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Prevalence of smartphone addiction and associated factors in Brazilian adults

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Abstract

We aimed to evaluate the prevalence of smartphone addiction and associated factors in Brazilian adults. A cross-sectional study was carried out with a sample of 274 Brazilian smartphone users aged 18-59 years. Data were collected between April and July 2018 using three instruments: a sociodemographic/lifestyle questionnaire, the International Physical Activity Questionnaire, and the Mobile Phone Addiction Test. The Pearson correlation test and bi- and multivariate analyses were performed to check for potential associations between smartphone addiction and the study variables. The participants used the smartphone for 10.1 ± 4.73 hours a day. In all, 47.8% (n=131) of the participants were mildly addicted and 44.9% (n=123) were moderately addicted. Addiction was associated with the amount of use ($r=0.40$; $p=0.000$), age ($r=-0.20$; $p=0.001$) and neck pain (OR=1.912; $p=0.008$). In the multivariate analysis, strong smartphone addiction was associated with the amount of use (OR=1.766; $p=0.000$) and neck pain (OR=1.172; $p=0.037$). The prevalence of smartphone addiction was high in our sample and it was associated with the amount of smartphone use and neck pain.

Keywords: Smartphone; Addiction medicine; Neck pain; Risk factors; Adults

1. Introduction

Following the fusion of the smartphone with the internet, an array of features and applications have been introduced, including e-mail, messaging, games, business, social networks and geolocation, increasing the demand for mobile devices and making smartphone technology an essential component of daily life [1].

Brazil boasts one of the world's largest populations of smartphone users: devices are used to access the internet by 97% and to send text, voice and multimedia messages through a variety of applications by 95.5% [2]. Likewise, a recent Brazilian survey revealed very high indices of mobile device use. Thus, 87% of public health service users access the internet with smartphones [3].

However, the vulgarization of mobile devices has also brought negative impacts with it, such as the emergence of nomophobia—a new form of psychological distress. Though presently not defined as a disorder, nomophobia can be deleterious to mobile device users' health, inducing social, mental and behavioral changes and physical effects such as musculoskeletal symptoms [4, 5]. Smartphone addiction is a major health concern of the 21st century, affecting the work environment and personal relationships alike [6].

Earlier studies have reported disquieting levels of smartphone addiction (5-64%), depending on the country and on geographical and cultural factors [4]. A multicenter study found higher levels of addiction in Asian than American

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universities (11.15% vs. 6.36%) [7]. Likewise, the number of college students in Colombia, Spain and the US reporting smartphone-related health problems rose by 400% in the period between 2005 and 2017 [8].

Brazilian studies adapting and validating two instruments (the Smartphone Addiction Scale - Short Version, and the Smartphone Addiction Inventory) found a prevalence of 35% and 33% among university students [9, 10]. However, these results need to follow up by more extensive investigations in order to subsidize public policies for the awareness and prevention of smartphone addiction and its long-term consequences [11]. The purpose of the present study was to evaluate the prevalence of smartphone addiction and associated factors in a sample of Brazilian adults.

2. Material and methods

This cross-sectional and analytical study is part of an umbrella project on the association between cervical muscle-joint dysfunction and mobile device use at different ages conducted at a university in Fortaleza, with recruitment and data collection between April and July 2018. The study protocol was previously approved by the human research ethics committee of the University of Fortaleza (Coética/Unifor) and filed under entry #2.144.930. All participants gave their informed written consent. A state capital in Northeastern Brazil, Fortaleza lies on the shore of the Western Atlantic. With its 2,452,185 inhabitants, it is the fifth-largest metropolis in the country [Brazilian Institute for Geography and Statistics. Population, <https://cidades.ibge.gov.br/brasil/ce/fortaleza/panorama>, Last accessed on 03/05/2020]. The municipal human development index is 0.754 and 97% of the population use smartphones to access the internet [12].

