# Chronic Mental Health Conditions and Sleep Efficiency:
## A Variability Investigation

Authors:
Jesse Bahrke[1], Joanna Buscemi[2], Susan T. Tran[2], Rachel Neff Greenley[1], & Steven A. Miller[1]
1: Rosalind Franklin University of Medicine and Science
2: DePaul University

Abstract
This study examines the impact of mental health conditions on sleep efficiency. Utilizing location-scale modeling with self-report and actigraphy data, we explore associations between anxiety and depression, and both mean level and variability in sleep efficiency, providing insights into potential factors influencing sleep quality in individuals with mental health conditions.

Purpose
Sleep efficiency has been defined as the ratio of total sleep time to time in bed (Reed & Sacco, 2016), and has been identified as a significant predictor of depression and anxiety levels (Lim et al., 2022). Furthermore increased variability in sleep duration has been associated with both diminished subjective sleep quality and lower subjective well-being (Lemola, Ledermann, & Friedman, 2013). While our understanding of how anxiety and depressive symptoms affect sleep patterns in emerging adults (EA) is limited, it's crucial to focus on this age group because most in EA don't meet their sleep requirements (Maslowsky & Ozer, 2014). Furthermore, few studies have examined the relationship between sleep efficiency variability and these disorders, and many have focused on self reported sleep quality instead of objective measures such as actigraphy. The study addresses this gap in the literature, aiming to enhance our understanding of the intricate interplay between mental health conditions and sleep specifically in emerging adults.

Procedure
260 undergraduate students participated. The sample ($M_{age}$ = 19.60) was mostly female (69.1%) and racially diverse (53.2% non-Hispanic White). Anxiety and depression were measured by a Physical Health Information Form, in which participants indicated a diagnosis of depression currently, never, or in the past but not currently. For 14 consecutive days, participants wore Actigraph monitors that provided daily values for sleep efficiency, and utilizing a location-scale model, we assess the impact of self-reported anxiety or depression on sleep efficiency. This statistical approach explores variations within and between individuals, examining both the average level and variability of sleep efficiency in those with and without self-reported mental health conditions.

Results
Anxiety did predict mean level sleep efficiency differences between groups with and without anxiety (Estimate = 1.3557, SE = 0.5694, p = 0.0181), with the anxiety group

resulting in higher sleep efficiency. Depression did not result in a significant mean difference in sleep efficiency between groups with and without reported depression (Estimate = -0.8232, SE = 0.6347, $p$ = 0.1960).

Anxiety and depression did not predict between-subject variability, models yielded non-significant results for both anxiety (Estimate = 3.7033, SE = 0.3.0802, $p$ = 0.2306) and depression (Estimate = 0.4447, SE = 0.3818, $p$ = 0.2453).

Anxiety did predict within-subject variability between groups with and without anxiety (Estimate = -0.1447, SE = 0.0884, $p$ = 0.0355) and depression also did not predict within-subject variability between groups with and without depression (Estimate = -0.0348, SE = 0.0300, $p$ = 0.2474).

Conclusions & Implications
This study explores the effects of anxiety and depression on sleep efficiency, employing location-scale models to discern their specific influence on both average and variability of sleep efficiency levels. Results indicate that anxiety shows a significant impact on average sleep efficiency levels, while depression does not. Even though mean-level differences were found, neither anxiety or depression showed a distinct impact on variability patterns. Findings have the potential to inform targeted interventions and emphasize the significance of further studies in unraveling these complex relationships. Overall, our study contributes valuable insights for understanding the nuanced intersections between mental health conditions and sleep, guiding future research and clinical applications.

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References
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## TABLE 1 - Anxiety and Depression as predictors of sleep efficiency level and variability

| Parameter | | Standard Error | t Value | Pr > \|t\| | 95% Confidence Limits | | Gradient |
|-----------|---|---------------|---------|---------|----------|----------|----------|
| $\beta_0$ | Mean Intercept | 0.2471 | 372.91 | <.0001 | 91.6595 | 92.6336 | 0.000012 |
| $\beta_1$ | Anxiety Mean Effect | 0.5694 | 2.38 | 0.0181 | 0.2334 | 2.4780 | -0.00002 |
| $\beta_2$ | Depression Mean Effect | 0.6347 | -1.30 | 0.1960 | -2.0742 | 0.4277 | 0.000059 |
| $\alpha_0$ | Between Variability Intercept | 3.1003 | -0.38 | 0.7073 | -7.2762 | 4.9449 | -0.00009 |
| $\alpha_1$ | Between Variability Anxiety Slope | 3.0802 | 1.20 | 0.2306 | -2.3677 | 9.7743 | -0.00007 |
| $\alpha_2$ | Between Variability Depression Slope | 0.3818 | 1.16 | 0.2453 | -0.3077 | 1.1972 | 0.000217 |
| $\tau_0$ | Within Variability Intercept | 0.03084 | 88.28 | <.0001 | 2.6620 | 2.7836 | -0.00647 |
| $\tau_1$ | Within VariabilityAnxiety Slope | 0.06839 | -2.12 | 0.0355 | -0.2794 | -0.00987 | -0.00073 |
| $\tau_2$ | Within Variability Depression Slope | 0.03003 | -1.16 | 0.2474 | -0.09400 | 0.02436 | -0.00187 |
| COV | Scale | 0.9513 | -3.44 | 0.0007 | -5.1450 | -1.3950 | -0.00184 |
| varScale | Covariance | 0.1250 | 3.74 | 0.0002 | 0.2208 | 0.7136 | -0.01375 |

DF = 217