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Effect of smart phone usage on hand grip, pinch strength, and upper extremity function among college student in selected places of Bengaluru

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Abstract
Background: With the growing prevalence of smartphone use, concerns have emerged regarding its potential impact on musculoskeletal health. This study aims to investigate the effect of smartphone usage on hand grip strength, pinch strength, and upper extremity function among college students in Bengaluru. Although previous research has explored general musculoskeletal symptoms associated with smartphone use, specific effects on hand and upper extremity function remain underexplored, particularly within the context of young adults in India.
Objectives: The primary objectives of this study were to assess hand grip strength, pinch strength, and upper extremity function among college students, to evaluate the correlation between smartphone usage and these measures, and to determine the impact of smartphone usage on hand grip strength specifically.
Methods: A cross-sectional study was conducted involving 240 college students aged 18-25 years from Bengaluru. Participants were categorized based on age and gender and were assessed using a hand dynamometer for grip strength, a pinch gauge for pinch strength, and the Upper Extremity Functional Index (UEFI) questionnaire for overall upper extremity function. Smartphone usage was recorded through self-reported data. Descriptive statistics summarized demographic data and outcomes, while inferential statistics, including Pearson's and Spearman's correlations, were used to analyse relationships between smartphone usage and musculoskeletal parameters. Statistical analyses were performed using R Version 4.1.0, with Microsoft Excel 2016 and Word 2016 for data presentation.
Results: The study found weak to negligible correlations between smartphone usage and hand grip strength (right hand: $r = 0.248$, left hand: $r = 0.0120$), and pinch strength (right pinch: $r = 0.0403$, left pinch: $r = 0.0357$). However, a high negative correlation was observed between smartphone usage and UEFI scores ($r = -0.0847$), suggesting that increased smartphone use may negatively affect overall upper extremity function. Despite these findings, the impact of smartphone usage on hand and pinch strength appeared minimal.

Keywords: Smartphone usage, hand grip strength, pinch strength, upper extremity function, college students, musculoskeletal health, cross-sectional study

Introduction

In today's rapidly advancing technological landscape, smartphones have become an indispensable part of daily life. Their role extends beyond communication, serving as primary tools for information access, entertainment, and social interaction. Among various technological innovations, the smartphone stands out due to its widespread use and impact on modern living [1]. The global smartphone user base was projected to reach 3.5 billion in 2020, reflecting a 9.3% increase from the previous year. This surge is particularly evident among younger populations, with university students being prominent users. A survey highlighted that 50% of teenagers are at risk of developing smartphone addiction, with university students averaging more than 3.5 hours of daily usage [2]. This prolonged usage is associated with musculoskeletal discomfort, particularly pain at the base of the thumb [3].

The growing dependence on smartphones has brought about various health concerns, including musculoskeletal issues. Prolonged smartphone use, especially involving repetitive thumb and finger movements, has been linked to upper limb dysfunction. Several studies have found a correlation between smartphone usage duration and the severity of musculoskeletal symptoms, with high-frequency users displaying reduced hand function and pinch strength compared to their low-frequency counterparts [4].

One of the most frequently performed tasks in daily life involves manipulating objects using a firm grip. The strength of the hand grip and pinch is fundamental to many activities, and any decline in these functions can significantly affect upper extremity performance [5]. Variations in posture, such as elbow positioning and the support of the forearm, can also influence grip strength. This strength is typically measured by the static force exerted by the hand when squeezing a dynamometer, with the grip involving the coordination of various internal and extrinsic muscles [6].

Prehension, or the act of grasping objects, is categorized into power grip and precision handling. Power grip, which involves flexing the fingers and stabilizing the object with the thumb, is a key aspect of hand function. The effectiveness of this grip can be influenced by the size, shape, and weight of the object, as well as by the user's hand characteristics [7]. Additionally, the incidence of musculoskeletal disorders (MSDs) in the hand, wrist, forearm, and neck has been rising globally due to the increased use of handheld devices. These issues are exacerbated by repetitive thumb and finger movements, as well as by the static and awkward postures often adopted during smartphone use [8].

