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Effect of texting and handwriting on hand-grip and key-pinch strength among female-collegiate students: randomized controlled trial

Tarek Mohamed Fathi El-gohary,[1] Marwan Mahmoud Aljohani[2]

Abstract

Objective: To evaluate immediate and long-term effect of texting or handwriting on hand-grip and key-pinch strength among healthy female students.

Method: The single-blind, randomised controlled trial was conducted between February and April 2021 after approval from the ethics review committee of the College of Medical Rehabilitation Sciences, Taibah University, Saudi Arabia, and comprised female Physio Therapy students aged 19-23 years who were right-hand dominant and had normal body mass index. The subjects used smartphones and electronic gadgets for >2hrs daily, writing more than 10min/day. They were randomised using sealed envelopes into five groups. Group A practised 10min texting, group B 15min texting, group C 10min writing, group D 15min writing, and group E used the phones only for talking or watching, with no texting or writing, and was taken as the control group. Hand-grip strength and key- pinch strength were assessed one minute before starting, and within one minute after having finished the assigned hand activity. All measurements were recorded in the sitting position using a single hand-grip dynamometer. Data was analysed using SPSS 23.

Results: Of the 65 individuals assessed, 60(92.3%) were initially enrolled, but the study was finished by 50(83.3%) subjects with a mean age of 20.88±0.98 years and mean body mass index 20.8±2.30kg/m2. There were 12(24%) subjects in group A, 7(14%) in group B, 12(24%) in group C, 10(20%) in group D and 9(18%) in group E. The association of the time-based groups with hand-grip and key-pinch strength was not significant (p>0.05).

Conclusions: Texting and handwriting did not have any significant immediate effect on hand-grip or key-pinch strength.

Clinical Trial Number: (NCT04810416).

Key Words: Hand-strength, Pinch-strength, Students, Text messaging, Writing.

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Introduction

The number of smartphone users worldwide is expected to rise to 7.26 billion by 2022 and to 7.49 billion by 2025.[1] Recent research showed that more than half of medical students are addictively overusing their smartphones,[2] which are portable devices that combine basic phone functions and several computing functions. Nowadays, many college students rely on such devices for academic purposes.[3] Texting and writing on the digital screen are fundamental parts of daily academic activities. Additionally, the extensive mobile operating systems have facilitated web browsing and multimedia functionality, which in turn has increased smartphone usage.[2]

[1]Department of Biomechanics, Cairo University, Egypt, [2]Department of Physical Therapy, College of Medical Rehabilitation Sciences, Taibah University, Saudi Arabia.

Correspondence: Tarek Mohamed Fathi El-gohary.
Email: dr.elgoharyt@yahoo.com
ORCID ID. 0000-0002-8761-0201

Handwriting is an essential communication skill that needs to be mastered by college students for having a successful academic career.[4] Texting is a term that describes the act of creation and electronic transmission of short text messages between mobile devices. Texting started using alphanumeric plain text, and has progressed to include multimedia messaging services. Text messaging requires individuals to adopt inappropriate neck posture, called text neck, which might be associated with neck pain.[5] Neck pain has negative effects, and tends to increase neck muscle activities among smartphone users.[6] The users should avoid excessive neck flexion and be aware of the need to keep 0° neck flexion angle to minimise muscle activity and gravitational moment which reduce neck discomfort.[7]

There is gap in knowledge regarding how the activities like texting or handwriting would affect hand-grip strength (HGS) or key-pinch strength (KPS). There is also uncertainty about the impact of the length of smartphone usage on hand strength. The current study was planned to fill the gap by the examining the immediate effect of texting and handwriting on HGS and KPS, and to evaluate the possible effect of the length of usage time. It was hypothesised that the length of usage time would not have a significant effect on either HGS or KPS.

