

Sleep and Menstrual Cycle Effects on Hemodynamic Reactivity in Women

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Paper presented at the Western Psychological Association Meeting, April, 2011



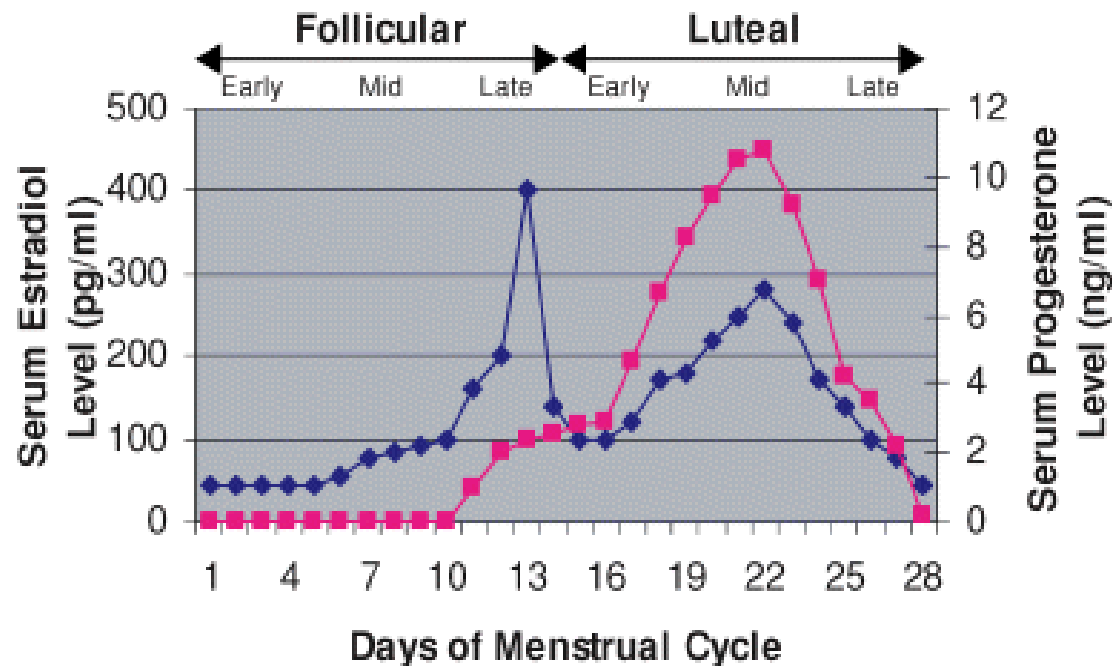
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Female Reproductive Endocrinology 101



Headache. 2006;46(3):365-386. © 2006 Blackwell Publishing

Background: Cycle Phase Dependent Variations in Stress Responses



Compared to the follicular phase, stress responses during the luteal phase show greater:

■ HPA-Axis Reactivity

- salivary cortisol reactivity (Kajante & Phillips, 2007; Kirschbaum, Kudielka, Gaab, Schommer, & Hellhammer, 1999; Lustyk, Olson, Gerrish, Holder, & Widman, 2010; Tersman, Collins, & Eneroth, 1991)

■ Psychophysiological Reactivity

- hemodynamic reactivity (Lustyk et al., 2010; Sato, Miyake, Akatsu & Kumashiro, 1995; Tersman, Collins, & Eneroth, 1991)

Background: Cycle Differences – Premenstrual Symptoms



■ PMS?

- 90% of Women report premenstrual symptoms (Campagne & Campagne, 2007; Dell, 2004)
- Somatic and Affective
- Molimina, PMS, or PMDD
- Impair Quality of Life / Disease Burden (Lustyk & Gerrish, 2010)





Background: Studies of Cycle Phase Dependent Responses

- The story is mixed
- Woods et al. (1994)
 - PMS vs non-PMS response to stressor across cycle
 - PMS: Increased electromyogram & skin conductance responses, luteal
 - Skin temperature levels similar across cycle phase and groups
 - A cycle phase of testing effect on frontalis muscle tension across groups
- Epperson et al. (2007)
 - PMDD: Acoustic startle response to stressor, luteal



Menstrual Cycle and Sleep

- Diagnostic & Statistical Manual of Mental Disorders
 - PMDD: hypersomnia or insomnia
- American College of Obstetricians & Gynecologists
 - PMS & sleep?
- Shechter & Boivin (2010)
 - Menstrual phase sleep disturbances
 - Chronotherapeutic methods aimed at realigning circadian rhythms



