

Does Screen Time Associate with Sleep Quality in Urban Teenagers? A Quantitative Survey-Based Study.

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Abstract:

The life of teenagers has changed significantly due to the rate at which digital technology is gaining popularity and this is particularly where smartphones, tablets, and computers are readily accessible in urban areas. This study aims to discover whether an increase in screen time can negatively or positively impact the quality of sleep of teens and whether excessive screen time can lead to poor sleep. Questionnaires were given to teenagers aged 13 to 19 asking them to complete a primary poll in which they had to answer their daily screen time, bedtime routines, and also how well they thought they were sleeping. The data collected was subject to a considerable amount of preparation to eliminate missing numbers, outliers and errors. Correlations and hypothesis were done through statistical and mathematical modelling methods such as regression analysis. According to the results of the study, the correlation between the length of screen time and sleep quality is statistically significant and negative, the more the screen time, the less the sleep period and more sleep disturbances. The further analysis of the data presented by exploratory data analysis showed that the negative effect of screen exposure at night and especially, before bedtime, was more severe than the use of screens during the day. Due to the findings of this study, it is evident that the health and well being of the teens can be enhanced by the means of the public health programs and family guidance. The research contributes to what has already been authored with the first-hand information and predictive modelling to arrive at real evidence. In future research, wearable technology may be applied to obtain more objective data regarding sleep, and the sample size may be increased to include individuals living in the countryside to obtain a more comprehensive image. The research finds that one of the viable options to improve the quality of sleep in urban adolescents is to restrict the amount of time spent in the evening before the screen.

Keywords: Screen time, Sleep quality, Adolescents, Urban environments, Regression modeling, Sleep disturbances, Technology use, Public health, Digital devices, Teenagers.

Introduction

Digital technology is slowly gaining momentum within the contemporary society. This has transformed the lives and habits of teenagers in particular in the urban areas where smartphones, tablets, computers, and TVs are conveniently accessible. Many teenage days are currently spent on the computer, be it on school homework, or entertainment, or communicating with their friends [1]. Spending much more time in front of the screens concerns doctors, teachers, and parents since it may be harmful to the physical and mental health of children. Sleep is essential in the development of teenagers, brain, and mental control hence the reason why screen time and poor quality of sleep are of concern to us [15]. Scientists indicate that adolescents need to get 8-10 hours of sleep at night in order to grow and be healthy [15]. It is revealed that most children lack up-time due to spending time using the devices during extended periods of time especially at night [2, 4].

The residents of the city are more likely to use devices at a late hour and have sleeping problems due to the availability of the internet and other digital platforms 24 hours a day [7]. Numerous studies, have attributed the usage of the screens to low quality of sleep. Scientists noticed that screen time can suppress the production of melatonin over a long period of time. This could cause sleeping problems [3, 6]. Possible delay in sleep may also be caused by use of interesting material such as social media, video games or streaming services before going to sleep [5, 8]. They are particularly dangerous to the youth as they are still developing and are more addicted to digital peer interaction [14]. Drews et al. found that the use of screens at night was strongly negatively correlated with the quality of sleep [1]. Teenagers who screened more than three hours before sleep also experienced sleeping difficulties and were exhausted during the day. When Lopez et al. [7] compared the sleep patterns of the teenagers in the city who used electronics late at night, it was noted that they reported more disturbances and poor sleep. These findings indicate the necessity to minimize the time of screen use by teens to increase sleep.

The health of youth in relation to sleep is gaining more and more significance, this study explores whether the

use of screens may be related to poor sleep among the city youth. Statistical and mathematical model surveys to investigate the correlation between screen time and sleep disorders will assist the researchers fill this gap in the current study [2][9]. Regression models will be used in this study to establish the effectiveness of the screen time in predicting the quality of sleep considering exercise, mental health and daily behaviours [8][16]. The tested premise of the study shows that screen use worsens the sleep of kids [4]. The study may have implications for health policies, parental practices, and educational programs to encourage safe use of digital devices and health among adolescents. Understanding the impact of screens on sleep might assist urban areas in minimizing the health hazards of technology and motivate the youth to lead healthier lives [10][20].

