Original Research Article

Curse of the technology-computer related musculoskeletal disorders and vision syndrome: a study

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ABSTRACT

Background: Computer Related Musculoskeletal disorders and Vision Syndrome (CRMSKVS) is defined as symptoms due to prolonged use of Visual Display Terminal (VDT).
Methods: A cross-sectional observational study was done among office-workers working on computer terminal. A self-reported questionnaire was distributed and Musculoskeletal (MSK) and visual symptoms in the preceding 12 months (01 October 2017 to 30 September 2018) were taken as dependent variable. Multivariate analysis was done to identify the determinants of CRMSKVS.
Results: Responses from 1193 subjects were included in the study. CRMSKVS was present in 489 cases (40.98%; males - 37.5%, females - 58.29%). The main MSK symptoms were pain/stiffness in neck (40.98%), shoulder (38.99%), lower back (35.6%) and elbow/wrist/hand/fingers (23.1%). The ocular symptoms were excessive watering (39.6%), pain (24.99), irritation (18.6%), burning/itching sensation (29.8%), redness (40.7%), blurring of vision (13.2%) and headache (40.9%). Female gender (OR-1.498(1.262-1.778)), long duration of working hours (OR-2.77(2.399-3.214)), poor break duration (OR-2.59(2.172-3.089)), excessive smart phone use (OR-2.071(1.834-2.338)), poor posture (OR-3.883(3.282-4.592)), inappropriate distance of computer screen (OR-2.173(1.829-2.582)), low height of screen (OR-1.936(1.527-2.454)), distance of keyboard (OR-3.161(2.528-3.953)) and distance of mouse (OR-5.785(3.932-8.512)) were identified as significant determinants of CRMSKVS.
Conclusions: CRMSKVS is an emerging pandemic which needs urgent attention by medical and administrative authorities. The device factors, personal factors, environmental and ergonomic factors are the modifiable risk factors for CRMSKVS.

Keywords: Computer related musculoskeletal disorders and vision syndrome, Computer vision syndrome, Occupational health hazards, Smart phones and health

INTRODUCTION

Computing devices, ranging from computers to smart phones, have become 'part and parcel' of our lives, be it a professional work or a leisure activity. Mankind has benefitted from this digital metamorphosis but at the cost of its health. The price of technological revolution paid is adoption of a sedentary lifestyle. According to WHO, physical inactivity is among the top four causes of death.[1] Physicians describe 'sitting' as 'the new smoking' - a charged bomb of ill-health, ready to explode.[2] Office-workers are the most sedentary population, spending maximum time at work 'sitting'.[3] Increased computer use

by office workers has resulted in various Musculoskeletal (MSK) and computer-related eye strain problems which is a part of this emerging "sitting disease" pandemic.[4,5]

Computer Related Musculoskeletal disorders and Vision Syndrome (CRMSKVS) is defined as symptoms due to prolonged use of Visual Display Terminal (VDT). Ocular symptoms are due to asthaenopia or dry eye related while extra-ocular symptoms involve musculoskeletal and peripheral nervous system. MSK and visual problems due to computer use are the reason for most out-patient visits to any surgery and eye clinic.

MSK conditions comprise 2% of global disease burden and 2nd highest volume of years lived with disability.[5,6] Number of people affected with MSK disorders have gone up by 1.25 times.[5] Complications of MSK disorders are known as "cumulative trauma disorders" or "repetitive strain injuries" are present in 25% of patients.[7] American Optometric Association reported an addition 10 million new cases of computer-related eyestrain each year. Comprehensive disease burden of MSK and visual complaints across the globe necessitates further research on CRMSKVS.

Since most common users of computers are office workers, we decided to evaluate CRMSKVS in this specific group of population. We designed a study to determine the prevalence and determinants of CRMSKVS in them.

METHODS

A cross-sectional observational study was done among professionals involved in administrative work, predominantly working on computer terminal. The study was conducted in a metropolitan city of North India during the month of October 2018.

Inclusion criteria

- Age ≥ 21 years
- Employed in the current position for at least one year from October 2017 to September 2018.
- Spend at least 50% of their working time at desk with a computer.

Exclusion criteria

- Suffering from any rheumatological, degenerative or connective tissue disorders.
- History of any major injury in past and/or who underwent surgery of the upper/lower extremity for musculoskeletal conditions/prolapsed intervertebral disc.
- Any history of uncorrected refractive error, ocular surface disorders, ocular neuromuscular disorders, keratitis, uveitis, vitreo-retinal or neuro-ophthalmic disorders and ophthalmic surgery.

