

Smartphone use addiction and musculoskeletal disorders among university students

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Keywords: Smartphone addiction, Musculoskeletal disorders, adolescents, pain .

Abstract: Objective: The aim of this study was to determine the potential association of self-reported smartphone addiction and to correlate its relationship with musculoskeletal discomfort in neck and hands of young healthy university students.

Methods: A total of 160 university students aged (18-25) years were randomly recruited to participate in this observational analytical study. Based up on the period of using smartphone, the participants were classified into four groups:- 1-2 hrs/day, 2-3 hrs/day, 3-5 hrs/day, and ≥ 5 hrs /day. A smartphone use addiction with musculoskeletal discomfort in neck and hands and adiposity consequences were estimated using a pre-validated questionnaires and anthropometric measurements respectively.

Results: The findings showed that the smartphone use addiction was significantly associated with neck pain and disability and hand discomforts as well as adiposity markers in 70 % of the study population. Whereas females comprised the most addicted and affected if compared to males user (43.1% vs33.1 %). Generally, smartphone use for longer periods correlated positively with adiposity, NDI, CHDQ, and VAS pain scores.

Conclusion: Smartphone use addiction correlated positively with adiposity and musculoskeletal problems in the shoulder neck and hands predominantly the thumb among university students. Thus, new public health educational programs were recommended to inform people especially the students about the physical risks associated with excessive use of smartphones.

الاضطرابات الناتجة عن إدمان استخدام الهواتف الذكية وتأثيرها السلبي على العضلات للطلاب الجامعيين

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ملخص البحث: هدفت الدراسة إلى تحديد الارتباط المحتمل لإدمان استخدام الهواتف الذكية المبلغ عنه ذاتياً وعلاقته بالألم العضلات والعظام في الرقبة وأيدي طلاب الجامعات الشباب الأصحاء. الطريقة: تم اختيار عينة الدراسة عدد 160 طالب جامعي تتراوح أعمارهم بين (18-25) سنة بشكل عشوائي للمشاركة في هذه الدراسة التحليلية القائمة على الملاحظة. بناءً على فترة استخدام الهاتف الذكي، تم تصنيف المشاركين طبقاً لفترة استخدامهم الهاتف إلى أربع مجموعات: 1-2 ساعة / يوم، و 2-3 ساعات / يوم، و 3-5 ساعات / يوم، و ≤ 5 ساعات / يوم. يستخدم الهاتف الذكي إدماناً مع الشكوى من الألم العضلي الهيكلي في الرقبة واليدين وتم تقدير معدلات السمنة باستخدام استبيانات تم التحقق من صحتها مسبقاً وقياسات أنثروبومترية على التوالي. وأظهرت النتائج أن إدمان استخدام الهاتف الذكي كان مرتبطاً بشكل كبير بالألم الرقبة واليد ومشاكل ومضايقات إعاقة الحركة بالإضافة إلى علامات السمنة في 70٪ من عينة الدراسة. في حين شكلت الإناث الأكثر إدماناً وتأثراً إذا ما قورنت بالمستخدمين الذكور (43.1٪ مقابل 33.1٪). بشكل عام، يرتبط استخدام الهاتف الذكي لفترات أطول بشكل إيجابي بدرجات السمنة وNDI وCHDQ وVAS. الخلاصة: يرتبط ادمان استخدام الهواتف الذكية ارتباطاً إيجابياً بالسمنة والم العضلات الهيكلية في الكتف والرقبة واليدين في الغالب الإبهام بين طلاب الجامعة. وبالتالي، تمت التوصية ببرامج تعليمية صحية عامة جديدة لإعلام الناس خاصة الطلاب بالمخاطر الجسدية المرتبطة بالاستخدام المفرط للهواتف الذكية.

Introduction

Nowadays, a smartphone was the most popular devices used for fast communications among younger ages particularly; adolescents.¹ University students usually use a smartphone text messaging (SMS) as the most frequently used type of communicative medium.¹

Recent studies showed that more than 79% of the population between the age of 18-44 years have their cell phones with them almost all the time, with only 2 hours of their walking day spend without their cell in hand.^{1,2}

Problematic use of smartphone communication technologies directly leads to significant and persistent functional impairments with distress which significantly may constitute behavioral addiction among users.²⁻³ Several health hazards ranging from psychosocial disturbances (anxiety and depression),⁴ potentially fatal injuries from traffic accidents,⁵ and social problems like poor family and peer relationship,⁶ were all a contributing factors associated with the use of smartphone technologies.⁴⁻⁶ In addition, risk factors such as repetitive continuous movements of the thumb and fingers have all been identified among smartphone users which significantly may lead to disorders of the thumb and its musculature like tendinosis of the extensor pollicis longus or myofascial pain syndrome in the hand.⁷