Despite the increasing body of research on the effects of smartphone usage on musculoskeletal health, there remains a noticeable gap in understanding its specific impact on hand grip, pinch strength, and upper extremity function among college students in Bengaluru. The high prevalence of smartphone usage in this demographic raises concerns about its potential impact on musculoskeletal health, particularly on crucial aspects such as hand grip and pinch strength, which are essential for daily activities. Existing studies have highlighted the link between prolonged smartphone use and musculoskeletal symptoms, yet there is a significant lack of research focusing on young adults in the Indian context. This study aims to address this gap by investigating the effects of smartphone usage on upper limb function among college students in selected areas of Bengaluru. The findings are expected to provide valuable insights that could inform the development of preventive strategies and ergonomic interventions to mitigate the adverse effects of excessive smartphone usage in this population.

Objectives: To assess hand grip strength, pinch strength, and upper extremity function among college students in selected areas of Bengaluru.

To determine the correlation between smartphone usage and hand grip strength, pinch strength, and upper extremity function.

Scope of study

- The study will investigate how varying levels of smartphone usage affect hand grip strength, pinch strength, and overall upper extremity function among college students in Bengaluru.
- The findings are intended to offer valuable insights for creating ergonomic guidelines and preventive measures to address and reduce musculoskeletal issues related to excessive smartphone use among this population.

Methodology

Materials and Methods

Source of data: The study was conducted on students between 18 to 25 of age group in Selected places in Bengaluru.

Method of collection of data: The data for the study was collected based on the following categories:

Study setting: Selected colleges will be recruited from South Bengaluru. (R V College of physiotherapy, BES Institute of Technology, BES College of Arts, Commerce and Science). Total 3 colleges were selected for data collection.

Study subjects: College students who uses smart phone.

Study design: A Cross - sectional study.

Method of collection of data

Sampling method: Done in 2 stages, 1st stage: colleges will be selected on convenient basis. 2nd stage: Students will be selected using Purposive Sampling Technique based on inclusion and exclusion criteria.

Sample size: Subjects matching up inclusion and exclusion criteria from selected 3 colleges.

Sample size calculation: As per inclusion and exclusion criteria students were recruited for the study Total n=240.

Selection criteria

Inclusion criteria

Age of respondent should be between 18 to 25 years

Subject willing to participate and voluntarily ready to sign informed consent form

Smart phone usage duration in a day minimum of 5 hours

Exclusion Criteria

Subject with neuro muscular disorder, surgical history of medial nerve release

Tendon lesion of thumb or hand, previous fracture of hand or wrist

Subject with Hyperhidrosis

Subject with psychological disorders

Subject who has participated in similar type of study

Methods of data collection

Materials required

- Stationary
- Weighing scale
- Inch tape
- Consent form
- Screening form
- Hand dynamometer (MG4800)
- Pinch gauge (Baseline ®)

Questionnaire form: Upper limb functional index-15

Duration of the Study: Data was collected over a period of approximately 3 months' time.

Procedure

After obtaining permission from the Institutional Ethics Committee (IEC) of RV College of Physiotherapy, demographic data were recorded using a screening form. Participants were then assessed for hand grip strength, pinch strength, and upper extremity function. The collected data were analysed to determine the impact of smartphone usage.

Hand Grip Strength: Hand grip strength, an indicator of overall and upper body muscular strength, is measured using a hand dynamometer. This measurement provides insight into general health and physical capability. The procedure involves the client sitting with their shoulder abducted, elbow extended to 90 degrees, forearm in a neutral position, and wrist neutral. The dynamometer is placed in the client's hand, who is instructed to squeeze as tightly as possible. Smooth and steady grip application is preferred over jerky motions. Three trials are conducted using the second handle-width setting of the dynamometer. Results are compared with the opposite extremity, and care is taken to avoid testing if any healing tissues could be affected.

Pinch Grip Test: Pinch strength is assessed using a pinch dynamometer or pinch meter. The client, seated with elbow bent to 90 degrees, arm adducted, and forearm neutral, performs three types of pinch grips:

Lateral Pinch (Key Pinch): The pinch meter is placed between the radial sides of the thumb and index finger.

Three-Point Pinch (Three-Jaw Chuck Pinch): The meter is placed between the pulps of the thumb, index, and middle fingers.

Two-Point Pinch (Tip-to-Tip Pinch): The meter is placed between the tips of the thumb and index finger.
Each test is performed three times, and the average is calculated. Equipment is calibrated before each test, and results are analysed accordingly.

