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Smartphone Strain: Investigating The Effects on Handgrip and Key Pinch Strength in Collegiate Individuals

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Abstract:

Background And Purpose: Smartphones have become indispensable in modern society. Young children and college students have become ardent smart phone users as a result of their social involvement with communication technology. Frequent smartphone use causes repetitive stress injuries to the thumb and fingers. Hand is the only prehensile organ in humans. The relationship between smartphone usage with handgrip strength and key pinch strength in college students must therefore be evaluated.
Methodology: 100 number of students were selected for study through random sampling based on inclusion and exclusion criteria. The subject's testing position was maintained according to the American Society of Hand Therapist (ASHT) for measuring hand grip strength using Jamar Dynamometer and key pinch strength using Pinch Gauge Dynamometer.
Result: Un- paired t test was used to compare both hands grip strength and key pinch strength with normative data. Paired t test was used to compare right hand grip strength and key pinch strength with left hand grip strength and key pinch strength. Level of significance selected is $p \leq 0.05$.
Conclusion: The study shows that there is a significant decrease in grip strength and key pinch strength of both hands but no difference is seen between right and left hand grip strength and key pinch strength.

Keywords: Grip strength, Pinch strength, Smartphone, repetitive stress injuries, smartphone addiction, muscle fatigue, motor skills, fine motor control, musculoskeletal issues.

INTRODUCTION

Technology's rapid evolution is crucial in daily life, with increased use of smartphones and thumb use. However, prolonged smartphone use and faulty wrist posture can lead to collective wrist joint trauma.
The hand grip and pinch grip are crucial for various movements in humans. Prehension grip holds objects between fingers and thumb tips, involving intrinsic and extrinsic muscles. Pinch grip flexes fingers, abducts thumb, and extends joint. Side-to-side grip requires adduction of fingers.[1,3,2,4 & 5]
A study found that students spend 7.35 hours daily using single hand-held devices, leading to carpal tunnel syndrome (CTS) due to repetitive wrist movements, causing narrowing and increased pressure in the carpal tunnel.[6,7]
Preliminary studies on the effect of mobile hand-held device use among university students revealed a significant association between upper extremity symptoms and frequent utilization of a mobile hand-held device.[8]
In my current study, I am finding out the relationship between smartphone use with grip strength and key pinch strength in collegiate students.

MATERIALS AND METHODS

This was an observational study.
Source of sample: I.T.S Institute of Health and Allied Sciences, Ghaziabad, U.P. Sample size : 100

Inclusion criteria: male and female, 18-25 years, college going students , using Smartphones since 1 year for at least 4-5 hours per day and having no acute pain in hands and arms .

Exclusion criteria included-Pain, Carpal tunnel syndrome, Cervical pathology, Previous Contracture, Recent Trauma, Recent Fracture, Tendon lesion, Lateral and Medial epicondylitis, Tremors, Burns, any other joint or tendon pathology, no auditory, visual, or perceptual deficiencies.

Sampling method: Random sampling

Instruments : Jamar Hand Dynamometer, Pinch Guage Dynamometer, Weighing machine, Inch tape.
Prior to beginning the sampling, the Age, Gender, Anthropometric measurements (height, weight, and BMI), and hand dominance of each student were recorded. Both instruments were caliberated periodically during the study. Scores were read on the medial side of the red read out marker. Three readings each were recorded for measuring Grip and Key Pinch Strength in all subjects.

MEASUREMENT PROCEDURE

Standard position for grip strength testing as per American society of Hand Therapists(ASHT):
1. Subject position: upright seating , feet rested on floor
2. Shoulder position: adducted and neutrally rotated
3. Elbow position: 90 degree flexed
4. Forearm position: neutral
5. Wrist position: extended and ulnarly deviated

The gauge was placed between the thumb pad and index finger's middle phalanx, with deviations causing interruptions. Subjects chose hand, and mean of three trials compared with normative data from previous large-scale investigations.

Fig.1.Measuring hand grip strength.