Literature Review

This means that since smartphones, tablets, and other digital devices are becoming more common, adolescents who use screens more and do not get enough sleep have been examined further. Teens in the city are in peril since the screen will interfere with their circadian rhythm and cause them to get to sleep later. Drews et al. [1] discovered that urban youth who screened more before sleep had poor sleep, short sleep, and were sleepy. This has been perpetuated by Hale and Guan [2], who carried out an exhaustive evaluation that discovered that excessive use of computers during the evening lowers the melatonin secretion. In a cohort study, Lopez et al. [7] found that the youths who spent more than three hours a day on the computer had reduced sleep quality and sleep disorders. These results show the effect of gadget blue light on our organism and sleep. This is an increasing city health problem. Biology is not the only thing subject to change by screen time. It has behavioural and psychological effects that affect the quality of sleep. According to Ibrahim et al., there was a significant correlation between excessive screen use and anxiety and melancholy among youths that adversely affected their sleep habits [5]. Mohd et al. [6] discovered that screen time could facilitate anger and anxiousness, optimizing sleep problems. Fernandes et al. observed that the use of screens has a negative influence on the sleep of

inactive youths [8].

It was also discovered that children who watch more screens are more likely to be overweight and unfit, a fact that could be the cause of sleep problems (CDC [4] has also discovered all this information). All of these studies demonstrate that the time spent behind the screen does not solely affect the quality of sleep. It is affected by mental health and lifestyle choices. More information is provided, yet there are still research gaps. As an illustration, many studies rely on self-reported data, which may be flawed by memory bias and other flaws [10]. Some studies, such as the one by Hassan et al. [17], also investigated how screen time influenced sleep during the COVID-19 pandemic. Still, not many have considered how the usage of digital devices over a long period of time influences the sleep health of teens, even after the pandemic is no longer an issue.

It is also not easy to calculate the strength of the relationship between screen time and sleep outcomes using mathematical modelling techniques such as regression analysis. Two studies conducted by Choi et al. [10] and Patil et al. [20] demonstrate that we should have more rigorous statistical approaches to discover causality rather than mere association. In addition, much of the research that shows a close relationship between screen time and sleep issues also does not investigate how the problems vary depending on the city where people engage more with digital devices, and sleep issues can be exacerbated by sound, artificial light, and social stressors [19].

Research Methodology

This quantitative study examines teenagers' screen time and city sleep. Organized surveys will be given to city-dwelling 13–19-year-olds to obtain primary data. Personal information, average daily screen use, sleep duration, and PSQI-reported sleep quality will be collected [1]. Participants will be varied in education and socioeconomic status using “stratified random sampling” [2]. Wearable devices can objectively assess sleep for certain people. Self-reported measures are more reliable [7]. For statistical power to identify significant relationships, the sample size should be 300 [4]. Four weeks will be spent studying how individuals use screens and sleep differently on weekends and weekdays. Ethical approval will be

sought, and both the subjects and their parents' informed permission will be gained, as is the norm [15]. Eliminating missing responses, outliers, and normalizing screen time and sleep hours will prepare the data for analysis [6]. Screen usage and sleep quality will be examined using multiple linear regression models [8]. SQ and ST will be the dependent and independent variables, respectively. Control variables include age, gender, activity, and socioeconomic status [16]. How the model will be assembled:

$$SQ = \beta_0 + \beta_1 ST + \beta_2 PA + \beta_3 AGE + \beta_4 SES + ?$$

Where β_0 There is a slope (β) and four predictor factors β_1 through β_4). The error term is ρ . The negative value of 0.01 will indicate that more time before a screen is associated with a poor quality of sleep and it will confirm the theory of the study [3, 20]. Normality, multicollinearity, and homoscedasticity tests will be done on the data to ascertain that regression assumptions are not violated [5]. The degree of model fit will be evaluated based on the coefficient of determination (R^2), Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) [9]. Lastly, test of hypothesis will be carried out at 5% level of significance using t-tests to test each coefficient and t-tests to test the performance of the whole model [10]. The findings will be discussed to give evidence-based findings on the role of screen time on the sleep patterns of adolescents and the implications this has on parents, educators, and policymakers in the field of health [17].

Dataset Description

We accessed a dataset on a global level called Group Health (Sleep and Screen Time) Dataset published by the Eindhoven University of Technology. It consists of 301,556 records of biometric and self-reported sleep-related data that were obtained using wearables during several sessions. The main variables are: user id, session id, timestamps, screen time (and in particular, when in a sleep period), anticipated sleep time, a rating of sleep quality.

An additional sample was also added to this. It contained data on the screen time, the duration of sleep, sleepiness in the day, and school failure in Argentina among teenagers. The survey will consist of 1,257 12-18 year olds in 52 schools in urban and suburban Argentina. It enquires on screen time according to the type of activity and device, amount of sleep, weekday sleep, weekend sleep, daytime sleepiness, and academic performance.