Upper Extremity Functional Index (UEFI)
The UEFI is used to assess functional impairment in individuals with musculoskeletal upper limb dysfunction. This self-reported questionnaire asks participants to rate the difficulty of various activities on a scale from 0 to 4, with 0 indicating extreme difficulty and 4 indicating no problem. The total score, which ranges from 0 to 100, reflects the overall functional status, with 0 representing the worst condition and 100 the best.

Statistical Analysis Tools: The data collected for this study was analysed statistically as follows:

Result analysis: The data collected for this study were analysed using both descriptive and inferential statistical methods. Categorical variables were presented in frequency tables and graphs as needed, while quantitative variables were summarized using mean ± standard deviation with a 95% confidence interval. For inferential statistics, Pearson’s correlation or Spearman’s rank correlation coefficients were calculated to explore the relationships between hand grip strength, pinch strength, and upper extremity function, with statistical significance set at $p \leq 0.05$, subject to normality assumptions. The data analysis was performed using R Version 4.1.0, with Microsoft Excel 2016 and Microsoft Word 2016 utilized for generating tables and graphs.
The data obtained from the study were analysed statistically and presented as follows:

Table 1: Age Distribution of subject

Age (Years)	Number (n =240)	Percentage (%)
18-19	119	49.58
20-21	57	23.75
22-23	74	30.83
24-25	4	1.66

In the present study, out of 240 recruited students 49.58% were in the age group of 18-19, 23.75% were in the age group of 20-21, 30.83% belongs to the age group of 22-23 and 1.66% subjects were in the age group of 24-25.

Table 2: Distribution of Body Mass Index of subject

BMI	Number (n =240)	Percentage (%)
Underweight (<18.5)	34	14.17
Normal Weight (18.5 – 24.9)	165	68.75
Pre-Obesity (25.0 – 29.9)	35	14.58
Obesity Class I (30.0 – 34.9)	6	2.50

In the present study, it shown that out of 240 subjects 14.17% were in the underweight class of BMI Classification, 68.75% were in the normal weight classification, 14.58% were in the pre-obesity class which constitutes most of the subjects 2.5%

Table 3: Distribution of Educational Qualification of subject

Education Qualification	Number (n =240)	Percentage (%)
BPT 2nd year	24	10
BPT 3rd years	30	12.5
BPT 4th years	15	6.25
BPT intern	24	10
BSC 2nd years	66	27.5
Diploma	80	33.3

In the present study, it shows that 10.0% were studying in BPT 2nd years, 12.5% were studying in BPT 3rd years, 6.25% were studying BPT 4th year, 10% were interns, 27.5% are studying in B.Sc., 33.3% studying in diploma.

Table 4: Distribution of Hand Dominance in subject

Hand Dominance	Number (n =240)	Percentage (%)
Left	4	1.66
Right	236	98.33

In the present study, it shown that majority of the student respondents were of right-hand dominance 98.33% and 1.66% had Left hand side as their dominance.

Table 5: Gender distribution of subject

Gender	Number (n =240)	Percentage (%)
Female	154	64.2
Male	86	35.8

In the present study, it shows that 64.2% are males and 64.2% are females.

Table 6: Distribution of Hand Grip strength (Males & Females)

	Classification			
	Men		Women	
	Left	Right	Left	Right
Excellent	2	2	34	18
Good	3	4	6	14
Average	30	33	51	50
Below Average	7	5	43	23
Poor	44	42	20	49
	86	86	154	154

Table 7: Distribution of pinch Grip strength (Males & Females)

	Female		
Age	**Weak**	**Normal**	**Strong**
18-19	5	23	4
20-24	28	60	17
25-29	2	10	5
18-19	0	4	29
20-24	4	20	23
25-29	0	5	1

In the present study, showed out of 240subjects studied that 22.2% were weak, 68.85% were normal, 8.95% were strong. In the present study, showed out of 240 subjects studied 5% population scored 80-90 and 95% population scored 90-100 which indicate, at their best state.