During the use of smartphone technologies, the most tasks are that the users require to stare sharply downwards or to hold their arms out in front of them to read the screen which makes their head move forward and cause an excessive anterior curve in the lower cervical vertebrae and an excessive posterior curve in the upper thoracic vertebrae to maintain balance, placing stresses on the cervical spine and the neck muscles.⁷⁻⁹ It was reported that incorrect posture of the head and neck has been correlated with chronic musculoskeletal pain,⁸⁻⁹ whereas forward head posture is one of the most commonly recognized poor postures in the sagittal plane.⁸

In addition, during repetitive use of hand held devices (HHD) such as smartphones significantly associated with the incidence of musculoskeletal disorders (MSD) of hand, wrist, forearm, arm and neck has been increasing worldwide.⁹⁻¹² A relation between smartphones design and anthropometry of the users has been reported to produce discomfort and fatigue in hand, elbow and shoulder while using the HHD.⁹⁻¹² Smartphones use abdication is becoming a growing problem and having a large impact globally. However, in Arab and African regions, little is known about the risks of smartphones use on hand and shoulder muscles as well as musculoskeletal discomfort among university adolescent.

Hence, the aim of the present study was to determine the potential association of the level of self-reported smartphone addiction and to correlate its relationship with musculoskeletal discomfort in neck as well as in hand in young healthy university students.

Materials and Methods

Subjects

This observational analytical study included a total of 160 subjects aged (18-25) years randomly recruited from participants who attended to Qalyoub Youth Center, Egypt. Subjects with minimum Smartphone use of ≥ 1 hour

per day and able to understand, and fill the questionnaires included in this study during the period from April to July 2016. Students with neck or upper extremity musculoskeletal trauma or spinal cord injury prior to the study or have any other medical cause or a known condition which could lead to pain in the neck or upper limb was excluded. Nature and purpose of the study was explained and informed oral consent was taken from the participants. Demographic and clinical data of the participants are listed in Table (1).

Anthropometric measurements

Based up on age and gender specific BMI cut off criteria previously reported.¹³⁻¹⁴ The participants in this study were divided into four categories: underweight (BMI; < 16.2 kg/m²), normal weight (BMI; 16.2-17.3kg/m²), overweight (BMI; 17.4 -21.45kg/m²), and obese (BMI; ≥ 22 kg/m²). In addition, waist-to-height ratio (WHtR) was also calculated as mentioned before in the literatures.¹⁴⁻¹⁵

Assessments of Smartphone addiction, Neck and hand fatigue

A pre validated questionnaires containing four parts; Demographics (Name, age, gender, hand dominance), and hours of mobile usage per day, Smartphone Addiction Scale (SAS), Neck Disability Index (NDI) score, and Cornell Hand Discomfort Questionnaire (CHDQ).¹⁶

1- Smartphone addiction scale (SAS)

For all participants, smartphone addiction was estimated using a reliable and valid self-reporting measuring scale (SAS) as previously reported.¹⁷ It consists of six factors and 33 items, with a six-point Likert scale (1: "strongly disagree" to 6: "strongly agree"). The six factors were daily-life disturbance, positive anticipation, withdrawal, cyberspace-orientated relationship, overuse and tolerance. In this scale (SAS), the students circle the statement which most closely describes their smartphone use characteristics. The scores of SAS scale range from 33 to 198, whereas the higher the score of SAS, the greater the degree of pathological use of the smartphone.¹⁸

2- Neck disability index (NDI)

All students were subjected to assess the effects of smartphone use on neck pain and symptoms during a range of functional activities by using a pre-validated 10-item, 50-point index questionnaire (NDI) as previously reported.¹⁹ This index is the most widely used and most strongly validated instrument for assessing self-rated disability in patients with neck pain.¹⁹ The 10 items, four relate to subjective symptoms (pain intensity, headache, concentration, sleeping), four activities of daily living (lifting, work, driving, recreation) and two discretionary activities of daily living (personal care, reading) Each item is scored on a 0 to 5 rating scale, in which zero means [No pain], and 5 means [Worst imaginable pain].¹⁹

3- Cornell hand discomfort questionnaire (CHDQ)

