



Resting Heart Rate, Sleep, and Stress: The Physiological Stress Response of NCAA Division III Female Student-Athletes



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Do perceived stress levels of NCAA Division III female student-athletes align with changes in daily resting heart rate (RHR) as a response to acute stressors associated with academic, athletic, and social engagement?

Does average heart rate (HR) rise during an acute stressful event such as an exam?

Does increased perceived stress initiate changes in sleep patterns such as sleep duration, time spent in bed, perceived sleep quality, and deviation from normal bedtime?

Background

Student-athletes experience stress associated with their athletic participation in addition to their academic obligations.^{1, 2, 3, 4} Although stress typically has a psychological origin, past research has used heart rate as a proxy for stress^{5, 6} and stress also influences the circadian rhythm and interrupts sleep patterns.^{5, 7, 8} These physiological changes are often the result of acute stressors, and chronic stress may cause sustained changes in biological processes that cannot be easily measured or detected.^{9, 10}

Methods

n = 8, varsity women's basketball student-athletes

Subjects completed surveys regarding their perceived stress levels associated with their academic, athletic, and social engagement.



Continuous heart rate measurements were collected via Fitbit Inspire 2 from 10am-5pm M-F of five pre-determined collection periods throughout the semester.

Sleep patterns were determined by surveys completed by subjects.

Stepwise elimination of linear mixed effects models determined which variable offered the most parsimonious model for each factor of the stress response.

Results

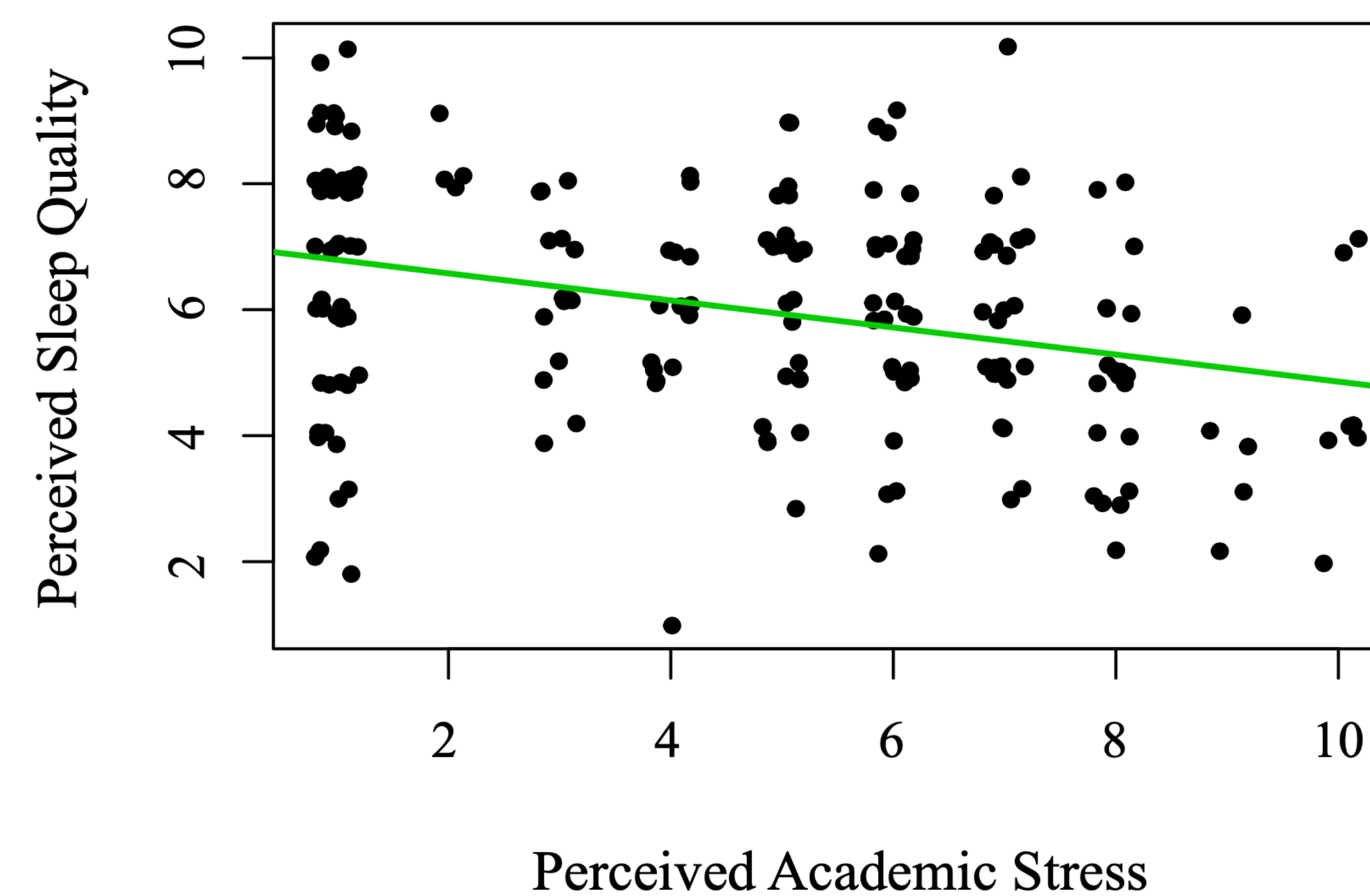


Figure 1: Perceived sleep quality of NCAA Division III women's basketball student-athletes on a scale from 1-10 presented as a function of perceived academic stress on a scale from 1-10 (est. = -0.17, $p=9.89E-5$).