Purposes

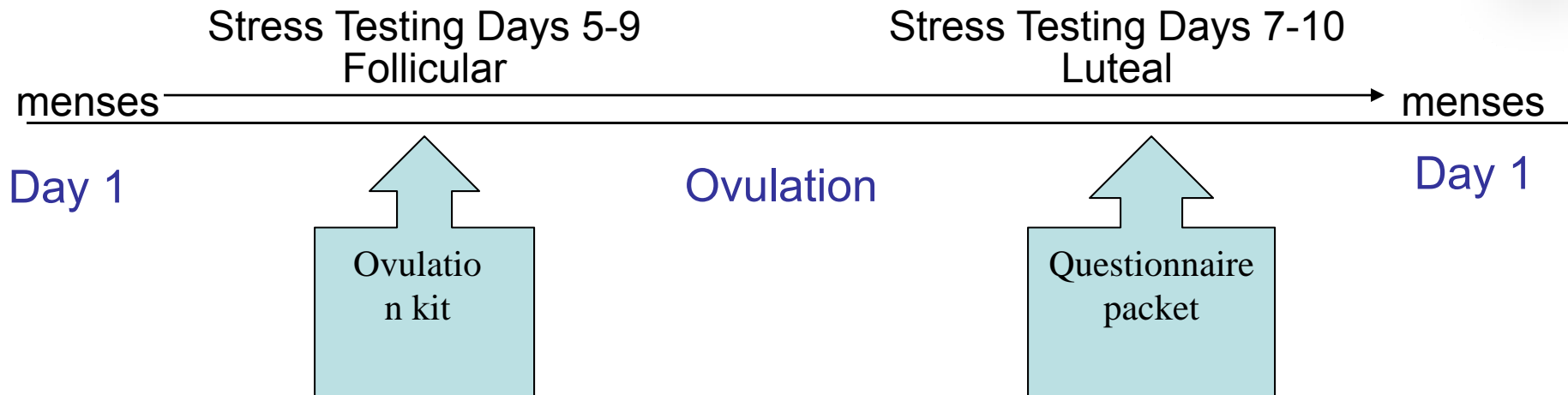
- (1) To assess the interrelationships between premenstrual symptomatology and sleep characteristics.*
- (2) To determine if premenstrual symptomatology and/or sleep characteristics explain increased luteal phase psychophysiological and neuroendocrine reactivity to a laboratory stressor.*
- (3) To determine if premenstrual symptomatology and/or sleep characteristics differentially predict cycle phase dependent psychophysiological and neuroendocrine reactivity to laboratory stressors.*



Procedure

- Recruitment:
 - Local advertisements: “...study investigating stress and women’s health issues”
- Telephone screening:
 - Inclusion:
 - Freely cycling women
 - 21-40 day cycles
 - Exclusion:
 - *Rx* known to impact the stress response
 - health conditions known to impact the cycle (e.g., PCO) or stress testing (e.g., hypertension)
- Eligible participants were asked to call the laboratory on the first day of their next menstrual cycle in order to begin participation.

Timeline



Questionnaire Packet:

- *Shortened Premenstrual Assessment Form (SPAF; Allen, McBride & Pirie, 1991)*: 10 item self reported premenstrual symptomatology (e.g., pain, water retention, affect) as indicated in a change from normal
- *Pittsburg Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman & Kupfer, 1988)*: 19 item self reported sleep characteristics indicated by the components: quality, disturbance, medication use, and daytime dysfunction and the continuous measures of sleep latency, duration, and habitual sleep efficiency

Stress Testing Measures



Hemodynamic

- Blood pressure (BP):
 - An auto-inflatable sphygmomanometer, (Dinamap 1846: Critikon, Inc., Tampa, FL) took BP at timed intervals.
- Heart rate (HR):
 - Monitored continuously with electrocardiography (ECG) via a PowerLab data acquisition system (Powerlab/800; AD Instruments).

