CIS 9655
Project Report
Group 3 - Jaime Bunay, Payal Surana, Sadhvi Grover

The Impact of Screen Time on Adolescents and Adults. (8-17 years, 18+ years)

Hypothesis:

With the rapid integration of digital technology into everyday life, screen time has become a significant aspect of both adolescent (ages 8–17) and adult (ages 18 and above) routines. Recent studies show that adolescents spend up to 9 hours daily on screens, while adults average up to 13 hours combining work and personal use. Although screens offer access to education, communication, and entertainment, prolonged screen exposure has been associated with reduced cognitive function, disrupted sleep patterns, declining academic performance, and adverse effects on physical health.

Approach:

This study analyzes publicly available datasets (sourced from Kaggle) to examine the impact of screen time on academic performance, sleep quality, and physical activity. The datasets will be cleaned, merged, and categorized into two groups: adolescents (aged 8–17 years) and adults (aged 18 years and above).
The study will compare the effects of screen time on adolescents versus adults, aiming to identify whether younger individuals experience more substantial academic and sleep disruptions. In contrast, adults experience higher stress and compulsive usage. The findings will provide valuable insights and practical recommendations for promoting healthier screen time habits.

The analysis includes:

- Data preprocessing and age binning
- Visual exploration of patterns (e.g., screen time vs. grades, sleep, activity)
- Correlation analysis to assess the strength of relationships

Methodology:

To ensure a clean and consistent dataset for analysis, the following data preprocessing and transformation steps were applied to the two source datasets (University Students and Largest Problematic Internet Usage):

1. Handling Missing and Inconsistent Data

- In the university dataset, all NaN, 'None', and 'Unknown' values were replaced with the **most frequent (mode)** value of the respective column.

- Ensured data completeness and uniformity across both categorical and numerical variables, handling data using mode (for categorical) and median (for numerical) imputation.

2. Standardizing Units Across Datasets

- Screen time and physical activity in the problematic usage dataset were recorded initially in seconds and converted to **minutes** to align with the university dataset's scale.

3. Categorizing and Binning Data

- Created **Age Bins**:
  - Adolescents: 8–11, 12–14, 15–17
  - Adults: 18–20, 21–22
- Numerical scores were converted into letter grades (A–F) based on standard academic grading used in colleges, where scores below 60% were assigned an F. This allowed us to create a consistent scale for comparing academic performance across both adolescent and adult groups.
- Physical activity was categorized into **Low**, **Medium**, and **High** levels based on time spent.

4. Column Renaming and Structural Alignment

- Renamed specific columns in the Largest Problematic Usage dataset to match naming conventions in the university dataset.

- Alphabetically sorted all column names in both datasets for a consistent structure and easier merging.

5. Merging the Datasets

- Combined the two cleaned datasets into a unified dataframe (final_df) for seamless analysis across the entire age range of 8–22.

6. Grouping and Mapping Comparable Features

- Matched similar attributes across datasets (e.g., Grades, AgeBin, PhysicalActivity).

- Created mappings to unify disparate formats under standard scales for direct comparison.

7. Derived Metrics & Aggregations

- Used groupby and .mean() functions to calculate trends by age group (e.g., average sleep, screen time).

- Computed **value counts and percentages** for grades and activity levels for comparative visualizations.

8. Statistical Preparation

To prepare the dataset for analysis and visualizations, we applied the following steps:

- Selected key columns: Age, AgeBin, Grades, PhysicalActivity, ScreenTime, and SleepPatterns

