



## RESEARCH ARTICLE

### EFFECT OF MISUSE OF TABLET ON MUSCULAR PERFORMANCE OF WRIST AND ELBOW IN NORMAL SUBJECTS

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#### ABSTRACT

**Background:** The usage of tablet or media tablet computers have become a viable consumer alternative to traditional notebook (laptop) and desktop computing modes. The light weight of the tablet makes it with the users everywhere and so the users spend many hours using it.

**Objective:** This study was conducted to investigate the effect tablet use on muscle performance of wrist and elbow and the effect of period of tablet usage.

**Methods:** The current study was conducted on 60 subjects. They were assigned randomly into three equal studies groups A, B and C with their mean ages were (23±2.63), (22.8±3.01) and (23.4±2.47) years respectively. Peak torque of right elbow flexors and right wrist extensors were measured for groups using Biodex system 3 isokinetic dynamometer.

**Results:** The study revealed that the median score of the peak torque of right elbow flexors at 120 degrees/sec of "group A", "group B", and "Group C" showed there were significant differences (p=0.0001). Mann-Whitney U test (post hoc tests) revealed that there was no significant difference of the mean values of the "post" test between (group A versus B) with (p=0.383). While, there was significant difference among (group A versus C), and (group B versus C) with (p=0.001) and (p=0.0001) respectively and this significant increase in favor of group (B) and group (A) than group (C). The study also revealed that the median score of the peak torque of right elbow flexors at 120 degrees/sec of "group A", "group B", and "Group C" showed there were significant differences (p=0.003). Mann-Whitney U test (post hoc tests) revealed that there was no significant difference of the mean values of the "post" test between (group A versus B) with (p=0.155). While, there was significant difference among (group A versus C), and (group B versus C) with (p=0.001) and (p=0.037) respectively and this significant increase in favor of group (B) and group (A) than group (C).

**Conclusion:** Our study revealed that the peak torque of wrist extensors and elbow flexors of subjects using tablet more than four hours were less than those using tablet two hours and those not using tablet and this show the effect of misuse of tablet on muscle performance in normal subjects.

#### INTRODUCTION

The usage of tablet or media tablet computers have become a viable consumer alternative to traditional notebook (laptop) and desktop computing modes. In 2014, around 840 million people across the globe used a tablet is expected to rise to over 1.4 billion by 2018 (Statista, 2016). The light weight of tablets and inherently portable devices offer many potential usage locations and positions (rather than being constrained to level surface such as desks, tables, or laps). People may use the tablet in positions which may either promote more neutral, comfortable postures, or potentially awkward postures (Young *et al.*, 2013). Tablet users may be exposed to higher wrist extensions when interacting with a tablet touch screen that is

not laid flat. Furthermore, supporting and tilting an input device with one hand while simultaneously interacting with the other hand has not been required for standard computing situations and results in various user grip approaches (Wagner *et al.*, 2012). The elbow is always flexed during use tablet; the degree of flexion during typing is greater than during media consumption (Visich, 2014). The purpose of the study was to investigate the effect of tablet misuse on muscle performance of wrist and elbow.

#### MATERIALS AND METHODS

##### Participants

Sixty normal subjects of both sexes were participated in this study. The subjects were excluded from the study if they

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hadtrauma in elbow or wrist, musculoskeletal disorders related to neck or upper limb, neurological diseases that affect muscular performance, burn on hand or forearm burn and if they were practicing sports that require use of wrist or elbow muscles group. They were assigned randomly into three equal studies groups. Group (A) consisted of 20 subjects who don't use tablet with mean age, body mass, and height values of 23±2.63 years, 72.05±13.06 Kg, and 170.8±9.10 cm respectively. Group (B) consisted of 20 subjects who use tablet for two hours daily with mean age, body mass, and height values of 22.8±3.01 years, 70.75±11.32 Kg, and 169.8±6.91 cm respectively. Group (C) consisted of 20 subjects who use tablet for four hours daily with mean age, body mass, and height values of 23.4±2.47 years, 66.3±13.65 Kg, and 164.9±8.94 Kg respectively.

**Design of the study**

A single repeated test design was used, with one independent variable was the tested group and dependent variable was the peak torque of elbow flexors and wrist extensors. Subjects were assigned into three equal groups (A, B, C):

- Group (A) was consisted of 20 normal subjects, who don't use tablet.
- Group (B) was consisted of 20 normal subjects, who use tablet two hours daily.
- Group (c) was consisted of 20 normal subjects, who use tablet four hours daily.

**Instrumentation**

Biodex system 3 multi-joint testing and rehabilitation system (Biodex medical system, Shirley, NY, USA) one of the modern isokinetic systems that was used to measure the peak torque of wrist extensors and elbow flexors.

**Procedures**

**Pretesting and familiarization**

The test aims was explained for the subjects. The subjects were familiarized with isokinetic dynamometer through giving full instructions about the procedures to be done. Subjects had read and sign consent form.

