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Association of musculoskeletal pain patterns of college students due to the usage of mobile phone

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KEYWORDS
Standardized Nordic Musculoskeletal Questionnaire; Posture; Studying; Cross-sectional study; McGill Pain Questionnaire.

ABSTRACT
Mobile phones have become widely used as online learning platforms, which provide students with flexibility to access content at a time and in a place that is convenient for them. Due to the ubiquity of mobile phones, they may be used in a variety of positions that could expose their musculoskeletal system. This study aimed to investigate if there is an association between musculoskeletal pain patterns due to the usage of mobile phones. Cross-sectional study was conducted on 778 students with individual mobile phones through self-made questionnaire that consisted of general information and a standardized Nordic Musculoskeletal Questionnaire. The study revealed that the predominant site of pain patterns was the neck (64.27%), lower back (66.2%), and upper back area (54.37%). Duration of 19- 24 hours (93.57%) and sitting position (58.87%) was associated with a higher frequency of mobile phone use. Regarding patterns of pain, fatigue (26.74%) type was predominant. There was statistically significant difference found between specific mobile phone usage behaviors and patterns of musculoskeletal pain. More specifically, study sessions were linked to upper back pain (p-value = 0.049), hips/thigh (p-value = 0.021), and neck pain (p-value = 0.021). Social media streaming was linked to neck pain (p-value = 0.041) and ankle pain (p-value= 0.035). Leisure activities and video games were linked to lower back pain (p-value = 0.048), whereas how a mobile phone is held related to wrist pain (p-value = 0.005). The posture adopted and duration of usage are strong determinants of musculoskeletal pain patterns. The study's findings indicate a strong link between musculoskeletal pain in the neck, upper back, and hips and mobile phone usage, particularly in terms of duration and posture. Understanding this relationship can help raise awareness among students, guide prevention, diagnosis, and treatment strategies.

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Introduction

Mobile phones have become an essential part of our lives, offering a range of mobile applications utilized for communication, education, and entertainment[1]. During the COVID-19 pandemic, students spend more time at home which results in extensive use of mobile phones, tablets, and other hand-held devices for their studies and daily usage[2]. The amount of mobile phone users, particularly among college students, has expanded dramatically in recent years[3]. Students spend an average of seven hours per day staring at their phone screens[4]. With that being said, students unknowingly adapt an awkward posture when using mobile phones leading to improper postural alignment[5]. Hence, fatigue, discomfort, and pain increases.

Musculoskeletal pain pattern refers to the temporal nature of pain and how the individual's pain changes with time. Theoretically, pain pattern involves the onset, frequency, duration, location and characteristics[6]. Furthermore, extended and repetitive use of mobile phones, along with poor ergonomics, can lead to muscle and joint issues known as musculoskeletal disorder (MSDs). These disorders may appear as pain patterns in the neck, shoulders, upper back pain, and in the hands or wrists[7]. MSDs affect not only workers in the workplace but also students who excessively use various electronic devices daily for both education and recreation[8].

Despite its importance, very limited literature exists about musculoskeletal pain patterns related with the use of mobile phones and its relationship with regards to location in the body region, frequency, duration, and posture. Therefore, the purpose of the present study is to determine the association of mobile phone use and musculoskeletal pain patterns among college students in Doña Remedios Trinidad Romualdez Educational Foundation, Inc. (DRTREFI) and Dr. Vicente Orestes Romualdez Educational Foundation (DVOREF) at Tacloban City, Leyte, Philippines.

