YANGON UNIVERSITY OF ECONOMICS

DEPARTMENT OF STATISTICS

MASTER OF APPLIED STATISTICS PROGRAMME

FACTOR ANALYSIS OF IMPACT OF SMARTPHONE ON USERS

(CASE STUDY IN AHLONE TOWNSHIP)

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MAS - 43

DECEMBER, 2019

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This thesis is submitted to the Board of Examination as partial fulfillment of the requirements for the Degree of Master of Applied Statistics

Approved by the Board of Examiners

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ABSTRACT

Mobile smartphones had improved communication in society via the social media. Most of the smartphone users face were locked on the smartphone screen. That was a significant challenge for the positive and negative impacts. The study focuses on identifying different dynamic factors among the impacts on smartphone users with age group between 15 to 49 years at Ahlone Township. In this study, a two-stage random sampling was used to obtain the sample respondents. A face to face interviewing method, was applied to collect data from 356 respondents at randomly selected wards. The interview questions were constructed by a five-point Likert scale and offline data collection tools (KoBoToolbox) was used. According to factor analysis, it was found that the main impact of smartphones are “Social”, “Health”, “Communication and Emotional”, “Addiction” and “Negative Impact”. Although almost all the respondents suffer from health-related symptoms, two symptoms namely Tinnitus and Occiput pain were associated with frequent usage to the smartphone. Moreover, the study recommended to provide health knowledge and educational awareness to the public. Further researches on identified factors, using other models are be recommended.

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LIST OF ABBREVIATIONS

ASEAN	: Association of South East Asian Nations
ELF	: Extremely Low- Frequency
EMFs	: Electromagnetic Fields
EV	: Eigenvalues
ICT	: Information and Communication Technology
IARC	: International Agency for Research on Cance
KMO	: Kaiser Meyer Olkin
MAP	: Minimum Average Partial
MAS	: Master of Applied Statistics
MMK	: Myanmar Kyat Currency
MPT	: Myanma Posts and Telecommunications
NGOs	: Non Government Organizations
PCA	: Principal Component Analysis
RF	: Radio Frequency
SIM	: Subscriber Identification Module
SME	: Small and Medium-sized Enterprise
UN	: United Nations
WHO	: World Health Organization

CHAPTER I
INTRODUCTION

1.1 Rationale of the Study

Mobile smartphones improved communication among society, hence, the expression, Social Media. Users thought to get complete update information and communication network. Some were not using other items such as newspaper, journal, television, radio and books. Smart phone is very Frequent related with people as accessories. Mobile smartphone users have gone up to 33 million out of 54 million people in Myanmar, Smartphone usage rate is reported at 80% (Digital in Asia,2017).

Internet users in Myanmar increased by 97% in 2017, 70% are using smartphone (Internet in Myanmar, 2017). The year 2016, seventeen private companies were actively applying to register for internet service providers in Myanmar. However, up to internet service providers in September 2019. (Hurricane Electric, 2019).

The national baseline survey, shows 64% of women who own mobile phone have a "smartphone" compared to 65% of men. There was a high demand for smartphones even though many only use their smartphone for voice message. Despite the cost barrier, people are often not interested in keypad phones or less expensive smartphones, which are also perceived as low quality. Not even secondhand smartphones were considered (LIRNEasia,2015).

In addition, some parents use it as a toy when babies cry. Also, youth and adult smartphone users' eyes were locked on their smartphone for the digital exchange via social media, learning and entertainments. Accordingly, this study aims to identify the main factors which influence the emotions, addictions and health status of smartphone users by factor analysis.

In 2018, there were **20,335,000** Facebook users in **Myanmar.** The majority of them were men 62%, and women 38% and also people aged 18 to 34 were the largest Facebook user group (NapoleonCat, 2018).

Nowadays, smartphones had become more essential accessories in society. Most of the smartphone users face were locked on the smartphone screen. That was a significant challenge on the positive and negative impacts. In Myanmar, millions of smartphone users can get not only social happiness, improve knowledge but also can get depression, and unhappiness, and anger issues. Therefore, the impact of the smartphone depends on the purpose of "positive and negative" usage by smartphone users.

Therefore, smartphones are essential tools in our society and change to the digital platform and also to other related issues as addictions, education, knowledge, health, social, business, and workplace, where everything was a matter for controversy. However, there was a limited study on the impact of smartphones in Myanmar. This study aims to find out the main key factors related to the impact on smartphone users in Ahlone Township were explored by using factor analysis.

1.2 Objectives of the Study

The objectives of the study are:

i. To describe the socio demographic characteristic of smartphone users in Ahlone Township.

ii. To explore the association between frequent usage of smartphone and symptoms.

iii. To find out the factors related to impact on smartphone users in Ahlone Township.

1.3 Method of Study

In this study, the two stages sampling method was used to select the smartphone users in Ahlone Township. In addition, descriptive analysis was used to identify the socio-demographic situation of smartphone users, and chi-square tests is used for variables which were Health symptoms and Frequent usage to Smartphone. And Factor analysis was used to find out the impact of smartphone on users.

1.4 Scope and Limitations of the Study

This study sample survey is conducted in Ahlone Township, Yangon Region, in May, 2019. This township is chosen because of all mobile operators and WiFi services of Yangon can be accessed in Ahlone township. This township comprises of 10 Wards. The study covers the smartphone users permanently living and aged between 15 and 49 years in Ahlone township. The questionnaire design is modified by other International Research Papers.

1.5 Organizations of the Study

This study includes five chapters. Chapter I is the introduction, it described rationale of the study, objectives of the study, method of study, scope and limitations of the study and organization of the study. The related literature review and overview of smartphone are presented in Chapter II. The research methodology is shown in Chapter III. In Chapter IV gives an analysis of impact of smartphone on users in Ahlone township. And Chapter V is conclusion which include smartphone user’s situations, findings and discussions, suggestions and further research.

CHAPTER II
LITERATURE REVIEW AND OVERVIEW OF SMRTPHONE

This chapter describes the overview of the smartphone era in Myanmar and a literature review of an international researcher's overview.

2.1 Overview of the Smartphone Era in Myanmar

Nowadays, information and communications technology (ICT) infrastructure had been developing steadily in countries around the world. Mobile internet users were spending most of their time on social media with their smartphones. When it comes to social media, the majority of time spent using mobile internet media is on Facebook, Messenger, Games, YouTube. And also, Sale, Business, Learning, Services, Banking-System majority are changing to online platform using smartphones. Thus, smartphones become essentials tools for society.

Myanmar's Digital Economy has high potential if appropriate digital policies were developed and implemented. Due to many years of low economic development, the country trails its regional peers in a variety of digital rankings, ranging from the World Bank's ease of doing business, the United Nations UN's e-government index, networked readiness index, the ICT development index and fixed broadband penetration, due to a legacy of low economic development. However, following supporting reforms and policies in the telecommunications sector, mobile related indicators are at-par with or leading the region, with subscriber identification module (SIM) card penetration of more than 105% percent, of which 80% are attached to a smartphone (Telenor Company Research in 2018).

However, given the low unique SIM card penetration, there is still a lot of room for growth and particularly for rural, remote and vulnerable populations. Furthermore, Myanmar leads ASEAN in 3G/4G rollouts with 90% of the population living within range of mobile broadband. Though the unique mobile subscriber rate stands at 50%, uptake is impressive and shows good growth potential. It is evident that basic reforms and liberalization delivered results; going further requires more targeted and sophisticated reforms as will be explained in this report. Myanmar is thus a "digital native" country, with widespread use of smartphones and high penetration of mobile broadband (Report of Digital Myanmar in 2019).

2.2 Review on the Impact of Smartphone

The World Health Organization (WHO) International Agency Research Center made (IARC) a study on the potential health effects of exposure to RF radiation. The possible IARC classifications are listed in the following.

Group 1	Carcinogenic to humans
Group 2A	Probably carcinogenic to humans
Group 2B	**Possibly carcinogenic to humans**
Group 3	Not Classifiable
Group 4	Probably not carcinogenic to humans

In 2011, IARC classified as Group 2B in radio frequency electromagnetic fields. It found out a malignant type of Brain Cancer associated with wireless phone use. The Chairman of the IARC noted that while they are still accumulating evidence, the existing evidence "is strong enough to support" the 2B classification and the conclusion. The IARC 2B decision, though largely based on studies of cell phone users, reportedly applies to all RF exposures regardless of the source.

In the 2014, Study "Occupational Exposure to Extremely Low-Frequency Magnetic Fields and Brain Tumor Risks in the INTEROCC," focused on ELF, which is another form of non-ionizing radiation. This study found a "positive association between ELF in the recent past and glioma." As noted earlier, according to the CDC, "RF radiation is much higher frequency than ELF radiation and therefore potentially more harmful." (Electromagnetic Fields (EMFs), Extremely Low-Frequency (ELF) and Radiofrequency (RF), (April 28, 2016).

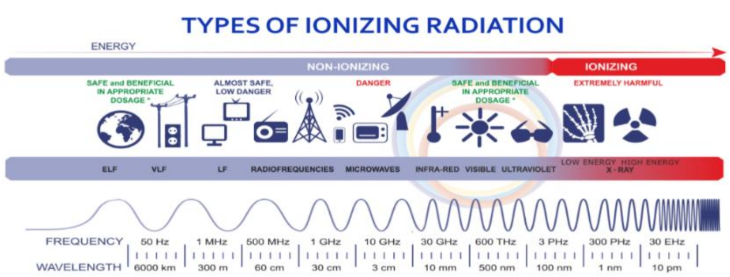


Figure 2.1 : Type of Ionizing Radiation

Source: www.polinaster.com

Symptoms of overexposures include, but are not limited to:

- Labored breathing
- Perspiring – immediate sensation of intense heating of the parts of the body exposed
- Pain
- Headache
- Numbness
- Paresthesia – a tingling or numbness, skin crawling, or itching
- Malaise or an overall sense of feeling mentally or physically unwell
- Diarrhea
- Skin erythema – a reddening of the skin due to inflammation

In addition to these symptoms, High RF was those who come in contact directly with an antenna may suffer severe burns. The burns had been deep and may have more negative impacts than they appear.

2.3 Related Studies

Smartphone addiction was increasingly affecting the masses and it was negatively impacting the younger generation. There are studies based on the impact of smartphone addictions on academic performance research. In this study, data was collected from 222 undergraduate engineering students' demographic information, internet access, and smartphone addictions from Biju-Pattnaik University of Technology and Kalinga Institute of Industrial Technology University from India. This study was analyzed not only using frequency-measures but also used Pearson's coefficient to investigate the relationship between attributes. In was found that a positive correlation existed between the internet connectivity (4G/ 3G) and smartphone addiction, a negative correlation between academic performance and smartphone addiction. The main findings were of immense use and could be used to reduce internet addiction amongst the student community and also enhance their academic performance (Pamela and Hrudaya, 2018).

To determine the investigations on smartphone addiction among high school students and their impact in eastern region at Burapha University, Chonburi, Thailand. The study population was 341 high school students from stratified random sampling. This study measures an alpha reliability of smartphone addiction, mood disorder, health problem, family relationship, academic performance, social relationship and Pearson's r correlation statistics for hypothesis testing. In the study, Pearson's r correlation smartphone addiction was the highest relationship with a mood disorder r = .667, followed by social relationship r = .625, family relation r = .620, academic performance r = .570, and health problem r = .481. The finding showed smartphone addiction had negative impacts on social relationship, family relationship, health problem, and poor academic performance of the students (Napassphol and Waiphot, 2018).

The mobile internet devices and smartphones were significant potential learning tools and educational interventions have attracted to increase these potentials. This study tries to find out the nature of students' use of smartphone and their attitudes on smartphone devices and successful teaching design. The data were collected from 232 respondents from Griffith University, School of Dentistry, Gold Coast, Australia. The study used descriptive statistics, Chi-square tests and linear regression tests. The finding showed no significant association between age group, gender, native, and smartphone skills. There was positive correlation between smartphone skills and students' attitudes toward improving access to learning material. This study found students used smartphones and social media for their education even though this technology had not been formally included in the curriculum (Andrea and Frauke, 2014).

In the 21st century, students have opportunities to learn information technology in the classroom. The study was to analyze teachers' perceptions of the challenges faced in using ICT tools in classrooms. The assessment was to collect the data randomly from a sample of 100 secondary school teachers in the state of Melaka, Faculty of Education, University of Malay, Malaysia. The analysis included both descriptive and inferential analysis. The finding was presented by independent t-test for the use of ICT tools by male and female teachers (M=2.08, SD =.997), (M=2.04, SD=0997) respectively. The study identified high level of challenges of using ICT tools in teaching and learning in the classroom among school teachers and recognizing the effectiveness of the extent of ICT tools in supporting teaching and learning in the classroom (Simin, 2016).

