

# Chronotype as a predictor of salivary cortisol levels in college students

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## Problem

Salivary cortisol is frequently used as a physiological marker of stress. However, large within- and inter-individual differences in cortisol exist, which reduce statistical power. In order to reduce the likelihood of Type II error, it is important for researchers to be cognizant of factors that can affect variability in cortisol. Diurnal variation in cortisol has been well-documented; cortisol levels peak upon awakening and decline during the day. Between-group comparisons based on a single cortisol measure must therefore control for this factor through methodology or statistical control. Power can be further increased if researchers determine which between-subject factors influence cortisol levels. The current study examines whether a person's chronotype (morning-eveningness; preference for activity in the morning or evening hours) is related to a single cortisol sample taken during the middle of the day.

## Method

A total of 120 undergraduate students (mean age 22.7 (5.7), 53% female, 93% Hispanic) attended group administration sessions. After a five-minute rest period, each participant provided a three-minute timed saliva sample and then completed a packet of measures that included demographic questions, measures of sleep quality (Pittsburgh Sleep Quality Index [PSQI]), and a chronotype measure (Lark-Owl Self-Test). Cortisol secretion rates (cortisol concentration X saliva secretion rate) were log-transformed to normalize the distribution of scores.

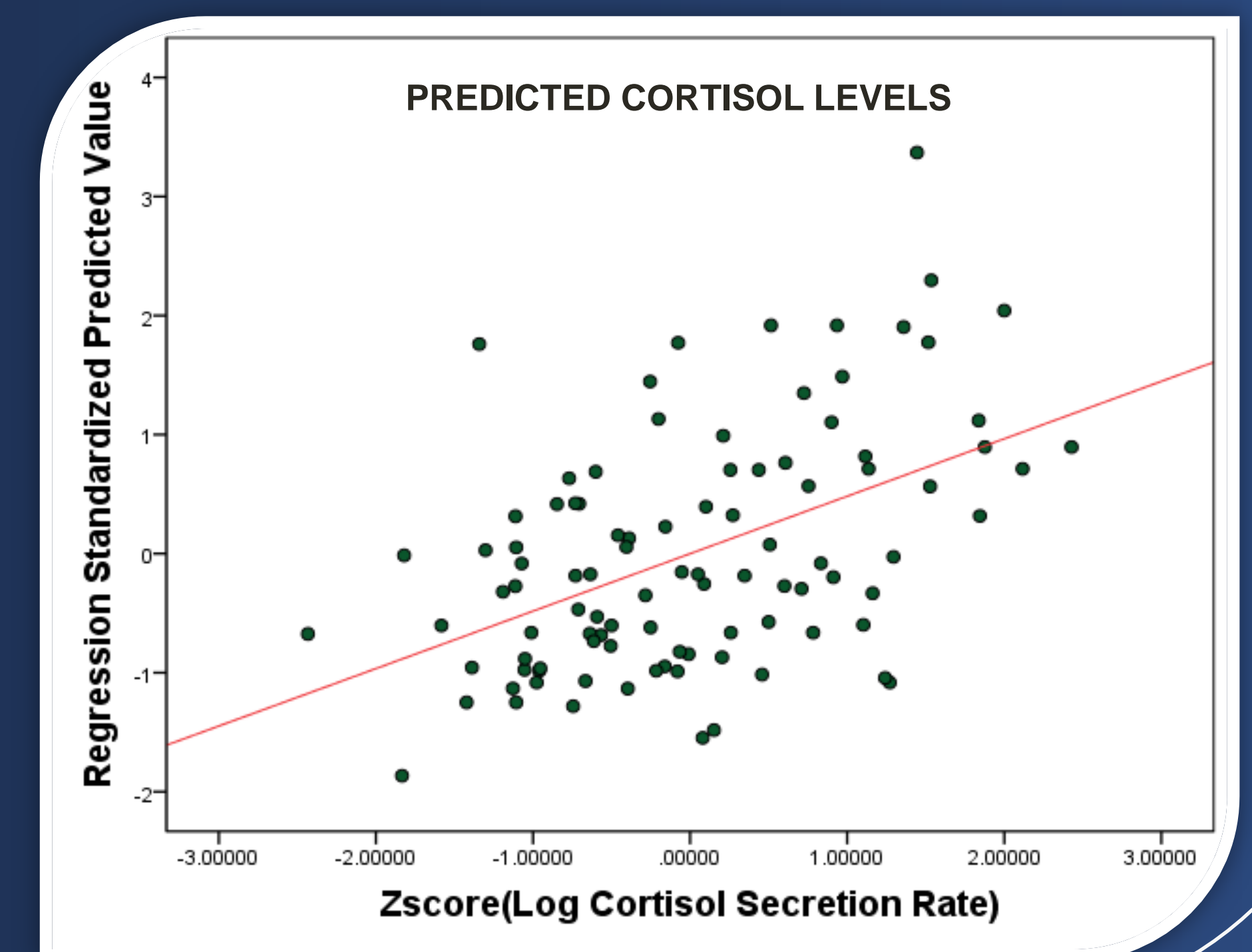
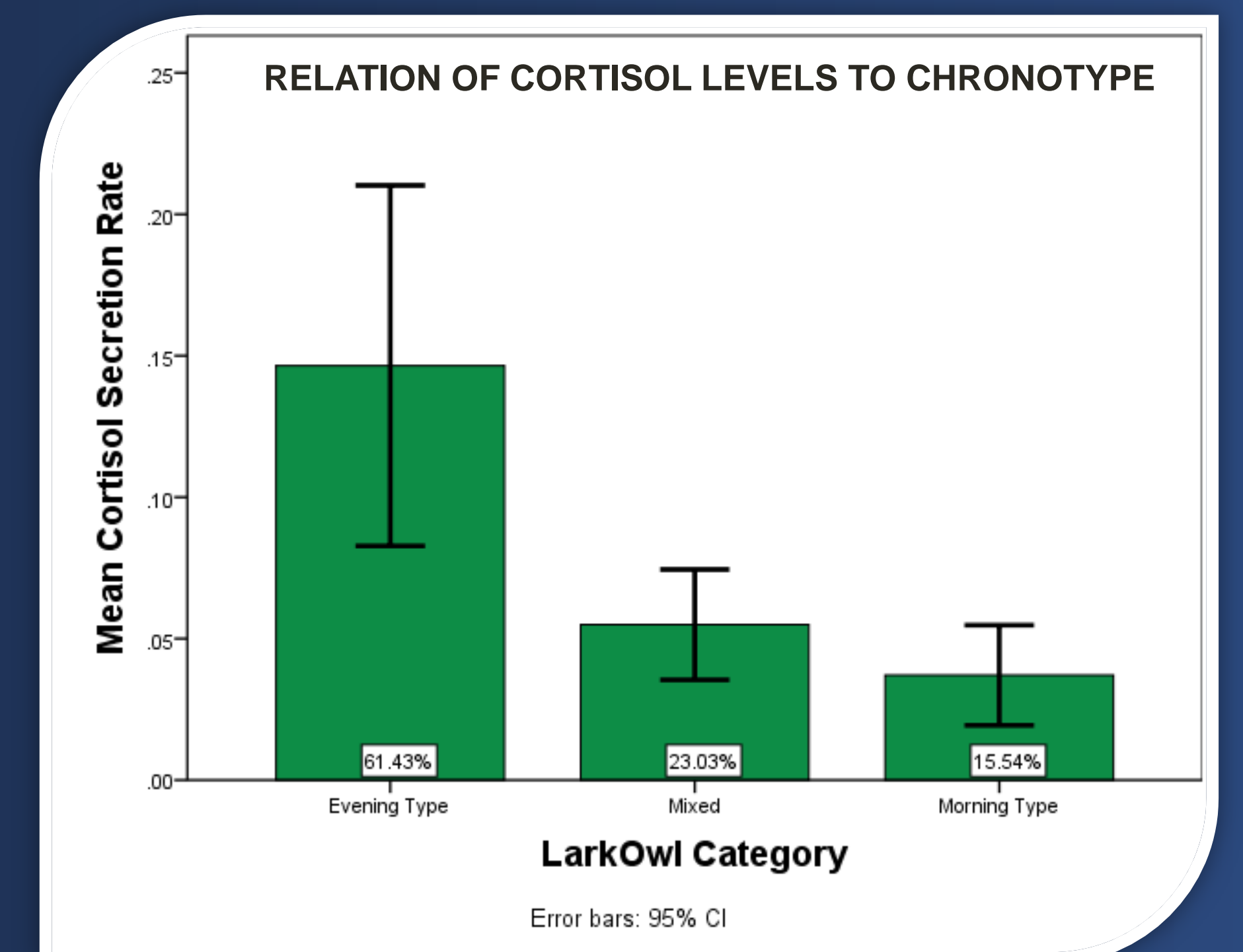
## Results

