

Students' knowledge of cervical posture while using the smartphone
Conhecimento de estudantes sobre a postura da cervical durante o uso do smartphone
Conocimientos de los estudiantes sobre la postura cervical al utilizar un smartphone

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Abstract

Background: in today's world, we are facing a society dependent on smartphones. The repeated movements and the bad posture alongside its excessive usage promote musculoskeletal malfunctions.

Objective: evaluate the individual's knowledge about the cervical posture when using the smartphone, understand if there is any association between posture and the discomfort felt within the users and, understand the self-awareness of the individuals regarding the posture they use.

Methodology: analytical study conceived among 318 students, and it was applied a questionnaire to characterize. A significance level of 0.05 was used.

Results: 52 individuals had knowledge about the best cervical posture to adopt, and they indeed adopt it. There was an association of having knowledge and adopting good cervical posture with having less discomfort. This prior association was statistically significant when adjusted for age, BMI and schooling. The students who knew the correct posture, having the first smartphone between the ages of 8 and 10 was a risk factor (OR=3.77), and using the smartphone less than 3 hours was a protective factor (OR=0.44).

Conclusion: the individuals with the knowledge about good posture and who indeed adopt it while using their phones, revealed a tendency to have less discomfort.

Keywords: neck pain; information; self perception; digital technology

Resumo

Enquadramento: atualmente, estamos perante uma sociedade dependente dos smartphones. Os movimentos repetidos, a má postura e o uso excessivo, podem provocar disfunções músculo-esqueléticas.

Objetivo: avaliar o conhecimento dos indivíduos sobre a postura da cervical na utilização do smartphone, determinar se existe associação entre a postura e o desconforto, e perceber a autoperceção dos indivíduos em relação à postura que utilizam.

Metodologia: estudo analítico, em 318 estudantes, onde foi aplicado um questionário de caracterização. Utilizou-se um nível de significância 0,05.

Resultados: 52 indivíduos possuíam conhecimento sobre a melhor postura da cervical na utilização do smartphone e adotam-na. Houve associação entre ter conhecimento e adotar uma boa postura da cervical. Esta associação é estatisticamente significativa quando ajustada para a idade, IMC e escolaridade. Os estudantes que detinham conhecimento da postura cervical, ter tido o primeiro telemóvel entre os 8 e 10 anos foi fator de risco (OR=3,77), e utilizar o smartphone menos de 3 horas um fator protetor (OR=0,44).

Conclusão: os indivíduos com conhecimento acerca de uma boa postura e a adoção da mesma aquando da utilização do telemóvel, revelam uma tendência para apresentar menos desconforto.

Palavras-chave: dor cervical; informação; auto percepção; tecnologia digital

Resumen

Marco contextual: actualmente nos encontramos ante una sociedad dependiente de los smartphones. Los movimientos repetitivos y las malas posturas y lo uso excesivo pueden causar disfunciones musculoesqueléticas.

Objetivo: Evaluar el conocimiento de los individuos sobre la postura cervical al utilizar un smartphone, determinar si existe una asociación entre la postura y la incomodidad, y comprender la autopercepción de los individuos respecto a la postura que utilizan.

Metodología: estudio analítico sobre 318 estudiantes, y se aplicó un cuestionario para caracterizar. Se utilizó un nivel de significación de 0,05.

Resultados: 52 personas tienen conocimiento sobre la mejor postura del cuello para adotar y adoptan-na. Há una asociación entre tener conocimientos y adoptar una buena postura del cuello con menos molestias. Esta asociación, está estadísticamente significativa cuando se ajustó por edad, IMC y escolaridad. Los estudiantes que tenían conocimientos sobre la postura cervical, haber tenido su primer smartphone entre 8 y 10 años fue un factor de riesgo (OR=3,77), y usar el smartphone menos de 3 horas un factor protector (OR=0,44).

Conclusión: Los individuos que tienen conocimientos sobre la buena postura y que la adoptan mientras utilizan sus teléfonos, revelan una tendencia a tener menos molestias.