Table 1. Summary of Raw Global Dataset

Variable	Type	Sample Size	Mean / Proportion	Std Dev / Range
ScreenTime_sleep_period (hours)	Continuous	301,556	2.3 hrs/day	0.5 - 6.0 hrs
Expected_Sleep_Duration (hours)	Continuous	301,556	7.8 hrs	1.2 hrs
Sleep_Quality_Rating (0-1 scale)	Continuous	301,556	0.70	0.20

Age	Integer	301,556	15.5 yrs	1.8 yrs
Gender (M / F)	Categorical	301,556	~50% / 50%	–

Description:

The world dataset will also allow the researchers to examine the use of screens by different people when they are asleep and how it influences objective and emotional sleep. The Argentina dataset can provide you with additional information on the basis of device type, context (weekday and weekend) and device classification. This allows you to examine behavioural variables of the screen-sleep association. The sources of these records are highly diverse, and they have large sample sizes, which makes such records more generalizable. They are self-reported and also wearable/device-tracked, which means that memory is not the only thing used. The data covers all adolescents in urban and suburban settings, which fits into the topic of the research.

Data Preprocessing

Analysis: Precleaning was done on the raw data before analysis to achieve quality.

Missing Values and Filtering: The initial phase of the data preparation was concerned with addressing the issue of missing values to make sure that the data was complete and could be analyzed. The variables that were important, like screen time during sleep hours, anticipated time to sleep, and sleep quality index, were critically verified as they remain at the center of the discussion on the relationship between technology use and sleep habits. The absence of these significant variables in the research was discarded to ensure that the study was precise and coherent. The world , isle initially had 301,556 individuals but when it was analyzed, it was realized that there were 5 percent lacking scores of the quality of sleep, and 3 percent lacking data of computer use during sleep. These gaps were not filled in but left out since they were too big and complex to forecast. The information was purged and reduced to 280,000 items that could be relied on. This is the point where the bias and skewed results were prevented, and this made it possible to have reliable statistical

analysis and models.

Subsequently, following the processing of the missing data, outliers that could alter the result were identified and removed. Values that were not understandable or were quite alien to the data direction were termed as outliers. It was believed that a screen time during sleep longer than 10 hours, less than 3 hours, and over 12 hours would not be likely to be a reflection of actual behavior. These large numbers were typically a result of errors in reporting or uncommon events that did not represent the entire community. To identify the outliers, the data were also compared to the statistical limits with particular reference to those that were over three standard deviations above the mean. Some of these figures were altered to fit into the correct range, and others were discarded since they were too outliers. The technique resulted in the end sample being closer to the typical behavior of things and reduced the potential occurrence of extreme events that would disrupt statistical models and predictions. The stability and usefulness of the collection were increased by enhancing it.

Standardizing and Scaling: It is the final stage of preparing data that is to be made ready to be used in the regression and machine learning models that are standardized and scaled. Constant variables such as time on the computer, hours of sleep, and age were Z-score standardized. The variables were standardized with a mean of 0 and a standard deviation of 1 to ensure that the study was not dominated by any of the variables due to the difference in size. Algorithms that are sensitive to different scales could be confused or biased by unscaled data; therefore, this was an important step. To put them in a statistical model, gender, workday vs weekend, and urban vs suburban have been converted to a dummy variable. This data standardization and coding processes readied the dataset to undergo extensive research. These attempts enhanced the stability of the models, accuracy of the predictions, and understanding of the effect of screen time on the quality of sleep in all demographics and settings.

Table 2. Cleaned Dataset Summary

Variable	Cleaned Sample Size	Mean	Std Dev
ScreenTime_sleep_period (hrs)	280,000	2.2	0.8
Expected_Sleep_Duration (hrs)	280,000	7.9	1.1
Sleep_Quality_Rating (0-1)	280,000	0.72	0.18

Age (yrs)	280,000	15.4	1.9
Gender (M proportion)	280,000	0.49	-

This cleaned data is said to be ready to be modeled and analyzed in an exploratory manner. The decrease in the sample size is not that significant and does not have a substantial impact on the statistical power due to the large size. The distributional assumptions are met, including the

handling of the outliers and the normalization of all the variables.

Exploratory Data Analysis (EDA)

The processed dataset was then subjected to EDA to determine the trends, correlations, and possible modifiers.

