

# Evaluating the relationship between smartphone addiction/overuse and musculoskeletal pain among medical students at Qassim University

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## ABSTRACT

**Background:** Smartphone use has greatly increased in recent days, and most of the daily tasks are done through these devices. As a result, long time use may involve bad posture that may result in musculoskeletal pain. Therefore, it is important to evaluate the association between addiction/overuse of smartphones and musculoskeletal pain. **Aim:** To determine the prevalence of addictive/overuse of smartphones among medical students and to investigate if there is an association between smartphone addiction and musculoskeletal pain. **Method:** A cross-sectional study conducted at Qassim University, medical college. The Smartphone Addiction Scale Short Version (SAS-SV) was used to measure the level of smartphone addiction while the Nordic musculoskeletal questionnaire (NMQ) was utilized to evaluate the musculoskeletal pain. **Results:** The prevalence of smartphone addiction among medical students was relatively high (60.3%). The most frequent pain related to smartphone addiction was in the neck (60.8%), followed by lower back (46.8%), shoulder (40.0%). The academic year level was statistically associated with the level of smartphone addiction. Moreover, we found a significant relationship between musculoskeletal pain and smartphone addiction at certain body regions, neck, wrist/hand and knees, Other musculoskeletal parameters included in the test were found to have no statistically significant association. **Conclusion:** More than half of the medical students identified as addicted to smartphones. The most common musculoskeletal pain was the neck, lower back, and shoulder. The academic year level found to have a significant association with the level of smartphone addiction while musculoskeletal pain such as neck, wrist, and knee were the independent significant factors of smartphone addiction; therefore, it is important to educate the community about the effect of being addicted to smartphone use in order to prevent the consequences of this behavior.

**Keywords:** Addiction, medical students, musculoskeletal pain, Nordic musculoskeletal questionnaire, smartphone, Smartphone Addiction Scale Short Version

## Introduction

Smartphone is a popular device that can perform complicated tasks, which typically have a touchscreen interface, Internet access, social network, and gaming application (apps).<sup>[1]</sup> Smartphones come with its operating system enabling users to download different apps from different apps developer which

completely change the user experience to the endless possibility of user-smart phone interface. In the recent years, smartphones kept evolving to be multitasking, complete and on many occasion to displace electronic devices such as a computer, camera and many others which made us use them more often. However, using smartphone to achieve daily tasks by a combination of internet use and mobile calls can lead to smartphone addiction. Smartphone addiction is an emerging phenomenon in the communities which lies under behavioral addiction category.<sup>[2]</sup> behavioral addiction produces short-term reward that may lead

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to persistent behavior even with the knowledge of adverse consequences.<sup>[3]</sup>

There have been many concerns about smartphones addiction and people are becoming more dependent on them. In one study, many factors have been considered such as daily life stress and communication skills level. There was a significant relationship between life stress and smartphone addiction when compared with a control group.<sup>[4]</sup> In addition there an interesting article discussed the restriction of smartphones and If there will be some related withdrawal symptoms. There were 127 participants who were restricted from using smartphones for 72 hours, three scales related to withdrawal symptoms have been implied. Results using Smartphone Withdrawal Scale (SWS) and the Fear of Missing Out Scale (FoMOS) were higher than the control group which means those who were restricted from using smartphones experienced withdrawal symptoms.<sup>[5]</sup>