The use of smartphone among university students is an important part of their life at Saudi-Arabla. This study was based on data collected from 324 students of various academic levels at Najran University. It was a study on the trends in smartphone usage for learning, learning activities, and recording lecture notes using smartphones. This study found 91.69% of students have used smartphones to log in to their academic portal, 66.89% participants never used smartphones to record class lectures, and findings also suggest that university students in Saudi Arabia did not fully utilized smartphones for learning purposes (Hejab, 2014).

Most of the students were using the smartphone for entertainment, social and education purposes. Research conducted among medical students of University Putra Malaysia showed that the prevalence of at-risk cases which can be identified as smartphone addiction is 46.9 % of students out of 228 students. Additionally, smartphone usage pattern among students was found, and identify the positive and negative effects of smartphone on students by focusing on their education, psychology, and social life. (Manvin and Narina, 2018).

Smartphone has the ability to perform almost every operation necessary for individuals at any time or place. The study investigated the daily usage of smartphones by individuals in different age groups, 18-28, then ages 29-40, and lastly ages 40-55 at Virginia and Maryland. These studies were conducted via an online assessment through an email. Assessment questionnaires collected demographic, level of agree and disagree on smartphone usage, and some questions about the perceptions. The results indicated 70% female respondents, 25% male respondents. 6 out of 20 respondents believed smart phones put a damper on their social interactions. Fifty percent of participants consider that smartphones have a negative effect on their social interactions. This study found, the younger age group spend more time on their smartphone, the more applications and capabilities available to individuals the more amount of negative social life impacts (D'Juan, 2018).

Cell phone is used by everyone today. Using without any knowledge is unsafe from their harmful effects. The study collected random sampling to age group 17 to 23 from the urban and rural areas of India college students. The study found the symptom of the major system of our body like the nervous system (neurological symptoms such as depression, sadness, irritability and headaches, anxiety, loss of memory and lack of sleep). Headache was found to be the commonest symptom (51.47%) followed by irritability/anger (50.79%). Other common mental symptoms included lack of concentration and poor academic performance, insomnia, anxiety etc. Among physical symptoms –body aches (32.19%), eye strain (36.51%), digital thumb (13.8%) were found to be frequent. It was found that electromagnetic radiations emanating from the phones are the cause of various cancers of the human body, and also short-term effects such as generalized aches and pain. It was informed that, though cell phones have many obscure short-term effects like the digital thumb and other generalized aches and pains, the long-term effects were more manifest and well-defined. Listening to loud music and keeping the volume at a higher level has auditory effects which may prove detrimental over a period of time. Eye strain and any subsequent damage could be also avoided by restricted use (Acharya et al, 2013).

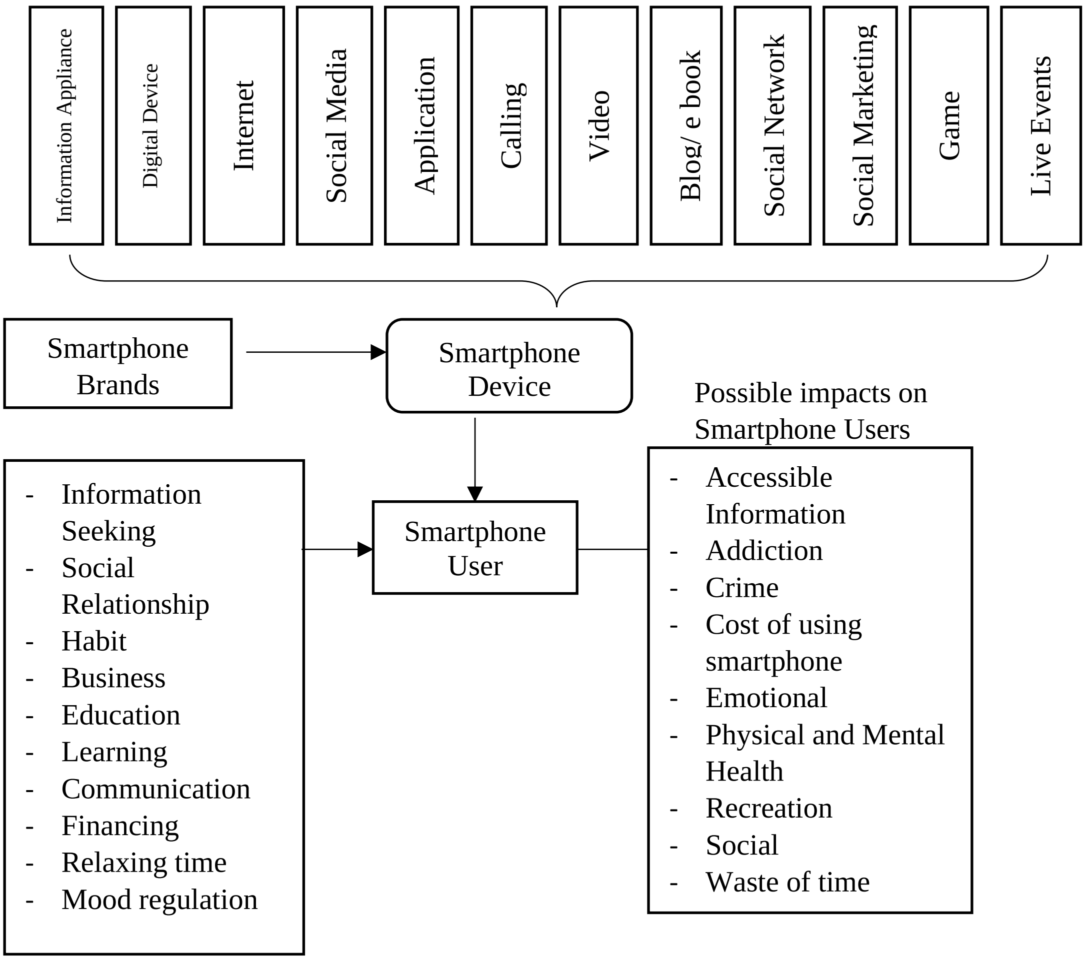
Smartphones have very important roles in several sectors, one was to complete their tasks, and communicate with a remote workplace. It is now seen that employees perform their duties in the evening from their homes or during holidays and vacations. Therefore, smartphone gives employees the ability to communicate with their place of work and perform their duties any time in any place. The study aims to find out the impact of smartphone usage in the workplace, which may be positive or negative and which had influenced productivity and organization. Survey questionnaires were distributed to 120 employees from the government office in Salalah Oman. In-depth interviews methodology was adopted in the study. Statistical methods have been used for reliability test, frequency distributions, arithmetic mean and standard deviation, Pearson's Correlations, and multiple regression. As expected, the study found that there are benefits or positive impacts attached to the use of the smartphone in the workplace (Abdullah, 2017).

Mobile phones have become basic elements of communication. Consumers are showing preference towards smartphones as it is being used for a variety of purposes. Abdullah, 2017 was undertaken on 638 mobile phone users of Haryana state of India. The data was analysed using factor analysis and multiple regressions. With the help of factor analysis ten decision factors of consumer buying behaviour were derived. The findings showed that "speed & performance" had the highest positive impact on the satisfaction followed by "brand & advertising" and "recommendations & reviews". The study provided useful insights of the consumer buying behaviour towards mobile phones (Vishesh and Dr. Shivani, 2016). Factor analysis were tested in Kaiser-Meyer-Olkin KMO, Bartlett's test of Sphericity indicates Chi-Square and significant level and further Principle Component analysis with Varimax rotation method. The first run found ten decision factors of consumer buying behaviour such as Physical Dimensions, Design & colour, Battery life, Camera quality, Speed, Recommendation and reviews, Brand Name, Price Advantage, Availability, Exchange possibility. The factor analysis results showed that seven factors out of ten were found important viz. i) Price Advantage, ii) Brand & Advertising iii) Reviews & Recommendations iv) Speed & Performance, v) Battery Life vi) Camera and vii) Exchange Possibility.

Based on the review of the information previous studies focused on the health affects and other related causes of the smartphone separately. This indicated that the impact of smartphones among different dynamic factors was needed to identify to Smartphone users.

2.4 Conceptual Framework of the Study

Nowadays, the impacts of smart phone among users become the interesting issue to validate its impacts. Though many studies evidenced its impacts on various points of views such as health, social, educational, etc., there was limited evidences of the typical impacts of smart phones users because of emerging issues. Accordingly, the conceptual framework of the study was developed by author's own compilations which were based on the various theoretical views. Based on these concepts, this study was conducted among smart phone users of Ahlone Township.



Source: Author's Compilation from Literatures (2019)

Figure 2.2: Conceptual framework for the impact on smartphone user

CHAPTER III
RESEARCH METHODOLOGY

This chapter describes the research methodology of the thesis. It includes research strategy, research method, research approach, the data collection methods, sampling procedure, research process, type of data analysis and ethical considerations of the study.

3.1 Survey Design

The study was conducted in Ahlone township, Yangon. It covers 10269 household and 50689 population. There are 10 wards in the township. There were three different types of household density at the township. It was based on their ward area scale. The map of Ahlone township is as follows:

Figure 3.1:Ahlone Township Map

Source: Township General Administration Department

The primary data of permanent living household in Ahlone township and the sample Wards described in the following table (3.1 and 3.2)

Table 3.1 : Ahlone Township's Permanent Living Household

Ward No	Ward Name	Number of Household
1	Ayarwaddy	122
2	Saw Yan Paing (North)	543
3	**LutLatYae**	**569**
4	Saw Yan Paing (East)	723
5	KayinChan	739
6	**Galone**	**892**
7	Saw Yan Paing (South)	1095
8	SinMin	1657
9	**HtarNar**	**1758**
10	Saw Yan Paing (West)	2170

Source: Township General Administration Department

Table 3.2 : Sample Wards

Ward No	Ward Name	Number of Household
3	LutLatYae	569
6	Galone	892
9	HtarNar	1758
TOTAL		3219

Source: Township General Administration Department

Sample Size Determination

In this survey, the population is unknown. So, the required sample size was calculated using the following "unknown sample size for estimation of population formula".

$$n = \frac{n_0}{1+(n_0-1)/N}$$

where

$$n_0 = \frac{4\hat{p}_1\hat{q}_1}{B^2} + 1$$

$\hat{p}_1$ = estimated proportion of the population (0.5)

$\hat{q}_1$ = 1 - $\hat{p}_1$

B = Tolerable error, confidence interval to the permissible error (0.05)

N = 3219

$$n_0 = \frac{4*0.5*0.5}{0.05^2} + 1$$

$$= 400$$

$$n = \frac{400}{1+(400-1)/3219}$$

n= 355.887

≈ 356

It can be concluded that the sample size needs to collect 356 Households.

The sampling interval (k) obtained by using k = $\frac{N}{n}$

$$\frac{3219}{356} = 9.04$$

The number of households and sample households in each selected Wards presented in table 3.3.

Table 3.3 : Sample Size for Each Ward

Ward	Number of Household	Sample Households
LutLatYae	569	63
Galone	892	99
HtarNar	1758	194
Total Sample Size “Interview”	3219	356

Source: Township General Administration Department

3.2 Data Collection Methods and Tools

The data collection used KoBoToolbox (Offline data collection system). It had more effect on data collection mechanism. In the study, the initiative was to collect the minimum sample size for pilot testing. Based on the results of pilot testing, assessment was continued in the data collection process. The data collection method used Face to Face interview. The study constructed questionnaire which included five-point Likert scale (1 being strongly disagreed and 5 being strongly agreed), and quantitative data collection method.

Firstly, collected data were checked daily updated figure in KoBoToolbox dashboard. The completed sample size collected from KoBoToolBox were downloaded from the data dashboard. Then, data were analyzed by using Statistical Package for the Social Science (SPSS) Version 24 and Microsoft Spreadsheet Excel software (2016). In this analysis, socio-demographic characteristics of smartphone users and their correlations were calculated by descriptive statistics, and Factor Analysis model and parallel test. The study adhered to the ethical considerations as follows:

- In this study, before the assessment survey approval and permission by the General Administration Department and area authorities were taken.
- In this study, interviewers were organized and shared information content.
- In this study, interviewers were respected for the autonomy and self-determination of all human beings, their freedom, and their capacity to decide.
- This study takes respondents' data on confidentiality

3.3 Theoretical Background

Reliability Analysis

Reliability is the scale construction counterpart of precision and accuracy in physical measurement. Reliability can be thought of as consistency in measurement. To establish the reliability of the data, the reliability coefficient (Cronbach Alpha) was verified. There are a number of different reliability coefficients. One of the most commonly used is Cronbach’s alpha. Cronbach’s alpha can be interpreted as a correlation coefficient; it ranges a value from 0 to 1. Robinson and Shaver (1973) suggested that if Alpha is greater than 0.7, it means high reliability and if Alpha is smaller than 0.3, it means low reliability.

