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NECK – UPPER EXTREMITY MUSCULOSKELETAL DISORDERS AMONG WORKERS IN EGYPTIAN TELECOMMUNICATIONS COMPANY AT MANSOURA CITY

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Abstract:

The aim of this work was to study the prevalence of neck- upper extremity musculoskeletal disorders (MSD), mainly carpal tunnel syndrome (CTS), among video display terminal(VDT) users and to determine the association between CTS and occupational physical and psychosocial risk factors. A comparative cross- sectional study was conducted upon (60) VDT users (at risk group) and a matched control group composed of (35) non-VDT users. The population studied was subjected to a structured questionnaire, clinical examination, and investigation in the form of electrophysiological studies and of neck X- ray. There was no statistically significant difference in the prevalence of neck -upper extremity MSD during the past year between the two groups. The prevalence of CTS among the VDT users was 3.3% which was similar to that found in other studies. The mean age of CTS cases (58±1.4years) was statistically significantly higher than the symptom- free VDT users (45.8±4.6years). The physical work stressors and psychosocial factors were more common among CTS cases compared to non-cases, however, the difference was not statistically significant.

Introduction

Work- related musculoskeletal disorders (WMSD) have become the subject of growing concern among population of industrialized countries during the last three decades [1]. Although so many articles on WMSD have been published, most of these studies were based on populations in Europe and North America which cannot be generalized to other developing populations due to difference in economic, social and healthcare system [2].

Carpal tunnel syndrome (CTS) is a frequent outcome of work-related musculoskeletal disorder and is associated with significant cost and disability [3].

The association between computer use and CTS is still controversial and a few studies on the subject have been published until now. In a surveillance of compensated cases of carpal tunnel syndrome in Massachusetts, workers who frequently used video display units, such as insurance adjusters, data entry operators, general office clerks, computer operators, and secretaries, had high incidence of CTS [4].

In 1994, Hales et al. reported increased prevalence of work-related upper extremity musculoskeletal disorders (WUEDs) among telecommunication workers who use VDTs. Among these WUEDs, tendon-related disorders were most common followed by muscle related disorders, nerve entrapment syndromes, joint-related findings, and ganglion cyst. The hand-wrist was the area most affected, followed by neck area, the elbow area and the shoulder area [5]. Also, a cross-sectional study conducted in telecommunications industry in Malaysia revealed that the over all prevalence of MSDs among different occupations like operators using VDTs, switch board operators, clerks, data entry processors and supervisors was found to be 31.2% and the prevalence among the various occupations differed, being the highest in the switchboard operators and data processors and the lowest in the supervisors [6].

Toomingas et al. (2003) studied the symptoms and clinical findings from musculoskeletal system among call center operators (CC) in Sweden and found that CC operators are more symptom-loaded than other professional computer users in spite of their younger age and shorter duration of exposure. Symptoms were long lasting and recurrent. Muscle tenderness and nerve affection in the neck-shoulder region were the most common specific finding [7]. Moreover, Rocha et al. (2005) found that the prevalence of neck- shoulder symptoms was 43% and of wrist- hand was 39% in CC operators in Brazil [8]. Also, Norman (2005)

confirmed that CC operators had a higher prevalence of neck and upper extremity disorders than other professional computer users [9].

The call center operator is the individual whose job requires spending a significant proportion of his working time responding to telephone calls and simultaneously using VDT, hence, CC operators share VDT users in telecommunications> companies in ergonomic hazards and consecutively musculoskeletal symptoms and disorders[9].

A survey was done on employees working at a medical facility who were identified as frequent VDT users and the frequency of clinically defined CTS was found to be 10.5% and the frequency of electrodiagnostically confirmed CTS was 3.5%. The authors concluded that frequency of CTS in VDT users is similar to that in the general population [10].Also, a cross-sectional study was performed in communication technology company and found that the prevalence of CTS symptoms among VDT users was 3.8% on 340 subjects, while prolonged median motor distal latency (>4.2 milli second) was disclosed in 3.7% of a subgroup receiving examination [11].