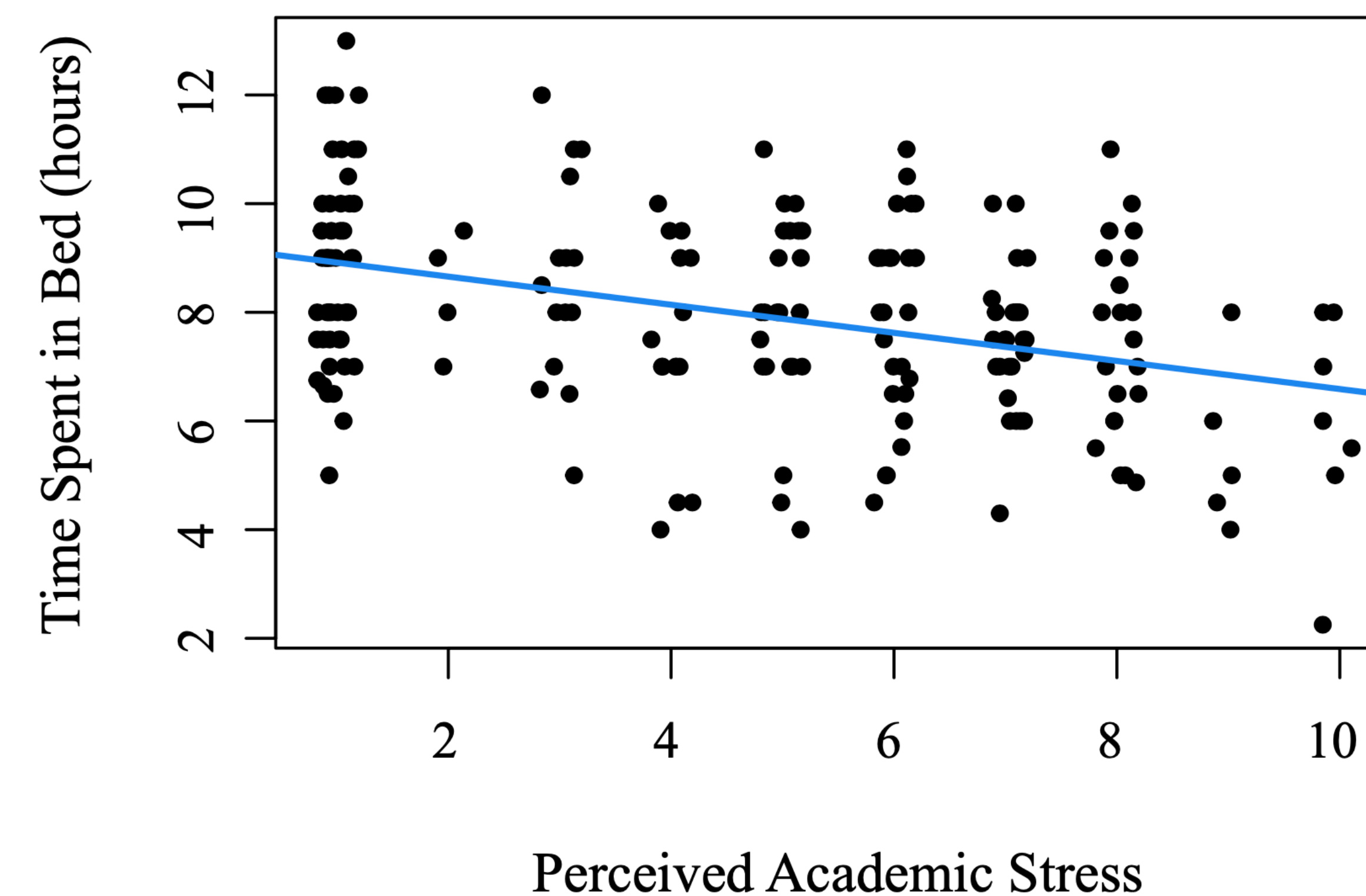


Figure 2: Estimated time spent in bed (hours) of NCAA Division III women's basketball student-athletes presented as a function of perceived academic stress on a scale from 1-10 (est. = -0.13, $p = 4.45E-5$).

Discussion

	Stressor	Expected Change	Observed Change	Estimate	p-value
Week 1 <i>No Stressors</i>	academic	baseline	baseline	-	-
	athletic	baseline	baseline	-	-
	social	baseline	baseline	-	-
Week 2 <i>First Official Basketball Game</i>	academic	no change	no change	0.75	0.083
	athletic	increase	increase	1.17	0.0003
	social	no change	increase	1.04	0.001
Week 3 <i>Following Thanksgiving Break</i>	academic	no change	increase	0.91	0.036
	athletic	increase	increase	1.24	0.00012
	social	increase	no change	-0.17	0.58
Week 4 <i>Final Exam Week</i>	academic	increase	no change	0.73	0.097
	athletic	no change	no change	-0.43	0.18
	social	no change	decrease	-0.85	0.0077
Week 5 <i>Winter Break</i>	academic	decrease	decrease	-3.97	2.00E-16
	athletic	increase	increase	0.83	0.01
	social	decrease	decrease	-0.83	0.0095

Table 1: Expected perceived stress levels for each week compared to the observed changes. Bolded p-values indicate a significant change from Week 1.

No stressor had a significant influence on RHR, and HR did not significantly shift during a stressful event. Instead, whether subjects napped offered the best predictor of resting heart rate (RHR), with results displaying a decrease in RHR of 3.59 bpm ($p=2.88E-5$).

Subjects reported a lower perceived quality of sleep (Figure 1, $p=9.89E-5$) and spent less time in bed (Figure 2, $p=4.45E-5$) when experiencing increased levels of academic stress, though athletic and social stress did not display a significant relationship with sleep.

Results of the present study may indicate that student-athletes experience chronic stress rather than acute stress, but further research is required regarding heart rate variability (HRV) and sleep stages.

Acknowledgements

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