NATIONAL INSTITUTE OF BUSINESS MANAGEMENT

HIGHER NATIONAL DIPLOMA

# STATISTIC FOR COMPUTING

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(coursework documentation)

**DECLARATION**

We, the undersigned members of the research group for “Sleep patterns and cognitive performance”, hereby declare that the research submitted in partial fulfilment of the requirements for Higher National Diploma in Software Engineering at National Institute of Business Management is our original collective work. We have researched collaboratively for this study. We acknowledge that all sources of information and materials used during this research, including google forms, have been properly cited and referenced. Any contributions made by others to this project have been duly acknowledged. We further declare that this research has not been submitted, in part or in full, for the award of any other degree or diploma to any institution or university. This project has been completed under the guidance and supervision of Miss. Thilini Dharmasena (Lecturer – NIBM Galle), and we have adhered to all ethical and academic standards while conducting the research and compiling this report. We understand that any violation of ethical research practices, including plagiarism or misrepresentation of sources, could lead to consequences outlined by NIBM policies.

Research Team,

Sleep patterns and cognitive performance

**DEDICATION**

This project is dedicated to our Research Supervisor, Miss. Thilini Dharmasena (Lecturer – NIBM Galle), who guided us throughout this journey. Your feedback and dedication to our success have been invaluable.

To Miss. Sandaruwani Pathirage, Miss. Asanthi Kurukulasooriya, Mr. Supun Asanga (Lecturers – NIBM) for providing us with their unquenchable support whenever we needed. To our esteemed colleagues, we extend our sincerest appreciation for your support during the challenging times.

To our families, friends and the loved ones, who believed in us even in our challenging times, your encouragement and love have been a constant source of inspiration.

Research team,

Sleep pattern and cognitive performance

**ACKNOWLEDGEMENT**

**"Behind every pioneering research there's in an effort that is invaluable support and inspiration of many individuals, and this study has no difference."**

We would like to extend our heartfelt gratitude to all those who have been contributing to the successful completion of the "**sleep patterns and cognitive performance**". This journey was helped by various individuals' and organization's support, guidance and contributions.

Our deepest appreciation goes to our research supervisor, Miss. Thilini Dharmasena, whose expertise, patience for being with us and feedback guided as through this research journey. Your guidance has been crucial in shaping our ideas and helping us align our research with best practices.

ABSTRACT

This study investigates the impact of sleep on the cognitive performance, mainly focusing on three key variables as sleep quality, sleep architecture, and sleep duration. Using quantitative data from 67 respondents collected via a structured Google Form survey, this research aims to explore the relationship between the sleep patterns and the cognitive functions, such as memory, attention, and problem-solving skills. The findings reveal that sleep quality significantly effects the cognitive performance, by highlighting the importance of restful and uninterrupted sleep for enhanced mental functioning. Conversely, sleep architecture and duration were found to have minimal effects on cognitive outcomes, indicating that the structure and length of sleep do not substantially improve cognitive performance on their own. These results underscore the need to prioritize sleep quality and explore other factors that may affect cognitive health. The study contributes to the valuable insights into how would a better sleep management can optimize cognitive abilities and overall mental well-being, advocating for strategies which enhances the sleep quality to support cognitive function in our daily life.

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## INTRODUCTION

Sleep plays a very important role like maintaining health and cognitive function. As it is important in physiological process, it affects in many ways like in human performance, it can include the memory, attention, problem solving, and decision making. And also understanding the relationship between sleep and cognitive performance is very important in today's fast paced world.

This report examines the influence of the three independent variables as sleep quality, sleep architecture, and sleep duration on the dependant variable cognitive performance. Sleep quality refers to the way how well a person sleeps, considering factors like restfulness, disturbances, and overall satisfaction. Sleep architecture, on the other hand, involves the structure of sleep stages. Sleep duration measures the total amount of sleep time an individual receives.

The aim of this report is to statistically analyse how the variations in these sleep factors affect the cognitive performance of an individual, which encompasses mental functions such as memory retention, executive functioning, and attention span. By exploring these relationships, this study seeks to contribute to a deeper understanding of how sleep impacts our daily cognitive abilities, and most importantly offering the insights that can inform strategies for improving cognitive performance through better sleep management.