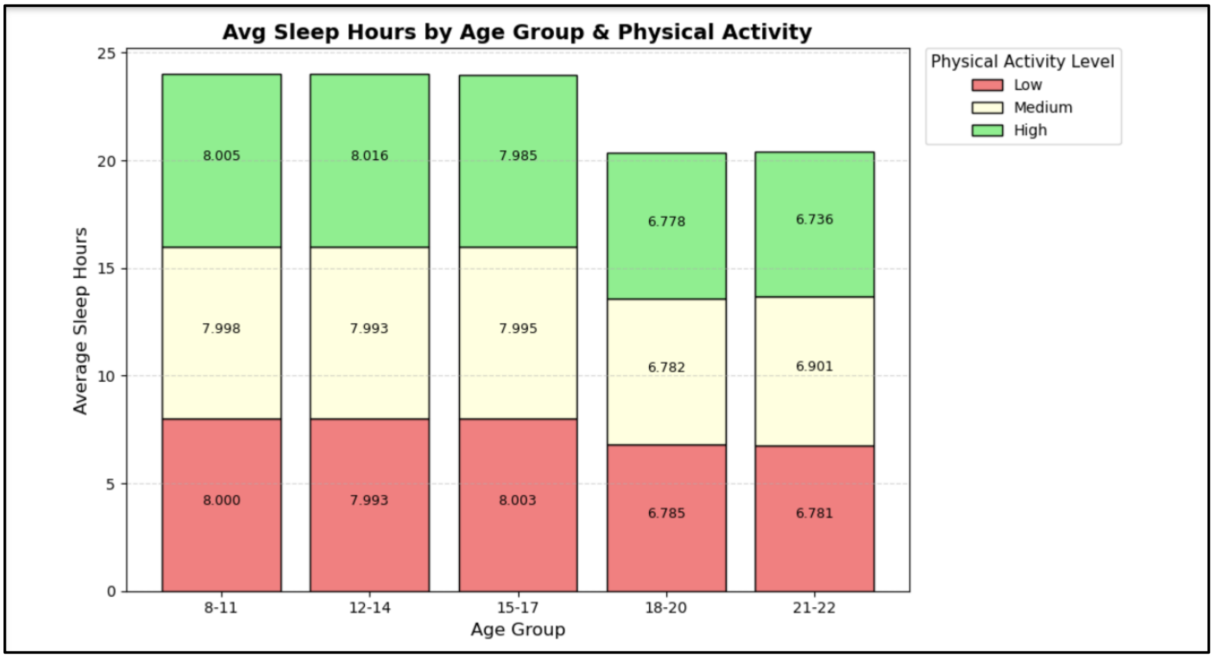
- Used grouping (like .groupby().mean()) to find average values by age group

- Dropped missing values where needed (e.g., for correlation plots)

- Formatted and scaled the data for use in Correlation heatmaps, Scatterplots and boxplots, Area and line charts

Visualizations & Key Insights:

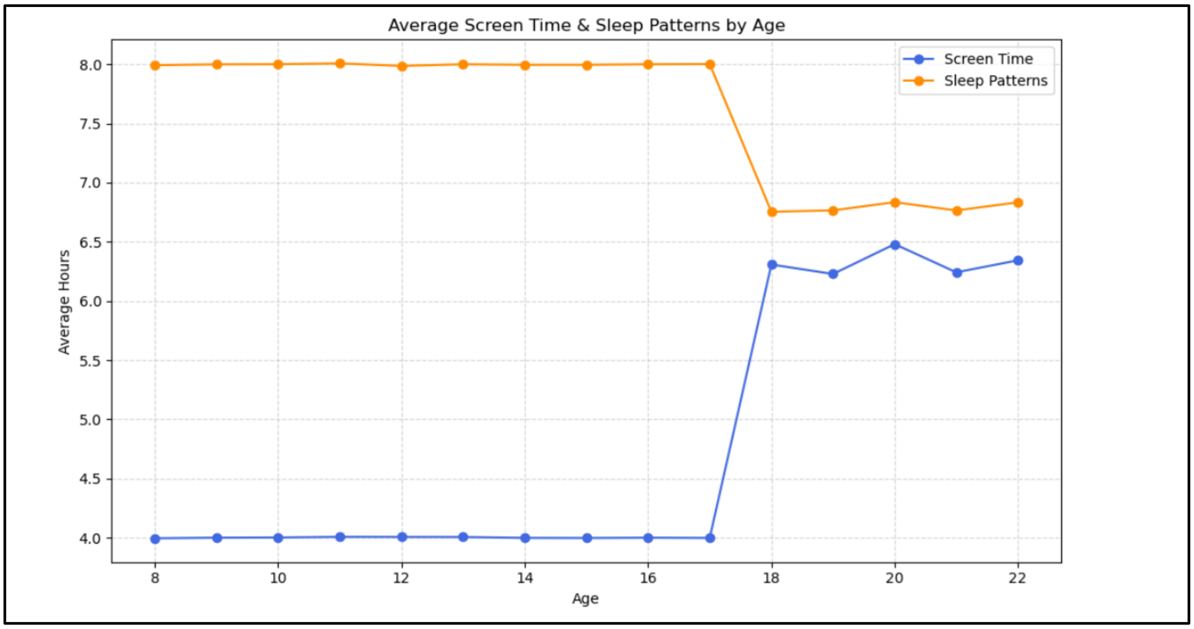
1. Average Sleep Hours by Age Group and Physical Activity



With the growing use of digital devices in daily life, screen time has become a major part of work and leisure, especially for adolescents and adults. However, increased screen exposure is often linked to poor sleep quality and lower physical activity levels. This chart provides an overview of how average sleep hours vary by age group and physical activity level.

