Original Article

Work-Related Risk Factors for Carpal Tunnel Syndrome and De Quervain's Tenosynovitis Among Workers Using Touchscreen Devices

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Abstract

In recent years, touchscreen gadgets have become popular due to their ease of use. The majority of office employees now bring their devices to the workplace. However, research has connected many musculoskeletal diseases with extended touchscreen usage. Using a touchscreen device puts more strain on the wrists than using a keyboard. Hence, it causes carpal tunnel syndrome. The study aimed to determine how common Carpal Tunnel Syndrome and Dupuytren's disease are among office employees who use touchscreen devices in the IT department of the Security Forces Hospital in Riyadh. Twenty male office employees (aged 24 to 65) who often use touchscreen devices were recruited randomly for this research by responding to an online survey on demographics and employment status. The existence of CTS symptoms was looked for using Phalen's test and Tinel's sign. The existence of DQT was investigated using Finkelstein's tests. The research was performed at the Security Forces Hospital in Riyadh between March 2020 and April 2020. 60% of touchscreen users likely suffer from CTS. Around 35% of people have likely DQT. Several potential risk factors for CTS are correlated with CTS symptoms, albeit not substantially. The male office employees in the IT department of SFHP in Riyad are at increased risk for CTS and DQT due to their frequent usage of touchscreen devices.

Keywords: Carpal tunnel syndrome, De quervain's tenosynovitis, Ergonomics, Touchscreen

Introduction

The touchscreen device is one of the easiest interfaces to use, making it the preferred interface. Touch screen devices allow people to use types of touch screen interfaces, including laptops, smartphones, iPads, or any touch screen interface without training. This technology has become more popular because it is simple and easy to use. These touchscreen devices provide quick access to all types of digital media that help the office employee and facilitate his job. Also, text can be displayed in various languages depending on the user's needs. Office workers use their technology to store data, photograph information, and check e-mails.

Moreover, it has now begun to replace the scanner device with its imaging service through applications that provide the scanner service that saves time and allows the use of social media applications [1]. Despite their many advantages in Saudi Arabia, there is a danger of becoming dependent on touchscreen gadgets. According to research [2], this behavior is linked to various unfavorable outcomes for users' sleep, diet, and energy levels.

Musculoskeletal diseases have been related to using touchscreen devices for lengthy periods. By comparing the muscle activity of young people with and without chronic neck-shoulder pain while using touchscreen smartphones, Xie *et al*. (2016) found that those with symptoms exhibit higher levels of muscle activity in the neck and shoulder region when sending texts. It has been shown [3]. In addition, using a touchscreen device might put extra strain on the wrists compared to typing. Increased touchscreen use may also be linked to other musculoskeletal problems, especially in the regions served by the median nerve. For instance, touchscreen devices have been linked to alterations in the median nerve, which may increase the incidence of carpal tunnel constriction and, in turn, carpal tunnel syndrome (CTS) [4].

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Workers who use their hands often and with great force are more likely to develop carpal tunnel syndrome than those who do not [5]. Carpal tunnel syndrome's actual origin is unclear. Several hypotheses have been proposed to explain the signs and studies showing decreased nerve conduction. These include microvascular insufficiency, vibration, and mechanical compression hypotheses according to the principles of mechanical compression. Nighttime discomfort and tingling or numbness along the median nerve in the hand are hallmarks of carpal tunnel syndrome [6].

Range of motion, Phalen's test, and Tinel's signs are all helpful in diagnosing carpal tunnel syndrome via a physical examination, but none of them is definitive. Nerve conduction tests are considered the diagnostic standard. They have the potential for over- and under-reporting [6]. Also linked to increased touchscreen use, De Quervain's tenosynovitis, often known as "Gamers thumb" or "Blackberry thumb," is caused mostly by excessive thumb usage. Friction between supporting bands produces micro-damage and increases swelling and stenosis during ulnar deviation when the wrist is in the dorsiflexion position [7].

This painful thumb ailment was initially detected in 1895 and is named after the Swiss surgeon who made the discovery, Dr. Fritz de Quervain. Pain and swelling above the radial styloid are hallmark signs of De Quervain's tenosynovitis, worsened by thumb motion and wrist deviation [8]. De Quervain's tenosynovitis affects around 1.3% of women and 0.5% of men in the general population between the ages of 18 and 65 [9]. Previous research has shown that musculoskeletal diseases are more common among those who regularly use electronic gadgets or other items needing thumb mobility.