The main purpose of this work was to study the prevalence of neck-upper extremity musculoskeletal disorders, mainly CTS, among VDT users and to determine the association between CTS and occupational physical and psychosocial risk factors as well as personal risk factors.

Subject and methods

Study design and population

A comparative cross-sectional study was conducted on (95) employees in the Egyptian telecommunications company at Mansoura city from February 2006 to August 2007. They were divided into two groups: the at risk group which consisted of (60) telephone operators using VDT and the control group which consisted of (35) non-VDT users. The at risk group consisted of telephone operators employed as directory assistance operators (n=40), telegraph operators (n=6), cabin operators (n=4), and data entry operators (n=10). The control group were selected from clerical jobs without VDT use in the same company, matched in age,sex, and duration of work.

Job Description

The at risk group spent much time seated at keyboards and video monitors, worked in constrained awkward sitting postures with repetitive hand-arm movements from keying activities. Leaning forward on the elbow was a common feature of telephone operators. Directory assistance operators used keyboards only to receive incoming

and outgoing calls. But telegraph operators and data entry operators use keyboards and mouse.

The control group prepared work schedules and assigned switchboard positions, maintained record of incoming and outgoing long-distance and tie line calls, noting duration and time of call. The posture adopted by the control group was prolonged static sitting position in writing posture to prepare records and work schedules. They performed localized contact stress on forearm and sometimes the elbow against sharp edges of work surface.

Methods

The population studied were subjected to a structured questionnaire which fulfilled the requirements of the study and included sociodemographic data(age, gender, smoking and general health status data), occupational history (duration of employment, weekly working hours, daily VDT working hours, workstation displays, and usage of input devices), musculoskeletal symptoms (site, onset, course, duration, precipitating workload factors such as standing, sitting, repetitive arm movements, standing for long period, sitting for long period and working in uncomfortable posture. These informative data about musculoskeletal system affection and their precipitating risk factors were quoted from the Dutch Musculoskeletal Questionnaire [12]. Questions on the history of sensory and motor affection of median nerve in both hands such as tingling and /or numbness in hand or fingers, pain, weakness were included in the questionnaire. Psychosocial risk factors such as subjective perception of job dissatisfaction, work overload, long work hours, physical environmental hazards(lighting, climate, noise) were quoted from Norman (2005) [9].

Anthropometric measurements such as weight, height and body mass index were obtained for all subjects. Body mass index was calculated according to the following equation :Body Mass Index (BMI = Body weight (Kg) /(Height in meters^2)[13] The subjects were classified according to BMI to underweight if BMI<18.5, normal weight (18.5-24.9), over weight (25-29.9) and obese equal to or more than 30).

The workers with potential work-related musculoskeletal symptoms of neck-upper extremity (pain, stiffness ,numbness and tingling and muscle weakness) that lasted more than one year ,started with current work ,with no previous accident ,symptoms lasted for more than 1 week or occurred at least once a month within the past year were referred for clinical examination and investigations in the form of X ray of the neck. A subgroup of symptomatic workers with

numbness ,tingling ,burning ,or pain (NTBP) in the fingers ,hands ,or wrists (n=12) for at least three episodes ,or in one episode lasting more than 1 week during the previous12 months were subjected to electrophysiological studies for both median and ulnar nerves in both hands.[14]

Electrophysiological studies

Nerve conduction studies (NCVs) were done for both median and ulnar nerves and electromyography for abductor pollicis brevis and abductor digiti minimi in both hands using Neuropack 2 device, Nihon Kohden, model MEB/MEM. 7102 A/K.02, Tokyo, Japan. The nerve conduction studies were done in the electrophysiology unit, Neurology Department, Mansoura University Hospital.