Palabras clave: dolor de cervicales; información; autopercepción; tecnología digital

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INTRODUCTION

Smartphone means “smart cellphone”. It contains the basic features of a mobile phone, as text messaging and calling. Additionally, it includes advanced features such as touch screen, Internet connection and

many different applications (Xie, Szeto, Dai, & Madeleine, 2016). The technological revolution set by these “pocket computers” is considered to be one of the greatest ever. The easy handling and the versatility of smartphones are two of the great attributes that have led to their massive impact in contemporary society (Panova & Carbonell, 2018). For example, in Europe, about 46% of the children between 9 and 16 years old already own a smartphone (Mascheroni & Ólafsson 2015), and that tendency, which grows with age, seems to be actually connected to the features of the smart cellphone. However, young adults are called “digital natives”, because they are the most frequent users of smartphones. This generation even depends on the resources of this device for their everyday life (Lopez-fernandez, Kuss, Romo, Morvan, & Kern, 2017). Thus, the smartphone is an essential part of the daily routine of young adults (Panova & Carbonell, 2018). They spend an average 2-4 hours a day using the device, which accounts to 700-1400 hours of cumulative use per year (Hansraj, 2014). Excessive use of smartphones originates static, long postures with flexion of the cervical spine (Ahmed & Abdel-aziem, 2016). The strong effort of this position, combined with a set of repetitive movements, can perhaps cause long-term musculoskeletal issues (Ahmed & Abdel-aziem, 2016; Damasceno et al., 2018; Lee, Kang, & Shin, 2015). The anterior posture of the head may cause shortening of the muscle fibres and stresses the muscles surrounding the atlanto-occipital joint. The incorrect cervical posture is for some believed to be one of the main causes of cervicgia, which in the worst cases can even decrease the quality of life (Ahmed & Abdel-aziem, 2016; Damasceno et al., 2018; Lee, Kang, & Shin, 2015). All of this pathophysiological process can be explained by the excessive use of the smartphone, because it makes the user look below the central viewing angle of the body, that is, moving the head forward to watch the screen of the smart cellphone (Damasceno et al., 2018; Santos, et al., 2017). The literature has designated the concept of Text Neck when referring to cervical pain that can extend to shoulders and upper limbs, caused by the constant use of smartphones. However, there is a gap between the knowledge of how young adults should use the smartphone correctly and the fast technological development of these mobile devices (Lopez-fernandez et al., 2017). Understanding the risk factors of the excessive use of smartphones, knowing about a good cervical posture when using the equipment and being able to apply that knowledge is essential for enjoying the benefits of using such equipment without putting the health at risk (Chow & Ma, 2017; Monteiro, 2009). It is critical to alert users for a greater knowledge about a correct cervical posture while using the smartphone, and to raise awareness among students about the fact that this behaviour can cause symptoms and even musculoskeletal syndromes on the cervical spine and upper limbs. Therefore, the purposes of this study aimed to evaluate the individual’s knowledge about the cervical posture when using the smartphone, secondly, understand if there is any association between posture and the discomfort felt within the users and, finally, understand the self-awareness of the individuals regarding the posture they use, and what do they consider as correct.

METHODOLOGY

Analytical cross-sectional study, where participation was voluntary, using a non-probability convenience sampling technique. Of the 320 potentially eligible students, two participants were excluded from the sample because they didn’t own a smartphone and they failed to complete the assessment tools used correctly, namely the socio-demographic questionnaire. The final sample consisted of 318 students enrolled and attending higher education in the school year 2018/2019 at Escola Superior de Saúde Vale do Sousa – CESPU. Firstly, we have asked for permission to carry out the study from the Ethics Committee of the Institution. Such permission was granted under the number 25/CE-IUCS/2018. All the volunteers received an informed consent under the Helsinki model, and the anonymity and confidentiality of data was guaranteed. The survey conducted for this study

consisted of multiple choice and short answer questions, with the purpose of characterizing the sample. Thus, the survey was divided into three groups, (1) sociodemographic characteristics, (2) psychosocial and physical factors on the use of smartphone, (3) questions about musculoskeletal symptoms. For the purpose of the study, it was necessary to understand the knowledge and self-awareness of the cervical posture adopted when using the smartphone. Therefore, based on the article published by Hansraj, (2014) e Damasceno et al. (2018), we have captured images for this very purpose. The images captured portray four different cervical postures during the use of the smartphone:



Figure 1 - A



Figure 2 - B



Figure 3 - C



Figure 4 - D

In this study, the perception of each student regarding cervical posture while using the smartphone was assessed through a question. In the four response options, Figure A, depicting 0° of cervical flexion, was considered to be the correct posture while using the smartphone (Hansraj, 2014). Figure B, with 15°, Figure C with 30° and finally, Figure D, with 45° of flexion, were all considered incorrect (Hansraj, 2014). Initially, we have made a descriptive analysis of the descriptive variables extracted from the sociodemographic questionnaire. For quantitative variables, we have used measures of dispersion and central tendency after testing their normality and, for qualitative variables, we have computed absolute and relative frequencies. We have performed an inferential analysis to evaluate the association between exposure variables and outcomes, specifically the knowledge about a correct cervical posture while using the smartphone, the discomfort associated to such use and the perception of each student about the posture he uses during the use of the smartphone. We have used the chi-square test. We have also resorted to binomial logistic regression models to quantify association measures (Odds Ratio) between the participants that have shown discomfort while using the smartphone, the knowledge about a good posture or lack thereof, and the adoption of such a good posture or not. Additionally, we have noted the risk factors that prevent students from adopting a good posture, even when they know about it. A significance level of 0.05 was adopted.

RESULTS

Of the 318 students, 205 (64.50%) individuals were female. The age of participants ranged from 15 to 47 years, with a median of 21 (IQR: 3). In terms of Body mass index (BMI), participants have shown a median of 21.87 (IQR: 3.56). At the same time, we have evaluated the use of the smart cellphone: 303 (95.30%) of the students use it in their spare time, whilst 271 (85.20%) individuals consider that this device is essential for their daily routine. Table 1 shows the characterization of the sample regarding the number of hours of smartphone use, as well as the age in which the participant has first owned a smart cellphone. It was found that 152 (47.80%) of the participants use the smartphone between 3h to 6h per day and 126 (39.60%) individuals, had their first smartphone between 10 and 12 years of age.

Table 1

Characterization of individuals regarding the number of hours of smartphone use and age of the first smartphone

	Frequency (n)	Percentage (%)
Using the <i>smartphone</i> <3 hours a day	98	30.80%
Using the <i>smartphone</i> ≥3 and ≤6 hours a day	152	47.80%
Using the <i>smartphone</i> ≥6 hours a day	68	21.40%
Owning the first <i>smartphone</i> <8 years old	25	7.90%
Owning the first <i>smartphone</i> ≥8 and <10 years old	92	28.90%
Owning the first <i>smartphone</i> ≥10 and <12 years old	126	39.60%
Owning the first <i>smartphone</i> ≥12 years old	75	23.60%

n: sample number; %: percentage; <: less than; >: greater than; ≤ less than or equal to; ≥ greater than or equal to.

We have found that, of the 318 students, only 52 had knowledge about a correct cervical posture and adopted that posture while using the smartphone. On the other hand, 120 individuals had no knowledge on the perception of the correct posture and revealed no interest in acquiring it. Table 2 shows that there is a relationship between discomfort, knowledge about the correct posture and adoption of said posture while using the smartphone. Students who have knowledge and adopt the correct cervical posture feel less discomfort (23.1%), even if the numbers are not statistically significant ($p=0.079$).

Table 2

Association between knowledge, adopting the correct posture and discomfort while using the *smartphone*.

