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Original Research Article

Effect of Computer Use on Tactile Perception and Dexterity of Hand in Frequent Computer Users

Swati Kubal [1], Himanshi Thaker[*2].

[1] Assistant Professor, Physiotherapy school and centre, Topiwala National Medical College, Mumbai, Maharashtra, India.

[*2] Intern, Physiotherapy School and Centre, Topiwala National Medical College, Mumbai, Maharashtra, India.

ABSTRACT

Context: Frequent use of computer involves repetitive tasks of hand. As previous studies imply that repetitive tasks lead to degeneration of the sensory representation of the hand and thus have an effect on sensory motor functions of hand.

Aims: The present study aimed to find out the effect of computer use on tactile perception and dexterity of hand in frequent computer users.

Settings and Design: The study was cross-sectional, analytic study conducted at the physiotherapy O.P.D. at a tertiary care hospital. Forty adults participated in the study recruited on the basis of computer use. There were 20 frequent users (e"2hours/day, e"12 months) and 20 occasional users (<2hours/day, <12 months).

Methods and Material: Tactile perception was assessed by two point orientation discrimination test using an aesthesiometer and dexterity of hand was assessed by grooved pegboard test using a grooved pegboard.

Statistical analysis used: Unpaired t test or Mann Whitney U test was performed according to the distribution of the data in each group.

Results: The study showed significant difference for Two point orientation discrimination test in dominant hand (*P*=0.0033 for thenar and *P*=0.0043 for hypothenar) and non-dominant hand (*P*=0.0016 for thenar and *P*=0.0100 for hypothenar). There was no significant difference for Grooved pegboard test in frequent computer users when compared with occasional users.

Conclusions: The present study gives e vidence that early signs of deficits occur in people exposed to repetitive computer tasks.

KEY WORDS: Computer Use, Repetitive Tasks, Hand Functions, Tactile Perception, Dexterity.

Address for correspondence: Himanshi Thaker, Intern, Physiotherapy School and Centre, Topiwala National Medical College, Mumbai, Maharashtra, India.
E-Mail: himanshithaker@gmail.com

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INTRODUCTION

Use of computer on a regular basis has become very important in today's world. It's use has grown extensively as well. The computer tasks involve repetition of fine motor activities of hand for typing on keyboard and pointing, clicking with mouse. There are peak forces exerted to activate the keys of the keyboard, which are more in case of frequent users and also more force is exerted back on their fingers by hitting down to the bottom of the key [1,2]. Evidence indicates that working

frequently with computer is associated with the development of variety of work related health problems [3,4]. These are Occupational Overuse Syndrome (O.O.S.) also known as Repetitive Strain Injury (R.S.I.) which is caused by repetitive movements or sustained awkward posture [1,5].

Occupational overuse syndrome are often thought to occur because of soft tissue inflammation resulting from cumulative micro-trauma to the muscles and nerves but recent evidences suggest that they occur because of an abnormal sensory processing [6,7]. Brain mapping done on monkeys, who had developed deficits in fine motor functions because of repetitive tasks of hand grip, showed degradation of cortical sensory motor representation of the affected hand [7]. Abnormal sensory input caused by repetitive movements can lead to degradation in sensory representation of the hand which in turn can lead to R.S.I [8]. Studies show that tactile perception and dexterity of hand is affected in R.S.I [5,9,10]. This is the sensory degradation hypothesis. Tactile perception in hand is an active perception. In this the movements are actively directed to get information by perceiving through the sensation of touch. It forms a closed active perception loop. Dexterity is the ability to manipulate objects with hands. It is a complex psychophysical phenomenon. It requires sensory motor activity for coordinated fine motor skills.

The evidence available to explain the extent of somatosensory degradation at which early signs of hand dysfunction appears, is deficient. Early detection of subtle deficits is important for development of preventative strategies. Therefore, the aim of the present study was to find out early changes in tactile perception and dexterity in asymptomatic adults exposed to repetitive computer tasks.

MATERIALS AND METHODS

The present study was a cross-sectional, analytic study conducted at the physiotherapy outpatient department of a tertiary care hospital. The study began after taking approval from the physiotherapy department review board and taking permission from the Dean of the tertiary care hospital. Forty subjects were included in the study by convenience sampling. The sample size was calculated using the formula

$$N= 2\times(z_\alpha+z_\beta)\times [\sigma_1^2+\sigma_2^2/ (\mu_1-\mu_2)^2]$$

since the present study involved comparison of two groups[11]. Participants were recruited by inclusion and exclusion criteria. Participants were divided into two groups as frequent users (FU) or occasional users (OU) on the basis of computer use per day (FU≥2hrs/day) (OU<2hrs/day) and years of being in the same occupation (FU at least 12 months)[4]. A symptomatic individuals between 18 to 58 years of age were included. Individuals with previous history of diagnosed neuropathy or diseases that are commonly associated with peripheral neuropathy (eg. renal disease, diabetes, rheumatoid arthritis) or musculoskeletal symptoms related to neck and upper extremity were excluded. Each participant participated in a single testing session and was given an information sheet to know the details of the study. A written consent was obtained. Data were obtained from the participants and recorded.

Two point orientation discrimination test [13,14]: An aesthesiometer was used to test tactile perception. Participants were blind-folded and indicate when asked whether they felt one or two points of contact. When two points were indicated, they were required to state if the points of contact were oriented vertically or horizontally. The test was performed in both hands over the hypothenar and thenar eminences. Assessment was performed in ascending order with separations between 4 and 14 mm. Two vertical and horizontal trials were performed at each site for each distance of separation. The distance at which the participant consistently had ¾ correct responses for the thenar and hypothenar eminences were recorded.

