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ORIGINAL ARTICLE

Comparison of Musculoskeletal Symptoms of Neck and Shoulder among Different Types of Hand Held Device Users

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ABSTRACT

Background: Prolonged and forceful utilization of hand-held devices has contributed to a global increase in upper extremity and cervical musculoskeletal disorders. These pathologies are directly associated with excessive use of mobile phones and similar devices.
Aim: To evaluate the impact of diverse hand-held devices on musculoskeletal (MSK) symptoms in the neck and shoulder and investigate the relation between usage duration and MSK symptoms in the neck and shoulder region.
Methods: This study utilized an observational design with a self-structured questionnaire approved by the Department of Physical Therapy at Sargodha Medical College. The sample consisted of 300 young adults aged 21 to 28 years, selected through convenient sampling across different academic years. Data collection involved the distribution of a comprehensive questionnaire, ensuring meticulous responses and privacy. Inclusive criteria included 2nd to final year students, while exclusions maintained homogenity.
Results: Among the 300 participants, 76% experienced musculoskeletal discomfort in the neck and shoulder regions, while 24% were asymptomatic. Specifically, 57% reported pain, 16% had numbness, 5% experienced cramping, and 22% felt stiffness. Moreover, 55% of the total population reported some level of pain on Visual Analog Scale, while 45% were pain-free. The study highlights the need for ergonomic design considerations in hand-held devices to minimize the risk of musculoskeletal symptoms in neck and shoulder regions. The findings can guide development of user education programs and workplace interventions to promote proper posture and exercises for individuals using hand-held devices, thereby reducing musculoskeletal discomfort.
Conclusion: Excessive utilization of handheld devices is intricately associated with cervico-brachial discomfort, revealing correlations between device typology, duration of usage, postural alignments, and musculoskeletal symptoms.
Keywords: Hand-held devices, musculoskeletal symptoms, neck and shoulder discomfort

INTRODUCTION

Hand-held devices, encompassing mobile phones, tablets, music players, and gaming devices, have attained indispensable status in the realms of communication, entertainment, and internet connectivity. The burgeoning mobile phone market has undergone substantial proliferation, providing a diverse range of cost-effective models[1]. The scarcity of individuals devoid of a mobile phone has become increasingly conspicuous. Regrettably, the protracted and immoderate employment of these devices has engendered the emergence of musculoskeletal pathologies among users[2].

The rise in upper extremity and cervical musculoskeletal disorders worldwide is linked to prolonged and forceful use of hand-held devices. Repetitive thumb and finger movements exert significant biomechanical strain, increasing the risk of thumb-related conditions like extensor pollicis longus tendinosis and myofascial pain syndrome[3].

Research studies on smartphone usage have consistently shown adverse effects on the musculoskeletal system. A retrospective analysis found that all regular handheld device users experienced thumb and forearm discomfort, accompanied by neuropathic sensations in the thenar eminence. Similarly, adolescents extensively using electronic devices displayed a high prevalence of musculoskeletal pain and pain syndrome[4].

Prolonged engagement with hand-held devices, characterized by cervical flexion and sustained awkward postures, leads to musculoskeletal manifestations, particularly in the neck region[5]. Cervical spine kinematic changes increase susceptibility to cervical pain, while electromagnetic field exposure from hand-held devices is strongly associated with fatigue, sleep disturbances, headaches, and earaches[6].

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A Singaporean study with 1884 participants examined the impact of smartphone and tablet usage on musculoskeletal symptoms and visual health in adolescents. Smartphone usage was found to be associated with various factors, including gender, school level, device type, and activities, with an average daily duration of 264 minutes. Participants experienced musculoskeletal discomfort and visual symptoms, with increased smartphone use linked to higher risks. Surprisingly, increased smartphone use was inversely associated with myopia susceptibility. Tablet usage did not show significant associations. These findings highlight the physiological consequences of excessive smartphone engagement in adolescents and emphasize the need for proactive measures[7].