Material and methods

The study was conducted in DRTREFI-DVOREF using a cross-sectional research design. The total number of students enrolled in DRTREFI-DVOREF is 2148, but it ended up with a sample size of 942 because 4th-year medicine was exempted due to their hectic schedule. Some students also refused to participate; therefore, the data that we gathered garnered a total of 778 out of 942. The number of respondents was calculated with Slovin's formula with a 95% margin of error to determine the sample size of the population. A stratified sampling formula was also utilized to compute the sample size per year level. Afterwards, a simple random sampling method using Microsoft Excel was used to gather random participants according to the number of sample size per program. Inclusion criteria, regardless of sex, included participants with 19 and above years of age, owns a touchscreen mobile phone, and is willing to participate in the study. A survey of 51,000 people in 32 countries found that 93% of 18 to 24-year-olds owned and used mobile phones frequently[9]. All students who had recent accident or trauma, chronic systemic illness, & previous surgery for the last six months were excluded from the study. Participants were informed about the purpose of conducting the study and informed consent was obtained from the participants. This study used two-part semi-structured questionnaire which was verified for its acceptable internal reliability with a Cronbach's alpha coefficient of 0.7187 and content validity through the method of panel experts comprising licensed physiotherapist and a professional statistician. The first part contains demographic information such as age, gender, course and year level, and participants' mobile phone use such as handedness, frequency, duration, and position. The second part was based on the standardized Nordic Musculoskeletal Questionnaire[10]. Respondents were asked to report the location of their pain, while the types of

pain experienced-such as fatigue, numbness, pins and needles, aching, cramping, and stiffness-were categorized using the McGill Pain Questionnaire[11]. Additionally, pain severity was measured using the Numerical Pain Rating Scale[12]. The approval from Eastern Visayas Health Research and Development Consortium (EVHRDC) - Ethics Review Committee with ERC Protocol No. 2023-012 was obtained on May 3, 2023.

Statistical analysis

Descriptive statistics were employed to define demographics and findings of the study which included mean values and standard deviation (SD) for continuous variables and frequency and percentage for categorical variables. A Chi-square test was used to examine the relationship between musculoskeletal pain patterns and mobile phone usage[13]. A p-value < 0.05 was considered to be statistically significant. Data was analyzed using the Statistical Package for Social Sciences (SPSS version 21).

Results

Table 1 displays the succeeding discussion of the percentage distribution of the students' demographic profile. The table shows that participants were predominantly female, accounting for 65.4% of the total sample. Age distribution shows that the majority of respondents (71.85%) were between the ages of 19 and 22. Notably, first- and third-year college students made up the majority of the sample (56.42%). According to course enrollment data, BS in Medical Technology is the most represented program, accounting for 30.33% of all participants. Furthermore, a high proportion of participants identified as right-handed, accounting for 84.96% of the overall sample.

Table 1 Frequency and percentage distribution of demographic profile

Variable	Category	Frequency	Percentage
Age	19-20 years	299	38.43
	21-22 years	260	33.42
	23-24 years	99	12.72
	25-26 years	42	5.40
	27 years and above	78	10.03
Sex	Male	272	34.96
	Female	506	65.04
Year level	First year	224	28.79
	Second year	199	25.58
	Third year	215	27.63
	Fourth year	140	17.99
Course/Program	Doctor of Medicine	78	10.03
	Bachelor of Science (BS) Physical Therapy	113	14.52
	BS Criminology	16	2.06
	College of Law	88	11.31
	BS Medical Technology	236	30.33
	BS Entrepreneurship	17	2.19
	BS Biology	33	4.24
	BS Nursing	197	25.32
Handedness	Right-handed	661	84.96
	Left-handed	100	12.85
	Ambidextrous	17	2.19

Table 2 shows the distribution of duration and frequency of mobile phone use, purpose of usage, how mobile phone is held when using it, and posture adopted during usage were presented in the succeeding tables. The analysis of mobile phone usage patterns revealed interesting insights into participants' behaviors. Nearly all respondents reported using their phones continuously throughout the day, with 95% indicating 24-hour usage. Primary purposes for mobile phone usage were studying (79.18%) and internet browsing (80%), indicating a significant reliance on mobile devices for academic and informational purposes. A proportion of participants reported spending two to six days engaged with their phones, representing 79.56% of the sample. In terms of phone handling, a majority of participants employed a two-handed grip (54.24%), while others also preferred using their phones while in a seated position (58.87%).

