

ORIGINAL ARTICLE

Correlates of awareness level of Otorhinolaryngologists in India about the radiation hazards of mobile phone usage

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Citation

Anand PU, Varshney S, Angral S, Sasanka KSBS, Gupta P, Bhattacharya S. Indian J Comm Health. 2022;34(4):542-548. <https://doi.org/10.47203/IJCH.2022.v34i04.017>

Source of Funding: Nil Conflict of Interest: None declared

Article Cycle

Received: 07/09/2022; Revision: 17/10/2022; Accepted: 11/12/2022; Published: 31/12/2022

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Abstract

Background-There is a definitive risk to human health because of mobile phones. The awareness towards mobile phones emitted electromagnetic radiation is of paramount importance to prevent health risks and possible negative health disorders. **Aim and objectives**-The aim of the survey is to assess the awareness of mobile phone radiation and its harmful effects on the body and the mobile phone usage trend among Otorhinolaryngologists from India. **Methodology**-The present survey aimed to obtain baseline data on cell phone usage and radiation awareness among a relatively homogenous cohort of Otorhinolaryngologists from India. This is a cross-sectional online survey assessing awareness of Mobile Phone radiation through a custom-made questionnaire devised by the authors which consisted of four parts: 1. Demographic details, 2. Mobile phone usage trend, 3. Knowledge of mobile phone radiation 4. Awareness of health hazards produced by mobile phone radiation. **Results**- The total number (n) of otorhinolaryngologists to whom the questionnaire was sent was 6336 of which 259 of them responded which formed the sample size of our study. Thus, the response rate of the survey was 4%. A total of 259 Otorhinolaryngologists participated in the study. The mean age of the population involved in the survey is 41.7810.32 years. The male-female ratio of the survey is 161:98 respectively. There were 172 private and 87 government ENT practitioners in the survey. MS otorhinolaryngology was the most common qualification of the study with 223 doctors having the degree, 20 having DNB, and 7 of them having completed DLO. The mean years of medical practice after postgraduation of the Otorhinolaryngologists participating in the questionnaire are 13.537.38 years. The major contributors to the survey were private ENT consultants with a count of 110, followed by Senior Residents 58, Assistant Professor 39, Professor 29, Associate professor 10, and Additional professor 13. It was evident from the questionnaire that 242 of the respondents were right-handed and 204 of the study population used their right ear for talking over the phone, it was also cross-checked by giving a miss call to them in close vicinity. The mean years of exposure to mobile phone usage by Otorhinolaryngologists are 15.01 5.75. A maximum of 153 surgeons were using mobile phones for 11-20 yrs. The average hours of daily mobile phone usage were 373 minutes. A highest of 101 Otorhinolaryngologists using mobile phones for >4 Hrs. Surprisingly through the questionnaire we came to know that a total of 60 doctors among the 250 use the phone daily for an average of more than 10 Hrs, which is 24% of the study population surveyed. Questions 15-24 were purposed to bring the awareness knowledge of the respondents towards electromagnetic radiation of the cellular phones, and it can be arbitrarily said that a score of 5 or more means that the person is aware. The average of the correct responses to each of the 10 questions given by the ENT practitioners is 5.97±1.66. Similarly, questions 25 to 35 assess the awareness of health hazards produced by mobile phone radiation. The mean correct response of the Otorhinolaryngologists is 6.30±1.87.

Keywords

Mobile Health; Health, Radiation; Radiation, Cancer

Introduction

The history of mobile phones goes back to 1908 when a US Patent was issued in Kentucky for a wireless telephone. The first handheld cellular mobile phone was demonstrated by John F. Mitchell and Martin Cooper of Motorola in 1973, using a handset weighing 2 kilograms(1). Smartphones, once a status symbol has now become a product of the commoners. The past two decades have seen an exponential increase in the use of cellular phones in both developing as well as in developed countries(2). According to a market research firm techARC, India had 502.2 million smartphone users as of December 2019, which means over 77 percent of Indians are now accessing wireless broadband through smartphones(3).