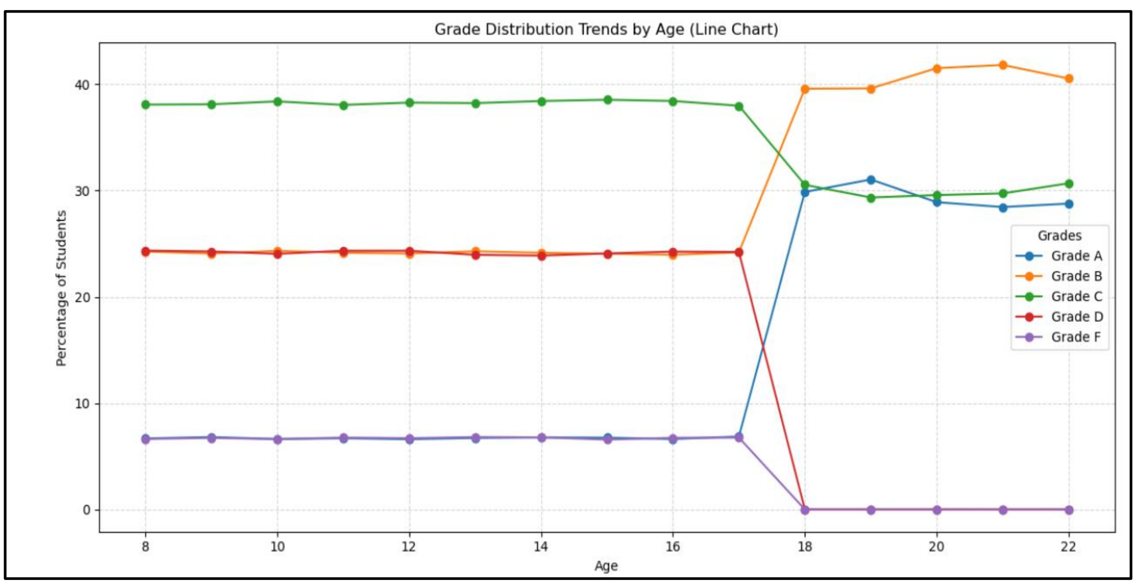
The data shows that adolescents (ages 8 to 17) tend to get around 8 hours of sleep across all levels of physical activity—low, medium, and high. This suggests that younger individuals, regardless of how active they are, generally maintain a healthier sleep routine. In contrast, sleep hours decline among adults (ages 18 and above). Even those with high levels of physical activity sleep less, averaging closer to 6–7 hours. This decrease may be due to increased responsibilities, academic or work pressures, and longer screen time, especially in the evening. The chart highlights an important trend: **as people get older, maintaining sufficient sleep becomes more challenging, and screen time may be one of the contributing factors.**

2. Average Screen Time and Sleep Patterns by Age



Building on the earlier observation that sleep declines as individuals age, this following chart examines how screen time may contribute to this change. During adolescence (ages 8–17), screen time remains relatively steady at around 4 hours per day, while the average sleep duration remains close to 8 hours. However, at age 18, there is a sharp increase in screen time — rising to over 6 hours — and a noticeable drop in sleep to below 7 hours. This pattern continues into early adulthood, suggesting that increased screen exposure may be a key factor affecting sleep quality and duration as people age.