Fig.2. Measuring pinch strength';

RESULTS

The data was analyzed using SPSS version 16.Un-paired t test was used to compare right and left-hand grip strength with normative data grip strength, right and left hand key pinch strength with normative data key pinch strength. Paired t test was used to compare right hand grip strength with left hand grip strength and right hand key pinch strength with left hand key pinch strength. Level of significance selected was $p \leq 0.05$.

Table 1. Comparison of NDGS with RHGS

Gender	NDGS	RHGS	T	P
Male	33.67	24.341	8.974	0.00
Female	19.51	14.218		

NDGS= Normative data of grip strength
RHGS= Right hand grip strength

Table 1. The statistical analysis of means (NDGS and RHGS) shows that there was a significant difference at level of significance $p<0.05$.

Table 2.Comparison of NDGS with LHGS

Gender	NDGS	LHGS	T	P
Male	33.67	24.99	8.164	0.00
Female	19.51	13.69		

NDGS= Normative data of grip strength
LHGS= Left hand grip strength

Table 2. The statistical analysis of means (NDGS and LHGS) shows that there was a significant difference at level of significance $p<0.05$.

Table 3. Comparison of NDKPS with RHKPS

Gender	NDKPS	RHKPS	T	P
Male	6.97	5.753	6.984	0.00
Female	4.85	3.82		

NDKPS= Normative data of Key pinch strength
RHKPS= Right hand Key pinch strength

Table 3. The statistical analysis of means (NDKPS and RHKPS) shows that there was a significant difference at level of significance $p<0.05$.

Table 4. Comparison of NDKPS with LHKPS

Gender	NDKPS	LHKPS	T	P
Male	6.97	6.11	6.532	0.00
Female	4.85	3.66		

NDKPS= Normative data of Key pinch strength
LHKPS= Right hand Key pinch strength

Table 4 The statistical analysis of means (NDKPS and LHKPS) show that there was a significant difference at level of significance $p<0.05$.

Table 5. Comparison of RHGS-LHGS with RHKPS-LHKPS

	Mean	T	P value
RHGS-LHGS	0.1769	0.337	0.737
RHKPS-LHKPS	0.0065	0.087	0.93

RHGS= Right hand grip strength
LHGS= Left hand grip strength
RHKPS= Right hand Key pinch strength
LHKPS= Right hand Key pinch strength

Table5 The statistical analysis of means (RHGS-LHGS and RHKPS-LHKPS) show that there was no significant difference at level of significance $p<0.05$.

Fig.3. comparison of Mean values of key pinch strength (right and left) with normative data of Indian population.

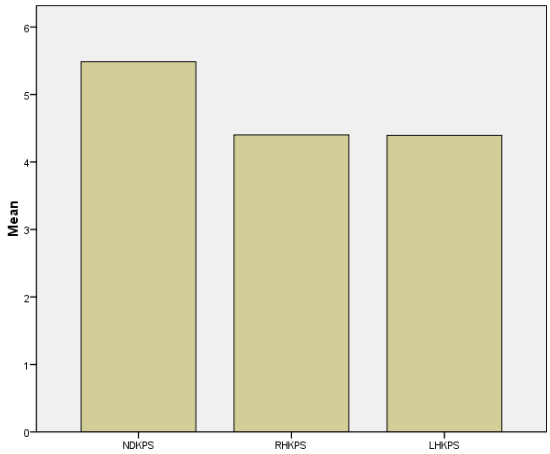
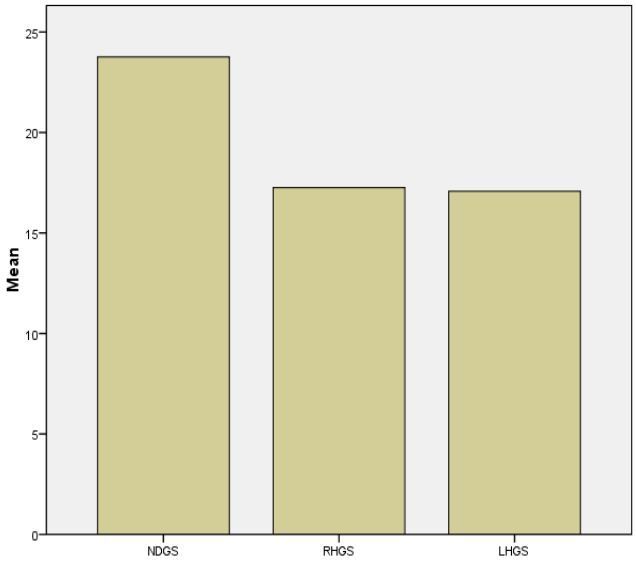


Fig 4. Comparison of mean of grip strength (right and left) with normative data of Indian population.