	With discomfort while using the <i>smartphone</i> n(%)	Without discomfort while using the <i>smartphone</i> n(%)	<i>P</i>
Group 1 - Individuals have knowledge and adopt a correct posture	12 (23.1%)	40 (76.9%)	$p=0.079$
Group 2 - Individuals have knowledge but do not adopt a correct posture	42 (38.5%)	67 (61.5%)	
Group 3 - Individuals do not have knowledge but they try to obtain it	18 (48.6%)	19 (51.4%)	
Group 4 - Individuals do not have knowledge and they don't try to obtain it	47 (39.2%)	73 (60.8%)	

In the analysis of Table 3, after adjusting the variables age, BMI and education of students, the participants who have knowledge on the correct posture and adopt it have statistically relevant less discomfort when they use the smart cellphone (OR=0.47; CI 95%: 0.22-0.97) when compared to individuals who have no knowledge and don't try to obtain it.

Table 3

Assessment of discomfort on the 4 groups mentioned in the table, gross and adjusted for age, BMI and Education of Students (n = 119)

		Gross		Adjusted*	
		OR	95% CI	OR	95% CI
Group 1 - Participants have knowledge and adopt a correct posture		0.47	(0.22-0.96)	0.47	(0.22-0.97)
Group 2 - Participants have knowledge and do not adopt a correct posture		0.99	(0.58-1.69)	0.95	(0.55-1.63)
Group 3 - Participants do not have knowledge but they try to obtain it		1.47	(0.70-3.10)	1.51	(0.71-3.19)
Group 4 - Participants do not have knowledge and they don't try to obtain it		1	1	1	1
Age		1.03	(0.95-1.10)	1.03	(0.97-1.10)
BMI		1.02	(0.94-1.10)	1.02	(0.95-1.10)
Education	Higher Education	1.25	(0.64-2.50)	1.33	(0.70-2.60)
	Learning course	1	1	1	1

*Adjusted for Age, BMI and Education of individuals; OR: *Odds Ratio*; %: percentage; CI: confidence interval; BMI: Body Mass Index;

We have found that 142 participants consider that the most correct posture is A and, actually, only 4 of them affirmed to adopt that posture. We have also noticed that most of the students in this sample use posture C more frequently.

While assessing table 4, after adjustment for age, BMI and education of students, we have found that having a smartphone between 8 and 10 years old was associated OR= 3.77; CI 95%: 1.32-11.54) with not adopting a correct cervical posture. Regarding the number of hours a day that individuals use the smartphone, we have noticed that, the higher the number of hours, the lower the odds for adopting a posture known to be correct (for example: OR=0.44; CI 95%: 0.14-1.25 for not adopting a correct posture in the lowest category of time for smartphone use). However, none of the associations quantified in the categories of hours per day demonstrate statistical significance.

Table 4

Relationship between the age of ownership of the first *smartphone* and time of use and the absence of a correct posture, among students who consider to have knowledge about correct posture (n=161).

	Gross	Adjusted*

		OR	95% CI	OR	95% CI
Owning the first <i>smartphone</i> at <8 years old		1.04	(0.28-4.03)	1.09	(0.27-4.65)
Owning the first <i>smartphone</i> at ≥8 and <10 years old		3.33	(1.27-9.34)	3.77	(1.32-11.54)
Owning the first <i>smartphone</i> at ≥10 <12 years old		1.41	(0.62-3.12)	1.82	(0.72-4.68)
Owning the first <i>smartphone</i> at >12 years old		1	1	1	1
Using the <i>smartphone</i> <3 hours a day		0.53	(0.19-1.38)	0.44	(0.14-1.25)
Using the <i>smartphone</i> ≥3 and ≤6 hours a day		0.72	(0.27-1.78)	0.66	(0.24-1.68)
Using the <i>smartphone</i> ≥6 hours a day		1	1	1	1
Age		1.01	(0.95-1.10)	0.97	(0.90-1.05)
BMI		1.17	(1.04-1.33)	1.16	(1.03-1.33)
Education	Higher Education	2.47	(1.07-5.73)	2.51	(0.99-6.37)
	Learning course	1	1	1	1

*Adjusted for Age, BMI and Education; OR: *Odds Ratio*; %: percentage; CI: confidence interval; BMI: Body Mass Index; <: Less than; >: Greater than; ≤ Less than or equal to; ≥ Greater than or equal to;