Motor and sensory nerve conduction studies were performed under the agreements between researchers and employees made before studies. Regarding the motor conduction studies, the compound motor action potential (CMAP) was recorded over the abductor pollicis brevis for the median nerve, and the abductor digiti quinti for ulnar nerve. For motor conduction velocity studies distal stimulation was 8 cm away from the recording site and the proximal stimulation was at the antecubital fossa. Concerning sensory studies of the median nerve, the conduction velocity can be calculated with only single stimulation because there is no transmission along neuromuscular junction or muscle fibers. Therefore, only one stimulation site was used at the wrist which is identical to the distal stimulation site in motor nerve conduction study (13 cm proximal to the active recording electrode) and the following parameters were assessed for both motor and sensory NCVs: the distal motor latency (DML) at the wrist and proximal motor latency (PML) at the elbow, the distal sensory latency (DSL),the amplitude of CMAP and SNAP(sensory nerve action potential), conduction distance and conduction velocity [15].

Diagnostic criteria for different neck-upper extremity musculoskeletal disorders

Cervical spondylosis and cervical disc space narrowing: The diagnosis was based on clinical history of neck pain accompanied by stiffness, with radiation into the shoulders or occiput with arm, forearm, and/or hand pain. It may be chronic or episodic, with long periods of remission. Radiography confirmed the diagnosis by the presence of cervical spondylotic changes with narrowed disc space.

Cervical radiculopathy: The diagnosis was based on clinical history and ex-

amination findings such as: complaints of neck and arm pain in conjunction with diminished upper limb sensation, reflexes or motor power, and positive Spurling's test (radicular pain reproduced with cervical lateral flexion, rotation and axial compression). Radiography confirmed the diagnosis by the presence of cervical spondylotic changes with narrowed disc space.

Neurogenic thoracic outlet syndrome: The diagnosis of neurogenic thoracic outlet syndrome was based on clinical history of pain, numbness/ tingling, and heaviness of the upper extremity with radiography showing cervical rib articulating with first rib.

Carpal tunnel syndrome: The diagnosis of carpal tunnel syndrome was based on clinical history of numbness, tingling, burning, or pain (NTBP) on the palmer aspect of thumb, index, middle and radial half of the ring finger besides abnormal electrophysiological findings which are distal motor latency of median nerve >4.2 millisecond and distal sensory latency of median nerve >3.7 millisecond.

Statistical Methods

Data were analyzed using the statistical package for social science (SPSS) program version 10 under Windows. The normality data was first tested by one sample Kolmogorov-Smirnov test. Descriptive statistics, means and standard deviation were calculated to describe central tendencies in each of the groups. Comparison between groups was done using student t-test for continuous variables and Chi square-test (χ^2) for discrete variables. Fisher exact test was considered when the cell value was less than 5. P value less than 0.05 was considered significant and p value less than 0.001 was considered highly significant.

Results

Sociodemographic characteristics

There were no statistically significant differences (P >0.05) between the at risk VDT users and controls in all the sociodemographic characteristics. The mean age of the at risk group and the controls were 44.8±9.3 years and 45.6±8.6 years, respectively. Most of the VDT users (at risk group) and the controls were females (73.3% and 71.4%), married (95% and 85.7%), from urban areas (71.7% and 82.9%), with technical education (66.7% and 51.4%) and non-smokers (78.7% and 91.4%) respectively. The mean duration of employment was 19±10.3 years for the VDT users and 20.5±8.6 years for the controls (Table 1).

Musculoskeletal disorders

The prevalence of neck-upper extremity musculoskeletal disorders among the workers in the Egyptian telecommunica-

tions company at Mansoura presented in table (2) revealed that the prevalence of entrapment neuropathies as cervical radiculopathy and carpal tunnel syndrome were higher among the VDTs users compared to controls ,but the difference was not statistically significant (P>0.05). Also, cervical spondylosis, cervical disc space narrowing and thoracic outlet syndrome were higher among the controls than the VDT users but the difference was not statistically significant (P>0.05).

Nerve conduction velocity studies

The CTS cases had significantly prolonged sensory and motor latencies (p<0.05) compared to non-cases. Also, the motor and sensory conduction velocities were slower in CTS cases compared to non-cases, the difference (p<0.05) being statistically significant in the sensory conduction velocity only (Table 3).