The sample consisted of 274 adults aged 18-59 years. All were university students or staff and all reportedly used smartphones as a matter of routine. The exclusion criteria were diagnosis of discopathy, degenerative cervical fractures or lesions or history of surgery involving the spine, thyroid gland, head or neck, as self-reported at the time of recruitment. Seven subjects were excluded due to incomplete participation in the protocol of the umbrella project. The sample size was estimated based on a finite population of 1,436,575 adults (according to the population pyramid of the municipality of Fortaleza), a reported 18% prevalence of neck pain among mobile device users [13], a 5% level of accuracy, a 95% confidence interval, and a 20% increase to compensate for sample loss. The subjects were recruited by public call through posters displayed on the premises (lobby, hallways, academic centers, course coordination offices, main offices, personnel department) providing information on the time and place of the data collection. Those who accepted the invitation were asked questions about their use of smartphones. To do so, three questionnaires were used. In order to minimize sampling bias, the interviewers administering the questionnaires were previously trained.

The first instrument collected information on sociodemographic variables (sex, age, marital status, ethnicity/skin color, level of schooling, remunerative occupation, social class), the dominant upper limb, life style (smoking, sleep, alcohol consumption, satisfaction with weight), overall health, use of prescription glasses/lenses, and neck pain. The instrument was designed by the researchers based on a population survey. The second instrument was the short form of the International Physical Activity Questionnaire (IPAQ) which uses 8 questions to estimate how much time and effort is spent on physical activity in different settings, such as work, transportation, household chores and leisure. The IPAQ classifies physical activity into different levels [14]. In this study we adopted the dichotomy "sedentary vs. non-sedentary" (the latter including the categories 'very active', 'active' and 'not active enough'). The third instrument was the Mobile Phone Addiction Test (MPAT) which evaluates the level of smartphone addiction through 25 items scored on a 5-point Likert scale (never=1; always=5). The sum of the scores classifies the individual as having 'no addiction' (≤ 50), 'mild addiction' (51-75), 'moderate addiction' (76-99) or 'severe addiction' (≥ 100) [15]. However, for the sake of analysis, the variable was dichotomized into "weak addiction" (0-75) and "strong addiction" (≥ 76). A question was added to the instrument regarding the daily number of hours of mobile device use.

The collected data were submitted to descriptive and inferential statistical analysis using the software SPSS Statistics (v. 23.0). Qualitative variables were expressed as relative (%) and absolute (n) frequencies, while numerical variables were expressed as mean values \pm standard deviation. Some variables were dichotomized and analyzed with inferential statistics: marital status (single vs. non-single), skin color (white vs. non-white), social class (A/B vs. C/D/E), overall health (poor [from very poor to fair] vs. good [from good to excellent]) and smartphone addiction (weak vs. strong).

In the bivariate analysis, associations between the dependent variable (level of smartphone addiction) and the independent variables (sociodemographics, lifestyle and neck pain) were identified with Pearson's chi-squared test and raw odds ratios (OR) and their respective confidence intervals (CI). Correlations between smartphone addiction and amount of use, age and hours of sleep were tested with Pearson correlations, following confirmation of normality of distribution with the Kolmogorov-Smirnov test. Finally, a backward stepwise multivariate logistic regression was performed, adopting $p < 0.20$ as inclusion criterion in the model. Adjusted OR values and their respective confidence intervals were calculated, with the level of statistical significance set at 5%.

3. Results

The predominant sociodemographic characteristics in the sample were: female sex (69.0%, n=189), single status (88%, n=241), incomplete college education (81.4%, n=223), no remunerative occupation (74.8%, n=205), social class C (41.2%, n=113), and right-handedness (88.7%, n=243) (Table 1).

Table 1 Distribution of sociodemographic variables in a sample of 274 adult smartphone users. Fortaleza, Ceará, 2018.

Sociodemographic variables	n	%
Sex		
Male	85	31.0
Female	189	69.0
Marital status		
Single	241	88.0
Married	28	10.2
Separated	1	0.4
Divorced	4	1.5
Widowed	0	0.0
Ethnicity/skin color		
White	127	46.4
Black	9	3.3
Brown/mixed	124	45.3
Indigenous	1	0.4
Asian	13	4.7
Schooling		
Elementary school, incomplete	0	0.0
Elementary school, complete	1	0.4
High school, incomplete	1	0.4
High school, complete	19	6.9
College, incomplete	223	81.4
College, complete	30	10.9
Remunerative occupation		
Yes	69	25.2
No	205	74.8
Social class		
E	24	8.8
D	56	20.4
C	113	41.2
B	66	24.1
A	15	5.5
Dominant upper limb		
Right	243	88.7
Left	29	10.6
Both	2	0.7

The predominant lifestyle characteristics were: no history of smoking (84.3%, n=231), no sleep disturbances (74.8%, n=205), infrequent alcohol consumption (41.2%, n=113), good overall health (54%, n=148), sedentary lifestyle (50%, n=137), no neck pain (51.1%, n=140) and mild smartphone addiction (47.8%, n=131) (Table 2).