Reliability Test

Before using the factor analysis, it is very important to test the reliability of the dimensions in the questionnaires. Cronbach’s alpha, a statistical test used to examine the internal consistency of attributes, was determined for each dimension. This statistical test shows the attributes are related to each other and to the composite scores. The composite scores for each section of the questionnaires was obtained by summing up the scores of individual statements. Cronbach’s alpha is defined as -

$$\alpha = \frac{K}{K-1}[1 - \frac{\sum_{i=1}^{k} S_i^2}{S_T^2}]$$

Where

α =Cronbach's alpha,

K= Number of Statement

S_i^2 = variance of each statement

S_T^2 = variance for sum of all items

If alpha value is high, then this suggests that all of the items are reliable and the entire test is internally consistent. If alpha is low, then at least one of the items is unreliable and must be identified via item analysis procedure. However, the Cronbach's alpha value should be above 0.7.

Testing for Sampling Adequacy

Kaiser-Meyer-Olkin (KMO) test is a measure of how suited the data is for Factor Analysis. The test measures sampling adequacy for each variable in the model and for the complete model. The statistics is a measure of the proportion of variance among variables that might be common variance. If lower the proportion, the more suited the data is to Factor Analysis. KMO takes the value between 0 and 1. A rule of thumb for interpreting the statistic. KMO value lies between 0.8 and 1.0 indicate the sampling is adequate. KMO value less than 0.6 indicates the sampling is not adequate and that remedial action should be taken. KMO values close to zero means that there are large partial correlations compared to the sum of correlations. In other words, there are widespread correlations which are a large problem for factor analysis

The Bartlett's test of Spherically relates to the significance of the study and thereby shows the validity and suitability of the responses collected to the problem being addressed through the study. For a large sample, Bartlett's test approximates a Chi-square distribution. However, the Bartlett's test compares the observed correlation matrix to the identity matrix. Therefore, the Bartlett's test forms something of a bottom-line test for large samples, but is less reliable for small samples. For factor analysis to be recommended suitable, the Bartlett's Test of Sphericity must be less than 0.05. In addition, very small values of significance (below 0.05) indicate a high probability that is significance relationship between the variables, whereas higher values (0.1 or above) indicate the data is inappropriate for factor analysis.

Orthogonal factor

The orthogonal factor (Richard A. Johnson, 1992) was described. The observable random vector X, with p components, has mean μ and covariance matrix $\mathbf{\Sigma}$.

The factor model postulates that **X** is linearly dependent upon a few unobservable random variables F_1, F_2, …., F_m, called common factors, and p additional sources of variation e_1, e_2, … e_p, called errors or, sometimes, specific factors. in particular, the factor model can be selected as follows:

factor is

$$X_1 - \mu_1 = \ell_{11}F_1 + \ell_{12}F_2 + \ell_{13}F_3 + \ldots + \ell_{1m}F_m + \varepsilon_1$$
$$X_2 - \mu_2 = \ell_{21}F_1 + \ell_{22}F_2 + \ell_{23}F_3 + \ldots + \ell_{2m}F_m + \varepsilon_2$$
$$\vdots \qquad\qquad \vdots$$
$$X_p - \mu_p = \ell_{p1}F_1 + \ell_{p2}F_2 + \ell_{p3}F_3 + \ldots + \ell_{pm}F_m + \varepsilon_p$$

or in matrix notation,

$$\underset{(p\times 1)}{\mathbf{X} - \boldsymbol{\mu}} = \underset{(p\times m)}{\mathbf{L}}\ \underset{(m\times 1)}{\mathbf{F}} + \underset{(p\times 1)}{\boldsymbol{\varepsilon}}$$

μ_i = mean of variable *i*

ε_i = *i*th specific factor

F_j = *j*th common factor

ℓ_{ij} = loading of the *i*th variable on the *j*th factors

The unobservable random vectors **F** and **ε** satisfy the following conditions:

F and ε are independent

$E(\mathbf{F}) = \mathbf{0}$, Cov $(\mathbf{F}) = \mathbf{I}$

$E(\boldsymbol{\varepsilon}) = \mathbf{0}$, Cov $(\boldsymbol{\varepsilon}) = \mathbf{\Psi}$, where $\mathbf{\Psi}$is a diagonal matrix

Covariance Structure

The orthogonal factor model implies a covariance structure for X,

$$\begin{aligned} \Sigma &= \text{Cov}(\mathbf{X}) = \text{E}\,(\text{X} - \mu) \\ &= \text{LE}(\text{FF}')L' + \text{E}(\varepsilon F')L' + \text{LE}(F\varepsilon') + \text{E}(\varepsilon\varepsilon') \\ &= \mathbf{LL}' + \mathbf{\Psi} \end{aligned}$$

by independence, $\text{Cov}(\boldsymbol{\varepsilon},\mathbf{F}) = \text{E}(\varepsilon,\text{F}') = 0$

$$\text{Cov}(\mathbf{X}) = \mathbf{LL}' + \mathbf{\Psi}$$

Or

$$\text{Var}(X_i) = \ell_{i1}^2 + \cdots + \ell_{im}^2 + \psi_i$$

$$\text{Cov}(X_i, X_k) = \ell_{i1}\ell_{k1} + \ell_{i2}\ell_{k2} + \cdots + \ell_{im}\ell_{km}$$
$$\text{Cov}(\mathbf{X}, \mathbf{F}) = \mathbf{L}$$

Or

$$\text{Cov}(X_i, F_j) = \ell_{ij}$$

The model $\mathbf{X} - \boldsymbol{\mu} = \mathbf{LF} + \boldsymbol{\varepsilon}$ is linear in the common factors. The portion of the variance of the i^{th} variable contributed by the m common factors is called the i^{th} communality. That portion of Var (X_i) = σ_{ii} due to the specific factor is called uniqueness or specific variance. Denoting the i^{th} communality by h_i^2,

$$\underbrace{\sigma_{ii}}_{\text{Var}(X_i)} = \underbrace{\ell_{i1}^2 + \ell_{i2}^2 + \cdots + \ell_{im}^2}_{\text{communality}} + \underbrace{\psi_i}_{\text{Specific Variance}}$$

or

$$h_i^2 = \ell_{i1}^2 + \ell_{i2}^2 + \cdots + \ell_{im}^2$$

and

$$\sigma_{ii} = \text{h}_i^2 + \psi_i, \qquad \text{i} = 1, 2, \cdots, \text{p}$$

The i^{th} communality is the sum of squares of the loadings of the i^{th} variable on the m common factors.

Methods of Estimation

The sample covariance matrix **S** is an estimator of the unknown population covariance matrix $\boldsymbol{\Sigma}$**.** If the off-diagonal elements of **S** are small or those of the sample correlation matrix **R** essentially zero, the variables are not related, and a factor analysis will not prove useful. In these circumstances, the specific factors play the dominant role, whereas the major aim of factors analysis is to determine a few important common factors (Richard A. Johnson, 1992).

If Σ appears to deviate significantly from a diagonal matrix, then a factor model can be entertained, and the initial problem is one of estimating the factor loadings $\boldsymbol{\ell_{ij}}$ and specific variances $\boldsymbol{\psi_i}$. Two most popular methods of the parameter estimation are the principal component method and the maximum likelihood method. the solution from either method can be rotated in order to simplify the interpretation of factors. If the factor model is appropriate for the problem to try more than one method of solutions should be consistent with one another.

The Principal Component Method (Principal Factor)

The Principal Factor (Richard A. Johnson, 1992) was described. The spectral decomposition provides us with one factoring of the covariance matrix Σ. Let Σ have eigenvalue – eigenvector pairs $(\lambda_{i,} e_i)$ with$\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_p \geq 0$. then,

$$\sum = \lambda_1 e_{\,1} e_1' + \lambda_2 e_{\,2} e_2' + \cdots + \lambda_p e_{\,p} e_p'$$

$$= \left[\sqrt{\lambda_1} e_1 \,\vdots\, \sqrt{\lambda_2} e_2 \,\vdots\, \cdots \,\vdots\, \sqrt{\lambda_p} e_p\right] \begin{bmatrix} \sqrt{\lambda_1} e_1' \\ \cdots\cdots \\ \sqrt{\lambda_2} e_2' \\ \cdots\cdots \\ \vdots \\ \cdots\cdots \\ \sqrt{\lambda_p} e_p' \end{bmatrix}$$

This fits the prescribed covariance structure for the factor analysis model having as many factors as variables (m =p) and specific variances ψ_i = 0 for all i, the loading matrix has *j*th column given by $\sqrt{\lambda_i} e_j$. This can be written

$$\underset{(p\times p)}{\sum} = \underset{(p\times p)}{\mathbf{L}} \underset{(p\times p)}{\mathbf{L}'} + \underset{(p\times p)}{\mathbf{0}} = \mathbf{LL}'$$

Apart from the scale factor $\sqrt{\lambda_i}$, the factor loadings on the *j*th factor are the coefficients for the *j*th principal component of the population.

Although the factor analysis representation of **Σ** is exact, it is not particularly useful. It employs as many common factors as there are variables and does not allow for any variation in the specific factors $\boldsymbol{\varepsilon}$. One approach when the last **p-m** eigenvalues are small, is to neglect the contribution of $\lambda_{m+1} e_{m+1} e_{m+1}' + \cdots + \lambda_p e_p e_p'$ to $\sum$. Neglecting this contribution, the approximation is obtained.

$$\sum = \left[\sqrt{\lambda_1} \mathbf{e}_1 \,\vdots\, \sqrt{\lambda_2} \mathbf{e}_2 \,\vdots\, \cdots \,\vdots\, \sqrt{\lambda_m} \mathbf{e}_m\right] \begin{bmatrix} \sqrt{\lambda_1} e_1' \\ \cdots\cdots \\ \sqrt{\lambda_2} e_2' \\ \cdots\cdots \\ \vdots \\ \cdots\cdots \\ \sqrt{\lambda_m} e_m' \end{bmatrix} = \underset{(p\times m)}{\mathbf{L}} \underset{(m\times p)}{\mathbf{L}'}$$

The approximate representation is assuming that the specific factors $\boldsymbol{\varepsilon}$ are of minor importance and can also be ignored in the factoring of **Σ**. The approximation can be written as following

$$\sum = \mathbf{L}\,\mathbf{L}' + \boldsymbol{\Psi}$$

$$= \left[\sqrt{\lambda_1}\mathbf{e}_1 \ \vdots \ \sqrt{\lambda_2}\mathbf{e}_2 \ \vdots \ \cdots \ \vdots \sqrt{\lambda_m}\mathbf{e}_m\right] \begin{bmatrix} \sqrt{\lambda_1}\mathbf{e}_1' \\ \cdots\cdots \\ \sqrt{\lambda_2}\mathbf{e}_2' \\ \cdots\cdots \\ \vdots \\ \cdots\cdots \\ \sqrt{\lambda_m}\mathbf{e}_m' \end{bmatrix} + \begin{bmatrix} \psi_1 & 0 & \cdots & 0 \\ 0 & \psi_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \psi_p \end{bmatrix}$$

where $\psi_i = \sigma_{ii} - \sum_{j=1}^{m} \ell_{ij}^2$ for $i = 1, 2, \ldots, p$

To apply this approach to a data set $\mathbf{x}_1, \mathbf{x}_2, \ldots, \mathbf{x}_n$, it is customary first to center the observations by subtracting the sample mean $\bar{x}$. The cantered observations

$$\mathbf{x}_j - \bar{\mathbf{x}} = \begin{bmatrix} x_{j1} \\ x_{j2} \\ \vdots \\ x_{jp} \end{bmatrix} - \begin{bmatrix} \bar{x}_1 \\ \bar{x}_2 \\ \vdots \\ \bar{x}_p \end{bmatrix} = \begin{bmatrix} x_{j1} - \bar{x}_1 \\ x_{j2} - \bar{x}_2 \\ \vdots \quad \vdots \quad \vdots \\ x_{jp} - \bar{x}_p \end{bmatrix}, \ j = 1, 2, \ldots, n$$

have the same sample covariance matrix **S** as the original observations.

In cases where the units of the variables are not commensurate, it is usually desirable to work with the standardized variables.

$$\mathbf{z}_j = \begin{bmatrix} \frac{(x_{j1} - \bar{x}_1)}{\sqrt{s_{11}}} \\ \frac{(x_{j2} - \bar{x}_2)}{\sqrt{s_{22}}} \\ \vdots \\ \frac{(x_{jp} - \bar{x}_p)}{\sqrt{s_{pp}}} \end{bmatrix}, \ j = 1, 2, \ldots, n$$

This sample covariance matrix is the sample correlation matrix **R** of the observations $\mathbf{x}_1, \mathbf{x}_2, \ldots, \mathbf{x}_n$, Standardization avoids the problems of having one variable with large variance unduly influencing the determination of factor loadings. The sample covariance matrix **S** or the sample correlation matrix **R** is known as principal component solution.