DISCUSSION

After presenting these results, it is evident that the duration and frequency of smartphone use among students is high, and the knowledge on the correct cervical posture regarding the use of smartphone and subsequent adoption do not follow the profile characteristics. In the sample of this study, the age of the participants ranged from 15 to 47 years old. These data are consistent with a study conducted by Velthoven and colleagues (2018), who found that young adults are the most frequent smartphone users, since they depend on the functionalities of the equipment for their daily lives (Velthoven, Powell, & Powell, 2018). Effectively, with the new models of smartphones increasingly appealing, functional and with more versatile features young adults feel a greater need to use the mobile device (Ahmed & Abdel-aziem, 2016). Concerning the use of the smart cellphone, this study has found that 95.3% of students use it in their spare time, whereas 85.2% consider that this device is essential for their daily routine. These results are consistent with a study by Roberts et al (2014), that has concluded that about 60% of students are dependent of smartphones, and that they are also the population who uses this mobile device more frequently. Students consider this equipment to be an important part of their life, and they admit that they cannot spend a day without a smart cellphone (Roberts et al., 2014). Regarding the knowledge on the correct cervical posture while using the smartphone, we have noticed that 161 students claim to have such knowledge, against 157 participants who admit not having it. Among the students who have knowledge, only 52 reveal that they apply it when they use the mobile device. However, of the individuals who lack knowledge, 120 have no interest on searching for information on the correct cervical posture for the use of smartphones. The truth is that, nowadays, there is lack of knowledge about adopting a good cervical posture for the use of smartphones (Lopez-fernandez et al., 2017). While relating students with knowledge on the cervical posture for smartphone use and those who feel discomfort on that task, we have noticed that there is a link between discomfort, knowledge about a correct posture and adopting

such posture while using the smartphone. Students who have knowledge and adopt the correct cervical posture feel less discomfort (23.1%) than other individuals. Additionally, we have realised that the link between discomfort, knowledge about a correct posture and adoption of such posture while using the smartphone remained after the adjustment for age, BMI and education of the sample. Grimby-ekman et al., (2017) found, in a study, that there is a link between excessive exposure to smartphones and discomfort in the cervical spine, shoulders and tingling of upper limbs (Grimby-ekman, Hagberg, Gustafsson, & Thom, 2017). The increased frequency and duration of the exposure to smart cellphones cause concerns regarding the impact on the biomechanics of the cervical spine (Ahmed & Abdel-aziem, 2016; Chany, Marras, & Burr, 2007). During the exposure to a smartphone, the user frequently keeps it below the eye level; therefore, the cervical becomes anteriorly positioned and flexed. Maintaining this posture may originate musculoskeletal discomfort in this area and, consequently, in the upper limbs (Lee et al., 2015). This brings up the need for a synergy between understanding risk factors of using a smartphone excessively, knowing about a good use of the equipment and having the ability to apply such knowledge to prevent discomfort and a possible musculoskeletal syndrome (Chow & Ma, 2017; Monteiro, 2009). In this study, the Figure A, depicting 0° of cervical flexion, was chosen by 142 students as the correct posture. However, only 4 individuals used it frequently while exposed to smartphones. Most of them, 198 students, admit adopting the posture depicted in figure C, in which the cervical shows a 30° flexion. According to Hansraj (2014), the weight of an adult head is about 5 to 6 kilograms (kg). The head exerts a weight on the spine that increases proportionally to the flexion of the cervical. When the head is flexed at 15°, the weight increases to 12 kg, at 30° the weight rises to 18 kg. At 45° of cervical flexion, the head weighs 22 kg. While using the smartphone, keeping the cervical spine flexed and the shoulders in an anterior position recurrently and for long periods of time originates a loss of the natural curvature of the cervical that, later, causes muscular tension and deterioration of that region. Although it is difficult to avoid using the smartphone, users can make an effort and adopt a more correct cervical posture while exposed to the device. The correct posture is defined by the alignment of the ears with the shoulders and coapted scapulae. In this position, the stress on the column is reduced. For this position to be maintained, students must look at their smart cellphones with the cervical spine in a neutral position, to avoid spending so many hours a day with a flexed cervical (Hansraj, 2014). The posture depicted in Figure C, with 30° of cervical flexion, may cause the text neck syndrome if adopted recurrently, because the user watches the smartphone below the central viewing angle of the body, that is, moving the head anteriorly. This syndrome is common in students due to the excessive use of the smart cellphone (Damasceno et al., 2018; Santos, C. et al., 2017). Concerning the prevention of discomfort and the presence of musculoskeletal dysfunctions, it becomes necessary to actively intervene in the population that, in part, even admits having knowledge about the subject, but, however, does not adopt it. Thus, we have concluded that having the first cellphone between 8 and 10 years old (OR=3.77; IC 95%: 1.32-11.54) may be a risk factor for not adopting a good cervical posture, adjusted to age, BMI and education of students. These data are consistent with a study by Mascheroni & Ólafsson (2015), where it was found that, in Europe, children have cellphones increasingly earlier; from 9 to 16 years old, 46% already have their own mobile device (Mascheroni & Ólafsson 2015). On the other hand, it has been found that spending less hours a day using the smartphone helps to prevent the adoption of an incorrect cervical posture, although it isn't statistically relevant (OR=0.44; CI 95%: 0.14-1.25). According to Ahmed & Abdel-aziem (2016), it is necessary to educate students about the importance of a correct postural alignment of the cervical spine while using smartphones. It is also necessary to raise awareness through postural re-education from the first exposure (Ahmed & Abdel-aziem, 2016). In order to approach individuals who feel discomfort while using smartphones, with the purpose of achieving a recovery of cervical pain and, possibly, a reduction of relapses, it is advised to recommend exercises for stretching and strengthening of deep muscles of the cervical and shoulders (Harvard Medical School, 2014).

