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ORIGINAL

Smartphone use: implications for musculoskeletal symptoms and socio-demographic characteristics in students

Uso de teléfonos inteligentes: implicaciones para los síntomas musculoesqueléticos y características sociodemográficas en estudiantes

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ABSTRACT

Introduction: smartphone use has substantially increased in the past decade, becoming an important part in population's usual activities, but the relationship between smartphone addiction, smartphone use, and neck disability in adults remains uncertain. The objective of this study: (1) investigate the association between neck disability and smartphone use time with socio-demographic characteristics, musculoskeletal symptoms, and smartphone addiction among university students; and (2) assess the association between smartphone addiction with socio-demographic characters, musculoskeletal symptoms.
Methods: 228 students (74 males and 154 females; average age 29,41 years old) were enrolled in the study. Participants answered questions about sociodemographic characteristics, smartphone time use, smartphone addiction (SAS-SV), musculoskeletal symptoms in the neck and upper limb, and neck disability (NDI).
Results: individuals with neck disability were associated with, gender, general health, presence of neck and shoulder pain, and smartphone addiction. More time spent on smartphones was associated with some socio-demographic characteristics, the presence of shoulder pain, and smartphone addiction.
Conclusions: smartphone addiction was associated with lower age, higher educational level, neck disability, and smartphone time use in students.

Keywords: Smartphone Addiction; Smartphone Use Time; Musculoskeletal Symptoms; Neck Disability; Students.

RESUMEN

Introducción: el uso de teléfonos inteligentes ha aumentado sustancialmente en la última década, convirtiéndose en una parte importante de las actividades habituales de la población, pero la relación entre la adicción a los teléfonos inteligentes, el uso de teléfonos inteligentes y la discapacidad del cuello en adultos sigue siendo incierta. El objetivo de este estudio: (1) investigar la asociación entre la discapacidad del cuello y el tiempo de uso de teléfonos inteligentes con características sociodemográficas, síntomas musculoesqueléticos y adicción a los teléfonos inteligentes entre estudiantes universitarios; y (2) evaluar la asociación entre la adicción a los teléfonos inteligentes con caracteres sociodemográficos y síntomas musculoesqueléticos.
Métodos: se matricularon en el estudio 228 estudiantes (74 hombres y 154 mujeres; edad promedio 29,41 años). Los participantes respondieron preguntas sobre características sociodemográficas, uso del tiempo del teléfono inteligente, adicción a los teléfonos inteligentes (SAS-SV), síntomas musculoesqueléticos en el cuello y las extremidades superiores y discapacidad del cuello (NDI).
Resultados: las personas con discapacidad de cuello se asociaron con el género, la salud general, la presencia de dolor de cuello y hombros y la adicción a los teléfonos inteligentes. Pasar más tiempo frente a los teléfonos

inteligentes se asoció con algunas características sociodemográficas, la presencia de dolor de hombro y la adicción a los teléfonos inteligentes.
Conclusiones: la adicción a los teléfonos inteligentes se asoción con una menor edad, un mayor nivel educativo, discapacidad del cuello y uso del tiempo del teléfono inteligente en los estudiantes.

Palabras clave: Adicción a Teléfonos Inteligentes; Tiempo de Uso de Teléfonos Inteligentes; Síntomas Musculoesqueléticos; Discapacidad del Cuello; Estudiantes.

INTRODUCTION

Smartphone has substantially increased in the past decade, becoming an important part of the population's usual activities, such as communication activities, study, leisure, and internet access. In Brazil, 64,7 % of the population over 10 years old access the internet in their daily life, 77,1 % have a personal smartphone and 94,6 % use the smartphone regularly for internet access overcoming the use of computers and tablets for the same objective.[1] In 2022, 84,7 % of the population over 10 years old already regularly used the internet as an integral part of their daily activities.[2] The increased number of people using smartphones can lead to harmful behaviors, such as an increase in spent time on smartphone use, and psychological complaints, such as addiction.

