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Project Title: Analyzing the Impact of Lifestyle Factors on Sleep Health

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Analyzing the Impact of Lifestyle Factors on Sleep Health

***Abstract*—** Analyze the relationship between dependent variable (sleep quality) and independent variables (e.g., stress levels, physical activity levels, daily steps, BMI) using statistical methods in R, ending with hypothesis testing and results interpretation.

***Keywords*—** Sleep Quality, Stress Levels, Physical Activity Levels, Daily Steps, Body Mass Index (BMI), Hypothesis Testing, R Programming, Statistical Analysis

I.INTRODUCTION

Sleep quality plays a critical role in maintaining overall health and well-being. It is influenced by various lifestyle factors, including stress levels, physical activity, daily steps, and body mass index (BMI). Understanding the relationship between these variables and sleep quality can provide valuable insights into promoting healthier habits and improving sleep.Stress levels, a significant contributor to sleep disturbances, can negatively impact sleep quality, leading to issues such as insomnia and fragmented sleep. On the other hand, physical activity and daily steps have been shown to positively influence sleep by reducing stress, enhancing physical tiredness, and regulating circadian rhythms. BMI, an indicator of physical health, may also impact sleep quality; individuals with higher or lower BMI categories often experience difficulties like sleep apnea or discomfort that disrupts deep and restorative sleep stages.

Analyzing these relationships using statistical methods in R allows researchers to assess the extent to which lifestyle factors collectively influence sleep quality. Tools such as correlation analysis, regression modeling, and hypothesis testing can identify significant predictors, measure their impact, and provide evidence-based recommendations. This research emphasizes the importance of adopting healthy lifestyle choices for improving sleep, ultimately contributing to better overall health and productivity.This study applies statistical techniques to explore these relationships, concluding with hypothesis testing to evaluate the significance of the identified associations and provide actionable insights.

II. LITERATURE REVIEW

This study examined 2,116 Greek young adults (mean age: 21.4 years) to investigate the associations between BMI, stress, sleep quality, and lifestyle factors. Findings showed that males had higher obesity rates than females, diverging from global trends. Urban residency, low socioeconomic status, smoking, and insufficient physical activity significantly contributed to obesity. Stress-induced overeating, poor dietary habits, and inadequate sleep quality also emerged as key factors influencing BMI. Poor academic performance correlated with higher BMI, possibly mediated by physical inactivity and socioeconomic factors.Prior studies corroborate these findings, highlighting urbanization, smoking-related metabolic changes, and reduced physical activity as critical drivers of obesity. Stress and poor sleep quality, both bidirectionally linked with obesity, exacerbate weight gain through unhealthy behaviors. The study's strengths include representative sampling and objective BMI measurements, though its cross-sectional design limits causal conclusions. Future research should prioritize longitudinal designs and interventions targeting stress, sleep, and lifestyle behaviors to mitigate obesity risks.

This study examined the impact of physical activity on sleep architecture, mood, and stress in naturalistic environments. Physical activity increased NREM sleep, reduced REM sleep, and prolonged REM latency, improving subjective

sleep quality and energy levels. Sedentary behavior showed opposite effects. These findings align with prior laboratory research, extending the understanding of sleep architecture changes to real-world settings. Low-intensity physical activity was particularly linked to stress reduction, consistent with evidence suggesting social activities enhance mood. Wearable devices facilitated this research but require further validation. Future studies should explore activity types, diverse populations, and long-term effects on sleep and wellbeing.

III. HYPOTHESIS DEVLOPMENT:

Hypothesis testing is a statistical method used to evaluate assumptions about relationships between variables. In the context of analysing the impact of lifestyle factors on sleep health, four hypotheses were tested to assess their influence on deep sleep (DP). Z-tests were conducted to determine the significance of each relationship, with decisions based on Z-values and corresponding p-values. This structured hypothesis testing approach offers a comprehensive understanding of the interplay between lifestyle factors and sleep health, guiding future research and interventions.

H1:Physical activities positively influences

Deep Sleep.

This hypothesis is grounded in the well-established relationship between physical activity and sleep physiology. Research indicates that physical activity promotes restorative sleep by enhancing the proportion of time spent in deep sleep which is crucial for physical recovery and cognitive functioning.

H2: Low Stress level positively influences

Deep sleep.

