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Prevalence of Musculoskeletal Disorders (MSD) and Smartphone Addictions Among University Students in Malaysia

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Abstract---University students in Malaysia were identified as a high-risked population for smartphone addiction. It was proved that repetitive movements when using a smartphone will eventually lead to musculoskeletal disorders (MSD). The main objectives of this study were to assess the level of smartphone addictions and the presence of MSD among university students in Malaysia. Moreover, this study tried to explore the association between the two objectives above. Two hundred and twenty-six (n=226) university students in Malaysia aged 17-35 years old participated in this study through convenience sampling. Participants were asked to complete a set of self-reported questionnaires via online. The data were analysed by using descriptive analysis and inferential analysis (Spearman correlation test). About 82.3% (n=186) of participants reported the presence of MSD symptoms in at least one body part and neck has the highest prevalence of MSD, 65.9% (n=149). Moreover, the study also found that 73.5% (n=166) of participants were at risk of having smartphone addiction. After analysis, the presence of MSD in 17 body parts showed significant positive association ($p < 0.05$) with smartphone addiction. However, all of them had a low correlation score ($r < 0.18$). The high prevalence of smartphone addiction among university students is alarmed in the study.

Keywords---MSD, musculoskeletal disorders, smartphone addiction, university students.

Introduction

According to a survey done by the Malaysian Communications and Multimedia Commission (2018), the number of smartphone users increased to 76.4% in 2018 and 95% of Malaysians with tertiary education level are adopted at least a smartphone. Milenkovic (2020) found that people spent 4.5 hours daily on their phone throughout the day, and the time on smartphones increased even more on weekends. Besides the long duration, users are constantly performing tasks within a small phone screen with a combination of repetitive movements at last leads to musculoskeletal disorders (MSD) day by day (Damodaran et al., 2019; Korhan & Elghomati, 2019). Fatigue and pain are the common symptoms of MSD that are indicated by smartphone users due to the presence of static and repetitive motion which leads to reduced blood circulation and also prevents nutrients from being supplied to muscles (Kim & Kim, 2015). Moreover, previous study found that 77.66% of the study population who was a smartphone user had experienced at least a kind of musculoskeletal symptoms in their body parts (Tantawy et al., 2017).

The prolonged use of smartphones not only causes physical dysfunction; it also affects one's mental health which results in addiction towards smartphones. The excessive pattern of smartphone use was found among the younger generation who mostly tried to login into their social accounts (Enez Darcin et al., 2015). This had brought out a phenomenon of "Smartphone Addiction". Although there is still

no established diagnostic criterion for smartphone addiction in Diagnostic and Statistical Manual of Mental Disorders, 5th Edition (DSM-5), but there is other non-substances related addiction diagnosis like "Internet Gaming Disorder" (Ching et al., 2015; Azlina Wati et al., 2018). This kind of addictions are mainly described by excessive or poorly controlled preoccupation, needs or behaviours regarding smartphone use, to the extent that individuals neglect other areas of life (Ching et al., 2015). A few previous research articles also revealed that students in three different public universities in Malaysia were at high risk to develop smartphone addiction (Azlina Wati et al., 2018; Ithnain et al., 2018; Lei et al., 2020). Hence, this can clearly show the severity of smartphone addiction among Malaysian especially among the young adults and it is needed to acquire extra research on this topic.

Most of the previous articles concentrated on smartphone-addicted university students with psychosocial concerns, such as anxiety, depression, psychological distress and loneliness as well as the effects on their academic results (Suki, 2013; Wong et al., 2015; Samaha & Hawi, 2016; Elhai et al., 2017; Ithnain et al., 2018; Lei et al., 2020). Recently, researchers started to investigate about the association between MSD with smartphone addiction globally (Sharan et al., 2014; İnal et al., 2015; Balakrishnan et al., 2016; Y. Xie, Szeto, & Dai, 2016; Qasim et al., 2017; Eitivipart et al., 2018; Namwongsa et al., 2018; Shah & Sheth, 2018; Baabdullah et al., 2020). However, there was still limited studies done about addiction among Malaysian's smartphone users with physical disability such as MSD. Back in 2016, a study showed 72.5% of students in a private university admitted they suffered from at least mild pain at the upper limb due to usage of handheld devices (Balakrishnan et al., 2016). The limitation of the study is that it was done in a small scale which focused on an institution's students only. Hence, a bigger sample size is chosen for this study to have a better look at MSD and smartphone addiction among Malaysia's university students as well as their association. Therefore, the general aim of this study was to investigate the level of smartphone addictions and the presence of MSD among university students in Malaysia. Besides, this study also attempts to determine the association between the risks of smartphone addiction with the prevalence of MSD among university students in Malaysia.