A survey in 2009 revealed that in 2020, the penetration rate of smartphone in India reached 54 % and was estimated to reach 96% in 2040(4). Another survey conducted by the Mobile Ecosystem Forum from November to December 2019, found that the highest penetration rate among smartphone users was in the age group of 16 to 24 years, which is 37%. This was followed by the age group between 24 and 35 years old. Older Indians of age 50 and above surveyed had a lower penetration rate for smartphone usage(5). Science and technology have made the unthinkable possible time and again and smartphones is one such invention. Telecommunication from a time where pigeons were used as messengers to now a day, the ascension is miraculous. Mobile phones can be used to makes emergency calls, send messages, assess a person health, bank, and what not. This amazing gadget is not all good, as it could cause increased risk of vehicular accidents, carcinoma, sensorineural hearing loss and sleep disturbances, behavioural changes(6)(7). There is a huge void in the data of patterns of cell phone use among medical professionals that needs to be addressed. This also leads to the question are we aware of such harmful effects of the mobile phone, which were the core aims of this present questionnaire-based survey.

Mobile phones emit radiofrequency electromagnetic waves (RF-EMW), These waves transmit signals from the cellular phone to the base stations and antennas. The frequency of such waves is low and ranges from 800-2200 MHz. However there is still risk to the human user, because our bodies can act as antennas that absorb these waves and convert them into eddy currents(8).

The preliminary cell phone system, Analogue NMT (Nordic Mobile Telephone) system, was introduced in the 1980s, and operated at an electromagnetic resonance of 902.5 MHz A decade later, the GSM (global system of mobile communications) succeeded it, operating at a radiofrequency of 902.4 MHz, pulsing at 217 Hz. The most

recent DCS (digital cellular system) operates at a radiofrequency of 1800 MHz(9). Advances in cell phone telecommunication systems are obviously associated with an increasing signal frequency, which correlates with higher energy radiofrequency waves. Networks used by specific countries differ in the transmission frequencies for the radio waves. European and Asian countries operate at 850/900 MHz, whereas in United States mainly networks operate at 1800/1900 MHz. Increased frequency means increased energy in the waves. Furthermore, increasing globalization has yielded cellular phones which can function in multiple countries, and over all four frequencies (850/900/1800/1900 MHz), thereby appropriately termed quad-band phones.

According to International Agency for Research on Cancer, the mobile radiations are classified as Group-2B - possibly carcinogenic radiations i.e., there “could be some risk” of carcinogenicity(10).

It is important to know about specific absorption rate (SAR) for discussing the health hazards further. It is the rates at which the EMR is absorbed by human bodies is called as specific absorption rate (SAR). It is a standardized unit that measures the impact of radiofrequency electromagnetic waves on the human body, and it is expressed as Watt/Kg. The FCC (Federal Communication Commission) has limited the maximum legal SAR of any handheld cell device to 1.6 Watt/kg and from the year 2000 onwards, all cell phone manufacturers must place labels on their phones providing their radiation levels(11). We do not possess ample knowledge on the pathophysiology of the mobile phone radiations, but it is considered that part of the electromagnetic waves emitted by mobile phone is absorbed by the human body, thus acts as a parasitic antenna that receives the EMW from external sources(12).The effects of these radiations can be classified into thermal and non-thermal effects.

The tissue temperature increase resulting from exposure to EMW is referred to as “thermal effects”. This increased temperature in the tissues is produced because of absorption of high frequency EMV and result in enhanced electrical conductivity. This increased temperature can hamper the normal cellular function and development(13). The increased local tissue temperature is because of imbalance between two factors 1. Heat generation which is dependent on SAR and energy level (power density) of emitted EMW 2. Heat dissipation which is dependent on heat conduction to other tissues, convection through blood perfusion, and radiation to the surroundings. Generally, the two most vulnerable organs to thermal effects are the eyes and testes because of limited capacity of heat dissipation. But the current safety guidelines have kept the SAR in check so that the produced heat is negligible(12).

Cell phone electromagnetic radiation related biological consequences is Nonthermal if the interactions doesn't produce heat or a measurable rise in temperature. This mainly because of the magnetic field, rather than the electrical field of the EMW. It is considered to have more harmful effects because of its ability to penetrate human body while electrical field has poor skin permeability. Non thermal effects can affect the human body at tissue, cellular and sub-cellular levels.

As of today, mobile phones are used at an enormous number by all the age groups. Particularly, the age group of 25–34 is found to have the highest mobile phone usage rate of 62%(14). According to Dagli et al It has been noted that an average person spends 90 minutes a day on their phone which is used not only for having conversations but also for accessing internet, pictures, and videos(15).

