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Original Research Article

The Relationship Between Smartphone Usage Duration with Hand Grip, Pinch Grip Strength and It's Impact on NCS Motor Parameters of Median Nerve in Young Population – An Observational Study

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ABSTRACT

Background: There seems to be a lack of literature regarding the association between handgrip strength and nerve conduction parameters of the median nerve among smartphone users in the young population. There is a need to investigate the inter-relation of grip strength with smartphone usage and motor parameters of the median nerve by carrying out a nerve conduction study.

Aims: The study aims to find out the correlation between hand-grip and pinch-grip strength on nerve conduction study motor parameters among smartphone users.

Methods and Material: 112 young adult participants were included. Hang grip strength and pinch grip strength were assessed for both hands and after three trials, the average was calculated. The average screen time of their smartphones over the past week was noted, and simultaneously, the motor nerve conduction study parameter of the median nerve was performed.

Statistical analysis: Pearson's correlation was applied to find out the correlation between the component of the handgrip, pinch grip, and motor nerve conduction velocity of the median nerve. The p-value of < 0.001 was considered statistically significant.

Results: The study obtained a significant negative correlation between smartphone usage with amplitude and nerve conduction velocity and a significant positive correlation with the latency of the median nerve.

Conclusions: The study concluded that smartphone usage reduces the hand grip and pinch grip strength and significantly affects the motor parameters of the median nerve.

KEYWORDS: Smartphone screen time, hand grip strength, pinch grip strength, median nerve.

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INTRODUCTION

Global smartphone usage was anticipated to reach 3.5 billion users in 2020, up 9.3% from 2019. According to a survey report, smartphone usage increased by 50 % and was one of the profound reasons for smartphone addiction in teens [1]. Modern technology is critical today as it deescalates the human effort required for task performance. Smartphones are used not only for communication but also as vital social accessories; because of that, young adults have become keen smartphone users [2]. Smartphones have influenced practically every aspect of human life. Business, education, health, and social life are some of the sectors where the most obvious impact is seen. With the surge in smartphone use, public and clinical literature reports indicate a link between hand-held device use and musculoskeletal problems in the upper extremities. Many cumulative trauma disorders to the neck, shoulders, hands, and wrists were reported due to the overuse of smartphones.[3] A study by Ming et al. found that upper limb musculoskeletal disorders were more common in those adults who used smartphones for over three years. The repetitive static motion of the hands may also decrease blood supply and prevent nutrition from being delivered to muscles, thus leading to pain and muscle fatigue. One Case report shows a relationship between high typing counts and hand problems, particularly De Quervain's tenosynovitis and osteoarthritis of the first carpometacarpal (CMC) joint at the base of the thumb.[4] Young people prefer to use the smartphone with a single hand, despite its structure and design that allow both hands. Single-handed interaction can significantly benefit the user by freeing a hand for other activities. On the other hand, an individual who uses a single-handed smartphone is compelled to engage in repetitive wrist flexion and extension. Furthermore, repetitive wrist movements play a role in the etiopathogenesis of Carpal Tunnel Syndrome (CTS) because repetitive wrist flexion/extension narrows the carpal tunnel and increases pressure inside the tunnel [1]. It has been observed that university students spend an average of more than 3.5 hours each day on their mobile phones texting, emailing, scheduling, and browsing the Internet. They commonly get pain at the bases of their thumbs. The pinch grasp and handgrip are fundamental functions for a variety of activities. One of the most prevalent motions used in daily tasks and vocational sectors is object manipulation with a stable hand grip. Reduced grip strength and hand manipulation control can affect physical and physiological factors. According to one article, smartphone use for an extended time was linked to weaker hands and pinch grips [3]. Also, some studies show Smartphone usage reduced handgrip strength and hand function, resulting in lower handgrip strength in the dominant hand [2]. Various factors such as age, gender, height, bone mineral density, hand size, upper arm circumference, hand dominance, occupation, social status, and lifestyle have been found to affect Grip strength [3]. Anne et al. did one study suggesting correlation coefficients between 0.736 and 0.890 ($p > 0.01$); grip strength was strongly correlated with total muscle strength. This finding suggests that grip strength can be used in the clinical setting as a tool to assess someone's overall muscle strength quickly [4,5].

Hand dynamometry is one of the most accepted methods for evaluating the integrity of hand function. Even with different assessors or dynamometer brands, handgrip strength may be accurately measured when standardized procedures and calibrated tools are utilized. Although it is not explicitly stated that the association is causal, grip strength is related to and predictive of various medical issues. As much as various other methods have been invented or available to proclaim the strength of the hand musculature, handheld dynamometry is one of the most reliable and valid among the others [6]. Both strength and mass depend on peripheral innervation, which is evaluated by a nerve conduction study [7].