Methodology

This study is a cross-sectional study which investigated the prevalence of both MSD and smartphone addiction among university students in Malaysia as well as the association between risk of smartphone addiction and the presence of symptoms related to MSD among university students using convenience sampling. This study received 331 samples (n=311) at the end of data collection. One hundred and five participants' (n=105) questionnaires were rejected due to incomplete answers. So the total number of samples of this study is 226 (n=226).

The data was collected via Google Form, where a set of questionnaires consisting of 3 sections was disseminated through social network platforms. The collected data through the questionnaire consists of a total of three sections:

- Demographic data.
- Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) and Cornell Hand Discomfort Questionnaire (CHDQ) used for measuring the presence of MSD's symptoms at body parts and hands.
- Smartphone Addiction Scale (SAS), used to distinguish the level of risk for smartphone addiction among the users.

All the data obtained from the online self-report questionnaires was analysed by using SPSS (Statistic Program for Window Package Version 26.0). Data was analysed by using descriptive and inferential analysis. The outcome from Section 1 of the questionnaire which was Demographic Data was illustrated in percentage and table. Furthermore, the prevalence of MSD for each body region based on CMDQ & CHDQ was calculated by using a scoring method by simply counting the number of symptoms per person and presented in the bar graph and the total prevalence of MSD is shown in a pie chart. Moreover, the level of addiction score from the SAS questionnaire was calculated in the cut-off point of 98. The higher the score indicates the higher risk of being smartphone-addicted and the result is portrayed into a pie chart.

The non-parametric test was used in inferential analysis after the outcomes were shown smaller than 0.05 after normality test was done (Kolmogorov-Smirnov test). Level of confidence interval 95% and p-value 0.05 was set for analysing the data. The data for inferential analysis are shown in the tables. The Spearman correlation test was used to find associations between prevalence of MSD with psychosocial addiction towards smartphones. For this analysis, the calculation of score CMDQ and CHDQ was in a scoring number where each of the points will be multiplied. On the other hand, SAS scoring was calculated based on their total score.

This study was approved by Institutional Review Board (IRB) of Perdana University in order to protect rights and safeguard the welfare of human subjects. Besides, an online consent was provided to each participant before starting the questionnaires to ensure the participant understood the nature of research, be informed of the purpose, risk and benefits and alternative therapies. Nevertheless, only faculty members who were not directly involved in teaching the students or administration staff approached the students for recruitment.

Results

The age of the participants of this study ranged from 17-35 years old. Females constituted 77.40% of the participants (n=175) with a mean age of 21.5±2.3 years while the males formed 22.60% (n=51) with a mean age of 21.4±1.9 years. Forty-one point two percent of the participants (n=93) were studying in private universities and 66.40% (n=150) of the study population were undergraduate students as shown in Table 1.

Table 1
Summaries of demographic data

Variables	Frequency (n)	Percentage (%)
Age (years)		
17-21	124	54.9
22-26	95	42.0
27-31	6	2.70
32 and above	1	0.4
Gender		
Male	51	22.6
Female	175	77.4
Type of Institution		
Public University	55	24.3
Public Polytechnic	29	12.8
Private University	93	41.2
Private University College	28	12.4
Private College	21	9.3
Educational Level		
Pre-University Level	6	2.7
Diploma	53	23.5
Skill Certificated	5	2.2
Undergraduate	150	66.4
Postgraduate	12	5.3

Figure 1 showed the prevalence of MSD present in upper body parts. More than 60% of participants (n=149) claimed the presence of discomfort at their neck region. It is also the highest prevalence of MSD among all body parts. Left thigh region had the least complaints by the sty population, about 16.2% (n=43).

