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# From restless nights to productive days: Investigating sleep hygiene, social rhythm, and sleep quality in young adults

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ABSTRACT

Sleep is essential for health, well-being, and productivity, particularly among young adults entering the workforce. This study investigated the role of sleep hygiene and social rhythm as predictors of sleep quality, emphasizing implications for daily productivity among young adults in Malaysia. A longitudinal survey was conducted with 113 participants who completed either paper-based or online diaries. Participants provided demographic information and responded to the Insomnia Severity Index (ISI), Pittsburgh Sleep Quality Index (PSQI), Sleep Hygiene Inventory (SHI), Social Rhythm Metric (SRM II-5), Consensus Sleep Diary (CSD), and Stanford Sleepiness Scale (SSS). Participants generally demonstrated good sleep hygiene (M = 12.52; SD = 6.70) and above-average social rhythm (M = 4.78; SD = 1.62). The majority were classified as good sleepers, with a mean PSQI score of 4.29 (SD = 2.44), diary-reported sleep quality (M = 3.52, SD = .38), total sleep time (M = 7 hours 7 minutes, SD = 54 minutes), and sleep efficiency (M = 86.61%, SD = 7.19%). Sleep hygiene showed a significant positive correlation with PSQI-measured sleep quality but was not significantly correlated with diary-reported sleep quality. Regression analysis demonstrated that sleep hygiene was a stronger predictor of overall sleep quality ($\beta = .69$, $t(110) = 8.38$, $p < .001$), while social rhythm significantly predicted sleep efficiency ($\beta = .33$, $t(110) = 3.17$, $p < .002$). These findings highlight the importance of healthy sleep habits and regular daily routines in enhancing sleep quality, and potentially improving productivity among young professionals. Future research should explore these relationships in diverse populations to further substantiate generalisability and practical applications for workplace productivity enhancement.

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## INTRODUCTION

Sleep is a fundamental component of good health and optimal functioning. Governed by circadian rhythms and neurochemical processes (Hoey et al., 2014), sleep influences both psychological and physical well-being. Among young adults particularly those who are transitioning into the workforce, inadequate or disrupted sleep has been associated with numerous health concerns, including daytime sleepiness (Zhang et al., 2023), hypertension (Lv et al., 2024), obesity (Wang et al., 2022), and depression (Pandi-Perumal et al., 2020). Furthermore, sleep disturbances significantly impact daily functioning such as decision-making, attention, and emotional regulation (Mukherjee et al., 2024; Stores et al., 2023; Zimmerman et al., 2024) which are crucial for job efficiency, stress management, and workplace performance. The prevalence of insomnia has been rising globally (Chalet et al., 2024). In Malaysia, 33.8% of adults reported experiencing insomnia symptoms, with 12.2% meeting the criteria for chronic insomnia (Tan et al., 2022). Among university students, 36% reported insomnia symptoms, while 40% experienced irregular sleep schedules, which contribute significantly to poor sleep quality (Ong et al., 2023). These patterns are concerning when they enter the workforce, where poor sleep quality can contribute to reduced work engagement, presenteeism, and poor stress resilience (Peng et al., 2023). This study aims to provide a more comprehensive understanding of sleep research in Malaysia, by addressing gaps in examining sleep predictors, prevalence, and the relationship between sleep and behaviour. By focusing on sleep hygiene and social rhythm as predictors, the study contributes to a holistic understanding of how sleep impacts young adults' professional readiness, including cognitive performance and stress regulation. Additionally, this study introduces the Social Rhythm into Malaysian sleep research, expanding local applicability and relevance to occupational well-being.

Sleep quality is influenced by environmental and social cues that regulate circadian rhythm. The Social Zeitgeber Theory (Ehlers et al., 1988) suggests that disruptions in social routines, often triggered by stress could destabilize circadian rhythms and impair sleep. The Social Rhythm Metric (SRM) (Monk et al., 1991), originally developed for bipolar disorder, has since been applied to general populations (Van Tienoven et al., 2014). While studies show associations between irregular social rhythms and poor mental health (Margraf et al., 2016), inconsistencies remain particularly in non-clinical populations. Some research supports significant links between regularity and sleep (Haynes et al., 2016), while others find weaker relationships (Kim, 2015), pointing to the need for more targeted investigation. Veterans with PTSD and depression showed that stabilizing social rhythms improved both sleep quality and mental health outcomes. Circadian rhythm disruptions are commonly observed in individuals with mood disorders, emphasizing the importance of integrating social rhythm interventions into sleep management strategies (Takaesu, 2018). Similarly, Luik et al. (2015) reported that fragmented activity rhythms were strongly correlated with generalized anxiety disorder and sleep disturbances.