## PROJECT OBJECTIVES

The main objective of this project is to statistically analyse the relationship between sleep and the cognitive performance by examining the effects of sleep quality, sleep architecture, and sleep duration on different cognitive functions. Specifically, this study aims to:

1. Evaluate how different levels of sleep quality influence cognitive performance, including the attention, memory, and the executive functioning.
2. Investigate the impact of sleep architecture on the cognitive outcomes.
3. Assess the relationship between sleep duration and cognitive performance, determining maximum sleep amounts for enhanced mental functioning.

## CONCEPTUAL FRAMEWORK

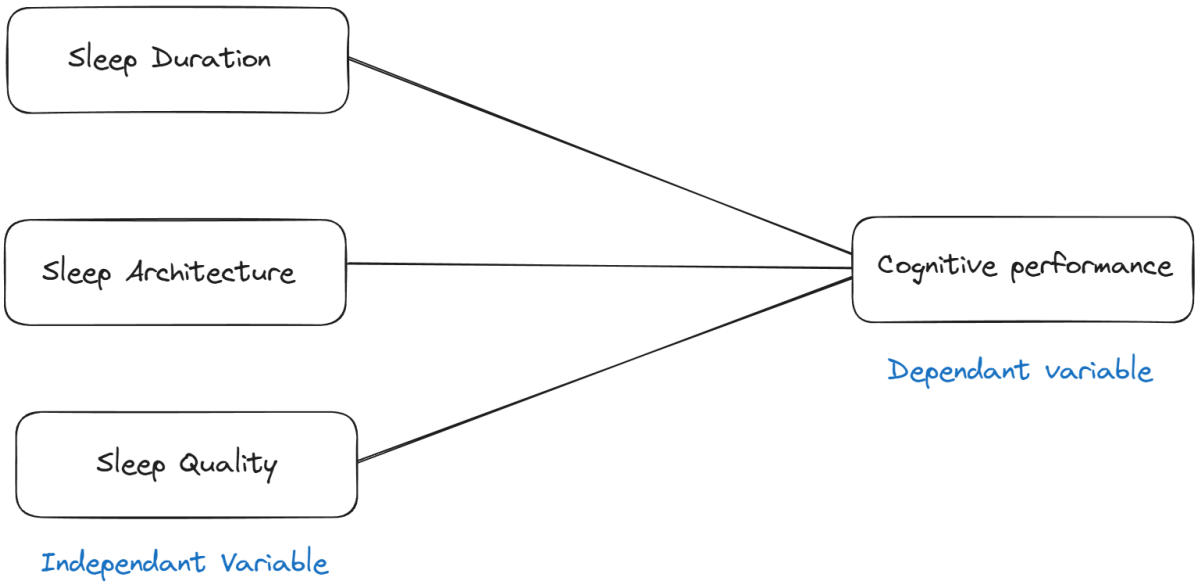


*Figure 1 - Conceptual Framework*

## DATA COLLECTION PROCEDURE

The following questionnaire was created to systematically evaluate the impact of sleep on the cognitive performance. This tool aims to gain some idea into the complex relationship between various aspects of sleep such as sleep quality, sleep architecture, and sleep duration and cognitive functions among the individuals. By analysing these relationships, the study contributes to a more comprehensive understanding of how sleep affects mental performance.

Exactly 67 responses were used during the research analysis process.

Survey link: Sleep and Cognitive Performance (google.com)

**QUESTIONAIRE**

**Section 1: Sleep Duration**

1. On average, I get enough sleep each night.
2. I have a consistent sleep schedule, going to bed and waking up at the same time every day.
3. The amount of sleep I get each night is sufficient.
4. I frequently sleep for less than six hours in a night.

**Section 2: Cognitive Performance**

5. I find it difficult to concentrate or remember things after a night of inadequate sleep.
6. My performance in college or work varies with different amounts of sleep.
7. I notice a difference in my problem-solving abilities after a good night's sleep.
8. I often make mistakes or have trouble focusing when I haven't slept enough.

**Section 3: Sleep Quality**

9. I often feel mentally fatigued during the day.
10. I find it easier to learn new information when I am well-rested.
11. It usually takes me less than 30 minutes to fall asleep after going to bed.
12. I often wake up more than once during the night.
13. I wake up feeling refreshed in the morning.
14. I spend most of my time in bed actually sleeping.
15. I wake up from light sleep feeling refreshed and ready to start my day.

