



## RESEARCH ARTICLE

### SLEEP, SELF-REGULATION AND STRESS AMONG SMARTPHONE USERS

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#### ABSTRACT

There has been an increase in recognition of the negative aspects of smart phone overuse in the young students. These negative aspects include significant effects on sleep, self-regulation and stress. This emerging issue motivated me to analyse the relationship between the aforementioned factors and smart phone usage. The investigation includes data collected from students in the age group of 19 through 22 using an online questionnaire. The participants are divided into high smart phone users and low smart phone users based on the self reported rating scale. Tests were also used to identify their sleep patterns which include sleep latency, subjective sleep quality, duration, habitual sleep efficiency, sleep disturbances, daytime dysfunctions and use of sleep medications. In addition to that, self report scales were used to identify self-regulation capacity and stress among the participants. Characterization of the overall relationship between usage pattern related effects is illustrated in this research. This study showed significant positive co-relation between perceived stress and smart phone usage. Smartphone usage is also negatively correlated with sleep quality and self regulation capacity among students. There is also a difference between the self regulation capacity, perceived stress and quality of sleep of high and low smart phone users.

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## INTRODUCTION

The world has seen immense technological advancement since the rise of digital era. New inventions have made human life easier and fast paced. These inventions, like the computers, laptops, cameras, television, internet, smart phones etc. only to name a few, form an integral part of daily lives of people across the globe. These devices affect human lives in various ways. It has now become a trend worldwide to possess various smart phones with all the latest features in them. They certainly are having a strong grip over the masses all over the world.

### Smart phones

The first touch screen smart phone named Simon was introduced by IBM an American multinational in 1992. The term 'Smartphone' was introduced by Ericsson – the multinational networking and telecommunication giant in the year 1997. This word was used to describe GS 88 'Penelope' which was launched then. The term 'Smartphone' was introduced in the market, and it referred to a new class of mobile phones that provides integrated services from communication like wireless communication, voice communication, computing, messaging, and other mobile

phone applications called "apps". The introduction of the term was a marketing strategy to make a difference between the conventional mobile phones and the new "smart phones". The difference between feature phones and smart phones is that the smart phone is a miniature computer that can also place and receive calls. Most smart phones have a virtual store for thousands and thousands of mobile applications which make them smarter than the regular cell phone. With distinguished features like games, navigation maps, image editors, multiple web browser options, some phones even take a step further and provide with a virtual built in assistant like Apple I Phone's Siri which make the phones even smarter than the conventional feature phone. The functionality of a feature phone however is only limited for placing and receiving calls, message services and conventional games. To make it simple, all smart phones possess the ability to function as a cell phone but the vice versa is not true. I Phone and Android are the most widely accepted operating systems for a smart phone. Storage space and battery life are also one of the many features that distinguish a smart phone from a feature phone/cell phone. Smart phones have larger number of functions and require larger battery and storage space for functioning as compared to that of a feature phone. Myriad number of functions provided by the smart phone explains their popularity worldwide. They are now becoming an integral part of daily lives of many individuals. The number of smart phone users in the world is expected to pass the five billion mark by 2019. The number of smart phone

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users is forecast to grow from 2.1 billion in 2016 to 2.5 billion in 2019, with smart phone penetration rates increasing as well. Just over 36% of the world's population is projected to use a smart phone by 2018, up from about 10% in 2011. One of the major factors to consider for the growth of smart phone users is internet technology. There has been a drastic growth in broadband and Internet service providers business in past few years and one of the main reasons for this drastic increase in their business is the ever increasing use of smart phones and growth of smart phone and mobile applications. Approximately 40% of the world population has an internet connection today. In the year 1995, it was less than 1%. The number of internet users has increased tenfold in the duration from 1999 to 2013. The first billion mark was reached in 2005. The second billion in 2010. The third billion in 2014. Young internet users spend 185 minutes per day on an average.