Emerging occupational research underscores the critical role of social rhythms in sustaining workplace performance. Disruptions in daily routines have been linked to mental exhaustion, professional burnout, and diminished job satisfaction (Daher et al., 2024; Lo et al., 2022). These adverse outcomes not only compromise individual well-being but also negatively influence organisational efficiency, emphasizing the importance of routine stabilization as a strategic focus in human resource practices. Employees with erratic sleep-wake patterns have been shown to report lower satisfaction in their roles and increased levels of burnout, often driven by inadequate restorative time and chronic cognitive strain. Daher et al. (2024) similarly found that variability in daily routines and sleep disturbances was tied to decreased workplace engagement and elevated presenteeism. Collectively, these insights highlight those fostering regular social rhythms contributes to both psychological wellness and optimal job performance by sustaining energy levels, enhancing cognitive precision, and supporting stress adaptability.

Sleep hygiene encompasses a set of behaviours conducive to quality rest, including maintaining a regular sleep schedule, moderating caffeine consumption, and minimizing screen exposure before bedtime

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(De Pasquale et al., 2024). While evidence indicates that sleep hygiene alone may have limited effectiveness (Black et al., 2015), it becomes more impactful when paired with complementary strategies such as mindfulness practices or sleep extension interventions (Dewald-Kaufmann et al., 2014; Cretu et al., 2016). Neglecting sleep hygiene has been associated with reduced workplace productivity, compromised decision-making capacity, and heightened emotional reactivity (Pilcher & Morris, 2020)—factors that are particularly detrimental in high-demand occupational settings.

Sleep deprivation has also been linked to absenteeism. Daher et al. (2024) found that employees with poor sleep quality were more likely to take sick leave. Caldwell et al. (2018) reported higher absenteeism among workers in high-stress jobs with sleep disorders. However, Firat et al. (2018) found no direct link between sleep duration and absenteeism, suggesting moderating influences such as workplace culture. These mixed results emphasize the need for research that critically examines context-specific variables influencing work attendance and efficiency. The relationship between social rhythm, sleep hygiene, and sleep quality is complex. Ng et al. (2016) investigated poor sleep quality, irregular rhythms, and maladaptive behaviours in patients with bipolar disorders. Moss et al. (2014) and Vollmer et al. (2017) highlighted the benefits of regular routines and morningness-eveningness preferences. However, existing literature often lacks synthesis across populations, calling for more integrative models that reflect both behavioural and psychosocial influences on sleep.

An expanding body of research within business and human resource disciplines highlights the critical role of restorative sleep and consistent daily routines in fostering sustainable employee performance. Inadequate sleep has been linked to heightened turnover intentions, increased absenteeism, and elevated risk of burnout (Litwiller et al., 2017; Wendsche & Lohmann-Haislah, 2017; Varma et al., 2025). Conversely, human resource strategies that incorporate flexible work arrangements and sleep education initiatives have been shown to enhance both productivity and job satisfaction (Arora et al., 2014). Collectively, existing evidence suggests that integrated interventions addressing both sleep hygiene and social rhythm regulation hold considerable promise for improving the well-being and professional functioning of young workers (Lim et al., 2023). However, methodological limitations and variability in findings indicate the need for further investigation—particularly within culturally specific and occupationally diverse settings such as Malaysia. This study contributes to that effort by examining how behavioural patterns related to sleep and routine influence sleep quality, and in turn, affect productivity, stress regulation, and workplace engagement among emerging professionals.

## METHODS

This study employed a longitudinal survey design to examine the relationship between sleep hygiene, social rhythm, and sleep quality in 113 young adults. Data were collected over seven days to capture variations in sleep patterns and social rhythms across weekdays and weekends, as significant differences often emerge during these timeframes (Monk et al., 2006). A week-long monitoring period is considered sufficient to provide a representative snapshot of monthly trends (Lau et al., 2022). This longitudinal approach offers a robust framework for investigating the complex interplay of sleep-related factors.

Figure 1 illustrates the participant's recruitment process, from the initial response of interested participants to the final inclusion of the participants. Of the 130 potential participants, 115 met the inclusion and exclusion criteria. Those eligible participants ($n$ = 115) were required to provide informed consent before proceeding with the study. They completed a set of questionnaires, including a demographics survey, the Sleep Hygiene Inventory (SHI), the Insomnia Severity Index (ISI), and the Pittsburgh Sleep Quality Index (PSQI). Completing the questionnaires took approximately ten minutes. Following this, participants were given instructions on how to complete the Bedtime Diary and Morning Diary. They recorded their sleep patterns for seven consecutive days and returned the diaries on Day 8. Upon submission, participants were debriefed to ensure they had completed the monitoring process without any difficulties, and any

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questions they had were addressed. Two participants were excluded due to incomplete diary entries. Thus, the final analysis was conducted using data from 113 participants. The protocol of this study was reviewed and approved by the Human Research Ethics Committee, Universiti Pendidikan Sultan Idris (Reference number: 2019-0047-01).