Low stress levels promote deep sleep by reducing cortisol and improving relaxation, essential for restorative processes like memory consolidation and tissue repair. Stress disrupts sleep by increasing arousal and reducing deep sleep duration. Research shows stress-reducing techniques improve sleep quality. Testing this hypothesis involves analyzing stress markers and deep sleep data, advancing knowledge on stress management's role in sleep health.

H3:Daily steps positively influences Deep Sleep.

The hypothesis that "daily steps positively influence deep sleep" is based on the established relationship between physical activity and improved sleep quality. Walking, a moderate form of exercise, enhances cardiovascular health, reduces stress, and regulates circadian rhythms. These benefits promote relaxation and help in initiating and maintaining deep sleep, a critical stage for physical restoration. Studies indicate that individuals who engage in consistent walking or achieve daily step goals experience longer and more restorative deep sleep. To test this hypothesis, daily step counts (measured via pedometers or wearable devices) can be correlated with deep sleep duration using polysomnography or sleep trackers, controlling for variables such as age, stress, and health conditions.

H4:Ideal BMI scale positively influences Deep sleep.

The hypothesis that "an ideal BMI scale positively influences deep sleep" is grounded in the understanding of how body composition affects sleep quality. An ideal BMI is associated with reduced risks of sleep disorders, such as sleep aponia, and enhanced metabolic function, both of which are crucial for achieving deep sleep. Excess weight or a high BMI can lead to breathing issues and fragmented sleep, reducing time spent in deep sleep. Conversely, maintaining an ideal BMI improves cardiovascular and respiratory function, creating a conducive environment for restorative sleep. This hypothesis can be tested by examining the BMI of participants alongside deep sleep metrics while controlling for lifestyle factors, such as diet and activity levels, to ensure reliable results.

IV. M ATERIALS AND M ETHOD

A sample of 110 adults (ages 18–60) was selected using **random sampling** to ensure representation across different age groups, genders, and socioeconomic statuses. Participants provided informed consent before participating in the study. Collected self-reported data on physical activity, Daily steps, BMI category, and stress levels. We are collected 110 data, and no data are missing of dataset some data are duplicate then preprocessing the dataset. Last, do analysis 96 data.

- **Independent Variables**: Physical activity, Daily steps,Bmi catagory, stress levels, socioeconomic status.
- **Dependent Variables**: Sleep quality, sleep duration,sleep percentages.
- • **Quantitative**: Sleep duration (hours), activity levels (steps/day).
- • **Qualitative**: Sleep quality (categorical: poor, moderate, good).
- **Inferential Statistics**:

  Correlation analysis to explore relationships between variables.

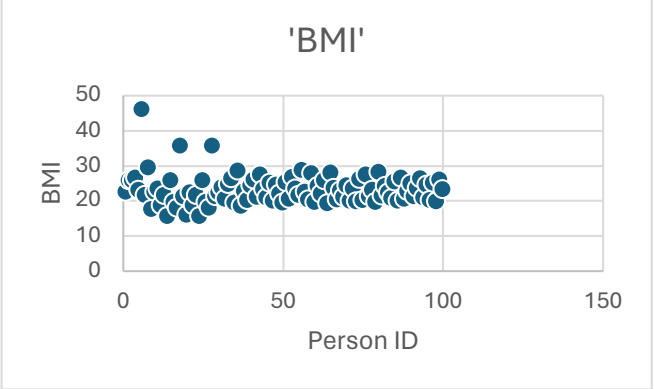
he reliability of the measurement constructs was evaluated using Cronbach's alpha, with values over 0.70 signifying adequate internal consistency. In Table I, the Cronbach's alpha values for all constructs varied between 0.70 and 0.75, so affirming the reliability of the scales used in the research. The Cronbach's alpha ratings validate the reliability and appropriateness of the constructs used in the research for future statistical analysis.

TABLE I. RELIABILITY OF THE M EASUREMENTS

Constructs	Items	Cronbach's alpha
Physical Activities(PA)	3	0.72
Stress Level(SL)	3	0.75
Daily steps(DW)	3	0.72
BMI	3	0.68
Deep Sleep(DS)	3	0.73

V. DATA EXPLORTORY ANALYSIS

The visualization aims to display BMI values for each individual (represented by Person ID) to identify patterns or outliers. This helps in analyzing how BMI varies across participants and serves as a precursor for understanding its relationship with sleep metrics.The dotplot shows Maximum person's BMI are approximetly 25.