### Sleep

Sleep plays a vital role in good health and well-being throughout the life of a human. According to National Institutes of Health, an average human spends about one third of his/her life sleeping. Getting enough quality sleep at the right times not only helps protect mental and physical health, but also provides quality of life and safety. Studies show that sleep deficiency alters activity in some parts of the brain. It may have trouble in decision making, problem solving, controlling emotions and behavior, and coping with change. Sleep deficiency is also linked to depression, suicide and risk-taking behavior and other diseases like stroke high blood pressure etc. Sleep is essential for optimal functioning of the body and ignoring the need for sleep has many negative consequences, including irritability, exhaustion, lack of concentration, and impaired judgment.

### Self Regulation

Self-regulation is "self exerting control over oneself". It consists of deliberate efforts by the self to alter its own states and responses, including behavior, thoughts, impulses or appetites, emotions, and task performance. It is now recognized as a central function of the "self". The practical importance of self-regulation cannot be minimized.

### Various examples of the same can be stated as under

- People exhibiting personal and social problems, that incapacitate the modern society, have some degree of self-regulation failure at their core. These problems include alcoholism and addiction, obesity and binge eating, anger management, and other emotional control problems.
- Poor self regulation is also linked to antisocial impulsivity and aggressive behavior which lead to crime and violence.
- Unwanted pregnancy and sexually transmitted diseases are some sexual problems that can be avoided with effective self-regulation.
- Underachievement in school and work often a reflection of inadequate self-regulation. Financial problems, like losses in business due to impulsive decisions, failure to save for the future, or impulsive shopping and credit card debt, also positively indicate a lack of self regulation.

- Various health problems could be avoided and prevented by self-regulation, such as to ensure regular exercise, oral hygiene and personal care which included proper diet and supplementary intake.

Though smart phones contribute to making lives easier, students might tend to overuse them as a means to escape reality which possibly affects their sleep, self-regulation and stress.

### Review of Literature

EMarketer (2012) found in a survey, 21% of college students use their smart phone for communication purposes and 19% of them use their smart phones for social networking apps with Face book being the most commonly used app. Kuss, Griffiths, Karila, and Billieux, 2014 found cultural differences may have contributed to the high prevalence of excessive technology use in Asia is usually higher than in the West, as has been detected in a review of Internet addiction studies. Berger (2013) in his study showed that students who use cell phones both more in class and also out of class get lower grades than their peers who use their phones comparatively less. Researchers have found close relationship between smart phone overuse and poor mental health including deprivation of sleep and attention deficits. Interactive characteristics of smart phones contain inducing and reinforcing features that promote excessive usage behaviours. Gradisar *et al.* pointed specifically at the cell phone showing data that of those who reported using their cell phones during the last hour before bed, more than half (57%) left their ringer on, which was, in turn, associated with difficulty returning to sleep after awakening; 20% of young adults reported being awakened at least a few nights a week, most often by an alert or notification from a cell phone. Long Xu, Zhu, Sharma, and Zhao found that those Chinese college students who used more social media witnessed more sleep problems.

Fossum, Nordnes, Storemark, Bjorvatn, and Pallesen (2014) found that Norwegian college students who used more night time media in bed, particularly the computer and mobile phone for playing, surfing, and reading showed more insomnia. Moruzzi (1966, 1972) Sleep has a major role in the recovery from neuronal plasticity associated with learning and memory. Sleep deprivation negatively impacts memory encoding and positive memory encoding in particular, but also that negative stimuli are largely resistant to the effects of sleep loss. Doane and Thurston (2014) found that high daily stress among adolescents was associated with reduced sleep duration. Thomée (2012) in her research showed that heavy smartphone and computer usage is causing stress, insomnia and depression. It could cause stress reactions. Nolen-Hoeksema (1990) and Weissman *et al.* (1996) noted that across many nations, cultures and ethnicities, women are about twice as likely as men to develop depression which is linked to anxiety. Depression has a strong relationship to anxiety as prolonged stress can lead to depression (Sarafino, 2002). Many people are strongly attached to their smart phone (Rush, 2011) and increasingly also expect others to be available at any time. This can cause stress or anxiety when the device is not at immediate reach (Carbonell, Oberst, and Beranuy, 2013) one cannot be reached by others, cannot contact friends, or fails in being up-to-date (Lee, Chang, Lin, and Cheng, 2014; Sayrs, 2013). Results do suggest that social stress positively influences addictive smart phone behaviour. A high level of social stress