We have come across some limitations, such as the lack of studies that relate the importance of knowing a correct cervical posture to the exposure to smartphones. Additionally, the fact that scientific evidence is scarce about the correct cervical position when using a smartphone. The results obtained can provide useful information to substantiate future suggestions, such as the implementation of preventive programs to improve the way students use their smartphones. These programs, specifically regarding cervical posture, must be implemented in very young ages, considering the first exposure to the device. For those who already feel discomfort in using the smartphone, creating intervention programs for relieving such discomfort is also fundamental. Considering the several areas of expertise of physical therapy, it is relevant to increase health literacy on this matter.

CONCLUSION

In relation to having knowledge about the correct posture of the neck when using a smartphone, it was found that more students said to have knowledge than those who said they did not. We conclude that individuals who had knowledge on a good posture and adopted it during the use of smartphones reveal a tendency for less discomfort. This association remained regardless of age, BMI and education of individuals. Regarding the group that had the knowledge but didn't use it, we have noticed that owning the first smartphone between 8 and 10 years old was a risk for not adopting a good cervical posture and using the smartphone less than 3 hours a day prevents the adoption of an incorrect cervical posture while using the smart cellphone.

BIBLIOGRAPHIC REFERENCES

- Ahmed, A., & Abdel-aziem, A. A. (2016). ScienceDirect Exercise training and postural correction improve upper extremity symptoms among touchscreen smartphone users. *Hong Kong Physiotherapy Journal*, 35, 37–44. <https://doi.org/10.1016/j.hkpj.2016.06.001>
- Damasceno, G.M., Ferreira, A.S., Nogueira, C., Reis, F.J.J., Andrade, I.C.S., & Meziat-Filho, N. (2018). Text neck and neck pain in 18-21-year-old young adults. *Eur Spine J.*, 27(6), 1249-1254. DOI: [10.1007/s00586-017-5444-5](https://doi.org/10.1007/s00586-017-5444-5)
- Chany, A., Marras, W. S., & Burr, D. L. (2007). The Effect of Phone Design on Upper Extremity Discomfort and Muscle Fatigue. *Human Factors*. 49(4), 602–618. DOI: [10.1518/001872007X215683](https://doi.org/10.1518/001872007X215683)
- Chow, T. C., & Ma, W. W. K. (2017). Do We Really Know What People are Using Their Smartphone for?. *International Symposium on Educational Technology* 1–5. DOI: [10.1109/ISET.2017.16](https://doi.org/10.1109/ISET.2017.16)
- Monteiro, M. (2009). *A literacia em saúde* (Tese de Mestrado). Universidade Lusófona de humanidade e Tecnologias
- Grimby-ekman, A., Hagberg, M., Gustafsson, E., & Thom, S. (2017). Texting on mobile phones and musculoskeletal disorders in young adults: A five-year cohort study. *Applied Ergonomics*, 58, 208–214. <https://doi.org/10.1016/j.apergo.2016.06.012>