**Isokinetic testing of wrist extensors**

Subjects were sitting with the axis of rotation of biodex dynamometer arm lies between the proximal row of the carpals, at the capitate bone, and the radius of radiocarpal joint. To achieve that the seat back was tilted 85°, elbow flexion 90°, dynamometer rotation 0° and dynamometer was tilted to 0°. Straps were used to fix and stabilize the trunk, shoulder and forearm. Subjects moved the wrist from 60° flexion to 30° extension (Reichard *et al.*, 2010). 120°/sec speed was used (Stefanska, 2006). Subjects made four attempts.

**Table 1. Descriptive statistics and One Way Analysis of Variance (ANOVA) for the mean age, weight, and height values for the three tested groups**

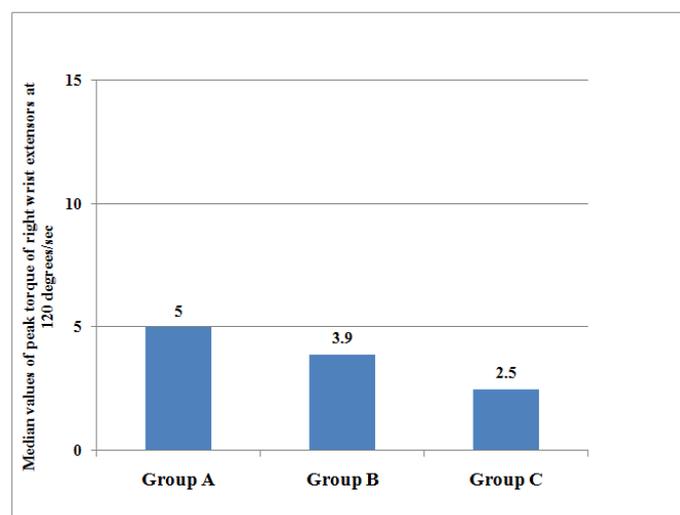
	Group A (N=20)	Group B (N=20)	Group C (N=20)	F-value	P-value	Level of significant
Age (years)	23±2.63	22.8±3.01	23.4±2.47	0.252	0.778	N.S
Body mass (kg)	72.05±13.06	70.75±11.32	66.3±13.65	1.124	0.332	N.S
Height (cm)	170.8±9.10	169.8±6.91	164.9±8.94	2.837	0.067	N.S

\*Significant at alpha level <0.05 N.S: Not significant

**Table 2. Descriptive statistics (median and Interquartile Range) and comparison tests for peak torque of right wrist extensors at 120 degrees/sec among different groups**

Mann-Whitney U test (Post hoc tests)			
Right Wrist extensors	Group A Vs. group B	Group A Vs. group C	Group B Vs. group C
U-value	147.5	78.5	123
Z-value	-1.421	-3.288	-2.084
P-value	0.155	0.001*	0.037*

\*Significant at alpha level <0.05, IQR: Interquartile Range

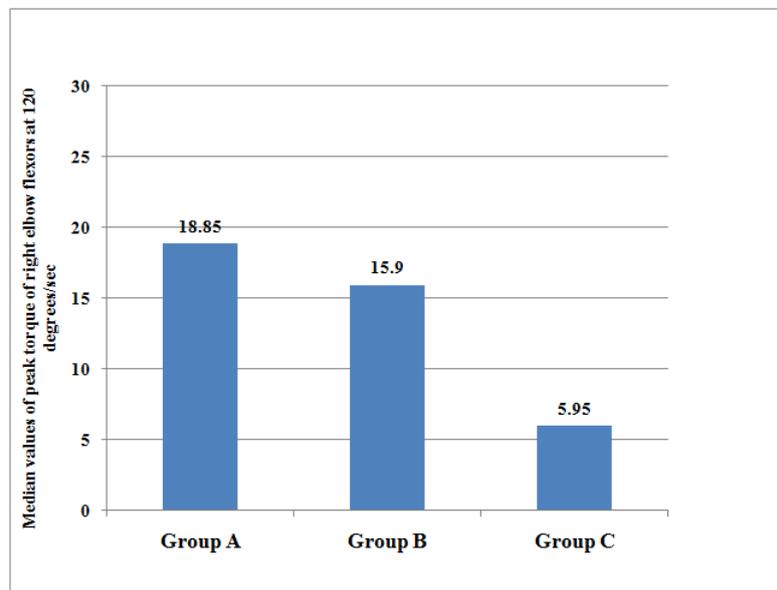


**Figure 1. Median values of peak torque of right wrist extensors at 120 degrees/sec among different groups**

**Table 3. Descriptive statistics (median and Interquartile Range) and comparison tests for Peak torque of right elbow flexors at 120 degrees/sec among different groups**

Mann-Whitney U test (Post hoc tests)			
Right Elbow flexors	Group A Vs. group B	Group A Vs. group C	Group B Vs. group C
U-value	167	48.5	50.5
Z-value	-0.879	-4.099	-4.045
P-value	0.383	0.001*	0.0001*