**Section 4: Sleep Architecture**

16. I frequently experience interrupted sleep during the night.
17. I often have vivid dreams that I remember in the morning.
18. I often experience deep, uninterrupted sleep during the night.
19. My body temperature drops and my heart rate slows as I fall asleep.

## DATA ANALYSIS

This chapter contains the final data analysis from the questionnaire, which was created utilizing the conceptual framework described in the previous chapter. Software from IBM (SPSS) and Microsoft Excel was utilized to assess this data.

## SIMPLE REGRESSION ANALYSIS

- **Independent variable 1: Sleep Duration**

  Normal Probability plot:

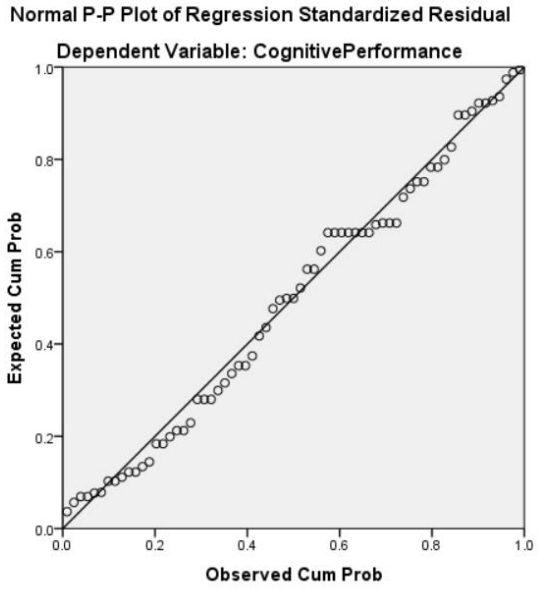


*Figure 2 - Normal Probability Plot (Sleep Duration)*

This graph depicts **positive strong covariance behaviour**, suggesting a visual representation of how sleep duration impacts the cognitive performance.

- **Summary table:**

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .008[a] | .000 | -.015 | .65653 |

a. Predictors: (Constant), SleepDuration

b. Dependent Variable: CognitivePerformance

*Figure 3 - Sleep Duration (Summary Table)*

1. **R (0.008):**

   This is the correlation coefficient, representing the strength of the linear relationship between the independent variable which is Sleep Duration and the dependent variable which is Cognitive Performance. An R value close to zero suggests that there is little to no linear relationship.

2. **R Square (0.000):**

   This is the coefficient of determination, which indicate how much of the variance in the dependent variable Cognitive Performance is explained by the independent variable Sleep Duration. Here, the R Square value of 0.000 means that the model explains 0% of the variance in cognitive performance, so Sleep Duration has no significant predictive power.

3. **Adjusted R Square (-0.015):**

   This is a modified version of R Square that adjusts for the number of predictors in the model. A negative Adjusted R Square means that adding the predictor (Sleep Duration) does not improve the model. It actually worsens the fit compared to a simple mean model.

- **Anova table**

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .002 | 1 | .002 | .004 | .947[b] |
| | Residual | 28.017 | 65 | .431 | | |
| | Total | 28.019 | 66 | | | |

a. Dependent Variable: CognitivePerformance

b. Predictors: (Constant), SleepDuration

*Figure 4 - Sleep Duration (Anova Table)*

- We reject the alternative hypothesis (H1) and accept the null hypothesis (H0) because the significance value (0.947) is much higher than 0.05.
- This implies that there is no statistically significant relationship between Sleep Duration and Cognitive Performance in this analysis. The high p-value shows that the impact of

Sleep Duration on Cognitive Performance is not significant, and the model does not provide any meaningful explanation of the variability in Cognitive Performance.