A study investigated the postural effects of handheld device use in 21 college students. Comparative analysis of posture variables, including head translation, angulation, shoulder angulation, shoulder translation, and rib translation, revealed significant distinctions among mobile phones, tablets, and laptops. Notably, tablet utilization induced distinct postures, implying a potential for heightened deleterious consequences. These findings emphasize the imperative of postural considerations and the implementation of interventions to alleviate adverse effects, particularly when employing tablets and other handheld devices[8].

A study investigated screen-related symptoms in healthy adolescents using tablets and smartphones. Among the participants (aged 11-13), 98% used smartphones and 34% used tablets. Symptoms such as headache, neck pain, tiredness, and tired eyes were reported by 12-41% of adolescents, with higher rates associated with tablet use, longer screen time, and shorter viewing distances. Adolescents with musculoskeletal pain had lower levels of physical activity. These findings highlight the significance of promoting visual ergonomics and physical activity to enhance the well-being of adolescents[9].

This study aimed to evaluate the effects of different handheld devices on musculoskeletal symptoms in the neck and

shoulder regions. It examined the relation between device types, postures, and usage duration, providing valuable insights for clinicians and researchers. The findings contribute to optimizing ergonomic practices and addressing musculoskeletal discomfort associated with handheld device use.

This research study holds significant implications in comprehending the impact of handheld devices on musculoskeletal health from an ergonomic perspective. By investigating different device types, analyzing posture-related factors, and considering usage duration, it aims to identify critical risk factors associated with musculoskeletal discomfort.

The study findings will play a vital role in developing targeted interventions, guidelines, and preventive measures to mitigate musculoskeletal symptoms in the neck and shoulder, thereby improving the overall well-being and promoting musculoskeletal health awareness among handheld device users.

MATERIAL AND METHODS

The research design of this study employed an observational methodology and utilized a self-structured questionnaire that received ethical approval from the Department of Physical Therapy at Sargodha Medical College in Pakistan. The sample size comprised 300 participants within the age range of 21 to 28 years, representing the young adult demographic. Convenient sampling was employed to select participants across different academic years of Sargodha Medical College, ensuring adequate representation at various educational stages.

Data collection involved the dissemination of the comprehensive questionnaire to eligible participants, who were instructed to provide meticulous responses based on their individual experiences and perspectives. The questionnaire encompassed a wide array of variables relevant to musculoskeletal health, ergonomic practices, and other pertinent factors. All ethical considerations were taken into account. Participants were afforded ample time and privacy to ensure accurate and thoughtful completion of the questionnaire. Inclusive criteria for participant selection encompassed 2nd, 3rd, 4th, and final year students of Sargodha Medical College, as these individuals were deemed to possess sufficient exposure to the study context. Conversely, exclusions were made for 1st year students, wheelchair-disabled individuals, faculty members, alumni, and partially completed questionnaires to maintain homogeneity and focus on the target population.

The data collection procedure adhered to rigorous standards to enhance the reliability and validity of the gathered information. Through the implementation of a standardized questionnaire and consistent data collection techniques, potential biases were mitigated, ensuring the robustness of the collected data. This systematic approach facilitated the extraction of valuable insights and enabled a comprehensive exploration of musculoskeletal health factors within the selected cohort of medical college students.

RESULTS

The analysis of 300 participants revealed their gender distribution, with 170 females and 120 males. Figure 1 visually represents the proportion of each gender within the participant cohort. The participants' ages were categorized into four groups: 5% in the 21-22 age bracket, 15.6% in the 23-24 age group, 26.6% in the 25-26 age range, and the largest proportion, 47.3%, between 27 and 28 years old. These age groupings depicted in Figure 2, offer valuable insights into the participants' distribution based on their specific age demographics.

A study with 300 participants explored handheld device usage and musculoskeletal discomfort. Findings showed that 61% used touch screen phones, 4% used keypad phones, 11% owned tablets, and 15% had a combination of keypad and touch screen devices. Notably, 9% had a mix of touch screen mobiles, tablets, and keypads. Discomfort levels were highest among touch screen phone users (78.69%), followed by those with both keypad and touch screen devices (76%) and tablet users (88.23%). Discomfort was reported across different postures: 81% of sitters, 64% of those lying down, and 83% of individuals standing. Among sitters, 30% had a neutral neck position, 44% displayed a slightly flexed neck, and 26% exhibited a fully flexed neck, which was associated with higher discomfort.