Behavior addictions can be defined as a compulsive desire to do something that results in harmful reactions for oneself and other people, and several behavioral addictions are present in very common situations, such as compulsive buying, compulsive sexual disorder, internet addiction, and gambling.[3] Numerous studies have explored the impact of smartphones on mental[4,5] and physical disability[6,7,8,9] in adolescents and young people. Changes in the positioning of the neck can lead to the appearance of symptoms in the cervical, shoulder, and upper limb regions. Musculoskeletal symptoms (MSS) are a major cause of functional limitation, incapacity for work, reduced quality of life, and general health.[10,11,12] MSSs, particularly those of the upper body, are increasingly prevalent in western societies, and they are more common among women than among men.[12]

Cross-sectional studies previously performed report that more than half individuals included in your sample have rated as smartphone addicted[7, 13] and this variable was associated with neck pain,[7] shoulder pain[9] and wrist/hand pain.[13] The underlying mechanism behind the relationship between smartphone addiction and MSSs has been discussed in the literature in recent years.[7,8,13] However, these studies presented a sample of individuals normally under 23 years old.

The excessive time spent on the smartphone can have negative consequences such as addiction and influencing other lifestyle habits (e.g. junk food and sugar-sweetened beverage consumption in front of screens), and contribute to health issues, such as overweight, depression, and sleep problems[14,15] interfering on general health. However, these studies normally addressed adolescents. Furthermore, many studies measure specific educational levels,[7,9,16] normally undergraduate students. However, there is still limited understanding of how the time spent on smartphones and smartphone addiction varies across different socio-demographic characters as age groups, educational levels, general health status, vision problem, and concern about posture.

The aim of this study was: (1) investigate the association between neck disability and smartphone use time with socio-demographic characteristics, musculoskeletal symptoms, and smartphone addiction among university students; and (2) assess the association between smartphone addiction with socio-demographic characters, musculoskeletal symptoms.

METHODS

Study design and setting

This cross-sectional study design utilized a self-administered survey of university students in two Colleges from Vitória and Linhares City, Brazil. Data collection started in July and ended in late December 2019. The inclusion criteria for this study were defined as students who were 18 years of age or older and actively enrolled and attending classes during the data collection period. Students were categorized into the following groups: undergraduate - those who had not completed their college degree, graduate - those who had completed their college degree but had not pursued any postgraduate courses, and post-graduate - those who had completed at least one postgraduate course, even if they were concurrently studying another postgraduate course. The exclusion criteria were any participants with neck, shoulder, upper back, lower back, elbow, or wrist-hand musculoskeletal trauma, and those with congenital deformities, serious surgical or neurological diseases, limb injuries, or limb pain in the prior six months. The questionnaire was developed in the SurveyMonkey© (www.surveymonkey.com) application and distributed by Facebook, WhatsApp, and other social media. The completion rate of the survey was 77,29 % (Of 295 participants who initially engaged in the survey, 228 completed the questionnaire and were included; missing values or individuals who did not complete at least 90 % of the

questionnaire were excluded). Hair, Babin[17] suggest having at least five to ten respondents for each question. In this case, we achieved a ratio of 9,12 respondents for each question (228 questionnaires/25 questions). Participants were explicitly told that "this survey is assessing behaviors related to daily smartphone use and musculoskeletal symptoms" and to respond accordingly.

Instruments and outcome measures

Instruments used in the study included: (1) smartphone Addiction Scale – Short Version (SAS-SV), (2) smartphone time use questionnaire, (3) musculoskeletal symptoms in the neck and upper limb, (4) neck pain intensity and (5) neck disability index (NDI). Socio-demographics including age, gender, weight, height, body mass index (BMI), vision problems, educational level, self-perception of health general status, and concern about body posture while texting on a smartphone.

Smartphone addiction was measured with the Smartphone Addiction Scale – Short Version (SAS-SV). The SAS-SV is a 10-question questionnaire that measures the subject smartphone addiction/dependence, with six answer options in each question: (1) "strongly disagree", (2) "disagree", (3) "somewhat disagree", (4) "somewhat agree", (5) "agree", and (6) "strongly agree". The total score of SAS-SV ranges from 10-60 points, with higher scores being a greater chance of being addicted to the smartphone.[18,19] As recommended by Kwon, Kim[18] 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.