A self-reported pre-structured, pre-tested questionnaire was distributed to office workers. Subjects whose questionnaire had missing data were excluded from analysis. The questionnaire included personal details such as age, sex and working details of the work-setting and self-reported visual or MSK problems. Self-reported MSK and visual symptoms in the last one year were taken as dependent variable. The questions relating to MSK disorders were modified from the Nordic Musculoskeletal Questionnaire.[8] Visual problems of red eye, itching, excessive watering, headache, and burning sensation were inquired. Work-place assessment questions were as per recommendations of the "ISO Standard - Ergonomic requirements for office work with VDT".[9]

The responses were graded as 'good' and 'poor' for the variables as shown in Table 1. 'Good working' condition was defined as sitting in straight position, feet touching ground with or without foot rest, availability of elbow and back support, availability of anti-glare screen, source and direction of lighting appropriate, direction of AC vents away from eyes and absence of dust on VDT.

Table 1: Response grading.

Parameter	Good	Poor
Duration of work on computer/desk	<8 hours	>8 hours
Break duration between work	>30 min	<30 min
Duration of smart phone use	<2 hours	>2 hours
Distance of screen	50-70 cm	<50/>70cm
Height of computer	≥10 cm	≤10 cm
Distance of keyboard	≥15 cm	<15 cm
Distance of mouse	≥15 cm	<15 cm

Sample size was calculated using formula

$$SS = \frac{Z2\ x\ (p)\ x\ (1-p)1}{C^2}$$

Where

Z= value (for example 1.96 for 96% confidence level)
p= percentage picking a choice
C= confidence interval, expressed in decimals

Analysis was done using the SPSS version 20. p-value ≤0.05 was considered statistically significant. Odds Ratio (OR) with 95% Confidence Interval (CI) was calculated. Multivariate analysis was done to identify the determinants of CRMSKVS. Informed consent was obtained from the study participants.

They were explained about purpose of the study and were assured about the confidentiality and anonymity of the information so obtained. Ethical clearance for the study was obtained from institutional ethics committee.

RESULTS

A self-reported pre-structured, pre-tested questionnaire on CRMSKVS was distributed to 1,988 office workers, of which 1,409 responded. 216 subjects had either missing data in the questionnaire or did not meet the inclusion/exclusion criteria, hence excluded from analysis. Thus, responses from 1193 subjects were included in the study. The general characteristics and demographic variables of the subjects are shown in Table 2. There were 994 males (83.3%) and 199 females (16.7%) with majority of them in the age group of 30-50 years (60.77%). CRMSKVS was present in 489 cases (40.98%; males - 37.5%, females - 58.29%).

Table 2: General characteristics and demographic variables (n=1193).

Category		Male (%)	Female (%)	Total (%)
Age group (years)	21-30	132(13.3)	54(27.1)	186(15.6)
	31-40	436(43.9)	61(30.7)	497(41.7)
	41-50	198(19.9)	30(15.1)	228(19.1)
	>50	228(22.9)	54(27.1)	282(23.6)
Designation	Senior executive and equivalent	319(32.1)	24(12.1)	343(28.8)
	Director and below/ equivalent	375(37.7)	97(48.7)	472(39.6)
	Clerks	108(10.9)	18(9.0)	126(10.6)
	Others	192(19.3)	60(30.2)	252(21.1)
Duration in similar kind of job (years)	Up to 5	388(39.03)	59(29.6)	447(37.46)
	5-15	410(41.24)	90(45.22)	500(41.9)
	>15	196(19.71)	50(25.12)	246(20.62)
CRMSKVS present		373(37.5)	116(58.29)	489(40.98)
Total		994(83.3)	199(16.7)	1193

(CRMSKVS - Computer related musculoskeletal disorders and vision syndrome)

The distribution of CRMSKVS is shown in Table 3. The main MSK symptoms were pain/stiffness in neck (40.98%), shoulder (38.99%), lower back (35.6%) and elbow/wrist/hand/fingers (23.1%). The visual symptoms were excessive watering (39.6%), pain (24.99), irritation (18.6%), burning/itching sensation (29.8%), redness (40.7%), blurring of vision (13.2%) and headache (40.9%).

Multivariate analysis was done to identify the determinants of CRMSKVS (as shown in Table 4). 60% of subjects worked less than 8 hours/day while 40% worked more than 8 hours/day. 70% of those subjects, working more than 8 hours/ day with inadequate break duration in between had CRMSKVS. 78% of those who had inaccurate work posture (inability to maintain erect posture while sitting, lack of elbow support/back support or footrest) had CRMSKVS. Ergonomics of workstation such as distance of computer screen, keyboard and mouse from worker and height of the screen were identified as determinants of CRMSKVS. Duration of work on computer/day, break duration in between work/day, smart phone use/day and work posture were other significant determinants.

