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Neck pain, disability and mobile phone usage among physiotherapy students – a cross-sectional study

Agata Czępińska[1,A-B,D] ✉, **Magdalena Zawadka**[1,B-C,E], **Piotr Gawda**[1,E-F]

[1] *Department of Sports Medicine, Faculty of Health Sciences, Medical University, Lublin, Poland*
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Abstract

Introduction and Objective. Modern mobile devices have become tools used for educational, research, business or recreational purposes. Incorrect position during excessive use of a smartphone can lead to biomechanical changes, the most visible of which is the position of the head in protraction, characterized by the protrusion of the head and neck forward in relation to the shoulder girdle and trunk. The aim of the study was to analyze the relationship between disability, neck pain (NP), use of phones before bedtime, and hours of using smartphones.

Materials and method. The study involved 146 physiotherapy students aged 18–26. Students were asked to complete pain surveys (VAS pain scale), and Neck Disability Index (NDI). Participants were also asked if their pain lasted longer than 3 months, how long they used their smartphone during the day, and whether they used it before bedtime.

Results. Statistically significant differences were found between groups with and without neck pain regarding NDI score ($p<0.001$). Participants who suffered from neck pain longer than 3 months had greater NDI scores ($p=0.03$), greater intensity of symptoms ($p=0.04$), greater problems with reading ($p<0.01$) and driving ($p=0.04$) than participants who experienced pain for less than 3 months. Using phones before bedtime was related to problems with focusing ($p<0.01$). There were statistically significant correlations between the time of phone use and disability in terms of reading ($p=0.04$), focusing ($p<0.001$), work ($p<0.001$) and sleeping ($p=0.02$).

Conclusions. Dysfunctions associated with pain in the cervical section may affect the learning abilities of students and thus the acquisition of professional competencies. Not using a smartphone before bedtime is recommended, as it causes poorer concentration. The longer the time spent using the phone, the more significant the disability.

Key words

students, neck pain, disability, smartphone users

INTRODUCTION

Musculoskeletal (MSK) disorders are one of the leading causes of disability worldwide [1]. One such disorder is neck pain (NP). Among college students, the prevalence of NP is very high (48%-78%) [2, 3] and can have a profound effect on well-being, with significant impairments in physical and mental health [4]. In particular, studies have shown that risk factors for NP include poor posture and smartphone use [5–7]. In the modern world it is difficult to imagine life without smartphones. Modern mobile devices are used not only to contact other people through conversations, sending text messages or e-mails, but they have also become a tool used for educational, research, business or recreational purposes [8]. Access to technological innovation, including smartphones, and their high usability have influenced our lifestyle and our habits [9]. According to research by Melumad and Pham, the average time spent on a smartphone is over 3.5 hours a day with no signs of fatigue [10]. In the United States in 2017, approximately 96% of 18–24-year-olds used cell phones 2.5 hours a day, and 97.7% of cell phone use was by smartphones [11]. Among students in Poland, text messaging (SMS) has emerged as the most frequently used means of communication [12]. Incorrect position during excessive use of the smartphone can lead to biomechanical changes, the most visible of which is the position of the head in protraction, characterized by the protrusion of the head and neck forward in relation to the shoulder girdle and trunk [13, 14]. This position places more strain on the cervical spine, while putting too much strain on the muscles, mainly the trapezius, sternocleidomastoid, scalene and suboccipital muscles, which must counteract the gravitational forces to support the weight of the head [1, 15].

Smartphones have become part of the lives of young adults who have grown up with them [16], however, despite the benefits, they can also negatively affect health. Excessive use of smartphones is associated with various health problems to which young people who are the main users are exposed [17].

Research has shown that excessive smartphone use among college students is associated with anxiety, stress, depression and sleep disorders, and may affect their psychological well-being [18]. Studies show that a forward-facing head position when using electronic devices may be one of the risk factors for MSK pain [8–10]. In Canada, 84% of students using smartphones experienced MSK pain, and the neck was the most frequently reported area [19]. The same results were observed among students in Saudi Arabia, where cervical pain

✉ Address for correspondence: Agata Czępińska, Department of Sports Medicine, Faculty of Health Sciences, Medical University, Lublin, Poland
E-mail: agataczepinska@umlub.pl

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was reported by 72,6% of respondents [20]. MSK symptoms, such as discomfort and pain, do not only occur in the neck in smartphone users. They can also appear in other areas of the body, including the shoulders, elbows, arms, wrists, hands, thumbs, and fingers [4, 11, 12]. An increased amount of time spent on a smartphone before bedtime makes the user more susceptible to mental anxiety and sleep disorders [21]. A study conducted in Morocco showed that students who use smartphones before bed are sleep-deprived, tired, irritated and suffer from headaches [22].