The smartphone time use was measured with the question: "On a regular day, how much time do you spend reading, texting, and playing games on your smartphone?" participant have 9 answer options: "I use my cell phone only for calls", "less than 1 hour", and other options ranging from "more than 1 hour" to "more than 7 hours", as performed in a previous study.[16]

Information about perceived symptoms in the neck and upper extremities was collected using the question Are you currently experiencing any of the following symptoms? (a) pain in the upper part of the back/neck, (b) pain in the shoulders/arms/wrists/hands, (c) numbness/tingling in the hand/fingers. There were five response categories: (1) "no", (2) "yes, for less than a week", (3) "yes, for 1 week to 1 month", (4) "yes, for 1-3 months", (5) "yes, for more than 3 months". For clarity, there was an illustration in the questionnaire of an upper half body, with references to the body parts mentioned. In the analysis the responses were dichotomized as no (response category 1) and yes (response categories 2-5).[8]

The neck disability was assessed with the Neck Disability Index (NDI). The NDI is a 10-item questionnaire designed to assess neck pain and disability. This questionnaire is based on the Oswestry Index a 10-item measure designed to assess pain-related limitations in activities of daily living. The NDI is scored using a percentage of the maximal pain and disability score.[20] Patients scored between 0-4 points (0–8 %) were considered with no disability, patients scored between 5-14 points (10 – 28 %) were considered with mild disability, patients scored between 15-24 points (30–48 %) were considered with moderate disability, and patients scored between 25-34 points (50- 64 %) considered with severe disability, and patients scored between 35-50 points (70–100 %) were considered with complete disability.[21]

Data analysis

Statistical analyses were performed using the Statistical Package for Social Sciences (IBM® SPSS® Statistics, Inc., Chicago, IL, USA) Version 22. Descriptive summary statistics, including frequencies and percentages, were calculated. Chi-square test was used to evaluate differences between the NDI and smartphone use time with socio-demographic characters and musculoskeletal symptoms. A One-way ANOVA test was conducted to assess the impact on NDI and smartphone use time with age, SAS-SV and BMI, post-hoc t-test with the Bonferroni correction were employed to determine significant differences. A multiple linear regression model was used to evaluate the effect of the dependent variable SAS-SV and the independent variables in this model. All reported p-values were two-sided tests and were compared to a significance level of 5 %; differences were considered statistically significant at $p < 0,05$. Only results with this significance are reported in this paper.

RESULTS

Our sample was comprised of 228 participants. The mean age of participants was 29,4 (SD ± 10,6) years old, most of the subjects were female (67,5 %) and non-married (66,7 %), almost half were graduation students (44,7 %), good general health (44,7 %) and had some vision problem (41,7 %). The mean score of NDI was 32,3 (SD ± 09,2) and the mean score of SAS-SV was 30,9 (SD ± 8,8). Musculoskeletal symptoms showed a prevalence of 56,1 % for neck/upper back pain, 55,7 % for shoulder/upper extremities, and 32,9 % for hand/finger numbness. 54,4 % of the sample were concerned about their posture sometimes. On the other hand, gender ($P = 0,005$), general health ($P = 0,040$), neck ($P < 0,001$) and shoulder ($P = 0,021$) symptoms, and SAS-SV ($P < 0,001$) was statistically associated with the level of neck disability (table 1).