The effects on health by mobile radiations has a been subject of debate for a long time. The rapid growth in the number of cell phone users has raised questions about possible biological effects of the radiation emitted and there has been growing concern about the possible adverse health effects due to exposure to radiofrequency radiations from the mobile phones. Despite an extensive increase in mobile phones within last few years, very little is known about the effect of long-term exposure that is experienced by people using mobile phone or living near mobile phone base stations. In the past, several investigations have been conducted to evaluate the possible biological effects resulting from human exposure to mobile phone radiations. the most widely accepted mechanism of interaction between radiofrequency radiation and biological systems is based on tissue heating that occurs when tissue or total body temperature increases for more than 1°Celceus overloading cell thermoregulatory capacity leading to increased reactive oxygen species (ROS) that play a role in the biological effects leading to DNA damage(16,17).

After International Agency for Research on Cancer classifying the mobile phone radiation as possibly carcinogenic it attracted the interest of various researchers all over the globe. Hardell et al in the year 2008 conducted a meta-analysis on long-term mobile phone use and the association with brain tumours and concluded a consistent pattern of an association between mobile phone use and ipsilateral glioma and acoustic neuroma using ≥ 10 -years latency period(18). Also, a meta-analysis done by Bayazit. V et al it was asserted that there are significant effects of EMF on the cancer development. In addition, more comprehensive future investigations are required to determine definite effects of EMF on human diseases(19).

Contrastingly Rööslı et al performed a systematic review with meta-analysis and concluded that the evidence available from various studies included in his review did not indicate an association between Mobile Phone use and tumours development(20). The author also suggested

that any potentially undetected risk is expected to be small from an individual perspective and might concern long latency periods (>15 years), rare brain tumour subtypes, and Mobile Phone usage during childhood and has recommended furthermore quality research on the topic.

Several studies have denoted the detriment effect of mobile phone radiation towards the male reproductive system. Leaky plasma membranes, calcium depletion and oxidative stress are the postulated cellular mechanisms mediating the harmful effects of cell phones radiation on sperm and male fertility potentials.

A meta-analysis done by Gang Yu et al stated that in East Europe and West Asia, mobile phone use is associated with a decline in human sperm density and motility(21). Similarly, Rago et al. found significantly altered sperm DNA fragmentation in subjects who use mobile phones for more than 4 h/day and in particular those who place the device in the trousers pocket(22).

But a systematic review done by J. Hamada et concluded that a significant correlation cannot be obtained between mobile phone radiations and male fertility(8).

There are certain literature that state that mobile phone radiation causes Fluctuations in electroencephalograph (EEG) pattern, sleep pattern and neuroendocrine functions along with decreased cognitive function and melatonin secretion(23,24).

It is clear from the above group of studies that there is a definitive risk to human health because of mobile phones. The awareness towards mobile phone emitted electromagnetic radiation is of paramount importance to prevent health risks and possible negative health disorders. But sadly, the literature that number of studies among otolaryngologists is scarce and , awareness generation is essential to increase the risk perceptions on a topic.

Aims & Objectives

The aim of the survey is to assess the awareness of mobile phone radiation and its harmful effects to the body and the mobile phone usage trend among Otorhinolaryngologists from India.

Material & Methods

The present survey aimed to obtain baseline data of cell phone usage and its radiation awareness among a relatively homogenous cohort of Otorhinolaryngologists from India as mostly they deal with the patients having hearing loss/problems. This is a cross sectional online survey assessing awareness on Mobile Phone radiations through a custom-made questionnaire devised by the authors which consisted of four parts: 1. Demographic details, 2. Mobile phone usage trend, 3. Knowledge on mobile phone radiation 4. Awareness towards health hazards produced by mobile phone radiation. The questionnaire had 35 items to be filled in by the respondents represented as [Table 1](#). Questions 1-9 dealt