Principal Component Solution

The principal component solution (Richard A. Johnson, 1992) was described. The principal component factor analysis of the sample covariance matrix **S** is specified in terms of its eigenvalue – eigenvector pairs $(\hat{\lambda}_1, \hat{e}_1), (\hat{\lambda}_2, \hat{e}_2), (\hat{\lambda}_3, \hat{e}_3), \ldots, (\hat{\lambda}_p, \hat{e}_p)$ where . $\hat{\lambda}_1 \geq \hat{\lambda}_2 \geq \hat{\lambda}_3 \geq \cdots \geq \hat{\lambda}_p$.

Let m < p be the number of common factors. Then the matrix of estimated factor loading $(\tilde{\ell}_{ij})$ is given …

$$\tilde{\mathbf{L}} = \left[\sqrt{\hat{\lambda}_1, \hat{\mathbf{e}}_1} \;|\; \sqrt{\hat{\lambda}_2, \hat{\mathbf{e}}_2} \;|\; \sqrt{\hat{\lambda}_3, \hat{\mathbf{e}}_3} \;|\; \dots \;|\; \sqrt{\hat{\lambda}_p, \hat{\mathbf{e}}_p} \right]$$

The estimated specific variance are provided by the diagonal elements of the matrix $S - \tilde{L}\tilde{L}'$.

$$\tilde{\Psi} = \begin{bmatrix} \tilde{\psi}_1 & 0 & \cdots & 0 \\ 0 & \tilde{\psi}_2 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \tilde{\psi}_p \end{bmatrix} \quad \text{with} \quad \tilde{\psi}_i = s_{ij} - \sum_{j=1}^{m} \tilde{\ell}_{ij}^2$$

Communalities are estimated as

$$\tilde{h} = \tilde{\ell}_{i1}^2 + \tilde{\ell}_{i2}^2 + \cdots + \tilde{\ell}_{im}^2$$

The principal component factor analysis of the sample correlation matrix is obtained by starting with **R** in place of **S**.

Residual Matrix

If the number of common factors is not determined by a priori considerations based on the estimated eigenvalues in much the same manner as with principal component, consider the residual matrix

$$\mathbf{S} - (\tilde{\mathbf{L}}\tilde{\mathbf{L}}' + \tilde{\mathbf{\Psi}})$$

resulting from the approximation of S by the principal component solution. The diagonal elements are zero. Sum of squared entries of

$$(S - (\tilde{\mathbf{L}}\tilde{\mathbf{L}}' + \tilde{\mathbf{\Psi}})) \leq \hat{\lambda}_{m-1}^2 + \cdots + \hat{\lambda}_p^2$$

The contributions of the first few factors to the sample variances of the variables should be large. The contribution to the sample variance s_{ii} from the first common factor is $\tilde{\ell}_{i1}^2$. The contribution to the total sample variance, $s_{11} + s_{22} + \cdots + s_{pp} = \text{tr}(\mathbf{S})$, from the first common factor is then

$$\tilde{\ell}_{11}^2 + \tilde{\ell}_{21}^2 + \cdots + \tilde{\ell}_{p1}^2 = (\sqrt{\hat{\lambda}_1}\, \hat{\mathbf{e}}_1)' (\sqrt{\hat{\lambda}_1}\, \hat{\mathbf{e}}_1) = \hat{\lambda}_1$$

since the eigenvector $\hat{e}_1$ has unit length. In general

$$\begin{pmatrix} \textit{Proportion of total} \\ \textit{sample variance} \\ \textit{due to jth factor} \end{pmatrix} = \begin{cases} \dfrac{\hat{\lambda}_j}{s_{11} + s_{11} + s_{11} + \dots + s_{pp}} & \text{for a factor analysis of } \mathbf{S} \\ \dfrac{\hat{\lambda}_j}{p} & \text{for a factor analysis of } \mathbf{R} \end{cases}$$

Frequently used as a heuristic device for determining the appropriate number of common factors. The number of common factors retained in the model is increased until a "suitable proportion" of the total sample variance has been explained.

Factor Rotation

The factor rotation (Richard A. Johnson, 1992) was described. All factor loadings obtained from the initial loadings by a orthogonal transformation have the same ability to reproduce the covariance matrix. An orthogonal transformation of the factor loadings as well as the implied orthogonal transformation of the factors is called factor rotation. If $\hat{L}$ if the p x m matrix of estimated factor loadings obtained by any method; then

$\hat{\mathbf{L}}* = \hat{\mathbf{L}}\mathbf{T}$, where $\mathbf{T}\mathbf{T}' = \mathbf{T}'\mathbf{T} = \mathbf{I}$ is a p × m matrix of rotated loadings.

The estimated covariance matrix remains unchanged, since

$$\hat{\mathbf{L}}\hat{\mathbf{L}}' + \hat{\Psi} = \hat{\mathbf{L}}\mathbf{T}\mathbf{T}'\hat{\mathbf{L}} + \hat{\boldsymbol{\Psi}} = \hat{\mathbf{L}}* \hat{\mathbf{L}}*' + \hat{\boldsymbol{\Psi}}$$

Equation indicates that the residual matrix, $\mathbf{S}_n - \hat{\mathbf{L}}\hat{\mathbf{L}}' - \hat{\boldsymbol{\Psi}} = \mathbf{S}_n - \hat{\mathbf{L}}* \hat{\mathbf{L}}*' + \hat{\boldsymbol{\Psi}}$ remains unchanged. The specific variance $\widehat{\psi_i}$ and hence the communalities $\hat{h}_i^2$, are unaltered. Thus, from a mathematical viewpoint, it is immaterial whether $\hat{\mathbf{L}}$ or $\hat{\mathbf{L}}*$ is obtained.

The original loading may not be readily interpretable. It is usual practice to rotate until a simpler structure is achieved. Each variable loads-highly on a single factor and has small to moderate loadings on the remaining factors. It is possible to get this simple structure and the rotated loading for the decathlon data provide a clear pattern. Graphical and analytical methods should be concentrated for determining an orthogonal rotation to a simple structure.

Oblique Rotation

The oblique rotation (Richard A. Johnson, 1992) was described. Orthogonal rotations are appropriate for a factor model in which the common factors are assumed to be independent. Many investigators in social sciences consider oblique (nonorthogonal) rotations, as well as orthogonal rotations. Oblique rotation is frequently a useful aid in factor analysis.

If the *m* common factors as coordinate axes, the point with the *m* coordinates $(\hat{\ell}_{i1,}\hat{\ell}_{i2,}\hat{\ell}_{i3,}, \dots, \hat{\ell}_{im})$ represents the position of the i^{th} variable in the factor space.

Assuming that the variables are grouped into non overlapping clusters, an orthogonal rotation to a simple structure corresponds to a rigid rotation of the coordinate axes such that the axes, after rotation, pass as Frequent to the clusters as possible. An oblique rotation to a simple corresponds to a nonrigid rotation of the coordinate system such that the rotated axes (no longer perpendicular) pass (nearly) through the clusters. An oblique rotation seeks to express each variable in terms of a minimum number of factors preferably, a single factor.

The Varimax Rotation

The varimax rotation (Richard A. Johnson, 1992) was described. When principal components analysis and factor analysis identify the underlying factors, they do so using a greedy algorithm. They begin by identifying the first component in such a way that it explains as much variance as possible, and proceed by identifying the next component in such a way that it explains the maximum possible amount of the remaining variance and so on.

In statistics, a varimax rotation is used to simplify the expression of a particular sub-space in terms of judging a few major items each. The actual coordinate system is unchanged, it is the orthogonal basis that is being rotated to align with those coordinates. The sub-space found with principal component analysis or factor analysis is expressed as a dense basis with many non-zero weights which makes it hard to interpret. Varimax is so called because it maximizes the sum of the variances of the squared loadings (squared correlations between variables and factors). In addition to, varimax rotation, where the factor axes are kept at right angles to each other, is most frequently chosen. Ordinarily, rotation reduces the number of complex variables and improves interpretation. Almost all applications of principal component analysis and factor analysis in survey research apply the varimax rotation method.

Velicer's Minimum Average Partial (MAP) Test for Verifying Analysis

The MAP method (Velicer, 1976) was developed in the context of principal component analysis and is based on the matrix of partial correlations. Each component is partialled out of the correlation matrix and the average of the squared partial correlations is computed. The number of factors to retain is determined by the point where the minimum average of the squared partial correlations is obtained. The rationale of this procedure can be described as follows: as common variance is partialled out of the correlation matrix for each successive component, the MAP criterion will keep on decreasing. At the point where the common variance has been removed, extracting additional components will result in unique variance being partialled out, and the MAP criterion will begin to rise. The MAP procedure, therefore, provides an unequivocal stopping point for the number of factors by separating the common and unique variance and retaining only those factors that consist primarily of common variance. The MAP procedure begins with the computation of the partial covariance matrix,

$$C_m = \mathbf{R} - A_m A_m^T$$

C_m = The partial covariance Matrix that results from partialling out the first *m* components from **R**

R = The correlation matrix

A_m= The component loading matrix for components 1 to m.

Next, the partial correlation matrix is obtained

$$R_m^* = D^{-\frac{1}{2}} C_m D^{-\frac{1}{2}}$$

R_m^* = The partial correlation matrix

D = diag (C_m)

The MAP criterion is then obtained by averaging the squares of the partial correlations contained in R_m^* .

$$\text{MAP}_m = \sum_{i=1}^{p} \sum_{\substack{j=1 \\ i \neq j}}^{p} \frac{r_{ijm}^{*2}}{p(p-1)},$$

where *p* is the number of variables

This procedure is repeated until $p - 1$ components have been partialled out of **R** (partialling out *p* components would result in a null partial covariance matrix). Finally, the first factor by averaging the squares of the correlations contained in **R**:

$$\text{MAP}_0 = \sum_{i=1}^{p} \sum_{\substack{j=1 \\ i \neq j}}^{p} \frac{r_{ij}^{*2}}{p(p-1)},$$

$\text{MAP}_0 < \text{MAP}_1$, no factors should be extracted

MAP method with continuous variables had been evaluated in some of the most relevant factor retention. Zwick and Velicer (1982) carried out the first systematic examination of this procedure and found it to be more accurate than other stopping rules such as the eigenvalue greater than 1 rule and Bartlett's significance test (Bartlett, 1950, 1951).

Their results also showed that it was affected primarily by the size of the factor loadings and had a tendency to under factor with a small number of variables per factor. The same tendency to under factor with low factor loadings and a small number of variables per factor was found in this study, replicating previous results.

O'Connor's Parallel Analysis

Parallel Analysis is determining the number of retained components when using PCA on a correlation matrix. This method determines to component significance, describes Parallel Analysis.

Horn (1965) developed Parallel Analysis as a modification of Cattell's scree diagram to alleviate the component indeterminacy problem. Parallel Analysis is a "sample base adaptation of the population-based [Kaiser's] rule" (Zwick & Velicer 1986), and allows the researcher to determine the significance of components, variable loadings, and analytical statistics. The rationale is that sampling variability will produce eigenvalues > 1 even if all eigenvalues of a correlation matrix are exactly one and no large components exist (as with independent variates) (Zwick & Velicer 1986; Buja & Eyuboglu1992). The eigenvalues (EV) from research data prior to rotation are compared with those from a random matrix (actually normal pseudorandom deviates) of identical dimensionality to the research data set (i.e. same number of *P* variables and n samples). Component PCA eigenvalues which are greater than their respective component eigenvalues from the random data would be retained. Frane & Hill (1976) suggested that research data be subsequently reanalyzed (run through PCA/FA again) using only the 'correct' number of components.

Determining Significant Loadings

Parallel Analysis determines which variable loadings are significant for each component (Buja & Eyuboglu1992; Pohlmann unpubl.), thus parsimoniously simplifying structure and reducing the analysis of noise. The Parallel Analysis procedure would replace subjectively determined thresholds (e.g. common thresholds are 0.5 and 0.8), and the inappropriate interpretation of correlation significance between variables and components. PCA extracts as much variance as possible out of the data. Even when the variables are uncorrelated, PCA will produce non zero component correlations. If a matrix of zero correlations, with values of one along the diagonal, is subjected to PCA, all eigenvalues (sum of the squared variable component correlations) will equal one. Hence, the average squared variable-component correlation is the reciprocal of the number of variables. Any inferential analysis of variable-component correlations must consider this bias. Correlation tables fail to provide guidance in the distribution of variable loadings.