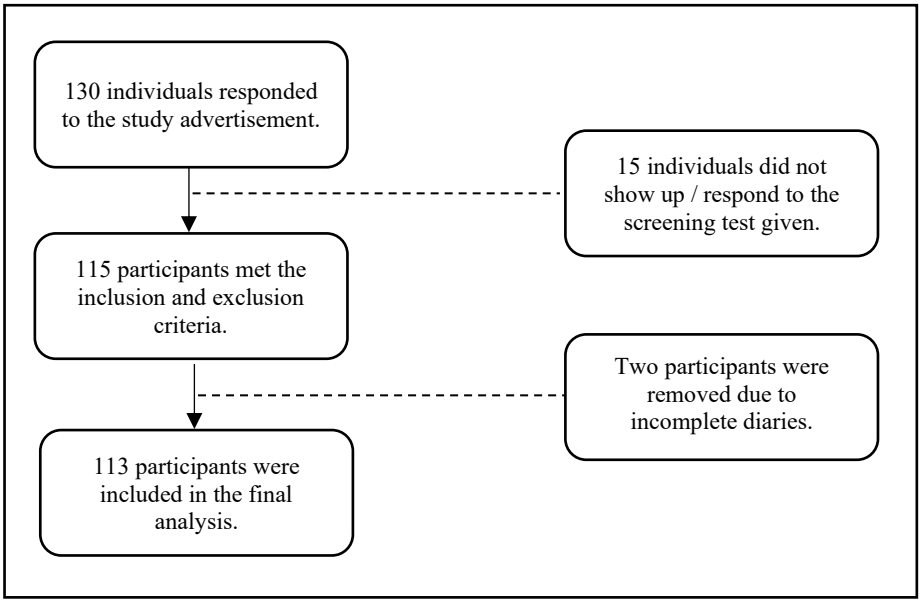


Fig. 1. Recruitment process and flow of data collection

Figure 2 presents the longitudinal design, outlining the timeframe for participants to complete the morning and bedtime diaries. The flow diagram illustrates the procedure for the seven days self-monitoring diary completion conducted at home. Participants began by completing Day 1 on the same day of the briefing. The following morning, they completed the Day 2 Morning Diary and at the end of the day, they recorded their entries in the Day 2 Bedtime Diary. This procedure was repeated until Day 8 when participants completed the Day 8 Morning Diary and returned both sets of diaries to the experimental lab.