Table 8: Distribution of UEFI -15 (Males & Females)

Score	80-90	90-100
Female	8	146
Male	4	82

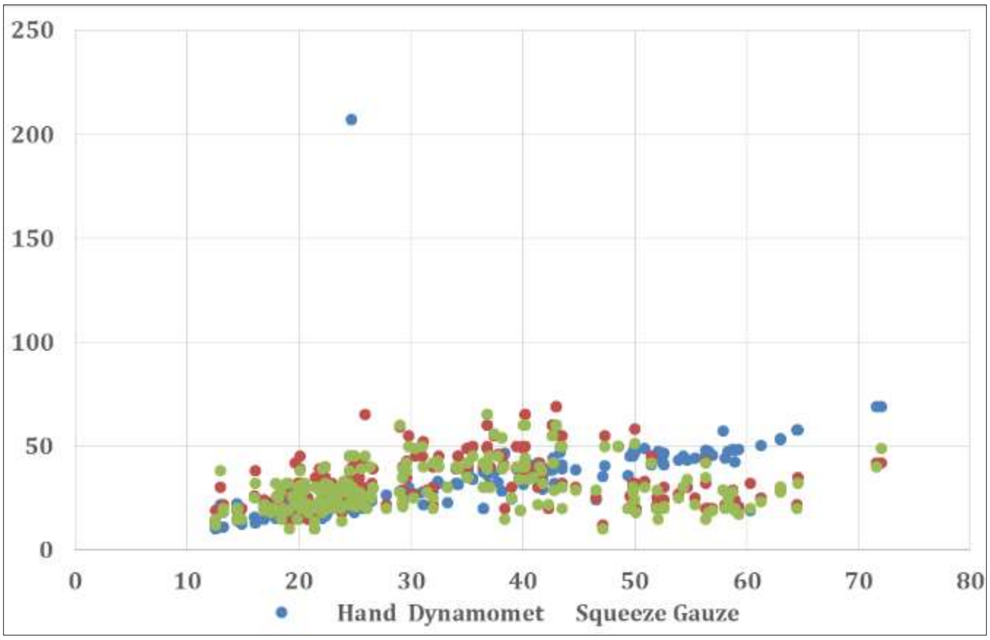

Fig 1: Correlation between hand grip and pinch strength

Table 9: Demonstrates that hand grip and pinch strength correlated with Pearson's coefficient 0.927 which indicates high positive correlation

1			
0.927192	1		
0.308283	0.293538	1	
0.255091	0.242477	0.629004	1

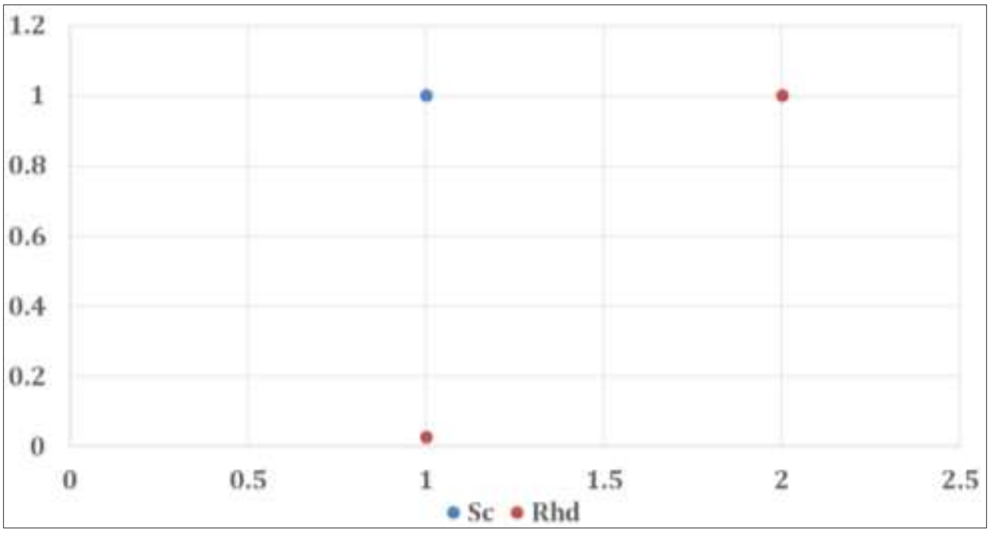

Fig 2: Correlation between smartphone usage (hrs) and right-hand grip

Table 10: Demonstrates that right hand grip and smartphone usage are correlated with Pearson's coefficient 0.248 which indicates negligible correlation

