INTRODUCTION

Mobile/hand phones are powerful communication devices, first demonstrated by Motorola in 1973, and made commercially available from 1984.[1] In the last few years, hand phones have become an integral part of our lives. The number of mobile cellular subscriptions is constantly increasing every year. In 2016, there were more than seven billion users worldwide. The percentage of internet usage also increased globally 7-fold from 6.5% to 43% between 2000 and 2015. The percentage of households with internet access also increased from 18% in 2005 to 46% in 2015.[2]

Parlay, the addiction behavior to mobile phone is also increasing. In 2012, new Time Mobility Poll reported that 84% people “couldn’t go a single day without their mobile devices.”[3] Around 206 published survey reports suggest that 50% of teens and 27% of parents feel that they are addicted to mobiles.[4] The recent studies also reported the increase of mobile phone dependence, and this could increase internet addiction.[3] Overusage of mobile phones may cause psychological illness such as dry eyes, computer vision syndrome, weakness of thumb and wrist, neck pain and rigidity, increased frequency of De Quervain's tenosynovitis, tactile hallucinations, nomophobia,
insecurity, delusions, auditory sleep disturbances, insomnia, hallucinations, lower self-confidence, and mobile phone addiction disorders. In animals, chronic exposure to Wi-Fi radiation caused behavioral alterations, liver enzyme impairment, pyknotic nucleus, and apoptosis in brain cortex. Kesari et al. concluded that the mobile phone radiation may increase the reactive oxygen species, which plays an important role in the development of metabolic and neurodegenerative diseases.

In recent years, most of the global populations (especially college and university students), use smartphones, due to its wide range of applications. While beneficial in numerous ways, smartphones have disadvantages such as reduction in work efficacy, personal attention social nuisance, and psychological addiction. Currently, the addiction to smartphones among students is 24.8%–27.8%, and it is progressively increasing every year. Mobile phone is becoming an integral part to students with regard to managing critical situations and maintaining social relationships. This behavior may reduce thinking capabilities, affect cognitive functions, and induce dependency. The signs of smartphone addiction are constantly checking the phone for no reason, feeling anxious or restless without the phone, waking up in the middle of the night to check the mobile and communication updates, delay in professional performance as a result of prolonged phone activities, and distracted with smartphone applications.

Mobile phone is the most dominant portal of information and communication technology. A mental impairment resulting from modern technology has come to the attention of sociologists, psychologists, and scholars of education on mobile addiction. Mobile phone addiction and withdrawal from mobile network may increase anger, tension, depression, irritability, and restlessness which may alter the physiological behavior and reduce work efficacy. Hence, the present study was planned to study the addiction behavior of mobile phone usage using an online survey.

METHODS

This study was approved by Human and Animal Ethics Committee of AIMST University (AUHAEC/FOP/2016/05) and conducted according to the Declaration of Helsinki. The study was conducted among a sample of Malaysian adults. The study participants were invited through personal communications to fill the online survey form. The study was conducted between December 2015 and 2016. The study instrument comprised eight segments, namely, informed consent information, consent acceptance page, demographic details, habituation, mobile phone fact and electromagnetic radiation (EMR) details, mobile phone awareness education, psychomotor (anxious behavior) analysis, and health issues. If any of the participants were not willing to continue in the study, they could decline as per their discretion.

Totally, 450 participants were informed about the study and 409 participated in the study. The demographic details of the study participants are summarized in Table 1. The incomplete forms were excluded from the study. The participants’ details were maintained confidentially.

Statistical analysis
Frequency of the data was calculated and the data were analyzed using two-sided Chi-square test with Yate’s continuity correction.

RESULTS

Totally, 409 individuals participated in the study, of which 42.3% were males and 57.7% were females, between the age group of 18 and 55 years. Nearly 75.6% of the respondents were between the age group of 21 and 25 years. The mean age of the study participants was 22.88 (standard error = 0.24) years. The study participants’ demographic details are summarized in Table 1.

About 95% of the study participants were using smartphones, with 81.7% of them having at least one mobile phone. Most of the study participants used mobile phone for more than 5 years. Around 64.3% of the study participants use mobile phone for an hour (approximately) and remaining use it for more than an hour. Nearly 36.7% of the study participants have the habit of checking mobile phones in between sleep, while 27.1% felt inconvenience with mobile phone use. Majority of the respondents were using mobile phone for communication purposes (87.8%), photo shooting (59.7%), entertainment (58.2%), and educational/academic purposes (43.8%). Habits of mobile phone usage among the study participants are summarized in Table 2.