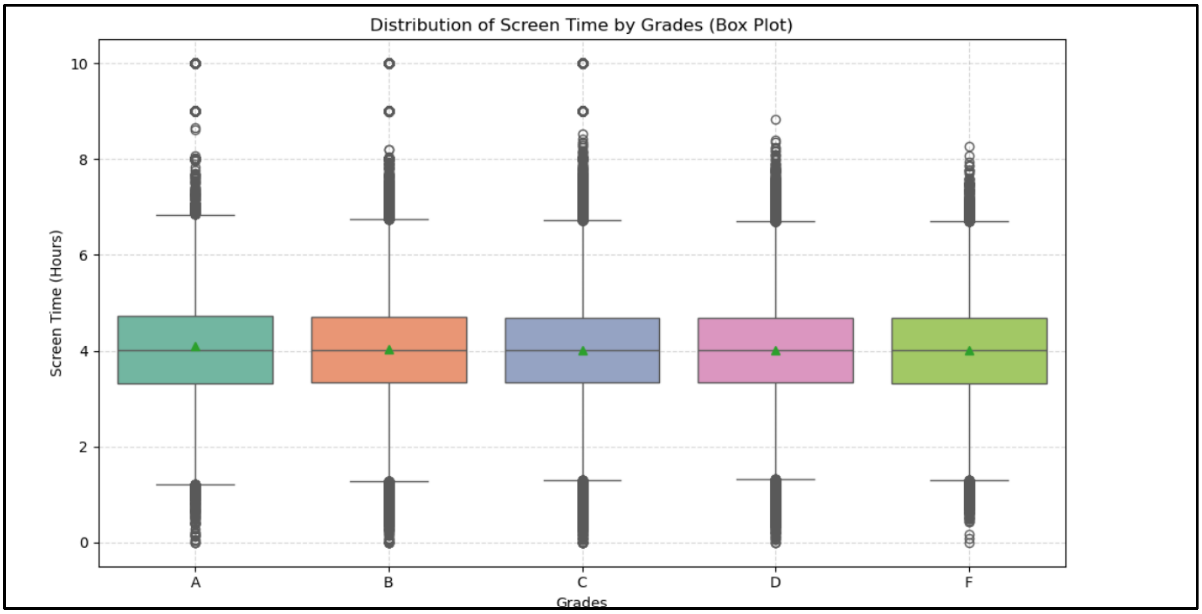
3. Grade Distribution Trends by Age



Now, we examine another essential factor — academic performance — and how it evolves with age. From ages 8 to 17, the grade distribution remains relatively consistent, with most students receiving grades of C and D. However, at age 18, there is a noticeable shift: Grades A and B rise sharply, while lower grades decline. This could be due to changes in education systems or increased focus on higher studies.

Despite reduced sleep and higher screen time in adults, academic performance appears to improve. While this may seem optimistic on the surface, it could suggest that adults are spending more screen time on academic or professional tasks, possibly at the expense of rest. It raises an important question: Are better grades being achieved at the expense of well-being?

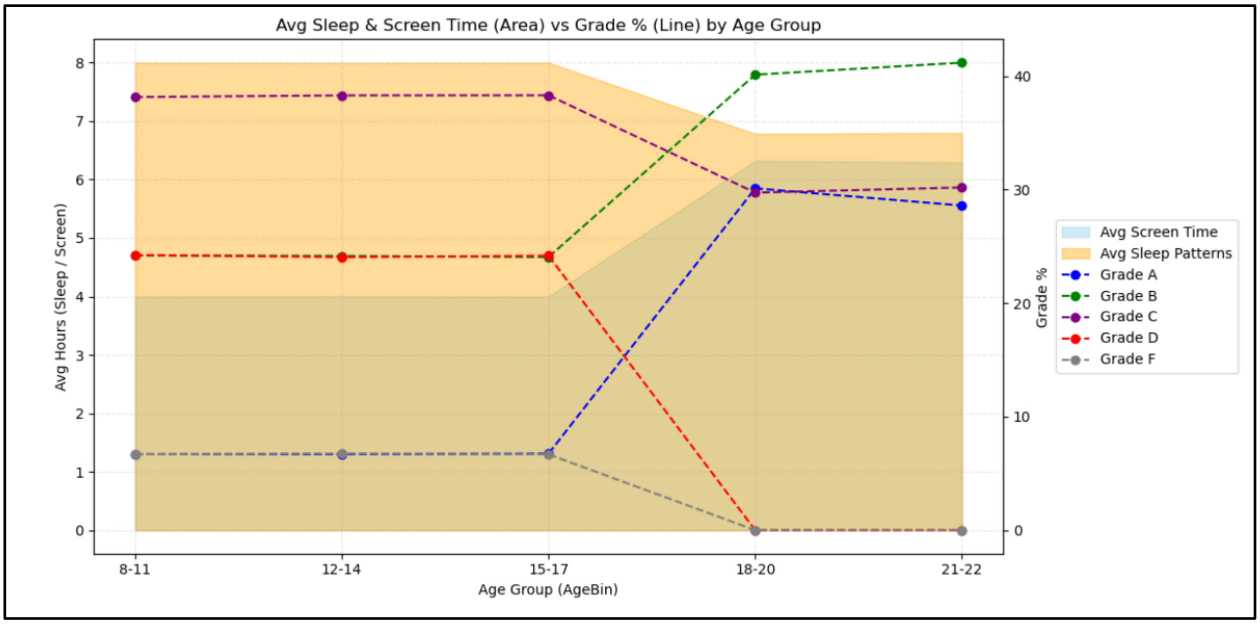
4. Distribution of Screen Time by Grade Levels



To further explore the connection between screen time and academic performance, this chart examines how screen time is distributed across different grade levels.

