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Impact of Cellphone on Sleep Cycle of Liberal Arts Students

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Abstract

Number of adults suffering from sleep deprivation has been increasing over the last couple of decades with the introduction of technology in our day-to-day life. Mobile phone usage has been identified as the main driver for increase in the sleep deprivation cases each year. This study has been conducted to find the relation between mobile phone usage and the quality of sleep. Although many studies have been made, a localized study has yet to be conducted for the inhabitants of Indian Subcontinent. This study has been conducted to find the relation between mobile phone usage and the quality of sleep in the students of Liberal Arts Department of Amity University, Haryana, India. A google form has been shared which constitutes mobile-related sleep risk factors Questionnaire (MRSRF) to the students and responses are recorded. After analysis of the data it has been found that a staggering 92% of the participants use mobile before going to sleep and almost half of participants sleep less than 6 hours per day, Which is less than the WHO's recommended sleep for an adult. Results from conducting Linear regression and Random forest regression Analysis shows that with increase in mobile phone usage, the quality of sleep reduces. Based on the estimated statistics Mean squared Error, Mean absolute error and Root mean squared error, Random Forest Regression model estimates the quality of sleep better than Linear Regression model. Importance and Measures to have a good night's sleep has been shared with students to reduce the mobile screen time and in-turn reducing the sleep deprivation.

1. Introduction

Ever since humans have inhabited the earth, Sleep has been an omnipresent behavior necessary for the support of physical health and for maintaining a good level of cognitive function. Thousands of studies have been conducted on the importance of sleep across all age groups. However, over the last couple of decades sleep deprivation has garnered more attention as it effects millions of people across the world to this day. Sleep deprivation can change your sleep patterns as well as it effects your hormone systems resulting in weight gain, insulin resistance, hypertension and decrease in cognitive ability (Laposky et al, 2008).

One of the reasons for sleep deprivation is usage of Smart phones. With its ease of availability and limitless functionalities, Smart phones have become an essential part of life for millions of people throughout the world. According to the Telecom Statistics India, an annual publication by the Economic Research Unit, Department of Telecommunications, Ministry of Communications, Government of India, the number of mobile phone users has crossed 500 million in Jan 2020 up from 242.92 million in 2015. It has been reported that one in every four children and young people are suffering from Problematic cell phone use (PSU) (Sohn S et al, 2019). Also it was determined that bedtime use of media devices was positively associated with poor sleep quality and excessive daytime sleepiness (Carter B, 2016).A study conducted on 95,680 adults by Munezawa *et al.* showed that mobile phone use for calling and for texting after lights out was associated with short sleep duration, poor sleep quality, excessive daytime sleepiness, and insomnia symptoms (Munezawa et al, 2011).A study conducted on American college students indicated that problem mobile phone use using "Mobile Phone Problem Use Scale" is related to poor sleep quality (Abbey G et al, 2011). A regional study in Saudi Arabia showed that there was an positive correlation between mobile phone usage and sleep disturbance (Al-khlaiwi T et al, 2004). In India, it was reported that about 33% of the adults have sleeping disorder insomnia (Bhaskar S et al, 2016).Very few regional studies have been made to study the effect of smart phone usage on sleep deprivation in India.

The whole education system all over the world has collapsed due to COVID-19. As a result students are more dependent on e-learning. It has not only increased the usage of mobile hpnes among students but this shift has actually lead to more sleep related problems among students.

 For understanding the relation and for spreading awareness about sleep deprivation, We are conducting this study to explore whether excessive use of mobile phones among liberal arts student in Amity University, Haryana ages 18-24 causes sleep deprivation. We are choosing this segment of population due to the fact that we study in the same institution with the chosen respondents which is Amity University, Haryana.

1.1 Research Objectives

The general aim of the study is to access whether excessive use of mobile causes sleep deprivation among liberal arts students at Amity University, Haryana.

The specific objectives are :

1. To study the relation between mobile phone usage and quality of sleep
2. To explore the remedial measures for sleep deprivation.

1.2 Statement of the Problem

This study is conducted to investigate the usage of mobile phones among the students and its relation to sleep deprivation, particularly in the liberal arts students ages 18-24 in Amity University, Haryana.