creates anxiety to be in the spotlight or interact with people in real life (Whang *et al.*, 2003). The result is that social interactions in real life are ignored, while more anonymous interactions online increase (Whang *et al.*, 2003). Seay and Kraut (2007) showed that self-regulation is critical for controlling online gaming behaviours, and they considered how it can be incorporated into the game designs to prevent addictive behaviours. Significant amount of research work done earlier suggests the unique co-relation between sleep, stress and self-regulation. It thus becomes imperative to study it in the context of smart phone using students in the Indian society.

### Significance of Study

India sees a fast paced digital growth. This digital growth is supported by various technological advancements and certainly, smart phone is one of them. It can now be seen that out of the total mobile phone users in the population on 1.2 billion, 10% users are smart phone users. And when the study narrows down, a majority chunk of smart phone users are young adults and college students. The reachability of smart phones is not as obscure as it was some decades ago. With multiple brands, and multiple feature availability, they are also getting economical and to add to all this the youth is readily accepting the newer technology. Hence it has become crucially important to study the importance of the penetration of smart phones in the daily lives. Addiction to smart phones and problematic smart phone usage patterns is a matter of growing concern. Growing competition in the academic field has also led to a change in the routine of college students. It has an impact on various factors pertaining to their life. Factors like stress, sleep, self regulation could possibly have affected in some way or the other. To monitor those changes is important and their effect on the youth cannot be neglected. This study would be important in assessing the relationship between smart phone users and attributes like stress, sleep and self-regulation in their life. Further, addiction also plagues the society be it substance or behavioural. It thus has become of extreme importance to study smart phone over-use and its related effects on stress, sleep and self- regulation among the young students in India. It would foster the knowledge in this area and help understand the rationale for many other further studies.

If smart phone over-use poses an eminent threat to the students, it could have immense power to have a significant impact on the entire nation, given the fact that India is a country of youth. This study also could give a brief idea about the impact of smart phones in the lifestyles of those using them. Thus, this study could be the basis of many further researches in this arena.

## MATERIALS AND METHODS

### Objectives

- To study the quality of sleep among smart phone users.
- To study the perceived stress among smart phone users.
- To study the self-regulation capacity among smart phone users.

### Hypotheses

- Low smart phone users will have good sleep quality than high smart phone users.
- Low smart phone users will have high self regulation capacity than high smart phone users.
- Low smart phone users will have low perceived stress than high smart phone users.
- There will be a positive co-relation between sleep quality and self regulation capacity among smart phone users.
- There will be a negative co-relation between sleep quality and perceived stress among smart phone users.
- There will be a negative co-relation between self regulation capacity and perceived stress among smart phone users.

### Sample

The main aim of any psychological research is to make valid generalisations such that they are extended to those beyond who participate in it. It is not feasible to collect data from each and every person from the population of interest as it would take a very long time and will be quite expensive. Hence, a small group of individuals known as “sample” is selected in order to represent the entire population.

### There are two basic sampling methods

- Probability sampling – Here, every individual in the population is known and has a certain probability of being selected.
- Non-probability sampling – This method is usually selected when the total number of representations in a population are not entirely known; hence, efforts are made to select a group of representatives that resemble the entire population.

### For this research, the criteria are as mentioned below

- Indian students studying in colleges in the age group of 19 to 22 years and residents of the city of Pune.
- Students possessing smart phones with internet connectivity available in it.

Among the various methods of non-probability sampling, purposive sampling is one in which, the sample of interest is selected subjectively by the researcher. In order to glean the desired sample for the aforementioned requirement, purposive sampling is the best suited sampling technique among all the other possible non probability techniques. In order for the research to be precise, the sample size will be large enough of about 150 students from the selected population of research which comprises 75 male and 75 female students.