Surprisingly, the average screen time is quite similar for all grades — around 4 hours a day. Students getting As and Bs spend about the same amount of time on screens as those with lower grades. This suggests that it’s not just the amount of screen time that matters, but also how it’s used. Productive screen use, such as studying, may support better performance, whereas passive use may not. Other factors, such as sleep and time management, may also play a significant role in academic success.

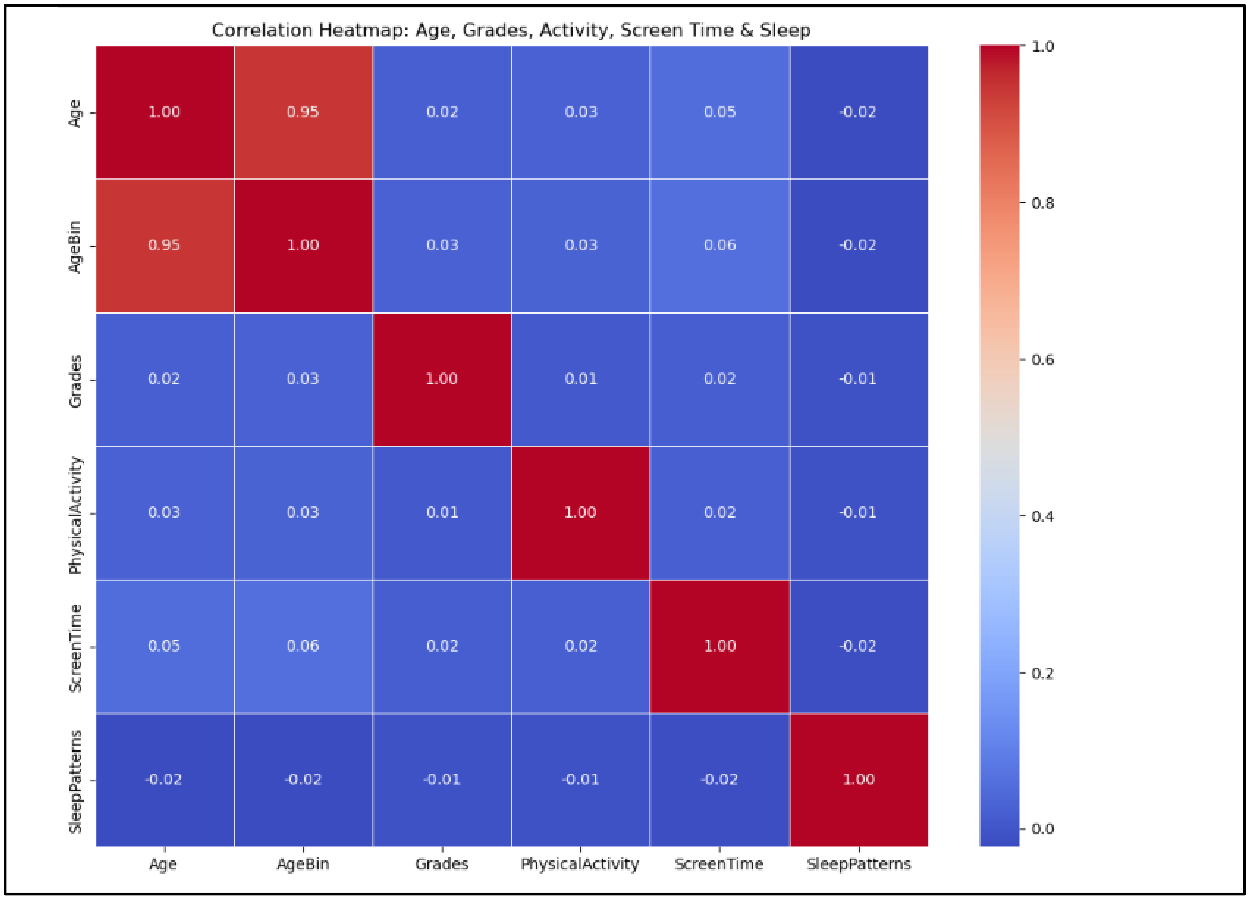
4. Average Sleep and Screen Time Compared to Grade Percentage by Age Group



This chart brings everything together — sleep, screen time, and academic performance — across different age groups. It tells a clear and striking story. In younger age groups (8–17), students get more sleep, have lower screen time, and show a steady spread of grades. But starting at age 18, everything shifts. Sleep drops sharply, screen time rises, and suddenly, lower grades disappear while A and B grades surge. On the surface, this may appear to be academic success, but it comes at a cost.