DISCUSSION

This study was conducted to examine the effect of smartphone use/ usage on grip strength and key pinch strength among collegiate students.
In the present study, the right hand and left hand grip strength and key pinch strength demonstrated significant difference which means that null hypothesis is rejected and alternate hypothesis is accepted.

The results also showed that males have more grip strength and key pinch strength as compared to females. This is attributed to the fact that males are taller due to which the arm length is more and they get a better leverage for grip and pinch strength. We also found that there is weak a correlation between anthropometrics variables.
Modern smartphone designs can cause a decrease in grip strength and key pinch strength due to repeated finger motions. This study tested key pinch strength in the carpometacarpal joint, which regulates the ability to reach keys on the screen. The thumb, the most affected part of the hand, showed a reduction in strength due to touchscreen phone use.[9, 10 & 11]
The reason for this may be over use of muscles leading to fatigue and pain. However in this study pain was not an outcome measure. In addition, the grip strength and pinch strength was found to be positively correlated.
Overall, the addiction severity also seemed to have a positive correlation of duration and time of smart phone use, with grip and pinch strength.

Sumit Kalra's 2017 and Kim et al.'s 2015 studies found that frequent smartphone use can affect hand function and pinch grip strength due to extensive thumb flexion. Collegiate students' grip strength decreases due to enlargement of tendons,

median nerve, and CMC joints involvement. Physical factors like reduced contracting muscle fibers and changes in muscle fiber type also contribute to this issue.
Ilik et al. found that repeated wrist-flexion and extension movements may lead to larger median nerves in high-frequency smartphone users, as well as increased pressure in the carpal tunnel, resulting in decreased space for the nerve inside.[6]
Namwongsa et al. found that the usage of muscles, posture, and muscular force were important risk factors for upper-limb musculoskeletal diseases, which put more strain on the joints and nerves, especially in smartphone users.[2]
El-Azab et al. found a positive correlation between daily smartphone usage and the severity of upper-limb symptoms like pain, fatigue, and poor posture, impacting upper-limb functions.[8]
A study found that frequent mobile phone texting thickens FPL tendons in the MT region, but other uses like internet browsing and gaming may also impact FPL tendons thickness. Long-term static loading and overuse of hand muscles contribute to myofascial pain syndrome.[13]
In the present study we found that the grip strength and key pinch strength of both hand decreases as compared to normative data. Males have more grip and key pinch strength than females. But there is no significant difference between dominant and non dominant hand.

FUTURE SCOPE /FUTURE RESEARCH DIRECTIONS?

1) The study can be done to see the effect of body posture on grip and pinch strength (especially neck posture and upper limb extremity).
2) More wider age group can be assessed.
3) Electrophysiological changes in median nerve can be studied with decreased grip strength.

STRENGTHS OF STUDY

Quantifiable data of study.
Clear cause-and-effect relationship: how smartphone use directly impacts grip strength and pinch strength.
Potential for identifying trends.
Possibility for establishing guidelines towards usage of smartphones.

LIMITATIONS OF STUDY

1. Only college going students (18-25) year of age were taken.
2. Three finger pinch and pulp pinch were not examined.
3. Only 90 degree of elbow flexion was used to assess the grip strength.
4. Grip strength can be checked with diurnal variations.

CONCLUSION

Thus, the study concluded that the grip strength of the right and left hands, as well as the key pinch strength of the right and left hands, were decreased in college going students who used smartphones excessively compared to normative data of the Indian population, and that there is no difference between the grip strength of the right and left hands and the right and left hand key pinch strength because smartphones are typically used with both hands.

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