Table 2 Distribution of mobile phone usage

Variable	Category	Frequency	Percentage
Frequency on the usage of mobile phone	Never	2	0.26
	1-2 days	258	33.16
	3-4 days	361	46.40
	5-6 days	117	15.04
	7 days	40	5.14
Duration on the usage of mobile phone	< 6 hrs	4	0.51
	7-12 hrs	15	1.93
	13-18 hrs	31	3.98
	19-24 hrs	728	93.57
How mobile phone is held	I don't hold my mobile phone	1	0.13
	Only right hand	251	32.26
	Only left hand	84	10.80
	Both hands	422	54.24
	Others	20	2.57
Posture adopted during usage	Standing	9	1.16
	Sitting	458	58.87
	Lying in front	46	5.91
	Lying on side	134	17.22
	Lying on back	131	16.84

Table 2 Distribution of mobile phone usage (Cont.)

Variable	Category	Frequency	Percentage
Purpose of usage:			
Text, call and email	I don't use it	32	4.11
	< 30 mins	372	47.81
	30 mins - < 1 hr	124	15.94
	1 hr - 2 hrs	134	17.22
	> 3 hrs	116	14.91
Studying	I don't use it	73	9.38
	< 30 mins	89	11.44
	30 mins - < 1 hr	147	18.64
	1 hr - 2 hrs	167	21.47
	> 3 hrs	302	38.82
Social Media	I don't use it	8	1.03
	< 30 mins	31	3.98
	30 mins - < 1 hr	118	15.17
	1 hr - 2 hrs	169	21.72
	> 3 hrs	452	58.10
Leisure and games	I don't use it	54	6.94
	< 30 mins	145	18.64
	30 mins - < 1 hr	119	15.30
	1 hr - 2 hrs	246	31.62
	> 3 hrs	214	27.51
Internet Browsing	I don't use it	4	0.51
	< 30 mins	162	20.82
	30 mins - < 1 hr	113	14.52
	1 hr - 2 hrs	222	28.53
	> 3 hrs	277	35.60

Table 3 presents the data with regards to musculoskeletal pain patterns which was categorized as location of pain according to their body parts (neck, shoulder, elbow, wrist/hand, upper back, lower back, one or both hips/thigh, one or both knees, and one or both ankles/feet), type of pain experienced, rating of pain severity, and relation of symptoms to mobile phone use. The examination of musculoskeletal pain patterns illuminated prevalent discomfort among participants. Lower back pain emerged as the most commonly reported issue, affecting 66.2% of respondents. This was closely followed by neck pain, experienced by 64.27% of participants, and upper back pain, affecting 54.37%. The majority of participants acknowledged experiencing physical symptoms such as stiffness and fatigue (71.72%), with a subset reporting sensation of pins, needles, and numbness (10.93%). Despite these findings, a significant proportion of participants (80.59%) reported no pain, while 19.4% of participants experienced pain ranging from 3 to 7. Furthermore, 30.9% of participants strongly agree & agree respectively that all the symptoms were related to the usage of mobile phones. Notably, there were notable correlations found between specific mobile phone usage behaviors and patterns of musculoskeletal pain. More specifically, extended

study sessions were linked to upper back pain with *p*-value = 0.049; social media streaming (*p*-value = 0.041) and studying (*p*-value = 0.021) were linked to neck pain, whereas leisure activities and video games were linked to lower back pain with *p*-value = 0.048.