### Tests

#### Smartphone addiction

The tool used to investigate smart phone addiction is SPAI (Smart Phone Addiction Inventory). It was developed by Yu-Hsuan Lin, Li-Ren Chang, Yang-Han Lee, Hsien-Wei Tseng, Terry B. J. Kuo and Sue-Huei Chen in the year 2014. The exploratory factor analysis done by the researchers, resulted

into four factors namely: compulsive behaviour, functional impairment, withdrawal and tolerance. The test-retest reliabilities i.e. interclass correlation was measured as 0.74–0.91. The internal consistency (Cronbach's  $\alpha$ ) was obtained as 0.94 for the total scale and for the four factors "compulsive behaviour", "functional impairment", "withdrawal", and "tolerance" were 0.87, 0.88, 0.81, and 0.72, respectively. The four subscales had moderate to high correlations i.e. 0.56–0.78. The p-value of the Bartlett test was less than 0.001, which indicated that the factor analysis was appropriate. This is a 26 item scale and the total scores ranged from 26 to 104.

## Sleep

The Pittsburgh Sleep Quality Index (PSQI) is a self report questionnaire that assesses sleep quality and quantity. It was developed by Buysse, D.J., Reynolds, C.F., Monk, T.H., Berman, S.R., and Kupfer, D.J. in the year 1989. It comprises of 19 self report items and yields seven component scores namely: sleep latency, subjective sleep quality, duration, habitual sleep efficiency, use of sleep medications, sleep disturbances and daytime dysfunction. The sum of these seven components yields the Global Sleep Quality Index and the scores range from 0-21. For the global sleep quality scale, the Cronbach's  $\alpha$  reported was 0.83. The global sleep quality score greater than 5 discriminated good sleepers from poor sleepers and also yielded a diagnostic sensitivity of 89.6% and specificity of 86.5%. The subject is asked to answer the questionnaire on a 4 point Likert scale with 0 as very good, 1 as fairly good, 2 as fairly bad and 3 as very bad.

## Self-regulation

The Self-Regulation Questionnaire (SRQ) was developed by Brown, Miller, and Lawendowski in the year 1999. The internal consistency of this scale had a Cronbach's  $\alpha$  as 0.91. The test re-test score was also very high and had  $r = 0.94$ ,  $p < .0001$ . This is a 63 item scale which classifies the result into three ranges namely: High (intact) self-regulation capacity, intermediate (moderate) self-regulation capacity and low (impaired) self-regulation capacity. The scoring is based on the five-point Likert scale with 1 as strongly disagree, 2 as disagree, 3 as uncertain or unsure, 4 as agree and 5 as strongly agree.

## Stress

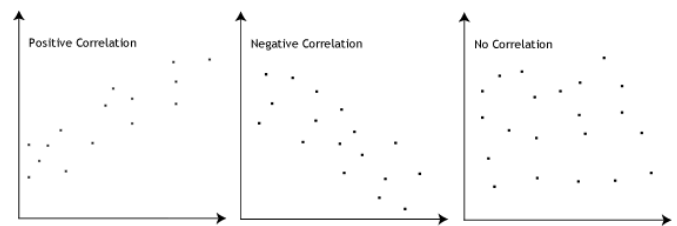
Perceived Stress Scale (PSS) is a 10 item scale and was developed by Cohen, Kamarck, and Mermelstein in 1983. It reported Cronbach's  $\alpha$  as 0.84-0.86. The test-retest reliability for this scale was 0.85. The subject is asked to answer the question in a five point Likert scale with options like never, almost never, sometimes, fairly often and very often. The total score is calculated by finding the sum of all the ten items and the final scores range between 0 and 40. Higher score indicates more stress.

## Statistical analysis

The objective of this study as mentioned earlier is to study sleep quality, perceived stress and self regulation capacity among smart phone users. This entails the detailed association (if any) between the selected variables, that is, to measure how well these variables are related to one another.