\*Significant at alpha level <0.05, IQR: Interquartile Range

**Figure 2. Median values of peak torque of right elbow flexors at 120 degrees/sec among different groups**

### Isokinetic testing of elbow flexors

Subjects were sitting with the axis of rotation of biodex dynamometer arm passes through the center of the trochlea and the capitulum, bisecting the longitudinal axis of the shaft of the humerus. To achieve that the seat back was tilted 85°, dynamometer orientation 30° and dynamometer was tilted to 0°. Straps were used to fix and stabilize the trunk, shoulder and forearm. Subjects moved the elbow from full extension to 140° flexion (Law *et al.*, 2011). 120°/sec speed was used (Stefanska, 2006). Subjects made four attempts.

### Statistical analysis

Statistical analysis was conducted using SPSS for windows, version 22 (SPSS, Inc., Chicago, IL). Descriptive statistics were used in age, body mass and height values for the three tested groups. Non-parametric statistical tests in the form of Kruskal-Wallis H test (nonparametric alternative to the one-way ANOVA) was used to compare all dependent variables at different groups and "Mann-Whitney U tests" was used as post hoc tests if Kruskal-Wallis H test among three groups is significant.

## RESULTS

The current study was conducted on 60 subjects. They were assigned randomly into three equal groups A, B, C. The descriptive statistics of the three groups were presented in table 1. One Way Analysis of Variance (ANOVA) indicated that there were no significant differences ( $p > 0.05$ ) in the mean values of age, body mass, and height among the three tested groups as shown in Table 1.

### a) Peak Torque of Right wrist extensors at 120 degrees/sec:

As presented in Table (2) and illustrated in Figure (1), among groups comparison the median score (IQR) of the peak torque of right wrist extensors at 120 degrees/sec of "group A", "group B", and "Group C" were 5 (3.62), 3.9 (3), and 2.5 (1.68) respectively. "Kruskal-Wallis H test" revealed that the median score of the peak torque of right elbow flexors at 120 degrees/sec at "group A", "group B", and "Group C" showed there were significant differences ( $p = 0.003$ ). Mann-Whitney U test (post hoc tests) conducted and result was presented on Table 2.

### b) Peak Torque of Right Elbow Flexors at 120 degrees/sec:

As presented in Table (3) and illustrated in Figure (2), among groups comparison the median score (IQR) of the peak torque of right elbow flexors at 120 degrees/sec of "group A", "group B", and "Group C" were 18.85 (15.225), 15.9 (8.3), and 5.95 (3.15) respectively. "Kruskal-Wallis H test" revealed that the median score of the peak torque of right elbow flexors at 120 degrees/sec at "group A", "group B", and "Group C" showed there were significant differences ( $p = 0.0001$ ). Mann-Whitney U test (post hoc tests) conducted and result was presented on Table 3.

## DISCUSSION

This study was conducted to investigate the effect of mis use of tablet on muscle performance of wrist and elbow in normal subject using Biodex system 3 isokinetic dynamometer. The result of our study revealed that the misuse of tablet affect the muscle performance of wrist and elbow and that may lead to

musculoskeletal problems with prolonged misuse. Our findings agreed with previous study on 200 students and found 116 (58.0%) of the student having weakness in the arm, shoulder and hand, 47 (23.5%) student having mild weakness, 28 (14.0%) students having moderate weakness, and 9 (4.5%) of them having severe weakness. The symptoms of pain were evaluated by using VAS (visual analogue scale), 27.5% of them were known to be unaffected by hand pain symptom, 44.5% of them were affected by mild hand pain, for moderate hand pain there were 24% of them. Apart from that there were 3.5% of students were known to be affected by severe hand pain and worst possible pain (Balakrishnan *et al.*, 2016). Also our findings agreed with previous study, that have reported misuse of tablet computers leads to degraded wrist and neck postures, which may increase risk for injury or illness development for these parts of the body (Werth and Babski-Reeves, 2012). Similarly, another study concluded that large tablets had higher forearm muscle activity, shoulder moment, and wrist extension than small devices (Pereira *et al.*, 2013). Another study found that students experienced physical discomfort associated with use of tablet and potentially experienced discomfort in eyes, neck, head, right hand/wrist, upper, and lower back (Sommerich *et al.*, 2007).

#### Limitation of study

This study was limited by psychological condition of the subjects, variation in life style of the subjects and the pre-exercise level of the subjects.

#### Conclusion

On the basis of the finding of this study, the peak torque of wrist extensors and elbow flexors of subjects using tablet more than four hours were less than those using tablet two hours and those not using tablet and this shows the effect of misuse of tablet on muscle performance in normal subjects.

#### Recommendation

Repetition of the study with a larger sample size, electromyographic investigation to explore the most activated muscles of upper limb during tablet use, influence of ergonomic intervention on muscle performance of tablet users and specific exercise programs to improve muscle performance of tablet users.

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