Tenderness on palpation across the first dorsal compartment may be detected during a physical examination. De Quervain's tenosynovitis has long been diagnosed using Finkelstein's test, initially published in 1930. Compared to Eichhoff's test, Finkelstein's proved more reliable [10]. Therefore, there is a lack of data on the incidence of carpal tunnel and De Quervain's tenosynovitis in the workplace in nations throughout the Arabian Peninsula, including Saudi Arabia. As of 2012 [11], the following may be said. Especially those who utilize a variety of touchscreen devices during the workday, such as those employed in offices.

This research set out to answer the following questions: 1. How common are symptoms of carpal tunnel syndrome and De Quervain's tenosynovitis among male office employees who use touchscreen devices in the IT department at Security Forces Hospital (SFHP) in Riyadh? 2. To learn how parameters like age, amount of time spent using touchscreens, and level of expertise relate to the incidence of carpal tunnel. As a result, we expected that male office employees in the IT department of a hospital for the security forces would have a greater incidence of carpal tunnel and De Quervain's tenosynovitis than their female counterparts. We also postulated that the likelihood of developing CTS or DQT increases with practitioner seniority, age, and time in practice.

Materials and Methods

Participants

The research method was a descriptive cross-sectional analysis. Twenty male office workers who utilize touchscreen devices meet the inclusion criteria of being between the ages of 24 and 65, being full-time employees, and regularly (more than 2 hours per day) using touchscreen interface devices. The population size was calculated to be 71 employees, the confidence level was 95%, and the margin of error was set at 0.5 to arrive at the sample size. Based on this evaluation, we need to recruit 61 participants.

Participants with a history of hypothyroidism, diabetes mellitus, rheumatoid arthritis, cervical radiculopathy, a history of hand injury or surgery, a diagnosis of carpal tunnel syndrome (determined by nerve conduction studies), or the use of corticosteroids for the treatment of De Quervain's tenosynovitis were not included in this study.

Measuring Outcomes

Diagnosing carpal tunnel syndrome requires thorough testing. Therefore, we performed Finkelstein's test, Phalen's test, and Tinel's sign to diagnose De Quervain's tenosynovitis. Each subject in Phalen's study was instructed to stretch their wrists to their fullest extent while pressing them together for one full minute. The reproduction of tingling and paresthesia into the hand throughout the median nerve's course indicates a positive test **(Figure 1)**. According to research [12], the sensitivity and specificity of Phalen's test are 67.2% and 92.9%, respectively.

A sitting posture with the elbow flexed 30 degrees, the forearm supinated, and the wrist in a neutral position is required for Tinel's sign. Then, he should use his finger to tap lightly over the median nerve in the wrist. If the test subject has a tingling feeling in their fingertips that is not unpleasant, the result is affirmative **(Figure 2)**. Rayegani *et al*. (2004) reported that Tinel's sign had a sensitivity of 53.4% and a specificity of 95.6%.

During the Finkelstein test, the participant's wrist is placed on the edge of a table. After that, the participant flexed their wrist into their palm while actively deviating their wrist **(Figure 3)**. These actions may also be performed as the participant palpates the abductor pollicis longus and extensor pollicis brevis tendons across the lateral radius, looking for signs of movable nodularity, tendon rub, or popping. Results are positive if the patient has discomfort in the extensor tendon along the radial side of the elbow. Finkelstein's test [10] has a 99% sensitivity and a 29% specificity.

The research was carried out at the IT section of the Security Forces Hospital in Riyadh between March 2020 and April

2020. We obtained consent from the Security Forces Hospital's Ethical Review Committee (H-01-R069) and then emailed the IT staff there, requesting them to complete an electrical questionnaire (Additional file 1). Factors such as age, gender, employee description, job experience, number of hours per day spent using touchscreens, most frequently used finger when using touchscreens (thumb or index), touchscreen device type, and the presence of medical conditions like hypothyroidism, diabetes mellitus, rheumatoid arthritis, cervical radiculopathy, previous hand injury or surgery, and medically diagnosed carpal tunnel syndrome (by nerve conduction studies) were all taken into account. The use of injectable corticosteroids to treat De Quervain's tenosynovitis was another question we posed to the participants.

