Analysis

December 3, 2023

1 Descriptive Statistics & Visualization

1.1 Descriptive Statistics

[2]:
```
import pandas as pd
import numpy as np

df= pd.read_csv('data/all.csv', parse_dates=True, )
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 108 entries, 0 to 107
Data columns (total 21 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   Timestamp                       108 non-null    object
 1   Age Group                       108 non-null    object
 2   Gender                          108 non-null    object
 3   Education Level                 108 non-null    object
 4   Occupation                      108 non-null    object
 5   Exercise Days/Week              108 non-null    object
 6   Device Usage (hrs/day)          108 non-null    object
 7   Screen Time Before Sleep        108 non-null    object
 8   Height (cm)                     83 non-null     float64
 9   Weight (kg)                     92 non-null     float64
 10  Bedtime                         108 non-null    object
 11  Wake-up Time                    108 non-null    object
 12  Sleep Onset Time                108 non-null    object
 13  Nap Duration                    108 non-null    object
 14  Sleep Duration (hrs/24hr)       107 non-null    object
 15  Sleep Quality                   108 non-null    int64
 16  Sleep Disturbances              108 non-null    object
 17  Sleep Medication                108 non-null    object
 18  Language                        108 non-null    object
 19  BMI                             80 non-null     float64
 20  Calculated Night Sleep Duration  105 non-null   float64
dtypes: float64(4), int64(1), object(16)
memory usage: 17.8+ KB
```

Some random samples from the dataset:

[3]:

	Age Group	Gender	Education Level	Occupation	\
50	16-24	Male	High School	Student	
75	25-34	Male	Master's	Other	
59	25-34	Male	Doctorate	Professional/Office Worker	
92	25-34	Female	Master's	Professional/Office Worker	
35	25-34	Female	Bachelor's	Professional/Office Worker	

	Exercise Days/Week	Device Usage (hrs/day)	Screen Time Before Sleep	\
50	3-4 Days	1-3 Hours	30-60 Minutes	
75	3-4 Days	4-6 Hours	<30 Minutes	
59	5+ Days	4-6 Hours	1-2 Hours	
92	3-4 Days	4-6 Hours	1-2 Hours	
35	1-2 Days	7+ Hours	30-60 Minutes	

	Height (cm)	Weight (kg)	Bedtime	Wake-up Time	Sleep Onset Time	\
50	174.00	79.0	01:00	07:00	<15 Minutes	
75	NaN	NaN	23:00	07:00	<15 Minutes	
59	180.00	85.0	23:00	06:30	<15 Minutes	
92	NaN	NaN	23:00	06:00	<15 Minutes	
35	172.72	70.0	23:00	06:00	15-30 Minutes	

	Nap Duration	Sleep Duration (hrs/24hr)	Sleep Quality	Sleep Disturbances	\
50	30-60 Minutes	4-6 Hours	2	Rarely	
75	<30 Minutes	6+ Hours	4	Sometimes	
59	No Nap	6+ Hours	4	Rarely	
92	No Nap	6+ Hours	4	Rarely	
35	No Nap	4-6 Hours	4	Rarely	

	Sleep Medication	Language	BMI	Calculated Night Sleep Duration
50	No	English	26.1	6.0
75	No	Bengali	NaN	8.0
59	No	English	26.2	7.5
92	No	Vietnamese	NaN	7.0
35	No	English	23.5	7.0

1.1.1 Overall descriptive stats

[5]:

	Height (cm)	Weight (kg)	Sleep Quality	BMI	\
count	83.000000	92.000000	108.000000	80.000000	
mean	165.305542	67.415217	3.444444	24.552500	
std	8.321679	12.798085	0.824092	4.245503	
min	150.000000	43.000000	2.000000	17.500000	
25%	160.000000	59.800000	3.000000	21.500000	
50%	167.000000	68.000000	3.000000	23.550000	
75%	171.000000	75.000000	4.000000	26.600000	
max	185.000000	100.000000	5.000000	39.400000	

```
       Calculated Night Sleep Duration
count                       105.000000
mean                          7.036952
std                           1.368431
min                           1.670000
25%                           6.500000
50%                           7.000000
75%                           8.000000
max                           9.750000
```

- **Sleep Quality:** On average, respondents rated their sleep quality around 3 on a scale, indicating moderate sleep quality.
- **BMI:** The average Body Mass Index (BMI) is around 23.55, with a range extending from 16.5 to 39.4.
- **Calculated Night Sleep Duration:** The average night sleep duration is around 7 hours, with a wide range from 1.67 hours to almost 9.75 hours.