A Parallel Analysis procedure applying the same methodology (e.g. rotations) as PCA can be used to derive random variable loadings. Multiplying the total number of variable loadings (number of variables × number of extracted components) by the significance level (i.e. 0.05= 95^{th} percentile) results in an empirical estimate of the 95th percentile. This empirical estimate is an objectively determined threshold for significant loadings and is appropriate for either correlation or covariance matrix PCA loadings. Buja & Eyuboglu (1992) also report a series of loadings tables (median, 90^{th}, 95th, and 99th quantiles) for determining the significant variable loadings prior to rotation for a correlation matrix. The determination of significant loadings may seem cumbersome, but it was necessary when using a technique without objective stopping rules.

CHAPTER IV

ANALYSIS OF IMPACT OF SMARTPHONE ON USERS IN AHLONE TOWNSHIP

This chapter presents the analysis of Impact of Smartphone in Ahlone township based on results of data collected from sample. The statistical analysis, descriptive data analysis, reliability test, factor analysis, and verifying to analyse for main key factors.

4.1 Socio Demographic Characteristics of Smartphone Users

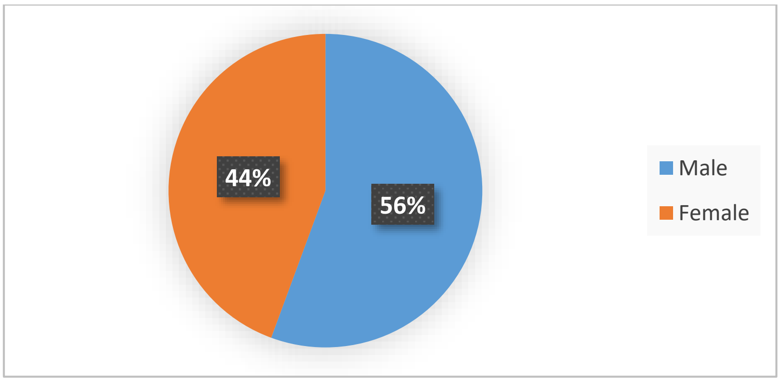
4.1.1 Distribution of Respondent Gender

The percentage of the respondent in Ahlone township by male and female percentage is described in the table (4.1) and figure (4.1).

Table 4.1 Respondent Gender Percentage

Gender	Number of Respondents	Percentage
Male	198	55.6
Female	158	44.4
Total	356	100.0

Source: Survey Data, 2019



Source: Survey Data, 2019

Figure 4.1 : Distribution of Respondent's Gender Ratio

Accordingly, there are 11% more males respondents than females in Ahlone township.

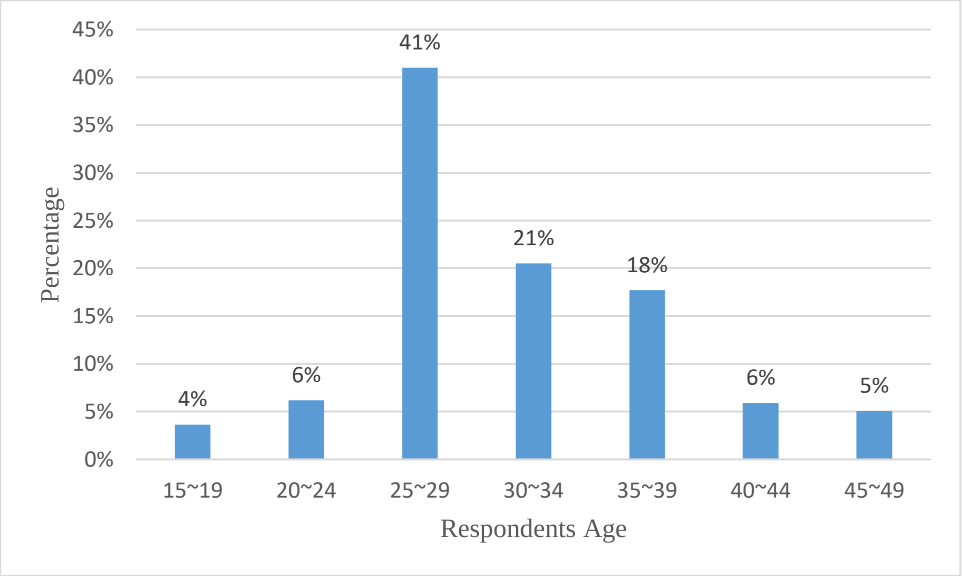
4.1.2 Distribution of Smartphone User Respondents by Age

Age of respondents was classified in 7 groups such as 15 to 19 year, 20 to 24 year, 25 to 29 year, 30 to 34 year, 35 to 39 year, 40 to 44 year, 45 to 49 year. This distribution of the age of smartphone user is presented in table (4.2) and figure (4.2)

Table 4.2 : Age Distribution of Smartphone Users

Age (Years)	Number of Respondents	Percentage
15~19	13	4%
20~24	22	6%
25~29	146	41%
30~34	73	21%
35~39	63	18%
40~44	21	6%
45~49	18	5%
Total	356	100%

Source: Survey Data, 2019



Source: Survey Data, 2019

Figure 4.2: Distribution of Smartphone User by Age

Data shows the number of respondents, 79% of age between 25 to 39 years group, were the highest number of respondents on the assessment for the smartphone users in Ahlone township.

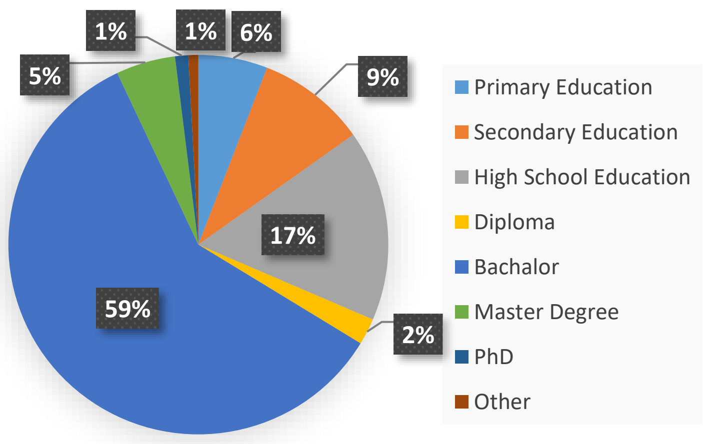
4.1.3 Educational Level of Smartphone Users

The number of the respondent educational level is described in the following table. This was classified into 9 categories such as Primary Education, Secondary Education, High School Education, Diploma, Bachelor, Master Degree, PhD and Other.

Table 4.3 Distribution of Educational Level of Smartphone Users

Educational Level	Number of Respondents	Percentage
Primary Education	21	5.9
Secondary Education	33	9.3
High School Education	58	16.3
Diploma	8	2.2
Bachelor	211	59.3
Master Degree	18	5.1
PhD	4	1.1
Other	3	.8
Total	356	100.0

Source: Survey Data, 2019



Source: Survey Data, 2019

Figure 4.3: Distribution of Respondents Educational Level

On the educational level, 59% of respondents were significantly in the "Bachelor degree". Respondent of "other" was 1% represented by Non-Educated.

4.1.4 Marital Status of Smartphone Users

The total number of respondent's marital status table shows four different types of marital status such as Married, Divorced, Widow/Widower, and Single. The number of Single respondents and Married respondents are greater than Divorced and Widow/Widower respondents. However, Single respondents were higher than Married respondents.

Table 4.4: Distribution of Respondents' Marital Status

Marital Status	Number of Respondents	Percentage
Married	141	39.6
Divorced	2	0.6
Widow/Widower	2	0.6
Single	211	59.3
Total	356	100

Source: Survey Data, 2019

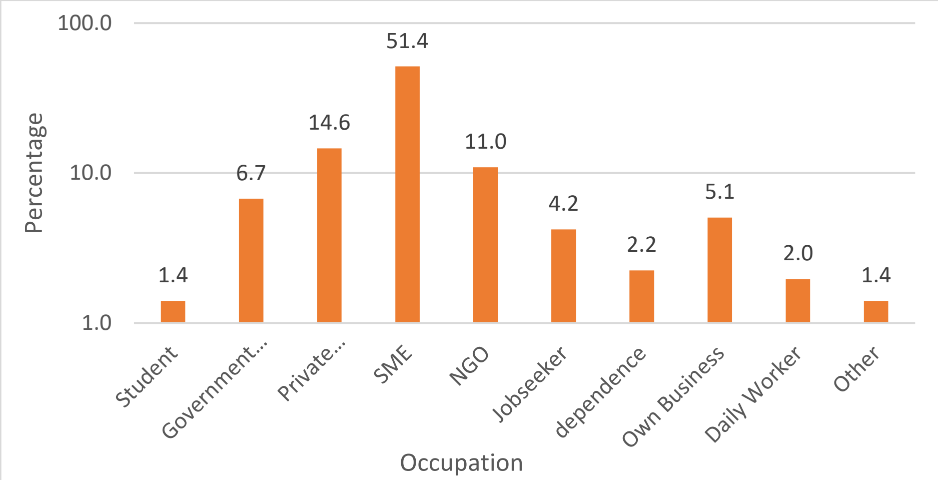
4.1.5 Occupations of Smartphone Users

The study divided 10 groups of occupations. These include students, Government employees, Private employees, Small and Medium Enterprises (SME), Development staff (NGO), Jobseeker, Own Business, Dependent, Daily Worker and Other. All of these distributions are as follows.

Table 4.5: Distribution of Smartphone Users by Occupations

Occupations	Number of Respondents	Percentage
Student	5	1.4
Government employees	24	6.7
Private employees	52	14.6
SME	183	51.4
NGO	39	11.0
Jobseeker	15	4.2
dependence	8	2.2
Own Business	18	5.1
Daily Worker	7	2.0
Other	5	1.4
Total	356	100.0

Source: Survey Data, 2019



Source: Survey Data, 2019

Figure 4.4 : Distribution of Respondents Occupations

Small and Medium Enterprises has a significant high number in the respondents using smartphone in Ahlone township. Respondents in Other 1.4% include "Actor", "Designer", "Driver" and "Photographer".

4.1.6 Respondents by Monthly Income of Smartphone Users

Monthly Income was classified in 10 categories with the amount of income in this study. These included "income under 150000", "income 150000 to 300000", "income 300000 to 450000", "income 450000 to 600000", "income 600000 to 750000", "income 750000 to 900000", "income 900000 to 1000000" "income 1000000 to 1500000", "income above 1,500,000" and "No Income".

Table 4.6 : Distribution of Respondents Smartphone Users Monthly Income

Income Level	Income MMK	Number of Respondents Income	Percentage
1	Under 150,000	18	5.1
2	150,001 to 300,000	95	26.7
3	300,001 to 450,000	150	42.1
4	450,001 to 600,000	22	6.2
5	600,001 to 750,000	6	1.7
6	750,001 to 900,000	5	1.4
7	900,001 to 1,000,000	7	2.0
8	1,000,001 to 1,500,000	25	7.0
9	Above 1,500,000	28	7.9
Total		356	100.0

Source: Survey Data, 2019

Generally, Income level 3 was significantly higher in the number of respondent smartphone users. 75% of income level was between 150000 to 600000 and 14.9% of income level was between 1000000 to above 1500000. Additionally, respondents did not answer "No Income" category.

4.1.7 Distribution of Smartphone Brand

The usage of smartphone brands was classified into 10 brands in this study. following table describes the distribution of smartphone brands.

Table 4.7 : Distribution of the Usage of Smartphone Brand

Smartphone Brand	Number of Respondents	Percentage
Apple	51	14.3
Samsung	46	12.9
Huawei	70	19.7
Mi	121	34.0
Oppo	37	10.4
Sony	2	.6
LG	2	.6
Vivo	17	4.8
Coolpad	2	.6
Other	8	2.2
Total	356	100.0

Source: Survey Data, 2019

Most, respondents were using smartphone Mi Brand (34%). The Oppo Brand was two times lower than Huawei Brand Smartphone. The Apple Brand was one percent greater than Samsung Brand. (91%) usage of the smartphone included Mi Brand, Huawei Brand, Apple Brand, Samsung Brand and Oppo Brand.

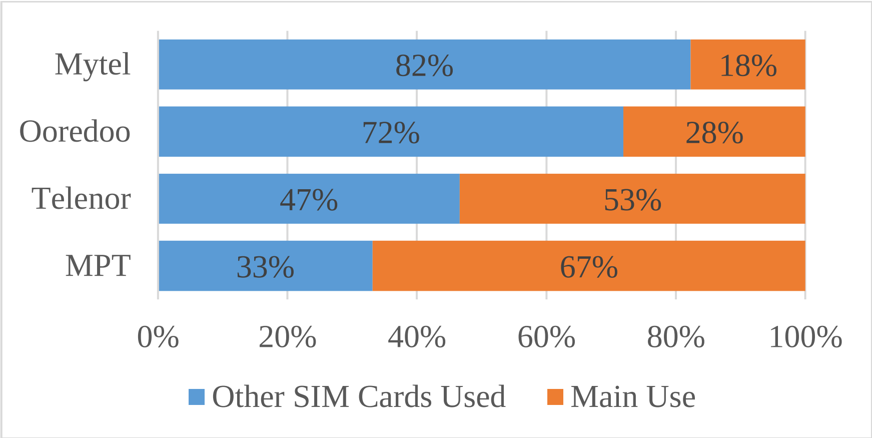
4.1.8 Distribution of Respondents Using More than One Operator

The following table describes main use of SIM cards (Mobile Operator) and dual SIM cards usage by respondent smartphone users.