Table 3 Distribution of musculoskeletal pain patterns

Variable	Category	Frequency	Percentage
Location of pain	Neck	500	64.27
	Right shoulder	135	17.35
	Left shoulder	40	5.14
	Both shoulder	222	28.53
	Right elbow	51	6.56
	Left elbow	14	1.80
	Both elbow	38	4.88
	Right wrist	199	25.58
	Left wrist	39	5.01
	Both wrist	127	16.32
	Upper back	423	54.37
	Lower back	515	66.20
	One or both hips/thigh	138	17.74
	One or both knees	115	14.78
	One or both ankles/foot	110	14.14
Types of pain	I do not have any symptoms	135	17.35
	Stiffness	182	23.39
	Fatigue	208	26.74
	Pins and needles and numbness	85	10.93
	Aching and cramping	168	21.59
Rating of pain severity	0 - 2 (no pain at all)	627	80.89
	3 - 5	147	18.89
	6 - 10	4	0.51
Do you think the pain was related to the use of your mobile device	Strongly agree	87	11.183
	Agree	154	19.794
	Neither	294	37.789
	Disagree	218	28.021
	Strongly disagree	25	3.213

Table 4 exhibits the association between the musculoskeletal pain patterns particularly the neck, wrist/hand, upper back, lower back, both hips/thighs, both knees, and both ankle/foot, and usage of mobile phone. There is a significant association between the pain experienced by the students on their neck area and mobile phone usage specifically the social media, showing a chi square value of 23.35 with *p*-value = 0.041, and studying using mobile phone with chi square value of 31.09 with a *p*-value = 0.021. Nevertheless, there is enough evidence to support the link between the wrist/hand and the way the phone is held. The chi square value is 28.2, and the *p*-value = 0.005, which is less than the significance standard of 0.05, according to the evidence. The

result further shows that there was a significant correlation between the upper back area of pain and studying using mobile device as it indicates a chi square value of 9.28 with *p*-value = 0.049. Also, there is a significant connection between lower back discomfort and leisure and mobile gaming as it indicates a chi square value of 9.58 and a *p*-value= 0.048. Lastly, there is a strong correlation between one or both ankle/foot pains experienced by the students and social media, as shown by a chi square value of 10.35 and a *p*-value = 0.035.

Table 4 Association between musculoskeletal pain patterns (location of pain) and mobile phone use

Variable	Areas	Chi-square value	*p*-value
Frequency of use	Neck	2.35	0.671
	Wrist/Hand	15.05	0.089
	Upper Back	0.97	0.807
	Lower Back	0.52	0.915
	Both Hips/Thigh	0.400	0.94
	Both Knees	2.98	0.395
	Both Ankle/Foot	2.82	0.516
Duration of use	Neck	7.4715	0.113
	Wrist/Hand	13.87	0.309
	Upper Back	0.85	0.932
	Lower Back	6.81	0.146
	Both Hips/Thigh	8.12	0.087
	Both Knees	4.06	0.398
	Both Ankle/Foot	9.39	0.052
Text, Call and Email	Neck	3.15	0.864
	Wrist/Hand	6.91	0.553
	Upper Back	4.29	0.369
	Lower Back	4.41	0.354
	Both Hips/Thigh	4.01	0.405
	Both Knees	1.99	0.738
	Both Ankle/Foot	3.83	0.43
Studying	Neck	31.09	0.021*
	Wrist/Hand	9.79	0.634
	Upper Back	9.28	0.049*
	Lower Back	2.96	0.564
	Both Hips/Thigh	11.55	0.021*
	Both Knees	0.74	0.947
	Both Ankle/Foot	5.23	0.264
Social Media	Neck	23.35	0.041*
	Wrist/Hand	9.99	0.616
	Upper Back	4.62	0.329
	Lower Back	6.21	0.184
	Both Hips/Thigh	5.79	0.215
	Both Knees	2.89	0.576
	Both Ankle/Foot	10.35	0.035*

Table 4 Association between musculoskeletal pain patterns (location of pain) and mobile phone use (Cont.)