NCS is an objective, non-invasive test in which the nerve is stimulated electrically, and the evoked potential is recorded either from the nerve itself or from the muscle. Various pathological conditions show nerve conduction abnormalities, such as damage or loss of myelin, focal compression, axonal loss, or generalized peripheral neuropathy. NCS includes the assessment of motor and sensory action potentials, namely, compound muscle action potential (CMAP) in motor nerves and sensory nerve action potentials (SNAP) in sensory nerves. Commonly measured parameters of CMAP and SNAP include distal latency, amplitude, conduction velocity, and duration. Different pathological processes result in changes in NCS parameters [8]. A study report demonstrated that median motor nerve electrophysiological findings were strong predictors of the results of hand-function tests in the hand osteoarthritis patient population [9].

A study demonstrated that the wrist angle was an important factor that could affect the deformability of the median nerve in unclenched and clenched fists conditions and also showed that the median nerve deforms with finger flexion movements while clenched fist condition contributes to higher deformation percentages of median nerve parameters [10]. Since there is paucity in the literature regarding the relationship between the handgrip and pinch grip strength with the NCS parameter. Here, the study aims to find out the correlation between smartphone usage on the handgrip and pinch grip and its impact on motor parameters of the median nerve. The study's objectives were to study the relationship between smartphone usage by using mobile system screen time and handgrip strength using a hand-held dynamometer, pinch grip strength using a pinch-gauge dynamometer, and the impact on median nerve motor parameter using a nerve conduction study instrument.

SUBJECTS AND METHODS

The study was approved by 'Institutional Ethics Committee.' A total of 112 young individuals were selected with a convenient sampling method.

The inclusion criteria for selecting the individuals were 1>Young population aged 18-30 years 2> Normal individuals without pathology, disease, or fracture. 3> Smartphone usage (weekly duration average) according to IOS and Android systems.

The exclusion criteria were 1> Individuals with neurological or musculoskeletal or inflammatory joint disease. 2>A person with a surgical history, tendon transfer, fractures of the wrist, or any region of the whole upper limb. 3> Metabolic disease and neuropathic disease were excluded. G* power software was used to calculate sample size, and an a priori test for correlation showed that the minimum sample required to achieve the power of (1-β error probability) =0.85 was 112 with the effect size (*d*)=0.3.) After acceptance to participate, consent forms were given for signing, and then the investigator filled out an assessment sheet with anthropometric measurements, height & weight. The handgrip & pinch grip strength was then taken by the Saehan handheld dynamometer and Saehan pinch gauge, respectively. The smartphone screen time was then asked, and the weekly average screen time was checked (one time only) according to the smartphone's inbuilt and reported in hours and minutes. A Median Nerve Motor Conduction Velocity Study was conducted to obtain the parameters like latency, amplitude, and nerve conduction velocity of both the right and left upper extremities using Clarity Octopus New.

RESULTS

Data collected were entered and analysed by SPSS (Statistical package for social science) version 23.0 for Windows (IBM). Descriptive statistics was used to analyze the baseline characteristics of participants. Results of the outcome measures were expressed as summary measures (Mean±SD).

In the demographic characteristics, Out of 112 subjects, 33 were male, and 79 were female. Among them, 76(67.9%) were single-handed, and 36(32.2%) were double-handed. There were 104 right-handed & 8 left-handed. In this study, the hand grip of participants using smartphones was assessed by a handheld dynamometer, and along with that, the motor parameters (latency, amplitude, NCV) of the median nerve were checked through the

Table 1: Baseline characteristics of participants.

Variables	Mean±SD
Age (years)	20.27± 1.39
Height (cm)	163.02 ± 9.29
Weight (kg)	54.96 ± 12.78
BMI (kg/m^2)	20.29 ± 3.85
Screen time (h)	5.92±1.44
right pinch grip (kg)	4.45 ± 1.75
left pinch grip (kg)	4.27 ± 1.62
right-hand grip (kg)	19.57 ± 7.60
left-hand grip (kg)	18.43 ± 7.76
right latency (ms)	3.89 ± 0.56
left latency (ms)	3.9275 ± 0.52
right amplitude (mV)	7.36 ± 3.79
left amplitude (mV)	7.67 ± 3.63
right motor nerve conduction velocity (m/s)	58.75 ± 4.55
left motor nerve conduction velocity (m/s)	58.83 ± 4.72

Table 2: Comparison of Smartphone Screen time with Handgrip, pinch grip, and motor parameters of Median nerve.