Figure 1: Gender of participants

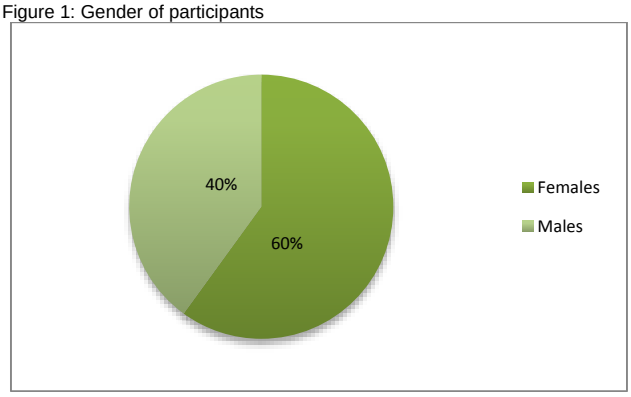


Figure 2: Age of participants

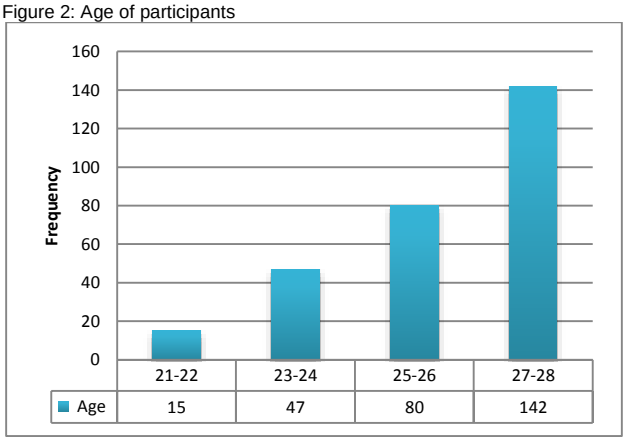
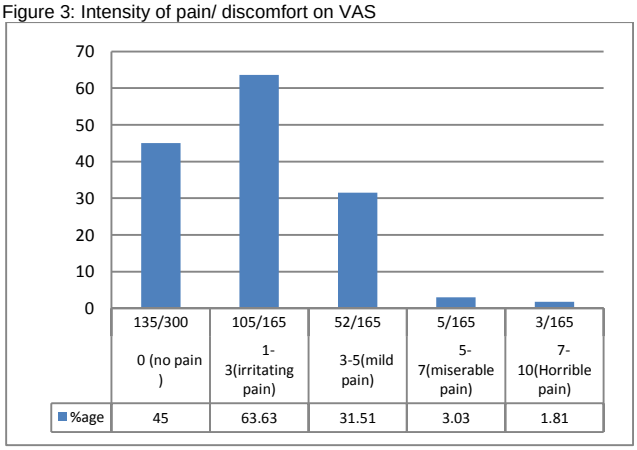


Figure 3: Intensity of pain/ discomfort on VAS



Intensity of pain/ discomfort on VAS: Among the 300 respondents, 76% exhibited musculoskeletal discomfort in the cervical and scapular regions, while 24% were asymptomatic. Within the affected population of 227 individuals, the prevalence of specific symptoms was as follows: pain (57%), numbness (16%), cramping (5%) and stiffness (22%). Regarding duration, 79.3%

experienced discomfort for less than 30 minutes, 13.26% for 30 minutes to 1 hour, 4.9% for 1 to 2 hours, and 2.64% for more than 2 hours. Discomfort was localized in the head area (8.37%), neck (15.42%), upper back (64.31%), and arm/hand (11.89%). Among the total respondents, 45% were pain-free, while 55% reported varying levels of pain on the Visual Analog Scale. The detailed illustration of pain intensity on VAS is shown in figure 3.