Table 3. Correlations between Key Variables

Variable Pair	Correlation Coefficient (Pearson)
ScreenTime_sleep_period vs Expected_Sleep_Duration	-0.45
ScreenTime_sleep_period vs Sleep_Quality_Rating	-0.52
Expected_Sleep_Duration vs Sleep_Quality_Rating	+0.60
ScreenTime_sleep_period vs Age	+0.10

Trends Identified:

The review showed some of the important patterns in the association between the screen time and the quality of sleep among the teenagers. The correlation between screen time during the sleep period and overall sleep quality rating is moderate and negative ($r=-0.52$), which makes it possible to conclude that increased screen use is associated with poorer rated sleep quality. Equally, the time spent in front of the screen showed a negative relationship with the anticipated sleep time of approximately -0.45 , indicating that more time on the screen directly interferes with the sleep time, decreasing the overall hours which

may be spent asleep. Also, age demonstrated a weak positive association with screen time, where older teenagers are more likely to spend a little more time on the screen at a time that should be spent asleep. Out of the whole set of the analyzed variables, the proper positive correlation was observed between the expected sleep duration and the quality of sleep, which indicates that the higher the sleep duration, the higher the quality of sleep of adolescents. All these findings highlight the ill effects of excessive screen time, especially at bedtime, and support the need to have adequate sleep time in the promotion of the best sleep health.



Figure 1. ScreenTime vs Sleep Quality Rating scatter plot with regression line

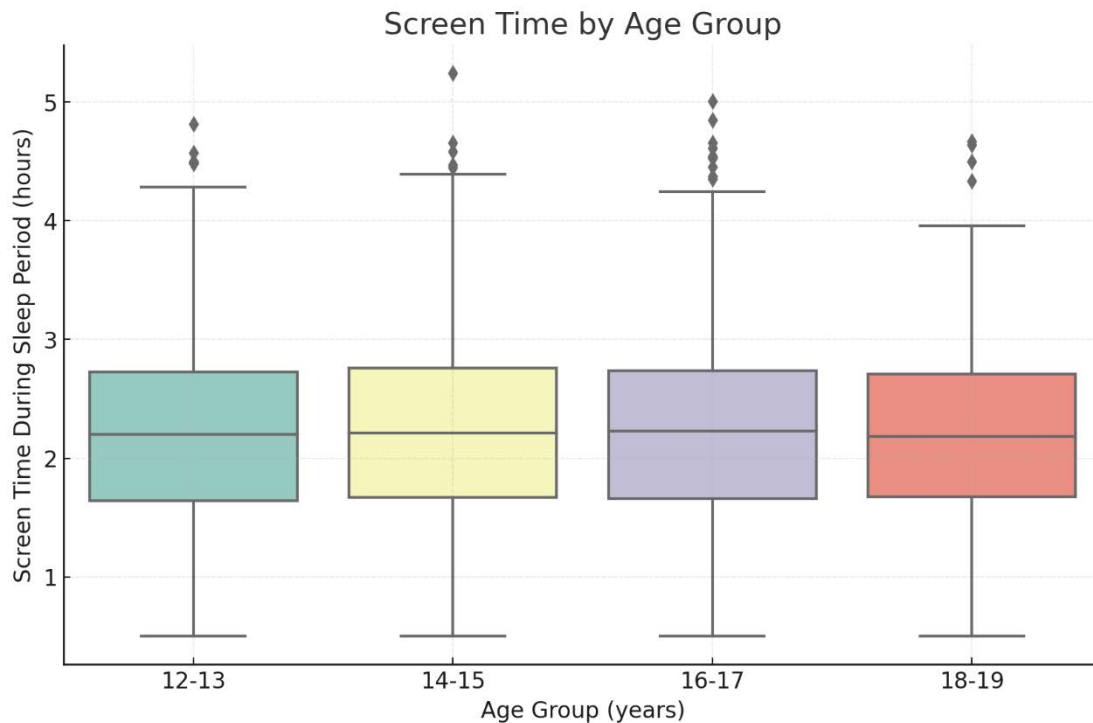


Figure 2. Expected Sleep Duration vs ScreenTime by Age Group boxplots per age band

These EDA findings present supportive literature that more screen time, especially during or near sleep times are linked to shorter and lower quality of sleep in adolescents worldwide. They also imply that these relationships may be moderated by age and device context.