Subjects and Methods

The single-blind, randomised controlled trial (RCT) was conducted between February and April 2021 at the College of Medical Rehabilitation Sciences, Taibah University, Saudi Arabia. After approval from the institutional ethics review committee, the study was registered at ClinicalTrials.gov (NCT04810416).

The sample size was calculated using G*power version 3[8] with effect size 0.8, power 0.8 and alpha (α) error 0.05 for a priori power analysis, while using one-tail t test for the difference between two independent means.

The sample was raised consecutively, using homologous convenience sampling technique. Those included were female Physio Therapy students aged 19-23 years who were right-hand dominant and had normal body mass index (BMI). The subjects used smartphones and electronic gadgets for >2hrs daily, writing more than 10min/day. Healthy individuals were identified as those who had no systemic disease, taking medications on a regular basis or having upper extremity and/or neck pain >2/10 in severity at the time of inclusion.

Normal body weight was defined as BMI 18.5-24.9kg/m^2.[9] Individuals were excluded if they had a history of acute upper extremity or neck injury, diagnosed with carpal tunnel syndrome, de Quervain's tenosynovitis, and any significant limitation of mobility or were suffering from neuromuscular disorder.

After taking written informed consent, data was collected regarding demographics as well as weight, BMI, mid-upper arm circumference and upper arm length. All subjects were screened for upper limb functional mobility, neck mobility and neck pain[10] before they were randomised using sequentially numbered, opaque, sealed envelopes into five groups. Group A practised 10min texting, group B 15min texting, group C 10min writing, group D 15min writing, and group E used the phones only for talking or watching, with no texting or writing, and was taken as the control group. All the participants practised a familiarisation session to experience HGS and KPS measurements.

The subjects undertook the assigned activity independent of the assessor who was blinded to the process. The gauge faced away from the participants' face. Two stations were used; one for data collection and practising the assigned hand activity, and the second was meant for HGS and KPS assessment. Physiotherapists, who were trained and evaluated for reliability, conducted all measurements at the institutional laboratory. Every participant was shown the pain body diagram to mark the site of pain in the neck and upper extremities, and were asked to indicate pain severity using the pain- intensity numeric rating scale (NRS).[11] Pain was considered significant if it was scored 2 or above in severity, and those with pain score 4 or above were excluded. Neck mobility was assessed at flexion, extension, side bending to the right and left, and rotation to the right and left. Every subject was instructed to sit on an armless chair with the trunk in upright position. Inclinometer was used to measure neck mobility and to ensure the inclusion of individuals with normal neck mobility in all directions.

functional mobility of the upper limbs was assessed using right and left Apley's scratch test[12-13]. Every participant was shown the Apley's test and then instructed to stand up straight with feet in line with the shoulders' width. The researcher recorded the distance, if any, between middle fingers tips, and recorded zero if there the finger touched or overlapped.[12,13]

The anatomical landmarks used to measure upper arm length were the acromion and olecranon process. Mid-upper arm circumference was measured at the midpoint between the tip of the shoulder and the tip of the elbow. With the arm hanging loosely straight down, a measurement tape was snugly wrapped around the arm at the midpoint mark and measured to the nearest 1mm.[14]

HGS was assessed one minute before starting the hand-activity and within one minute after having finished the assigned hand-activity. All measurements were recorded in the sitting position using a single hand-grip dynamometer (Sammons Preston, Bolingbrook, IL) that was calibrated according to the manufacturer's specifications. The dynamometer handle was set in its second position for all testing. The gauge of the dynamometer was set to face away from the participants face. HGS for the right hand was recorded in a single session.[12] Every participant had to sit comfortably in an armless chair with the feet touching the floor, keeping her shoulder in neutral position, elbow in 90° flexion, forearm in neutral position, and wrist joint in either neutral or extension position, as instructed. The order of measurement was counterbalanced to avoid any order effect as a violation of internal validity. Every participant was asked to squeeze the dynamometer handle as strongly as possible doing single repetition. All measurements were recorded in kilograms.[12,15-17]

KPS was also assessed one minute before starting the hand-activity and within one minute after having finished the assigned hand-activity.