A pre-validated 6-item questionnaire (CHDQ) was used for measuring hand discomfort among participated students who use smartphones as previously mentioned in the literature.²⁰ The questionnaire (CHDQ) contains a hand map diagram showing 6 shaded areas of the hand supported by questions about the following; 1. Prevalence of musculoskeletal pain, 2. Discomfort, and 3. Interference with work occurred during the previous week.²⁰ Total discomfort score was calculated by using the following formula:

$$\{[\text{Frequency} \times \text{discomfort} \times \text{interference}]\} \dots^{20}$$

Where, higher the scores indicated more discomfort. Maximum scoring for each area is 90, and the total scoring for 6 areas is 560, (Higher scores showing more discomfort).²⁰

Also, pain of neck and hands of the subjects was assessed by using a standard validated VAS of 100 mm.²¹

4- Statistical analysis

A statistical SPSS program for Windows v.20 package was used to calculate frequencies of the studied variables. The numerical scores of SAS, NDI, CHDQ, and other related demographic parameters were presented as Mean \pm SD. Both ANOVA and Dunnett post hoc test was used to compare the data between groups.¹⁷⁻²⁰ χ^2 test was applied to determine the statistical association between the studied variables {SAS and NDI and SAS and CHDQ scores}, the data considered significant at $p < 0.05$ with 95% CI.¹⁷⁻²⁰

Results

In this observational analytical study, a total of 160 university subjects aged (18-25) years were randomly recruited to study the effect of smartphone use on neck and hands of the users. Smartphone addiction was reported in 70 % of the study population, most of them were of females (43.1% vs33.1 % for males) as shown in table (1) and figure (1A).

Table (1). Anthropometric and demographic measurements of the subjects classified according to the use of smartphone addiction scores (mean \pm standard deviation).

Parameters	Hours of phone use/day			
	1-2 hrs/day	2-3hrs/day	3-5 hrs/day	≥ 5 hrs /day
No (%)	20 (13.3)	18 (12)	50 (33.3)	72(48)
Age (Years)	18.9 \pm 1.8	19.3 \pm 1.3	18.8 \pm 1.7	19.3 \pm 1.5
Gender (M/F)	8/12	8/10	21/29	32/40
Weight (kg)	64.6 \pm 3.8	78.6 \pm 6.3 ^a	81.5 \pm 2.3 ^b	89.5 \pm 3.7 ^c
Height (m)	1.45 \pm 2.1	1.58 \pm 1.6	1.65 \pm 5.1	1.76 \pm 4.6
BMI (kg/m ²)	17.8 \pm 1.6	19.5 \pm 1.7 ^a	22.8 \pm 6.3 ^b	26.8 \pm 2.8 ^c
WHR	0.48 \pm 0.5	0.56 \pm 1.3 ^a	0.68 \pm 3.1 ^b	0.79 \pm 4.8 ^c
WHtR	0.51 \pm 0.6	0.59 \pm 0.91 ^a	0.86 \pm 0.65 ^b	0.92 \pm 0.78 ^c

Statistical analyses by One-way ANOVA with Dunnett post-hoc test. ^a $p < 0.05$, ^b $p < 0.01$, ^c $p < 0.001$. BMI, body mass index; WHR, waist to height ratio; WHtR: Waist-to-height ratio.

