

Sex Hormones and Cerebrovascular Endothelial Function

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INTRODUCTION

- Females have a reduction in cerebral blood flow velocity and peripheral endothelial function post-menopause when sex hormone concentrations decrease.³ It is unclear whether these reductions in endothelial function also occur in cerebral arteries.
- Transient hypercapnia is used to induce shear stress in cerebral vessels to activate vasodilatory processes and measure cerebrovascular reactivity (CVR). Vasodilation from transient hypercapnia is partially endothelial mediated.²
- Estrogen decreases vascular tone by binding to receptors on the endothelium and activating vasoactive mediators such as nitric oxide (NO) and prostanoids.⁴

Purpose: We aim to characterize cerebral endothelial function in males and females.

Hypothesis: We hypothesize that females will have more variation in their endothelial function between visits based on menstrual cycle phase, compared to males.

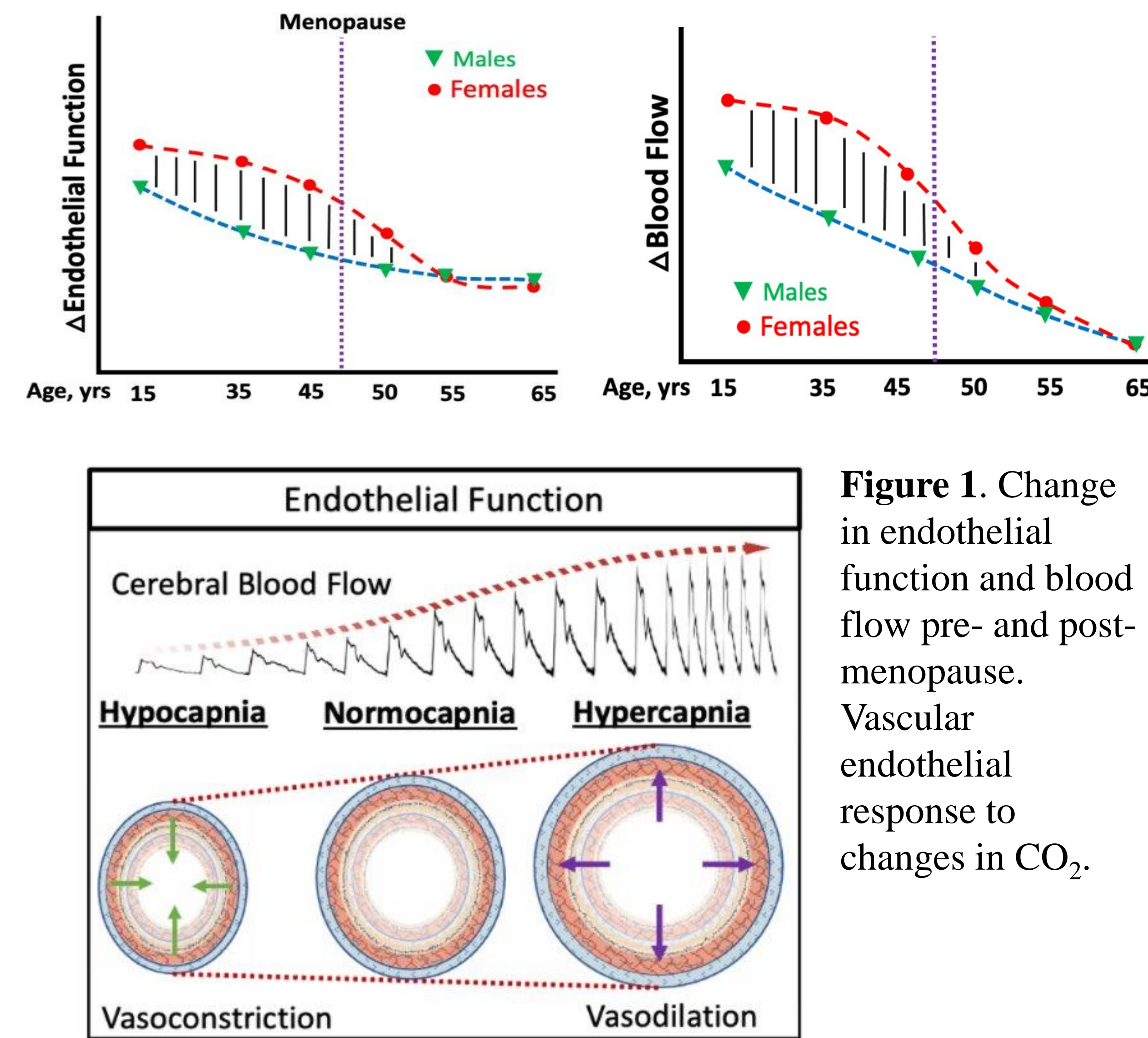
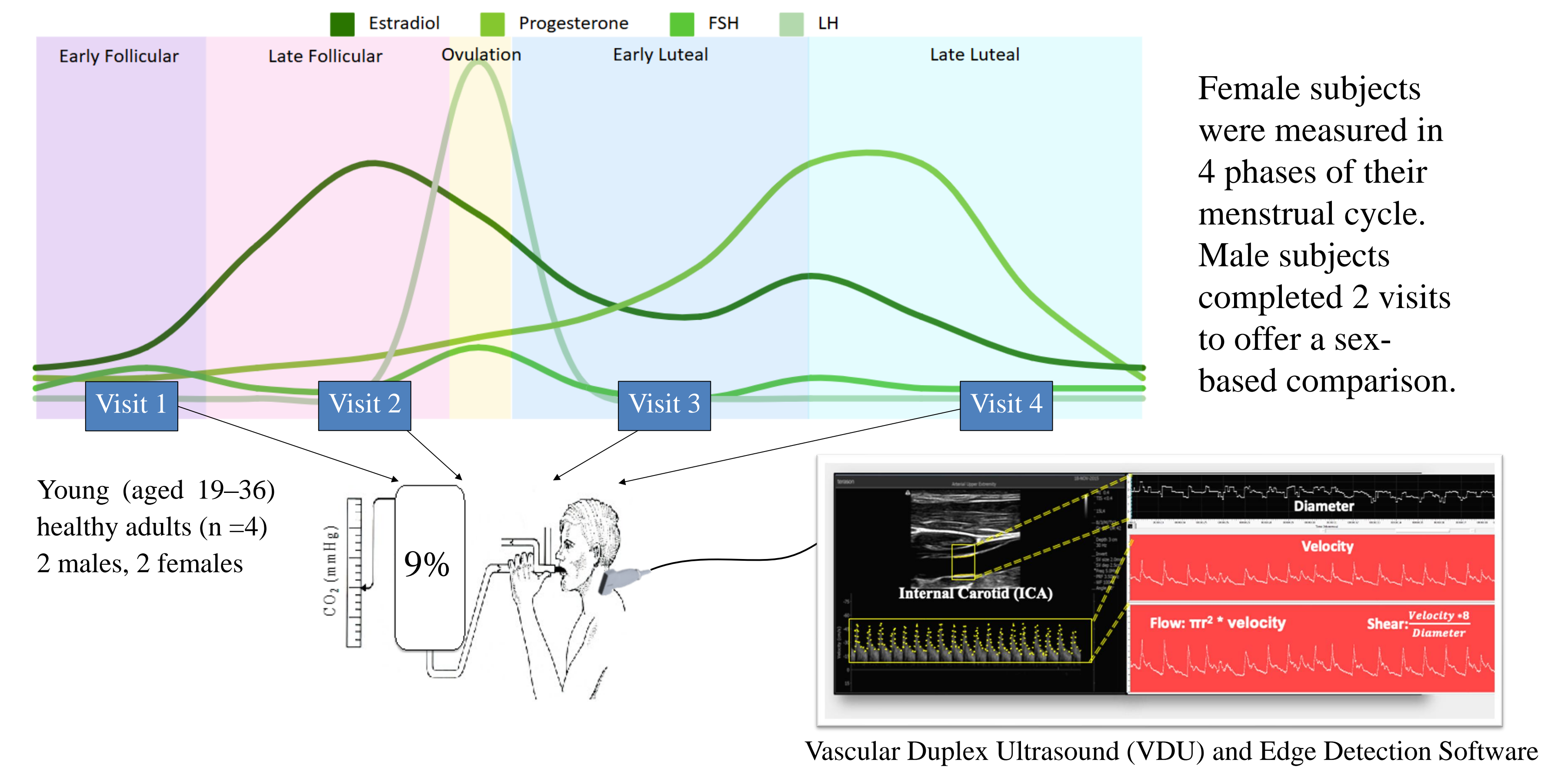


Figure 1. Change in endothelial function and blood flow pre- and post-menopause. Vascular endothelial response to changes in CO₂.