1.3 Research Questions

1. How excessive use of mobile phones is responsible for sleep deprivation?
2. What are the remedial measures for sleep deprivation?

1.4 Significance of the Study

Our youth needs good quality sleep, yet social and educational demands make them as one of the most sleep deprived age groups in the society. The negative outcomes associated with insufficient sleep due to reduced time in bed, poor sleep quality or variable sleep schedules range due to sleepiness leads to poor grades and worsened academic performance, reduced positive affect and adverse physical and mental health problems. Unfortunately, students may not realize the short and long-term consequences of poor sleep habits. Also, there is a lack of routine screening for students sleep health problems especially in our society. Students therefore require programs to improve their sleep health and needs education regarding the after-effects of sleep restriction or deprivation which are closely linked to their functional outcomes.

This study is thus an attempt look at the sleeping pattern in students and to improve students sleep habits and behaviours by enhancing the sleep quality. This study is also helpful in increasing the awareness about sleep deprivation. This study will also benefit other researchers as their reference in exploring the relation of mobile phone usage and poor sleep quality.

2. LITERATURE REVIEW

Sleep is a ubiquitous behavior in a normal human and is also an basic human need and a good night's rest improves health, quality of life. Several indicators can be used to describe sleep disturbance or sleep disorders. World Health Organization, 1998 has specified the following indicators for sleep disorder:

1) Sleep latency
2) Number and duration of nocturnal awakenings
3) total sleep time
4) Modifications in amount and proper rhythms of particular sleep stages such as slow wave sleep (SWS, or stages 3 and 4)
5) Rapid Eye Movement sleep (REM sleep), together with modifications in the autonomic functions (heart rate, blood pressure, vasoconstriction and respiratory rate)
6) Repetitive nights of sleep disruption among one week or one month.

A study conducted by Naja Hulvej Rod et al, 2018 has concluded that the high smartphone activity during bed hours among young adults may pose a public health challenge and may also lead to Obesity in young adults. The study also found that in young adults more than 12% were using smartphone in the middle of the night for about 3 to 5 hours and adults who were using smart phones at bed time had a 48 minutes shorter sleep.

A study conducted on 1925 students in Saudi Arabia (Nazish Rafique et al, 2020) showed that students who were using mobile for more than 8 hours in a day and students who use mobile for at least 30 mins before bed time are positively correlated with poor sleep quality.

Research conducted by Jing-wen He et al, 2020 in China reports that restricting mobile phone use close to bedtime reduced sleep disorders and improved the sleep duration and working memory.

Results from Laposky et al, 2008 shows that sleep deprivation can change your sleep patterns and also effects your hormone systems resulting in weight gain, insulin resistance, hypertension and decrease in cognitive ability.

Sohn S et al, 2019 proposed that some policies should be put into regulation as it was found that one in every four children and young people are suffering from Problematic cell phone use (PSU).

Jing-wen He et al, 2020 assessed the effects of restricting mobile phone usage at bedtime before sleep and it was found that restricting mobile phone usage for four weeks effectively improved their sleep latency, increasing sleep duration, sleep quality and working memory.

Violaine Kubiszewski et al, 2013 confirmed that an evening screen time of one hour or more is associated with a higher risk of sleep problems, particularly going to bed late and difficulty waking up.

It has also been found that sleep loss can casually affect mood states in healthy adolescents, with females having heightened vulnerability. (Michelle. A. Short et al, 2015).

A study conducted by Julian Lim (2008) in Psychology Department, University of Pennsylvania, USA concludes that people suffering from sleep deprivation does not have a good level of vigilant attention and are extremely sensitive.

Many tools and questionaries are being used across the world to determine the quality of sleep and sleep latency. The most popular one is **The Pittsburgh Sleep Quality Index (PSQI)** and **MOBILE RELATED SLEEP RISK FACTORS (MRSRF) QUESTIONNARE.** This questionnaire is used to find out the mobile related sleep risk factors and mobile use sleep safety practices in mobile users.