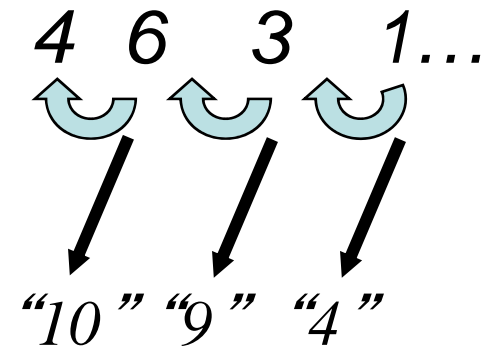
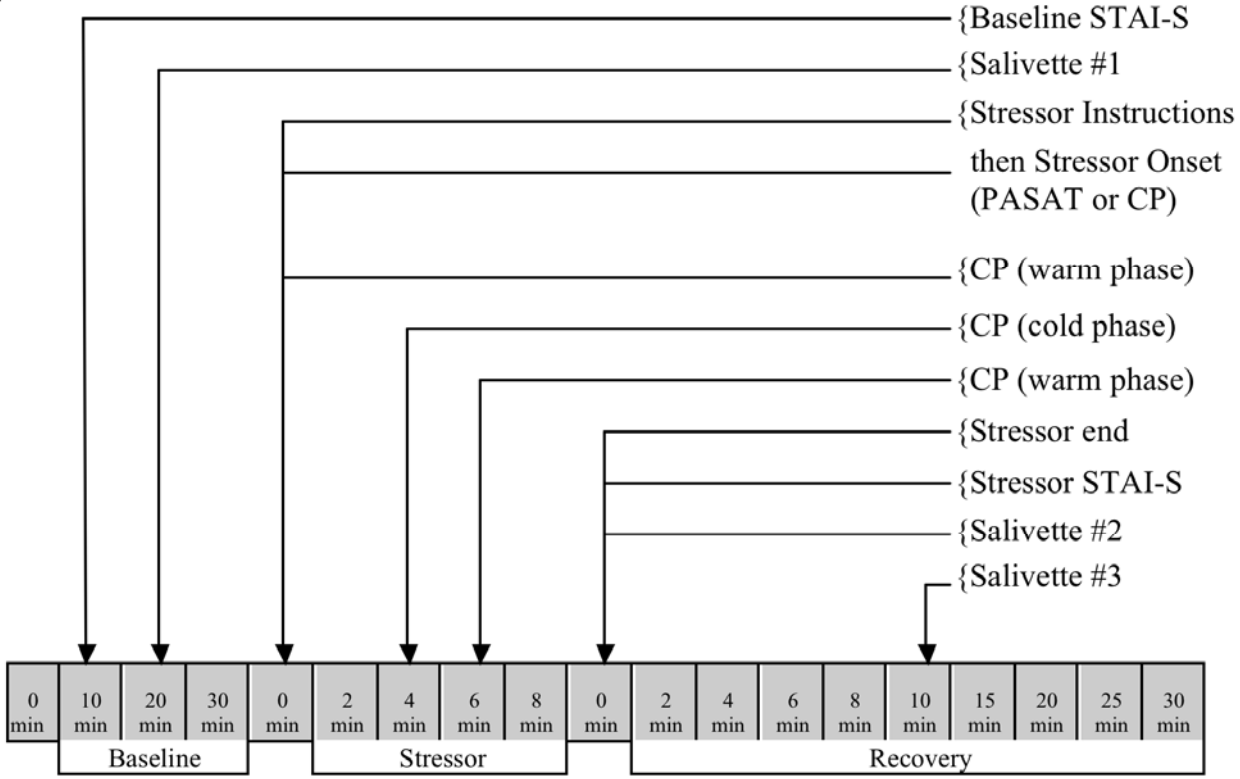
Neuroendocrine

- Salivary cortisol:
 - Collected at timed intervals and assayed at Salimetrics (Salimetrics, LLC, State College, PA).

Self Report

- State Anxiety:
 - State Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) measured subjective feelings of anxiety with higher scores reflecting more anxiety.

Stress Testing Protocol





Sample Characteristics ($N = 78$)

Ethnicity:

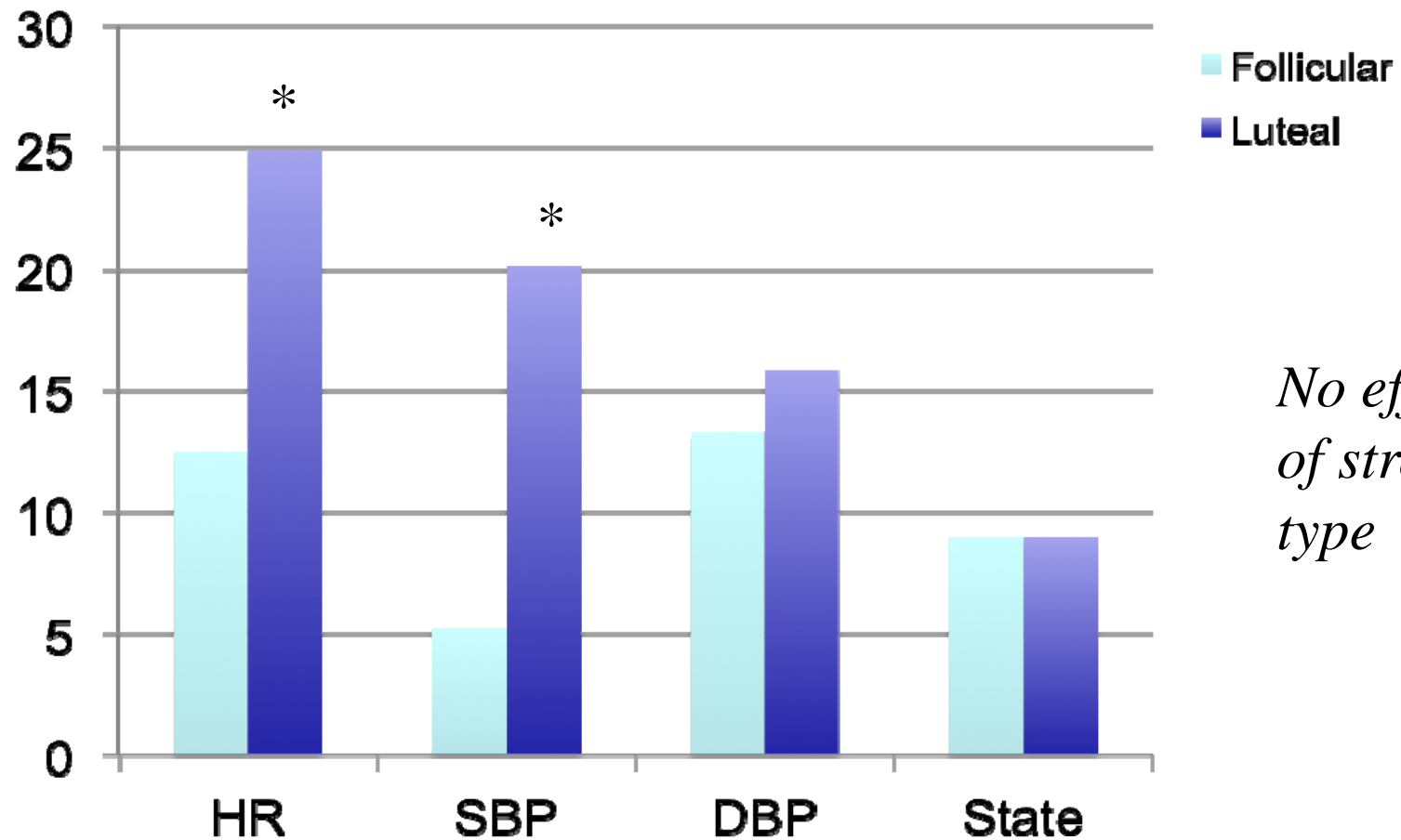
White/Caucasian (65%)
Asian/Asian American (15%)
Black/African American (8%)
Native American/Alaskan (5%)
Latino/Hispanic (4%)
Other (1%)

Ages:

18-21 (50%)
22-25 (19%)
26-29 (13%)
30-33 (8%)
38-45 (10%)

No diagnoses of PMS, PMDD, or sleep disorders
Average BMI (22) within normal range