METHODS



Transient Hypercapnia Protocol:

1 minute BL → 2 deep breaths of 9% CO₂ → 30 seconds breathing 9% CO₂ → 3-minute recovery

Partial pressures of end-tidal CO₂ and O₂, ventilation, blood pressure, heart rate, and ICA velocity and diameter (via VDU) were collected during each visit. Blood flow and shear rate area under the curve were calculated using offline edge detection software.

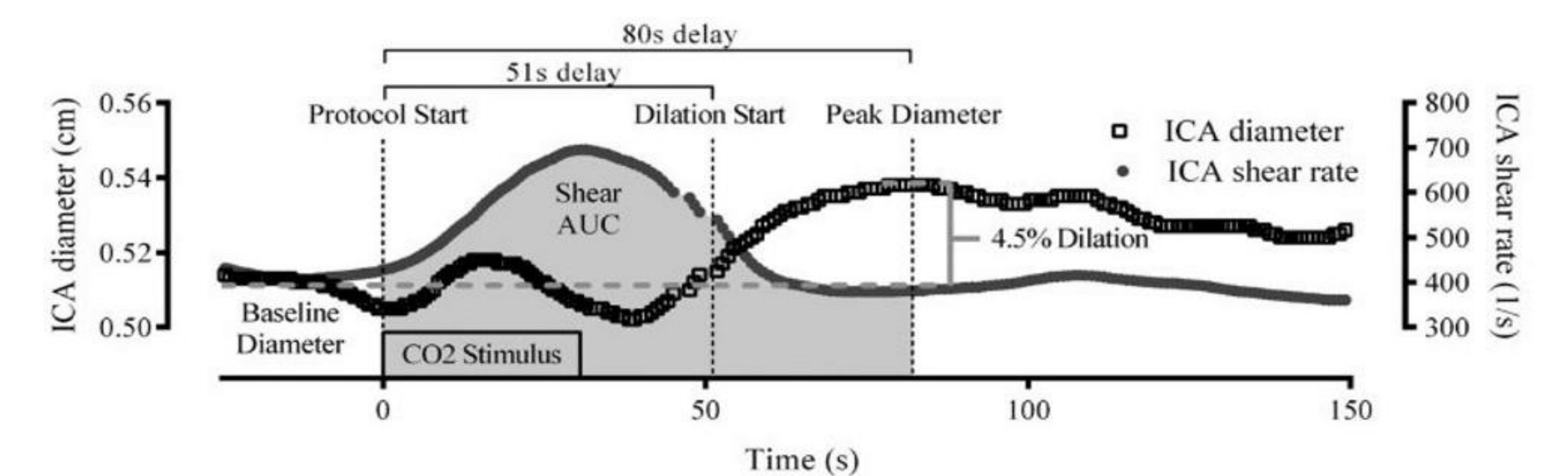


Figure 2. Vascular dynamics from a transient CO₂ test mirror the response seen in peripheral FMD, therefore can be used to measure CVR. Peak diameter occurs ~60s after peak shear and ~80s after the hypercapnic stimulus.¹