	SC	R.Hg
SC	1	
R.Hg	0.024806369	1

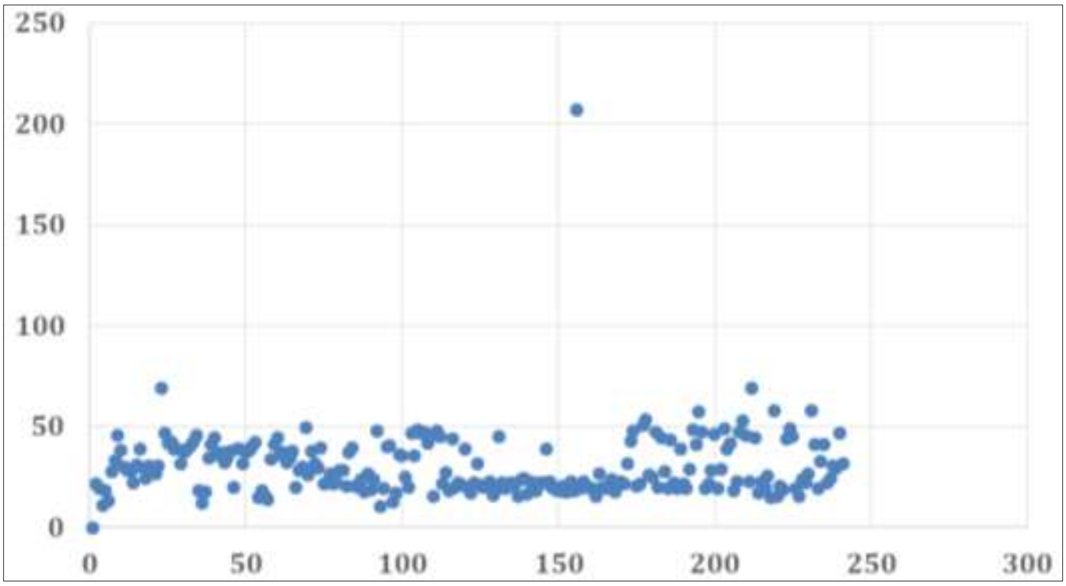

Fig 3: Correlation between smartphone usage(hrs) and left-hand grip

Table 11: Demonstrates that left hand grip and smartphone usage are correlated with Pearson's coefficient 0.0120 which indicates negligible correlation

	SC	L.Hg
SC	1	
L.Hg	0.012038077	1

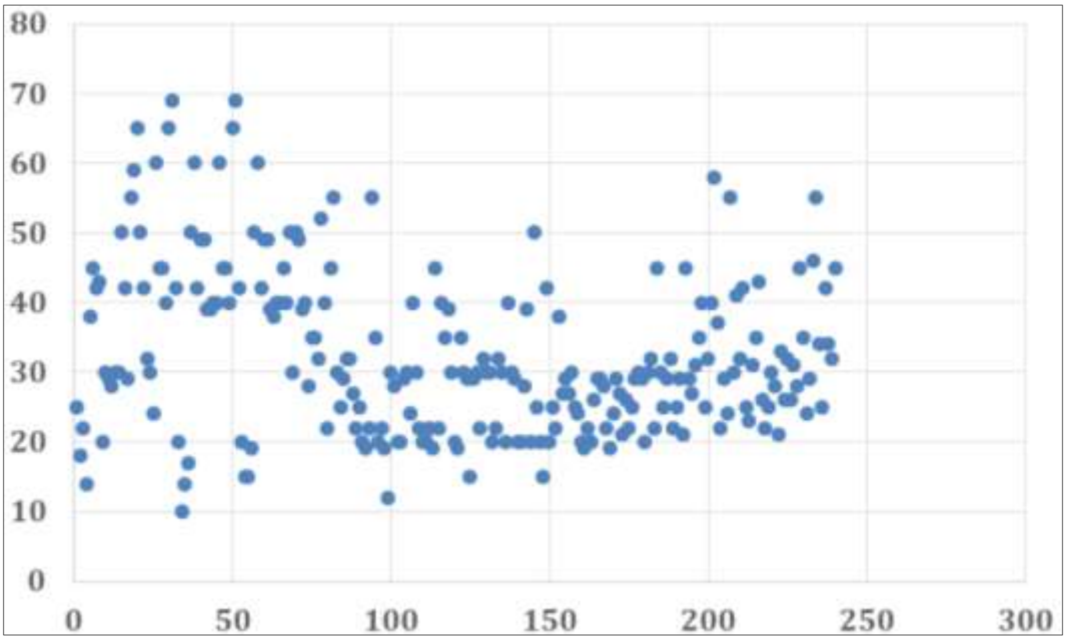

Fig 4: Correlation between smartphone usage(hrs) and right pinch grip

Table 12: Demonstrates that right pinch grip and smartphone usage are correlated with Pearson's coefficient 0.0403 which indicates low positive correlation