with the demographic details of the respondents. Questions 10-14 enquired about the mobile phone usage patterns of the respondents. Questions 15-24 assessed knowledge on mobile phone radiation and Questions 25-35 assess the awareness towards health hazards produced by mobile phone radiation. For knowledge and awareness, <5 or 5 was considered as poor score, 6-7 was considered average/borderline score and 8-9 was considered as good score. After formation of the questionnaire pretesting of the questionnaire was done and appropriate corrections were made. The target population was fixed as practicing Otorhinolaryngologists who are members of Association of Otorhinolaryngologists of India (AOI) all over the country. The survey was a close ended survey, and the respondents were at times contacted randomly to be a part of the survey. No advertisement or flyer as such was used for the survey. The questionnaire was in the format of a google form which doesn't allow inadvertent tampering, editing or sequence change of the questions by the respondents. Questions were mostly multiple-choice pattern with three options at most. The questionnaire was sent as an email, WhatsApp link to the respondents between March 2021-November 2021. Sometimes the respondents were randomly contacted telephonically using random numbers created for the research purpose and were asked to participate in the survey. The personnel information of the respondents like mobile number and email ID were withheld and concealed from public as the access to the forms were not given to anyone else but authors. The respondents were not given a review step to review and recorrect their answers. Repeat responses from the same respondents that occurred was excluded. All data were collected prospectively and analysed with SPSS version 21. (IBM SPSS Statistics). Data from incomplete questionnaire responses were not included and the questionnaires dated after DEC 1, 2021, was not taken into consideration. The data collected through the questionnaire was scrutinized and represented using descriptive statistics by means of central tendencies while weighting and propensity matching were not used. We included otorhinolaryngologists who were willing to participate in the survey and who are the Members of AOI (Association of Otorhinolaryngologists of India). We excluded, Junior residents and doctors without a post graduate ENT degree. An attempt was made to correlate the continuous variables of Age, awareness scores and mobile phone exposure. IBM SPSS statistical software version 21 was used for analyzation of the data. The correlation was done using pearson's coefficient and the analysis revealed there was no correlation among Age and awareness scores with a P value of 0.018. The correlations between Mobile phone exposures and awareness scores were statistically not significant ($p < 0.005$).

Results

The total number (n) of otorhinolaryngologists to whom the questionnaire was sent was 6336 of which 259 of them responded which formed the sample size of our study. Thus, the response rate of the survey is 4%.

A total of 259 Otorhinolaryngologists participated in the study. The mean age of the population involved in the survey is 41.78 ± 10.32 years. Among them 161 was male and 98 were female. There were 172 private and 87 government ENT practitioners in the survey. MS otorhinolaryngology was the most common qualification of the study with 223 doctors having the degree, 20 had DNB and 7 of them have completed Diploma in Otorhinolaryngology. The mean years of medical practice after postgraduation of the Otorhinolaryngologists participating in the questionnaire is 13.53 ± 7.38 years. The major contributors for the survey were private ENT consultants with a count of 110, followed by Senior Residents 58, Assistant Professor 39, Professor 29, Associate professor 10, Additional professor 13.

It was evident from the questionnaire that 242 of the respondents were right-handed and 204 of the study population used their right ear for talking over the phone, it was also cross checked by giving a miss call to them in the close vicinity. The mean years of exposure to mobile phone usage by the Otorhinolaryngologists is 15.01 ± 5.75 . A maximum of 153 surgeons were using mobile phones for 11-20 yrs. The average hours of daily mobile phone usage were 373 ± 4.69 minutes. A highest of 101 Otorhinolaryngologists using the mobile phones for >4 Hrs. Surprisingly through the questionnaire we came to know that a total 60 doctors among the 250 uses the phone daily for an average of more than 10 Hrs, which is 24% of the study population surveyed.

The questions 15-24 were purposed to bring of the awareness knowledge of the respondents towards electromagnetic radiation of the cellular phones and it can be arbitrarily said that a score of 5 or more means that the person is aware. The average of the correct responses to each of the 10 questions given by the ENT practitioners is 5.97 ± 1.66 . Similarly, the questions 25 to 35 assess the awareness towards health hazards produced by mobile phone radiation. The mean correct response of the Otorhinolaryngologists is 6.30 ± 1.87 .

Discussion

The present study was conducted in the motive of getting to know the awareness of Otorhinolaryngologists towards mobile phone radiation and health hazards produced by it. A total of 259 otorhinolaryngologists participated in the study. The state wise distribution of the participants is as shown in Table 5. Tamil Nādu, Maharashtra, West Bengal were the major contributors for the survey, Tamil Nādu being the highest with 83 otorhinolaryngologists participating. The mean awareness score on mobile phone radiation as found by the study is 5.97 ± 1.650 as given in

Table 1. The mean Awareness score on health hazards produced due to Mobile phone radiation as shown in Table 2. is 6.30 ± 1.868 . Thus, the study reveals that otorhinolaryngologists were aware of the mobile phone radiations and had a better knowledge on the hazards produced by the mobile phone radiation.