Variable	Areas	Chi-square value	*p*-value
Leisure	Neck	3.43	0.833
	Wrist/Hand	10.65	0.489
	Upper Back	1.46	0.559
	Lower Back	9.58	0.048*
	Both Hips/Thigh	1.79	0.774
	Both Knees	3.92	0.417
	Both Ankle/Foot	3.44	0.487
Internet browsing	Neck	3.05	0.55
	Wrist/Hand	7.14	0.848
	Upper Back	2.11	0.716
	Lower Back	2.71	0.608
	Both Hips/Thigh	6.28	0.179
	Both Knees	6.65	0.156
	Both Ankle/Foot	4.14	0.388
How Mobile Phone is Held	Neck	4.48	0.345
	Wrist/Hand	28.2	0.005*
	Upper Back	3.43	0.489
	Lower Back	1.69	0.792
	Both Hips/Thigh	3.86	0.425
	Both Knees	3.43	0.489
	Both Ankle/Foot	9.22	0.056
Posture adopted during usage	Neck	2.83	0.587
	Wrist/Hand	8.97	0.706
	Upper Back	1.41	0.843
	Lower Back	12.59	0.013*
	Both Hips/Thigh	3.91	0.418
	Both Knees	4.32	0.364
	Both Ankle/Foot	2.52	0.64

Note: * significant difference (*p*-value < 0.05)

Table 5 shows the Chi Square test of musculoskeletal pain patterns (types of pain, rating of pain severity, and relation of pain experienced) and mobile phone usage. The table showed that a *p*-value range of 0.37 to 0.85 was more than the 0.05 significant threshold. The corresponding null hypothesis is accepted. However, a chi square value of 26.4 and a *p*-value = 0.049 show a strong correlation between the types of aches experienced by the students and the posture employed when using mobile phones. There is concrete evidence that the duration of using mobile devices is strongly associated with the rating of pain severity experienced by the students. Furthermore, a substantial correlation between the symptoms that the students report and the amount of time they spend using mobile devices and accessing the internet, as shown by a chi square value of 42.87 with a *p*-value = 0.049. A chi square value of 29.2 and a *p*-value = 0.023 show a high correlation between the symptoms experienced by the participants and mobile device use, particularly internet browsing.

Table 5 Chi square test of musculoskeletal pain patterns and mobile phone usage

Variable	Chi-square value	*p*-value
Types of pain		
Frequency of mobile phone use	12.38	0.415
Duration of mobile phone use	10.3	0.85
Text, call and email	11.04	0.807
Studying	20.64	0.193
Social media	12.84	0.685
Leisure	17.15	0.376
Internet browsing	17.24	0.37
How mobile phone is held	14.24	0.581
posture adopted during usage	26.4	0.049*
Rating of pain severity		
Frequency of mobile phone use	2.52	1.000
Duration of mobile phone use	40.6	0.018*
Text, call and email	26.56	0.325
Studying	27.19	0.296
Social media	9.03	0.998
Leisure	32.04	0.126
Internet browsing	29.7	0.195
How mobile phone is held	7.82	0.999
posture adopted during usage	30.9	0.157
Relation of pain experienced		
Frequency of mobile phone use	12.56	0.402
Duration of mobile phone use	42.87	0.001*
Text, call and email	10.77	0.824
Studying	12.04	0.741
Social media	20.62	0.194
Leisure	22.27	0.135
Internet browsing	29.2	0.023*
How mobile phone is held	18.77	0.281
posture adopted during usage	16.08	0.448

Note: *significant difference (*p*-value < 0.05)

Discussion

This study investigated the association of musculoskeletal pain patterns among mobile phone users on college students using an online semi-structured questionnaire. The study revealed that the most common site of pain patterns was the neck (64.27%), lower back (66.2%), and upper back area (54.37%).