	SC	R. Pg
SC	1	
R. Pg	0.040347	1

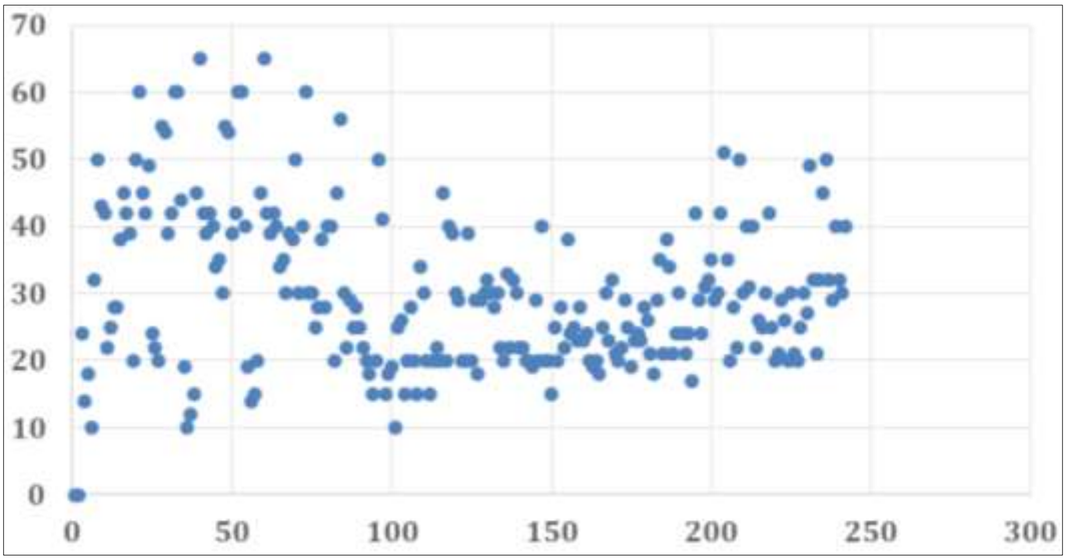

Fig 5: Correlation between smartphone usage(hrs) and left pinch grip

Table 13: Demonstrates that left pinch grip and smartphone usage are correlated with Pearson's coefficient 0.0357 which indicates low positive correlation

	SC	L.Pg
L.Pg	1	
SC	0.035719	1

Table 14: Demonstrates that UEFI -15 and smartphone usage are correlated with Pearson's coefficient -0.0847 which indicates high negative correlation

	SC	UEFI
UEFI	1	
SC	-0.084787347	1

Discussion

This cross-sectional study aimed to investigate the impact of smartphone usage on hand grip strength, pinch strength, and upper extremity function among college students, including 240 participants who were assessed for various musculoskeletal parameters. The demographic analysis revealed a diverse group of students, with a majority being female and engaged in different levels of physiotherapy and related fields.

The distribution of hand grip strength showed that 52.7% of participants had average strength, and 26.14% had poor strength, which suggests a notable proportion of the sample might be at risk for diminished upper extremity function. However, the correlation between smartphone usage and hand grip strength was weak, with Pearson's coefficients of 0.248 for right hand grip strength and 0.0120 for left hand grip strength, indicating negligible to very low correlations. This finding is in line with some studies which suggest that while smartphone use may affect hand grip strength, the effect is relatively minor compared to other factors like age and overall physical activity [9].

Pinch strength results indicated that 68.85% of participants had normal pinch strength, while 22.2% were classified as weak. The correlations between smartphone usage and pinch strength were also low, with Pearson's coefficients of 0.0403 for right pinch grip and 0.0357 for left pinch grip. This low positive correlation supports earlier research suggesting that prolonged smartphone use might contribute to reduced pinch strength, though the impact is not substantial [10]. The Upper Extremity Functional Index (UEFI) score showed a Pearson's coefficient of -0.0847 with smartphone usage, indicating a high negative correlation. This finding suggests that excessive smartphone use might adversely affect overall upper extremity function, potentially due to poor posture or repetitive strain, which aligns with the concerns highlighted in previous studies [11].