On further scrutinizing the data gathered a state wise mean scores of awareness on mobile phone radiation and health hazards produced by the same were obtained as given in Table 5. Tamil Nādu had the highest score of 6.39 & 6.35, followed by Andhra Pradesh 6.00 & 6.82, Gujarat 5.18 & 6.00, Kerala 5.79 & 5.93, Maharashtra 5.78 & 6.35, West Bengal 5.58 & 5.50 and Karnataka 5.44 & 6.81 respectively. To put it zonally we can say that the data attained through the current study implies that southern states of India has scored higher mean. Whether the awareness is better compared to other states of India is a debate for future. The mean years of mobile phone exposure of the Otorhinolaryngologists included in the study is 15.01 ± 5.09 years., as given in Table 3. That shows that even a professional like surgeon is heavily exposed to mobile phone radiations. Hardel et al states that mobile phone radiation exposure of >10 years could be a risk factor for Brain tumours like glioma and vestibular schwannoma(18). Thus, denoting that the Otorhinolaryngologists are placed at risk for developing health hazards because of the mobile phone radiations. A state wise mobile exposure was also retrieved from the data available as given by Table 5. Showing that Rajasthan had the lowest mean of 9.67 yrs. Bihar had the highest exposure of 20 yrs. Even the lowest scoring state is at a considerable risk. The daily mobile phone usage of the Otorhinolaryngologists was also retrieved and found to have a mean of 373.01 Minutes i.e, 6hrs and 21minutes roughly as shown in Table 4. This could be an indicator of a probable addictive behaviour exhibited by the Otolaryngologist. The state wise categorization of the data shows that Pondicherry has the maximum mobile phone daily usage of 690 minutes which is 11 hrs & 5 Mins. Followed by Uttarakhand as the least mobile phone daily usage of 90 minutes as demonstrated in Table 5.

Conclusion

It was evident from our survey that the otolaryngologist had an average/borderline awareness towards mobile phones emitted radiations and its deleterious effects on the body, which is to be improved in the future so that we can be aware and make people around us aware

Recommendation

Furthermore, research in the topic is always warranted to ascertain a definitive causal relation between mobile phones and health abnormalities till then a precautionary approach towards mobile phones is recommended. The authors recommend that mobile phone users to strictly adhere to the national safety guidelines for mobile phones and discourage younger people from prolonged mobile

phone usage. It was also found out in the study that age is a confounding factor for mobile phone radiation exposure increase in age increases mobile phone radiation exposure.

Limitation of the study

The response rate for a questionnaire type of studies is always dull and our study also faced with the same hurdle of getting through to the participants. A total sample of 6336 was chosen and emails and wats app messages were sent several times over a period of 3 months to obtain a response Of 259 (4%). Questionnaire based studies are still undervalued and responded in an era as modern as today.

Authors Contribution

Study conception and design-PA, SV, SA, Draft writing-KSBS, PA, PG Final editing-SB

Acknowledgement

The authors would like to thank all the authors of those books, articles, and journals that were referred in preparing this manuscript.

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Tables

TABLE1: AWARENESS SCORES ON MOBILE PHONE RADIATION

N		259	
Mean		5.79	
Std. Deviation		1.650	
Marks attained	Frequency	Percent	
0	1	0.4	
1	2	0.8	
2	2	0.8	
3	10	3.9	
4	33	12.7	
5	53	20.5	
6	55	21.2	
7	54	20.8	
8	37	14.3	
9	12	4.6	
Total	259	100	

TABLE2: AWARENESS SCORE ON HEALTH HAZARDS PRODUCED DUE TO MOBILE PHONE RADIATION

N		259	
Mean		6.3	
Std. Deviation		1.868	
Marks	Frequency	Percent	
0	3	1.2	
1	2	0.8	
2	5	1.9	
3	8	3.1	
4	26	10.0	
5	31	12.0	
6	51	19.7	
7	56	21.6	
8	54	20.8	
9	23	8.9	
Total	259	100.0	

TABLE 3 EXPOSURE TO MOBILE PHONE RADIATION IN YEARS.