Table 1: Frequency & percentages of responses regarding usage of handheld devices

Questions regarding usage of handheld devices	**N**	**Frequency and percentages of participant's responses**					
Type of hand held device used	300	Keypad phone	Touch screen mobile	Tablets	Keypad and touch screen mobile	Key pad, touch screen mobile and tablet	
		11(4%)	**183(61%)**	**34(11%)**	**46(15%)**	**26(9%)**	
Frequency of discomfort with reference to type of hand held device	300	Keypad phone	Touch screen mobile	Tablets	Keypad and touch screen mobile	Key pad, touch screen mobile and tablet	
		3(27%)	**144(78.69%)**	**30(88.23%)**	**35(76%)**	**15(57.6%)**	
Position usually maintain while using hand held devices	300	Standing	Sitting on Floor	Sitting on Chair/ Couch	Lying on Side	Lying on Stomach	Lying on Back
		30(10%)	**14(4.67%)**	**156(52%)**	**35(11.67%)**	**14(4.67%)**	**51(17%)**
Frequency of pain with reference to posture		In standing	In sitting	In lying			
		25/30(83.3%)	**138/170(81.1%**	**64/100(64%)**			
Position of neck in sitting posture	170	Neutral position	Slightly flexed	Fully flexed			
		50(30%)	**75(44%)**	**45(26%)**			
Frequency of discomfort with reference to neck posture in sitting position		Pain in neutral position	Pain in slightly flexed	Pain in fully flexed			
		25/50(50%)	**70/75(93.33%)**	**43/45(95.5%)**			
How long has the handheld device been used?	300	Less than 5 years	5 to 10 years	More than 10 years			
		157(52.33%)	**134(44.67%)**	**9(3%)**			
Duration of daily usage of hand held device	300	1-2 hrs	2-4 hrs	4-6 hrs	>6 hrs		
		73(22.3%)	**77(25.6%)**	**100(33.3%)**	**50(17%)**		
Hand held device mostly used at	300	College	Hostel	Community	Home		
		16(5.33%)	**196(65.33%)**	**28(9.33%)**	**60(20%)**		
Most often holding device	300	One handed	Both handed	NO hands ,device is placed on support surface			
		155(52%)	**140(46%)**	**5(2%)**			
In sitting which position assume while using handheld device?		back support & device in lap	No back support & device in lap	With back support & holding device in hand	NO back support & hold device in hand		
		4/170 (2.35%)	**1/170(0.59%)**	**60/170(35.29%)**	**105/170(61.8%)**		
Discomfort from hand held device affects sleep	227	Yes	No				
		85(37.44%)	**142(62.56%)**				
Stop using hand held devices because of discomfort	227	Yes	No				
		140(61.67%)	**87(38.33%)**				
Pain reliefs by rest		Yes	No				
		90(39.65%)	**137(60.35%)**				

DISCUSSION

This study investigated the effects of diverse handheld device typologies on musculoskeletal symptoms in the cervical and scapular regions. Handheld devices have become integral to daily activities, encompassing communication, recreation, education, and employment. Participants utilizing keypad phones, touch screen mobiles, and tablets were observed in various bodily orientations during device utilization. The study included 350 individuals from Sargodha Medical College in Pakistan, employing a questionnaire-based approach to gather data on device classification, usage duration, posture, and experienced discomfort.

In recent research, a significant proportion of students (88.23%, 30/34) reported experiencing neck and shoulder symptoms while using tablets. Among these students, discomfort was specifically reported in the neck (15.42%), both neck and shoulder (64.31%), right shoulder (11.89%), and left shoulder (8.37%). These findings highlight a higher prevalence of symptoms in the shoulder and neck regions compared to other areas. These results align with a previous study which demonstrated that smartphone addiction was associated with musculoskeletal pain in the neck, shoulder, elbow, and hand. Specifically, 43.3% reported neck pain, 42.9% reported shoulder pain, and 27.9% reported elbow pain during prolonged smartphone use[10].

Current study found that 81.17% of participants experienced neck and shoulder discomfort, with the slightly flexed neck position (93.33%) and fully flexed position (95.55%) contributing to higher discomfort. In relation to previous studies, one study in 2022 reported a strong association between daily smartphone usage and neck pain, with 71.4% of participants experiencing neck pain[11]. Another study revealed that increased mobile phone usage was linked to forward head posture and upper limb disabilities[12]. These findings highlight the impact of handheld devices on musculoskeletal health and reinforce the need for ergonomic practices during device usage.