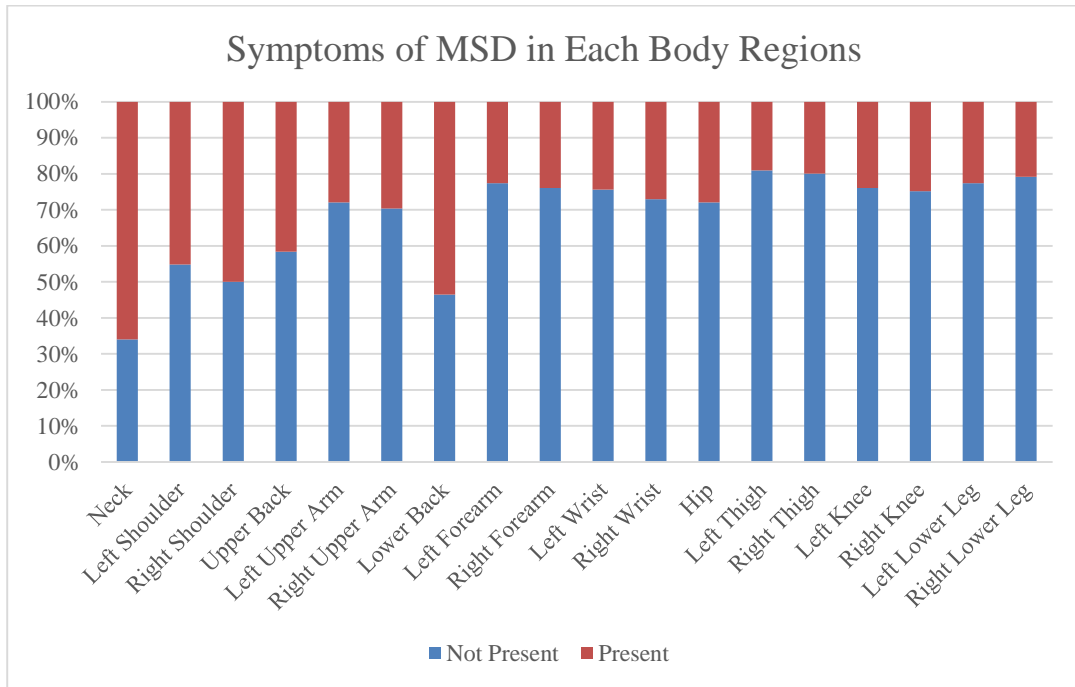


Figure 1. Prevalence of MSD in each body regions

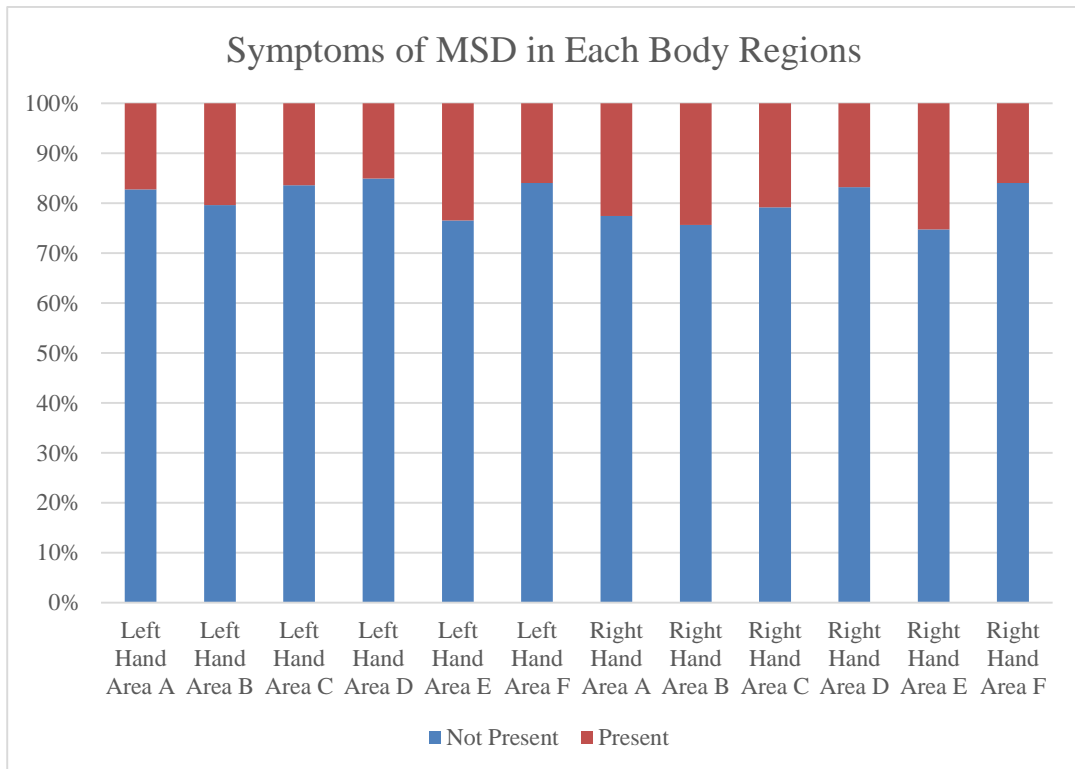


Figure 2. Prevalence of MSD in both hands regions

Of MSD among the hand region is the area E, the thenar eminence part of the right hand, 33.1% of participants (n=88) claimed discomfort in that area. In contrast, only 20.7% of participants (n=55) mentioned the presence of discomfort at left hand's area D.

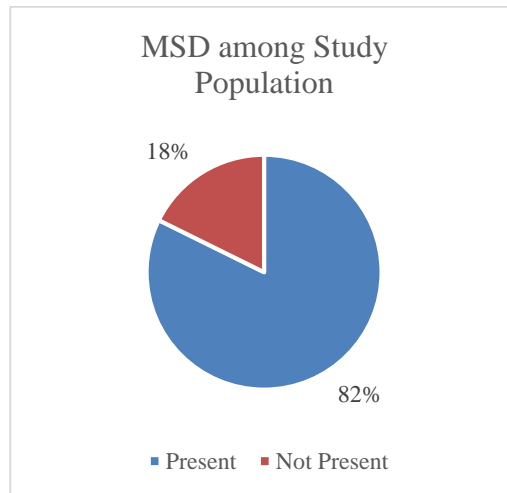


Figure 3. Prevalence of MSD among study population

As a summary, about 82.3% of participants (n=186) reported the presence of MSD symptoms in one or more body parts. Figure 4.3 is used to represent the data analysed in a pie chart.

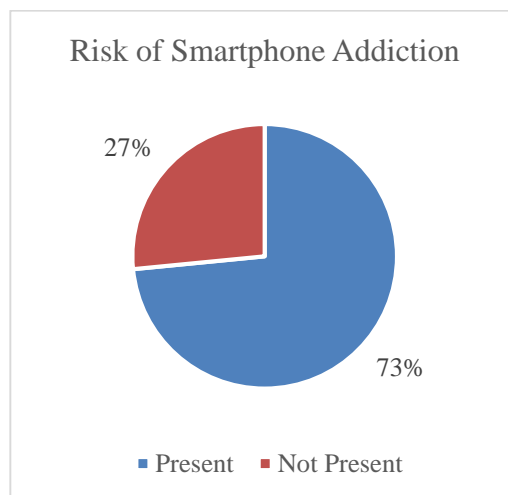


Figure 4. Prevalence of smartphone addiction

Based on the pie chart shown in Figure 4.4, 73.5% (n=166) of participants were at risk for smartphone addiction where their total score is above 98. Meanwhile only 27% (n=60) of them scored low on addiction. As a result of the non-parametric distribution of the data, the variables obtained were further analysed using Spearman's rho (r) correlations.