Table 4.8 Distribution of Mobile Operators usage by smartphone users

Telecom Operator	Other Sim Cards Used	Main Use
MPT	33%	67%
Telenor	47%	53%
Ooredoo	72%	28%
Mytel	82%	18%

Source: Survey Data, 2019



Source: Survey Data, 2019

Figure 4.5: Distribution of Mobile Operators usage by smartphone users

Thirty three percent of MPT Telecom users used together with other Telecom services, while 82% of Mytel Telecom users shared with those.

The following table describes most used telephone operator by smartphone users.

Table 4.9 : Distribution of Respondents Primary using Telecom Service

Telecom Operators	Number of Respondents	Percentage
MPT	154	43.3
Telenor	96	27.0
Ooredoo	65	18.3
Mytel	41	11.5
Total	356	100.0

Source: Survey Data, 2019

Most of the respondents (43%) were using MPT, (27%) Telenor, (18%) Ooredoo and (12%) Mytel respectively.

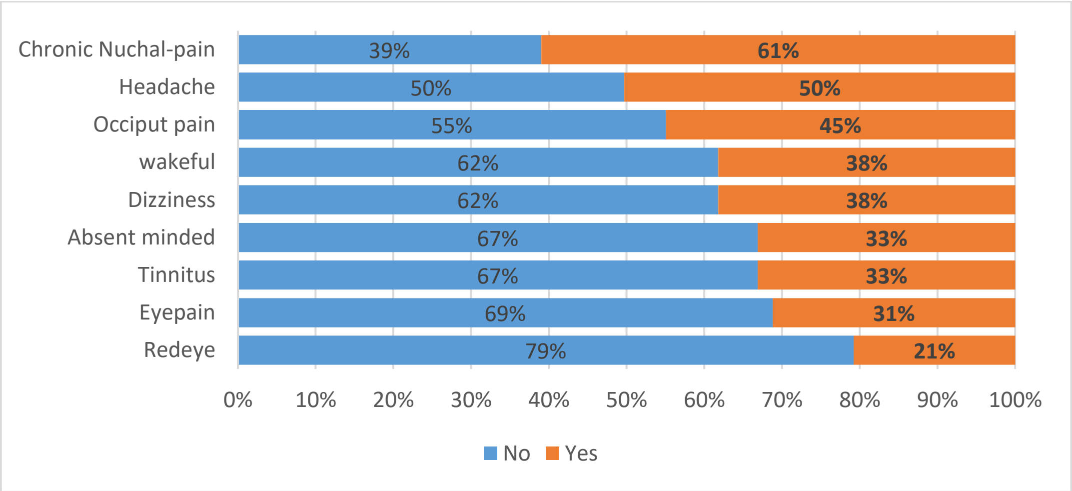
4.1.9 Symptoms of Smartphone Users

Symptoms of smartphone users are describe in the following table (4.10). These symptoms are the physical effects of using a smartphone.

Table 4.10 : Symptoms of Smartphone Users

Symptoms	No	Yes
Tinnitus	67%	33%
Headache	50%	50%
Dizziness	62%	38%
Absent minded	67%	33%
wakeful	62%	38%
Redeye	79%	21%
Eyepain	69%	31%
Occiput pain	55%	45%
Chronic Neck-pain	39%	61%

Source: Survey Data, 2019



Source: Survey Data, 2019

Figure 4.6: Symptoms of Smartphone Users

More than 40% of smartphone users suffered occiput pain, and headache, and Chronic Nuchal-pain. Less than 40% of smartphone users suffered in Wakeful, Dizziness, Absent-mindedness, and also Tinnitus, and Eyes pain.

4.2 Association between Frequent usage of Smartphone and Symptoms

The following table was explored association between Frequent Usage of Smartphone and Symptoms

Table 4.11: Association between Frequent Usage of Smartphone and Symptoms

Frequent usage to Smartphone \ Symptoms		**Tinnitus**		**Headache**		**Dizziness**		**Absent-minded**		**Wakeful**		**Red-eye**		**Eye-pain**		**Occiput pain**		**Back-pain**	
		No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
No	Count	20	2	13	9	15	7	15	7	17	5	17	5	12	10	19	3	8	14
	Percentage	5.62	0.56	3.65	2.53	4.21	1.97	4.21	1.97	4.78	1.4	4.78	1.4	3.37	2.81	5.34	0.84	2.25	3.93
Yes	Count	218	116	164	170	205	129	223	111	203	131	265	69	233	101	177	157	131	203
	Percentage	61.2	32.6	46.1	47.8	57.6	36.2	62.6	31.2	57	36.8	74.4	19.4	65.4	28.4	49.7	44.1	36.8	57
Total	Count	238	118	177	179	220	136	238	118	220	136	282	74	245	111	196	160	139	217
	Percentage	66.9	33.1	49.7	50.3	61.8	38.2	66.9	33.1	61.8	38.2	79.2	20.8	68.8	31.2	55.1	44.9	39	61

Source: Survey Data, 2019

Table 4.12 Result of Chi Square Test for Association between Frequent usage of Smartphone and Symptoms

Symptoms	Pearson Chi-Square Value	Degree of Freedom	Significance
Tinnitus within one month	6.123	1	**0.013**
Headache within one month	0.824	1	0.364
Dizziness within one month	0.405	1	0.525
Absent minded within one month	0.019	1	0.891
Wakeful within one month	2.379	1	0.123
Red eye within one month	0.054	1	0.817
Eye pain within one month	2.227	1	0.136
Occiput pain within one month	9.289	1	**0.002**
Back-pain within one month	0.071	1	0.790

Source: Survey Data, 2019

Moreover, the results of Chi Square test in the table (4.12) shows that there is association between frequent usage on smartphone and symptoms. There were nine different symptoms. According to the results of chi-square, the P value of Tinnitus and Occiput-pain are less than 0.05. Therefore, these two symptoms had associated between frequent usage of the smartphone by 95%.

4.3 Factor Analysis

The questionnaires were constructed with 40 items for impact of smartphone user data collected among respondents at Ahlone township. These included eight sectors on impact of smartphone. In smartphone, addictions sector was included waste on time, can't control on using smartphone, feeling and habits on using smartphone. Communication sector, included better friendship networks, and feelings on message function and social media functions, and usability on social networks. Misery sector, included noise of Rings, Voice, Beeps on the smartphone, and basic cause of the problem or argument on social media. Enjoy and the emotional sector, included motivation on the smartphone and user's attitude. Knowledge sector, included capacity of learning growing inspirations on the smartphone's capacity functions. The Social sector, included user security and related criminal, social and political activism. Work sector, included improve income generation, job finding and barriers to complete work. Awareness sector, included health awareness and the causes of symptoms. All these sectors finally come out with factors group related to respondents' answers.

4.3.1 Reliability Analysis to the Impact of Smartphone

This reliability analysis was referred to measure for the accuracy and consistency of collected data. This method was divided into two broad categories, there was external consistency procedures and internal consistency procedures. The reliability statistics results is described in the following table (4.13).

Table 4.13: Reliability Analysis Result

Cronbach's Alpha	N of Items
.888	40

Source: Survey Data, 2019

Cronbach's alpha reliability coefficient of overall items calculated as 0.888 which was greater than 0.7, high level of internal consistency for the overall items.

4.3.2 KMO and Bartlett's Test

Bartlett Test of Sphericity test sampling adequacy values were 0.846 and yielded a value of 5290.835 and an associated degree of significance smaller than 0.001.

KMO measure of sampling adequacy was 0.846. This means that the collected sample was adequate and the correlation matrix had significant correlations among these collected question variables.

Table 4.14: Kaiser Meyer Olkin (KMO) and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.846
Bartlett's Test of Sphericity	Approx. Chi-Square	5290.84
	Df	780
	Sig.	0.000

Source: Survey Data, 2019

4.3.3 Factor Analysis (First Run)

Factor analysis process use initial solution statistics and KMO and Bartlett's test for sphericity of correlation matrix and also selected Principal components method and extract based on eigenvalues greater than 1. Then selected varimax rotation method and selected coefficient absolute value are 0.33. This is suppressing of factors loading values less than 0.33.

In Factor analysis section, output of total variance was presented to extract associated eigenvalues with 12 common factors which was eigenvalue greater than 1. The percentage of total variance was described 22.685%, 6.052%, 5.053%, 4.651%, 4.326%, 3.713%, 3.486%, 3.263%,2.904%, 2.841%, 2.728% and 2.611% respectively. This was 64.312% of the total variance attributable to 12 factors and other 28 factors are only about 35.688% of the variance.

Table 4.15: Factor Analysis Output for Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.074	22.685	22.685	9.074	22.685	22.685	4.015	10.037	10.037
2	2.421	6.052	28.737	2.421	6.052	28.737	4.007	10.017	20.053
3	2.021	5.053	33.789	2.021	5.053	33.789	2.733	6.832	26.885
4	1.861	4.651	38.441	1.861	4.651	38.441	2.102	5.254	32.139
5	1.730	4.326	42.766	1.730	4.326	42.766	2.032	5.080	37.220
6	1.485	3.713	46.479	1.485	3.713	46.479	1.769	4.424	41.643
7	1.395	3.486	49.966	1.395	3.486	49.966	1.715	4.287	45.930
8	1.305	3.263	53.229	1.305	3.263	53.229	1.687	4.217	50.148
9	1.162	2.904	56.133	1.162	2.904	56.133	1.596	3.989	54.137
10	1.136	2.841	58.974	1.136	2.841	58.974	1.531	3.828	57.964
11	1.091	2.728	61.702	1.091	2.728	61.702	1.340	3.351	61.315
12	1.044	2.611	64.312	1.044	2.611	64.312	1.199	2.997	64.312
13	.966	2.415	66.728						
14	.872	2.181	68.908						
15	.839	2.097	71.005						
16	.784	1.961	72.966						
17	.748	1.870	74.836						
18	.731	1.828	76.664						
19	.711	1.777	78.441						
20	.699	1.747	80.188						
21	.647	1.618	81.806						
22	.626	1.564	83.370						
23	.569	1.423	84.794						
24	.539	1.347	86.141						
25	.537	1.343	87.484						
26	.498	1.246	88.730						
27	.487	1.217	89.947						
28	.465	1.162	91.109						
29	.429	1.072	92.180						
30	.410	1.024	93.205						
31	.399	.997	94.201						
32	.366	.916	95.117						
33	.340	.851	95.968						
34	.283	.707	96.675						
35	.268	.671	97.346						
36	.241	.602	97.948						
37	.229	.573	98.521						
38	.216	.541	99.062						
39	.208	.520	99.582						
40	.167	.418	100.000						

Extraction Method: Principal Component Analysis.

Source: Survey Data, 2019

Component Matrix

The component matrix presents the 12 components extracted with Principal component analysis method. Variables Q22, Q20, Q14, Q27, Q18, Q37, Q38, Q21, Q27, Q25, Q36, Q23, Q19, Q32, Q35, Q26, Q13, Q7, Q34, Q28, Q15, Q39 and Q17 are factor 1, variables Q16, Q4, Q5 are Factor 2, Q8 and Q3 are Factor 3, Q12 and Q40 are Factor 4, variable Q31 and Q33 is Factor 5 and Factor 6, Q1 and Q30 are Factor 8, Q6 and Q29 are Factor 9, variable Q11 is Factor 10, Q2 and Q9 are Factor 11 and Q10 Factor 12.

Table 4.16: Factor Analysis Output for Component Matrix

	Component											
	1	2	3	4	5	6	7	8	9	10	11	12
Q22	.780											
Q20	.725											
Q14	.688											
Q27	.683											
Q18	.677		-.365									
Q37	.677											
Q38	.647	-.371										
Q21	.640		-.427									
Q24	.610											
Q25	.604											
Q36	.597	-.342										
Q23	.583											
Q19	.572		-.442									
Q32	.563											
Q35	.529											
Q26	.498			-.336								
Q13	.497						-.350			.362		
Q7	.490			-.340						-.374		
Q34	.479	-.335										
Q28	.471											
Q15	.469	.405										
Q39	.443											
Q17	.434						-.433					
Q16		.477					-.382					
Q4		.453	.364			.362						
Q5		.432	.377			.390						
Q8			.486									
Q3			.430	-.401								
Q12				.507		-.332						
Q40	.401			.433								
Q31					.408		.365					
Q33	.375					.454						
Q1								.444				
Q30		.339						-.365				
Q6				.390					.454			
Q29	.333								-.342			
Q11	.414									.428		-.340
Q2								.336			-.535	
Q9	.386										.401	
Q10										.336		.432

Extraction Method: Principal Component Analysis.
a. 12 components extracted.