The study identified that duration of mobile phone use was a critical determinant of neck pain patterns, with a strong positive correlation between musculoskeletal pain patterns and extent of mobile phone use. A duration of 19-24 hours (93.57%) rate of usage of mobile phones was found in the study, and only few from the respondents who responded 6-18 hours of usage of their mobile phones. A study showed 79% of their participants

aged between 18 and 44 use their mobile phone continuously throughout the day, with only two hours of their entire day spent without their mobile phone in hand[14]. There is also concrete evidence that the duration of using mobile devices is strongly associated with the rating of pain experienced. This signifies when mobile phone use is increased, the rating of pain experienced by the students is also increased. Primary purposes for mobile phone usage were studying (79.18%) and internet browsing (80%), indicating a significant reliance on mobile devices for academic purposes. There is an adequate evidence to support the hypothesis that using a mobile device while studying has an impact on the human body, notably on one or both hips/thighs (p-value = 0.021), and upper back area (p-value = 0.049). A study stated that mobile phone use has been associated with musculoskeletal complaints in various parts of the body including neck, upper back, lower back, and hips[15]. In the present study, sitting position (58.87%) was associated with a higher frequency of posture adopted during mobile phone use compared to standing or lying positions. A significant connection between lower back discomfort and leisure was found as it indicated a chi square value of 9.58 and a p-value = 0.048. Evidence supported that those who became acclimated to sitting while mobile gaming experienced lower back pain compared to those who did not[16]. Therefore, sitting is not directly a risk factor for low back pain, but it may become a concern if it is combined with faulty posture that contributes to low back pain.

Our study also found that the most frequent characteristic of symptoms described by participants was fatigue (26.74%), and only 17.35% of students who responded that they did not experience any symptoms. The pain severity of most participants who use mobile phones were not extreme, and results showed that 80.59% of the students responded 0-2 or no pain at all. Moreover, more than one-third (37.79%) of the participants were unsure if their symptoms were linked to mobile phone use, and only 28% disagreed that their symptoms were related to it. These results suggested that symptoms of pain patterns from participants may not be entirely related to mobile phone itself, but rather influenced by a combination of other factors. Lastly, the study did not show any association for the usage of mobile phones for shoulder, elbow, and knee pain. Nevertheless, based on these findings, it appeared that most young people were experiencing issues with their bodies.

The study had some limitations; first, the data from the study may be a subject to recall bias because students were asked to recall the pain patterns that they had experienced which might or might not be present at the time they answered the survey questionnaire. The confounding effects of factors such as the type of mobile phone, screen size, and other devices used (e.g., laptops, tablets, computers), as well as additional physical activities unrelated to mobile phone use, could not be determined in this study. This limitation may impact the comprehensiveness of the findings regarding musculoskeletal pain patterns. Future research should aim to address these variables to provide a clearer understanding of their influence on pain experiences. Moreover, future studies on musculoskeletal pain patterns may improve upon performing comprehensive pain assessment that includes a detailed health history and physical examination. Further longitudinal and experimental studies must also be conducted in order to come up with innovative ideas with objective ascertainment of the risk factors and the outcome.

Conclusion

The study indicated that there is adequate evidence to support the hypothesis that mobile phone usage has an impact on the human body. It shows that pain pattern is most likely experienced due to its posture adopted and duration, rather than the frequency. Pain patterns in the neck, upper back, and hips is highly associated with studying. Wrist pain is correlated

with how the mobile phone is held. Low back pain has also been shown to be associated with leisure and the posture adopted with usage, whereas social media streaming presents an association with neck and ankle pain. However, there is no any association for the usage of mobile phones for shoulder, elbow, and knee pain. Additionally, over one-third of participants were unsure if the symptoms they experienced were connected to mobile phone use, and only 28% disagreed that their symptoms were related to it. These results suggest that the pain patterns may not be solely due to mobile phone use but could involve other factors. Nevertheless, these findings suggest that most young people are facing physical problems. Thus, the study underscores the necessity of acknowledging the influence of mobile phone usage on musculoskeletal health, especially for college students. Including habits like exercising, taking regular breaks, and maintaining good posture could help reduce the frequency of musculoskeletal pain patterns.

Take home messages

Musculoskeletal pain pattern is a concern for students who often utilize mobile phones. Proper health evaluation for students is recommended, and effective prevention strategies and exercise techniques must be implemented to promote good musculoskeletal health.

Conflicts of interest

The authors declare no conflict of interest.

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