❖ **Independent variable 2: Sleep Quality**

Normal Probability plot:

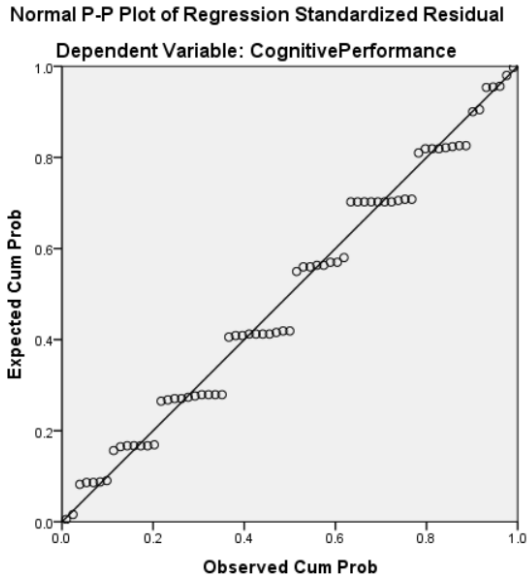


*Figure 5 - Sleep Quality (Normal Probability Plot)*

The graph shows **a strong positive covariance**, illustrating the relationship between sleep quality and cognitive performance. The alignment of observed and expected probabilities indicates that the residuals are normally distributed, supporting the validity of the regression model and highlighting the link between sleep and cognitive outcomes.

**Summary table**

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .426[a] | .182 | .169 | .59390 |

a. Predictors: (Constant), SleepQuality

b. Dependent Variable: CognitivePerformance

*Figure 6 - Sleep Quality (Summary Table)*

1. **R (correlation Coefficient):**

   In this model summary, R is 0.426. The correlation coefficient (R) measures the strength and the direction of the linear relationship between the independent variable which is Sleep Quality and the dependent variable Cognitive Performance. A value of 0.426 indicates a moderate positive correlation, suggesting that as sleep quality improves, cognitive performance tends to improve as well, though it is not very strongly.

2. **R Square (Coefficient of determination):**

   The R Square value is 0.182, which means that it is approximately 18.2% of the variability in cognitive performance can be explained by the sleep quality variable in this model. This suggests that sleep quality has a notable, but not an overwhelmingly strong, influence on cognitive performance, which shows that the other factors may also play significant roles.

3. **Adjusted R Square:**

   The Adjusted R Square value is 0.169. This metric adjusts the R Square value for the number of predictors in the model, accounting for the potential overestimation that can occur when additional variables are included. Since there is only one predictor here which is Sleep Quality, the slight decrease from 0.182 to 0.169 indicates a more accurate estimate of the explained variance, By consideration the sample size and the number of predictors.

**Anova Table**

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 5.092 | 1 | 5.092 | 14.436 | .000[b] |
| | Residual | 22.927 | 65 | .353 | | |
| | Total | 28.019 | 66 | | | |

a. Dependent Variable: CognitivePerformance

b. Predictors: (Constant), SleepQuality

*Figure 7- Sleep Qualitative (Anova Table)*

With a very significant Sig value of 0.000, the ANOVA table shows a statistically significant correlation in the study, suggesting a strong statistical impact in the context of the variables examined.

- **We accept the alternative hypothesis (H1) and reject the null hypothesis (H0)** since the significance value is less than 0.05, which is a typical cutoff point for statistical significance.
- Following established procedures, this indicates a strong statistical link, which validates the importance of the findings within the context of the data studied.

❖ **Independent variable 3: Sleep Architecture**

Normal Probability plot:

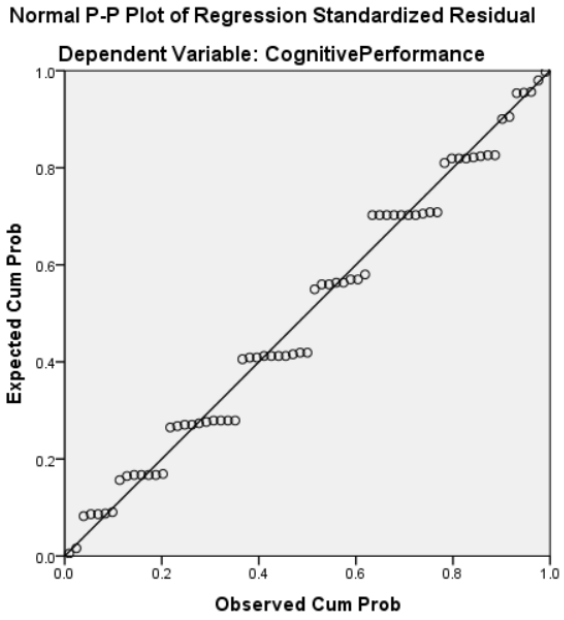


*Figure 8 - Sleep Architecture (Normal Probability plot)*

The graph shows **a strong positive covariance**, illustrating the relationship between sleep Architecture and cognitive performance. The alignment of observed and expected probabilities indicates that the residuals are normally distributed, supporting the validity of the regression model and highlighting the link between sleep and cognitive outcomes.