Demographic characteristics of CTS cases and non-cases

The mean age of CTS cases was significantly higher compared to non-cases of VDT users (58±1.4 years, 45±8.4years, respectively with P<0.05). However, there was no statistically significant difference between the two groups regarding gender and mean BMI (P>0.05) (Table 4).

The association of CTS with occupational risk factors

The mean duration of employment was statistically significantly higher in CTS cases compared to non-cases (P<0.05). However, the mean weekly hours of VDT use, duration of VDT use, repetition, awkward posture and forceful motions showed no statistically significant differences between the two groups (P>0.05). The psychosocial stressors in the form of job dissatisfaction, long work hours, work overload, limited social support were more common among CTS cases compared to non-cases but the difference was not statistically significant (P>0.05) (Table 5).

Table 1. Sociodemographic characteristics of the study population

Characteristics	At risk group (VDT users) (n=60) No (%)	Controls (n=35) No (%)	P value
Age in years			
• Less than 30	6 (10)	3 (8.6)	
• 30-	27(45)	12 (34.3)	0.51
• 45-60	27(45)	20 (57.1)	
Age, mean ±SD, y	44.8±9.3	45.6±8.6	0.66
Gender			
• Male	16 (26.7)	10 (28.6)	0.84
• Female	44 (73.3)	25 (71.4)	
Residence			
• Urban	43 (71.7)	29 (82.9)	0.21
• Rural	17 (28.3)	6 (17.1)	
Marital status			
• Married	53 (95)	30 (85.7)	0.14
• Unmarried	3 (5)	5 (14.3)	
Educational level			
• Secondary general school or lower	13 (21.7)	10 (28.6)	0.31
• Technical	40 (66.7)	18 (51.4)	
• University	7 (11.6)	7 (20)	
Body mass index(BMI)			
• Normal (18.5-24 kg/m^2)	8 (13.3)	5 (14.3)	0.18
• Heavy (25-29 kg/m^2)	10 (16.7)	10 (28.6)	
• Obese (≥30 kg/m^2)	42 (70)	20 (57.1)	
BMI ,mean± SD kg/m^2	32.38±6.3	30±4.6	0.07
Smoking status			
• Smoker (cigarette)	8 (13.3)	3 (8.6)	0.48
• Non-smoker	52 (78.7)	32 (91.4)	
Duration of employment in years			
• 5-	14 (23.3)	5 (14.3)	0.42
• 10-	11 (18.3)	5 (14.3)	
• 15+	35 (58.4)	25 (71.4)	
Duration, mean ±SD ,y	19±10.3	20.5±8.6	0.46

Table 2. Prevalence of neck -upper extremity musculoskeletal disorders among the workers in the Egyptian telecommunications company at Mansoura during the year of the study

Musculoskeletal disorders	At risk group (VDT users) (n=17) No (%)	Controls (n=5) No (%)	P value
Cervical spondylosis	11 (64.7)	4 (80)	1.00
Cervical disc space narrowing	11 (64.7)	4 (80)	1.00
Cervical radiculopathy	6 (35.2)	1 (20)	1.00
Thoracic outlet syndrome (TOS)	2 (11.7)	1 (20)	1.00
Carpal tunnel syndrome (CTS)	4 (23.5)	0 (0.0)	0.53

Table 3. Nerve conduction velocity studies (NCVs) among workers with symptoms suggestive of median neuropathy

	NCVs Parameter			
VDT users (n=12)	**Sensory latency (ms) (Mean±SD)**	**SCV (m/s) (Mean±SD)**	**Motor latency (ms) (Mean±SD)**	**MCV (m/s) (Mean±SD)**
CTS cases (n=4)	5.1±2.6	46.9	5.9±0.67	53±3.3
Non-cases (n=8)	2.7±0.57	58.6±6.3	3.3±0.39	57.7±3.9
P value	0.02*	0.03*	0.00*	0.15

SCV : Sensory conduction velocity **MCV: Motor conduction velocity**
ms: millisecond **m/s: meter per second**
***P value was less than 0.05**

Table 4. Demographic characteristics of CTS cases and non-cases of VDT users.