Table 3: Distribution of CRMSKVS problems amongst the study group (responses are not mutually exclusive).

Symptoms		Male (%)	Female (%)	Total (%)
MSK symptoms (pain/stiffness)	Neck	373(37.5)	116(58.29)	489(40.98)
	Shoulder	360(36.2)	105(52.7)	465(38.99)
	Lower back	309(31.08)	116(58.29)	425(35.6)
	Elbow/wrist/hand/fingers	187(18.8)	89(44.7)	276(23.1)
Eye symptoms	Watering	358(36.01)	114(57.28)	472(39.6)
	Pain	200(20.12)	98(49.2)	298(24.99)
	Irritation	127(12.78)	95(47.7)	222(18.6)
	Burning/itching sensation	255(25.65)	101(50.75)	356(29.8)
	Redness	371(37.32)	115(57.8)	486(40.7)
	Blurring of vision	125(12.58)	32(16.1)	157(13.2)
	Headache	373(37.5)	116(58.29)	489(40.9)
Total		373(37.5)	116(58.29)	489(40.98)

(MSK - musculoskeletal; CRMSKVS - Computer related musculoskeletal disorders and vision syndrome)

Association of various determinants of CRMSKVS is shown in Table 5. Female gender (OR-1.498(1.262-1.778)), long duration of working hours (OR-2.77(2.399-3.214)), poor break duration (OR-2.59(2.172-3.089)), excessive smart phone use (OR-2.071(1.834-2.338)), poor posture (OR-3.883(3.282-4.592)), inappropriate distance of computer screen (OR-2.173(1.829-2.582)), low height of screen (OR-1.936(1.527-2.454)), distance of keyboard (OR-3.161(2.528-3.953)) and distance of mouse (OR-5.785(3.932-8.512)) were identified as significant independent determinants of CRMSKVS.

Table 4: Determinants leading to CRMSKVS.

Parameter	Category	CRMSKVS present number (%)	CRMSKVS absent number (%)
Duration of work on computer/desk	Good <8 hours	147(20.58)	567(79.41)
	Poor >8 hours	342(71.39)	137(28.60)
Break duration between work	Good >30 min	241(28.35)	609(71.65)
	Poor <30 min	248(72.30)	95(27.70)
Duration of smartphone use	Good <2 hours	164(24.11)	516(75.89)
	Poor >2 hours	325(63.35)	188(36.65)
Working posture	Good	100(14.40)	594(85.60)
	Poor	389(78.00)	110(22.00)
Distance of screen	Good (50-70 cm)	282(31.65)	609(68.35)
	Poor (<50/>70 cm)	207(68.54)	95(31.45)
Height of computer	Good (≥10 cm)	389(37.20)	656(62.80)
	Poor (≤10 cm)	100(67.50)	48(32.50)
Distance of keyboard	Good (≥15 cm)	272(29.80)	642(70.20)
	Poor (<15 cm)	217(77.78)	62(22.22)
Distance of mouse	Good (≥15 cm)	317(31.76)	681(68.20)
	Poor (<15 cm)	172(88.21)	23(11.79)

(CRMSKVS - Computer related musculoskeletal disorders and vision syndrome)

Table 5: Correlation of CRMSKVS with determinants.

Variable	Category	Odds ratio (95% CI) for presence of CRMSKVS	p-value
Gender	Male	Referent	
	Female	1.498 (1.262 - 1.778)	
Duration of work on computer	Good <8 hours	Referent	
	Poor >8 hours	2.77 (2.399 - 3.214)	
Break duration between work	Good >30 min	Referent	
	Poor <30 min	2.59 (2.172 - 3.089)	
Duration of smart phone use	Good <2 hours	Referent	
	Poor >2 hours	2.071 (1.834 - 2.338)	
Working posture	Good	Referent	0.001
	Poor	3.883 (3.282 - 4.592)	
Distance of screen	Good (50-70 cm)	Referent	
	Poor (<50/>70 cm)	2.173 (1.829 - 2.582)	
Height of computer	Good (≥10 cm)	Referent	
	Poor (≤10 cm)	1.936 (1.527 - 2.454)	
Distance of keyboard	Good (≥15 cm)	Referent	
	Poor (<15 cm)	3.161 (2.528 - 3.953)	
Distance of mouse	Good (≥15 cm)	Referent	
	Poor (<15 cm)	5.785 (3.932 - 8.512)	

(CRMSKVS - Computer related musculoskeletal disorders and vision syndrome; CI - confidence interval)