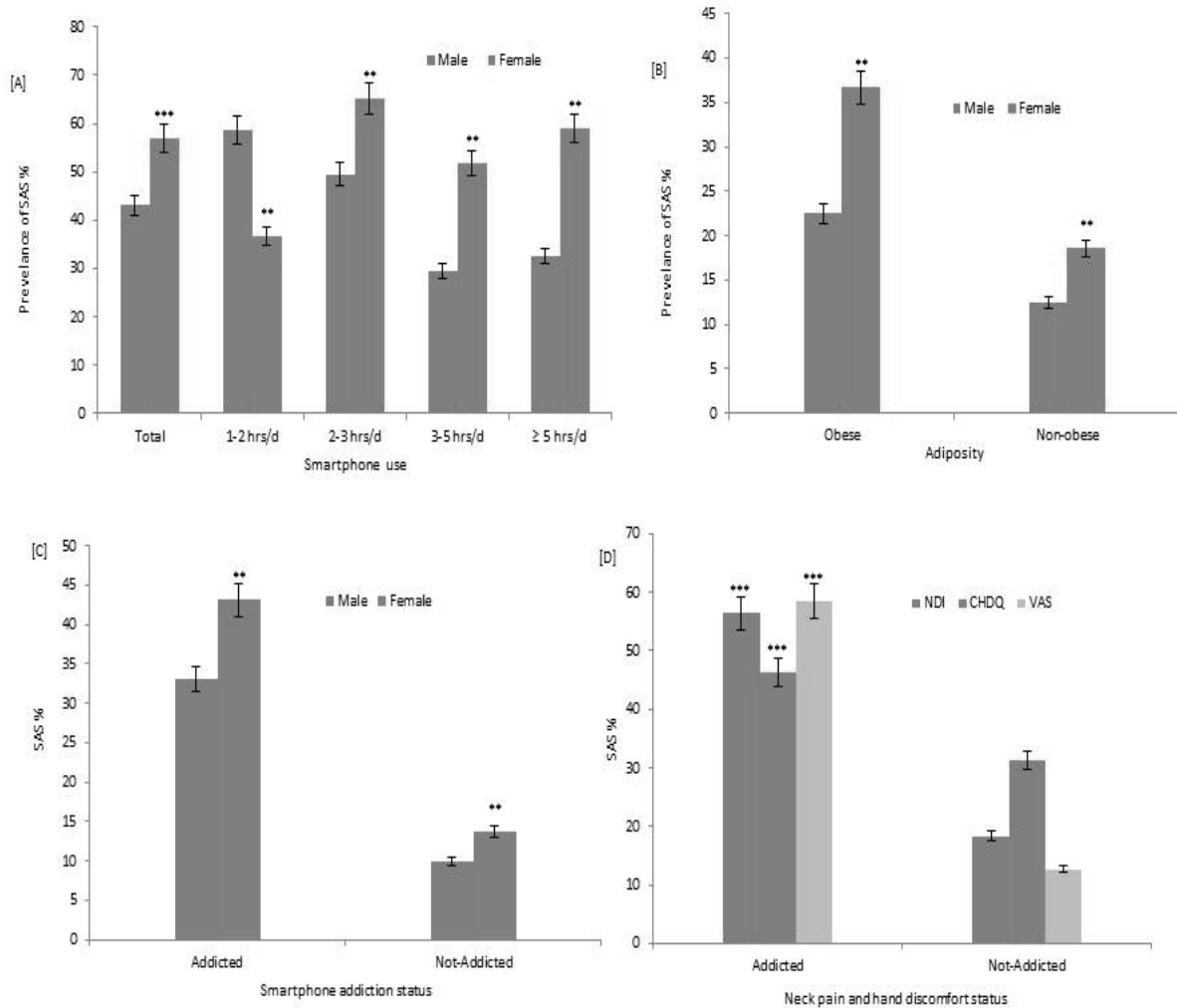


Figure (1). Factors and musculoskeletal discomfort associated with smartphone addiction (SAS score %) in physical exercise university students; [A]: females showed higher significant rates of smartphone use (SAS scores) compared to males; [B]: Adiposity was significantly more associated with SAS-addiction in females than males; [C]: Also, females showed addiction rates than males; [D]: In both genders, smartphone use addiction was significantly associated with neck pain and hand discomforts as measured by NDI, CHDQ, and VAS anlage scores. ** $p < 0.01$, *** $p < 0.001$.

Significant increase in the adiposity markers (BMI, WHR, and WHtR) was reported in subjects with longer smartphone use (2-3 hrs/d; $P=0.05$, 3-5 hrs/day; $P=0.01$ & ≥ 5 hrs/d; $P=0.001$) compared to subjects with mild or normal smartphone use (1-2 hrs/d) as in table (1). Adiposity was shown to be associated largely with the use of smartphone in female ($P=0.01$) compared to males as in Figure (1B).

In addition, smartphone use for long times as measured by SAS scores significantly associated with neck disability and pain (NDI; $P=0.001$ & VAS; $p=0.001$) and hand discomfort (CHDQ; $P=0.001$) in subjects who use smartphones for longer times compared to mild phone user (1-2 hrs/d) as in table (2).

Taber (2). Association between smartphone use, neck pain, and hand discomfort among physical exercise university students based up on hours of phone use/day (M±SD).

Parameters	Hours of phone use/day			
	1-2 hrs/day	2-3hrs/day	3-5 hrs/day	≥ 5 hrs /day
SAS	42±18.6	62.8±21.6 ^a	115.3±25.6 ^b	169.4±26.5 ^c
NDI	18.3±0.48	25.7±0.89 ^a	38.1±1.6 ^b	58.4±2.3 ^c
CHDQ	15.2±5.6	22.4±8.3 ^a	38.1±3.8 ^b	52.9±6.3 ^c
VAS pain score	5.1±3.7	9.3±3.7 ^a	15.3±6.1 ^b	22.3±7.4 ^c

SAS: Smartphone addiction scale; NDI: Neck disability index; CHDQ: Cornell hand discomfort questionnaire; VAS: Visual Analogue Scale. ^ap < 0.05, ^bp < 0.01, ^cp < 0.001.