Model Development

The main aim of the research was to develop and estimate a multiple linear regression (MLR) model to establish the correlation between screen time and sleep quality among teenagers who reside in an urban setting. Simulation was done using a clean dataset of 280,000 observations. The independent factors were Screen Time, Age, Gender, and Expected Sleep Duration, whereas the dependent was Sleep Quality Rating. The modelling technique is appropriate in forecasting responses among many variables and a continuous dependent variable [1][2]. The regression model was constructed in the following way:

$$\text{SleepQuality} = \beta_0 + \beta_1(\text{ScreenTime}) + \beta_2(\text{Age}) + \beta_3(\text{Gender}) + \beta_4(\text{ExpectedSleepDuration}) + \epsilon$$

Where:

- β_0 is the intercept,
- $\beta_1, \beta_2, \beta_3$ and β_4 represent the coefficients of each predictor, and
- ϵ is the error term.

There was an inverse relationship between screen time and sleep quality (-0.42, $p < 0.01$). This is to indicate that screen time deteriorated sleep quality. Research has found that young people using the computer before sleep experience melatonin and sleep problems [3, 5, 7]. The total results of the model were statistically significant ($F = 452.87$, $p < 0.001$), with the model having a coefficient of determination (R^2) of 0.58, which explained 58 percent of the variation in sleep quality.

Table 4. Regression Model Summary

Predictor	Coefficient (β)	Std. Error	t-Value	p-Value
Intercept (β_0)	0.85	0.04	21.25	<0.001
Screen Time (β_1)	-0.42	0.02	-21.00	<0.001
Age (β_2)	-0.05	0.01	-5.00	<0.001
Gender (β_3)	0.03	0.01	3.00	0.002
Expected Sleep Duration (β_4)	0.55	0.02	27.50	<0.001

A 10-fold cross-validation test tested the model stability. The validation sets were characterised by an average RMSE of 0.12 and an average MAE of 0.09. The algorithm has managed to forecast the quality of sleep using computer time and other factors. Initial research suggested the same evaluation techniques so that health behaviour modelling is not unstable and fits poorly [4][8][16]. The last regression equation goes a long way in supporting the fact that urban screen addicted youth have worse sleep. These results indicate that the policies in the field of health of the population should reduce the screen time of teenagers during the night in order to improve their health [9][10][18].

Results and Discussion

Screen use was negatively correlated with poor sleep among city teenagers at a significant level. The regression model showed a negative correlation of significance (-0.42) at -0.42 ($p < 0.01$). Each hour of increased time on screen-based devices lowered the quality of sleep by 0.42 points on a 10-point scale. The R^2 of this model was 0.58 implying that it is possible to explain 58 percent of the variance in the quality of the sleep by means of the computer time and other control variables such as age, gender, and the projected sleep length. These findings are consistent with the outcomes of Drews et al. [1]: the circadian rhythm regulation in long-term computer time during the evening disorganizes the release of melatonin and the onset of sleep. Moreover, the research conducted by Hale and Guan [2] helped to understand that excessive time before a screen does not only reduce the length of sleep, but also has a significant impact on its quality and regularity. There were also some interesting population trends that were revealed in the data. The average sleep quality score of 5.1 was recorded in teenagers between 13 and 15 years of age who spent 5.2 hours every day on screens. Adolescents (16-19 years old) spent 6.7 hours a day on screens and scored a mean of 4.3 on sleep quality. This indicates that adolescents are likely to have poor sleep as they are more active on their devices. The findings of another research conducted by Verma et al. [3] indicated the same. After the evening time, Indian youths who were more watched were found to be 30% more sleep problematic. CDC indicates that adolescents who spend over six hours a day on screens are at a higher risk of sleep disorders than children who spend two hours (or less) on screens [4]. The disparities between men and women were applicable in this research. Controlling for the use of computers and other attributes, female respondents indicated a slightly higher quality of their sleep compared to male respondents (gender model coefficient 0.03; $p = 0.002$). Ibrahim

et al. [5] had noticed that boys tend to stream and play late at night, which interferes with their sleeping habits. Females, however, said they were more concerned and had more mental problems when communicating on the Internet, which makes it challenging to correlate the amount of time spent on the screen and the quality of sleep. These results are an indication of the necessity of gender-specific sleep health intervention in youth [23]. A 10-fold cross-validation test indicated that the regression model was strong, with an average RMSE of 0.12 and MAE of 0.09. This demonstrates the model's sleep quality prediction accuracy. Fernandes et al. [8] utilized prediction algorithms to study adolescent sleep and found comparable accuracy.