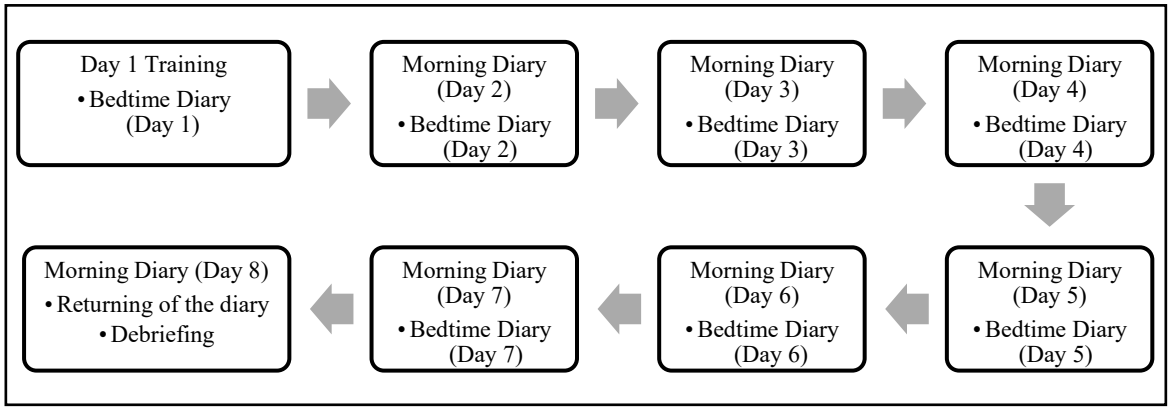


Fig. 2. Longitudinal study design

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## Measures

Sleep quality was assessed using six validated instruments. The Insomnia Severity Index (ISI; Morin et al. 2011) is a seven item self-report scale measuring insomnia severity over the past month with a total score ranging from 0 to 28. It has strong internal consistency (α =.90-.92) high sensitivity (86.1%) and specificity (87.7%) for insomnia detection. The Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989) differentiates good and poor sleepers through 19 self-reported items across seven components (subjective sleep quality, latency, duration, efficiency, disturbances, medication use, and daytime dysfunction). Scores range from 0 to 21, with scores ≥ 5 indicating poor sleep. The PSQI has high internal consistency (α = .83) and strong validity (sensitivity = 89.6%, specificity = 86.5%). Sleep hygiene was evaluated using the Sleep Hygiene Inventory (SHI; Mastin et al., 2006), a 13-item measure assessing inappropriate sleep behaviours on a 5-point Likert scale (0-4), with higher scores indicating poorer sleep hygiene. It has demonstrated good internal consistency (α = .66-.85) and test-retest reliability (.71-.86). Social rhythm was measured using the Social Rhythm Metric (SRM II-5; Monk et al., 2002), which records the consistency of five daily activities (out of bed, first contact, work/school start, dinner, bedtime). Activities completed within 45 minutes of a target time receive a score of 1, and the weekly average represents social rhythm stability. The SRM II-5 has good reliability (α = .72) and validity (kappa = .69, sensitivity = 74%, specificity = 95%). Sleep diaries were used to capture daily sleep patterns. The Consensus Sleep Diary (CSD; Carney et al., 2012) tracks bedtime, sleep onset, awakenings, wake time, total sleep time (TST), and sleep efficiency (SE), demonstrating strong validity and usability. Additionally, the Stanford Sleepiness Scale (SSS; Hoddes et al., 1973), a single-item 7-point Likert scale (1 = alert, 7 = sleep onset), was administered at the wake and before sleep. It has test-retest reliability (.88) and correlates with the Karolinska Sleepiness Scale ($r$ = .946), with acceptable reliability (Cronbach's α = .59).

## Analysis

Data was analysed using the Statistical Package for the Social Sciences (SPSS) version 26. Descriptive statistics were used to present the demographic characteristics of the participants, with frequencies and percentages reported for categorical variables (e.g., gender) and means and standard deviations for continuous variables (e.g., age).

Pearson correlations analysis was conducted to explore the relationships between sleep hygiene, social rhythm, and sleep quality variables including PSQI sleep quality, sleep diary reported sleep quality, total sleep time, and sleep efficiency. Multiple linear regression was then performed to examine the predictors of sleep quality. The independent variables were sleep hygiene (SHI scores) and social rhythm (SRM II scores), while the dependent variables included PSQI sleep quality score, total sleep time (from the sleep Diary), and sleep efficiency (from the Sleep Diary).

Before conducting the regression, eight key assumptions were tested. First, the dependent variables (PSQI score, total sleep time, sleep efficiency) were confirmed as continuous, meeting the assumption for regression analysis. Second, the presence of multiple independent variables in which the regression model included two independent variables (sleep hygiene, social rhythm), fulfilling this requirement. The third assumption, independence of residuals, the Durbin-Watson Test indicated acceptable values (PSQI = 1.6, Total Sleep Time = 1.8, Sleep Efficiency = 2.1), all within the recommended range of 1 to 3.

The fourth assumption, linearity, scatterplots with best-fit lines confirmed a linear relationship between the predictors and dependent variables. The fifth assumption of homoscedasticity, this assumption was assessed through scatterplots, ensuring the data points were evenly distributed. The sixth assumption, no multicollinearity, Variance Inflation Factor (VIF), and tolerance values were within acceptable limits (VIF: PSQI = 1.5, total sleep time = 1.5, sleep efficiency = 1.5; Tolerance: PSQI = .66, total sleep time = .66, sleep efficiency = .66).

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The seventh assumption, no significant outliers, Cook's distance values were below 1, confirming the absence of influential outliers. The eighth assumption, the normality of residuals, was verified using a Q-Q plot and the Shapiro-Wilk test. Although the PSQI Shapiro-Wilk score was low (.02), the Q-Q plot indicated normal distribution. The Shapiro-Wilk scores for total sleep time and sleep efficiency were 1.00, satisfying the normality assumption. The lower PSQI score may be attributed to the scoring method used in the PSQI instrument.

Finally, the sleep diary-reported sleep quality variable was excluded from the regression analysis due to insufficient correlation with the predictors, failing to meet the necessary assumptions for regression analysis.

## RESULTS

### Demographic characteristics of the participants

The study included 113 participants, with a mean age of 24 years (SD = 2.25), ranging from 20 to 29 years. The sample size of this study was also supported by the G*Power (version 3.1.9.4) calculation of sample size whereby the suggested sample size of 107 with a 95% confidence level ($\alpha = 0.05$), the effect size of 0.15, and the actual power of 0.95. The sample was predominantly female (77.9%), which aligns with the gender distribution in Malaysian universities. While this reflects real-world demographics, the overrepresentation of female participants may influence the findings, particularly given the documented gender differences in sleep patterns, stress responses, and health behaviours. Therefore, caution is advised when generalising these results to male populations or gender-diverse and workforce-specific contexts. Future research is encouraged to adopt more balanced sampling strategies to better capture gender-specific variations in sleep hygiene, social rhythm, and sleep quality. Most participants (78.8%) had a body mass index (BMI) within the normal weight range, while 2.7% were categorised as obese. Prior research indicates that BMI may influence sleep quality, with higher BMI associated with shorter sleep duration and increased sleep disturbances. However, given the small proportion of obese participants, the impact of BMI on sleep outcomes in this study may be limited. Ethnic distribution was reflective of Malaysia's diverse population, with 79.6% Malay, 11.5% Chinese, 6.2% Indian, and 2.7% from other ethnic groups. Cultural and lifestyle differences, such as dietary habits, sleep practices, and social norms, could contribute to variations in sleep hygiene and social rhythm. Future studies could explore whether these cultural factors influence sleep patterns among Malaysian young adults. In terms of sleep quality, 78.8% of participants were classified as good sleepers (PSQI $\leq$ 5), while 76.1% reported no symptoms of insomnia. This suggests that most participants maintained adequate sleep quality, which contrasts with some studies reporting high levels of sleep disturbances among university students. Possible explanations include effective sleep hygiene practices, consistent social rhythms, or lower academic stress levels in this cohort. Further exploration is needed to determine the factors contributing to their relatively good sleep quality. Table 1 presents the detailed participant's demographics and sleep variables.