The second component of the survey asked participants whether or not they had experienced wrist or hand pain, tingling, or weakness over the previous two weeks on an average day. Feelings of pain, numbness, tingling, or burning may accompany paraesthesia. Loss of feeling in the palm, first or second finger, or third finger. Suppose he has thumb motion and wrist deviation-induced discomfort and swelling above the radial styloid.

Carpal tunnel and De Quervain's tenosynovitis were diagnosed based on the following symptoms and signs:

One symptom of carpal tunnel syndrome is a positive result on Phalen's test **(Figure 1)** and Tinel's sign **(Figure 2)**.

A result of Finkelstein's test **(Figure 3)** for De Quervain's tenosynovitis is positive.

Figure 1. Phalen's test.

Figure 2. Tinel's sign.

Figure 3. Finkelstein's test

Statistical Analysis

Data were analyzed using IBM SPSS statistics (version 25.0 for Windows), part of the Statistical Package for the Social Sciences. All statistical tests were performed at the P 0.05 level of significance.

By counting how often men in the workplace who use touchscreen devices had a positive or negative result on Phalen's test and Tinel's sign, we could determine the prevalence of carpal tunnel syndrome and non-carpal tunnel syndrome among this group of men.

The frequency of a positive or negative Finkelstein's test was used to determine the prevalence of De Quervain's tenosynovitis and non-De Quervain's tenosynovitis, respectively.

Due to the limited sample size, we used Fisher's exact test to compare workers with and without probable CTS on each independent variable, and we used the t-test when more statistical power was needed.

Quantitative variables (such as age and education level) were provided as means and standard deviations using the t-test. In contrast, qualitative variables (such as the number of respondents and the percentage of those who are minorities in the workforce) were presented using Fisher's exact test.

Results and Discussion

This study surveyed twenty male office workers who use touchscreen devices **(Figure 4)**. Participants were screened for inclusion and exclusion criteria. Based on De Quervain's tenosynovitis criteria, the prevalence of probable De Quervain's tenosynovitis was 7 participants (35%), and 13 participants (65%) had non-De Quervain's tenosynovitis. In addition, based on carpal tunnel syndrome criteria, the prevalence of probable carpal tunnel syndrome was 12 participants (60%), and 8 participants (40%) had non-carpal tunnel syndrome. These results make the study hypothesis about the prevalence of carpal tunnel syndrome and probably De Quervain's tenosynovitis among office male workers trustworthy.

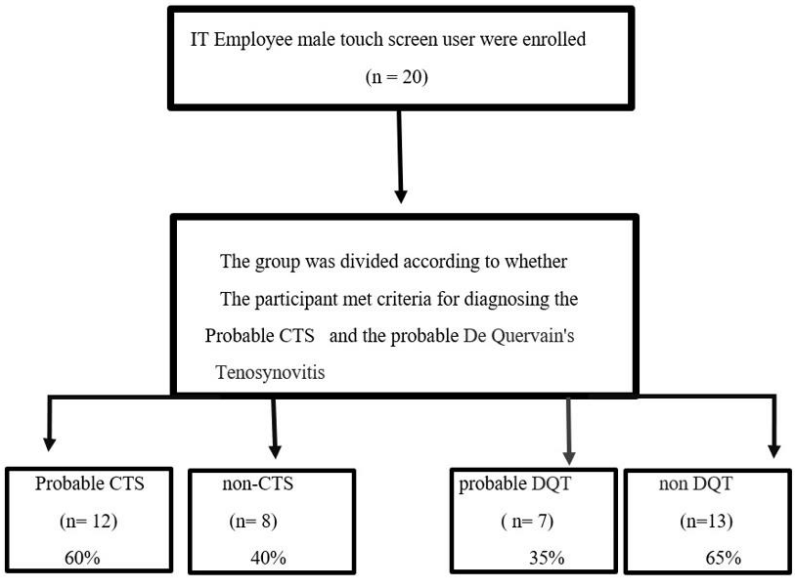

Figure 4. Study Flowchart of the male touchscreen users.