**Summary table:**

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .017[a] | .000 | -.015 | .65646 |

a. Predictors: (Constant), SleepArchitecture

b. Dependent Variable: CognitivePerformance

*Figure 9 - Sleep Architecture (Summary Table)*

1. **R (correlation Coefficient):**

A value of 0.017 indicates a very weak positive correlation between Sleep Architecture and Cognitive Performance. This suggests that there is almost no linear relationship between the two variables, meaning that variations in sleep architecture have little to no impact on cognitive performance in this model.

2. **R Square (Coefficient of determination):**

The R Square value is 0.000, which means that approximately 0% of the variability in cognitive performance can be explained by the sleep architecture variable in this model. This suggests that sleep quality does not have a notable influence on cognitive performance, indicating that other factors may play more significant roles in affecting cognitive outcomes.

3. **Adjusted R Square:**

Since there is only one predictor here, Sleep architecture, the negative adjusted R Square (-0.015) indicates that the model does not adequately explain the relationship between sleep architecture and the outcome variable.

**Anova Table**

**ANOVA[a]**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | .008 | 1 | .008 | .018 | .893[b] |
| | Residual | 28.011 | 65 | .431 | | |
| | Total | 28.019 | 66 | | | |

a. Dependent Variable: CognitivePerformance

b. Predictors: (Constant), SleepArchitecture

*Figure 10 - Sleep Architecture (Anova Table)*

- **We reject the alternative hypothesis (H1) and accept the null hypothesis (H0)** because the significance value (0.893) is much higher than 0.05.
- This implies that there is **no statistically significant relationship** between Sleep Architecture and Cognitive Performance in this analysis. The high p-value indicates that the impact of Sleep Architecture on Cognitive Performance is not significant, and the model does not provide any meaningful explanation of the variability in Cognitive Performance.

## MULTIPLE VARIABLE REGRESSION ANALYSIS

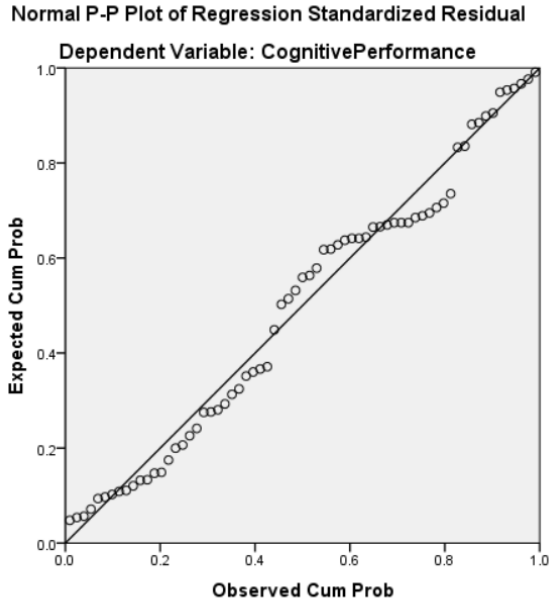


*Figure 11 - Cognitive Performance (Normal Probability plot)*

The above graph shows a positive strong behaviour. It can be interpreted that the all the key independent variables have a visible impact on the cognitive behaviour

**Summary table**

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .465[a] | .216 | .179 | .59030 |

a. Predictors: (Constant), SleepArchitecture, SleepDuration, SleepQuality

b. Dependent Variable: CognitivePerformance

*Figure 12 - Cognitive Performance (Summary Table)*

1. **Model R**:

   The value of 0.465 represents the correlation coefficient between the observed values of the dependent variable (*Cognitive Performance*) and the predicted values from the model. This suggests a moderate relationship between the independent variables (*Sleep Architecture*, *Sleep Duration*, *Sleep Quality*) and cognitive performance.