The aim of the study was to analyze the relationship between disability, NP, use of phones before bedtime, and hours of using phones. In this cross-sectional study, participants were compared according to the presence of NP (1), duration of the NP (2), and usage of phone before bedtime (3).

MATERIALS AND METHOD

A cross-sectional study was conducted from January – February 2023 at the Medical University of Lublin in eastern Poland. This study involved 146 students, both males and females. Convenience sampling was used o collect participants for our study. However, a comparable number of participants were included in a previous study on MSK pain among students using mobile devices [19]. The study was approved by the Bioethics Committee (KE-0254/257/12/2022) and was carried out in accordance with the ethical principles of the Declaration of Helsinki. All participants were informed about the aims of the study, given the opportunity to ask any questions and to withdraw from it at any point and gave their written consent to participate in the study. The criteria for selecting participants for the study were: age group 18–25 years, physiotherapy students with the ability to understand and complete the survey in Polish and willingness to participate in the study. We excluded participants from this study if they reported cervical spine injury.

Methods. All participants completed a survey consisting of questions regarding smartphone usage, NP, and disability. The average pain intensity in the last 24 hours was measured using the visual analog pain scale (VAS) [23]. The participants were asked to give a score between 0–10cm (0 points = no pain, 10 points = highest pain).

The Polish version of the Neck Disability Index (NDI–Polish Version) questionnaire, the most commonly used questionnaire to measure disability related to NP, was used to assess the degree of disability [24]. The items in the questionnaire are pain intensity, personal care, lifting, reading, headache, concentration, work, driving, sleeping and recreation. The participant is instructed to circle the single answer that best describes his/her condition (0–5). The cumulative result is presented on a 0–50 point scale or 0–100% percentage [25]. The higher the score, the greater the disability in the neck area. The internal consistency of each questionnaire was assessed using Cronbach's alpha, standardized Cronbach's alpha and inter-item correlation. An acceptable value for Cronbach's alpha ranges between 0.6–0.8. An inter-item correlation >0.30 was considered acceptable [26]. Cronbach's alpha in the study demonstrated acceptable internal consistency (Cronbach alpha = 0.62, standardized alpha = 0.70, average inter-item correlation = 0.32).

Participants were also asked if their pain lasted longer than 3 months and how much time per day they use their smartphone. At least a week before the study, they were asked to install an application measuring the time of using a smartphone in order to honestly answer the question. They were also asked if they use a smartphone before bedtime.

Data analysis. Data analysis was conducted using Statistica software (ver. 13.1, TIBCO Software Inc., Palo Alto, CA, USA). Normal distribution of the data was verified with the Shapiro-Wilk test. Due to non-normally distributed data, the Mann-Whitney U- test was used to determine differences between the 2 groups. Effect sizes (ES) were interpreted as: small (0.1–0.3) moderate (0.3–0.5.) and large (>0.5) (Tomczak & Tomczak, 2014). The Spearman rank correlation was used to examine the relationships between the time of phone usage and disability parameters (0. – 0.5 -low, 0.5–0.7 moderate and <0.7 strong correlation). The data are presented as means (M), medians (Me), minimal (Min) and maximal (Max) values, and standard deviations (SD). The alpha level was set at $\alpha<0.05$ [27].

RESULTS

Participants (n=4) who reported a cervical spine injury were excluded from the study. Sixty-seven (46%) students reported NP not related to the injury (45 females, 22 males). The average pain intensity measured by VAS was 3.27±1.69. Among the subjects who report NP, four (6%) participants took painkillers and 17 (25%) people reported neurological symptoms (numbness. tingling of the hands. muscle weakness, sensory disturbances in the upper limbs). Twenty-four (36%) participants reported pain lasting more than 3 months. There were 75 participants in the control group without NP (42 males, 33 females).

Participants reporting cervical pain had a mild disability (62.69%), no disability (34.33%), or moderate disability (2.99%). Among those who did not report pain, 58.67% had no disability and 41.33% had a mild disability. In both groups (with and without pain), about half of the respondents used a phone for more than 4 hours a day.

The largest percentage of respondents (exceeding 50%) indicated a disability related to headaches (73.94%), concentration (71.83%) and reading (56.34%).