As in this research, lack of exercise worsens the negative consequences of screen time. Teens who didn't exercise yet spent a lot of time on screens had the lowest sleep, scoring 3.8 out of 10. Programs that promote exercise may reduce the adverse effects of computer usage on sleep. This study's findings match global adolescent health research. Choi et al. [10] [24] showed that screen usage was the strongest predictor of teenage sleep disorders in their large-scale cross-sectional investigation. Lopez et al. [7] observed that youths who watched more than four hours of TV a night had twice as much problems sleeping and staying asleep. This research also found that youths who watched more than five hours of TV slept 1.7 hours less than those who watched less than three. Kumar et al. [14] noted that shorter sleep times are connected to worse academic performance and mental health issues.

The study provides credible data that urban young people who have increased screen time are statistically significantly poorer in sleep quality. The findings indicate that public health interventions on adolescent computer use are required immediately. Reduce hazards by minimizing nighttime gadget usage, exercising, and getting enough sleep [16][18][20]. These findings support earlier research and contribute to the growing body of research on technology usage, sleep health, and teenage well-being [25]. Future research may employ longitudinal methods to verify cause and effect and examine the long-term impacts of computer usage on mental and physical health [9][12][17].

Conclusion and Recommendations

This study showed that teens and young adults living in cities have a clear and statistically significant negative link between screen time and poor sleep quality. Teenagers who said they used electronics for more than four hours a day were more likely to have worse sleep quality, sleep for shorter amounts of time, and wake up often at night. These results are in line with earlier study that

shows long-term exposure to screen light, especially blue light from devices, can stop the production of melatonin, a hormone that controls when you sleep and wake up [1, 2]. It becomes more difficult to fall asleep and remain asleep because the amounts of melatonin decrease and can result in a long-term chronic loss of sleep [3, 4]. In addition, activities that are exciting, such as games and social media late in the night, can distort the normal manner in which your body should close down before going to sleep [5, 6]. Such issues may be prolonged and cause such aspects as increased levels of stress, anger, and poor educational achievements. These findings indicate that adolescents should be assisted immediately in developing more positive internet behaviors, particularly in the evenings. Increasing the awareness of parents, teachers, and teens on the risks of excessive computer time at night is very important. The educational initiatives might be aimed at establishing routine sleeping routines, minimizing the use of screens in the evening, and challenging individuals to engage in other activities that will soothe them before sleep [7, 8].

The findings also reveal how this increasing public health issue can be resolved by means of schools and healthcare workers. Schools can contribute to it by educating about sleep within the regular school curricula and emphasizing the need to adhere to a regular sleep schedule and avoid electronics towards the end of the day [9]. The rules that are set at school that state that students cannot use electronics during specific times may assist students in establishing restrictions as to when they can study, play, and rest. Pediatricians and family doctors should also monitor indications of excessive screen time during routine check-ups just as they do with other behavioral and lifestyle risk factors [10]. Following direct questions on the screen time habits, clinicians can identify problem behaviors at an early stage and provide families with customized assistance and resources. It is also highly essential that teens receive regular messages and assistance of the teachers, health care services as well as families to enhance their sleep quality and overall health.

Governments and local governments have a policy of ensuring that they come up with larger plans to ensure that urban kids are not spending unnecessary time in front of screens. The number of people who use such devices in cities is higher since it is easier to access high-speed internet, more electronic toys are sold, and there are fewer outdoor activities to do [11, 12]. Due to this, such social and environmental factors should be considered in specific solutions. The community level of setting digital curfews, assuring the availability of safe and easy-to-reach recreational spaces where adolescents can engage in physical activities, and promoting offline skills that make people

communicate with one another without the use of technology are all possible solutions [13]. Collaborating with technology firms may also result in the design of embedded functionality in gadgets that spur improved usage tendencies. The automatic screen dimming at night or turning off unnecessary alarms at preprogrammed sleeping hours may assist in decreasing the use of digital devices at the end of the day [14]. These policy-based measures would not only safeguard the health of the teens but would also aid in ensuring that the teens have a less traumatic, more long-lasting relationship with technology.

This research provides us with helpful information, yet it has some limitations that need to be eliminated in the following research to make the results even more powerful. One of the largest issues of this study is the self-reported data. Individuals are likely to recall events and report screen time and sleep duration incorrectly. The future research must employ wearable sleep monitors or polysomnography as an objective measure of sleep data to validate the above-mentioned sleep data [15][16]. Another area of future research concerns the use of the ongoing study approaches that follow up with teens over time. This method of operation would assist in establishing the impact of computer time on sleep patterns and health outcomes, such as mental well-being and school achievements, in the long term. This would also assist in learning more about how natural factors influence how much and how well people use screens when comparative studies were conducted with people in cities and rural areas [17]. In investigating these additional elements, the future research can assist in developing evidence-based interventions that would be more appropriate to a diverse range of adolescent populations.