[6]:
```
       Age Group Gender Education Level Occupation Exercise Days/Week  \
count        108    108             108        108                108
unique         5      3               4          7                  4
top        25-34   Male        Master's    Student           1-2 Days
freq          72     67              47         47                 43

       Device Usage (hrs/day) Screen Time Before Sleep Bedtime Wake-up Time  \
count                     108                      108     108          108
unique                      4                        4      18           20
top                 7+ Hours            30-60 Minutes   23:00        07:00
freq                       43                       45      24           18

       Sleep Onset Time Nap Duration Sleep Duration (hrs/24hr)  \
count               108          108                       107
unique                4            5                         3
top       15-30 Minutes       No Nap                 6+ Hours
freq                 55           61                        64

       Sleep Disturbances Sleep Medication Language
count                 108              108      108
unique                  5                2        4
top                Rarely               No  English
freq                   48              105       68
```

- **Age Group:** The most common age group among respondents is 25-34.
- **Gender:** A slightly higher number of male respondents compared to females.
- **Education Level:** The majority of respondents have a Master's degree.
- **Occupation:** Many respondents are students.
- **Exercise Days/Week:** '1-2 Days' is the most common response for exercise frequency.
- **Device Usage (hrs/day):** A large portion of respondents use devices for '7+ Hours' per

day.

- **Screen Time Before Sleep:** '30-60 Minutes' is the most common duration for screen time before sleep.
- **Sleep Disturbances:** 'Rarely' is the most frequent response, indicating that most respondents rarely experience sleep disturbances.
- **Sleep Medication:** The majority of respondents do not use sleep medication.
- **Language:** English is the most common language among respondents.

1.1.2 Sleep related fields

[7]:

	Sleep Duration (hrs/24hr)	Sleep Quality	Sleep Disturbances	\
count	107	108.000000	108	
unique	3	NaN	5	
top	6+ Hours	NaN	Rarely	
freq	64	NaN	48	
mean	NaN	3.444444	NaN	
std	NaN	0.824092	NaN	
min	NaN	2.000000	NaN	
25%	NaN	3.000000	NaN	
50%	NaN	3.000000	NaN	
75%	NaN	4.000000	NaN	
max	NaN	5.000000	NaN	

	Sleep Medication	Calculated Night Sleep Duration
count	108	105.000000
unique	2	NaN
top	No	NaN
freq	105	NaN
mean	NaN	7.036952
std	NaN	1.368431
min	NaN	1.670000
25%	NaN	6.500000
50%	NaN	7.000000
75%	NaN	8.000000
max	NaN	9.750000

Sleep Duration:

The most common reported sleep duration is '6+ Hours'. This suggests that a majority of the respondents are getting the minimum recommended amount of sleep for adults, which is usually around 7-9 hours. However, without more specific data on those who sleep '6+ Hours' (e.g., whether they are closer to 6 or 9 hours), it's hard to assess the adequacy of sleep duration precisely.

Sleep Quality:

The average sleep quality score is 3.44 out of 5. This indicates a moderate level of sleep quality among the respondents. A score closer to 5 would suggest better sleep quality, so there's room for improvement. The presence of some variability (standard deviation of 0.82) suggests differing sleep quality experiences among respondents.

Sleep Disturbances:

'Rarely' being the most common response for sleep disturbances is a positive sign, suggesting that most respondents do not frequently experience sleep disturbances.