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Table 1. Participants Demographics and Sleep Variables ($n$ = 113)

| | Frequency ($n$) | Percentage (%) | Mean | SD |
|---|---|---|---|---|
| Demographic Variables | | | | |
| Gender | | | | |
| Male | 25 | 22.1 | | |
| Female | 88 | 77.9 | | |
| BMI | | | 22.69 | 2.85 |
| Underweight (<18.5) | 5 | 4.3 | | |
| Normal (18.5 - 24.9) | 89 | 78.8 | | |
| Overweight (25 – 29.9) | 16 | 14.2 | | |
| Obesity (>30) | 3 | 2.7 | | |
| Race | | | | |
| Malay | 90 | 79.6 | | |
| Indian | 7 | 6.2 | | |
| Chinese | 13 | 11.5 | | |
| Others | 3 | 2.7 | | |
| Types of Sleepers | | | | |
| Good | 89 | 78.8 | | |
| Poor | 24 | 21.2 | | |
| Sleep Variable | | | | |
| Insomnia Severity Index | | | | |
| No clinically significant insomnia | 86 | 76.1 | | |
| Subthreshold insomnia | 23 | 20.4 | | |
| Moderate insomnia | 4 | 3.5 | | |
| Severe insomnia | 0 | | | |
| Sleep Hygiene: SHI (0 - 52) | | | 12.52 | 6.70 |
| Social Rhythm: SRM (0 - 7) | | | 4.78 | 1.62 |
| Sleep Quality: PSQI (0 - 21) | | | 4.29 | 2.44 |
| Sleep Quality Sleep Diary (1 - 5) | | | 3.52 | 0.38 |
| Total Sleep Time (in minutes) | | | 427* | 54 |
| Sleep Efficiency (in percentage) | | | 86.61 | 7.19 |
| Sleepiness Score (Risetime) (x-x) | | | 1.82 | 0.67 |
| Sleepiness Score (Bedtime) (x-x) | | | 4.55 | 0.97 |
| Average Awake Time | | | 7:50 AM | 0:49 |

*Note*. *7 hours 7 minutes

The mean SHI score was 12.52 (SD = 6.7), indicating that most participants demonstrated good sleep hygiene, as lower scores reflect better sleep practices. The mean SRM score was 4.78 (SD = 1.62), suggesting that most participants maintained above-average social rhythm regularity. Sleep quality, as assessed by PSQI, yielded a mean score of 4.29 (SD = 2.44), classifying 78.8% of participants as good sleepers (PSQI ≤ 5). Findings from the Sleep Diary revealed an average self-reported sleep quality score of 3.52 (SD = 0.38), a Total Sleep Time of 7 hours and 7 minutes (SD = 54 minutes), and an average Sleep Efficiency of 86.61% (SD = 7.19%). These values suggest that, on average, participants maintained a relatively healthy sleep pattern. Daytime and nighttime sleepiness was assessed using the Stanford Sleepiness Scale. Participants reported an average score of 1.82 (SD = 0.67) upon awakening, indicating alertness in the morning, and 4.55 (SD = 0.97) before bedtime, reflecting an expected increase in sleepiness as the day progressed.

Overall, the results suggest that most participants exhibited good sleep hygiene, maintained regular social rhythms, and experienced generally good sleep quality. These findings align with prior studies indicating that young adults with structured daily routines tend to report better sleep outcomes. However, individual variability in sleep duration and efficiency highlights the need for further investigation into factors that may contribute to sleep disturbances in this population.