3. METHODOLOGY

The study was conducted between 26th November 2020 to 29nd November 2020 on 100 students from Amity University, Haryana. A google form has been shared to the participants to record their responses on mobile-related sleep risk factors Questionnaire (MRSRF). After thorough literature review based on previous studies conducted on MRSRF, the following 12 questions have been taken into consideration for the current study:

- Gender (Male/Female)
- Age
- Do you use mobile phone before going to sleep? (Yes/No)
- On an average how many hours do you use mobile phone per day? (< 10 hours / 10 – 15 hours / > 15 hours)
- Do you keep your mobile on the bed while sleeping? (Yes/No)
- Do you keep your mobile phone within your reach while sleeping? (Yes/No)
- Do you use blue light filters on your mobile? (Yes/No)
- Do you wake up at least once to check mobile phone during night? (Yes/No)
- Do you face difficulty falling asleep? (Yes/No)
- What is your general wake up time in the morning? (Before 8 AM / Between 8 AM – 10 AM / After 10 AM?)
- What is your sleep duration (< 6 hours / 6 – 8 hours / > 8 hours)?
- Rate your quality of sleep on a scale of 1 to 10.

3.1 Data collection

Data was collected by conveniences sampling technique and response rate was 25% as 100 out of 400 students in liberal arts volunteered and completed the questionnaire. The online questionnaire was shared with each class on their Whatsapp groups. The students were assured about their confidentiality of their personal information.
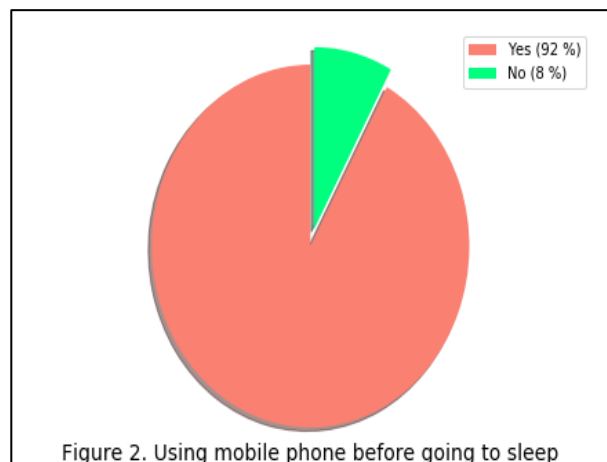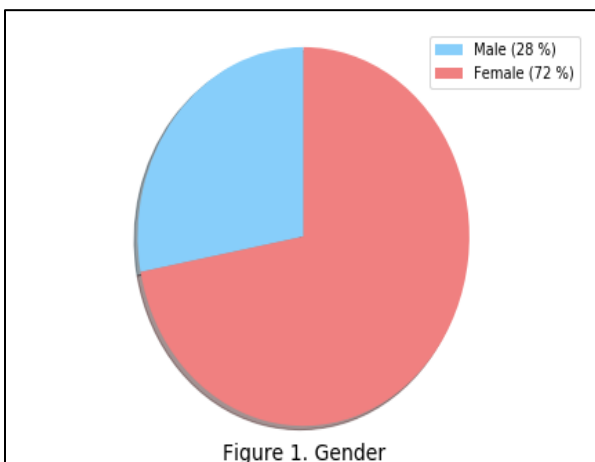
3.2 Inclusion criteria

1. The students between age 18-24 years who were willing to participate in the study.
2. The students who use mobile phone daily.

Exclusion criteria

1. Students who suffer from any mental health.
2. Students with any diagnosed sleep disorder.
3. Students with any diagnosed chronic respiratory disorder.
4. Student under any kind of prescribed or over the counter medication.