A hierarchical regression analyses was performed to examine the relationship between chronotype score and cortisol. To control for sex differences in cortisol, participants' sex was entered at the first step in the model and chronotype score was entered at the second step. Because of diurnal variation in cortisol, we also entered a second variable in the second step: the time subjects reported normally getting up in the morning. Chronotype accounted for a statistically significant proportion (13%) of the variance in cortisol levels ( $F[2,94] = 7.35, p = .002$ ); morning types tend to have lower cortisol. Wake time was not a significant predictor.

To examine whether an interaction between chronotype and wake-time might add some predictive power, a third step was added that entered a new computed variable (chronotype score X wake-time). Predictor and product variables were standardized into z-scores prior to entering them into the interaction model. The interaction was significant, suggesting that the relationship between chronotype and cortisol is moderated by the time an individual wakes up. The final model accounted for 24% of the variability in cortisol.

	R	R <sup>2</sup>	ΔR <sup>2</sup>	F	df	β weight
<b>Step 1 (Sex)</b>	.27	.07	.07*	7.4	1,96	
Sex						-.27*
<b>Step 2 (Chronotype)</b>	.44	.19	.12*	14.4	1,95	
z-Owl-Lark						-.35*
<b>Step 3 (Interaction):</b>	.49	.24	.05*	5.6	1,94	
z-Owl-Lark X z-Wake time						-.21*

Results of Regression Analysis Examining Chronotype and Chronotype by Wake Time Interaction as Predictors of (Log) Cortisol.



## Conclusion

Our results suggest that morning-eveningness accounts for some of the inter-individual variability in cortisol. Researchers examining differences in salivary cortisol might be able to increase the power of their studies by limiting recruitment to certain chronotypes or by using chronotype score as a statistical control. Wake-time was not a significant predictor of cortisol, thus the notion that Larks simply get up earlier and therefore show lower cortisol levels as a result of an earlier start of the diurnal decline is not viable. Variables such as age and sex are routinely controlled for in studies employing cortisol as a measure. Our data suggest chronotype may also be an important factor.

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