Hand side	Variables	Hand grip	Pinch grip	Latency	Amplitude	Nerve conduction velocity
Right side	**Screen time**					
	r	0.098	0.087	0.241*	-0.219*	-0.154
	p	0.306	0.362	0.01	0.02	0.106
Left side	**Screen time**					
	r	0.08	0.096	0.075	0.025	0.164
	p	0.399	0.312	0.431	0.799	0.084

*Correlation is significant at the 0.01 level

EMG-NCV machine.

Pearson's correlation was applied to find the correlation between the components of the handgrip, pinch grip, and motor nerve conduction velocity of the median nerve. The p-value of < 0.001 was considered statistically significant.

The above table shows there is a significant negative correlation between amplitude and nerve conduction velocity and a positive significant correlation between latency and screen time on the Rt side.

DISCUSSION

The study's primary aim was to find the correlation between handgrip, Pinch grip strength, and NCS parameters of the median nerve, such as latency amplitude and nerve conduction velocity among healthy young adults 18-30 years of age. The handgrip and pinch grip were taken by Saehan's handheld dynamometer and Saehan pinch gauge, respectively. NCS parameters were assessed by NCS instrument clarity octopus new. A total of n=112 subjects were assessed for hand grip, Pinch grip strength, and NCS parameter of the median nerve, and smartphone usage was calculated by weakly average screen time.

The results of the present study showed a significant negative correlation between screen time values with amplitude and nerve conduction velocity and a significant positive correlation with a latency of the median nerve on the Rt side only. This might be because many study participants were Rt handed and used single smartphones. This finding is supported by a study by Yuichi Yoshii et al., which found that nerve conduction delay is related to changes in material properties of the median nerve, where the conduction study was a principal indicator of thumb opposition strength [17]. Because extended smartphone use has been linked to median nerve enlargement, it is possible to explain the inverse relationship between smartphone usage length and hand-grip and pinch-grip strength.

The study aimed to determine smartphone users' value of handgrip and pinch grip strength. In various health-related conditions, grip strength has been considered one of the functional measures [12-14]. However, several studies have been done in the literature to determine the normal value of grip and pinch grip strength. The mean values obtained in this study were lower than measurements recorded in other populations. In this study, there is a negligible correlation between smartphone usage with hand grip and pinch grip; this may call for additional research in a large sample with better control over other factors, including the degree of physical activity, years of smartphone use, and occupational factors. This result is consistent with the study done by Ahmad et al., which found that a weaker handgrip and pinch grip strength was linked to and contributed to a longer average daily smartphone use period. This might be because modern smartphone design requires repeated finger motions such as tapping, pressing buttons, scrolling, and clicking. These repetitive finger motions affect the fingertip force, affecting muscular forces and tendon excursion [15].

According to Mork and Westgaard,2006 repetitive tasks such as using smartphones may be associated with an overload of low-threshold motor units [16]. In their studies, Kalra and Kim et al. also found a reduction in grip strength and hand function. They reported that physical factors such as a reduced number of contracting muscle fibers decreased motor-unit firing rates and change in muscle fibers type. Because extended smartphone use has been linked to median nerve enlargement, it is possible to explain the inverse relationship between smartphone usage length and hand-grip and pinch-grip strength [11].

CONCLUSION

The study concluded that smartphone usage reduces the hand grip and pinch grip strength and significantly affects the motor parameters of the median nerve.

Limitations of the Study: The female population was more compared to the male population. Right-hand dominant people were more compared to the left-hand. Single-handed use of mobile phones was more than double-hand usage. The baseline of the different components taken in the study was not the same. The study was limited to the median nerve and motor parameters only.

Future Recommendations: The baseline for every component could be the same for more accurate results. The specific operating system of smartphones should be used for screen time checks. Years of using smartphones should be considered. Intervention can be given for the reduced grip strength due to longer phone usage. The duration of the study can be prolonged to find correlations.

ABBREVIATIONS

CMC: Carpometacarpal
CTS: Carpal Tunnel Syndrome
MCP: Meta-Carpo Phalangeal
PIP: Proximal Interphalangeal
NCS: Nerve Conduction Study
CMAP: Compound Muscle Action Potential
SNAP: Sensory Nerve Action Potential
SPSS: Statistical Package for the Social Sciences
SD: Standard Deviation
MNCV: Motor Nerve Conduction Velocity

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Author Contribution

Dr Jagruti Patel: Research process, review of literature, discussion, research analysis.
Prachi Rana: Data collection, research design, research process, discussion.
Helly Patel: Data collection, research design, research process, editing, manuscript drafting.
Niral Patel: Data Collection, research design, research process.

Conflicts of interest: None

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