Sleep Medication:

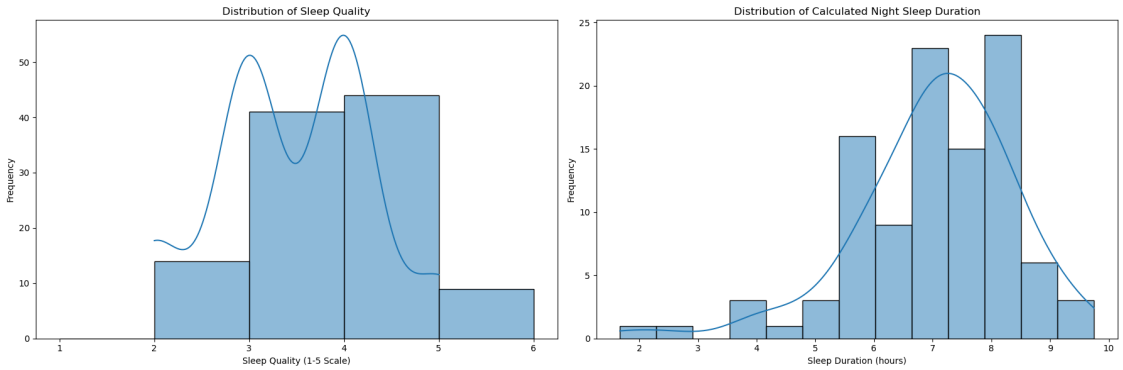
The fact that the vast majority of respondents do not use sleep medication (105 out of 108) could indicate that sleep issues are not severe enough to require medication, or there might be a preference for non-medical approaches to sleep improvement.

Calculated Night Sleep Duration:

The calculated average night sleep duration is approximately 7 hours, which aligns with general sleep recommendations. However, the range (minimum of 1.67 hours and a maximum of 9.75 hours) indicates significant variability among respondents. Overall, these statistics suggest a relatively positive picture in terms of sleep quantity (with most respondents getting 6 or more hours of sleep) and a moderate level of sleep quality. However, the variability in sleep quality and duration indicates that experiences vary significantly among individuals. This variability could be explored further to understand what factors (like lifestyle, diet, or exercise) might be influencing sleep patterns.

1.2 Visualization

1.2.1 Overview



Distribution of Sleep Quality:

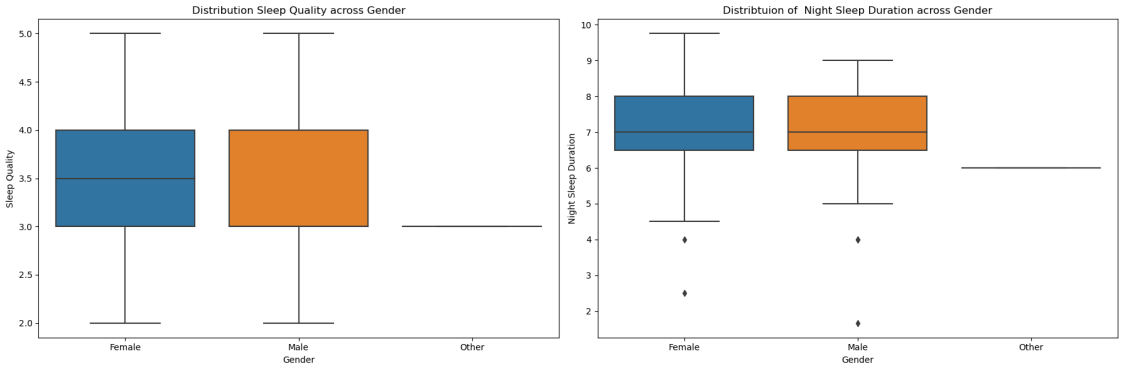
The sleep quality scores are distributed mainly between 2 and 4, with the majority of respondents reporting a sleep quality of 3. There's a smaller number of respondents with sleep quality scores of 5, indicating excellent sleep quality.

Distribution of Calculated Night Sleep Duration:

The histogram shows a fairly normal distribution centered around 7 hours, which aligns with general sleep recommendations. There are fewer instances of very short (<5 hours) or very long (>9 hours) sleep durations.