DISCUSSION

This study reported a prevalence of CRMSKVS as 40.98% among professionals involved in administrative job predominantly working on computer terminal in a metropolitan city which is similar to other studies.[10,11] Most of these subjects were in the age group of 30-50 years which is most active phase of their life. Impaired MSK health is responsible for the maximum loss of

'productive life years' when compared with other non-communicable diseases, resulting in premature retirement and abridged financial security.[12]

62% of 1193 subjects in this study were working in similar work condition for more than 5 years. 72% of subjects who developed CRMSKVS, were working >8 hours/day with less than 30 min break duration. Kaliniene et al, in their study found out that workers who worked for >4-6 hours/day had more chance to develop MSK symptoms.[13] Inappropriate chair or sitting improperly in front of VDT for cause muscle stiffness, headache, and backache as muscles and tendons become inflamed due to prolonged sitting.

The main MSK symptoms in this study were pain/stiffness in neck (40.98%), shoulder (38.99%), lower back (35.6%) and elbow/wrist/hand/fingers (23.1%). The common visual symptoms were excessive watering (39.6%), pain (24.99), irritation (18.6%), burning/itching sensation (29.8%), redness (40.7%), blurred vision (13.2%) and headache (40.9%). Similar figures were reported from developing and developed countries.[14-16]

78% of subjects of this study, who had inaccurate work posture, had CRMSKVS. CRMSKVS was present in 68% of subjects in whom distance of screen from operator and height of computer was inappropriate (distance of computer from operator <50/>70 cm, height of computer <10 cm). 78% of subjects in whom distance of keyboard (<15 cm) and 88% subjects in whom distance of mouse (<15 cm) from the operator was inappropriate had CRMSKVS. Marcus M et al, in their study on postural risk factors for MSK disorders found that inappropriate posture was the main factor in development of MSK pain in computer users.[17] Shahla et al, also found irregular posture as the main predictor of neck pain in computer office workers.[11]

Females were 1.5 times (OR-1.498(1.262-1.778)) more at risk to develop CRMSKVS in this study. Catarina Nordander et al, concluded that in identical work tasks, females had higher prevalence of MSK disorders of the neck and upper extremity than males.[18] Long duration of working hours (OR-2.77(2.399-3.214)) was another factor for CRMSKVS. Working on computer for more than 6 hours/day was associated with MSK pain in all body regions as found by Blatter and Bongers et al.[19] Poor break duration (OR-2.59(2.172-3.089)) was significant personal factor responsible for CRMSKVS. Studies have shown that people not getting enough breaks during working on computer terminal have increased prevalence of visual symptoms of strain and MSK pain.[20]

Excessive usage of smart phones (OR-2.071(1.834-2.338)) by these subjects was significantly responsible for MSK and visual symptoms. Seong-Yeol Kim et al, in their study found that prolonged continuous use of smart phone was responsible for neck and shoulder muscle fatigue and pain.[21] Smartphone use is the latest form of addiction amongst all age groups and population needs to be sensitized about its ill health. Various studies have reported association of poor or awkward sitting posture at the work place with CRMSKVS.[13,15-17] Poor posture (OR-3.883(3.282-4.592)), inappropriate distance of computer screen (OR-2.173(1.829-2.582)), low height of screen (OR-1.936(1.527-2.454)), distance of keyboard (OR-3.161(2.528-3.953)) and distance of mouse (OR-5.785(3.932-8.512)) were significant office related determinants of CRMSKVS in this study. All these factors are easily modifiable if office workers are educated about them. Authors collected the information through a self-reported questionnaire. There is a possibility of recall bias amongst subjects while answering symptoms in past.

CONCLUSION

Exponential pace of advancements in technology and declining prices of computer has given impetus to its use among all age groups either at workplace or at home. CRMSKVS is an emerging pandemic which needs urgent attention by medical as well as administrative authorities. The device factors, personal factors, environmental and ergonomic factors are the modifiable risk factors for CRMSKVS. Multipronged strategy, using awareness campaign, regular health check-ups and regulatory changes in the form of proper positioning and cleaning of VDT, correction of refractive errors, if any, proper illumination, avoiding direct exposure to AC vents, decreasing the number of hours/day at the computer terminal, increasing frequent breaks in the form of regular blinking, introducing 20-20-20 ocular rest and yoga/stretching exercises at workplace is needed to prevent CRMSKVS in the office workers. Unhealthy 'smart-worker' (addicted to smart phone) won't be efficient in the long run. Regulations on duration of smart phone use, based on risk-benefit analysis, should be made. These measures would not only improve the efficiency of the worker in office but also reduce the absenteeism due to CRMSKVS.

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