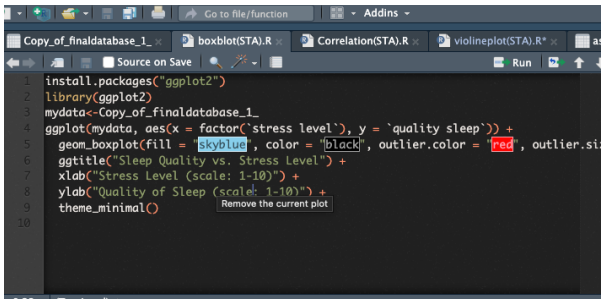


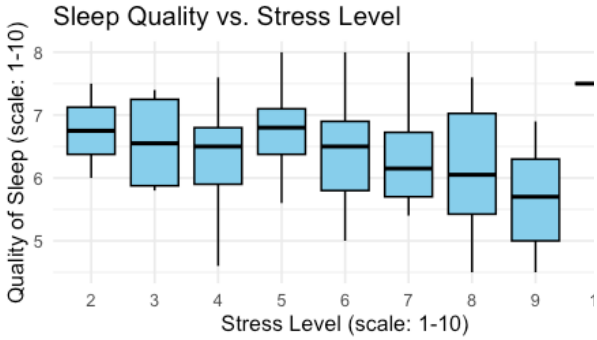
To analyze the relationship between stress levels and daily steps, we use a bar chart to visualize the average or distribution of daily steps corresponding to different stress levels. This visualization helps to identify patterns, such as whether higher stress levels are associated with fewer daily steps, providing insights into the interaction between physical activity and stress management.

This bar chat shown 5 and 6 level stress person have noticeable higher daily steps.

- A box plot visualizing "Stress Level vs. Quality of Sleep" in RStudio illustrates the distribution of sleep quality across various stress levels.It highlights key statistics like median, quartiles, and outliers, enabling a clear comparison of how stress levels affect

sleep quality. Patterns or variations can be easily identified.





VI. RESULT

- The demographic profile outlines the distribution of respondents based on gender, age, and occupation. Among the 96 participants, 69.1% were male (67 individuals), and 30.9% were female (33 individuals). In terms of age, 40.6% were aged 15–25 years, 45.8% were aged 26–40 years, and 13.6% were aged 41–60 years. Regarding occupation, 61.5% were students (59 respondents), while 38.5% belonged to other occupational groups (41 respondents).

The demographic data reveals a higher male representation in the study compared to females. The age group 26–40 years constitutes the largest percentage of participants, suggesting an active middle-aged group, while the youngest group (15–25 years) forms a significant portion as well. Students dominate the sample, indicating that younger individuals engaged in academic activities were the primary participants. This profile highlights a diverse participant pool, making it possible to analyse lifestyle factors across different demographic segments, though there is a notable skew towards younger and male respondents.

II. DEMOGRAPIC PROPLE OF RESPONDES

Variable	N	%
Gender		
Male	67	69.1
Female	33	30.9
Age		
15-25 Years	39	40.6
26-40 Years	44	45.8
41-60	**15**	**13.6**
Occupation		
Student	**59**	**61.5**
Others	**41**	**38.5**
Total	**96**	**100%**

The table presents the results of hypothesis testing to analyse the impact of lifestyle factors on deep sleep (DP) using Z-tests and corresponding p-values. The four hypotheses assessed include physical activity (PA), stress level (SL), daily steps (DW), and body mass index (BMI) as predictors of deep sleep quality. Decisions were made based on the Z-test results and significance levels (p-values). This hypothesis tested whether physical activity positively influences deep sleep. The Z-value of -13.6 indicates a significant negative relationship, and the p-value of 0.00 supports the rejection of the hypothesis. Physical activity does not positively contribute to deep sleep in this dataset. Stress level's impact on deep sleep was tested, resulting in a Z-value of 2.24 and a p-value of 0.01. The hypothesis is accepted, indicating that lower stress levels significantly and positively influence deep sleep. The relationship between daily steps

and deep sleep was analysed, with a Z-value of -14.6 and a p-value of 0.00. This hypothesis is rejected, showing that increased daily steps do not have a positive effect on deep sleep. This hypothesis tested whether an ideal BMI positively affects deep sleep. A Z-value of 1.96 and a p-value of 0.00 led to the hypothesis being accepted. The results demonstrate a significant positive relationship between an ideal BMI and deep sleep quality