4. ANALYSIS AND FINDINGS

The data was analysed in Python version 3.7.9 and Microsoft Excel 2019. Basic Statistics and various plots extracted from the responses collected through a predetermined google form to understand the general demographics of the collected data.
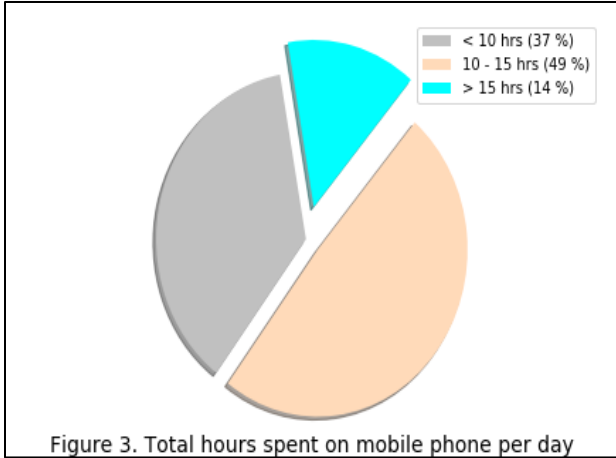

Figure 1. Gender

Male (28 %)
Female (72 %)

Figure 2. Using mobile phone before going to sleep

Yes (92 %)
No (8 %)

Figure 3. Total hours spent on mobile phone per day

Legend:
- < 10 hrs (37 %)
- 10 - 15 hrs (49 %)
- > 15 hrs (14 %)
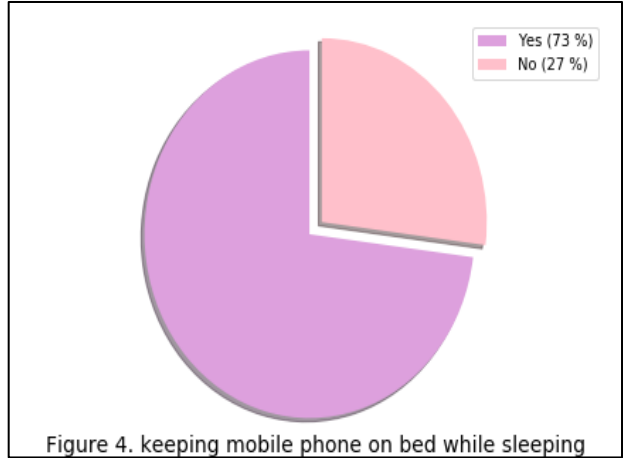
Figure 4. keeping mobile phone on bed while sleeping

Legend:
- Yes (73 %)
- No (27 %)
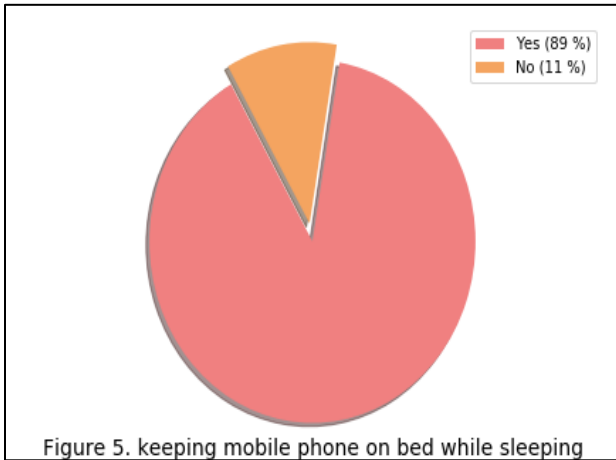
Figure 5. keeping mobile phone on bed while sleeping

Legend:
- Yes (89 %)
- No (11 %)
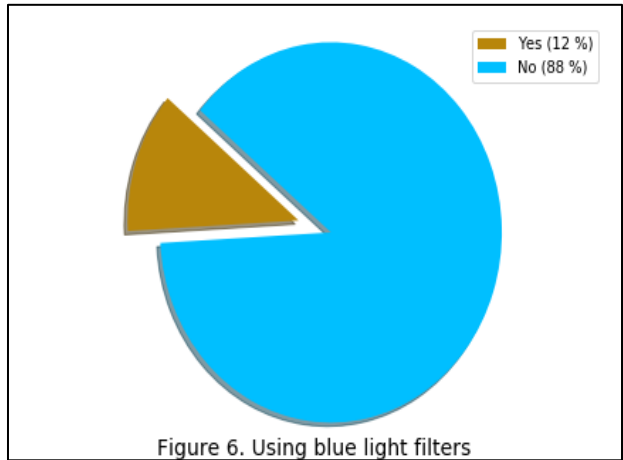
Figure 6. Using blue light filters