In 2014–2015 study was done among 2367 of Saudi University student, 27.2% admit using their Mobile phone more than 8 hours per day and 75% spent four hours daily using their phone.<sup>[6]</sup> That emerging phenomenon has been linked to a long list of health and social problems. One of which is non-traumatic musculoskeletal pain, smartphone addiction positively correlate with repetitive joint overuse and thus leading to inflammatory changes in healthy joints.<sup>[7]</sup> In addition, smartphone use usually requires flexing the neck downward and maintain the head in that positions for a long time.<sup>[8]</sup> Bad posture can cause tear of the spine and may require surgery in the future, according to research done by chief of spine surgery at New York Spine Surgery and Rehabilitation Medicine. His study found that flexing the neck 60 degree while using the phone same as apply 60-pound Weight on the spine.<sup>[9]</sup> In addition, studies relate musculoskeletal symptoms, including tenderness and decreased cervical range of motion, as well as muscular fatigue to smartphone use.<sup>[10,11]</sup> Also the poor posture that leads to muscle activation and degeneration of the ligaments can cause neck discomfort and affect the proprioceptors in the muscles and ligaments.<sup>[12-14]</sup>

There was a study investigating the health effects of using smartphone and portable electronic devices among Hong Kong people with result showed that out of the 1049 people surveyed, 70% of adults and 30% of children and adolescents have reported musculoskeletal symptoms in different parts of the body related to the use of electronic devices.<sup>[15]</sup> In addition, there are studies revealed a high incidence of musculoskeletal discomfort in the hand, wrist, arms, and neck caused by prolonged, forceful and repetitive use of mobile phones.<sup>[16-18]</sup> Moreover in one study was done in Majmaah University they found using smartphone is high risk for developing carpal tunnel syndrome symptom and affect range of wrist motion.<sup>[19]</sup> However, no study specified in how long is the duration that causing the musculoskeletal discomfort.

In the other hand, there are some studies correlate the neck discomfort resulting from smartphone use to the severity of head flexion, one of the study imply to the duration of using

the smartphone as it increases the head flexion resulting in neck discomfort.<sup>[20]</sup> However there is another study failed to relate smartphone use and the severity of head flexion<sup>[21]</sup> while there is another study demonstrate details about the neck flexion, they notice The muscle fatigue of the right upper trapezius and the left upper trapezius were highest when the cervical flexion angle was 50° and lowest when it was 30°.<sup>[22]</sup> In addition, the poor posture during the use of smartphone can cause physical problems, especially the neck and shoulder, are liable to be affected by using smartphone plus the muscles showing a high level of fatigue that increase the pain.<sup>[23]</sup>

The usage of smartphone has been increasing over years, in one of the studies were done in USA 2015 the adult spent approximately three hours daily (without counting phone calls) it's the double duration that was spent in 2012. It is expected to increase over time; therefore, it's considered an important medical issue to establish the relationship between smartphone addiction/overuse and musculoskeletal symptoms.<sup>[24]</sup>

## Methodology

This is a cross-sectional study conducted at the medical college in Qassim University (Buraidah campus). The Smartphone Addiction Scale Short Version (SAS-SV) questionnaires were used to measure the level of smartphone addiction while Nordic musculoskeletal questionnaire (NMQ) was utilized to evaluate the musculoskeletal pain of the respondents.

### Sample size and selection of sample

Assuming prevalence of addiction  $P = 0.5$  (50%),  $e = 0.05$  (5%) and confidence interval (CI) 95% applied on medical students' population (650) sample will be 242. Number of sample calculated through the following formulas:  $n1 = z2 \times P \times (1-P)/e2$  which gives 384 and adjusted by  $n2 = N \times n1/n1 + (N-1)$  giving the final sample estimation (242), the sample were chosen randomly from each academic years, the female participant were almost one third of all the sample size as they present the same percentage of the college students.

### Research instrument (Questionnaire) and its validation

In this study, data were collected through a self-administered questionnaire. The questionnaire consists of three parts. First part is demographics including age, gender, school year. The second part is the scale for time spend and behavior on smartphone using Smartphone Addiction Scale short version (SAS-SV). The third part consists of questions to measure the existence of musculoskeletal pain using another valid questionnaire (Nordic musculoskeletal questionnaire). SAS-SV is a well-validated questionnaire consisting of 10 questions that assess the level of risk on the addiction of smartphones. In addition, The SAS-SV validity was confirmed using SAS, SAPS, and KS-scale in 2013. SAS-SV significantly correlated with SAS, SAPS, and KS-scale ( $P = <.001$ ). The SAS-SV showed good reliability and validity for