## Pearson product-moment correlation

In the study of relationships, two variables are said to be correlated if change in one variable is accompanied by change in the other - either in the same or reverse direction. The Pearson product-moment correlation coefficient (or Pearson correlation coefficient) is a measure of the strength of a linear association between two variables. It is denoted by  $r$ . The Pearson correlation coefficient,  $r$ , can take a range of values from +1 to -1. A value of 0 indicates that there is no association between the two variables. A value greater than 0 indicates a positive association; that is, as the value of one variable increases, so does the value of the other variable. A value less than 0 indicates a negative association; that is, as the value of one variable increases, the value of the other variable decreases.



This is shown in the diagram as follows

The strength of association is an important parameter to consider in the Pearson's product moment correlation. There are certain guidelines for interpreting the Pearson's correlation co-efficient as mentioned in the table below:

Strength of Association	Coefficient, $r$	
	Positive	Negative
Small	.1 to .3	-0.1 to -0.3
Medium	.3 to .5	-0.3 to -0.5
Large	.5 to 1.0	-0.5 to -1.0

These values mentioned above are guidelines of whether an association is strong or not.

## Conditions for using Pearson's product moment correlation

- The variables are in the interval or ratio scale of measurement.
- A linear relationship between them is suspected.
- The variables that are to be measured can have entirely different units.

Considering all the above mentioned advantages and suitability of Pearson's product moment correlation coefficient, it was decided to use the same for studying the correlation between the following variables:

- Sleep quality and self regulation capacity among smart phone users.
- Self regulation capacity and perceived stress among smart phone users.
- Sleep quality and perceived stress among smart phone users.

## T-test

A t-test is an inferential statistical test that determines whether there is a statistically significant difference between the means

in two unrelated groups. It allows us to determine a *p* value that indicates how likely the results are developed by chance.

#### Assumptions made in carrying out a t-test

- The dependent variable must be continuous (interval/ratio).
- The observations are independent of one another.
- The dependent variable should be approximately normally distributed.

Statistical significance is determined by looking at the *p*-value. The *p*-value gives the probability of observing the test results under the null hypothesis. Thus, a low *p*-value indicates decreased support for the null hypothesis. However, the possibility that the null hypothesis is true and that we simply obtained a very rare result can never be ruled out completely. The cut-off value for determining statistical significance is ultimately decided on by the researcher, but usually a value of 0.05 or less is chosen. This corresponds to a 5% (or less) chance of obtaining a result like the one that was observed if the null hypothesis was true.

#### Hence t-test was selected to study the following

- Smartphone users and sleep quality among them.
- Smartphone users and self regulation capacity among them.
- Smartphone users and perceived stress among them.

#### Ethical issues

Utmost care is required to be taken in the light of ethical issues while conducting a research. There are certain main ethical issues that were considered while carrying out this research work, they are as under:

#### Confidentiality

This term means that the individuals are guaranteed privacy in terms of all personal information that is disclosed and that no information will be disclosed without the individual's direct permission.

#### Informed consent

Individuals participating in the research are entitled to know about the study, risks involved in it, protection of their rights and also give them the right to withdraw any time during the conduction of the research. Two aspects are important to consider in this regard and they include: voluntariness and competence. Voluntariness means that the consent is taken without exercising any duress, pressure or undue excitement or influence. The second major aspect to informed consent is whether the test taker is legally competent to give the consent.

#### Minimal risk

It pertains that no harm or discomfort should be experienced in the everyday life of the individual.

#### Deception and debriefing

Deception is involved in certain studies where some information is withheld from the participants of the research at any stage during the process of conducting it. Debriefing means that the harmful effects that were caused by deception are totally removed by the researcher. As this study involved no deception during any stage of the research process, debriefing was not necessary and hence not done.

#### Plagiarism

No idea in this entire research were taken from a different source and posed to my own idea. References are aptly provided to the sources of information wherefrom it has been taken. No harm whatsoever was caused to any individual while conducting this study. Privacy, confidentiality and informed consent were safeguarded by mentioning the following at the beginning of the questionnaire: Thank-you for agreeing to take part in this important study about smart phone users. It should take about twenty minutes of your time. Following sections will have some general questions. There are no right or wrong answers. best answer is the one which comes to your mind first, so do not think upon the questions for too long. Read all the answer options carefully for each question (wherever specified).