Data are R (spearman). SAS: Smartphone addiction scale; NDI: Neck disability index; CHDQ: Cornell hand discomfort questionnaire; VAS: Visual Analogue Scale; BMI, body mass index; WHtR: Waist-to-height ratio.

In both genders, smartphone use addiction was significantly associated with neck pain and hand discomforts as measured by NDI, CHDQ, and VAS pain scores (figure 1D). The data showed that smartphone addiction correlated positively with adiposity (BMI/ WHtR) and musculoskeletal discomfort as measured by NDI, CHDQ, and VAS pain scores as shown in table (3) and figure (1D).

Table (3). Correlation between smartphone use abduction with adiposity, neck pain and hand discomfort analysis among physical exercise university students (M±SD).

Parameters	SAS use addiction scores							
	1-2 hrs/day		2-3hrs/day		3-5 hrs/day		≥ 5 hrs /day	
	R	P	R	P	R	P	R	P
Adiposity (BMI/ WHtR)	0.123	0.01	0.365	0.001	0.214	0.001	0.251	0.001
NDI	0.615	0.01	0.714	0.001	0.418	0.001	0.618	0.001
CHDQ	0.384	0.01	0.478	0.001	0.517	0.001	0.478	0.001
VAS pain score	0.215	0.01	0.356	0.001	0.419	0.001	0.511	0.001

Also, compared to males, females showed higher ratios of smartphone use addiction which significantly associated with neck disability, hand discomfort, and severe musculoskeletal pain as in table (3) and figure (1C).

Discussion

The findings of this study showed that smartphone use addiction was significantly associated with neck pain and disability, and hand discomforts as well as adiposity markers in 70 % of the study population. Whereas females comprise the most addicted and affected compared to males user (43.1% vs33.1 %). Generally, smartphone use for longer periods correlated positively with adiposity, NDI, CHDQ, and VAS pain scores.

Recently, more than 79% of the population between the ages of 18-44 use their smartphones most of the day and suffer from severe musculoskeletal pain especially in neck and shoulder regions.¹⁻² Previously, also higher rates of smartphone addiction (36.5%) were reported among Saudi medical students which significantly associated with longer smartphone use periods.²² In this study and others,^{1-2,22-24} these high prevalence rates may be related to the simplicity of using smartphones than other touch screens to get a lot of educational material from the internet.

In this study, obesity (BMI) was reported in 70 % of the studied population who using smartphone applications for longer times, whereas females with obesity showed higher NDI, CHDQ, and VAS pain scores compared to males. Recently, negative impacts on levels of energy, sleep, eating behaviors, body weight, exercise, and academic achievements were associated with smartphone use addiction among younger ages.²⁵

Previous research reports suggested that the prevalence of smartphone addiction among students with poor physical activity and higher stress levels.²⁶ Thus, in this study, our participating students most likely to be physically inactive due to obesity. These parameters could be contributing factors to increased mobile addiction among physical exercise students.

Moreover, in this study SAS test showed a higher score especially among female students who use the smartphone for longer periods, indicating an addiction to smartphone use. Also, smartphone use addiction among our students correlated positively with NDI and the CHDQ scores which showing moderate neck pain and disability as well as hand and muscle shoulder discomfort.²⁷ This pain disability and hand discomfort of smartphone use may be due to repetitive and continuous movements of the head and neck toward the screen throughout the day. Such movements are associated with a high risk of chronic neck pain and may explain the strong association between SAS and NDI scores in the present study.²⁸

In addition, previous studies concluded that smartphone text messaging has an adverse effect on musculoskeletal system of hand in persons who extensively use mobile phone, and different pathologies such as tendinitis of extensor pollicis longus, myofascial pain syndrome of thenar muscles, 1st interossei, the risk of neck-shoulder, and lower back pain were described.²⁹⁻³¹

Conclusion

Smartphone use addiction correlated positively with adiposity and musculoskeletal problems in the shoulder neck and hands predominantly the thumb among university students. A pre-validated questionnaires and anthropometric measurements were used to estimate smartphone use addiction and adiposity consequences. The outcomes revealed that the studied side effects occurred in 70 % of the study population. Whereas females (43.1%) suffered the most addicted and affected if compared to males user (33.1 %). Generally, smartphone use for longer periods correlated positively with adiposity, NDI, CHDQ, and VAS pain scores. Thus, new public health educational programs were recommended to inform people especially the students about the physical risks associated with excessive use of smartphones.

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