Table 2
The association of MSD at each body parts and smartphone addiction

Variables	Score of risk of smartphone addiction		
Score of CMDQ	Frequency (n)	p-value (p)	Spearman rho (r)
Neck*	226	0.035	0.140
Left Shoulder	226	0.062	0.124
Right Shoulder	226	0.110	0.107
Upper Back*	226	0.038	0.138
Left Upper Arm	226	0.187	0.088
Right Upper Arm	226	0.103	0.109
Lower Back	226	0.145	0.097
Left Forearm*	226	0.045	0.134
Right Forearm*	226	0.044	0.134
Left Wrist	226	0.060	0.125
Right Wrist	226	0.050	0.130
Hip	226	0.127	0.102
Left Thigh*	226	0.031	0.144
Right Thigh	226	0.055	0.128
Left Knee**	226	0.003	0.200
Right Knee**	226	0.008	0.176
Left Lower Leg*	226	0.043	0.135
Right Lower Leg	226	0.111	0.106
Score of CHDQ	Frequency (n)	p-value (p)	Spearman rho (r)
Left Hand			
Area A*	226	0.041	0.136
Area B	226	0.068	0.122
Area C**	226	0.008	0.177
Area D**	226	0.004	0.191
Area E*	226	0.044	0.134
Area F	226	0.090	0.113
Right Hand			
Area A**	226	0.005	0.188
Area B	226	0.102	0.109
Area C**	226	0.006	0.181
Area D*	226	0.010	0.170
Area E**	226	0.004	0.192
Area F**	226	0.002	0.208