- Hansraj, K. K. (2014). Assessment of Stresses in the Cervical Spine Caused by Posture and Position of the Head. *Surgical Technology International XXV*, 1–3.
- Harvard Medical School. (2014). *How to soothe a sore neck*. https://community.alumni.harvard.edu/give/50398038?appealcode=M1931%20&utm_source=appeal&utm_medium=website&utm_campaign=hms_appeal_flagship&utm_content=aad_all_users_2021-11-09
- Kapandji, I.A. (2000). *Fisiologia articular: esquemas comentados de mecânica vertebral: tronco e coluna vertebral*.

- Lee, S., Kang, H., & Shin, G. (2015). Head flexion angle while using a smartphone. *Ergonomics*, 58(2), 220-226 <https://doi.org/10.1080/00140139.2014.967311>
- Lopez-fernandez, O., Kuss, D. J., Romo, L., Morvan, Y., & Kern, L. (2017). Self-reported dependence on mobile phones in young adults: A European cross-cultural empirical survey. *Journal of Behavioral Addictions*, 6(2), 168-177 <https://doi.org/10.1556/2006.6.2017.020>
- Mascheroni, G., & Ólafsson, K. (2016) The mobile Internet: Access, use, opportunities and divides among European children. *New Media & Society*. 18(8),1657-1679. DOI: [10.1177/1461444814567986](https://doi.org/10.1177/1461444814567986)
- Panova, T., & Carbonell, X. (2018). Is smartphone addiction really an addiction?. *Journal of Behavioral Addictions* 7(2), 252–259. <https://doi.org/10.1556/2006.7.2018.49>
- Richards, K. V, Beales, D. J., Smith, A. J., Sullivan, P. B. O., & Straker, L. M. (2016). Neck Posture Clusters and Their Association With Biopsychosocial Factors and Neck Pain in Australian Adolescents. *Physical Therapy*, 96(10), 1576–1587. <https://doi.org/10.2522/ptj.20150660>
- Roberts, J. A., Honore, L. U. C., Yaya, P., & Manolis, C. (2014). The invisible addiction: Cell-phone activities and addiction among male and female college students. *Journal of Behavioral Addictions*, 3(4), 254–265. DOI: <https://doi.org/10.1556/jba.3.2014.015>
- Santos, C., et al. (2017). Correlações Clínicas entre variações anatómicas sensitivas no plexo nervoso cervical com quadros de cervicalgia da síndrome do text neck (pescoço de texto) por uso indevido de smartphones. *Semana De Pesquisa E Extensão Da Universidade Tiradentes - SEMPESq-SEMEX*, (19). <https://eventos.set.edu.br/sempesq/article/view/8022>
- Velthoven, M.H.V., Powell, J., & Powell, G. (2018). Problematic smartphone use: Digital approaches to an emerging public health problem. *Journal of Marketing* 4, 1-9. <https://doi.org/10.1177/2055207618759167>
- Xie, Y., Szeto, G.P.Y., Dai, J., & Madeleine, P. (2016). A coparison of muscle activity in using touchscreen smartphonem among young people with and without chronic neck – shoulder pain. *Ergonomics*, 59(1), 61-72 DOI: [10.1080/00140139.2015.1056237](https://doi.org/10.1080/00140139.2015.1056237)