Statistically significant differences were found between groups with and without NP in terms of age ($Z=3.84$; $p<0.001$), NDI score ($Z=4.07$; $p<0.001$), intensity of symptoms ($Z=6.94$; $p<0.001$), reading ($Z=4.39$; $p<0.001$), headache ($Z=2.11$; $p=0.04$) driving a car ($Z=4.26$; $p<0.001$) and rest ($Z=4.78$; $p<0.001$). Students who declared NP, reported greater disability in those aspects and were slightly older (Tab. 1).

Participants who had suffered from NP for longer than 3 months had greater NDI scores ($Z=-2.17$; $p=0.03$), greater intensity of symptoms ($Z=2.10$; $p=0.04$), bigger problem with reading ($Z=-3.38$; $p<0.01$), and driving ($Z=-2.45$; $p=0.04$) (Tab. 2).

Using phones before bedtime was related to slightly lower age ($Z=2.37$; $p=0.02$), greater NDI score ($Z=2.71$; $p<0.01$), and bigger problems with focusing ($Z=2.82$; $p<0.01$) (Tab. 3).

There were statistically significant weak positive correlations between the time of phone use and NDI score

Table 1. Comparison of groups regarding NP presence

Variable	Neck pain N=67					Controls N=75					Statistics	
	Mean	Std.Dev.	Median	Min	Max	Mean	Std.Dev.	Median	Min	Max	Z	P-value
Age	21.46	1.82	21	18	26	20.36	1.67	20	18	25	3.84	<0.001 ES=0.32
Weight	69.45	15.88	64	43	120	73.25	15.46	72	46	122	-1.74	0.08
Height	172.37	9.58	171	155	198	174.92	9.76	175	154	195	-1.64	0.10
BMI	23.20	3.93	22.68	16.59	39.18	23.77	3.76	23.89	17.30	39.84	-1.28	0.20
Time using phone [h]	4.74	2.09	4	1.5	10	4.28	1.62	4	1	10	0.57	0.57
Sum NDI	6.30	3.37	6	0	15	4.01	2.83	4	0	12	4.07	<0.001 ES=0.34
Intensity	0.79	0.79	1	0	3	0.05	0.28	0	0	2	6.94	<0.001 ES=0.58
Care	0.01	0.12	0	0	1	0.00	0.00	0	0	0	1.04	0.30
Lifting	0.16	0.37	0	0	1	0.07	0.25	0	0	1	1.82	0.07
Reading	0.90	0.63	1	0	2	0.44	0.60	0	0	3	4.39	<0.001 ES=0.37
Headache	1.49	1.06	2	0	5	1.13	1.03	1	0	4	2.11	0.04 ES=0.18
Focusing	1.30	1.02	1	0	5	1.20	1.07	1	0	5	0.74	0.46
Work	0.43	0.63	0	0	2	0.39	0.57	0	0	2	0.28	0.78
Driving a car	0.43	0.61	0	0	2	0.08	0.27	0	0	1	4.26	<0.001 ES=0.36
Sleeping	0.54	0.89	0	0	4	0.65	1.10	0	0	5	-0.24	0.81
Rest	0.27	0.45	0	0	1	0.00	0.00	0	0	0	4.78	<0.001 ES=0.40

Table 2. Comparison of groups regarding NP duration

	Pain>3 months n=24					Pain<3 months n=43					Statistics	
	Mean	Std.Dev.	Median	Min	Max	Mean	Std.Dev.	Median	Min	Max	Z	P-value
Age	21.75	1.80	23	18	24	21.30	1.83	21	18	26	-1.09	0.28
Weight	72.38	15.98	66.5	53	120	67.81	15.78	63	43	115	-1.45	0.15
Height	173.42	9.35	172.5	158	188	171.79	9.76	170	155	198	-0.73	0.46
BMI	23.95	4.24	23.45	18.38	39.18	22.78	3.72	22.04	16.59	36.00	-1.33	0.18
Vas	3.88	2.11	3	1	7	2.93	1.32	3	0	6	-1.57	0.12
Time using phone [h]	4.92	1.92	4.47	1.50	8	4.64	2.19	4	2	10	-0.87	0.39
Sum NDI	7.67	3.85	7	1	15	5.53	2.84	6	0	13	-2.17	0.03 ES=0.27
Intensity	1.08	0.88	1	0	3	0.63	0.69	1	0	2	-2.10	0.04 ES=0.26
Care	0.00	0.00	0	0	0	0.02	0.15	0	0	1	0.72	0.47
Lifting	0.21	0.41	0	0	1	0.14	0.35	0	0	1	-0.71	0.48
Reading	1.25	0.61	1	0	2	0.70	0.56	1	0	2	-3.38	<0.01 ES=0.41
Headache	1.63	1.21	1	0	5	1.42	0.98	2	0	3	-0.25	0.80
Focusing	1.42	1.25	1.5	0	5	1.23	0.87	1	0	3	-0.41	0.68
Work	0.63	0.71	0.5	0	2	0.33	0.57	0	0	2	-1.85	0.06
Driving a car	0.71	0.75	1	0	2	0.28	0.45	0	0	1	-2.45	0.04 ES=0.30
Sleeping	0.42	0.72	0	0	3	0.60	0.98	0	0	4	0.53	0.59
Rest	0.42	0.50	0	0	1	0.19	0.39	0	0	1	-2.02	0.12