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## Correlation analyses of sleep hygiene, social rhythm, and sleep quality variables

Pearson's Correlation analysis of sleep hygiene, social rhythm, and sleep quality variables is presented in Table 2. Sleep hygiene showed a strong, significant positive correlation with sleep quality (SQ-PSQI), $r(111) = .71$, $p < .01$. Additionally, social rhythm demonstrated a moderate, significant negative correlation with sleep quality, $r(111) = -.44$, $p < .01$. These findings indicate that better sleep hygiene practices and greater social rhythm regularity are associated with higher sleep quality. Consistently, sleep hygiene was moderately, negatively correlated with total sleep time $r(111) = -.25$, $p < .01$, suggesting poorer sleep hygiene practices are linked to shorter sleep duration.

Meanwhile, social rhythm showed a significant, positive correlation with total sleep time ($r = .21$, $p < .05$), and sleep efficiency ($r = .44$, $p < .01$). This indicates that greater social rhythm regularity is associated with longer total sleep time and greater sleep efficiency. Additionally, findings revealed that sleep hygiene was moderately, and negatively correlated with sleep efficiency ($r = -.38$, $p < .01$), suggesting that poorer sleep hygiene practices correspond to lower sleep efficiency.

Table 2. Pearson correlations of sleep hygiene, social rhythm, sleep quality, total sleep time, and sleep efficiency

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Sleep Hygiene: SHI Score | - | | | | | |
| 2. Social Rhythm: SRM Score | -.58** | - | | | | |
| 3. Sleep Quality: PSQI Global Score | .71** | -.44** | - | | | |
| 4. Sleep Quality-Sleep Diary | -.01 | .2* | -.004 | - | | |
| 5. Total Sleep Time-Sleep Diary | -.25** | .21* | -.28** | -.18 | - | |
| 6. Sleep Efficiency-Sleep Diary | -.38** | .44** | -.42** | .13 | .53** | - |

*Note. ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)*

## Predictors of sleep quality

### *Model 1: Predicting Sleep Quality*

This model examines whether social rhythm is a stronger predictor of sleep quality (measured by PSQI) compared to sleep hygiene. The multiple linear regression analysis yielded an $R^2$ value of .51, suggesting that the model, which includes sleep hygiene and social rhythm explains approximately 50.9% of the variance in the PSQI scores. This model consists of Sleep Hygiene and Social Rhythm as predictors and a constant. The constant in this model represents Sleep Quality (PSQI score) in the absence of predictors, with a beta value of 1.441. The beta values for the two variables demonstrated opposing effects on sleep quality, with Sleep Hygiene showing a significant positive relationship ($\beta = .69$, $t(110) = 8.38$, $p < .001$) and Social Rhythm showing a non-significant negative relationship ($\beta = -.04$, $t(110) = -.49$, $p < .62$). These findings highlight that Sleep Hygiene is a significant and reliable predictor of sleep quality (PSQI score), whereas Social Rhythm does not significantly contribute to the prediction of sleep quality. While social rhythm may still play a role, its effect on sleep quality appears to be weaker compared to sleep hygiene.

### *Model 2: Predicting Total Sleep Time*

This model evaluates whether social rhythm is a stronger predictor of total sleep time compared to sleep hygiene. The multiple linear regression analysis yielded an $R^2$ value of .067, indicating that the predictors Sleep Hygiene and Social Rhythm explain only 6.7% of the variance in total sleep time. The low explanatory value suggests that these independent variables have limited significance in predicting total sleep time in this model. The model consists of sleep hygiene and social rhythm as predictors and a constant. The constant represents total sleep time when no predictors were included, with a beta value of 25981.21.

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The beta values for the two variables indicated a negative relationship between sleep hygiene and total Sleep time ($\beta$ = -.2, $t(110)$ = -1.72, $p$ < .089), and a positive relationship for Social Rhythm ($\beta$ = .09, $t(110)$ = .81, $p$ < .423). However, neither predictor showed statistical significance within the model, suggesting that other unmeasured factors may have a stronger influence on total sleep time. For instance, academic pressures, irregular class schedules, prolonged screen exposure before bedtime, caffeine consumption, and psychological stress may affect sleep duration more directly than routine-based behaviours (Dijk & von Schantz, 2005). Additionally, individual differences in chronotype and biological needs could contribute to variations in sleep requirements, further weakening the predictive strength of the examined variables. Future models should consider incorporating these contextual and behavioural factors to improve predictive accuracy and more accurately reflect the complex determinants of sleep duration among young adults specifically working young adults.

*Model 3: Predicting Sleep Efficiency*

This model evaluates whether social rhythm is a stronger predictor of sleep efficiency compared to sleep hygiene. The multiple linear regression analysis yielded an $R^2$ value of .22, indicating that the predictors of sleep hygiene and social rhythm together explain 21.8% of the variance in Sleep Efficiency. This model consists of sleep hygiene and social rhythm as predictors and a constant. The constant represents sleep efficiency in the absence of predictors, with a beta value was 82.21. The beta values for the two variables suggested opposing effects, with sleep hygiene showing a negative relationship ($\beta$ = -.19, $t(110)$ = -1.84, $p$ < .069) and social rhythm indicating a positive and statistically significant relationship ($\beta$ = .33, $t(110)$ = 3.17, $p$ < .002). While sleep hygiene did not emerge as a statistically significant predictor, social rhythm showed a significant positive correlation with Sleep Efficiency. These findings highlight social rhythm as a meaningful predictor of sleep efficiency, supporting the role of regular activities in aligning circadian rhythms, whereas sleep hygiene does not significantly contribute to the prediction of sleep efficiency in this model.