The study results indicate that 86.8% of the participants are aware about EMR and 82.6% of the study participants are aware about the dangers of EMR. The prolonged use/exposure to EMR may cause De Quervain’s syndrome, pain on wrist and hand, and ear discomfort. Among the study participants, 46.2% were having awareness on De Quervain’s syndrome, 53.8% were feeling ear discomfort, and 25.9% were having mild-to-moderate wrist/hand pain. Almost 34.5% of the study participants felt pain in the
wrist or at the back of the neck while utilizing smartphones [Table 3a]. Many of the study participants also agreed that mobile phone usage causes fatigue (12% agreed; 67.5% strongly agreed), sleep disturbance (16.9% agreed; 57.7% strongly agreed), and psychological disturbance (10.8% agreed; 54.8% strongly agreed) [Table 3b]. The study participants were having level 6 of awareness on mobile phone usage and EMR.

The behavioral analysis of the smartphone usage revealed that 70.4% of the study participants use smartphone longer than intended and 66.5% of the study participants are engaged for longer duration with smartphone. Nearly 57.7% of the study participants exercise control using their phones only for specific important functions. More number of study participants (58.2%) felt uncomfortable without mobile and were not able to withstand not having a smartphone, feeling discomfort with running out of battery (73.8%), felt anxious if not browsing through their favorite smartphone application (41.1%), and 50.4% of the study participants declared that they would never quit using smartphones even though their daily lifestyles were being affected by it. The study also revealed another important finding that 74.3% of smartphone users are feeling dependency on the use of smartphone. The addiction behavior analysis data of mobile phone are summarized in Table 4.

The study results also suggest that female participants were having more awareness than male participants ($P < 0.001$) [Table 5a] and were more dependent on smartphones than male participants ($P < 0.05$) [Table 5b]. Female participants were ready to quit using smartphones, if it affected daily lifestyle compared with male participants ($P < 0.05$) [Table 5b]. Habituation of mobile phone use and addiction behavior were compared between both genders of the study participants and are summarized in Table 5a and b, respectively.

A total of 297 participants were having accommodation in hostel, among them 39.6% of the study participants checked their mobile phone on an average of 21–30 times, a day, and 11.7% of the study participants checked their mobile phone more than 30 times a day. A total of 112 participants have accommodation in home, among them

### Table 1: Demographic details of the study participants

| Particulars                  | Number of participants (%) |
|------------------------------|----------------------------|
| Number of participants enrolled | 450                        |
| Number of participants participated | 409                        |
| Male                         | 173 (42.3)                 |
| Female                       | 236 (57.7)                 |
| Age group (years)            |                            |
| <20                          | 60 (14.7)                  |
| 21-25                        | 309 (75.6)                 |
| 26-30                        | 17 (4.2)                   |
| 31-35                        | 9 (2.2)                    |
| 36-40                        | 6 (1.5)                    |
| 41-45                        | 3 (0.7)                    |
| 46-50                        | 2 (0.5)                    |
| >51                          | 3 (0.7)                    |
| Academic qualification       |                            |
| Primary school education     | 1 (0.2)                    |
| Secondary school education   | 74 (18.1)                  |
| Graduate (undergraduate degree) | 315 (77.0)                |
| Graduate (postgraduate degree) | 19 (4.6)                  |
| Occupation                   |                            |
| Student                      | 335 (81.9)                 |
| Working (graduate)           | 60 (14.7)                  |
| Working (nongraduate)        | 14 (3.4)                   |
| Accommodation                |                            |
| Home                         | 112 (27.4)                 |
| Hostel                       | 297 (72.6)                 |

