The comparison of pinch strength among female typists and female non-typists

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\section*{Abstract}
Background: Typing is a common activity involving repetitive motion that can increase the risk of work-related injuries. To the best of our knowledge, the effect of typing on the pinch strength has not been investigated so far.

Objective: To investigate the pinch strength amongst female typists and non-typists.

Method: Thirty female typists and 30 female non-typists, aged 20–30 years old, participated in this prospective study. The pinch strength of the second, third, fourth and fifth fingers of the dominant hand was measured in a sitting position, using a pinch gauge. The data were analyzed using independent sample t-test.

Results: The results showed that there were significant differences in the pinch strength of the second, third and fourth fingers between the two groups. The strength of these fingers was reduced more than that in female non-typists.

Conclusion: Our results suggest that pinch strength might have decreased in female typists due to sharing common attentional resources, muscle fiber composition, and muscle fiber fatigue.

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\section*{1. Introduction}
Thumb/finger opposition is a function that plays a critical role in dexterous manipulation of objects and precision grip (Jenmalm and Johansson, 1997; Li et al., 2013). In testing the precision of the pinch grip, the thumb pulp and the fingertips are involved in fine object manipulation (Napier, 1956; Li et al., 2013; Radi, 2015). Pinch grip is used as an index to evaluate the precise hand movement in hand rehabilitation, daily activities (like writing, eating and handling objects), and some occupations such as typing (Mathiowetz et al., 1984).

Due to rapid advancement in technology, typing has become a popular activity. Typists have to maintain their upper extremity in a certain position to do repetitive hand movements that affect their muscle strength and performance.

Several studies have investigated the relationship between the hand grip strength and other factors among Asian population, including hand dominance (Nicolay and Walker, 2005), anthropometric variation (Nicolay and Walker, 2005; Koley and Singh, 2009), occupation (Kamarul et al., 2006), age (Wu et al., 2009; Hossain et al., 2012), gender (Nicolay and Walker, 2005; Wu et al., 2009), body composition (Bandyopadhyay, 2008), height (Hossain et al., 2012), and weight (Kamarul et al., 2006). To the best of our knowledge, Kamali et al. compared grip strength and endurance amongst Iranian typists and non-typists in both dominant and non-dominant hands. Their finding showed that typists had less grip strength and more grip endurance than non-typists (Kamali and Arman, 2003).

Even though several studies have been conducted on grip strength, none of them has focused on the effect of typing on pinch strength. Hence, with respect to the importance of thumb finger opposition in the dexterous manipulation of objects, this study was designed to evaluate the pinch strength among female typists and non-typists.

\section*{2. Method}

\subsection*{2.1. Participants}

Thirty female typists and 30 female non-typists, aged 20–30 years old, were recruited for this prospective study through leaflets.
All female typists used 10-digit touch method, and their average working hours were 8 h per day, five days per week. Inclusion criteria for female non-typists were those who did not participate in any manual labor more than 1 h per day including typing, weaving, playing a musical instrument, etc. The participants were excluded if they had neurological diseases, rheumatitis, diabetes, carpal tunnel syndrome, upper limb sensory deficits, cervical radiculopathy, dorsal wrist ganglion, any history of fracture or dislocation of the upper limbs six months prior to the study, or thoracic outlet syndrome. All participants signed a written informed consent approved by the local Ethics Committee at Shiraz University of Medical Sciences.

2.2. Procedure

A pinch dynamometer was used to measure the pinch strength (Be & L pinch gauge (0–60 lb)). All the tests were performed at 5–8 pm. To standardize the trial condition, all participants sat on an adjustable chair with shoulder adduction, 90° elbow flexion, forearm pronation, and 10–15 degrees of wrist extension. A pinch device was placed between the thumb pad and the second finger pad to apply maximum pressure. Pinch strength was also evaluated in the thumb-the third finger, thumb-the fourth finger, and thumb-the fifth finger in the dominant hand. The participants were instructed to exert maximum force by holding the grip for 2 s. To blind the assessor, a physical therapist measured all the measurements, and another physical therapist that was blinded to the participants’ groups analyzed the data. Pinch strength was measured three times with 1 min interval. An average of three measurements was used for analysis. Statistical analysis was performed using SPSS, version 18. Independent sample t-test was used to analyze the data. The significance level was set at P < 0.05.

3. Results

Table 1 shows the main characteristics of both groups. There was no statistically significant difference in terms of age, height and weight between the groups (Table 1).

The pinch strength data for each finger was normally distributed based on Kolmogorov–Smirnov test. The results of independent sample t-test showed that there were significant differences in the pinch strength of the second, third and fourth fingers between the two groups (Table 2). In fact, the finger strength was reduced in female typists compared to non-typist ones (P < 0.05) (Table 2).

4. Discussion

Results of this study indicate that the pinch strength was decreased in female typists in comparison with non-typists. Data from other studies highlighted the factors associated with decreased grip strength. Kamali et al. reported that female typists had less grip strength, but more grip endurance than female non-typists (Kamali and Arman, 2003).

There are several possible explanations for decreased pinch strength.

1) Previous research has revealed that precision grip is an attentional demanding task. By limited capacity theory, attentional demanding tasks and muscle responses compete for common attentional resources (Moseley et al., 2004; Lariviere et al., 2013; Jones et al., 2014). As a result, fewer attentional resources are allocated to muscle activities and it can lead to reduced pinch strength.

2) The other reason might be muscle fiber-type composition. Typing is a dynamic and repetitive movement that can be considered as a kind of endurance task (Radi, 2015; Nicolay and Walker, 2005). Slow-twitch muscle fibers are mainly activated during endurance tasks with less force generated, while fast-twitch muscle fibers are activated in strength and speed tasks that generate maximal force. Hence, individuals participating in endurance activities have a higher percentage of slow twitch muscle fibers. In repetitive and dynamic tasks, K+ concentration in the T-tubular system of muscle fibers reduces the muscle action potential velocity (Westerblad and Allen, 2003). Consequently, K+ concentration can disrupt the muscle strength by reducing the cellular membrane potential excitability (Westerblad and Allen, 2003). 3) Last but not least, the reduced pinch strength might be attributed to muscle fibers fatigue mechanism due to repetitiveness of the task (Sjøgaard and Søgaard, 1998). Fatigue in slow twitching muscle fibers can be attributed to the accumulated lactic acid and poor microcirculation (Cho et al., 2009).

This study was limited to female typists; hence, its outcome cannot be generalized for other occupations, age groups and genders. In addition, small sample size was another limitation that cannot be generalized for other occupations, age groups and genders. It seems that pinch strength was reduced in female typists in comparison with female non-typist.

Conflict of interest

No declared.

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