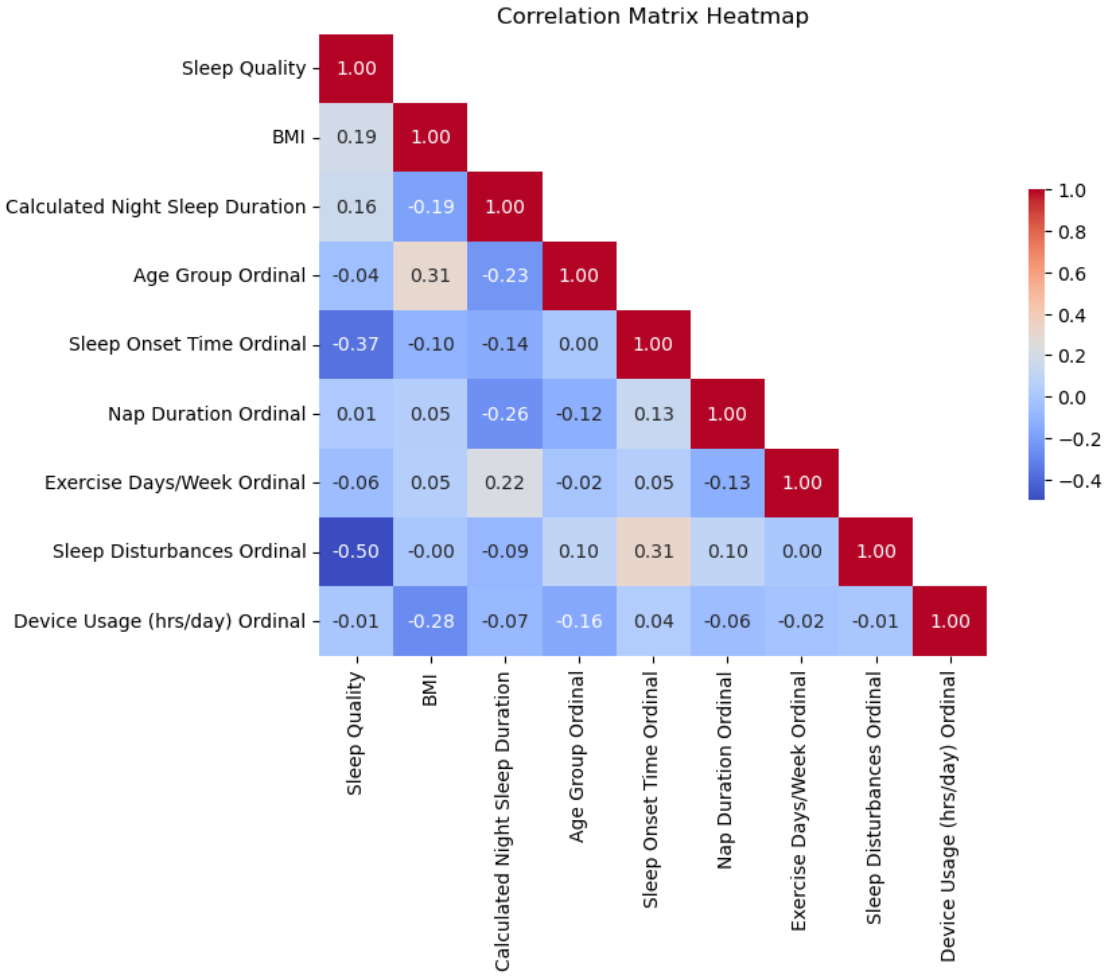
These distributions provide a baseline understanding of sleep patterns among the respondents. Next, let's proceed with the box plots for sleep quality across different exercise frequencies and

device usage categories, followed by a scatter plot for BMI vs. sleep quality and a bar chart for sleep disturbances. Let's start with the box plots.



Based on the analysis of the boxplots presented, it is evident that there is a remarkable similarity in sleep quality between male and female participants. Furthermore, the duration of sleep at night for both genders demonstrates a close alignment, with only slight variations observed in the first and second quartiles.