Furthermore, the prevalence of probable carpal tunnel syndrome was 25% (5 participants) in technical support office male workers who use touchscreen devices compared to 5% (one participant) in Enterprise resource planning. In addition, a high prevalence of probable carpal tunnel syndrome in smartphone users was 45% (9 participants), and an extraordinarily low percentage in iPad users was 0% (0 participants). A similar percentage was in non-carpal tunnel syndrome for iPad users.

Moreover, 8 participants (40.0%) with probable carpal tunnel syndrome prefer thumb. There was an equal percentage between (index, thumb, and index) with 2 participants (10.0%). No significant association was found between Carpal tunnel syndrome symptoms and the finger used (P = .189). Additionally, when we analyzed the impact of factors (years of experience, age, and duration of touchscreen usage) on the prevalence of carpal tunnel syndrome, there was no interaction effect, as shown in **(Table 1)**.

Table 1. Demographic data and occupational factors for office male workers who use touchscreen devices with probable Carpal tunnel syndrome and non-carpal tunnel syndrome.

Variable	probable CTS(n=12)	Non-CTS(n=8)	P value
Age, mean ± SD (year).	38.17(4.489)	39.63(5.263)	.807 b
Job, n (%).			
Technical support.	5(25.0)	4(20.0)	.788 a
Engineer.	2(10.0)	0(0.0)	
Nature admission.	2(10.0)	2(10.0)	
Application.	2((10.0)	1(5.0)	
Enterprise resource planning.	1(5.0)	1(5.0)	
Hours of using touchscreen /day, mean ± SD h/d.	4.08(2.429)	6.63(2.925)	.251 b
Years of Experience, mean ± SD.	15.42(4.522)	16.25(5.825)	.232 b

The type of touchscreen device you use n (%).			
Smartphone.	9(45.0)	8(40.0)	.125 a
Laptop.	3(15.0)	0(0.0)	
iPad.	0(0.0)	0(0.0)	
Used finger, n (%).			
Thumb with index.	2(10.0)	4(20.0)	.189 a
Thumb.	8(40.0)	4(20.0)	
Index.	2(10.0)	0(0.0)	

A Fisher's exact test, b t-test (CTS) Carpal tunnel syndrome. (h/d) hours/days. (SD) stander deviation. (n) number.

There was no significant difference (P =.251) between probable carpal tunnel syndrome and non-carpal tunnel syndrome with increased hours of using the touchscreen. For participants with probable carpal tunnel syndrome, the hours spent using a touchscreen were (Mean of 4.08, SD2.429), less than other participants with non-carpal tunnel syndrome, with a (Mean of 6.63, SD2.925). Likewise, no significant difference (P = .232) was found between probable carpal tunnel syndrome and non-carpal tunnel syndrome with increased years of experience. For participants with probable carpal tunnel syndrome, the years of experience was (Mean 15.42 SD 4.522), less than another participant's non-carpal tunnel syndrome (Mean 16.25 SD 5.825). When we looked for demographic data, the older participant was 49, and the youngest was 32. The result shows no significant correlation between age and Carpal tunnel Syndrome symptoms. For participants with probable carpal tunnel syndrome, the age was (Mean 38.17 SD 4.489), which is less than other participants with non-carpal tunnel syndrome, which was (Mean 39.63 SD 5.253).

In summary, several Carpal tunnel syndrome risk factors appeared to be non-significantly associated with Carpal tunnel syndrome symptoms. These results make the study hypothesis about years of experience, age, and duration of use increasing the risk of carpal tunnel syndrome not true.

Sixty percent of individuals reported having at least one symptom consistent with Carpal Tunnel Syndrome, the most notable finding of the current research. This observational research agreed with the findings of Woo *et al*. (2017), who found a correlation between prolonged computer usage and increased wrist/hand pain [13]. However, Woo, White, and Lai (2017) restricted their analysis to college students who often used touchscreen devices like laptops and desktops [13].

In addition, Mohammed (2019) also researched the occupational risk factors for Carpal Tunnel Syndrome among touchscreen users at Majmaah University [14]. He found that many participants reported experiencing Carpal Tunnel Syndrome symptoms. This was attributed to participants' poor posture while using the devices. In addition to traditional computers, this research also took into account smartphones.