Legend:
- Yes (12 %)
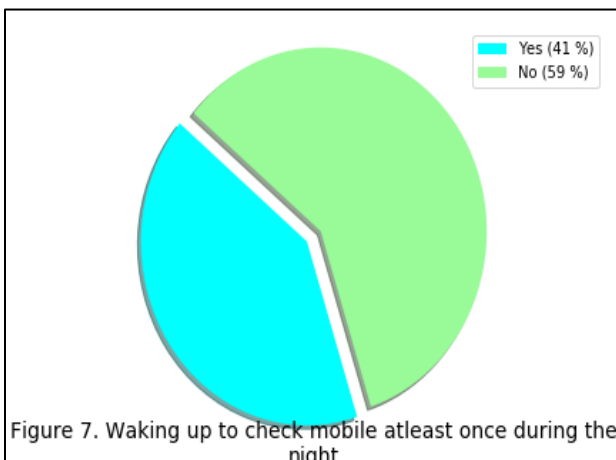- No (88 %)

Figure 7. Waking up to check mobile atleast once during the night

Legend:
- Yes (41 %)
- No (59 %)

Figure 8. Facing difficulty falling asleep

Legend:
- Yes (34 %)
- No (66 %)

Figure 9. General wakeup time
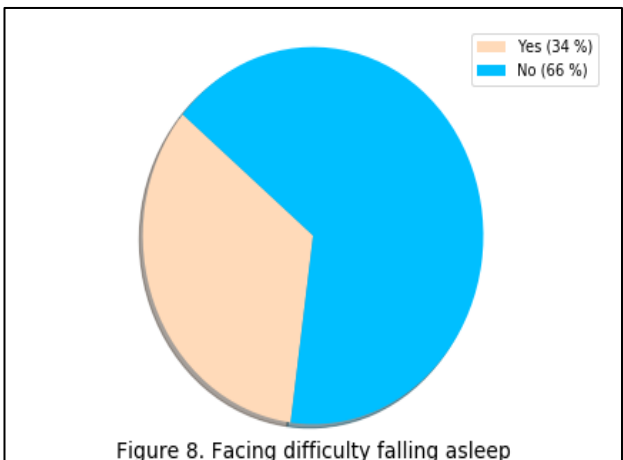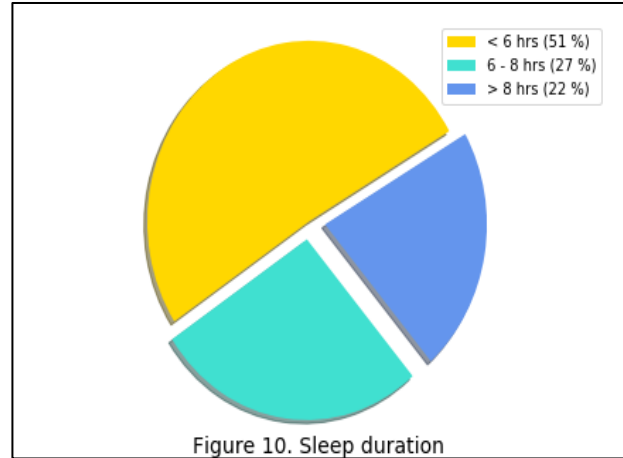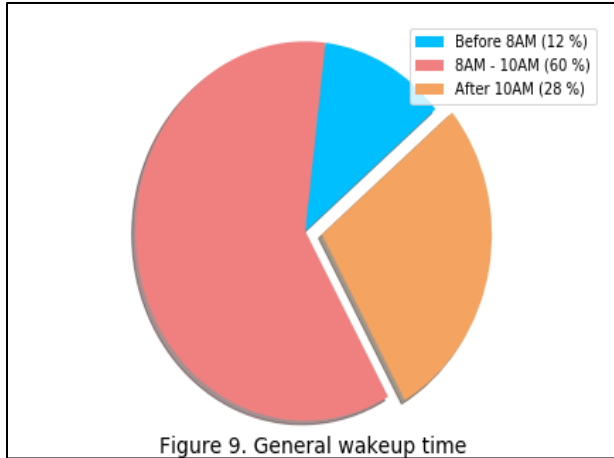