Characteristics	**VDT users**		**P value**
	CTS cases (n=2)	**Non-cases (n=56)**	
	No (%)	**No (%)**	
Age groups in years			
<45	0 (0.0)	33 (58.9)	0.18
≥45	2 (100)	23 (41.1)	
Mean± SD, y	58±1.4	45±8.4	0.03*
Gender			
• Male	1 (50)	15 (26.8)	0.47
• female	1 (50)	41 (73.2)	
BMI			
<30 kg/m^2	2 (100)	16 (28.5)	0.09
≥30 kg/m^2	0 (0.0)	40 (71.5)	
Mean ±SD (kg/m^2)	25.7±3.7	31±6.4	0.16

***P value was less than 0.05**

Table 5. The association of CTS with occupational physical and psychosocial risk factors among CTS cases and non-cases of VDT users

Occupational risk factors	VDT users		P value
	CTS cases (n=2)	Non-cases (n=56)	
	No (%)	No (%)	
Duration of employment			
<10 years	0(0.0)	14 (25)	0.43
≥10 years	2(100)	42 (75)	
Mean ±SD, y	32.5 (3.5)	19(9.3)	0.05*
Hours per week (Mean ±SD)	40±2.2	39.5±3	0.85
Duration of VDT use Mean ± SD, **y**	11±1.4	9.8±3.7	0.66
Physical risk factors			
Repetitive hand/wrist motions	2(100)	40 (71.4)	1.00
Awkward wrist posture	2 (100)	45 (80.3)	1.00
Forceful hand motions	1 (50)	9 (16.07)	0.31
Psychosocial risk factors			
Job dissatisfaction	2 (100)	13 (27.08)	0.06
Long work hours	2 (100)	34 (70.8)	0.52
Work overload	2 (100)	32 (66.6)	0.50
Limited social support	1 (50)	7 (14.5)	0.25

***P value was less than 0.05**

Discussion

A considerable and growing concern exists in both the lay and scientific communities that computers place users at increased risk of upper extremity musculoskeletal symptoms (MSS) and disorders (MSD) [16,17]. The musculoskeletal problems among VDT users have been linked to workplace ergonomic demands in numerous studies [5,9].

Hales et al. (1994) reported that the overall prevalence of potential upper extremity work-related musculoskeletal disorders defined by questionnaire and physical examination only was (22%) among VDT users in a large telecommunications company [5].

The prevalence of neck-upper extremity musculoskeletal disorders in our population at Mansoura telecommunications company was higher among VDT users (28.3%) compared to the control group (14.2%). However, the difference was not statistically significant. Cervical spondylosis and cervical disc space narrowing had high prevalence in both VDT users (64%) and the control group (80%) but the difference was not statistically significant. However, cervical radiculopathy had a higher prevalence (35.2%) among telephone operators VDT users compared to the control group (20%).

These results are in agreement with Toomingas et al. (2003) who reported that nerve affection in the neck shoulder region was the most common specific finding among CC operators[7]. Hassan and Abou EL-Soaud (1997) reported that 66.7% of data entry operators had occupational cervical disorders with radiculopathy, while 33.3% of them had cervical disorders without radiculopathy [18].

The present study results revealed that twelve subjects out of 95 (12.6%) of the studied population had symptoms suggestive of median neuropathy and were subjected to electrophysiological studies. Carpal tunnel syndrome was confirmed in 33.3% (four subjects out of twelve). The NCV studies of the symptomatic subjects showed significant prolongation of both sensory and motor latencies and significant slowing of sensory conduction velocity among CTS cases compared to non-cases.