Pinch gauge was used for testing KPS. All measurements were recorded in the sitting position, keeping shoulder in neutral position, elbow in 90° flexion, forearm in neutral position, and wrist joint at the position of participant's preference. The examiner held the distal end of the pinch gauge while every participant was instructed to press the thumb pad against the lateral aspect of the middle phalanx of index finger. All measurements were recorded in kilograms in a single session. The order of measurements was counterbalanced to avoid any order effect that could threaten the internal validity.[12,15,16]

Data was analysed using SPSS 23.[18] Data was expressed as mean ± standard deviation (SD), and frequencies and percentages, as appropriate. Shapiro-Wilk test was run to evaluate data normality. One-way analysis of variance (ANOVA) was used to establish baseline equivalency among the groups. A 5x2 mixed-design ANOVA was used to test intergroup and intragroup differences between pre-activity and post-activity scores, and the interaction effect at different levels of the independent variable. Pearson correlation coefficient was calculated for the anthropometric measurements of mid-upper arm circumference and upper arm length with HGS. Level of statistical significance was set at p≤0.05 with 95% confidence interval (CI).

Results

Of the 65 female students assessed, 60(92.3%) were initially enrolled, but the study was finished by 50(83.3%) (Figure). The overall mean age of the sample was

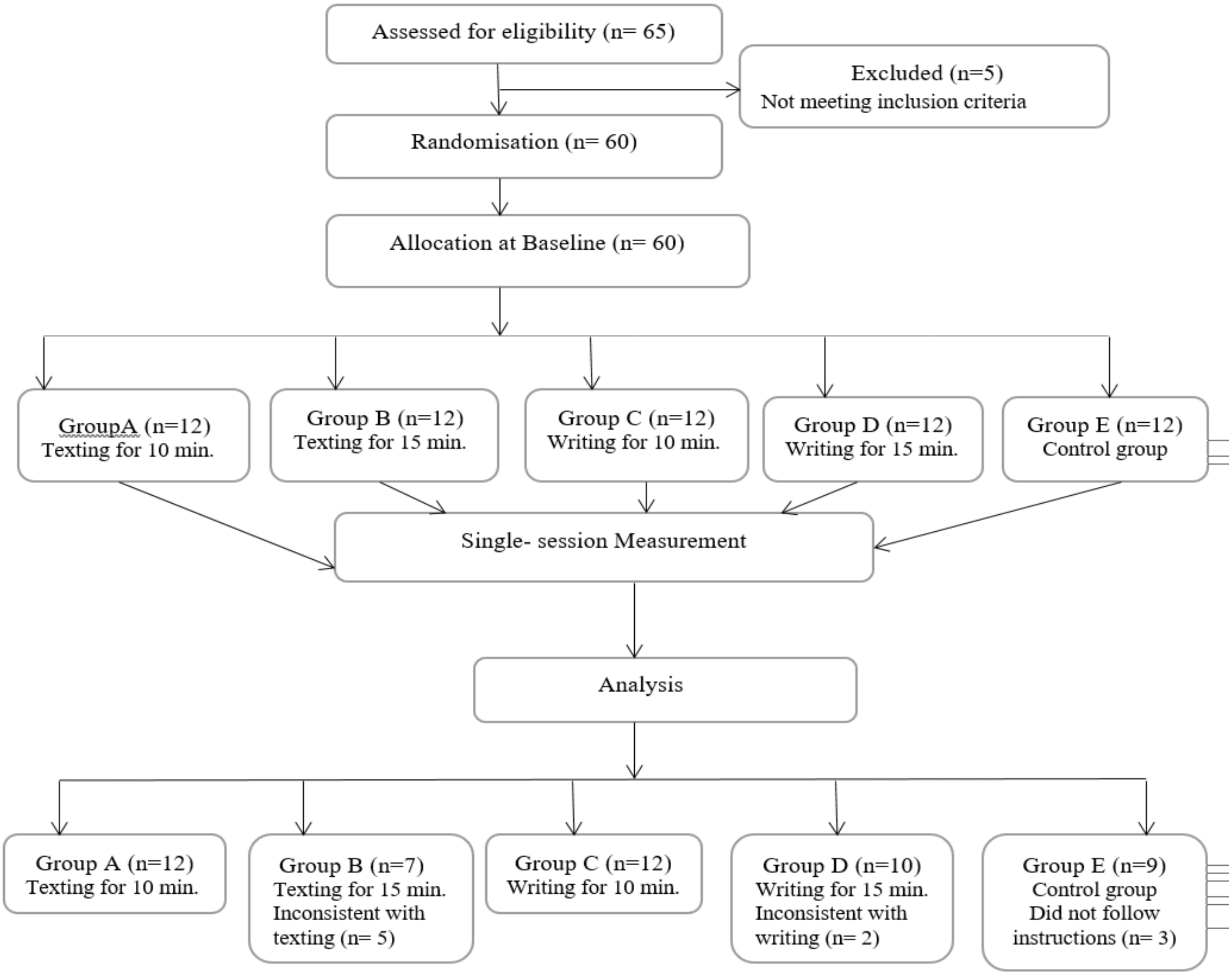

Figure: Flow chart of subjects' allocation and analysis.

Table-1: Descriptive statistics and characteristics of the participants.

Parameter	Mean	±SD	Range
Age (years)	20.88	0.98	(19-23)