Figure 10. Sleep duration

Scoring

A score of 0 or 1 is given to each response as follows:

Table 1. Scoring given to each question

Question	Score Allotted (Response)		
Do you use mobile phone before going to sleep?	Yes (1)	No (0)	
On an average how many hours do you use mobile phone per day?	< 10 hours (0)	10 - 15 hours (1)	> 15 hours (1)
Do you keep your mobile on the bed while sleeping?	Yes (1)	No (0)	
Do you keep your mobile phone within your reach while sleeping?	Yes (1)	No (0)	
Do you use blue light filters on your mobile?	Yes (1)	No (0)	
Do you wake up at least once to check mobile phone during night?	Yes (1)	No (0)	
Do you face difficulty falling asleep?	Yes (1)	No (0)	
What is your general wake up time in the morning?	Before 8 AM (0)	8 AM - 10 AM (1)	After 10 AM (1)

What is your sleep duration?	< 6 hours (1)	6 - 8 hours (0)	> 8 hours (0)

Based on each participants response to the questionnaire, total score is calculated for each participant and is used for comparing with the quality of sleep.

A linear regression and random forest regression analysis was conducted to the determine the dependency of various factors like Usage of mobile before sleeping, keeping mobile within your vicinity and other variables on the quality of sleep.
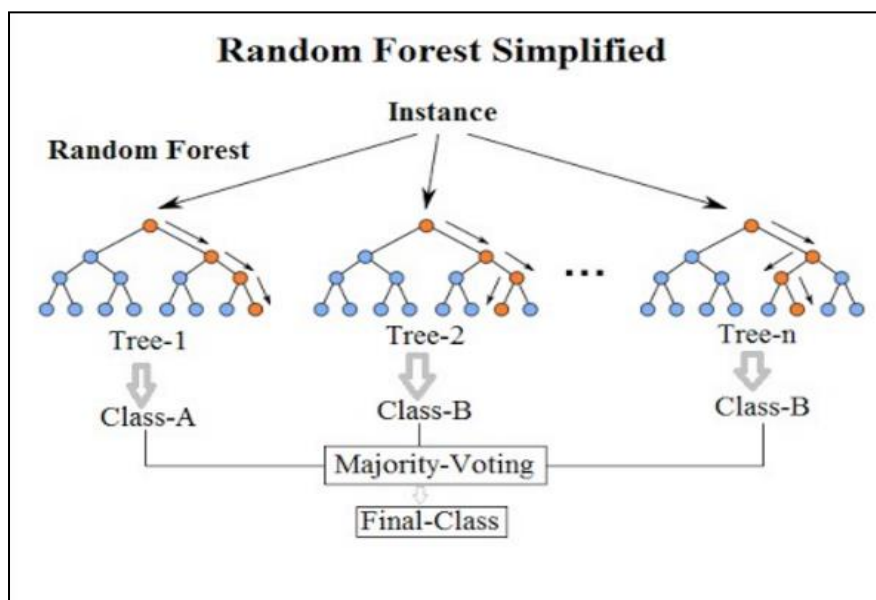
Linear Regression

Linear Regression is a form of supervised learning algorithm used when the predicted output is continuous and has a constant slope. Linear Regression is used to predict values within a continuous range.

A linear regression line has an equation in the form of Y = AX + B, Where X is an independent variable and Y is a dependent variable. Slope of the line is A and B is the intercept (the value of Y when X = 0)

Random Forest Regression

Random Forest Regression is a supervised learning algorithm that uses **ensemble learning** method for regression. Ensemble learning method is a technique that combines predictions from multiple machine learning algorithms to make a more accurate prediction than a single model.

Since Score is an independent variable, it is considered as X in our regression analysis. As the quality of sleep is dependent upon the score, it is considered a Y.