In addition, some studies have shown that those used to improperly typing on smartphone devices develop flexed neck and non-neutral wrist positions. Carpal Tunnel Syndrome [15] is linked to poor posture because it stresses the median nerve that runs from your neck to your wrists. Similarly, the high rate of likely cases of carpal tunnel syndrome we observed among smartphone users (45%) may be attributable to their awkward position. Certain wrist angles are optimal for using handheld devices with tiny screens. The force-generating ability of the finger muscles might be harmed by holding the fingers and thumbs in that posture for long periods when pushing buttons. In addition, carpal tunnel syndrome at work is strongly linked to repeated bending and twisting of the hands and wrists.

Additional non-neutral wrist postures have been uncovered by cross-sectional research. Occupational variables related to Carpal tunnel syndrome were explored by Maghsoudipour *et al*. in 2008. Carpal tunnel syndrome risk factors include bending or twisting the wrist [16].

Second, 35% of male office employees who use touchscreen devices reported symptoms of De Quervain's tenosynovitis. This is consistent with the findings of Ali (2014), who looked at the link between touchscreen use and De Quervain's tenosynovitis [17]. Nearly half of the participants had positive findings on the Finkelstein test, indicating thumb/wrist discomfort [17].

A similar conclusion was reached by Ma *et al*., who looked at the link between adolescent mobile gaming and the spread of De Quervain's illness. They discovered that the increased positive rate of Finkelstein's test was substantially connected with increased daily mobile gaming time and variations in wrist posture (p 0.05) [18]. Previous studies did find results comparable to ours; however, they were conducted on adolescent populations. De Quervain's tenosynovitis frequency among adults who regularly use touchscreen devices has yet to be studied.

Third, the data does not support the hypothesis that increasing age is associated with worsening Carpal Tunnel Syndrome symptoms. Carpal tunnel syndrome is more common in those over 50, according to research by Nathan *et al*. [19]. Both in the Maghsoudipour *et al*. research and in our own, the median

age of the workforce was in the mid-30s. Therefore, we cannot appropriately assess age [16].

In addition, Mohammed in 2019, In females, the link between age and Carpal Tunnel Syndrome symptoms was statistically significant (p = 0.000) [14].

Furthermore, the problem of age is not associated with the higher incidence of Carpal tunnel syndrome symptoms in men, as shown in both our research and the study of Maghsoudipour *et al*. (2008) [16].

Fourth, the prevalence of carpal tunnel syndrome did not vary with the number of hours spent using a touchscreen or the number of years an individual had been using one.

To our knowledge, proper wrist and finger positioning is essential for optimal performance and pressure distribution while using touchscreen devices, especially for extended periods. It may alter carpal tunnel pressure and deleterious affect hand muscles and nerves [20].

More so, researchers in 2019 discovered that Carpal tunnel symptoms were significantly correlated with the number of hours per day spent using a touchscreen. They use the same diagnostic and symptom-definition criteria [14].

Nonetheless, it is possible that discrepancies in the occupations investigated, the sample sizes used, and the gender of the study's participants all contributed to the divergent results.

It is vital to acknowledge many significant restrictions in the present investigation. Due to a lack of female participants and the known anatomical and anthropometrical differences between the sexes, the results of this study cannot be extrapolated to women, which may account for some of the discrepancies between them and those of other studies.

Second, since the research was conducted during an epidemic of Coronavirus Disease 2019 (COVID-19), collecting a bigger sample size was challenging. Some staff members have yet to reply to emails. Unfortunately, using an electronic questionnaire meant we could not go into detail about some specialized testing.

Conclusion

Office male workers who use touchscreen devices in the information technology department at the security forces hospital in Riyadh seem to have a high prevalence of Carpal tunnel syndrome symptoms, especially in technical support and particularly in those who use smartphones.

Also, the high prevalence of probable De Quervain's tenosynovitis was 35% in this population. Given the high prevalence of carpal tunnel syndrome symptoms and De Quervain's tenosynovitis in this population, we recommend raising awareness of the problem and educating about healthy postures while using these devices.

Due to the lack of such studies, we need studies in the future that assess the prevalence of De Quervain's tenosynovitis in touch screen users in the adult population.