the assessment of smartphone addiction. Furthermore, Nordic musculoskeletal questionnaire (NMQ) design to screen the existence of musculoskeletal pain. In addition, NMQ contains two major parts, the general part, and a specific part. General part made to assess the existence of musculoskeletal pain among the population generally without targeting specific anatomical locations while the specific part focusing on specific anatomical areas in the body. Furthermore, the specific part contains questions about symptoms and duration of the symptoms in the past time. NMQ developed by Kuorinka I, Jonsson B, Kilbom A *et al.* 1987, validity and reliability were tested. Reliability tested by a test-retest method and it shows identical answers ranging from 78-100% while the validity tested in comparing to the clinical history of musculoskeletal pain of participants and it shows identical answers ranging from 80% to 100%. NMQ provide useful and reliable data in relation to musculoskeletal pain.

### Statistical analysis method

The data analyses were performed using Statistical Packages for Social Sciences (SPSS) version 21, Armonk, NY: IBM Corp. Descriptive statistics are presented as numbers and percentages. The statistical significance of the relationship between independent variables and dependent variables are calculated using the Chi-square test;  $P \leq 0.05$  was considered as statistically significant.

The Smartphone Addiction Scale (SAS-SV), a short version where 10 out of 33 questions was selected for use in this study. As recommended by Kwon, Kim *et al.*,<sup>[25]</sup> we used smartphone addiction cut-off value of 31 points to determine the non-addiction and addiction of males whereas the cutoff value of 33 to determine non-addiction and addiction of female respondents. Nordic musculoskeletal questionnaire (NMQ) designed to screen the existence of musculoskeletal pain. NMQ was developed by Kuorinka I, *et al.*,<sup>[26]</sup> and its validity and reliability have been tested. NMQ provide useful and reliable data in relation to musculoskeletal pain.

### Ethical consideration

The ethical approval was taken from the subcommittee of Health Research Ethics, Deanship of Scientific Research, Qassim University, Data collectors were obtain verbal inform consent from each participant before the distribution of the questionnaire. The purpose of the study was explained clearly to participants. The questionnaire will not contain personal information's and responses could not traced at an individual level.

## Results

We recruited 242 medical students to be representative of smartphone users. Age range was 19–32 years old of whom the majority were more than 22 years' group (40.1%). Males dominated the females (64.9% vs 35.1%) and the junior level was more (69.0%). Older age group was more addicted to smartphone (40.1%) compared to the other age

group ( $P = 0.284$ ). No statistically significant association between gender and level of smartphone addiction was found between males and females ( $P = 0.375$ ). On the other hand, academic year level was statistically associated to the level of smartphone addiction ( $P = 0.019$ ) [Table 1].

Figure 1 depicts the Smartphone Addiction Scale-Short Version (SAS-SV), this questionnaire measures the level of smartphone addiction among medical students. The Smartphone addiction questionnaire items included the following statements: "Missing planned work due to smartphone use," "Having a hard time concentrating in class, while doing assignments, or while walking due to smartphone use," "Feeling pain in wrist or at back of the neck while using smartphone," "Won't be able to stand not having a smartphone," "Feeling impatient and fretful when I am not holding my smartphone," "Having my smartphone in my mind even when I am not using it," "I will never give up using my smartphone even when my daily life is greatly affected by it," "Constantly checking my smartphone so as not to miss conversations between other people on Twitter or Facebook," "Using my smartphone longer than I had intended," and "The people around me tell me that I use my smartphone too much." Based on the results, the majority of them either strongly disagree or disagree for almost all of the questions except for questions regarding "Having a hard time concentrating in class, while doing assignments, or while walking due to smartphone use," "I will never give up using my smartphone even when my daily life is greatly affected by it," and "The people around me tell me that I use my smartphone too much" where majority of them either strongly agree or agree.