Table 1. Description of socio-demographic characteristics by NDI

		Overall		Moderate disability		Sever disability		Complete disability		p
		N	%	N	%	N	%	N	%	
Gender†	Male	74	32,5	20	27,0	40	54,1	14	18,9	0,005
	Female	154	67,5	21	13,6	76	49,4	57	37,0	
Marital status†	Single	152	66,7	24	15,8	78	51,3	50	32,9	0,430
	Married	76	33,3	17	22,4	38	50,0	21	27,6	
Educational Level†	Undergraduate	41	18,0	7	17,1	22	53,7	12	29,3	0,056
	Graduation	102	44,7	19	18,6	42	41,2	41	40,2	
	Post-graduation	85	37,3	15	17,6	52	61,2	18	21,2	
General health†	Good	102	44,7	22	21,6	59	57,8	21	20,6	0,040
	Moderate	85	37,3	13	15,3	37	43,5	35	41,2	
	Poor	41	18,0	6	14,6	20	48,8	15	36,6	
Vision problem†	Yes	95	41,7	16	16,8	46	48,4	33	34,7	0,610
	No	133	58,3	25	18,8	70	52,6	38	28,6	
Posture†	Often	69	30,3	19	27,5	33	47,8	17	24,6	0,082
	Sometimes	124	54,4	16	12,9	69	55,6	39	31,5	
	Rarely	29	12,7	4	13,8	13	44,8	12	41,4	
	Never	6	2,6	2	33,3	1	16,7	3	50,0	
Neck†	No	100	43,9	31	31,0	52	52,0	17	17,0	<0,001
	Yes	128	56,1	10	7,8	64	50,0	54	42,2	
Shoulder†	No	101	44,3	24	23,8	54	53,5	23	22,8	0,021
	Yes	127	55,7	17	13,4	62	48,8	48	37,8	
Hand†	No	153	67,1	30	19,6	76	49,7	47	30,7	0,656
	Yes	75	32,9	11	14,7	40	53,3	24	32,0	
SUT†	Low	108	47,4	22	20,4	54	50,0	32	29,6	0,660
	High	120	52,6	19	15,8	62	51,7	39	32,5	
Age††		29,4	10,6	30,8	11,2	29,6	10,1	28,4	11,1	0,498
SAS-SV††, *, **		30,9	8,8	26,3	9,7	31,6	8,3	32,4	8,3	<0,001
BMI††		24,8	5,5	25,2	4,0	24,7	6,0	24,9	5,4	0,854

SAS-SV - Smartphone addiction scale short version, SUT – Smartphone use time, BMI - Body Mass Index.

† P value has been calculated using Chi square test.

†† P value has been calculated using One-way ANOVA and data are given as mean ± SD.

* difference between Moderate disability and Sever disability, ** difference between Moderate disability and Complete disability.

The results of smartphone use time and socio-demographic characteristics are presented in table 2. The marital status (P = 0,015), educational level (P < 0,001), general heatlh (P = 0,029), and shoulder symptoms (P = 0,020) was statistically associated to the smartphone use time. There were differences between the different SUT groups with age ($F_{2,225}$ = 16,5, P < 0,001), and with SAS-SV ($F_{2,225}$ = 17,7, P < 0,001).

The stepwise multiple linear regression analysis is presented in table 3. The model 1 found an association between the NDI with scores on SAS-SV (F [1,226] = 7,929; P = 0,005; R^2 = 0,034). The model 2 found an association between the NDI and lower age with scores in SAS-SV (F [2,225] = 8,755; P < 0,001; R^2 = 0,071). The model 3 found an association between NDI, lower age and better educational level with scores in SAS-SV (F [3,224] = 7,439; P < 0,001; R^2 = 0,091). Ultimately, model 4 found an association between the NDI, lower age, better educational level, and higher smartphone time use with SAS-SV scores (F [4,223] = 12,177; P < 0,001; R^2 = 0,179).