PRELIMINARY RESULTS

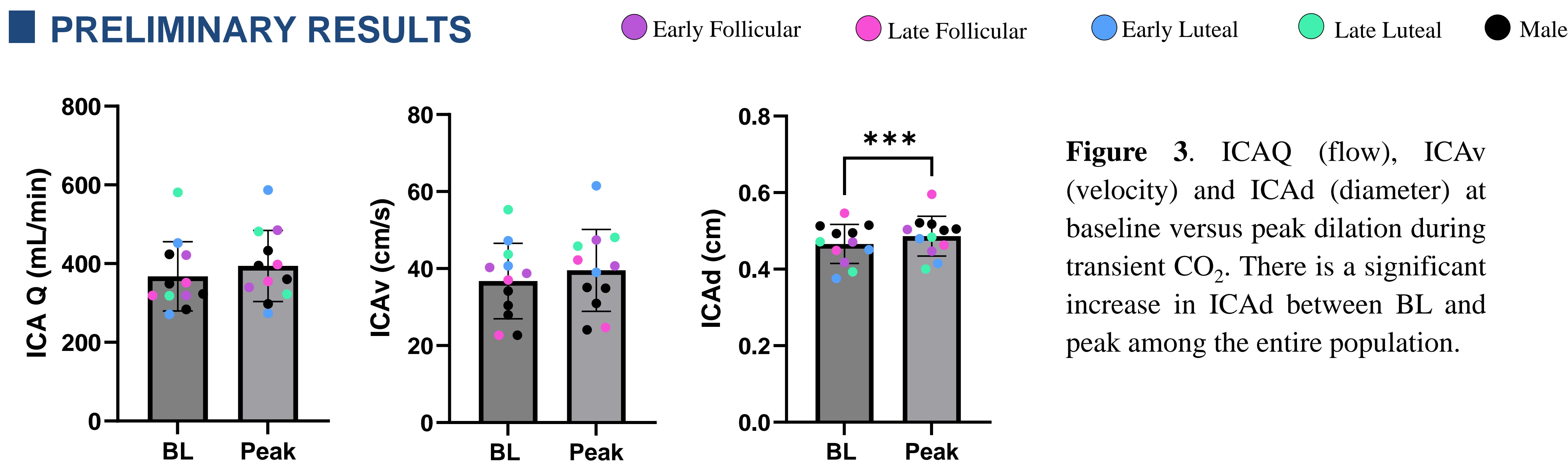


Figure 3. ICAQ (flow), ICAv (velocity) and ICAd (diameter) at baseline versus peak dilation during transient CO₂. There is a significant increase in ICAd between BL and peak among the entire population.