Table 2 Distribution of lifestyle, smartphone addiction and neck pain variables in a sample of 274 adult smartphone users. Fortaleza, Ceará, 2018.

Variables	n	%
Smoking		
Current smoker	4	1.5
Used to smoke	39	14.2
Never smoked	231	84.3
Sleep disturbances		
Yes	69	25.2
No	205	74.8
Alcohol consumption		
Never	86	31.4
Infrequently	113	41.2
Frequently	75	27.3
Satisfaction with weight		
Yes	89	32.5
No	185	67.5
Overall health		
Very poor	0	0
Poor	5	1.8
Fair	87	31.8
Good	148	54.0
Very good	34	12.4
Use of prescription glasses/lenses		
Yes	155	56.6
No	119	43.4
Physical activity profile		
Sedentary	137	50.0
Non-sedentary	137	50.0
Neck pain		
No	140	51.1
Yes	134	48.9
Smartphone addiction		
None	6	2.2
Mild	131	47.8
Moderate	123	44.9
Severe	14	5.1

The average age was 23 ± 6 years (range: 18-55), the amount of sleep per night was 6.4 ± 1.20 hours (range: 4.0-10.0), the mean MPAT score was 76.2 ± 12.88 (range: 42.0-112.0), and the daily amount of smartphone use was 10.1 ± 4.73 hours (range: 1.0-20.0).

Smartphone addiction was directly proportional to the amount of smartphone use ($r=0.40$; $p=0.000$) and inversely proportional to age ($r=-0.20$; $p=0.001$), but no association with the amount of sleep was observed ($r=-0.06$; $p=0.321$) (Figure 1). In addition, the amount of smartphone use was negatively associated with age ($r=-0.263$; $p=0.000$) (Figure 2).