The prevalence of smartphone addiction among medical students is presented in Figure 2. Smartphone addiction was determined among 146 students with an overall percentage of 60.3% while those without symptoms of addiction were 96 (39.7%).

Table 2 present the prevalence of musculoskeletal pain among medical students with smartphone addiction. It reveals that the most frequent pain related to smartphone addiction was in the

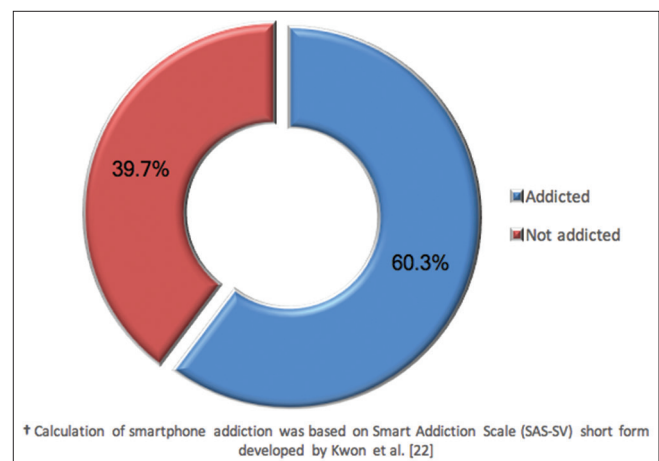


Figure 1: Smartphone Addiction Scale (SAS-SV)

**Table 1: Description of Socio demographic characteristics**

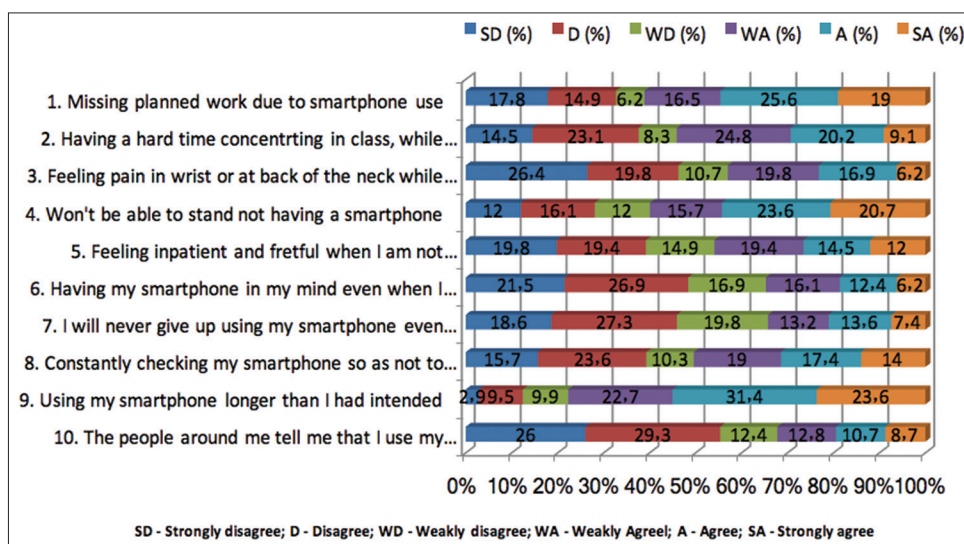
Study Data	Overall n (%) (n=242)	Smartphone addiction		P <sup>§</sup>
		Addicted n (%) (n=146)	Not addicted n (%) (n=96)	
Age group in years				
19-20 years	58 (24.0%)	38 (26.0%)	20 (20.8%)	0.322
21-22 years	87 (36.0%)	55 (37.7%)	32 (33.3%)	
>22 years	97 (40.1%)	53 (36.3%)	44 (45.8%)	
Gender				
Male	157 (64.9%)	95 (65.1%)	62 (64.6%)	0.938
Female	85 (35.1%)	51 (34.9%)	34 (35.4%)	
Academic year level				
Junior <sup>a</sup>	167 (69.0%)	109 (74.7%)	58 (60.4%)	0.019**
Senior <sup>b</sup>	75 (31.0%)	37 (25.3%)	38 (39.6%)	

