital Zurich. The study is planned to run from the fourth quarter 2016 to the second quarter of 2018, with 430 participants. The participants are requested to measure the specified parameters for a minimum of 6 months, and if they conceive, to term. We used linear mixed effects models with random intercepts and slopes to assess the differences between conceptive and non-conceptive.

Materials and methods

We included healthy, eumenorrheic women, 20-40 years old, who are trying to conceive. Participants wore the Ava bracelet which measures temperature, pulse rate, and heart-rate-variability among other parameters. An LH home-urine test was used to estimate the ovulation day. The late luteal phase was defined as ovulation+7 to the end of the cycle for the non-conceptive cycles, ovulation+10 to ovulation+18 for conceptive cycles. Associations were evaluated using linear-mixed-effects models with random intercepts for each participant.
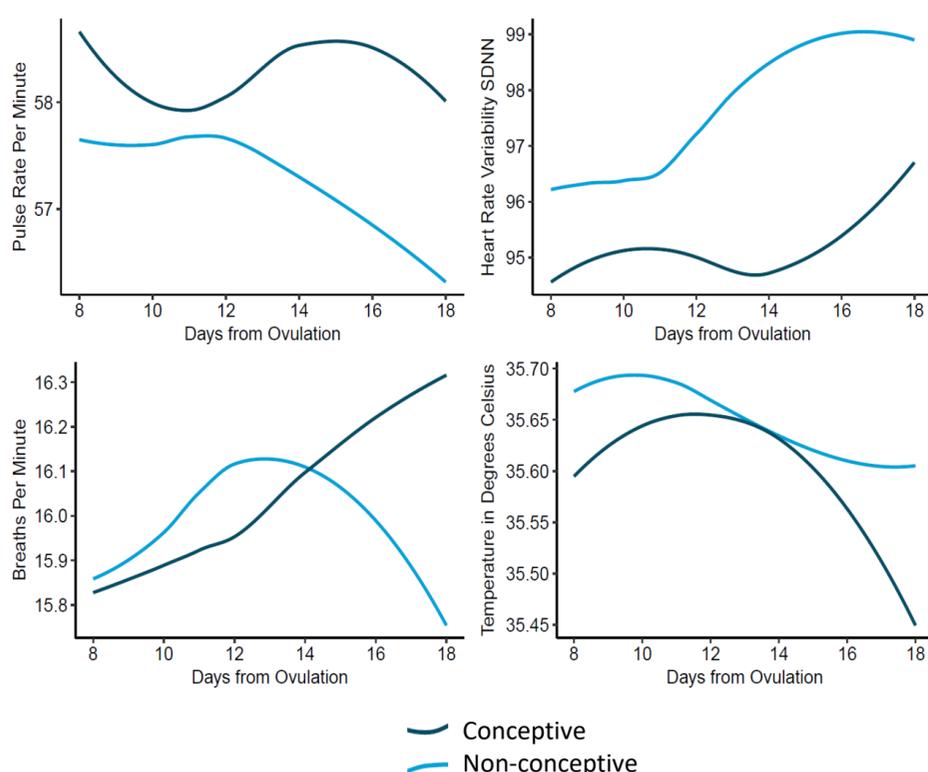
Results

We included 131 conceptive cycles and 853 non-conceptive cycles from 330 women in the analysis. In comparison to the late luteal phase of non-conceptive cycles, conceptive cycles were characterized by: an increase in pulse rate***, breathing rate***, wrist skin temperature*. In addition, non-conceptive cycles were more likely to have lower heart rate variability (HRV) SDNN***. Overall, the physiological parameters trends in conceptive cycles had steeper rises and falls, and more pronounced peaks and troughs, compared to non-conceptive cycles. This suggests that the underlying hormonal dynamics (which are responsible for the physiological changes) in conceptive cycles are similarly steeper in rising and falling, and have higher peaks and lower troughs. ($^+p<.10$, *p<.05, **p<.01, ***p<.001)

Covariate	Estimated Change	Standard Error
Pulse Rate	1.43 pulse/minute	0.18
Breathing Rate	0.31 breaths/minute	0.04
Temperature	0.05° Celsius	0.02
HRV SDNN	-3.14 standard units	0.65

Conclusions

Wrist worn wearables are capable of capturing known and novel early-pregnancy associated physiological changes. Wearables represent a useful and non-invasive research tool to monitor women's health, and given sufficient data could allow for the continuous monitoring of early-pregnancy. However, a bigger dataset will be needed to have a better general outcome.

— Conceptive
— Non-conceptive