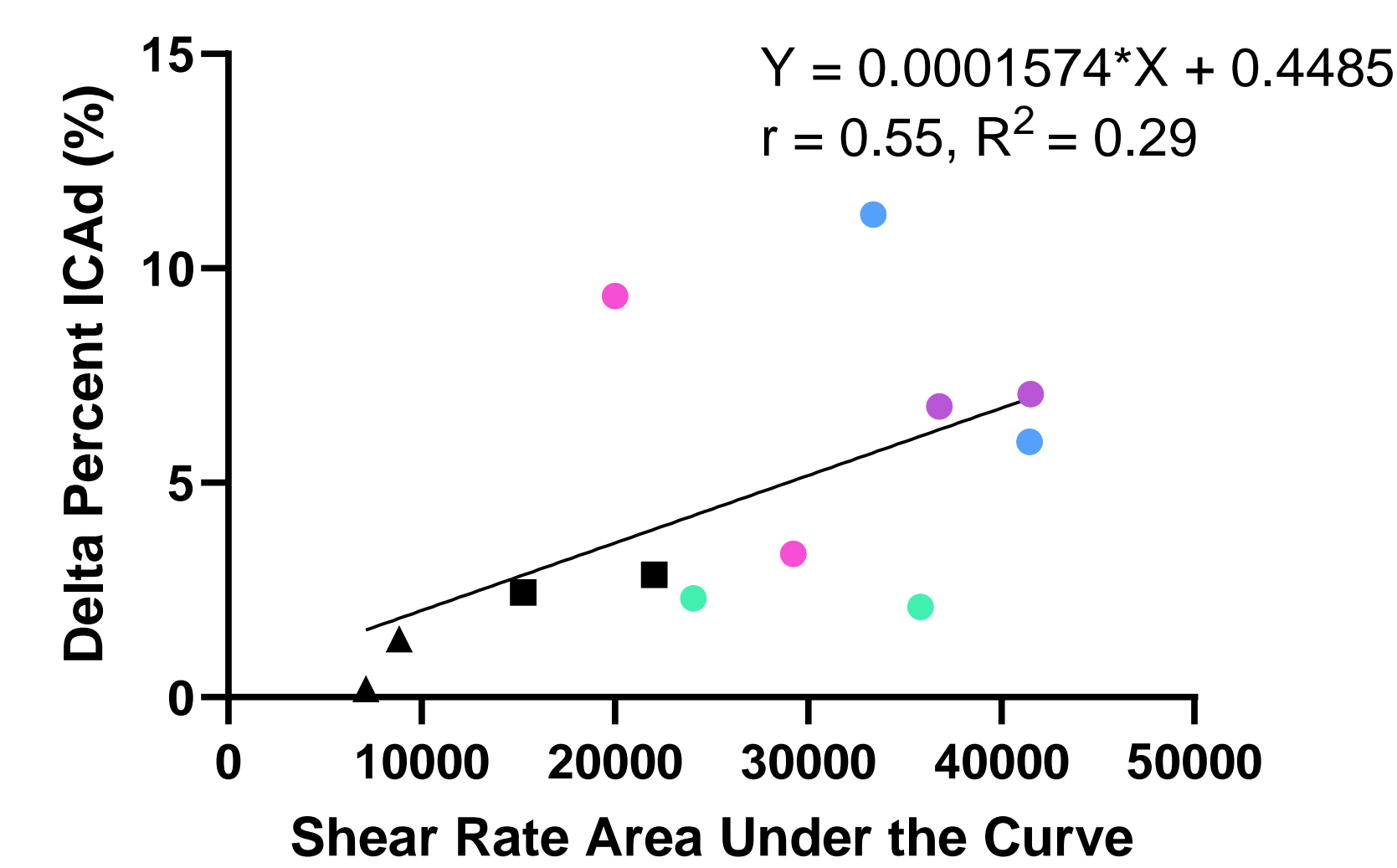


Figure 4. Moderate positive correlation between shear rate area under the curve and % change ICAd. Male data points are in black, female data points are coloured according to their cycle phase. Note that female data appears much more variable.

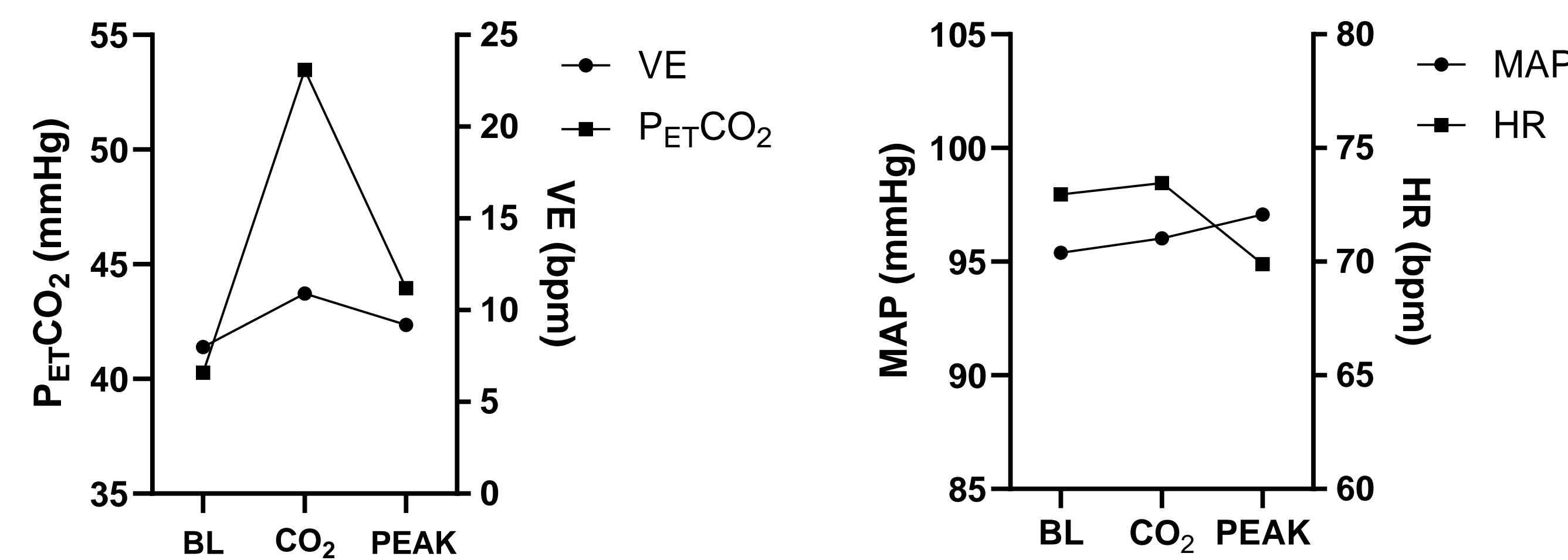


Figure 5. Partial pressure of end tidal CO₂ (P_{ET}CO₂), ventilation (VE), mean arterial pressure (MAP) and heart rate (HR) at baseline, during CO₂ and at peak dilation during transient CO₂.

CONCLUSIONS

- Preliminary analysis (n=2 males & 2 females), indicate that females have more variation between visits in endothelial function than males.
- Additionally, changes in internal carotid artery diameter (ICAd) during transient hypercapnia is associated with shear rate area under the curve (SRAUC) when sex is not used as a covariate.
- Future analysis of sex hormones and a larger sample will enable menstrual phase comparisons in assessment of cerebral endothelial function in males and females.

FUTURE DIRECTIONS

This research is only part of a much larger ongoing PhD study. As data collection continues, we will analyze the data and see whether the trends continue. We will also be analyzing previously collected blood hormone levels so we can better attribute blood flow changes to hormone levels rather than just self-reported menstrual cycle status.