The trade-off is clear: more screen time and better grades, but significantly less sleep. This chart highlights a deeper issue — while adults may be performing better academically, it could be happening at the expense of their health and balance. It raises a powerful question: is academic success genuinely worth it if it comes at the cost of rest and well-being?

5. Average Sleep and Screen Time Compared to Grade Percentage by Age Group



To conclude the analysis, this correlation matrix examines the strength of relationships between age, screen time, sleep, physical activity, and academic performance. Despite the clear patterns observed in the earlier visuals — such as sleep decline and screen time increase after age 18, or grade improvement in adulthood — the actual correlations between these variables are surprisingly weak.

For example, screen time has almost no measurable impact on grades or sleep in this dataset. Age also shows little to no direct relationship with academic performance or lifestyle habits. **This suggests that while trends are visually apparent, they don't follow simple linear paths. The key insight here is that screen time doesn't act alone — its impact likely depends on how it's used, along with other lifestyle factors like stress, time management, and motivation.** The matrix reminds us that human behavior is complex, and not everything meaningful shows up in basic correlation numbers.

This final view underscores the need for a deeper, more nuanced analysis to fully comprehend the effects of screen time, particularly in a world where digital life has become **the norm.**

Interpretation & Conclusion

Hypothesis Conclusion:

The hypothesis proposed that prolonged screen time has a negative impact on cognitive function, sleep quality, academic performance, and physical health, particularly as individuals transition from adolescence to adulthood.

At first glance, improved academic performance in adulthood may appear to be a positive outcome. However, deeper analysis reveals a possible trade-off: academic success may come at the cost of reduced sleep and personal balance. While screen time increases with age, it's not just the quantity that matters but the quality of usage. Productive screen time (e.g., for studying or working) may support performance, while passive or excessive use can silently impact well-being.

The findings partially support the hypothesis. The data indicate an evident rise in screen time and a decline in sleep after the age of 18, suggesting that adults are more susceptible to the demands of digital technology**. However, academic performance also improves — possibly due to increased focus, maturity, or differences in grading standards rather than screen use alone.** The correlation matrix further reveals weak statistical relationships between screen time, sleep, and grades, suggesting that these outcomes are likely shaped by more complex, contextual factors that are not fully captured in the dataset.

In conclusion, **while screen time appears to impact sleep, its relationship to academic outcomes is indirect and complex. These results underscore the importance of future research that considers how screen time is utilized and the broader lifestyle context underlying digital behaviors.**

Data Limitations:

While this analysis provides valuable insights into the impact of screen time on sleep, grades, and lifestyle behaviors across different age groups, several limitations should be considered.

- First, the data used is cross-sectional, which means they capture a single snapshot in time and cannot be used to establish causal relationships.

- Second, since the two source datasets did not share many standard variables, the scope of the analysis was limited to a specific set of overlapping features: Age, Age Bins, Sleep Pattern, Screen Time, Physical Activity, and Grades. While these were sufficient to observe broad trends, they may not fully capture the nuances needed to understand the deeper causes behind behavior changes.

Alternative Explanations:

- **Reverse Causality:** Poor sleep or academic struggles may lead to increased screen time, rather than the other way around.

- **Educational System Differences:** The improvement in grades observed after age 18 may be due to differences in grading systems or assessment styles in higher education, not necessarily better performance.

- **Motivation and Maturity:** Older students may be more focused or self-motivated, which could drive better academic outcomes regardless of screen time or sleep patterns.

- **Lifestyle Shifts:** Changes in lifestyle after age 18 — such as increased independence or more structured schedules — may influence sleep and screen use in ways not directly captured by the dataset.

Biases:

- **Lack of Contextual Data:** The dataset fails to distinguish between types of screen use (e.g., educational vs. entertainment), which may have significantly different impacts on performance and sleep.

- **Selection Bias:** Individuals who participate in such studies (especially those related to internet or screen usage) might be those who are more aware or concerned about their habits, leading to potential bias in the sample.

Datasets:

1. Factors_ affecting_ university_student_grades
2. Largest_Problematic_Internet_Usage_Dataset