Source: Survey Data, 2019

Rotated Component Martix

In the rotated component matrix was presented after 10 iterations rotation converged to using with Principal Component Analysis extraction method and Varimax with Kaiser Normalization rotation method. The rotation factor structures were shown in the Table (4.15) Q21, Q19, Q18, Q20, Q25, Q22, Q26 and Q14 are Factor 1, Q37, Q36, Q38, Q23, Q24, Q27 are Factor 2, Q34, Q33, Q32, Q39, Q35, Q40 are Factor 3, Q16, Q15, Q17 are Factor 4, Q29, Q28 are Factor 5, Q3, Q8, Q7 Q12 are Factor 6, Q31 and Q30 are Factor 7, Q4 and Q5 are Factor 8, (Q11, Q13), (Q1, Q6), Q10, (Q2, Q9) are Factor 9, Factor 10, Factor 11 and Factor 12 respectively.

Table 4.17: Factor Analysis Output for Rotated Component Matrix

	Component											
	1	2	3	4	5	6	7	8	9	10	11	12
Q21	.812											
Q19	.787											
Q18	.713											
Q20	.645											
Q25	.496	.408			.363							
Q22	.416	.385	.343									
Q26	.396					.376					.384	
Q14	.391	.360										
Q37		.795										
Q36		.788										
Q38		.780										
Q23	.341	.554										
Q24	.332	.484										
Q27	.357	.406			.360		.341					
Q34			.687									
Q33			.686									
Q32			.674									
Q39			.585									
Q35		.467	.502									
Q40			.415									
Q16				.845								
Q15				.646								
Q17		.358		.539								
Q29					.754							
Q28	.361				.578							
Q3						.646						
Q8						.600						
Q7	.331				.370	.471						
Q12					.349	-.417	.352					
Q31							.743					
Q30							.691					
Q4								.850				
Q5								.806				
Q11									.735			
Q13				.370					.680			
Q1										.687		
Q6										.648		
Q10											.815	
Q2												-.836
Q9												.457

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 10 iterations.

Source: Survey Data, 2019

4.3.4 Velicer's Minimum Average Partial (MAP) Test

The determining of MAP test was shown in the following factors focuses on the common variance in a correlation matrix.

Eigenvalues	**Number of Components**	**Squared**	**Power4**
9.0739	0.0000	.0501	.0072
2.4207	1.0000	.0125	.0008
2.0210	2.0000	.0119	.0005
1.8606	3.0000	.0115	.0004
1.7302	4.0000	.0116	.0004
1.4852	5.0000	**.0114**	**.0004**
1.3945	6.0000	.0119	.0004
1.3054	7.0000	.0121	.0004
1.1617	8.0000	.0128	.0005
1.1363	9.0000	.0135	.0006
1.0911	10.0000	.0145	.0007
1.0443	11.0000	.0159	.0010

Source: Survey Data, 2019

The smallest average squared partial correlation is **.0114**

The smallest average 4rth power partial correlation is **.0004**

The Number of Components According to the Original (1976) MAP Test is **5**

The Number of Components According to the Revised (2000) MAP Test is **5**

According to the Velicer's MAP test, the first section describes the eigenvalues generate from PCA on the 40 variables and also it presents which variables' eigenvalues was greater than 1.00.

Second section presents the smallest average squared partial correlations was 0.114 and the smallest average 4rth Power partial correlation is 0.0004 and the number of factors corresponding value was 5. Therefore, MAP test was indicated that five factors.

4.3.5 O'Connor's Parallel Analysis

This function was generated eigenvalues for random data sets with specified numbers of variables and cases. Typically, the eigenvalues derived from an actual data set was compared to the eigenvalues derived from the random data.

Table 4.18 : Parallel Analysis Output

Random Data Eigenvalues					
Root	Means	Prcntyle	Root	Means	Prcntyle
1.000000	1.703624	1.791022	21.000000	.952869	.971796
2.000000	1.622005	1.668002	22.000000	.925428	.947462
3.000000	1.560164	1.617173	23.000000	.900338	.922566
4.000000	1.506986	1.550448	24.000000	.876469	.898357
5.000000	1.458584	1.489982	25.000000	.852844	.874204
6.000000	1.417817	**1.450517**	26.000000	.828264	.851733
7.000000	1.377287	1.406305	27.000000	.803922	.823924
8.000000	1.337762	1.377486	28.000000	.781648	.800462
9.000000	1.303001	1.338884	29.000000	.760092	.783481
10.000000	1.267223	1.292401	30.000000	.734377	.759112
11.000000	1.236001	1.261650	31.000000	.711988	.732808
12.000000	1.203154	1.225463	32.000000	.688414	.711692
13.000000	1.173137	1.196887	33.000000	.664706	.691151
14.000000	1.142147	1.167326	34.000000	.642463	.661351
15.000000	1.112907	1.142595	35.000000	.617012	.634580
16.000000	1.086193	1.113852	36.000000	.593573	.612280
17.000000	1.059143	1.086566	37.000000	.568407	.596136
18.000000	1.027708	1.052371	38.000000	.540412	.562337
19.000000	1.001412	1.021162	39.000000	.509067	.534134
20.000000	.977004	1.001649	40.000000	.474448	.508036

Source: Survey Data, 2019

First Root column describes to 40 factors. The Means column describes to the mean eigenvalue for each factor. The Percentile (Prcntyle) column presents the eigenvalues that correspond to the 95th percentile of the distribution of the random data eigenvalues.

By comparing to the actual data set of eigenvalues and Percentile of parallel analysis, one to Six factor's eigenvalues (9.0739, 2.4207, 2.0210, 1.8606, 1.7302, 1.4852) are larger than Random Data Eigenvalue's 95th Percentile (1.791022, 1.668002, 1.617173, 1.550448, 1.489982, 1.450517) and Means value (1.703624, 1.622005, 1.560164, 1.506986, 1.458584, 1.417817). The seven factor eigenvalues (1.3945) was not significantly larger than six factors 95th percentile (1.406305) and mean value (1.377287).

O'Connor's Parallel Analysis was indicated that six factors and Velicer's Minimum Average Partial (MAP) Test were indicated that five factors in the Original 1976 MAP test, and the Revised 2000 MAP Test.

4.3.6 Factor Analysis (Second Run)

According to the MAP test analysis, the majority of different dimension on smartphone user respondents have five factors in this study. Therefore, second run of factor analysis was selected for five factors extract in Factor Analysis Extraction.

Total Variance Explained

The results of second run total variance explained five factors of initial eigenvalues factors was same in five factors of First run. The percentage of total variance in second run was 22.685%, 6.052%, 5.053%, 4.651% and 4.326% respectively. These factors contribute 42.766% of the total variance. The rest of 35 factors were only about 57.234% of the variance. table (4.19)

Table 4.19: Five Factor Structure Output for Total Variance Explained

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.074	22.685	22.685	9.074	22.685	22.685	5.621	14.053	14.053
2	2.421	6.052	28.737	2.421	6.052	28.737	3.952	9.880	23.933
3	2.021	5.053	33.789	2.021	5.053	33.789	3.281	8.202	32.135
4	1.861	4.651	38.441	1.861	4.651	38.441	2.156	5.389	37.524
5	1.730	4.326	42.766	1.730	4.326	42.766	2.097	5.242	42.766
6	1.485	3.713	46.479						
7	1.395	3.486	49.966						
8	1.305	3.263	53.229						
9	1.162	2.904	56.133						
10	1.136	2.841	58.974						
11	1.091	2.728	61.702						
12	1.044	2.611	64.312						
13	.966	2.415	66.728						
14	.872	2.181	68.908						
15	.839	2.097	71.005						
16	.784	1.961	72.966						
17	.748	1.870	74.836						
18	.731	1.828	76.664						
19	.711	1.777	78.441						
20	.699	1.747	80.188						
21	.647	1.618	81.806						
22	.626	1.564	83.370						
23	.569	1.423	84.794						
24	.539	1.347	86.141						
25	.537	1.343	87.484						
26	.498	1.246	88.730						
27	.487	1.217	89.947						
28	.465	1.162	91.109						
29	.429	1.072	92.180						
30	.410	1.024	93.205						
31	.399	.997	94.201						
32	.366	.916	95.117						
33	.340	.851	95.968						
34	.283	.707	96.675						
35	.268	.671	97.346						
36	.241	.602	97.948						
37	.229	.573	98.521						
38	.216	.541	99.062						
39	.208	.520	99.582						
40	.167	.418	100.000						

Source: Survey Data, 2019

Extraction Method: Principal Component Analysis.

Rotated Component Matrix

The second run, rotated component matrix were presents variables such as Q18, Q19, Q21, Q25, Q23, Q24, Q20, Q27, Q37, Q38, Q36, Q22, Q14 and Q26 in factor 1, variables Q34, Q35, Q32, Q39, Q33 in Factor 2, Q15, Q28, Q16, Q29, Q9, Q7, Q13 in Factor 3, Q4, Q5, Q31, Q6, Q8 in Factor 4, variable Q40, Q12, Q3, Q1, Q10 in Factor 5 respectively.

Table 4. 20: Five Factor Structure Output for Rotated Component Matrix

Rotated Component Matrix[a]

Questions	Component				
	1	2	3	4	5
Q18	**.716**				
Q19	**.670**				
Q21	**.667**		.377		
Q25	**.660**				
Q23	**.622**				
Q24	**.609**				
Q20	**.602**		.358		
Q27	**.599**		.356		
Q37	**.574**	.517			
Q38	**.559**	.521			
Q36	**.520**	.449			
Q22	**.506**	.491	.340		
Q14	**.468**				.332
Q26	**.425**	.338			
Q34		**.716**			
Q35		**.708**			
Q32		**.547**			
Q39		**.508**			.398
Q33		**.475**			
Q15			**.628**		
Q28			**.609**		
Q16			**.583**		
Q29			**.453**		
Q9			**.441**		
Q7			**.418**		
Q13			**.371**		
Q11					
Q4				**.653**	
Q5				**.566**	
Q31				**.488**	
Q6				**.442**	
Q8		.362		**.398**	
Q30					
Q17					
Q40					**.568**
Q12					**.510**
Q3				.445	**-.468**
Q1					**.363**
Q10					**-.362**
Q2					

Source: Survey Data, 2019

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization. a. Rotation converged in 19 iterations

After the clarify to cross-loaded items in the five factors table was the following:

Table 4.21: Social Factor

Q18	Via Social media of Smartphone, various kinds of literatures can be learnt.	.716
Q19	Via Social media of Smartphone, various kinds of art can be studied.	.670
Q21	Via Social media of Smartphone, various kinds of basic health knowledge can be studied.	.667
Q25	Via Social media of Smartphone, various kinds of Social Event can be studied and get information.	.660
Q23	Via Social media of Smartphone, various kinds of personal security can be affected.	.622
Q24	Via Social media of Smartphone, various kinds of affection can be experienced.	.609
Q20	Via Social media of Smartphone, various kinds of Music can be studied.	.602
Q27	Via Social media of Smartphone, behind of crime can be.	.599
Q37	Do you agree? Red-eye is due to prolonged use of the smartphone.	.574
Q38	Do you agree? Eyepain is due to prolonged use of the smartphone.	.559
Q36	Do you agree? Wakeful is due to prolonged use of the smartphone.	.520
Q22	Via Social media of Smartphone, various kinds of social crime can occur.	.506
Q14	Arguments or disputes arise through smartphone media.	.468
Q26	Via Social media of Smartphone, various kinds of politic and socio information can be studied	.425

Source: Survey Data, 2019

The first-factor table (4.21) identifies fourteen variables. This factor was included related to learning, knowledge, studies, and information, dating. And then other related to argue or dispute and social media can occur to crime. And then another three variables were related to physical symptoms such as Red-eye, Eye pain and wakeful. Therefore, it was labeled as Social Factor.

Table 4.22: Health Factor

Q34	Do you agree? Sudden dizziness is due to prolonged use of the phone.	.716
Q35	Do you agree? Amnesia is due to prolonged use of the smartphone.	.708
Q32	Do you agree? Tinnitus is due to prolonged use of the smartphone.	.547
Q39	Do you agree? Occiput pain is due to prolonged use of the smartphone.	.508
Q33	Do you agree? Headache is due to prolonged use of the smartphone.	.475

Source: Survey Data, 2019

The second-factor table (4.22) identifies with five variables that reflected on health symptoms such as Dizziness, Amnesia, Tinnitus, and headaches. Therefore, it was labeled as Health Factor.