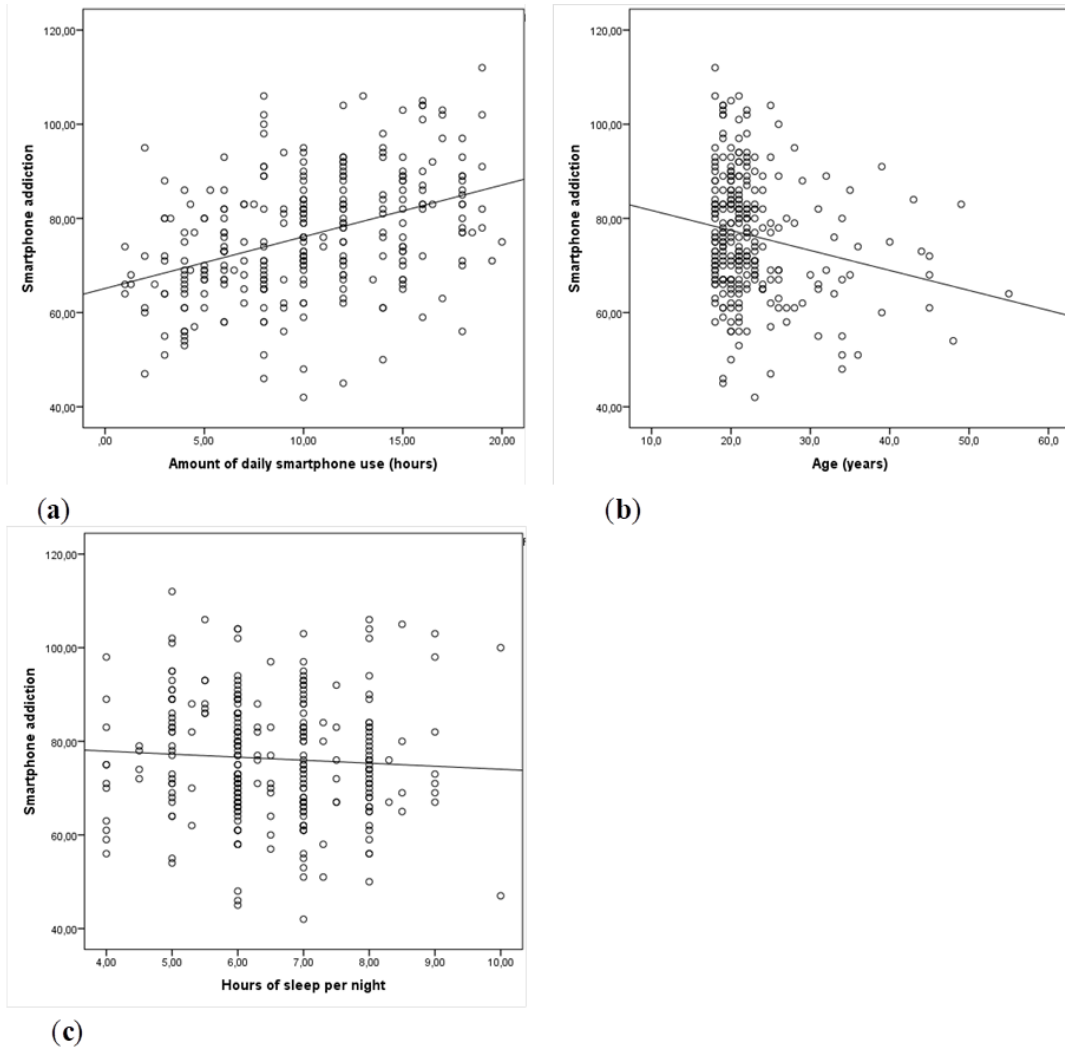


Figure 1 Correlation between smartphone addiction and the amount of daily use (a), age (b) and hours of sleep per night (c) in a sample of 274 adult smartphone users. Fortaleza, Ceará, 2018.

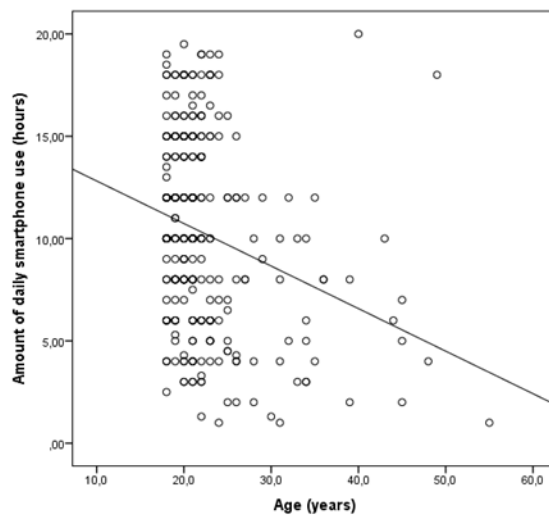


Figure 2 Correlation between the amount of daily smartphone use and age in a sample of 274 adult smartphone users. Fortaleza, Ceará, 2018.

In the bivariate analysis, strong smartphone addiction ($n=137$; 50%) was significantly associated with neck pain only ($OR=1.912$; $p=0.008$) (Table 3).

Table 3 Bivariate analysis of the association between smartphone addiction and sociodemographic variables, lifestyle and neck pain in a sample of 274 adult smartphone users. Fortaleza, CE, 2018.