Height (meters)	1.56	0.06	(1.44-1.68)
Weight (Kg)	51.12	6.84	(40-73)
BMI	20.8	2.30	(18.5-24.9)
Right Apley	1.3	4.5	(0-20)
Left Apley	4.04	6.93	(0-29)
Upper Arm Length	29.7	1.98	(26-34)
Mid- Upper Arm Circumference	25.4	2.46	(21-32)
Hand-Grip Strength Neutral Pre	18.7	5.2	(8-28)
Hand- Grip Strength Neutral Post	18.9	5.9	(8-34)
Hand- Grip Strength Extension Pre	17.9	5.5	(8-30)
Hand- Grip Strength Extension Post	17.9	5.7	(4-32)
Key- Pinch Strength Pre	0.52	0.06	(0.5-0.7)
Key- Pinch Strength Post	0.51	0.07	(0.2-0.7)
Characteristics	**N**		**%**
Participants BMI			
Normal	50		100%
Neck Pain			
No Pain	31		62%
Pain	19		38%
Groups' Activity			
Texting 10 minutes	12		24%
Texting 15 minutes	7		14%
Writing 10 minutes	12		24%
Writing 15 minutes	10		20%
Control group	9		18%

N: number, SD: Standard deviation, BMI: Body mass index.

20.88±0.98 years and BMI was 20.8±2.30kg/m^2. There were 12(24%) subjects in group A, 7(14%) in group B, 12(24%) in group C, 10(20%) in group D and 9(18%) in group E (Table 1). Baseline mean HGS and KPS values were not significantly different in the groups (p>0.05).

Intragroup and intergroup HGS and KPS values post-activity were not significantly different (p>0.05) (Table 2).

Weak positive correlation was found for mid-upper arm circumference and HGS of wrist neutral (p<0.05) and extension (p<0.05) positions. No correlation was found (p>0.05) for upper arm length and HGS with the wrist in neutral or extension position.

Discussion

The study showed that neither the activity nor the length of time spent texting or handwriting had any significant effect on HGS or KPS. To the best of our knowledge, the current study is the first to assess the effect of texting and handwriting on hand strength.