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References

1. Alfawareh HM, Jusoh S. The use and effects of smartphones in higher education. Int J Interact Mob Technol (IJIM). 2017;11(6):103-11.
2. Alosaimi FD, Alyahya H, Alshahwan H, Al Mahyijari N, Shaik SA. Smartphone addiction among university students in Riyadh, Saudi Arabia. Saudi Med J. 2016;37(6):675.
3. Xie Y, Szeto GP, Dai J, Madeleine P. A comparison of muscle activity in using touchscreen smartphone among young people with and without chronic neck–shoulder pain. Ergonomics. 2016;59(1):61-72.
4. Bower JA, Stanisz GJ, Keir PJ. An MRI evaluation of carpal tunnel dimensions in healthy wrists: implications for carpal tunnel syndrome. Clin Biomech. 2006;21(8):816-25.
5. Silverstein BA, Fine LJ, Armstrong TJ. Occupational factors and carpal tunnel syndrome. Am J Ind Med. 1987;11(3):343-58.
6. Arroari S, Spence AJ. Roy, Carpal tunnel syndrome. Ulster Med J. 2008;77(1):6-17.
7. Minamikawa Y, Peimer CA, Cox WL, Sherwin FS. De Quervain's syndrome: surgical and anatomical studies of the fibroosseous canal. Orthopedics. 1991;14(5):545-9.
8. Darowish M, Sharma J. Evaluation and treatment of chronic hand conditions. Med Clin. 2014;98(4):801-15.
9. Stahl S, Vida D, Meisner C, Lotter O, Rothenberger J, Schaller HE, et al. Systematic review and meta-analysis on the work-related cause of de Quervain tenosynovitis: a critical appraisal of its recognition as an occupational disease. Plast Reconst Surg. 2013;132(6):1479-91.
10. Wu F, Rajpura A, Sandher D. Finkelstein's test is superior to Eichhoff's test in the investigation of de Quervain's disease. J Hand Microsurg. 2018;10(02):116-8.
11. Raman SR, Al-Halabi B, Hamdan E, Landry MD. Prevalence and risk factors associated with self-reported carpal tunnel syndrome (CTS) among office workers in Kuwait. BMC Res Notes. 2012;5(1):289.
12. Rayegani SM, Adybeik D, Kia MA. Sensitivity and specificity of two provocative tests (Phalen's test and Hoffmann-Tinel's sign) in the diagnosis of carpal tunnel syndrome. J Orthop Med. 2004;26(2):51-3.
13. Woo EH, White P, Lai CW. Effects of electronic device overuse by university students in relation to clinical status and anatomical variations of the median nerve and transverse carpal ligament. Muscle Nerve. 2017;56(5):873-80.
14. Mohammad WS. Work-related risk factors for Carpal Tunnel Syndrome among Majmaah University female touchscreen users. Pak J Med Sci. 2019;35(5):1221.
15. Young JG, Trudeau MB, Odell D, Marinelli K, Dennerlein JT. Wrist and shoulder posture and muscle activity during touch-screen tablet use: effects of usage configuration, tablet type, and interacting hand. Work. 2013;45(1):59-71.
16. Maghsoudipour M, Moghimi S, Dehghaan F, Rahimpanah A. Association of occupational and non-occupational risk factors with the prevalence of work related carpal tunnel syndrome. J Occup Rehabil. 2008;18:152-6.
17. Ali M, Asim M, Danish SH, Ahmad F, Iqbal A, Hasan SD. Frequency of De Quervain's tenosynovitis and its association with SMS texting. Muscles Ligaments Tendons J. 2014;4(1):74.

18. Ma T, Song L, Ning S, Wang H, Zhang G, Wu Z. Relationship between the incidence of de Quervain's disease among teenagers and mobile gaming. Int Orthop. 2019;43:2587-92.
19. Nathan PA, Meadows KD, Istvan JA. Predictors of carpal tunnel syndrome: an 11-year study of industrial workers. J Hand Surg. 2002;27(4):644-51.
20. Ko K, Kim HS, Woo JH. The study of muscle fatigue and risks of musculoskeletal system disorders from text inputting on a smartphone. J Ergon Soc Korea. 2013;32(3):273-8.