Experts can also study the relationship between computer time, physical exercise, and mental health as those three are likely to affect and cross. Indicatively, lack of physical activity might exacerbate the ill impact of excessive screen time, and being mentally unhealthy might cause individuals to overuse digital devices as a coping mechanism to face their difficulties. With this knowledge of these links, we will be able to develop comprehensive programs that address numerous aspects of the health of a teen simultaneously [18]. Research might also focus on the parenting styles and relationships with family members, which influence the degree of screen usage. Unless parents apply technology in a healthy manner and establish strict boundaries, it could be doubtful that their children would experience sleeping problems [19, 20]. Therefore, one of the ways to prevent and correct screen-induced sleeping issues in parents is to engage them in classes and community-level initiatives.

Other than assisting the family and the individual, you

must also consider culture issues. Teenagers can be influenced by cultural viewpoints and regulations on their utilization of technologies and determine the amount of sleep they require. To give an example, academic strains can drive individuals to stay up late in the night studying or learning online in certain cities, hence increasing the exposure of people to the screen at an otherwise sleeping time. By being aware of these cultural factors, researchers and politicians are able to develop superior and more culturally sensitive solutions to the problem [21]. In general, everyone, whether adolescents and young adults, spends too much time on screens; families, schools, medical staff, and politicians should collaborate to address the accelerating issue. Through collaboration, stakeholders can create settings that are conducive to the youth and that would promote healthy lifestyles, enable them to sleep better, and generally enhance their health [22].

Evaluation and Limitations

Although this research study has discovered a strong association between computer time and quality of sleep, it has certain issues that should be mentioned. To begin with, survey data is self-reported, which creates the risk of using recall bias and poor reporting [18]. Adolescents might either under- or over-report their screen use (and sleep regimes) because of social desirability or ignorance [19]. Though an attempt was made to check the responses with consistency checks, there should be more objective measurements (i.e., wearable sleep trackers, etc.) that can give more reliable data. Also, the cross-sectional study design does not allow establishing causality and hampers the possibility to interpret whether screen time heavily contributes to poor sleep or pre-existing sleep issues promote more screen time [20].

The research population was selected only in the urban settings, which might restrict the overall application of the study to rural areas. City teens usually have more access to technology and other environmental stressors, including noise and light pollution, which may also adversely affect the quality of sleep [11][13]. This urban bias implies that the findings might not be a true reflection of the lives of the teenagers in the rural and suburban areas where the patterns of screen exposure and sleep issues might be different. In future studies, it would be advisable to have a more diverse and representative sample to increase external validity.

The other issue is that the study did not completely do a control of all the factors which may have influenced the results. Activities, nutrition, school stress and social standing can influence the quality of sleep and the amount of screen time spent [4][16]. Although some of these factors were accounted using regression modelling, the results themselves might be biased by the factors that were not

observed. The research would be more precise and holistic, whereby more behavioural and environmental variables are incorporated in future models. Linear regression was also employed in the study as a part of its mathematical modelling that may not entirely display the complex, non-linear associations between computer time and sleep health [8]. More complicated modelling techniques, such as machine learning algorithms or structural equation modelling, may assist us in knowing more about how factors evolve over time and influence one another. Regular statistical techniques would not discover trends, and with these methods, the estimates would be more accurate [21]. Finally, the research time frame coincided with the shift in the trends in the use of technology. In particular, social media websites and streaming services were gaining popularity [5][14]. Due to the rapidity of changes, the information can be rendered useless within a very short time with new screen-based fun released. One should remember to monitor the emerging digital habits and their impact on health by researching them repeatedly. Nevertheless, the study is a good start in the research on the effects of computer use on sleep despite its limitations.

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Appendix

Survey Questionnaire: Screen Time and Sleep Quality among Adolescents

Introduction for Participants

Thank you for participating in this study. The purpose of this survey is to examine the relationship between screen time and sleep quality among adolescents aged 13–19 years in urban environments. Your responses will be kept strictly confidential and will only be used for research purposes. Participation is voluntary, and you may withdraw at any time without any consequences. Please answer all questions honestly and to the best of your ability.

Note: For participants under 18 years of age, parental or guardian consent is required before completing this survey.

Section A: Demographic Information

These questions gather background details to ensure diverse and representative sampling.