### Table 2: Habituation analysis of mobile phone usage

| Habitation                                | Number of participants (%) |
|-------------------------------------------|----------------------------|
| Type of mobile phone usage                |                            |
| Smartphone                                | 390 (95.4)                 |
| Normal/basic phone                        | 2 (0.5)                    |
| Both smartphone and normal/basic phone    | 17 (4.2)                   |
| Number of cell phones used by the study participants |
| 1                                         | 334 (81.7)                 |
| >1                                        | 75 (18.3)                  |
| Number of years of mobile phone usage by study participants (years) |
| <5                                        | 59 (14.4)                  |
| 6–10                                      | 263 (64.3)                 |
| 10–15                                     | 78 (19.1)                  |
| 15–20                                     | 9 (2.2)                    |
| Duration of mobile usage per day (h)      |                            |
| 0–10                                      | 105 (25.7)                 |
| 11–20                                     | 104 (25.4)                 |
| 21–30                                     | 150 (36.7)                 |
| >30                                       | 50 (12.2)                  |
| Frequency of mobile phone checking (times) |                            |
| 0–10                                      | 150 (36.7)                 |
| 11–20                                     | 150 (36.7)                 |
| 21–30                                     | 150 (36.7)                 |
| >30                                       | 50 (12.2)                  |
| Checking mobile phone in-between sleep    |                            |
| Yes                                       | 150 (36.7)                 |
| No                                        | 259 (36.3)                 |
| Feeling inconvenience                     |                            |
| Yes                                       | 111 (27.1)                 |
| No                                        | 298 (72.9)                 |
| Most frequently used application by study participants (multiple selections) |
| Communications                            | 359 (87.8)                 |
| Photo                                     | 244 (59.7)                 |
| Entertainments                            | 238 (58.2)                 |
| Media                                     | 236 (57.7)                 |
| Education                                 | 179 (43.8)                 |
| Game                                      | 154 (37.7)                 |
| Sports                                    | 74 (18.1)                  |
| Reading news and books                    | 4 (1.0)                    |
| Reminder and calendar                     | 1 (0.2)                    |
28.6% of the study participants checked their mobile phone 21–30 times a day, and 13.4% of the study participants checked their mobile phone more than 30 times a day.

A total of 66.1% of participants having accommodation in a home use their phones longer than intended, whereas 71.8% of participants having accommodation in hostel are using phone longer than intended. Forty-one (36.6%) and 109 (36.6%) participants from home and hotel checked mobile phone in-between sleep, respectively. About 67.9% of participants having accommodation in home felt dependent on mobile and it was the same for participants having accommodation in hostel (76.5%).

**DISCUSSION**

The study results suggest that a significant number of the participants had addiction to mobile phone usage, but were not aware of it, as mobile phones have become an integral part of life. No significant differences were found on addiction behavior between the participants residing in hostel and homes.

| Place of hand phone keeping          | Number of participants (%) |
|--------------------------------------|----------------------------|
| In the bag                            | 152 (37.2)                 |
| Around pelvic area                   | 250 (61.1)                 |
| Around your neck                     | 7 (1.7)                    |
| Awareness about EMR                  |                            |
| Yes                                  | 355 (86.8)                 |
| No                                   | 54 (13.2)                  |
| Awareness on danger of EMR           |                            |
| Yes                                  | 338 (82.6)                 |
| No                                   | 71 (17.4)                  |
| Awareness on De Quervain’s syndrome/texting thumb |                |
| Yes                                  | 189 (46.2)                 |
| No                                   | 50 (12.2)                  |
| No idea                              | 170 (41.6)                 |
| Feeling of any ear discomfort while using mobile phone |            |
| Yes                                  | 220 (53.8)                 |
| No                                   | 359 (87.8)                 |
| Having any pain on wrist and hand because of smartphone use |          |
| Yes                                  | 106 (25.9)                 |
| No                                   | 303 (74.1)                 |
| Feeling torment/pain in the wrists or at the back of the neck while utilizing a smartphone |          |
| Yes                                  | 141 (34.5)                 |
| No                                   | 268 (65.5)                 |

**Table 3a: Analysis of awareness of mobile phone hazards**

EMR: Electromagnetic radiation

Mobile phone abuse is rising as an important issue among the world population including physical problems such as eye problems, muscular pain, and psychological problem such as tactile and auditory delusions.[13] Along with mobile phone, availability of Wi-Fi facility in residence place and work premises also increases mobile phone dependence. The continuous and constant usage of mobile phone reduces intellectual capabilities and work efficacy. A study conducted in Chinese population (160 million out of the total 1.3 billion people) showed that people affected by mobile phone dependence have difficulty in focusing on work and are unsociable, eccentric, and use phones in spite of facing hazards or having knowledge of harmful effects of this form of electromagnetic pollution.[14]