The results in Table 2 showed the association between smartphone addiction and musculoskeletal discomfort. To analyse the significant association between smartphone addiction and musculoskeletal among Malaysia's university students, Spearman Rank Correlation (r) had been used. The result of Spearman Rank Correlation (see Table 4.2) showed that there is significant positive association between them, including neck ($r=0.140$, $p=0.035$), upper back ($r=0.138$, $p=0.038$), left forearm ($r=0.134$, $p=0.045$), right forearm ($r=0.134$, $p=0.045$), left thigh ($r=0.144$, $p=0.031$), left knee ($r=0.200$, $p=0.003$), right knee ($r=0.176$, $p=0.008$) and left lower limb ($r=0.135$, $p=0.043$). For left hand, Area A ($r=0.136$, $p=0.041$), Area C ($r=0.177$, $p=0.008$), Area D ($r=0.004$, $p=0.191$), Area E ($r=0.044$, $p=0.134$) show result significantly positive related while right hand Area A ($r=0.188$, $p=0.005$), Area C ($r=0.181$, $p=0.006$), Area D ($r=0.170$, $p=0.010$), Area E ($r=0.192$, $p=0.004$), Area F ($r=0.208$, $p=0.002$) also have significant result. However, the

correlations of MSD among each body region and smartphone addiction are weak (Pallant, 2011).

Discussion

Prevalence of MSD among Malaysia's university students

Based on the result obtained, this study found that there was higher number of MSD among the university students in Malaysia. This findings is also supported by other previous studies who investigated the similar study (Sharan et al., 2014; Balakrishnan et al., 2016; Xie, Szeto, & Dai, 2016; Tantawy et al., 2017; Namwongsa et al., 2018; Ahmed et al., 2019). According to Tantawy et al. (2017), the prevalence of MSD ranged from 32.90% to 89.30% globally and the prevalence obtained by this study, 82.30% also fell along this range. According to systematic review by Y. Xie, Szeto, & Dai (2016), the highest prevalence of musculoskeletal complaints was found in neck complaints. This is also supported by this study's result which having 65.9% of participants (n=149) claimed that they had discomfort at neck region.

Prevalence of smartphone addiction among Malaysia's university students

This study found that 73% of participants (n=166) were having risk in developing smartphone addiction. However, the prevalence of smartphone addiction was stated to be between 39% and 40% (Alhassan et al., 2018). Therefore, the risk of smartphone addiction among Malaysia's university students is identified as high. The high prevalence of emotional disorders among university students in Malaysia was reported by Ahmed Al-Naggar et al. (2012). The study by Ithnain et al. (2018) discovered the positive association between depression as well as anxiety and the present of risk of smartphone addiction. This again proved the link between university students with smartphone addiction.

The association between MSD and smartphone addiction among Malaysia's university students

This study has also proved that there is an association between the risk of smartphone addiction and MSD in certain body regions among university students in Malaysia. Previous studies found the main pathology of MSD is linked with the presence of physical risk factors, like repetitive movements and static posture (Balakrishnan et al., 2016; Santoshi et al., 2019). This can be related with the use of smartphones who required repetitive movements over the thumb and fingers as well prolonged static neck flexion (Eitivipart et al., 2018). Neck is a common body regions the researcher focused on when came to MSD related with problematic smartphone use and this study's result is also supporting previous findings (Xie, Szeto, & Dai, 2016; AlAbdulwahab et al., 2017; Eitivipart et al., 2018; Namwongsa et al., 2019). The frequent neck flexion performed during smartphone usage causes excessive stress on relative muscles and leads to MSD (Lee et al., 2015; Xie, Szeto, Dai, et al., 2016; Eitivipart et al., 2018). Upper trapezius, who had its origins at the seventh cervical vertebra (C7) level and the insertion at the acromion of the scapula were having highest muscle activity

during prolonged neck flexion (Lee et al., 2015). Hence this leads to fatigue and discomfort over the upper back which is supported by our study result.