1.2.2 Correlation matrix

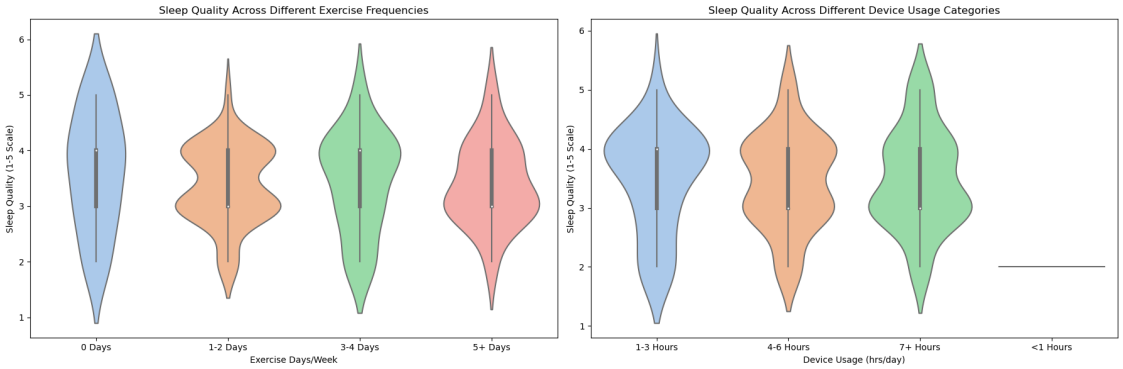


- **Sleep Quality:** Strong negative correlation with Sleep Disturbances (-0.55), indicating better sleep quality is associated with fewer disturbances. Moderate negative correlation with Sleep Onset Time (-0.32), suggesting that quicker sleep onset is associated with better sleep quality.
- **BMI:** Slight negative correlation with Calculated Night Sleep Duration (-0.19), suggesting that higher BMI might be slightly associated with shorter sleep duration, although the relationship is weak. Moderate negative correlation with Device Usage (-0.28), indicating that higher BMI is associated with less device usage.
- **Calculated Night Sleep Duration:** Negative correlation with Age Group (-0.23), indicating that older age groups might have shorter sleep duration. All other correlations with Calculated Night Sleep Duration are weak.
- **Age Group:** Moderate positive correlation with BMI (0.31), suggesting that higher BMI values are more prevalent in older age groups.
- **Sleep Onset Time:** No significant correlations with other variables, aside from the moderate negative correlation with Sleep Quality.

- **Nap Duration:** Weak correlations with all other variables.
- **Exercise Days/Week:** Slight positive correlation with Calculated Night Sleep Duration (0.22), implying that more exercise might be related to slightly longer sleep duration. Weak correlations with all other variables.
- **Sleep Disturbances:** Aside from the strong negative correlation with Sleep Quality, Sleep Disturbances show weak correlations with other variables.
- **Device Usage (hrs/day):** Moderate negative correlation with BMI (-0.28), as previously mentioned. Weak correlations with all other variables. This heatmap indicates that while some variables are correlated, most relationships are weak. The strongest observed relationships involve sleep quality, particularly its negative correlation with sleep disturbances and sleep onset time. This suggests that variables affecting the quality of sleep have a more significant impact on sleep disturbances and the time it takes to fall asleep. The correlations involving BMI, age group, and device usage suggest demographic and behavioral patterns but are not strong enough to imply causation.

1.2.3 Relationship with Sleep: Exercise and Device Usage

Sleep Quality



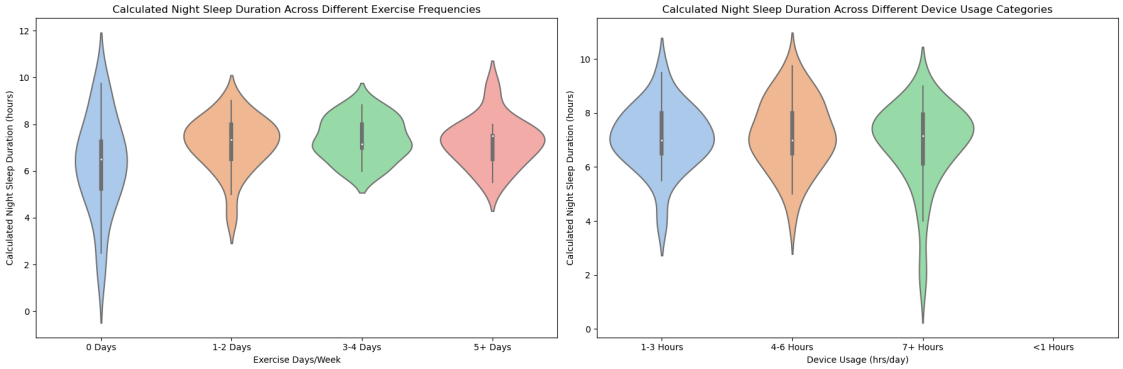
Sleep Quality Across Different Exercise Frequencies:

The plot shows the distribution of sleep quality scores for each exercise frequency category. While there is some variation in the spread and density of scores across categories, there is no clear pattern indicating a strong relationship between exercise frequency and sleep quality.