Variable	Smartphone addiction		Raw OR (95%CI)	p-value
	Weak n (%)	Strong n (%)		
Sex				0.695
Male	44 (32.1)	41 (29.9)	1	
Female	93 (67.9)	96 (70.1)	1.108 (0.664-1.849)	
Marital status				0.095#
Single	116 (84.7)	125 (91.2)	1	
Non-single	21 (15.3)	12 (8.8)	0.530 (0.250-1.126)	
Self-reported skin color				0.716
White	62 (45.3)	65 (47.4)	1	
Non-white	75 (54.7)	72 (52.6)	0.916 (0.569-1.472)	
Remunerative occupation				0.210
No	98 (71.5)	107 (78.1)	1	
Yes	39 (28.5)	30 (21.9)	0.705 (0.407-1.220)	
Social class				0.354
E/D/C	100 (73.0)	93 (67.9)	1	
B/A	37 (27.0)	44 (32.1)	1.279 (0.760-2.152)	
Alcohol consumption				0.153#
No	43 (31.4)	43 (31.4)	1	
Infrequent	63 (46.0)	50 (36.5)	0.794 (0.452-1.393)	
Frequent	31 (22.6)	44 (32.1)	1.419 (0.760-2.650)	
Sleep disturbances				0.889
No	102 (74.5)	103 (75.2)	1	
Yes	35 (25.5)	34 (24.8)	0.962 (0.557-1.660)	
Satisfaction with weight				0.367
Yes	48 (35.0)	41 (29.9)	1	
No	89 (65.0)	96 (70.1)	1.263 (0.761-2.096)	
Physical activity profile				0.717
Sedentary	67 (48.9)	70 (51.1)	1	
Non-sedentary	70 (51.1)	67 (48.9)	0.916 (0.570-1.471)	
Overall health				1.000
Poor	46 (33.6)	46 (33.6)	1	
Good	91 (66.4)	91 (66.4)	1.000 (0.606-1.651)	
Poor eyesight				0.715
No	58 (42.3)	61 (44.5)	1	
Yes	79 (57.7)	76 (55.5)	0.915 (0.567-1.475)	
Neck pain				0.008*
No	81(59.1)	59 (43.1)	1	
Yes	56 (40.9)	78 (56.9)	1.912 (1.183-3.090)	

OR=odds ratio; 95% IC=95% confidence interval. Chi-squared test, *= $p < 0.05$. #=variable added to the multivariate analysis.

However, in the multivariate analysis, it was significantly associated with both neck pain (OR=1.172; $p=0.037$) and the amount of daily smartphone use (OR=1.766; $p=0.000$) (Table 4).

Table 4 Multivariate analysis of the association between smartphone addiction and independent variables in a sample of 274 adult smartphone users. Fortaleza, CE, 2018.

Variable	Raw OR (95%CI)	Adjusted OR (95%CI)	p-value
Age	-	0.974 (0.914-1.037)	0.405
Marital status	0.530 (0.250-1.126)	1.042 (0.339-3.203)	0.943
Alcohol consumption	1.419 (0.760-2.650)	1.132 (0.802-1.600)	0.480
Neck pain	1.912 (1.183-3.090)	1.766 (1.036-3.010)	0.037*
Amount of smartphone use	-	1.172 (1.103-1.245)	0.000*

OR=odds ratio; 95% IC=95% confidence interval. Raw OR was not calculated for age and amount of smartphone use in the bivariate analysis. Parameters of the final model: 0.151 (Cox & Snell); 0.201 (Nagelkerke); χ^2 of the model=44.863. *= $p<0.05$.

4. Discussion

A major public health concern today, smartphone addiction was investigated in the present study along with potentially associated sociodemographic, lifestyle and health factors. The excessive use of mobile device technology has led to the emergence of new pathologies, such as nomophobia. Indeed, the near ubiquity of internet access and the abundance of attractive smartphone features would appear to contribute to the development of addictive behaviors [4].

The predominant characteristics of our subjects were: female sex, young age, college student, single status, sedentary lifestyle, absence of sleep disturbances, good overall health, and alcohol consumption. This profile is similar to that reported in other studies on smartphone users in Asia, Latin America, Europe and the US [8, 9, 16].

Half our subjects were classified as being strongly addicted to the smartphone. Addiction was significantly associated with the amount of use and neck complaints. No other factor (e.g., age, single status or alcohol consumption) made it to the final regression model.

According to a systematic review, smartphone addiction among adults varies greatly depending on the country, the questionnaire employed and the sampling criteria, making comparisons between studies difficult [4]. An Arabian study on 935 social network users under 18 years of age found a 81% prevalence of smartphone addiction, associated with young age and depression [17]. A Libanese study on 249 college students aged 17-26 years concluded that 44.6% were at high risk of strong smartphone addiction, associated with stress and dissatisfaction with life [18]. Likewise, 40% of 110 Korean college students (especially women) aged 19-25 years were at risk, depending on the amount of use [1]. A slightly lower prevalence (35.6%) was found in a Brazilian study on 415 college students aged 18-25 years [9].

In our study, the amount of smartphone use (up to an average of 10 hours/day) was significantly associated with smartphone addiction. This is supported by studies from Arabia and Korea showing that increasing the amount of smartphone use represents a potential risk factor for addiction [1, 19]. The number of hours of smartphone use was smaller in those two studies (6 and 9 hours, respectively) than in ours.