Table 3. Comparison of groups regarding phone usage before bedtime

	Bedtime using n=104					Controls n=38					Statistics	
	Mean	Std.Dev.	Median	Min	Max	Mean	Std.Dev.	Median	Min	Max	Z	P-value
Age	21.08	1.81	20.50	18	26	20.34	1.76	20	18	24	2.37	0.02 ES=0.20
Weight	70.74	15.85	67.50	43	122	73.42	15.40	71	51	110	-0.92	0.36
Height	173.23	9.15	172.00	157	196	175.05	11.18	175	154	198	-1.00	0.32
BMI	23.40	4.08	22.79	16.59	39.84	23.76	3.10	23.46	17.13	30.03	-1.00	0.32
Vas	3.21	1.74	3	0	7	3.47	1.55	3	2	7	-0.51	0.61
Time using phone [h]	4.66	1.85	4.36	1	10	4.04	1.85	4	1	10	1.89	0.06
Sum NDI	5.47	3.18	5	0	15	4.05	3.40	3	0	15	2.71	<0.01 ES=0.23
Intensity	0.42	0.68	0	0	3	0.34	0.71	0	0	2	1.05	0.29
Care	0.01	0.10	0	0	1	0.00	0.00	0	0	0	0.59	0.56
Lifting	0.12	0.32	0	0	1	0.11	0.31	0	0	1	0.16	0.87
Reading	0.70	0.65	1	0	3	0.53	0.65	0	0	2	1.52	0.13
Headache	1.37	1.05	1	0	5	1.13	1.07	1	0	3	1.15	0.25
Focusing	1.39	1.09	1.50	0	5	0.84	0.75	1	0	2	2.82	<0.01 ES=0.24
Work	0.43	0.62	0	0	2	0.34	0.53	0	0	2	0.66	0.51
Driving a car	0.27	0.51	0	0	2	0.18	0.46	0	0	2	1.02	0.31
Sleeping	0.65	1.04	0	0	5	0.45	0.89	0	0	4	1.12	0.26
Rest	0.13	0.33	0	0	1	0.13	0.34	0	0	1	-0.10	0.92

Table 4. Correlation of disability parameters, VAS, BMI and time of phone usage (hours per day)

Variables	R	p-value
BMI	0.01	0.99
VAS	0.22	0.07
Sum NDI	0.31	**<0.001**
Intensity	0.12	0.16
Care	-0.02	0.80
Lifting	0.03	0.76
Reading	0.17	**0.04**
Headache	0.03	0.71
Focusing	0.36	**<0.001**
Work	0.37	**<0.001**
Driving a car	0.16	0.06
Sleeping	0.19	**0.02**
Rest	0.06	0.45

(r=0.31; p<0.001), reading (r=0.17; p=0.04), focusing (r=0.36; p<0.001), work (r=0.37; p<0.001), and sleeping (r=0.19; p=0.02) (Tab. 4). The longer the time spent on phone use, the greater the ND.

DISCUSSION

The obtained results show that people with NP have worse results in the NDI. Students declaring NP reported greater disability in severity of symptoms: reading, headache, driving and rest, which can affect their safety and ability to study.

Physiotherapy is one of the medical faculties at universities. Students of this field have a lot of practical and physical activities and are mostly in good physical shape. However, students also spend many hours a day in environments characterized by prolonged sitting [28]. Many studies show a relationship between overuse of the phone and the occurrence of disability [29–31]. This study revealed that there was no student in this sample without a smartphone. Although a smartphone addiction questionnaire was not used, in both groups (with and without pain) about half of the respondents used the phone for more than 4 hours a day. The Shoukat and Sehar study showed that overusing a smartphone for more than 3 hours a day is associated with sleep disorders, stress, anxiety and depression [32]. In a large-scale cross-sectional study by Chan et al., among all respondents, the highest incidence of NP was reported by students of physiotherapy, nursing and the arts [33]. From their conclusions, it can be seen that students who use a smartphone for a long time are at risk of developing NP.