Sleep Quality Across Different Device Usage Categories:

Similar to exercise frequency, the distribution of sleep quality scores varies across device usage categories. However, there is no evident trend showing a significant impact of device usage on sleep quality.

Sleep Duration



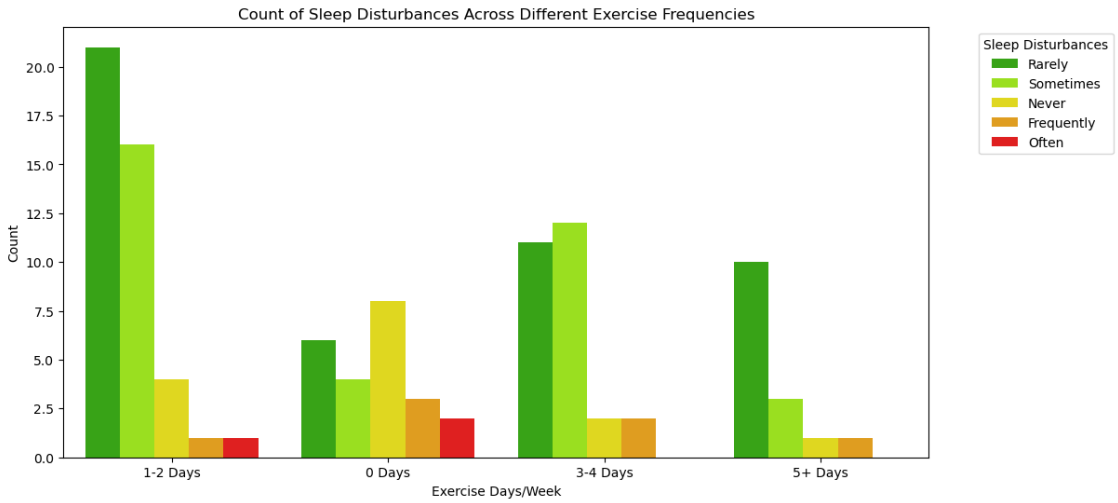
General Trends: The distribution of sleep duration across different exercise frequencies and device usage categories shows some variation, but not a distinct or consistent pattern that strongly suggests a direct relationship. For exercise, categories with higher frequencies ('3-4 Days', '5-6 Days') show a slightly more concentrated distribution around higher sleep durations, indicating a potential positive impact of regular exercise on sleep duration. However, this pattern is not uniformly observed across all exercise levels.

Impact on Lower Sleep Duration Bounds:

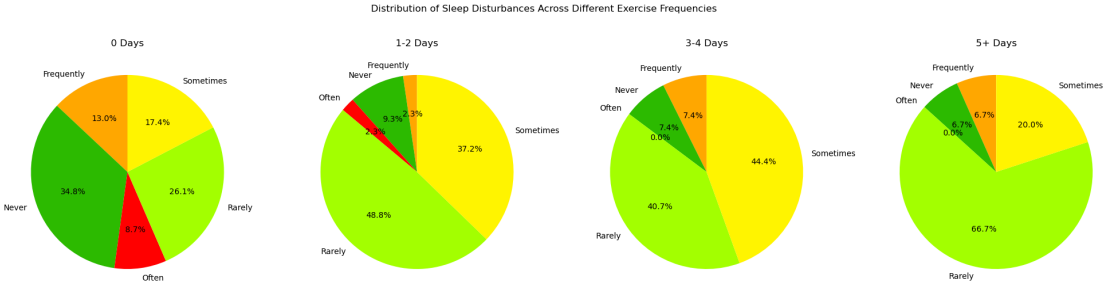
Exercise: In categories with lower exercise frequency ('0 Days', '1-2 Days'), the distribution has a tail extending towards shorter sleep durations. This suggests that within these groups, some individuals experience shorter sleep durations, potentially implicating lower physical activity as a factor in reduced sleep duration. This could be due to less physical tiredness, differing stress levels, or other lifestyle factors.

Device Usage: Similarly, for higher device usage categories ('5-7 Hours', '7+ Hours'), there's a noticeable extension towards shorter sleep durations. This indicates that among individuals with high screen time, a subset experiences shorter sleep. This could be attributed to factors like blue light exposure impacting circadian rhythms, increased mental stimulation, or the displacement of sleep time. These observations highlight the complex and multifaceted nature of factors influencing sleep duration. While higher physical activity and lower device usage might be associated with longer sleep durations for some individuals, the variability within each category underlines the influence of multiple interacting factors. These insights provide a basis for further investigation into how lifestyle modifications, such as increasing physical activity or managing screen time, could potentially improve sleep duration, particularly for those currently experiencing shorter sleep.