According to a laboratory study by Gustafsson et al. (2018), the muscle activities at forearms should be lower when an individual is typing on touchscreen when compared to typing on keypad. However, this study found that smartphone users still suffered in left and right forearm discomfort, which may due to the increased of muscle activity (Eitivipart et al., 2018). Y. Xie, Szeto, Dai, et al. (2016) did a cross-sectional study and discovered that unilateral typing was associated with higher levels of muscle activity in the forearm region. Hence, this may be the main reason that participants developed pain in forearms. In addition, this study found a positive association between presence of discomfort at left thigh, left knee, right knee and left lower limb with smartphone addiction. Though this findings is contradictory to previous findings by H.-J. Kim & Kim (2015), who found that pain in legs and feet was negatively correlated with the amount of time spent on smartphones. Hence, more study should be done to investigate the factors that caused lower extremities discomfort among the smartphone users.

Based on the result obtained, shaded area A, discomfort in the thumb for both hands is associated with smartphone addiction and it is consistent with previous studies' findings (Xie, Szeto, Dai, et al., 2016; Shah & Sheth, 2018; Ahmed et al., 2019; Baabdullah et al., 2020). It is because most of the smartphone related tasks required repetitive movement of the thumb (Baabdullah et al., 2020). The persistent movement of thumb leads to an increased risk of damage to the thumb musculature (Xie, Szeto, & Dai, 2016; Qasim et al., 2017). Moreover, participants also claimed discomfort over the shaded area A and C are the thumb, index finger, middle finger and the lateral side of the ring finger. These areas are the palmar cutaneous branches of median nerve and discomfort like pain in these regions may indicate the early sign of carpal tunnel syndrome (Gupta & Benstead, 1997). Carpal tunnel syndrome is a kind of MSD resulting from the compression of the median nerve at the wrist area (Shim, 2012; Woo et al., 2016). Previous study also found that excessive use of smartphones triggered carpal tunnel syndrome (Rodriguez-García et al., 2020). Shim (2012) and Woo et al. (2016) revealed that the median nerve has significant changes in the carpal tunnel when users were using their smartphone, which also suggested the increased risk of carpal tunnel syndrome.

This study also found that there is a significant association between discomforts present in area E, thenar eminence of both hands with smartphone addiction. The thenar eminence consists of the abductor pollicis brevis, the opponens pollicis, and the adductor pollicis brevis muscles (Van Sint Jan & Rooze, 1992). According to a study by Y. Xie, Szeto, & Dai (2016), the activity level of abductor pollicis brevis was higher when texting bilaterally. It is because abductor pollicis brevis helped the thumb to abduct, rotate and opposite at carpometacarpal joints and these movements are essential when using a smartphone (Napier, 1952; Xie, Szeto, & Dai, 2016). Besides, discomfort in area F, hypothenar eminence of right hand also showed positively significant with smartphone addiction. The presence of hypothenar eminence pain rarely occurred among smartphone users when

compared to other hand regions (Lutomia, 2019). Hence, limited explanation found regarding this issue when relating it with smartphone usage.

Last but not least, area D of both hands is also significantly associated with smartphone addiction. The involved muscles are adductor pollicis, lumbricals, dorsal interossei and palmar interossei. Studies reported that tendonitis of adductor pollicis was associated with text messaging (Ahmed et al., 2019). Again, it is related to the repetitive movements of the thumbs. The dorsal interossei muscles are used for abduction of the fingers while the palmar interossei muscles functioned when adduction of the fingers (Salsbury, 1937). When compared to the thumbs, other fingers are often used as support when holding a smartphone. The static position when holding a smartphone caused the physical load on the joint to increase over time and end up leading to those symptoms of MSD (Eitivipart et al., 2018). This study suggested further investigation on the similar topic can be done with an enlarged and normally distributed sample population or explore through an interview method in order to have a better view of the whole population. Besides, further research is advised to look into the associated factors for MSD and smartphone addiction.

Conclusion

The high prevalence of smartphone addiction among university students is alarmed in the study. The prolonged use of smartphones caused psychological issues as well as physical dysfunction in some part of the body. Hence, early screening is suggested by Hwang, Yoo, & Cho (2012) for every smartphone user regarding this issue. The overuse of smartphones should be evaluated, in order to develop addiction prevention programs including posture suggestion, stress coping method, promotion of positive mental health, and effective interpersonal relationships other than online communication (Hwang et al., 2012).

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