In reference to the duration of daily handheld device usage, the recent study findings indicate that 33.3% of the participants engaged with these devices for a substantial duration of approximately 4 to 6 hours, while 17% utilized them for an even more prolonged duration exceeding 6 hours. Additionally, a notable 93.33% of the participants reported experiencing pain when their neck was slightly flexed. These findings align with a prior study that revealed a higher prevalence (82.4%) of symptoms among individuals who utilized their devices for more than 30 minutes per session, in comparison to those who restricted their usage to 30 minutes or less. The most frequently encountered symptom was stiffness, which manifested predominantly in these individuals[13].

The findings from the current study indicate a significant association between the type of device used and the discomfort levels experienced by individuals. Among the participants, touch screen phone users exhibited the highest level of discomfort at 78.69%, followed by individuals who utilized both keypad and touch screen devices at a rate of 76%. Tablet users reported a slightly lower discomfort level but still at a substantial percentage of 88.23%. These results suggest that the specific device interface and interaction method employed during device usage may contribute to the discomfort experienced by individuals. Furthermore, the results of a previous study support the notion that the typing position adopted while using a smartphone, as well as the duration of usage, are linked to the presence of pain in the cervical (neck) region. This implies that the ergonomics of smartphone usage, including the posture and positioning of the device during typing or interacting with it, play a crucial role in the

development of cervical pain. The study findings emphasize the importance of considering the typing position and duration of smartphone use as potential factors contributing to cervical discomfort and pain[14].

The findings of our study revealed that 37.44% of individuals experiencing discomfort reported an impact on their sleep, while 62.56% stated that discomfort did not affect their sleep. In contrast, a previously published study in 2019 investigating the association between Problematic Mobile Phone Use (PMPU), depression symptoms, and sleep quality found that 27.5% of participants were classified as PMPU, 44.9% exhibited symptoms of depression, and 15.6% reported sleep problems[15]. Another study revealed that smartphone utilization has been linked to an escalation in both the duration and frequency of headaches among individuals with migraine. The excessive use of smartphones in this specific population has been found to negatively impact sleep quality and contribute to increased daytime sleepiness. Moreover, a direct correlation was observed between the intensity of smartphone use and a decline in overall quality of life[16].

CONCLUSION

The study arrived at the conclusion that the excessive utilization of handheld devices is intricately associated with cervico-brachial discomfort. Contributing factors encompassed the typology of the device, duration of usage, and postural alignments, all of which influence the manifestation of musculoskeletal symptoms. Noteworthy discernments were attained concerning the usage patterns of tablets and handheld devices, unveiling their correlative symptoms. Moreover, the investigation elucidated a notable incidence of musculoskeletal disorders within the university student cohort employing tablets and other electronic devices, wherein intriguing correlations emerged between demographic and ergonomic parameters and upper limb musculoskeletal disorders.

Limitations: This study is subject to a number of limitations, including:

- Inability to control for unknown contributing factors, such as previous injuries, repetitive activities, and exposure to other technologies, which may confound the surveyed risk factors.
- Non-laboratory study design, which may introduce variability and limit control over experimental conditions.
- Short time frame for conducting the research, potentially limiting the extent of data collection and analysis.

Recommendations: Based on the study's findings, we propose the following recommendations for future investigation:

- Conduct comprehensive comparative analyses using advanced imaging techniques to understand musculoskeletal symptoms in diverse handheld device user populations.
- Employ a multidimensional approach, including kinematic assessments and wearable technologies, to study the biomechanics of the neck and shoulder during handheld device use.
- Investigate the impact of gender-specific factors, such as hormones and anatomy, on musculoskeletal symptoms among handheld device users.
- Explore musculoskeletal stressors in different occupational cohorts using objective biomechanical assessments and ergonomic evaluations, considering physical demands, repetitive motions, and psychosocial factors.

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Authorship and contribution Declaration: Each author of this article fulfilled the following criteria of Authorship:

- Conception and design of or acquisition of data or analysis and interpretation of data.
- Drafting the manuscript or revising it critically for important intellectual content.
- Final approval of the version for publication.
- All authors agree to be responsible for all aspects of their research work

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