Table 4. Summary of multiple linear regression analyses examining sleep hygiene and social rhythm as predictors of sleep quality

| Predictors | *β* | *Std. error.* | *Beta* | *t* | *p* | Model Statistics |
|---|---|---|---|---|---|---|
| Model 1: Predicting Sleep Quality | | | | | | *n*= 112 |
| (PSQI Global Scores) | | | | | | |
| Sleep Hygiene | .25 | .03 | .69 | 8.38 | .000 | $R^2$= .51 |
| Social Rhythm | -.06 | -.04 | -.04 | -.49 | .624 | *p* = .001 |
| Model 2: Predicting Total Sleep Time | | | | | | *n*= 112 |
| (Sleep Diary Data) | | | | | | |
| Sleep Hygiene | -95.2 | 55.46 | -.2 | -1.72 | .089 | $R^2$= .067 |
| Social Rhythm | 184.44 | 229.24 | .09 | .81 | .423 | *p* = .022 |
| Model 3: Predicting Sleep Efficiency | | | | | | *n*= 112 |
| (Sleep Diary Data) | | | | | | |
| Sleep Hygiene | -.21 | .11 | -.19 | -1.84 | .069 | $R^2$= .22 |
| Social Rhythm | 1.46 | .46 | .33 | 3.17 | .002 | *p* = .001 |

## DISCUSSION

While the roles of sleep hygiene and social rhythm in enhancing sleep outcomes among young adults are well-documented, empirical research examining these variables within the Malaysian context remains relatively scarce. The present study lends support to the Social Zeitgeber Theory, which posits that

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disruptions in daily social routines can detrimentally impact sleep quality (Ehlers et al., 1988; Meng et al., 2023). Notably, although social rhythm was found to be a significant predictor of sleep efficiency, it did not strongly predict either sleep quality or duration. This may suggest that social rhythms are more tightly linked to biological mechanisms—specifically circadian alignment—that influence objective sleep efficiency more than subjective perceptions of sleep quality or total sleep time (Desai et al., 2024).

The Cognitive Model of Insomnia further clarifies the connection between poor sleep hygiene and diminished sleep efficiency and duration (Espie, 2007; Rossman, 2019). This model highlights how dysfunctional sleep-related cognitions and maladaptive behavioural patterns can perpetuate insomnia symptoms. Taken together, these findings emphasize the need to address both sleep hygiene practices and the consistency of social rhythms as dual pillars in strategies aimed at enhancing sleep health and mitigating insomnia.

The study also reinforces the principles of the Social Zeitgeber Theory, which maintains that regular social interactions and external time cues (zeitgebers) help synchronize the body's internal clock, thereby influencing not only sleep patterns but also eating habits and daily functioning. Our findings affirm that social rhythm is a salient predictor of sleep efficiency, underlining the critical role of maintaining structured social routines to support healthier sleep in young adults. This is consistent with earlier research by Sabet et al. (2021), which found that disrupted social rhythms contributed to poorer sleep, reduced sleep self-efficacy, and elevated symptoms of depression and anxiety. Likewise, Salehinejad et al. (2021) observed that pandemic-related home confinement led to weakened social cues, circadian misalignment, and declines in sleep quality.

Beyond sleep, the stability of social rhythms carries significant implications for professional productivity and occupational performance. Disruptions to circadian and social timing have been associated with impaired executive function, increased mental fatigue, and hindered career development. Lo et al. (2022) reported that employees with irregular sleep-wake schedules experienced elevated burnout, lower job satisfaction, and cognitive exhaustion. Similarly, Daher et al. (2024) linked poor sleep hygiene and erratic routines to reduced workplace engagement and elevated presenteeism. These findings underscore the broader importance of maintaining regular sleep and social patterns—not only for physical and emotional well-being but also for sustaining high-level performance in demanding professional roles. Additionally, social disconnection has been shown to compromise cognitive functioning, with sleep disturbance acting as a key mediating factor (Peng et al., 2023). Heightened sleep disruption has been associated with impairments in social cognition, visual learning, and working memory (Russo et al., 2015), outcomes that pose serious risks in cognitively intensive fields such as business, medicine, and education.