The statement “I will never quit using my smartphone even though my daily lifestyles are affected by it” was statistically significant (P = 0.0229). This points to a trend of mobile phone addiction among the respondents. This finding was discussed by Salehan and Negahban. They stated that this trend is due to the fast growth in the use of online social networking services (SNS). Extensive use of technology can lead to addiction. The use of SNS mobile applications is a significant predictor of mobile addiction. Their result showed that the use of SNS mobile applications is affected by both SNS network size and SNS intensity of the user. It has implications for academia as well as governmental and non-for-profit organizations regarding the effect of mobile phones on individual’s and public health.[15] The health risks associated with mobile phones include increased chances of low self-esteem, anxiety or depression, bullying, eye strain and “digital or mobile phone thumb,” motor vehicle accidents, nosocomial infections, lack of sleep, brain tumors and low sperm counts, headache, hearing loss, expense, and dishonesty. The prevalence of cell phone dependence is unknown, but it is prevalent in all cultures and societies and is rapidly rising.[16] Relapse rate with mobile phone addiction is also high, which may also increase the health risk and affect cognitive function. Sahin et al. studied mobile phone addiction level and sleep quality in 576 university students and found that sleep quality worsens with increasing addiction level.[17]

The statement “Feeling dependent on the use of smartphone” was also statistically significant (P = 0.0373). This was also
explored by Richard et al. among 404 university students regarding their addiction to smartphones. Half of the respondents were overtly addicted to their phones, while one in five rated themselves totally dependent on their smartphones. Interestingly, higher number of participants felt more secure with their phones than without. Using their phones as an escapism was reported by more than half of the respondents.

This study revealed an important fact that people are not actually addicted to their smartphones per se; however, it is to the entertainment, information, and personal connections that majority of the respondents were addicted to.[18]

The 2015 statistical report from the British Chiropractic Association concluded that 45% of young people aged 16–24 years suffered with back pain. Long-term usage of smart phone may also cause incurable occipital neuralgia, anxiety and depression, nomophobia, stress, eyesight problem, hearing problems, and many other health issues.[19]

A study conducted among university students of Shahrekord, Iran, revealed that 21.49% of the participants were addicted to mobile phones, 17.30% participants had depressive disorder, 14.20% participants had obsessive-compulsive disorder, and 13.80% had interpersonal sensitivity.[12] Nearly 72% of South Korean children aged 11–12 years spend 5.4 h a day on mobile phones, 25% of those children were considered addicts to smartphones.[20] Thomée et al. collected data from 4156 adults aged between 20 and 24 years and observed no clear association between availability demands or being awakened at night and the mental health outcomes.[21] Overuse of mobile phone can lead to reduced quality of interpersonal relationships and lack of productivity in daily life. The study outcome from different studies showed variable results on addictive behavior on mobile phone usage. The fact is over-/long-time usage of mobile phone may cause behavioral alteration and induce addictive behavior.

CONCLUSION

This study suggests that most of the study participants are aware about mobile phone/radiation hazards and many of them developed dependent behavior

| Table 4: Addiction behavior analysis of mobile phone |
|-----------------------------------------------|
| Particulars | Number of participants (%) |
| Awareness on time spend in smartphone | 249 (60.88) 160 (39.12) |
| Utilization of smartphone longer than intended | 288 (70.4) 121 (29.6) |
| Finding too much of time are engaged with smartphone | 272 (66.5) 137 (33.5) |
| Having control on using phone on specific objectives | 236 (57.7) 173 (42.3) |
| Missing planned work because of smartphone use | 150 (36.7) 259 (63.3) |
| Feeling of missing normal social life using smartphone | 114 (27.9) 296 (72.1) |
| Experiencing difficulties in regular day-to-day life (such as problems in completing job assignments) | 129 (31.5) 280 (68.5) |
| Feeling impatient and fretful when not conserving smartphone | 196 (47.9) 213 (52.1) |
| Having my smartphone in my mind even when i am not using it | 120 (29.3) 289 (70.7) |
| Feeling discomfort when your smartphone is running out of battery | 302 (73.8) 107 (26.2) |
| Feeling anxious if you not check your favorite smartphone application | 168 (41.1) 241 (58.9) |
| I will never quit using my smartphone even though my daily lifestyles are affected by it | 206 (50.4) 203 (49.6) |
| Feeling dependent on the use of smartphone | 304 (74.3) 105 (25.7) |
| Having any health issues due to use of smartphone | 60 (14.7) 349 (85.3) |