Sleep Disturbances The bar chart depicts the count of different sleep disturbance responses (Rarely, Sometimes, Never, Frequently, Often) across various exercise frequency categories (0 Days, 1-2 Days, 3-4 Days, 5+ Days). There is a noticeable trend where individuals who do not exercise (0 Days) have a higher count of sleep disturbances across almost all types of disturbance frequencies, especially for the responses 'Sometimes' and 'Rarely'. As the exercise frequency increases, the count of reported sleep disturbances seems to decrease, particularly for 'Sometimes' and 'Rarely' disturbances. For example, those exercising '5+ Days' show a lower count of disturbances. Interestingly, the 'Never' response appears to be relatively consistent across all exercise frequencies, suggesting a subset of individuals who do not experience disturbances regardless of exercise habits.



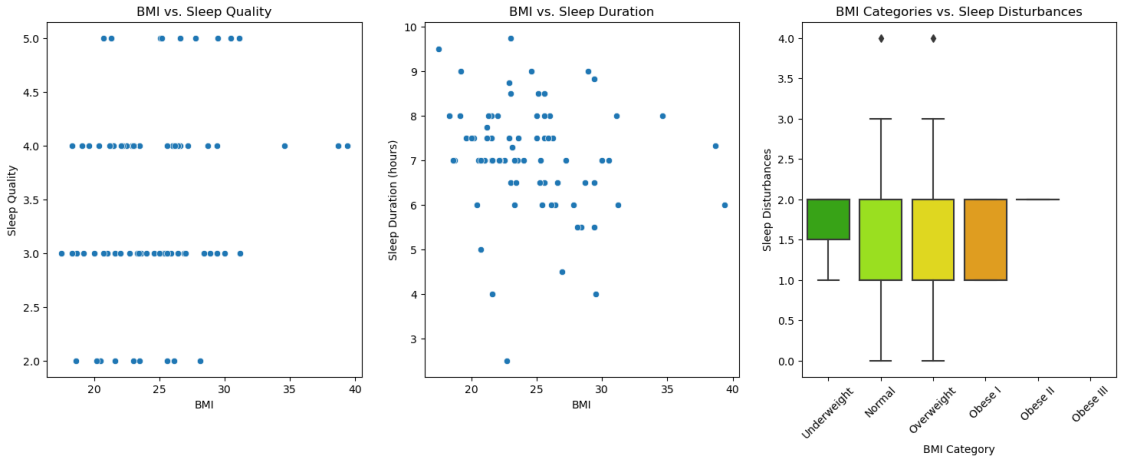
- The bar chart depicts the count of different sleep disturbance responses (Rarely, Sometimes, Never, Frequently, Often) across various exercise frequency categories (0 Days, 1-2 Days, 3-4 Days, 5+ Days).
- There is a noticeable trend where individuals who do not exercise (0 Days) have a higher count of sleep disturbances across almost all types of disturbance frequencies, especially for the responses 'Sometimes' and 'Rarely'.
- As the exercise frequency increases, the count of reported sleep disturbances seems to decrease, particularly for 'Sometimes' and 'Rarely' disturbances. For example, those exercising '5+ Days' show a lower count of disturbances.
- Interestingly, the 'Never' response appears to be relatively consistent across all exercise frequencies, suggesting a subset of individuals who do not experience disturbances regardless of exercise habits.



- The pie charts show the distribution of sleep disturbances within each exercise category. This gives a percentage breakdown of how often individuals within each exercise group experience sleep disturbances.
- In the '0 Days' exercise category, a significant proportion reports 'Sometimes' experiencing disturbances, followed by 'Rarely' and 'Frequently'. Interestingly, the majority of this group (34.8%) reported to 'Never' have sleep disturbances.

- As exercise frequency increases, there is a visible shift toward 'Rarely' being the most common response, suggesting better sleep quality with more frequent exercise.
- In the highest exercise frequency group ('5+ Days'), the majority report 'Rarely' experiencing sleep disturbances, which supports the notion that regular exercise may contribute to fewer sleep disturbances.