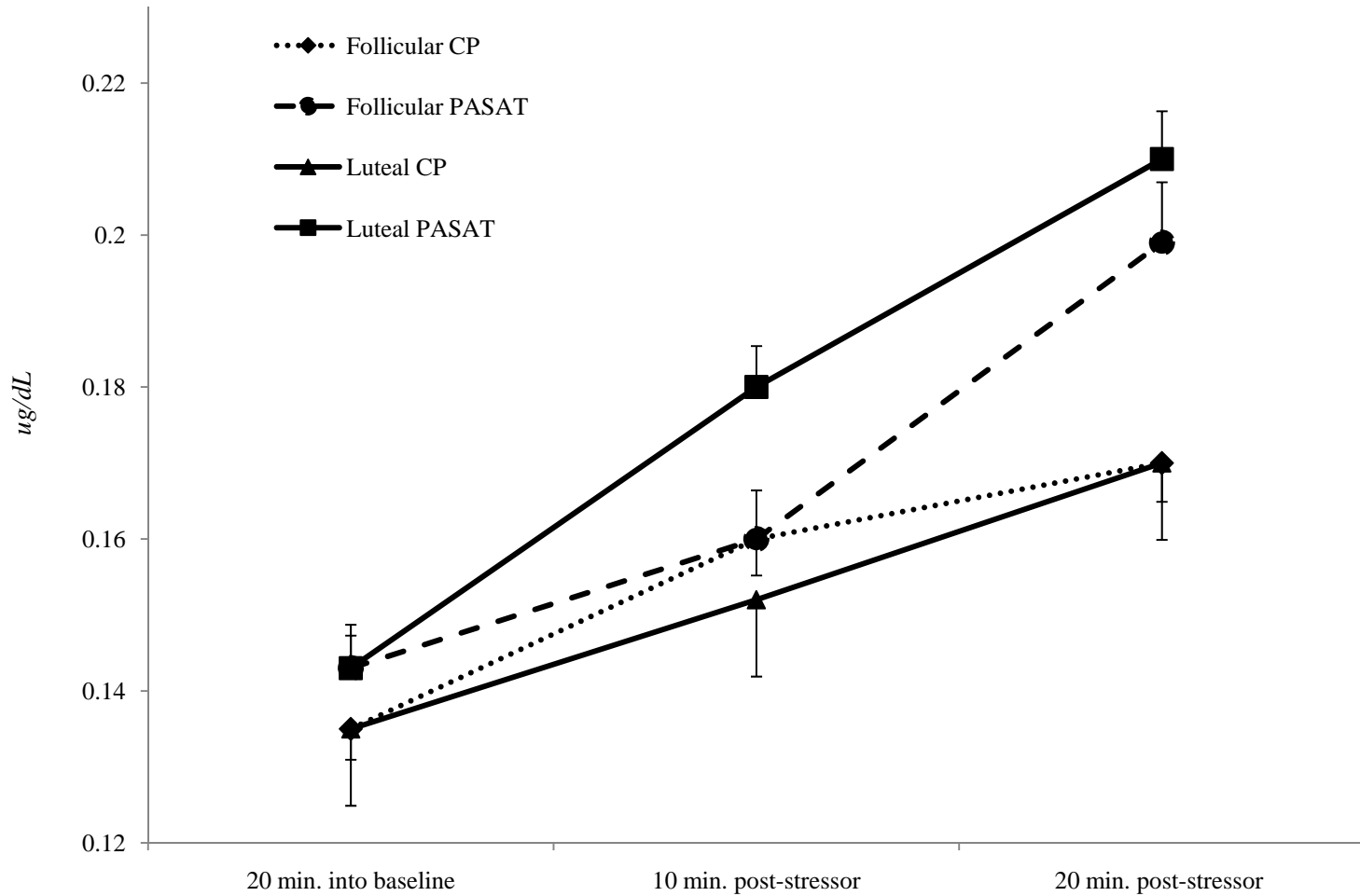
Results: Cycle phase effects on Psychophysiological Reactivity



*No effect
of stressor
type*



Results: Neuroendocrine Reactivity



Results: Premenstrual symptoms and sleep characteristics

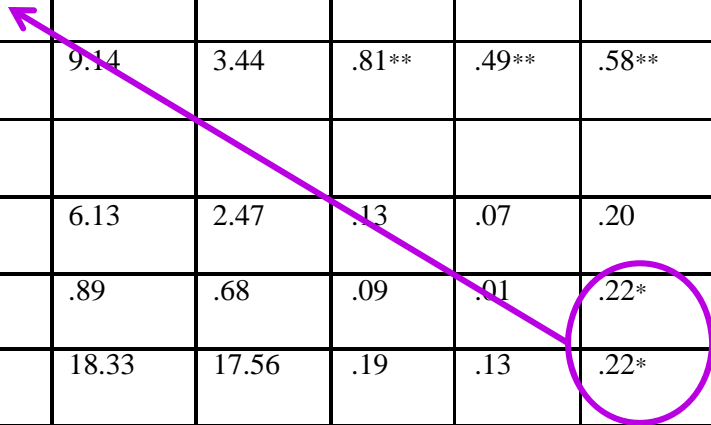


Variable	Mean (SD)	Reported Range	Possible Range
PMSR Summary Score	30.18 (9.4)	12 - 51	10-60
Affect	12.80 (4.5)	4 - 24	4-24
Water Retention	8.24 (3.4)	3 - 16	3-18
Pain	9.14 (3.4)	3 - 17	3-18
Global PSQI Score	6.13 (2.5)	2 - 13	0-21
Sleep Hours	7.08 (1.0)	4 - 10	--
Sleep Latency (min)	18.33 (17.6)	1 - 120	--
Sleep Efficiency	91.20 (9.9)	59 - 118	--
Component Scores			
Quality	.89 (.68)	0 - 3	0-3
Disturbance	2.14 (.47)	1 - 3	0-3
Medication	.20 (.55)	0 - 3	0-3
Daytime Dysfunction	1.17 (.58)	0 - 2	0-3