Table 2. Description of socio-demographic characteristics by SUT

		Overall		Low		Midle		High		p
		N	%	N	%	N	%	N	%	
Gender†	Male	74	32,5	30	40,5	28	37,8	16	21,6	0,178
	Female	154	67,5	49	31,8	54	35,1	51	33,1	
Marital status†	Single	152	66,7	47	30,9	51	33,6	54	35,5	0,015
	Married	76	33,3	32	42,1	31	40,8	13	17,1	
Educational Level†	Undergraduate	41	18,0	13	31,7	11	26,8	17	41,5	<0,001
	Graduation	102	44,7	28	27,5	35	34,3	39	38,2	
	Post-graduation	85	37,3	38	44,7	36	42,4	11	12,9	
General health†	Good	102	44,7	45	44,1	35	34,3	22	21,6	0,029
	Moderate	85	37,3	25	29,4	33	38,8	27	31,8	
	Poor	41	18,0	9	22,0	14	34,1	18	43,9	
Vision problem†	Yes	95	41,7	33	34,7	33	34,7	29	30,5	0,932
	No	133	58,3	46	34,6	49	36,8	38	28,6	
Posture†	Often	69	30,3	28	40,6	22	31,9	19	27,5	0,284
	Sometimes	124	54,4	36	29,0	50	40,3	38	30,6	
	Rarely	29	12,7	11	37,9	8	27,6	10	34,5	
	Never	6	2,6	4	66,7	2	33,3	0	0,0	
Neck†	No	100	43,9	40	40,0	37	37,0	23	23,0	0,136
	Yes	128	56,1	39	30,5	45	35,2	44	34,4	
Shoulder†	No	101	44,3	45	44,6	31	30,7	25	24,8	0,020
	Yes	127	55,7	34	26,8	51	40,2	42	33,1	
Hand†	No	153	67,1	53	34,6	56	36,6	44	28,8	0,944
	Yes	75	32,9	26	34,7	26	34,7	23	30,7	
Age††, *, **, ***		29,4	10,6	33,7	12,5	29,6	9,6	24,2	6,4	<0,001
SAS-SV††, *, **, ***		30,9	8,8	26,9	8,4	31,4	7,8	35,0	8,5	<0,001
BMI††		24,8	5,5	31,3	9,1	30,9	7,7	35,1	10,3	0,675

SAS-SV - Smartphone addiction scale short version, SUT - Smartphone use time, BMI - Body Mass Index.

† P value has been calculated using Chi square test.

†† P value has been calculated using One-way ANOVA and data are given as mean ± SD.

* difference between low and midle SUT.

** difference between low and high SUT.

*** difference between midle and high SUT.

Table 3. Associations between SAS-SV and participants' characteristics, as assessed by multiple linear regression.

	Model 1			Model 2			Model 3			Model 4		
	B	SE	p	B	SE	p	B	SE	p	B	SE	p
NDI	0,177	0,063	0,005	0,151	0,062	0,016	0,161	0,062	0,010	0,127	0,059	0,034
Age				-0,164	0,054	0,003	-0,234	0,063	0,000	-0,148	0,062	0,019
Education Level							1,968	0,924	0,034	2,095	0,881	0,018
SUT										3,537	0,721	0,000
R^2	0,034			0,072			0,091			0,179		

Note: B = Beta, SE = Standard Error, NDI = Neck Disability Index, SUT = Smartphone Use Time.

DISCUSSION

The neck disability was associated with some components of sociodemographic data, higher smartphone addiction, and musculoskeletal symptoms. Most of the respondents were female, and the prevalence of neck disability was higher among female participants, a trend consistent with findings in other studies.[9,22,23] Chen et al.[24] suggest that women tend to use smartphones for communication and social networking, while men often use them for gaming and video consumption. Some epidemiological studies underscore the significance of neck

pain as a global health concern. In these studies, neck pain is identified as the ninth leading cause of years lived with disability among females and the eleventh leading cause among males worldwide.[24] An interaction between NDI and smartphone addiction has been observed, and research on this interaction is still limited. AlAbdulwahab et al.[6] explored this relationship between neck disability and smartphone addiction in healthy individuals, finding an association between these variables. However, musculoskeletal conditions were not included in this study.

Smartphone use time showed an association with several items related to the participants' characteristics. In the present study, we found that 19,3 % of subjects use their smartphones for more than 6 hours on a regular day. This result stands in contrast to Damasceno et al.[16] and Correia et al.[25] findings, where 51,3 % and 29,38 % of participants, respectively, reported using smartphones for more than 7 hours per day. However, it's important to note that the samples in these studies primarily comprised younger subjects when compared to present study's sample. Additionally, this study found that the longest duration of smartphone usage was consistently observed among younger individuals. The average age in this study was 29,41 years (± 10,60), indicating a higher mean age compared to prior research, who showed a lower age range from 18,4 (± 0,7) to 27,4 (± 8,8).[9,16,25] Increased smartphone usage was linked to reduced physical activity and diminished mental health. Excessive smartphone screen time demonstrated adverse effects, extending to the influence of other unhealthy lifestyle behaviors, like the consumption of junk food and sugar-sweetened beverages while using screens.[15] Moreover, it was associated with various health issues, including overweight, depression, and sleep disturbances.[14,15] However, these studies focused on adolescents and young individuals. Other studies involving adults and extended timeframes could provide valuable insights into how this behavior manifests in this context.