| Table 5a: Comparison of habituation of mobile phone usage between genders |
|-----------------------------------------------|
| Particulars | Response | Male (%) | Female (%) | Level of significance |
| Checking mobile phone in-between sleep | Yes | 69 (39.9) 81 (34.3) | 0.2940 |
| | No | 104 (60.1) 155 (65.7) | |
| Feeling inconvenience | Yes | 53 (30.6) 58 (24.6) | 0.2117 |
| | No | 120 (69.4) 178 (75.4) | |
| Awareness about EMR | Yes | 140 (80.9) 215 (91.5) | 0.0043 |
| | No | 33 (19.1) 20 (8.5) | |
| Awareness on the danger of EMR | Yes | 140 (80.9) 198 (83.9) | 0.5143 |
| | No | 33 (19.1) 38 (16.1) | |
| Awareness on De Quervain’s syndrome/texting thumb | Yes | 80 (46.2) 109 (46.2) | 0.9910 |
| | No | 93 (53.8) 127 (53.8) | |
| Feeling of any ear discomfort while using mobile phone | Yes | 23 (13.3) 27 (11.4) | 0.6798 |
| | No | 150 (86.7) 209 (88.6) | |
| Having any pain on wrist and hand because of smartphone use | Yes | 45 (26.0) 61 (25.8) | 0.9702 |
| | No | 128 (74.0) 175 (74.2) | |
| Feeling torment/pain in the wrists or at the back of the neck while utilizing a smartphone | Yes | 61 (35.3) 80 (33.9) | 0.8564 |
| | No | 112 (64.7) 156 (66.1) | |

All the values are numbers of responses, The data were analyzed using two-sided Chi-square test with Yate’s continuity correction.

EMR: Electromagnetic radiation
Table 5b: Comparison of addiction behavior between genders

| Particulars                                    | Response | Male (%) | Female (%) | Level of significance |
|-----------------------------------------------|----------|----------|------------|-----------------------|
| Awareness on time spend in smartphone        | Yes      | 101      | 148        | 0.4330                |
|                                               | No       | 72       | 88         |                       |
| Utilization of smartphone longer than intended | Yes      | 122      | 166        | 0.9684                |
|                                               | No       | 51       | 70         |                       |
| Finding too much of time are engaged with smartphone | Yes      | 108      | 164        | 0.1647                |
|                                               | No       | 65       | 72         |                       |
| Having control on using phone on specific objectives | Yes      | 99       | 137        | 0.9477                |
|                                               | No       | 74       | 99         |                       |
| Missing planned work because of smartphone use | Yes      | 56       | 94         | 0.1491                |
|                                               | No       | 117      | 142        |                       |
| Feeling of missing normal social life using smartphone | Yes      | 48       | 66         | 0.9608                |
|                                               | No       | 125      | 170        |                       |
| Experiencing difficulties in regular day-to-day life | Yes      | 56       | 73         | 0.8404                |
|                                               | No       | 117      | 163        |                       |
| Won't be able to withstand of not having a smartphone | Yes      | 101      | 137        | 0.9466                |
|                                               | No       | 72       | 99         |                       |
| Feeling impatient and fretful when not conserving smartphone | Yes      | 89       | 107        | 0.2623                |
|                                               | No       | 84       | 129        |                       |
| Having my smartphone in my mind even when I am not using it | Yes      | 57       | 63         | 0.2069                |
|                                               | No       | 116      | 173        |                       |
| Feeling discomfort when your smartphone is running out of battery | Yes      | 125      | 177        | 0.2069                |
|                                               | No       | 48       | 59         |                       |
| Feeling anxious if you not check your favorite smartphone application | Yes      | 79       | 89         | 0.1302                |
|                                               | No       | 94       | 147        |                       |
| I will never quit using my smartphone even though my daily lifestyles are affected by it | Yes      | 99       | 107        | 0.0229                |
|                                               | No       | 74       | 129        |                       |
| Feeling dependent on the use of smartphone    | Yes      | 119      | 185        | 0.0373                |
|                                               | No       | 54       | 51         |                       |
| Having any health issues due to the use of smartphone | Yes      | 28       | 32         | 0.5485                |
|                                               | No       | 145      | 204        |                       |

All the values are numbers of responses. The data were analyzed using two-sided Chi-square test with Yate’s continuity correction

**Limitations**

- Cluster sampling from a wider population base could have provided a more clear idea regarding the topic of interest
- Increasing the time frame and number of study phases was not possible due to logistical issues
- Impact of smartphone addiction on sleep pattern could have been studied in-depth.

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**Conflicts of interest**

There are no conflicts of interest.

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