2. **R Square**:

   The R Square value of 0.216 indicates that approximately 21.6% of the variance in *Cognitive Performance* can be explained by changes in the independent variables. In

other words, these predictors account for a small but notable portion of the variation in the dependent variable.

3. **Adjusted R Square**:

   This value adjusts the R Square to account for the number of predictors in the model, providing a more realistic measure of the model's explanatory power. The adjusted value of 0.179 suggests that, after adjusting for the number of variables, about 17.9% of the variability in *Cognitive Performance* is explained by the model.

4. **Standard Error of the Estimate**:

   A value of 0.59030 represents the standard deviation of the residuals (the difference between observed and predicted values), indicating how much the predictions deviate from the actual observations on average.

**Anova table**

**ANOVA**[a]

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 6.066 | 3 | 2.022 | 5.803 | .001[b] |
| | Residual | 21.953 | 63 | .348 | | |
| | Total | 28.019 | 66 | | | |

a. Dependent Variable: CognitivePerformance

b. Predictors: (Constant), SleepArchitecture, SleepDuration, SleepQuality

*Figure 13 - Cognitive Performance (Anova Table)*

With a significance value of **0.001**, the null hypothesis is rejected in favour of the alternative hypothesis since the value is less than 0.05. This indicates that the key independent variables (*Sleep Architecture*, *Sleep Duration*, and *Sleep Quality*) have a statistically significant impact on *Cognitive Performance*. The F-statistic of **5.803** further suggests that the overall regression model is a good fit for the data, meaning that the predictors collectively explain a significant portion of the variability in the dependent variable.

## COEFFICIENT TABLE

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. | 95.0% Confidence Interval for B | | Correlations | | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | | Lower Bound | Upper Bound | Zero-order | Partial | Part | Tolerance | VIF |
| 1 | (Constant) | 1.397 | .630 | | 2.220 | .030 | .139 | 2.655 | | | | | |
| | SleepDuration | -.212 | .141 | -.182 | -1.510 | .136 | -.493 | .069 | .008 | -.187 | -.168 | .854 | 1.171 |
| | SleepQuality | .800 | .192 | .516 | 4.169 | .000 | .416 | 1.183 | .426 | .465 | .465 | .813 | 1.230 |
| | SleepArchitecture | -.142 | .156 | -.105 | -.914 | .364 | -.453 | .169 | .017 | -.114 | -.102 | .933 | 1.071 |

a. Dependent Variable: CognitivePerformance

*Figure 14 - Coefficientt Table*

- **Constant**: The constant value (1.397) is the predicted Cognitive Performance when all independent variables are 0.
- **Sleep Duration**: The coefficient (-0.212) shows a negative relationship with Cognitive Performance, but it is not statistically significant ($p = 0.136$).
- Sleep Quality: This variable has a significant positive impact on Cognitive Performance ($B = 0.800$, $p < 0.001$), indicating that better sleep quality is associated with better cognitive performance.
- **Sleep Architecture**: This variable has a negative but non-significant effect on Cognitive Performance ($B = -0.142$, $p = 0.364$).
- **Collinearity Statistics (VIF):** All VIF values are below 5, indicating no multicollinearity issues between predictors.

## CONCLUSION

In conclusion, this study has showed the impact of sleep on cognitive performance, focusing on key variables like sleep quality, sleep architecture, and sleep duration. Using the quantitative data from 67 respondents collected through a structured Google Form survey designed to assess "Sleep Patterns and Cognitive Performance," therefore, this research provides a clear idea how sleep affects the mental functioning.

Our findings reveal a complex relationship between sleep and cognitive abilities. Sleep quality emerged as a significant predictor of cognitive performance, emphasizing that restful and uninterrupted sleep is very important for enhancing memory, attention, and problem-solving skills. In contrast, sleep architecture and duration showed minimal impact on cognitive outcomes, suggesting that the structure and length of sleep alone do not significantly boost mental performance.

These results highlight the importance of prioritizing sleep quality to maintain and improve cognitive function in everyday life. And the study also highlights the need to explore other influencing factors beyond sleep for a more comprehensive understanding of cognitive health. This research contributes to the growing body of evidence for a better sleep management as a strategy to optimize cognitive abilities and overall mental well-being.