<sup>a</sup>Basic year (First, Second and third year level). <sup>b</sup>Clinical years (Fourth and Fifth year level). <sup>§</sup>P value has been calculated using Chi square test. \*\*Significant at P<0.05 level

**Table 2: Prevalence of Musculoskeletal pain among student with smartphone addiction**

Musculoskeletal parameters	No Pain n (%)	Pain (12-M) n (%)	Pain (7-D) n (%)	Both <sup>†</sup> n (%)	Total Pain <sup>‡</sup> n (%)
Neck	89 (36.8%)	78 (36.8%)	05 (02.1%)	70 (28.9%)	153 (63.2%)
Shoulder	144 (59.5%)	55 (22.7%)	02 (0.80%)	41 (16.9%)	98 (40.5%)
Upper back pain	159 (65.7%)	43 (17.8%)	07 (02.9%)	33 (13.6%)	83 (34.3%)
Elbow	222 (91.7%)	15 (06.2%)	02 (0.80%)	03 (01.2%)	20 (08.3%)
Wrist/Hand	167 (69.0%)	36 (14.9%)	04 (01.7%)	35 (14.5%)	75 (31.0%)
Lower back pain	126 (52.1%)	54 (22.3%)	05 (02.1%)	57 (23.6%)	116 (47.9%)
Hips/Thigh	205 (84.7%)	19 (07.9%)	06 (02.5%)	12 (05.0%)	37 (15.3%)
Knees	169 (69.8%)	37 (15.3%)	03 (01.2%)	33 (13.6%)	73 (30.2%)
Ankles/Feet	198 (81.8%)	22 (09.1%)	02 (0.80%)	20 (08.3%)	44 (18.2%)

M-Months; D-Days. <sup>†</sup>Cases with both pain in the last 12 months and in the last 7 days. <sup>‡</sup>Total pain has been calculated by adding pain (12-M) + pain (7-D) and both (12-M and 7-D)



**Figure 2:** Prevalence of smartphone addiction among medical students

neck (59.5%), followed by lower back (46.8%), and shoulder (40.0%), while the least of them was elbow (08.3%). We used Pearson's Chi-squared test to measure the association between smartphone addiction and the musculoskeletal problems of the students. Based on the results, neck ( $P = 0.041$ ), wrist/hand ( $P = 0.026$ ) and knees ( $P = 0.034$ ) were all shows significant association to the level of smartphone addiction. Other musculoskeletal parameters included in the test were found to have no statistical differences [Table 3].

A multivariate regression analysis has been conducted at Table 4 to predict the influenced of smartphone addiction from the academic year level and selected musculoskeletal pain. Regression was adjusted in the model such as academic year level, neck, wrist/hand, and knees. Based on the results, those senior level students are predicted to be less addicted to smartphone compared to junior level students (AOR = 0.501,  $P = 0.020$ ). On the other hand, those students without neck pain are likely to decrease their smartphone addiction as opposed