Research by Berolo *et al*. and Gustafsson *et al*. has documented that prolonged smartphone use can lead to musculoskeletal symptoms, including reduced hand grip and pinch strength^1^,4^. Smith and Leggat's review further supports the association between mobile phone use and musculoskeletal disorders, highlighting the need for ergonomic considerations to mitigate these effects [10].

The present study identified some correlations between smartphone usage and upper extremity function, the overall impact appears modest. The weak correlations observed suggest that smartphone usage alone may not be a major determinant of hand grip and pinch strength. However, the negative correlation with overall upper extremity function underscores the importance of ergonomic practices and balanced smartphone use to protect musculoskeletal health. Further longitudinal studies are needed to clarify these relationships and assess the cumulative effects of smartphone usage over time.

Limitations

Design and Measurement Issues: The cross-sectional design limits causal inference, and reliance on self-reported data along with variability in measurement techniques introduces potential biases and inaccuracies in assessing the impact of smartphone usage on musculoskeletal parameters.

Recommendations

Longitudinal and Objective Research: Conduct longitudinal studies with diverse populations using objective measures for smartphone usage and standardized assessment protocols for hand grip and pinch strength to better understand the causal relationships and ensure accurate, reliable results.

Conclusion

This study investigated the relationship between smartphone usage and various measures of upper extremity function, including hand grip strength, pinch strength, and overall upper extremity function among college students in Bengaluru. While the study identified weak correlations between smartphone usage and hand grip and pinch strength, the evidence suggests that smartphone use alone does not significantly impact these measures. The observed negative correlation with upper extremity function highlights the potential for smartphone use to affect overall musculoskeletal health, albeit modestly. These findings point to the need for further longitudinal research to better understand these relationships and the influence of other factors such as physical activity and ergonomic practices. Future studies should use objective measurements and standardized methods to provide more definitive conclusions.

Reference

1. Statista. Number of smartphone users worldwide from 2016 to 2021 [Internet]. 2020 [cited 2024 Aug 1]. Available from: https://www.statista.com/statistics/330695/number-of-smartphone-users-worldwide/
2. Twenge JM, Martin GN, Spitzberg BH. Trends in U.S. Adolescents' Media Use, 1976-2016: The Rise of Digital Media, the Decline of TV, and the (Near) Demise of Print. Psychol Pop Media Cult. 2019;8(4):329-345.
3. Berolo S, Wells RP, Amick BC III. Musculoskeletal symptoms among mobile hand-held device users and their relationship to device use: A preliminary study in a Canadian university population. Appl Ergon. 2011 Jan;42(2):371-378.
4. Gustafsson E, Johnson PW, Hagberg M. Thumb postures and physical loads during mobile phone use - a comparison of young adults with and without musculoskeletal symptoms. J Electromyogr Kinesiol. 2010 Apr;20(1):127-135.
5. Woo EH, White P, Lai CW. Musculoskeletal impact of the use of mobile handheld devices: A systematic review of literature. J Phys Ther Sci. 2016;28(12):3395-3399.
6. Dodds CJ, Woodward KA, Newton J, Lawton C, Oberlander TF. Assessment of hand grip strength in clinical practice: Considerations for test performance and clinical translation. Am J Occup Ther. 2018;72(4):7204395010p1-7204395010p8.
7. Edgren CS, Radwin RG, Irwin CB. Grip force vectors for varying handle diameters and hand sizes. Hum Factors. 2004 Winter;46(4):244-254.
8. Gerr F, Marcus M, Ensor C, Kleinbaum D, Cohen S, Edwards A, *et al*. A prospective study of computer users: I. Study design and incidence of musculoskeletal symptoms and disorders. Am J Ind. Med. 2002 Oct;41(4):221-235.
9. Berolo S, Wells R, Amick BC. Musculoskeletal symptoms among mobile phone users: A review. Int J Ind Ergonomics. 2011;41(6):403-412.
10. Gustafsson E, Karlqvist L, Nilsson T, Skerfving S. Mobile phone use and symptoms in the neck and shoulder: a prospective cohort study. Appl Ergon. 2018;68:184-191.
11. Smith DR, Leggat PA. Mobile phone use and musculoskeletal disorders: A review of the literature. Int J Occup Saf Ergon. 2016;22(2):183-194.
12. Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sørensen F, Andersson G, *et al*. Standardized Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon. 1987;18(3):233-237.