Steps involved in Regression

1) The response data collected was divided into training dataset (75 %) and validation dataset (25 %) randomly.
2) Then the training dataset (score (x) & quality of sleep (y)) was used to fit the linear regression and random forest regression.
3) Once the model has been fitted, then the validation data is fed into the trained model to get the predicted values of quality of sleep.
4) Mean Squared Error, Mean Absolute Error and Root Mean Squared Error was estimated between the predicted quality of sleep values and quality of sleep values from the validation dataset.
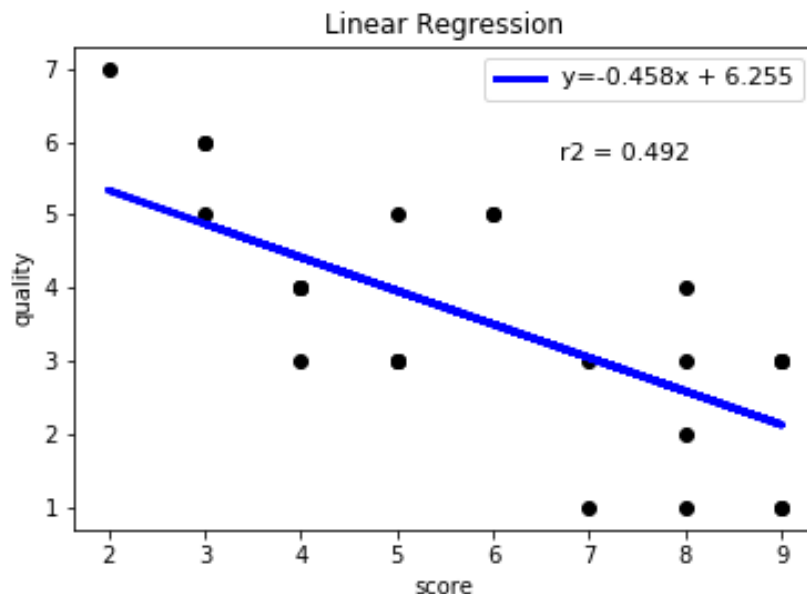
Figure 12. Linear Regression Model
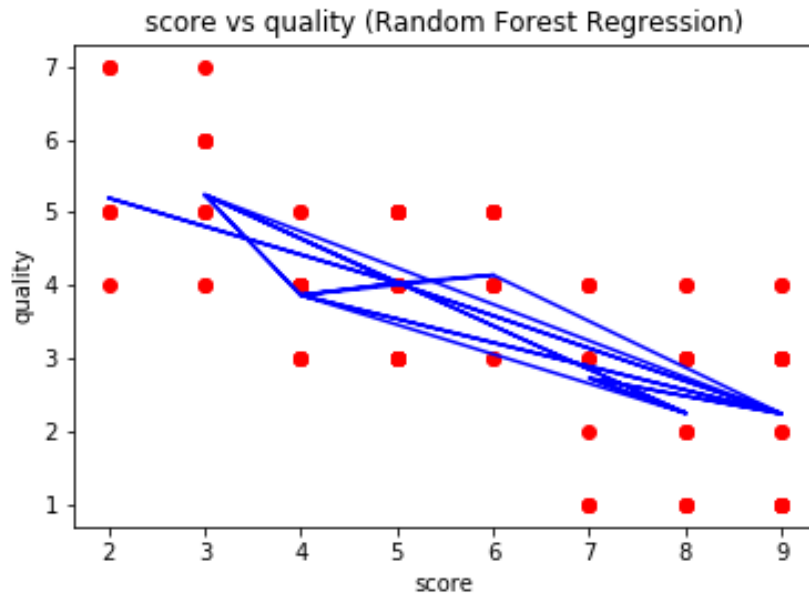
Figure 13. Random Forest Regression Model

Table 2. Calculated Statistics for regression model

Stat	Linear Regression	Random Forest Regression
Mean Absolute Error	0.983	0.845
Mean Squared Error	1.208	0.94
Root Mean Squared Error	1.099	0.969

Findings from the analysis

1) A staggering 92% of the participants use mobile before going to sleep.
2) About 88% do not use blue light filters on their mobile phone at night when lights are turned off.
3) 63 % of participants use mobile phone more than 10 hours per day.
4) Percentage of participants who keep mobile phone on bed while sleeping is about 73%.
5) 89% of participants keep their mobile phone on bed while sleeping.
6) About 41 % of participants say that they wake up at least once during the night to check mobile phone.
7) 34 % of participants say that they face difficulty in falling asleep.