**Table 3: Association between smartphone addiction and musculoskeletal problems**

Musculoskeletal parameters	Overall <sup>†</sup> n (%)	Smartphone addiction		P <sup>§</sup>
		Addicted n (%)	Not addicted n (%)	
Neck				
Pain	144 (59.5%)	95 (66.0%)	49 (52.7%)	0.041**
No Pain	93 (39.20%)	49 (34.0%)	44 (47.3%)	
Shoulder				
Pain	96 (40.0%)	60 (41.7%)	36 (37.5%)	0.519
No Pain	144 (60.0%)	84 (58.3%)	60 (62.5%)	
Upper back pain				
Pain	76 (32.3%)	49 (34.5%)	27 (29.0%)	0.380
No Pain	159 (67.7%)	93 (65.5%)	66 (71.0%)	
Elbow				
Pain	18 (07.5%)	13 (09.0%)	05 (05.3%)	0.287
No Pain	222 (92.5%)	132 (91.0%)	90 (94.7%)	
Wrist/Hand				
Pain	72 (30.3%)	51 (35.7%)	21 (22.1%)	0.026**
No Pain	166 (69.7%)	92 (64.3%)	74 (77.9%)	
Lower back pain				
Pain	111 (46.8%)	65 (46.1%)	46 (47.9%)	0.783
No Pain	126 (53.2%)	76 (53.9%)	50 (52.1%)	
Hips/Thigh				
Pain	31 (13.1%)	17 (11.9%)	14 (15.1%)	0.482
No Pain	205 (86.9%)	126 (88.1%)	79 (84.9%)	
Knees				
Pain	67 (28.0%)	33 (23.1%)	34 (35.4%)	0.037**
No Pain	172 (72.0%)	110 (76.9%)	62 (64.6%)	
Ankles/Feet				
Pain	42 (17.5%)	23 (15.8%)	19 (20.2%)	0.375
No Pain	198 (82.5%)	123 (84.2%)	75 (79.8%)	

<sup>†</sup>Pain in the last 7 days has been excluded from the table. <sup>§</sup>P value has been calculated using Chi square test

**Table 4: Multivariate regression analysis to ascertain the effect of smartphone addiction from the academic year level and selected musculoskeletal pain**

Predictor	AOR	95% CI	P
Academic year level			
Junior <sup>a</sup>	Ref		0.020**
Senior <sup>b</sup>	0.501	0.280-0.895	
Neck			
Pain	Ref		0.036**
No Pain	0.544	0.308-0.961	
Wrist/Hand			
Pain	Ref		0.042**
No Pain	0.511	0.267-0.976	
Knees			
Pain	Ref		0.009**
No pain	2.347	1.234-4.464	

AOR-Adjusted Odds Ratio; CI-Confidence Interval. <sup>a</sup>Basic year (First, Second and third year level). <sup>b</sup>Clinical years (Fourth and Fifth year level). \*\* Significant at P ≤ 0.05 level

to those with neck pain (AOR = 0.544, P = 0.036) while those students without wrist/hand pain are ascertained to be less addicted to smartphone compared to those with wrist/hand pain (AOR = 0.511, P = 0.042). On the contrary, those students without knee pain are likely to increase their smartphone addiction as opposed to those with knee pain (AOR = 2.347, P = 0.009).

## Discussion

The purpose of the present study is to estimate the prevalence of smartphone addiction and its relation to musculoskeletal pain among medical students. The findings of this study shows, 60.3% of the students are deemed addicted to smartphone. In Saudi Arabia, Alhazmi *et al.*,<sup>[27]</sup> published a study about ‘Prevalence and factors associated with smartphone addiction among medical students at King Abdulaziz University, Jeddah.’ They reported that among 181 medical students, 36.5% of them had been classified as addicted to smartphone which was slightly lower incidence rate compared to our study finding. In abroad, Elserty *et al.*<sup>[28]</sup> conducted a study about ‘Smartphone addiction and its relation to musculoskeletal pain in Egyptian physical therapy students’. They found out that among 420 physical therapy students, 62.4% found to have smartphone addiction with increased level of addiction in females more than males which was in agreement with our study results at the level of smartphone addiction prevalence. In Turkey, Tonga *et al.*,<sup>[29]</sup> published an article entitled ‘‘Evaluation of musculoskeletal complaints associated with smartphone use among university students and related risk factors.’’ Among 349 university students they recruited, they found out an incidence rate of smartphone addiction of 43% which was also slightly lower compared to our study outcome.