The poor neck posture, increased gravitational moment and neck muscle activities in addition to daytime tiredness may individually or collectively negatively affect the physical outcome measures of HGS and KPS.[6,7,19] The present study assessed a sample of female college students while texting and handwriting in the sitting position. The findings were in agreement with literature regarding having females doing more texting than males and poor head-neck posture in sitting position more than standing.[19,20] Eitivipart et al.[19] conducted a systematic literature search aimed at assessing the effect of smartphone use on increasing risks of musculoskeletal disorders and pain. Results showed that smartphone users tend to suffer poor posture, like increased neck flexion angle and forward head shifting in addition to increased muscle activity of erector spinae, upper trapezius and neck extensors. They concluded that smartphone usage may contribute to musculoskeletal disorders.

Alsalameh et al.[2] presented similar findings, and emphasised on educating the community about smartphone overuse to prevent negative cons- equences. Correia et al.[5] investigated the association between text neck and neck pain in adults, and showed that cervical flexion angle of the sitting subject using the smartphone did not have an association with neck pain, indicating that

Table-2: The hand-grip strength at baseline and post-activity.

Areas in HPE*	Hand-Grip St. Neutral Pre. (Mean± SD)	Hand-Grip St. Neutral Post. (Mean± SD)	*P*	Hand-Grip St. Extension Pre. (Mean± SD)	Hand-Grip St. Extension Post. (Mean± SD)	*P*
Texting 10 min.	18.08± 5.47	18.25± 5.29	> 0.05	17.92± 5.50	17.17± 5.15	> 0.05
Texting 15 min.	19.71± 6.36	20.28± 8.59	> 0.05	19.43± 7.55	17.86± 9.53	> 0.05
Writing 10 min.	18.67± 5.41	18.50± 5.47	> 0.05	16.58± 5.37	17.83± 5.08	> 0.05
Writing 15 min.	17.60± 5.87	18.20± 6.14	> 0.05	17.90± 5.13	17.60± 5.46	> 0.05
Control group	20.44± 3.13	20.33± 5.39	> 0.05	18.56± 5.47	19.56± 4.53	> 0.05
	P > 0.05	P > 0.05		P > 0.05	P > 0.05	

Hand-Grip St. Neutral Pre: Hand-grip strength wrist neutral pre-activity, Hand-Grip St. Extension Post: Hand- grip wrist extension post-activity; P: Probability, SD: Standard deviation.

text neck was not related to the increased prevalence of neck pain.

Namwongsa et al.[6] examined neck muscle activity at different angles of neck flexion while participants using their smartphones. Results showed that keeping neck flexion angle between 0° and 15° is recommended to decrease muscle activity and disorders associated with using smartphones. Users with neck pain should be aware when using smartphones since they tend to have higher neck muscle activity. Kietrys et al.[21] pointed out and confirmed the role of ergonomic stressors, mobile devices and texting style on trapezius muscle activity and cervical posture. Tapanya et al.[7] evaluated the effect of neck flexion angles on neck muscle activities and gravitational moment during smartphone usage while in the standing position. They recruited a sample of healthy young adults who were instructed to do texting for 3min at 4 different angles. Results revealed significant increase in gravitational moment of the neck and activity of the cervical erector spinae muscle with the increase of angle of neck flexion. The neck position of 0° flexion was the best position to reflect the lowest muscle activity. The study concluded that smart phone users should be encouraged to maintain the neck at 0° flexion to minimise the mechanical disadvantages and to mitigate neck discomfort[7].

The results of the current study are in harmony with the results of El-gohary et al.[12]

Grover et al.[20] reported that students who spent longer duration of messaging after lights out were more likely to suffer from daytime sleepiness and poor academic performance. Females showed more text messaging and daytime sleepiness than males.

A cross-sectional web-based survey showed that sending and/or receiving text messaging at night was significantly associated with daytime tiredness[22].

The current study has limitations, like a small sample size that comprised only female participants.

Conclusion

Texting and handwriting were not found to have any significant effect on HGS or KPS, but individuals must be aware of their posture to avoid medium- and long-term negative effects on spine and hand functions.

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