In contrast, maintaining consistent social routines and achieving better sleep efficiency have been linked to enhanced daytime functioning, higher energy levels, and improved work productivity. Numerous studies have consistently shown that good sleep quality, adequate sleep duration, and consistent sleep patterns are strongly associated with academic success (Okano et al., 2019). Likewise, regular and sufficient sleep contributes to positive workplace outcomes, such as quicker reaction times and increased motivation. A meta-analysis by Litwiller et al. (2017) emphasized the strong connection between sleep and job performance, underscoring sleep's vital role in both individual and organisational success. High-quality, consistent sleep is also associated with improved cognitive functioning and greater motivation. Peng et al. (2023) highlighted sleep's importance in occupational well-being, identifying occupational self-efficacy as a significant mediating factor. Conversely, insomnia has been linked to reduced productivity, higher absenteeism, and financial losses. Aye and Lee (2024) found that 59.4% of Malaysian working adults reported poor sleep quality, with contributing factors including pre-sleep device use, shifting workloads, and workplace distractions (Tan et al., 2022). Furthermore, a survey by CodeBlue (2019) revealed that over half of Malaysian employees experience work-related stress and sleep less than seven hours per night, resulting in diminished job performance and greater absenteeism—both of which adversely impact national economic productivity. Similarly, Roth (2007) reported that individuals with insomnia show increased rates

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of absenteeism and reduced workplace efficiency. Collectively, these findings emphasize the importance of prioritising sleep as a critical factor in workforce health and economic sustainability.

To address the negative impacts of poor sleep and irregular social rhythms, targeted interventions should be implemented in both educational and workplace environments. Universities and employers can introduce structured programmes that promote consistent daily routines, regular bedtimes, and reduced exposure to blue light before sleep. Adopting flexible or hybrid work arrangements may also help young professionals better align their work schedules with their natural chronotypes, thereby minimising circadian disruption and enhancing productivity. Digital tools, such as sleep-tracking apps and wearable devices, can further support behavioural consistency by encouraging self-monitoring and accountability. Incorporating these initiatives into broader wellness strategies—such as offering incentives for participation—can increase engagement. Workplaces can also foster a sleep-supportive culture by providing dedicated spaces for breaks, naps, or relaxation, particularly in high-stress settings. Additionally, expanding access to mental health services that include sleep-focused interventions, such as cognitive behavioural therapy for insomnia (CBT-I) and acceptance and commitment therapy (ACT) (Lee et al., 2025), may enhance psychological resilience and promote sustained workplace engagement.

This study is not without limitations. First, the absence of objective sleep measurements, such as actigraphy or polysomnography, limits the accuracy of the findings. Future research should consider incorporating such tools to complement self-reported data. Additionally, the cross-sectional design restricts the ability to establish causal relationships. Future studies should adopt longitudinal designs to better examine the directionality and long-term impacts of sleep hygiene and social rhythm on workplace performance. Broader sampling including working adults, shift workers, and clinical populations would also enhance the generalisability of the findings. The use of consumer-grade devices (e.g., Fitbit, Apple Watch, Samsung Gear) may allow for real-time tracking of both sleep and social rhythm metrics, offering richer, more reliable data. Future studies should also explore how sleep and social rhythms influence workplace performance specifically in cognitively demanding roles. Disrupted rhythms and sleep quality are known to impair concentration, creativity, and teamwork, skills critical in today's workplace. Additionally, studies should examine how post-pandemic lifestyle changes (e.g., remote work, delays in wake times) affect long-term sleep health. Longitudinal studies such as Cai et al. (2017) three-year study, could help clarify the role of lifestyle regularity in sleep health and workplace outcomes.

The study highlights sleep hygiene is a stronger predictor of PSQI-measured sleep quality, while social rhythm is more closely linked to sleep efficiency, as measured through sleep diaries. This distinction may reflect the different timeframes and scopes of the tools used, the Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989) and the Sleep Hygiene Inventory (SHI; Mastin et al., 2006) provide a snapshot assessment, while social rhythm and sleep efficiency rely on repeated, diary-based tracking, which may capture daily variability more effectively. Although neither factor predicted total sleep time, both offer valuable insight into the mechanisms that support healthy sleep, with direct relevance to academic and workplace performance.

In conclusion, sleep hygiene and social rhythm play complementary roles in promoting not only sleep quality but also cognitive clarity, decision-making, and workplace productivity. Optimising these behavioural patterns may enhance performance, reduce errors, and promote well-being across personal, academic, and professional domains. Future studies should continue to investigate these relationships across broader populations and incorporate mixed-method and longitudinal designs. As sleep becomes increasingly recognised as a foundation for workplace success, integrating behavioural sleep science into workplace policy may be essential for sustainable career development and national productivity.

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## CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial, or financial conflicts and declare the absence of conflicting interests with the funders.

## AUTHORS' CONTRIBUTION

Nicky Carlmond Ang conducted the research, performed data analysis and drafted the manuscript. Fatanah Ramlee supervised the research progress, reviewed the manuscript and finalised its submission. Vanida Tian reviewed and formatted the manuscript.

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