8) About 28% of participants wake up after 10 Am.
9) Almost half of participants sleep than 6 hours.
10)   Based on the fitted Linear Regression model, We conclude that with increase in mobile phone usage, the quality of sleep reduces as depicted by the linear regression line equation **"score = -0.458(quality) + 6.255"**.
11)   Based on the estimated statistics Mean squared Error, Mean absolute error and Root mean squared error, Random Forest Regression model estimates the quality of sleep better than Linear Regression model.

5. CONCLUSION

The study has shown that people are habituated to using mobile phone at night before going to sleep. A positive correlation has been identified between mobile phone usage and quality of sleep. Most of the people who use mobile more than 8 hours each day have rated their quality of sleep as poor, when compared to the people with daily mobile usage less than 8 hours. This study has incorporated a small sample size at the moment but can be further improved by increasing the sample size and implementing various regression algorithms like linear regression and random forest. Based on the conducted study, we want to spread awareness about the usage of mobile at night and also talk about the improvement in quality of sleep by gradually changing the habits or following the below mentioned things.

5.1 Remedial Measures

- Reduce the blue light exposure in the evening and night by activating the blue light filter in your mobile phone as blue light tricks your body into assuming its daytime.
- Don't consume caffeine in later part of the day.
- Long daytime naps will disrupt your good night's sleep. So please prefer to take only short naps during the day.
- Maintain consistent timing in your sleep schedule.
- Always try to maintain your bedroom temperature according to your needs.
- Make sure your bedroom is a quiet and relaxing place by minimizing external noise and highly intensive light.
- Always take a shower before going to bed.
- National Centre for Chronic Disease Prevention and Health Promotion, Division of Population Health, Federal Government of United States strongly recommends 7 or more hours of sleep per night for age group 18-60 years.

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Annexure

Python code used for Linear Regression

import pandas # for reading csv

import numpy # for numerical computation

import matplotlib.pyplot as plt # for plotting

import seaborn as seabornInstance # for plotting

from sklearn.model_selection import train_test_split

from sklearn.linear_model import LinearRegression

from sklearn import metrics

reading csv using pandas

#dataset = pandas.read_csv('responses.csv')

Consider X as Score because we want to predict the quality of sleep for a given score

X = dataset['score'].values.reshape(-1,1)

Y = dataset['quality'].values.reshape(-1,1)

Divide the dataset into training dataset (75%) and testing dataset (25%)

X_train,X_test,Y_train,Y_test   = train_test_split(X,Y,test_size=0.25,random_state=0)

Lets start fitting the dataset to linear regression algorithm

regressor = LinearRegression() ## intitating the algorithm class

regressor.fit(X_train,Y_train) ## training the algorithm .fit is a method in linear regression class

Y_pred = regressor.predict(X_test) ## Get Predicted Y by inputting X from testing dataset

After fitting the linear regression model, lets extract the slope and intercept

intercept = regressor.intercept_ ## extracting the intercept

```python
print("Intercept of the fitted model is ", intercept )

slope = regressor.coef_ ## extracting the slope

print("Slope of the fitted model is ", slope)

## calculate r2

r2 = regressor.score(X, Y)

print("Coefficient of determination is ", r2)

## plot

plt.scatter(X_test, Y_test, color='black')

plt.plot(X_test, Y_pred, color='blue', linewidth=3, label='y=-0.458x + 6.255')

plt.legend(fontsize=11)

plt.xlabel('score')

plt.ylabel('quality')

plt.title('Linear Regression')

plt.figtext(0.7, 0.7,'r2 = 0.492', wrap=True, horizontalalignment='center', fontsize=11)

plt.savefig(directory + 'linear_reg.png')

plt.close()

## Calculate the error between Y and Y_predicted based on the fitted model

print('Mean Absolute Error - Linear Reg :', metrics.mean_absolute_error(Y_test, Y_pred))

print('Mean Squared Error - Linear Reg :', metrics.mean_squared_error(Y_test, Y_pred))

print('Root Mean Squared Error - Linear Reg :',
numpy.sqrt(metrics.mean_squared_error(Y_test, Y_pred)))
```