Table 4.23: Communication and Emotional Factor

Q15	The smartphone usage was enjoyable for the user.	.628
Q28	Use of smartphone to complete my business on work.	.609
Q16	Smartphone motivates the user.	.583
Q29	The use of smartphones increase income	.453
Q9	Smartphone's social media can be provided to improve on social relationship	.441
Q7	Using smartphone get better communication with other people.	.418
Q13	Worried and anxious about smartphone. (when lost and damage)	.371

Source: Survey Data, 2019

The third-factor table (4.23) identifies with seven variables. This factor was found out in two different sectors that reflected on feeling-enjoyable, motivation, relationship, cause of increasing the business, better communication and worried anxiously. Therefore, it was labeled is Communication and Emotional.

Table 4. 24: Addiction Factor

Q4	When you do not have a smartphone with you, you are not confident and need to have something.	.653
Q5	If smartphone situations are over and in out of service area, then need for something in felt.	.566
Q31	Prolonged game playing with smartphone can affect business.	.488
Q6	The smartphone in used, even at meal times.	.442
Q8	The function of the message is very useful.	.398

Source: Survey Data, 2019

The fourth-factor table (4.24) identifies with five variables. This factor was included feeling is not confidence with smartphone missing, when the connection was cut off, I felt something was needed, Prolonged game playing and always used with eating time, Massage function was very useful. Therefore, it was labeled is Addiction.

Table 4.25: Negative Impact

Q40	Do you agree? Chronic Nuchal pain is due to prolonged use of the smartphone.	.568
Q12	Using a smartphone has more negative than positive impacts.	.510
Q3	At sleep time, I kept the smartphone under the pillow or on the bed.	
Q1	Do you Agree? Mostly I was losing time on the smartphone.	.363
Q10	Mail message, email, social media and games of the ringing, voice, beeps keep bothering the smartphone users.	-.362

Source: Survey Data, 2019

The table 4.25 identifies that four variables. That was reflected in the symptom of smartphone prolonged usage, and always keep on the bed, and sense of using a smartphone, and a waste of time, and bothering to relax time. Therefore, it was labeled is Negative Impact.

Table 4.26: Factors affecting among Smartphone users at Ahlone township

Questions	Social	Health	Communication and Emotional	Addiction	Negative Impact
Q18	.716				
Q19	.670				
Q21	.667				
Q25	.660				
Q23	.622				
Q24	.609				
Q20	.602				
Q27	.599				
Q37	.574				
Q38	.559				
Q36	.520				
Q22	.506				
Q14	.468				
Q26	.425				
Q34		.716			
Q35		.708			
Q32		.547			
Q39		.508			
Q33		.475			
Q15			.628		
Q28			.609		
Q16			.583		
Q29			.453		
Q9			.441		
Q7			.418		
Q13			.371		
Q4				.653	
Q5				.566	
Q31				.488	
Q6				.442	
Q8				.398	
Q40					.568
Q12					.510
Q3					-.468
Q1					.363
Q10					-.362

Source: Survey Data, 2019

Among 40 variables considered in this study, social factor, health factor, communication factor, emotional factor, additional factor and negative impact factor are found as main factors which are related to impacts on smartphone users.

CHAPTER V
CONCLUSION

This study was conducted in Ahlone Township using primary data collection survey, and two step sampling methods was completed in ten wards. Data collection was uses with open source KoboToolbox, it was simple, robust and powerful tools for data collection. In the data analysis factor analysis was used, verifying the analysis with Velicer's Minimum Average Partial (MAP) test and O'Connor's Parallel Analysis using IBM SPSS Statistics 24.0.

5.1 Findings

This survey was conducted to identify to the main key factors for the Smartphone user at Ahlone township area. In this area, information was collected among 356 respondents' smartphone users age between (15 to 49) years at selected three wards. The data collection completed in May 2019. It was to find their socio demographic situations and the main key factors on the impact of smartphone users among them. In this study, the number of male respondents was 12% more a female respondent rate in Ahlone township. Age group between 25 to 39 years highly responded to this study. The education status 59% of respondents have bachelor degree. According to the Myanmar Information Management Unit Township Profile, 98.5% was literate for 15-year-olds and above at Ahlone Township.

The study found that Occupation status 90.8% of respondents have employment. In Ahlone township, the total number of employments to population ratio are total 52.82 (male:66.30, female:40.55) in 2014 (source from Population and Housing Census). A significant increase can be seen in 51.4% of respondents who are using smartphone as SME owner at Ahlone township. However, respondents did not respond "No Income” category. Therefore, the total number of respondents were totally income by individually. It was having two options, direct income and indirect income. During the assessment, 94.4% of respondents were have direct income and other 5.6% of respondents were have indirect income. Moreover, most of the respondents was significant using with Mi Brand Smartphone at Ahlone township.

Nowadays, most of the people are using more than one Telecom SIM card. That depend on their service package and mobile bill deduction rate per minutes. Therefore, most of the respondents were using multiple SIM card. According to the respondents MPT and Telenor companies were highly usage by respondents at Ahlone township. About 61% of respondents were suffered in Chronic Nuchal pain, about 50% of respondents were suffered Headache and occiput pain, round about 35% of respondents were suffered wakeful, Dizziness, Amnesia, Tinnitus and eye pain. 21% of the respondents were suffered redeye. Therefore, the number of respondents smartphone users were have some affect in health status. In additional, Tinnitus and Occiput-pain of two symptoms were an association between Frequent usage to the smartphone.

In the reliability analysis, the Cronbach's alpha coefficient was calculated as 0.888 by examine on the 40 items total statistics. Therefore, reliability test is high level of internal consistency and accepting the reliability test. SPSS Output for Kaiser-Meyer-Olkin (KMO) and Bartlett's Test, Principal component and factor analysis are very suitable to analyze the survey data since KMO measure of sampling adequacy is 0.846 and Bartlett's Test of Sphericity sig is 0.000.

A sample of 356 Smartphone users (respondents) were surveyed to identify the important factors among their perceptions, awareness and practices. The factor analysis results described that five factors out of twelve were found the importance factor 1: Social, factor 2: Health, factor 3: Communication and Emotional, factor 4: Addictions, factor 5: Negative Impact. These five factors solutions were in line with the Velicer's Minimum Average partial (MAP) Test.

5.2 Discussions

In this Era, although mobile smartphone usage was not strange but health awareness and impact of smartphone knowledge are weak. Thus, this study aimed to find out key-main factors which were the impacts of using smartphone. Moreover, two-stage random sampling was used to select the required samples, and the factor analysis was used to identify the impact of smartphones among 15 to 49 years who were permanently living in Ahlone township.

This study found that a more important related factor to the impact of smartphone usage, that of great happiness and also depression, unhappiness, addiction and anger issue. The additional researches are highly recommends to identify impacts on smartphone user that could be applied in social, health, communication and emotional, addiction and Negative Impact sectors by using a similar method of study. In addition, some of the respondent's smartphone users suffer some effects on health status. Therefore, frequent usage of smartphones and some symptoms were an association with the respondents, this analysis was based on socio demographic data.

5.3 Suggestions and Further Research

Based on the study's findings, would like to suggest in order to follow key message considerations.

- Authorities should provide Health knowledge and awareness through the public alert campaigns.
- Department of Public Health, should initiate the health care strategy for Health knowledge on the impact of smartphone.
- After strategy and policy, key messages poster should be distributed to the state and regional level. Alternatively, TV channel, Radio FM, Social media should be broadcasted.
- For further research using identified factors, more deeply indented and to explore using other models should be recommended for the impact of smartphone.

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APPENDIX

Survey on Impact of Smartphone on Users
Questionnaire

My name is Myat Zaw Win. I am attending to Master of Applied Statistics (MAS) Programme of Yangon University of Economics. I would like to collect information from you. That is deeply support to my thesis of Master Degree. I am agreed to confidential on your information.

Q No	Questionnaires	Code	Label	Response
1	Respondents Age		_ _	
2	Gender	1 2 3	Male Female Other (Specify)	
3	Educational Status	1 2 3 4 5 6 7 8	Primary Secondary Higher Diploma Bachelor Master PhD Other (Specify)	
4	Marital Status	1 2 3 4	Married Divorce Widow/Widower Single	
5	Occupation	1 2 3 4 5 6 7 8 9 10	Student Public Staff Private Staff SME INGOs Job Seeker Dependent Own Business Daily Worker Other (Specify)	
6	If Other Occupation		…………..	
7	Respondents Monthly Income	1 2 3 4 5 6 7 8	Under 150,000 150,000 ~ 300,000 300,000 ~ 450,000 450,000 ~ 600,000 600,000 ~ 750,000 750,000 ~ 900,000 900,000 ~ 1,000,000 1,000,000~ 1,500,000	

		9 10	Above 1,500,000 No Income	
8	Household member		……………	
9	What do you used telecom service? (multiple)	1 2 3 4	MPT Telenor Ooredoo MyTel	
10	Which Telecom company is most used in your smartphone?	1 2 3 4	MPT Telenor Ooredoo MyTel	
11	What is your smartphone brand?	1 2 3 4 5 6 7 8 9 10 11	Apple Samsung Huawei Mi Oppo Sony LG Vivo Honor Coolpad Other (Specify)	
12	How about your expenses on the smartphone by month?		…………………………	
13	What is your priority for using smartphone?	1 2 3 4 5 6 7 8	Communications Read Information Playing Game Learning Using for Business Memories and Saving photos Watching Movies GPS, MAP	
14	Are your frequent usage to smartphone?	1 2	Yes No	
15	During the last month, did you suffer from Tinnitus?	1 2	Yes No	
16	During the last month, did you suffer headache?	1 2	Yes No	
17	During the last month, did you suffer dizziness?	1 2	Yes No	
18	During the last month, did you suffer wakeful?	1 2	Yes No	
19	During the last month, did you suffer amnesia?	1 2	Yes No	
20	During the last month, did you suffer redeye?	1 2	Yes No	

21	During the last month, did you suffer eye pain?	1 2	Yes No	
22	During the last month, did you suffer occiput pain?	1 2	Yes No	
23	During the last month, did you suffer chronic Nuchal pain?	1 2	Yes No	

Likert Scale Questions

Do you Agree? Mostly I was losing time on the smartphone.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

I can't control using social media through the smartphone.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

At sleep time, I kept the smartphone under the pillow or on the bed.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

When you do not have a smartphone with you, you are not confident and need to have something.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

If smartphone situations are over and in out of service area, then need for something in felt.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

The smartphone in used, even at meal times.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Using smartphone get better communication with other people.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

The function of the message is very useful.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Smartphone's social media can be provided to improve on social relationship
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Mail message, email, social media and games of the ringing, voice, beeps keep bothering the smartphone users.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

The voice, the phone rings, the game was bothering smartphone users.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Using a smartphone has more negative than positive impacts.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Worried and anxious about smartphone. (when lost and damage)
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Arguments or disputes arise through smartphone media.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

The smartphone usage was enjoyable for the user.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Smartphone motivates the user.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

The usage of smartphone was mostly for relaxation.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Via Social media of Smartphone, various kinds of literatures can be learnt.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Via Social media of Smartphone, various kinds of art can be studied.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Via Social media of Smartphone, various kinds of Music can be studied.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Via Social media of Smartphone, various kinds of basic health knowledge can be studied.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Via Social media of Smartphone, various kinds of social crime can occur.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Via Social media of Smartphone, various kinds of personal security can be affected.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Via Social media of Smartphone, various kinds of affection can be experienced.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Via Social media of Smartphone, various kinds of Social Event can be studied and get information.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Via Social media of Smartphone, various kinds of politic and socio information can be studied
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Via Social media of Smartphone, behind of crime can be.
Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Use of smartphone to complete my business on work.

Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

The use of smartphones increase income

Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Via Social media the job opportunity can be found

Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Prolonged game playing with smartphone can affect business.

Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Do you agree? Tinnitus is due to prolonged use of the smartphone.

Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Do you agree? Headache is due to prolonged use of the smartphone.

Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Do you agree? Sudden dizziness is due to prolonged use of the phone.

Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Do you agree? Amnesia is due to prolonged use of the smartphone.

Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Do you agree? Wakeful is due to prolonged use of the smartphone.

Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Do you agree? Red-eye is due to prolonged use of the smartphone.

Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Do you agree? Eyepain is due to prolonged use of the smartphone.

Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Do you agree? Occiput pain is due to prolonged use of the smartphone.

Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐

Do you agree? Chronic Nuchal pain is due to prolonged use of the smartphone.

Strongly disagree ☐ Disagree☐ Neither agree☐ Agree☐ Strongly agree☐