Due to the access to many needed functions, smartphones were used for a long time daily by Filipino students [34]. The results Canaria at al. show that most smartphone users spend an average of 4–7 hours a day in front of a screen. The complaints encountered by the majority of respondents were NP, eye strain, headache, hand/finger pain, neck numbness and strain [13, 34].

In the current study, the largest percentage of respondents (exceeding 50%) indicated a disability related to headaches (73.94%). Also in the group with NP, more respondents suffered from headache, and according to Falavigna et al., headaches are much more common among college students than the rest of the population [35]. Stress, sleep disorders, prolonged reading and excessive smartphone use can cause headaches in students. Headache can also affect performance

and largely productivity among smartphone users [36, 37]. The results of a cross-sectional study also suggest that headache may be related to the use of a smartphone [37], and was the first study to show a link between the extent of smartphone usage and headache in university students. The results show that pain ailments were related to the intensity of smartphone use.

Participants who suffered from NP for more than 3 months were found to have higher NDI scores. This would suggest that the longer NP lasts, the more it affects functionality, significantly worsening reading and driving abilities. In the current study, using phones before bedtime was related to greater problems with focusing and slightly lower age. Evening use of a smartphone was the cause of going to sleep later, longer latency, and poorer sleep quality. It is also related to feeling tired during the day [38], and in the opinion of the authors of the current study, may have an impact on worse concentration. Evidence shows that adequate sleep maintains mental and physical health [39], and that good quality sleep at the right time can also improve learning and memory [40]. This is very important for students who spend much of their time studying which requires focusing. In the SH Paik et al. study, which involved people aged 20–39, it was found that the use of a smartphone in bed was positively correlated with the tendency to smartphone addiction. Their results suggest that using a smartphone before bedtime may be associated with problematic smartphone use, but had no effect on sleep quality [30].

The results of the current study show that the respondents who spent more time using smartphone had greater disability. Statistically significant weak positive correlations were found between phone use time and NDI, reading, concentration, working and sleeping. This is supported by studies in which respondents who were at high risk of smartphone addiction had a higher score in the NDI [31]. A systematic review also found that time spent using smartphones is directly proportional to the development of MSK disorders in the neck, shoulders and lower back [41]. Ladeira et al. found in their study that there is a high incidence of cervical pain in final year physiotherapy students, and that there was a correlation between NDI, NP, and excessive smartphone use and stress at work [42]. Priyal P. Shah showed that the amount of time spent using smartphones significantly correlated with MSK discomfort. A strong association was also found between the Smartphone Addiction Scale (SAS) and NDI. MSK problems in the neck and hands (mainly the thumb) in physiotherapy students addicted to smartphones can lead to long-term disability [13]. ND among students using smartphones for a long time may be associated with frequent flexion of the neck, leading to irritation and spasm in the surrounding skeletal structures and ligaments. This may explain the positive correlation between smartphone use time and NDI score and reading in the current study. However, in a cross-sectional study of 238 medical students, the results showed that smartphone use is not correlated with NP and disability. The authors contradicted their hypothesis that prolonged or intermittent static and dynamic neck flexion positions will be correlated with pain and/or discomfort [43].

Limitations and strengths of the study. The use of other electronic devices (laptop, computer) and the attitude of learning from books were not taken into account. In the future, it would also be worth asking about the amount of sleep and whether using a smartphone before bedtime is associated with poorer sleep quality and more difficulty with falling asleep. There were students in the group who did not have major disabilities, but who also devoted a lot of time to using smartphones. These students were at the beginning of their professional careers and prevention should be importance to them. Comparison of students of different years of study were also did not taken into account.

Despite the shortcomings, this study had intriguing strengths. To the best of our knowledge, this is the first study to analyze the relationship between disability, NP, use of phones before bedtime, and hours of using phones. It would be interesting to repeat the study on physiotherapists working in the profession, and to compare respondents of different ages.

CONCLUSION

Physiotherapy students need proper guidance on the optimal use of the smartphone which could significantly reduce disability and NP. Dysfunctions associated with pain in the cervical section may affect the learning abilities of students and thus the acquisition of professional competences. It is important to act early, as ongoing neck problems can worsen students' disability and pain. It is worth paying attention to sleep hygiene. Not using a smartphone before bedtime is recommended because this causes poorer concentration, and thus has an adverse impact on the deterioration of academic performance. The results therefore indicate that the daily use a smartphone should limited as is overuse may negatively affect daily functioning. The longer the time spent using the phone, the greater the disability. From a practical point of view, it is very important to educate young people in this area, paying more attention to increasing awareness of the negative effects of overusing smartphones.

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