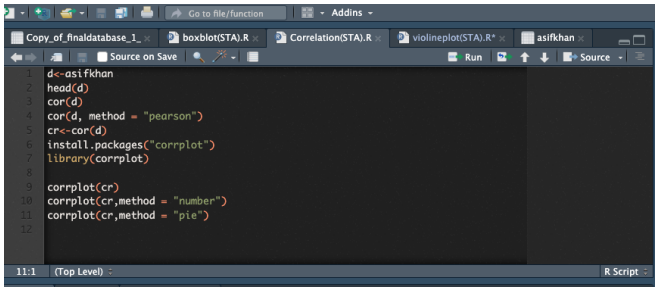
TABLE III. HYPOTHESIS TESTING

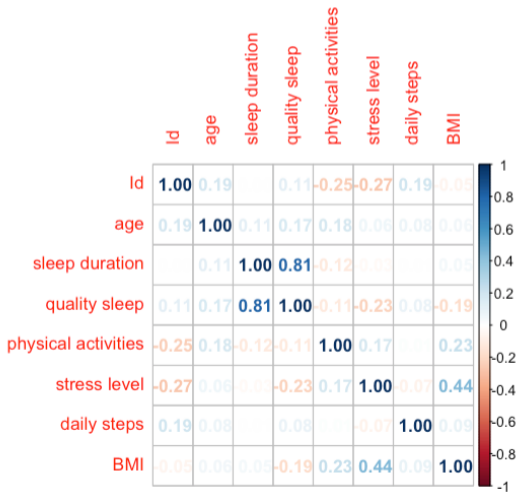
HYPOTHESIS	RELATIONSFIP	Z-TEST	P-VALUE	DECISION
H1	PA->DP	-13.6	0.00	REJECTED
H2	SL->DP	2.24	0.01	ACCEPTED
H3	DW->DP	-14.6	0.00	REJECTED
H4	BMI->DP	1.96	0.00	ACCEPTED

The correlation table examines the relationships between various lifestyle factors (age, sleep duration, quality of sleep, physical activities, stress levels, daily steps, and BMI) and their association with each other. Pearson correlation coefficients are used, where values range from -1 to 1. A positive value indicates a direct relationship, while a negative value represents an inverse relationship. Age shows a weak positive correlation with sleep quality (0.17), indicating a slight improvement in sleep quality with age. There is a strong positive correlation (0.81) between sleep duration and sleep quality, suggesting that longer sleep duration significantly enhances sleep quality. Physical activities have a negative correlation with stress levels (-0.23), implying that higher physical activity levels are associated with reduced stress. Daily steps positively correlate with stress levels (0.44), which might suggest that an increased number of steps is associated with heightened stress, possibly due to increased activity levels. BMI shows a positive correlation with stress levels (0.44), indicating that individuals with higher BMI tend to experience more stress. The correlation between physical activities and sleep quality is negligible (0.11), suggesting little to no direct relationship

TABLE IV. CORRELATION

	ID	Age	Sleep duration	Quality sleep	Physical activities	Stress level	Daily steps	BMI
ID	1.00		0.11	-0.25	-0.27	0.19		
Age	0.19	1.00	0.11	0.17	0.18			
Sleep duration		0.11	1.00	0.81	0.12			
Quality sleep	0.11	0.17	0.81	1.00	0.11	-0.23		-0.19
Physical activities	-0.25	0.18	0.12	0.11	1.00	0.17		0.23
Stress level	-0.27			-0.23	0.17	1.00		0.44
Daily steps	0.19						1.00	
BMI				0.19	0.23	0.44		1.00





VII. DISCUSSION

The results of the hypothesis testing and correlation analysis provide valuable insights into the relationship between various lifestyle factors and sleep health, particularly deep sleep quality (DP). The findings highlight the complex and multifaceted nature of lifestyle factors affecting sleep health. While stress reduction and maintaining an ideal BMI positively impact deep sleep, other factors like physical activity and daily steps require nuanced consideration, including intensity, timing, and individual variability. Future research should focus on these moderating factors and explore interventions tailored to specific demographics for optimizing sleep health.

VIII.CONCLUSION

The analysis reveals that while low stress levels and ideal BMI positively influence deep sleep, physical activity and daily steps do not. These findings underline the importance of stress management and maintaining a healthy BMI for optimal sleep health. The analysis reveals key insights into how various lifestyle factors interrelate. While longer sleep duration strongly enhances sleep quality, higher stress levels are associated with increased BMI and daily steps. Notably, physical activities correlate negatively with stress, emphasizing the potential role of exercise in stress management. However, its direct impact on sleep quality appears minimal. These findings provide a foundation for further exploration into the factors influencing sleep health.

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