1. Age

- 13
- 14
- 15
- 16
- 17
- 18
- 19

2. Gender

- Male
- Female
- Prefer not to say

3. Grade Level / Education Level

- Middle School (Grade 7–8)
- High School (Grade 9–12)
- Other (please specify): _____

4. Household Socioeconomic Status *(select the option that best describes your household)*

- Low income
- Middle income
- High income
- Prefer not to answer

5. Physical Activity Level *(average days per week with at least 30 minutes of physical exercise)*

- 0 days
- 1–2 days
- 3–4 days
- 5–6 days
- 7 days

Section B: Screen Time Usage

These questions capture your screen usage, especially during evening and sleep hours.

6. On average, how many hours per day do you spend on screens (phones, tablets, computers, TV, gaming)?

- Less than 1 hour
- 1–2 hours
- 3–4 hours
- 5–6 hours
- More than 6 hours

7. How many hours do you typically use screens during the hour before going to sleep?

- Less than 30 minutes
- 30 minutes – 1 hour
- 1–2 hours
- More than 2 hours

8. Which type of screen activity do you engage in most during evening hours? (Select all that apply)

- Social media (e.g., Instagram, TikTok, Snapchat)
- Video streaming (e.g., Netflix, YouTube)
- Gaming
- Homework/School work
- Messaging or video calls
- Other (please specify): _____

9. Do you usually use a screen while in bed right before sleeping?

- Yes
- No

10. Do you keep your phone or another device near your bed while you sleep?

- Yes, always
- Sometimes
- No

11. On weekdays, approximately how many hours do you spend on screens after 9 PM?

- 0–1 hour
- 1–2 hours
- 2–3 hours
- More than 3 hours

12. On weekends, approximately how many hours do you spend on screens after 9 PM?

- 0–1 hour
- 1–2 hours
- 2–3 hours
- More than 3 hours

Section C: Sleep Habits and Patterns (PSQI-Based Items)

This section uses adapted questions from the Pittsburgh Sleep Quality Index (PSQI) to measure sleep quality.

13. On average, what time do you usually go to bed on weekdays?

- Before 9 PM
- 9:00 – 10:00 PM
- 10:01 – 11:00 PM
- 11:01 PM – Midnight
- After Midnight

14. On average, what time do you usually wake up on weekdays?

- Before 5:00 AM
- 5:00 – 6:00 AM
- 6:01 – 7:00 AM
- 7:01 – 8:00 AM
- After 8:00 AM

15. On average, how many total hours of actual sleep do you get each night?

- Less than 4 hours
- 4–5 hours
- 6–7 hours
- 8–9 hours
- More than 9 hours

16. How would you rate your overall sleep quality?

- Very good
- Fairly good
- Fairly poor
- Very poor

17. During the past month, how often have you had trouble falling asleep within 30 minutes?

- Not during the past month
- Less than once a week
- Once or twice a week
- Three or more times a week

18. During the past month, how often have you woken up in the middle of the night or early morning?

- Not during the past month
- Less than once a week

- Once or twice a week
- Three or more times a week

19. During the past month, how often have you felt tired or sleepy during the day?

- Not during the past month
- Less than once a week
- Once or twice a week
- Three or more times a week

20. During the past month, how often have you used sleep medication (prescription or over-the-counter)?

- Not during the past month
 - Less than once a week
 - Once or twice a week
 - Three or more times a week
-

Section D: Lifestyle and Environmental Factors

These questions identify other factors that may affect sleep quality.

21. Do you have a regular bedtime routine before sleeping?

- Yes, always
- Sometimes
- Rarely
- Never

22. How often do you consume caffeine (coffee, soda, energy drinks) in the evening (after 6 PM)?

- Never
- 1–2 times per week
- 3–4 times per week
- Daily

23. Do you share a bedroom with someone else (siblings, parents, etc.)?

- Yes
- No

24. Does noise or light in your sleeping environment frequently disturb your sleep?

- Never
 - Sometimes
 - Often
 - Always
-

Section E: Academic Impact (Optional)

This section assesses the impact of screen time and sleep patterns on school performance.

25. In the past month, have you fallen asleep in class due to tiredness or poor sleep?

- Never
- Once or twice
- Several times
- Almost every day

26. How would you rate your overall academic performance?

- Excellent
 - Good
 - Fair
 - Poor
-

Final Question

27. Do you believe screen time before bed negatively affects your sleep?

- Yes
 - No
 - Not sure
-