Grooved pegboard test [15,12,6]: Grooved pegboard was used to test dexterity. It consists of 25 holes with randomly positioned slots. Pegs, which have a key along one side, must be rotated to match the hole before that can be inserted. This test requires more

complex visual-motor coordination than most pegboards. Participants were asked to put the pegs into the holes starting from the top row, completely from the opposite side to the same side of the hand used, filling from top to bottom. They had to perform as fast as they can with one hand at a time. Both the hands were timed. For each hand, the three scores are summed (the total time, total number of drops and the total number of pegs correctly placed in the board) to get complete score.

Statistical Analysis:

Statistical Analysis was done on GraphPad Prism 8 software. The level of significance was set at 0.05 for all tests performed. Shapiro-Wilk test was performed to find out if the data was normally distributed. Age and gender matched FU groups were compared with OU groups for two point orientation discrimination test and grooved pegboard test for both dominant and non-dominant hands. Unpaired t test was performed for normally distributed data. Mann Whitney U test was performed for data which was not normally distributed.

RESULTS

Demographic characteristics are shown in Table 1. In this study there were 16 males and 4 females in each group. Average age was 33 ±6 years in each group. Average hours/day of computer use of FU group was 4±1.5 hours more than OU group. Average years of computer use of FU group were 6±1.6 years more than OU group.

Comparison of average performance in the different tests between FU (Frequent) and OU (Occasional) computer users is shown in Tab.1.

Statistical Analysis showed significant difference in two point orientation discrimination test of dominant hand at thenar (*P*=0.0033) and hypothenar (*P*=0.0043), aspects. There was significant difference seen in two point orientation discrimination test of non-dominant hand at thenar (*P*=0.0016) and hypothenar (*P*=0.0100), aspects. There was no significant difference seen in grooved pegboard test of dominant hand (*P*=0.1217) and non-dominant hand (*P*=0.5689).

Table 1: Demographic Characteristics.

	Frequent User	Occasional User
Gender (n)	**Male (16) Female (4)**	**Male (16) Female (4)**
Age(years,Mean,S.D.)	32.95±6.211	32.95±6.211
Handedness (n,right;n,left)	19 Right, 1Left	18 Right, 2Left
Hours/day of computer use (Mean,S.D.)	4.875±1.891	0.200±0.3403
Years of computer use (Mean,S.D.)	8.325±5.287	1.630±3.651
<2yrs	1	15
2-5yrs	4	3
5yrs	15	2

DISCUSSION

The present study aimed at finding out early changes in tactile perception and dexterity in asymptomatic adults exposed to repetitive computer tasks. Assessment of asymptomatic participants in the study makes it clear that the findings will show early signs of deficits and not severe deficits.

A significant difference was found in two point orientation discrimination test of both dominant and non-dominant hand when FU were compared with OU. This implies that frequent computer users show early signs of hand dysfunction because of the repetitive computer tasks. This result is consistent with a study by Tremblay F, et al. which found out early signs of deterioration in tactile perception and manual dexterity associated with frequent computer use in females [6]. Also, a study by Byl NN1, et al. found that repetitive hand opening and closing can lead to motor control problems, measurable somatosensory changes, and problems in graphesthesia and stereognosis [8]. In two point orientation discrimination test, the two points can be

distinguished from one point only when the two points are separated enough to cause spatially distinguishable foci of neural activity [13].

Hence, the findings of the present study of early deficits are more likely to be central in origin. Deficits of peripheral origin would be very severe like in CTS, which is unlikely in our study because we have assessed asymptomatic participants [16]. Hence, the findings are more likely because of impaired capacity to process spatial information. This is supported by a study by Byl NN et al. which found that highly repetitive movements can degrade cortical representation of sensory information guiding fine motor hand movements [7]. Also, a study by Byl N et al. found out that the somatosensory differences as measured by tactile discrimination tasks represent degradation of the hand representation following prolonged, repetitive, tasks of hand [9].

The present study shows that average hours/day of computer use among FU is 4.875±1.891 and average years of computer use among FU is 8.325±5.287. These are the values of exposure required to cause early deficits of tactile perception in FU. This provides evidence to explain the extent of somatosensory degradation at which early signs of hand dysfunction appears.

In Grooved pegboard test, the pegs have to be adjusted with the finger to match with the hole, before inserting. This task requires visuo-sensory-motor integration[15]. Our study showed no significant difference in grooved pegboard test which is probably because our study couldn't cover a wide spectrum of age and exposure of computer use. Average age was 33 ±6 years in each group. Average hours/day of computer use of FU group was 4±1.5 hours more than OU group. Average years of computer use of FU group were 6±1.6 years more than OU group. So it's more likely that these age group of participants in our study did not get exposure of repetitive computer tasks, enough to cause the extent of somatosensory degradation, which could cause early motor deficits in asymptomatic FU affecting the dexterity of hand. Hence, further studies should be done with larger sample size to cover wider spectrum of age and exposure to repetitive computer tasks.

CONCLUSION

The present study found early deficits in tactile perception of hands in FU when compared with OU. This gives evidence that early signs of sensory deficits occur in people exposed to repetitive computer tasks. So it is necessary to target frequent computer users for preventative measures against occupational overuse syndrome.

Conflicts of interest: **None**

Author's contribution

All the authors have made substantial contributions to conception, design, acquisition of data, analysis and interpretation of data. All the authors are involved in drafting the manuscript and revising it critically for important intellectual content. All the authors have given final approval of the version to be published.

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