The prevalence of CTS among telephone operator VDT users was 3.3% after exclusion of two cases due to the presence of non-occupational risk factors in the form of diabetes mellitus. These results were consistent with the results of Stevens et al. (2001) who reported that 10.5% of a group of computer users at a medical facility met the clinical criteria of CTS and 3.5% were confirmed by nerve conduction studies.

Moreover, Hou et al. (2006) reported that the prevalence of CTS among male VDT users in a large communication and information company was 3.8% and they also reported that the percentage was similar to that in the general population [11]. However, the prevalence of CTS which was clinically and electro-physiologically confirmed in the general population was estimated as 2.7% [19].

In a one year follow up study of computer users in Denmark, the prevalence of interview-confirmed median nerve symptoms was 4.8% and the one year incidence of new or worsened CTS symptoms was 1.4% [20]. But, the baseline prevalence and one year incidence of electrophysiologically confirmed CTS was even lower in another study [21].

In our study, the mean age of CTS cases (58±1.4years) was statistically significantly higher than that of non-cases of VDT users (45.8±4.6years).These results were consistent with the findings of El Hawary et al. (2001) who reported that the prevalence of CTS typically increased with age particularly beyond the age of 35 years [22] .

The higher mean age of CTS cases in this study probably was attributed to the fact that occupational exposure to VDT was of relatively short duration (11±1.4 years) since the use of VDT at workplace was relatively recent.

Leclerc et al.(1998) and El Hawary et al. (2001) reported in their studies that the longer duration of work showed a relation with the prevalence of CTS. In the mean while, the mean duration of employment was statistically significantly higher in CTS cases compared to non cases among employees in Mansoura telecommunications company [23, 22].

The two CTS cases worked as switchboard and data entry operators. Premalatha and Hashem (1999) reported that the prevalence of upper extremity MSD at the telecommunications industry was the highest in the switchboard operators and data processors and the lowest in the supervisors[6].

The present study demonstrated that the occupational physical risk factors including repetitive hand/wrist motions, awkward wrist posture and forceful hand motions during keyboard use were more common among CTS cases compared to non- cases but the differences were not statistically significant.

Repetition, force, vibration and possibly extreme wrist posture are common occupational risk factors of CTS [24].

Repetitive movements during typing are common for most VDT workers, but the risk of CTS is not profoundly increased without concurrent exposure to forceful movements or vibration. Static posture of the neck and upper extremities is common for VDT users but the wrist posture is not so extreme to lead to the development of CTS as was observed in other occupations such as meat packing and dental hygienist [25].

Devereux et al. (2002) reported that physical and psychosocial risk factors may potentially interact at work to further increase the risk of symptoms of musculoskeletal disorders of the hand/ wrist and upper limbs [26].

The results of the present study revealed that job dissatisfaction, long work hours, work overload and limited social support from colleagues and supervisors were more frequently reported among CTS cases compared to non-cases of VDT users but the difference was not statistically significant .

Conclusion

The present study revealed that there was no statistically significant difference in the prevalence of neck-upper extremity musculoskeletal disorders among VDT users compared to controls. The prevalence of work- related CTS among the VDT users was 3.3% which was not markedly higher than that found in the general population. The results of this study revealed that the mean age of CTS cases was statistically significantly higher than that in the symptom free VDT users. The physical occupational risk factors including repetitive hand/wrist motions, awkward wrist posture and forceful hand motions during keyboard use were more common among CTS cases compared to non-cases. Moreover, the psychosocial factors including job dissatisfaction, long work hours, work overload and limited social support from colleagues and supervisors were more frequently reported among CTS cases than symptom free VDT users, but the difference was not statistically significant.

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Limitations of the study

- The relatively short duration of VDT use among the workers in the Egyptian telecommunications company at Mansoura since the VDT use started since 1994.
- One of the main services provided by switchboard department in the Egyptian

telecommunications company at Mansoura has been transmitted to principal centers in Cairo and Alexandria which resulted in marked downsizing of the number of switchboard operators by the company and lead to smaller number of studied VDT users in the current study.

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