The excessive smartphone use observed in our sample may be explained by the current profile of the Brazilian population. The topic was the object of a recent survey conducted by an international consulting firm. Findings based on interviews with eight thousand consumers from eight countries show that Brazilians ($n=1,021$) make frequent use of the smartphone throughout the day, consider internet connection the fourth-highest priority among their daily needs, and believe mobile device technology is an integral component of their lives [Oliver Wyman. <https://www.oliverwyman.com/br/noticias/2019/may/maioria-dos-brasileiros-sacrifica-habitos-de-consumo-para-priori.html>. Last accessed on 05/06/2020].

A significant association was observed in this study between smartphone addiction and neck pain. The latter is highlighted in a systematic review of 15 studies evaluating the relationship between musculoskeletal changes and mobile device use. The review shows a high prevalence of neck complaints among smartphone users (17.3-67.8%) and identifies four risk factors: neck flexion, frequency of phone calls, texting and gaming. 15 A longitudinal study also found

an association between smartphone use and episodes of neck pain in young adults (20-24 years), both in the short term (1 year) and in the long-term (5 years), though less so [20].

A posture associated with smartphone use, 'text neck' can cause neck pain by placing static stress on the muscles of the neck and shoulders [21, 22]. The cervical spine is subjected to additional forces when the head is flexed forward at varying degrees. According to one study, at the maximum tilt angle (60°), the weight seen by the spine surges to 60 lbs (27 kg) [23].

Spinal disorders represent a growing health burden worldwide. According to a survey covering the period 2005-2015, 21% of the world population suffers from neck problems, and the prevalence of neck-related disability has increased considerably over the past 25 years, in combination with the aging of the population [24]. In Brazil, neck dysfunction is a major cause of sick leave and illness benefit payouts—an alarming development for the public health system [Ministério da Fazenda. http://sa.previdencia.gov.br/site/2018/03/Auxilio-Doen%C3%A7a-Previdenciario_2017_completo_CID.pdf. Last accessed on 20/06/2020].

Despite the abundance of evidence for an association between intensive smartphone use and muscle-joint dysfunction, some controversy remains. Thus, a Brazilian study involving 150 students aged 18-21 years found no correlation between neck pain and smartphone-related neck flexion [25].

Other international studies have identified risk factors such as age, sex, lifestyle and mental health [4]. Age patterns are not entirely consistent across studies, but there is a consensus that youths under 30 years of age are more prone to smartphone addiction [7, 26]. With regard to gender, some authors believe women are more prone to improper use and addiction possibly because of greater fondness for multimedia applications and social networks [8, 27, 28].

A number of studies have found smartphone addicts to have inferior sleep quality and sleep fewer hours per night (about 4 hours) [29, 30]. Others have reported significant associations with alcohol consumption and low levels of physical activity [1, 27].

Based on these results, smartphone users are advised to abstain from excessive use and to maintain the cervical spine in the neutral position whenever possible. These recommendations are supported by studies proposing preventive and educational programs towards a healthier use of mobile devices, with emphasis on self-control [31, 32]. To avoid 'text neck', users should maintain an adequate posture, holding the device at the height of the eyes, supported by the arms - a strategy likely to reduce the risk of musculoskeletal disorders [21, 23].

Health professionals, managers, researchers and smartphone users should be made aware of the risk to physical and mental health posed by excessive use of mobile devices. All these stakeholders can contribute to the development of educational initiatives towards a better quality of life and a lessening of the negative impacts of smartphone addiction.

Our study was limited by the predominance of young college students in the sample, making it difficult to analyze variables relevant to older adults. Moreover, despite the use of sample size calculation and recruitment by public call, sampling was not perfectly random since it was limited to the premises of a teaching institution. Nevertheless, we believe our results are meaningful and make a significant contribution to current knowledge of the subject.

The study design may also have been affected by the small number of available Portuguese-language instruments for the evaluation of smartphone addiction. On the other hand, as shown by the literature, this limitation is recurrent in the field due to a considerable variation in terminology and instruments, often leading to inconsistent prevalences and low comparability.

5. Conclusion

The high prevalence of smartphone addiction observed in our sample was associated with the amount of device use and neck pain, but not with sociodemographic or lifestyle variables. Based on our results, we recommend implementing educational programs to promote a healthier use of mobile devices.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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