Results: Purpose 1: Relationships among symptoms and Sleep Characteristics



Measure	M	SD	1	2	3	4	5	6	7	8	9	10	11
SPAF													
1. PMSR	30.18	9.36											
2. Affect	12.80	4.46	.84**										
3. WR	8.24	3.40	.83**	.52**									
4. Pain	9.14	3.44	.81**	.49**	.58**								
PSQI													
5. GSS	6.13	2.47	.13	.07	.20	.06							
6. Quality	.89	.68	.09	.01	.22*	.00	.62**						
7. Latency	18.33	17.56	.19	.13	.22*	.12	.69**	.41**					
8. HSA	7.08	1.02	.08	.04	.12	.05	.55**	.16	.12				
9. HSE	91.20	9.89	.14	.12	.20	.03	.61**	.15	.43**	.42**			
10. SD	2.14	.47	-.14	-.16	-.13	-.05	.47**	.39**	.28**	-.06	-.02		
11. Meds	.20	.55	.03	-.02	.08	.02	.31**	.06	.01	-.03	.04	.26*	
12. DD	1.17	.58	.00	.06	-.07	-.01	.50**	.14	.13	.37**	.13	.18	.04



Results: Purpose 2

Between Cycle: Reactivity Delta Scores



$\Delta = \text{Luteal Reactivity} - \text{Follicular Reactivity}$

- Neither premenstrual symptoms or sleep characteristics significantly predicted delta scores.

Results: Purpose 3 -- Within Cycle



Predicting Psychophysiological and Neuroendocrine Reactivity

	HR		SBP		DBP		Cort		State					
	Follicular		Luteal		Follicular		Luteal		Follicular		Luteal			
	β	R^2	β	R^2	β	R^2	β	R^2	β	R^2	β	R^2		
SPAF														
Affect	.01		-.37		-.01		-.14		.15		-.14		.26*	
WR	.18		-.03		-.13		-.31*		.01		.04		-.21	
Pain	.10		.19		.08		.21		.03		.04		.11	
Model 1		.07		.03		.01		.10*		.03		.01	.03	.06
PSQI														
Quality	.03		.09		.27		-.10		.19		.33*		.12	
Latency	-.04		-.06		-.14		.12		.03		.08		-.09	
HSA	-.07		-.16		-.17		-.21		.03		-.02		-.28*	
HSE	-.09		-.41**		.04		.09		.08		.01		.08	
SD	.08		.15		.01		.07		-.25		-.19		-.07	
SM	-.001		-.20*		.01		.07		.16		-.09		-.01	
DD	-.01		-.04		.02		-.14		.004		-.02		-.06	
Model 2		.03		.31**		.10		.05		.12		.06	.06	.08
Total		.09		.33**		.11		.15		.15		.08	.08	.14



Discussion

- Very few significant relationships between premenstrual symptoms and sleep characteristics existed.
- Neither premenstrual symptoms nor sleep characteristics explained the increased hemodynamic or neuroendocrine responses observed during the luteal phase of the cycle.
- Within cycle analyses revealed significant relationships among symptoms and sleep variables during the luteal phase only.
 - Significant predictive models with heart rate and SBP reactivity during the luteal phase only



Limitations

- Self-reported symptoms and sleep characteristics
- Very few “short-sleepers”: < 5 hours (Okamura et al., 2010)
 - 2 women got less than 5 hours/night
 - 6 women got less than or equal to 5 hours/night
 - The median/mode was 7 hours/night
- Effects may lie with sleep architecture and not sleep characteristics



Conclusion

- Laboratory stress responses in women are related to premenstrual symptoms and sleep characteristics when testing occurs during the luteal phase but not the follicular phase.
 - For those wishing to look at cycle phase effects in stress responses, controlling for symptoms and sleep is warranted.
 - For those wanting to control for cycle phase, testing during the follicular phase produces responses unaffected by cyclical symptoms and sleep characteristics.