An association between smartphone time use and smartphone addiction also was found in this study. Previous study shows that more time spent on smartphone increases the probability of smartphone addiction.[26] Haug et al.[26] demonstrated that individuals who spend more than 5 hours on their smartphones during a typical day were approximately ten times more likely to be classified as smartphone addicts than those who use smartphones for less than 4 hours. Mustafaoglu et al.[9] used the long version of the smartphone addiction scale and found similar results to this study. The individuals in both studies[9, 26] were younger than this study and Haug et al.[26] had a sample with lower educational levels. Smartphone time use was associated with neck disability in adults. Bertozzi et al.[27] found that smartphone use in standing position had a significant correlation with the neck disability measured with the same instrument of this study. The mechanisms behind neck disability and smartphone use have been increasingly studied in recent years.[16,25] However, further research is warranted to gain a deeper understanding of this phenomenon. Smartphone addiction has a negative influence on physical activity amount in students,[27] and a lower level of physical activity is associated with neck pain and low back pain.[28,29] This can be an explanation of the association of smartphone time use with neck disability, although this study did not evaluate the level of physical activity among participants. However, more studies should be performed to explain the relationship between these hypotheses. In this study, individuals who spend more time on smartphones have a higher pain prevalence in the shoulder/upper extremities. This aligns with the findings of Ozdil et al.[23] study, which contrasts with other studies that found associations with both neck and shoulder symptoms.[4,8,9] The muscle activity in the upper trapezius is higher in subjects with chronic neck-shoulder pain than asymptomatic people when texting on a smartphone,[30] but these variables should be investigated in larger samples and with keypad smartphones in future studies for accurate conclusions.

The influence of age on smartphone addiction was evident, with younger individuals displaying a higher susceptibility to smartphone addiction. Additionally, the findings revealed that smartphone addiction was associated with factors such as neck disability, education level, and the amount of time spent using smartphones. However, more studies are needed to assess the impact of these variables with a wider age spectrum.

Limitations and study strength

The main limitation of this study is the cross-sectional design, without follow-up at different time points, because this design is not competent to find causal and prognostic effects. Cohort studies should be performed analyzing the relationship between neck disability, musculoskeletal symptoms, smartphone addiction, and smartphone time use in adults. Moreover, the individuals have not subdivided into chronic neck pain or acute neck pain. Previous studies show that most people with acute neck pain recover their symptoms until 6 weeks and chronic neck pain has a poorer diagnosis, with less than half of subjects recovering their symptoms until 1 year after inception[31] and these characteristics of clinical courses can be influence in analysis of this study. Despite this findings showing an older sample than other studies, the mean age of participants is still less than thirty years old, being needed more studies that investigate smartphone addiction and musculoskeletal symptoms in older adults and the elderly. Ultimately, the time spent on a smartphone on a regular day was measured subjectively, as well as, in other studies. Future studies should analyze the relationship between smartphone addiction, smartphone time use, neck pain and disability, and shoulder pain in longitudinal designs with the purpose of investigating causality and prognosis interactions through these variables.

In clinical practice, the healthcare professional should account for smartphone addiction in patients that present neck disability, because these variables have a positive correlation, as well as account for smartphone time use for detecting trending individuals that can be smartphone addicts. However, such results should be generalized with caution because they come from cross-sectional studies and, therefore, without competence to infer causality and prognosis through these variables.

CONCLUSIONS

Therefore, this study found that neck disability was associated with gender, general health, neck and shoulder symptoms, and smartphone addiction. Smartphone time use was associated with age, marital status, educational level, general health, shoulder symptoms, and smartphone addiction. Smartphone addiction was associated with higher neck disability level, lower age, higher educational level and higher smartphone use time. Clinicians should account for smartphone addiction in patients who present neck disability and account for smartphone time use for detecting trending individuals who can be smartphone addicts.

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The authors declare that there is no conflict of interest.

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