1.2.4 Relationship with Sleep: BMI



- **BMI vs. Sleep Quality (Scatter Plot on the Left):** The scatter plot shows individual points representing the relationship between BMI and sleep quality for each respondent. There does not appear to be a clear trend or pattern indicating a strong relationship between BMI and sleep quality. The points are quite dispersed, suggesting that other factors might also play a significant role in determining sleep quality.
- **BMI vs. Sleep Duration (Scatter Plot in the Middle):** Similar to sleep quality, the scatter plot for BMI and calculated night sleep duration does not show a distinct correlation. The spread of points indicates variability in sleep duration across the range of BMI values.
- **BMI vs. Sleep Disturbances (Box Plot on the Right):** The box plot visualization indicates that there is no clear or significant difference in the median sleep disturbances across BMI categories ranging from Underweight to Obese III. All categories have a similar median value, suggesting that BMI alone is not a strong predictor of sleep disturbances. The presence of outliers in each category suggests individual variability, and the interquartile ranges (box lengths) show that the spread of sleep disturbances is relatively consistent across categories, with some variation in the Underweight category. Overall, the plot suggests that while BMI may play a role, it is likely one of many factors that contribute to sleep disturbances.
- **Summary:** The data visualizations suggest that BMI, within the range present in the dataset, does not have a straightforward relationship with sleep quality, duration, or disturbances. This indicates the complexity of sleep-related issues and the possibility that they are influenced by a multitude of factors, with BMI being just one of them. Detailed statistical analysis would be required to identify any subtle patterns or to confirm the lack of a relationship.

1.3 Summary

In this document, we present a comprehensive analysis of the sleep survey data. The key points are:

1. **Descriptive Statistics Summary**:
   - **Sleep Quality**: The average rating is 3.44 out of 5, indicating moderate sleep quality with room for improvement.
   - **BMI**: The average BMI is approximately 24.55, with a range from 17.5 to 39.4, covering normal to obese categories.
   - **Sleep Duration**: The average night sleep duration is about 7 hours, with a range from 1.67 to 9.75 hours, showing significant variability.
2. **Visualization Summary**:
   - **Sleep Quality Distribution**: Scores are mainly distributed between 2 and 4, with 3 being the most common, suggesting moderate sleep quality overall.
   - **Sleep Duration Distribution**: There's a normal distribution centered around 7 hours, aligning with general recommendations.
3. **Correlation Matrix Summary**:
   - **Sleep Quality**: Shows a moderate negative correlation with sleep disturbances, which is expected as better sleep quality typically associates with fewer disturbances.
   - **BMI**: Displays low correlations with other variables, suggesting it is not a strong determinant of sleep patterns in this dataset.
   - **Sleep Duration and Exercise**: A small positive correlation suggests more exercise might be linked to slightly longer sleep duration, but the relationship is not strong.
4. **Relationship with Sleep, Exercise, and Device Usage**:
   - **Sleep Quality and Exercise**: No strong relationship is evident; sleep quality scores are distributed across exercise frequencies without a clear pattern.
   - **Sleep Quality and Device Usage**: Similar to exercise, no significant impact of device usage on sleep quality is observed.
   - **Sleep Duration Trends**: Some variation in sleep duration across exercise frequencies and device usage is noted, but no consistent pattern emerges.
5. **Sleep Disturbances**:
   - **Exercise Frequency**: A decreasing trend in sleep disturbances is observed with increased exercise frequency. Notably, individuals who do not exercise report higher disturbances, while those with higher exercise frequency report fewer disturbances.
   - **Sleep Disturbance Distribution**: Pie charts demonstrate that more frequent exercise correlates with 'Rarely' experiencing disturbances, suggesting a beneficial effect of exercise on sleep quality.
6. **BMI and Sleep**:
   - The scatter plots do not reveal a clear trend between BMI and sleep quality or duration, indicating that BMI is not a strong predictor of these aspects of sleep.
   - The box plot shows no significant differences in sleep disturbances across BMI categories.

Overall, the analysis suggests that while factors like BMI, exercise, and device usage have some association with sleep patterns, they do not exhibit strong, direct relationships within this dataset. Sleep quality, duration, and disturbances appear to be influenced by a complex interplay of factors, with individual variability playing a significant role.