In this study, we utilized the “Smartphone Addiction Scale-Short Version (SAS-SV) and Nordic Musculoskeletal Questionnaires (NMQ) to measure the smartphone addiction as well as the incidence of musculoskeletal pain while using smartphone.<sup>[25,26]</sup> This is consistent from several published studies with the same subject.<sup>[11,27-30]</sup> While Yang *et al.*,<sup>[11]</sup> applied the “modified Nordic Musculoskeletal Questionnaires (mNMQ). The modified NMQ employed six body regions from the original NMQ, and composed of eight questions that assessed upper body discomfort related to any pain or numbness in the previous 6 months. The mNMQ investigated pain and numbness in the body regions that are used most frequently during smartphone use, enabling participants to answer “yes” or “no” by using a simple body image. On the other hand, Choi and colleagues,<sup>[31]</sup> used “Lee Korean mobile phone addiction scale” to measure university students addiction to smartphone. This instrument has four sub-factors, including pathological commitment, life disorder, loss of control and compulsive symptoms compose of 25 questions. Each question consisted of a Likert scale “not at all” from 0 to “Strongly agree” with 4 points, the higher score the sum of each item smartphone addiction is high.

Moreover, the most frequent musculoskeletal pain region being accounted in this study was in the neck (59.5%), followed by lower back (46.8%) and shoulder (40.0%). This report is congruent from various papers.<sup>[11,28-30,32]</sup> In Egypt, the most frequent pain being experience by the physical therapy students was neck, eyes and back region<sup>[28]</sup> while in Turkey, the incidence of musculoskeletal pain were also identified in neck, shoulder, and upper back.<sup>[29]</sup> This result has been further validated by Yang and colleagues,<sup>[30]</sup> which they reported neck and elbow as the most frequent body pain being suffered by the adolescent students whereas in Korea, the most common musculoskeletal pain endured by the students was neck and shoulder.<sup>[31,32]</sup>

Musculoskeletal pain such as neck wrist/hand and knees were found to be the independent significant factors of smartphone addiction, we believe the knees pain is caused by something else and the statically association we found, it may related to the high prevalence of knees pain among the sample. In the other hand the paper published by Tonga *et al.*, they found Upper Limb discomfort was significantly related to the frequency of smartphone use, using Rapid Upper Limb Assessment (RULA)<sup>[29]</sup> while Yang *et al.* stated that upper back and elbow were significantly associated with the hours of smartphone use per day.<sup>[30]</sup> Moreover, this result was more substantial from the study published by Elserty *et al.*<sup>[28]</sup> When they tried to correlate the duration of smartphone used against feeling of discomfort in different body parts, among those body parts such as shoulder, arm, neck, eye, back, hand/finger, and wrist leg/feet, they found no strong correlation. On the other hand, when we assessed if smartphone addiction has any association with the basic demographic characteristics, we found academic year level was significantly associated with smartphone addiction. AlHazmi *et al.*,<sup>[27]</sup> found significant difference between daily hours of smartphone usage and smartphone addiction status while in

Korea, Choi<sup>[31]</sup> accounted smartphone addiction had significant association with gender and daily average used of smartphone.

## Recommendation

Since there is a limited published paper here in Saudi Arabia, further researches are needed in order to validate the findings of this study involving multi-institution to get better representative of study population. We further suggested including general population in the future research to obtain their general outlook with regards to the overuse of smartphone and its association with musculoskeletal pain.

## Conclusion

More than a half of the medical students identified as addicted to smartphone. The most common musculoskeletal pain was neck, lower back and shoulder. Academic year level found to have significant association to the level of smartphone addiction while musculoskeletal pain such as neck, wrist and knee were the independent significant factors of smartphone addiction. This study suggests limiting the excessive used of smartphone among medical students and emphasized the awareness of the risk factor toward smartphone addiction.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published.

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## Conflicts of interest

There are no conflicts of interest.

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