N		259	
Mean		15.01	
Std. Deviation		5.094	

TABLE 4 MOBILE PHONE USAGE PER DAY IN MINUTES

N		259	
Mean		373.01	
Std. Deviation		385.033	
Correlations: Age & awareness on mobile phone radiation		Age	Awareness on mobile phone radiation
Age	Pearson Correlation	1	-0.147
	Significance		0.018
	N	259	259
Awareness on mobile phone radiation	Pearson Correlation	-0.147	1
	Significance	0.018	
	N	259	259
Correlations: Age & Awareness on mobile phone radiation and health hazards		Age	Awareness on mobile phone radiation and health hazards
Age	Pearson Correlation	1	-0.008
	Significance		0.9
	N	259	259
Awareness on mobile phone radiation and health hazards	Pearson Correlation	-0.008	1
	Significance	0.9	
	N	259	259
Correlation: Awareness scores		Awareness on mobile phone radiation and health hazards	Awareness on mobile phone radiation
Awareness on mobile phone radiation and health hazards	Pearson Correlation	1	0.299
	Significance		0
	N	259	259
Awareness on mobile phone radiation	Pearson Correlation	0.299	1
	Significance	0	
	N	259	259

TABLE 5: DENOTING THE PARTICIPATION OF OTORHINOLARYNGOLOGISTS FROM VARIOUS STATES

State	Frequency	Percent	Mean mobile phone radiation awareness score	Mean awareness score on health hazards due to mobile phone	Mean mobile phone exposure in (Years)	Mean (minutes) of mobile phone usage per day
Andaman & Nicobar Islands	1	0.4	6	7	18	240
Andhra Pradesh	11	4.2	6	6.82	15.18	345.45
Bihar	1	0.4	6	7	20	120
Chhattisgarh	6	2.3	5.5	6	12.83	145
Delhi	8	3.1	5	5.75	16.13	159.38
Goa	1	0.4	7	7	10	180
Gujarat	11	4.2	5.18	6	15.82	126.36
Haryana	3	1.2	5.33	6.67	17	90
Jammu & Kashmir	2	0.8	6.5	4.5	13.5	300
Jharkhand	3	1.2	7	7.67	14.33	200
Karnataka	16	6.2	5.44	6.81	15.75	129.69
Kerala	14	5.4	5.79	5.93	13.43	311.43
Madhya Pradesh	5	1.9	6.6	5.6	15.6	216
Maharashtra	37	14.3	5.78	6.35	14.73	177.57
Mumbai	1	0.4	4	8	15	160
Odisha	5	1.9	7.2	7	16.8	192
Pondicherry	6	2.3	6.33	7	14.5	690
Punjab	2	0.8	5	8	17.5	225
Rajasthan	3	1.2	3.67	6	9.67	160
Tamilnadu	83	32	6.39	6.35	13.72	605.42
Telangana	4	1.5	6	6.25	15.5	105
Tripura	1	0.4	7	7	18	60
Uttar Pradesh	9	3.5	6.22	6.33	16.89	132.22
Uttarakhand	2	0.8	7.5	7	19.5	75
West Bengal	24	9.3	5.58	5.5	18.67	621.67
Total	259	100	5.97	6.3	15.01	373.01

Figures

FIGURE 1 SHOWING GENDER DISTRIBUTION

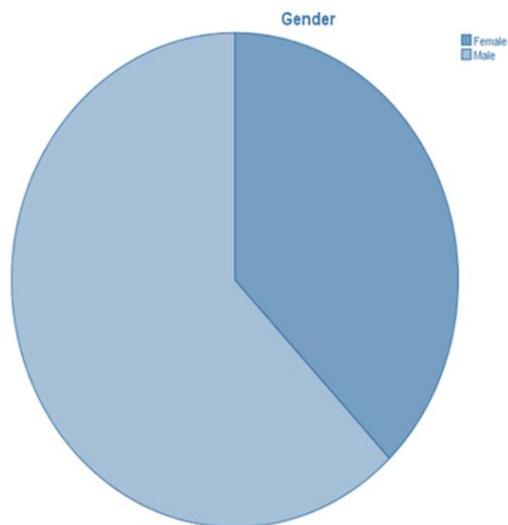


FIGURE 2 SHOWING THE DISTRIBUTION OF STATE