**Table 1. Sleep quality among high and low smart phone users.**

	Mean	Standard Deviation	N	t
Sleep quality of high smart phone users	5.48	2.8775	75	
Sleep quality of low smart phone users	4.3467	2.8828	75	2.4097

**Table 2. Self-regulation capacity among high and low smart phone users**

	Mean	Standard Deviation	N	t
Self regulation capacity of high smart phone users	205.92	15.6661	75	
Self regulation capacity of low smart phone users	219.7067	20.6776	75	4.6024

**Table 3. Perceived stress among high and low smart phone users**

	Mean	Standard Deviation	N	t
Perceived stress of high smart phone users	21.4	5.1255	75	
Perceived stress of low smart phone users	16.4133	4.4603	75	6.356

#### Privacy

The participants are entitled to the right to privacy, meaning, they decide how their information is communicated to others.

Please answer all the questions truthfully. Your responses are voluntary and will be confidential. Responses will not be identified by individual. All responses will be compiled together and analysed as a group.

**Quantitative analysis of data**

T-test and Pearson’s product moment correlation coefficient are used to statistically analyse the data of smart phone users.

**Results and interpretation of t-test**

A t-test is an inferential statistical test that determines whether there is a statistically significant difference between the means in two unrelated groups. Here, the two groups are sleep quality of low smart phone users and sleep quality of high smart phone users. This difference is considered to be statistically significant. Hence we accept the hypothesis, that low smart phone users will have good sleep quality than high smart phone users. Second, t-test was administered to check the difference between the means of self regulation capacity among high and low smart phone users. This difference considered to be statistically significant. Hence we accept the hypothesis that, low smart phone users will have high self regulation capacity than high smart phone users. Third, t-test was administered to check the difference between the means of perceived stress among high and low smart phone users. The difference between means of the two groups is considered to be statistically significant. Hence we accept the hypothesis that, low smart phone users will have low perceived stress than high smart phone users.

**Results and interpretation of Pearson’s product moment correlation**

Hypothesis stated that there will be a positive co-relation between sleep quality and self regulation capacity among smart phone users.

The table below depicts the co-efficient r:

**Table 4. Correlation between sleep quality and self regulation capacity**

	Sleep quality	Self regulation capacity
Sleep quality	1	0.3782
Self regulation capacity	0.3782	1

This shows that there is a positive correlation between the sleep quality and self regulation capacity of smart phone users. Hypothesis stated that there will be a negative co-relation between sleep quality and perceived stress among smart phone users.

The table below depicts the co-efficient r:

**Table 5. Correlation between sleep quality and perceived stress**

	Sleep quality	Perceived stress
Sleep quality	1	-0.5358
Perceived stress	-0.5358	1

This shows that there is a moderate negative correlation between the sleep quality and perceived stress of smart phone users. Hypothesis stated that there will be a negative co-relation between self regulation capacity and perceived stress among smart phone users.

The table below depicts the co-efficient r:

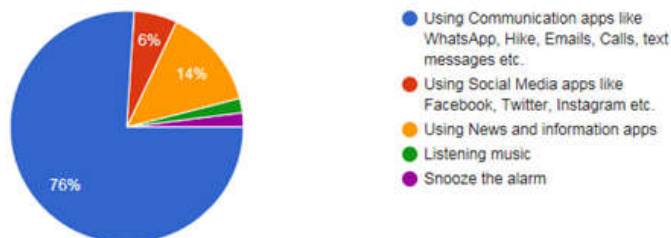
**Table 6. Correlation between self regulation capacity and perceived stress**

	Self regulation capacity	Perceived stress
Sleep quality	1	-0.5232
Self regulation capacity	-0.5232	1

This shows that there is a moderate negative correlation between the self regulation capacity and perceived stress of smart phone users.

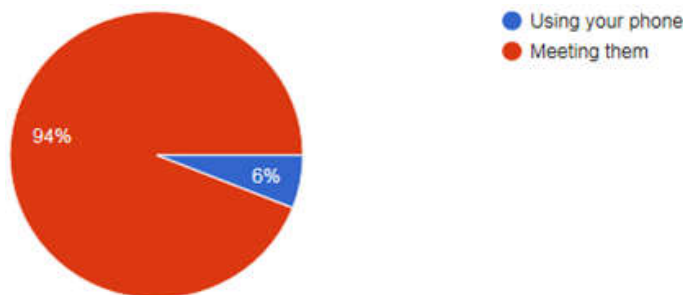
**Qualitative analysis of data**

There were certain questions asked in order to get a grip over the usage patterns of the smart phone users which could not be analysed from the quantitative data solely. Following are certain notable findings of the quantitative analysis.



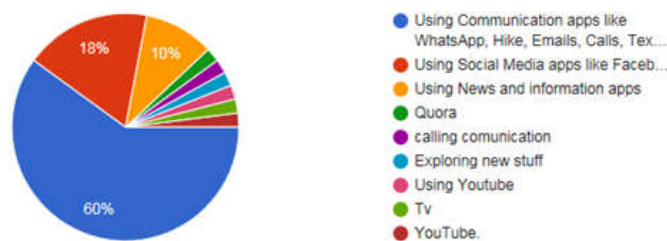
**Diagram 1. First activity on the smart phone after waking up**

It is quite interesting to note that the first activity on a smart phone after waking up is using communication apps like WhatsApp, Hike, text messages etc. of as large as 76% people surveyed confirmed about the same. The next most popular activity on a smart phone right after waking up is using information and news apps comprising 14% of the total population followed by 6% using social media apps like Face book, Twitter, Instagram etc.



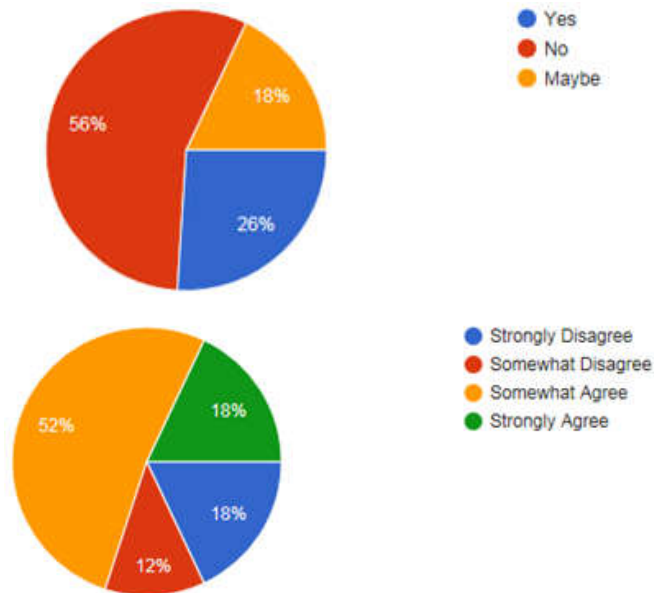
**Diagram 2. Preference of communicating with friends**

It is intriguing to note that 94% people in the sample population would prefer meeting their friends in contrast to only 6% who would prefer to do so using their phone.



**Diagram 3. Most preferred activity on a smart phone**

The most preferred activity on a smart phone by as large as 60% population is using communication apps, followed by usage of social media apps cutting off at 18%. It is important to note the contribution of communication activities in the entire features available on a smart phone. People consider their smart phones as private devices and more than half of them deny sharing it for a few days even for a fair compensation being offered for the use.



This question highlights that most of the users do realize that they spend too much time on their smart phones was pointed out by someone. 18% strongly agree to this point while 52% do somewhat agree.

#### Quantitative analyses of the research provide the following conclusions

- Low smart phone users have good sleep quality than high smart phone users.
- Low smart phone users have high self regulation capacity than high smart phone users.
- Low smart phone users have low perceived stress than high smart phone users.
- There is a positive co-relation between sleep quality and self regulation capacity among smart phone users.
- There is a negative co-relation between sleep quality and perceived stress among smart phone users.
- There is a negative co-relation between self regulation capacity and perceived stress among smart phone users.

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