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RESEARCH ARTICLE

INFLUENCE OF INDIVIDUAL FACTORS LIKE GENDER, PHYSICAL ACTIVITY AND AGE ON THE OCCURRENCE OF MUSCULOSKELETAL DISORDERS IN VIDEO DISPLAY TERMINAL USERS

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ABSTRACT

The ever increasing use of computers in various fields has led to rise in musculoskeletal problems related to its operation. The pre-tested Musculoskeletal Disorder (MSD) survey instrument that includes the constructs Equipment Design, Equipment Setup, Equipment Layout, Provision of Training, Work Environment, Psychosocial Work Aspect, Psychosocial Personal Aspect, Rest Break Frequency and Assumed Posture has been to solicit the respondents like Design Engineers, Systems Engineers, Managers, Data Entry Personnels working in Production, Service and Software industries in order to get their perceptions. The study was conducted in the state of Tamilnadu in South India. A total of about 600 questionnaires were distributed to the Video Display Terminals (VDT) users and 410 questionnaires were valid one. SPSS version 15.0 was used for all statistical computations. The associations of musculoskeletal disorders with gender were assessed to check whether the perception level of male VDT workers and female VDT workers on the MSD causing risk variables, MSD prevalence level and Job Prevention are different. From the results, it is understood that even though the male and female VDT workers perceive the same level of MSD prevalence, the female VDT users perceive the higher level of Assumed posture than the male VDT users, meaning that the women while using computers alter their body posture in a better way when compared to men. A hypothesis is framed and tested to check whether there is significant difference in the perception level of VDT users doing physical exercise and VDT users not doing physical exercise on the MSD causing risk factors, MSD prevalence and Job Prevention. It is inferred that the VDT users not doing physical activity perceive higher level of MSD prevalence when compared with VDT users doing physical activity. The association between computer workplace and the musculoskeletal disorder is also studied and the results show that the level of MSD prevalence level and Job Prevention differs significantly for various age groups since the value of significance is less than 0.05. The age group (35 – 40 years) perceives the higher level of MSD prevalence when compared to remaining age groups. Thus, our study suggests that MSDs are a common problem among those who use computer intensively. Results of this study can contribute to the development of appropriate hazard-prevention programs for workers who frequently use computers.

INTRODUCTION

Because of the nearly universal use of Video Display Terminals (VDT) in the workplace, a better understanding of the effects of their use is of importance for issues of cost and productivity as well as employee health. The ever increasing use of computers in various fields has led to rise in musculoskeletal problems related to its operation. Intensive computer work puts stress and strain on muscles, as well as joints, because of continuous and repetitive nature of movements. Individual factors, prolonged awkward postures, poor workstation design and psycho-social environment can lead to development of symptoms of musculoskeletal disorder (MSD). If these symptoms are ignored and if no preventive measures are taken, cumulative trauma disorders such as myalgia, myofascial syndromes, nerve entrapment syndromes, tendonitis, epicondilitis and tenosynovitis can develop. In this paper, which is a part of a broader cross-sectional study, 410 individuals using computers were studied, and a number of individual factors of presumed importance were investigated.

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MATERIALS AND METHODS

The pre-tested MSD survey instrument including the constructs Equipment Design, Equipment Setup, Equipment Layout, Provision of Training, Work Environment, Psychosocial Work Aspect, Psychosocial Personal Aspect, Rest Break Frequency and Assumed Posture has been to solicit the respondents like Design Engineers, Systems Engineers, Managers, Data Entry Personnels working in Production, Service and Software industries in order to get their perceptions. The study was conducted in the state of Tamilnadu in South India. A total of about 600 questionnaires were distributed to the VDT users of production and service industries. Out of total 600 questionnaires distributed, 427 were collected with the response rate of 71.16% of the respondents. Out of 427, only 410 samples were found to contain complete information and so were valid for analysis. The data, which had incomplete information, have been treated as in-valid and not used for the study. The valid responses were collected from the respondents who are from various age groups, income groups and qualification groups. SPSS version 15.0 was used for all statistical computations. Musculoskeletal disorder (MSD) was considered when one or more of the following symptoms were reported by the respondents: neck or shoulder stiffness; neck or shoulder pain; tingling/numbness in hands, thumbs or fingers during work or many hours after stopping work; hand and wrist pain;

backache; headache; leg cramps; leg stiffness; numbness in ankles and feet; swelling in ankles and feet; reduction in strength of hand and difficulty in grasping objects.

RESULTS AND DISCUSSION

Influence of gender on the level of MSD (H_1)

The associations of musculoskeletal disorders with gender and occupational ergonomic exposures should be assessed in order to determine whether women are at increased risk when exposed to the same ergonomic stressors as men. The female workers often suffer from musculoskeletal disorders because neither the tasks nor the equipment they use, which is normally designed for men, are adapted to their built and physiology (Raymond Dahlberg *et al.,* 2004). In order to check whether the perception level of male VDT workers and female VDT workers on the MSD causing risk variables, MSD prevalence level and Job Prevention is different, a hypothesis H_1 as given below was framed and tested.

H_1: There is a significant difference in the level of MSD causing risk factors, the MSD prevalence and Job Prevention between male and female respondents.

The respondents were divided into two groups based on gender. To test the hypothesis H_1, a two sample t-test was performed to predict the significant difference between two independent sample means. Table 1 presents the results of the t-test, including means and standard deviation of two groups, t-value, and two-tailed probability.

Table 1. Results of t – test based on gender

MSD Variables	N = 305 Male		N = 105 Female		t	SIG
	Mean	SD	Mean	SD		
Equipment Design	3.5388	0.7623	3.5048	0.6169	0.458	0.648
Equipment Setup	3.2251	0.6412	3.2794	0.7441	-0.666	0.506
Equipment Layout	3.4306	0.75486	3.4825	0.80726	-0.597	0.551
Work Environment	3.6973	0.87931	3.6063	0.7606	1.014	0.312
Psychosocial Work Aspect	3.5377	0.8474	3.4429	0.8751	0.981	0.327
Psychosocial Personal Aspect	3.7615	0.68875	3.6738	0.70636	1.118	0.264
Rest Break Frequency	3.4219	0.7157	3.4571	0.6606	-0.444	0.657
Assumed Posture	3.2197	0.79438	3.4254	0.91812	-2.197	0.029*
MSD Prevalence Level	2.2095	.72494	2.2138	.72741	-0.052	0.958
Job Prevention	1.7424	.76531	1.6635	.78347	0.906	0.365

*$p < 0.05$

The negative t value of Equipment Setup, Equipment Layout, Rest Break Frequency and Assumed Posture were due to the mean value of the first group (male group) which has a smaller value than the second group (female group). As indicated by the significance level of t-values given in the last column of the Table 1, significant differences were found among the two groups at 0.05 level for the factor Assumed Posture. The Assumed posture being a strong predictor of MSD prevalence level confirmed through step wise regression found to be significant when tested for significant difference in the level of MSD causing risk factors between male and female VDT workers. From the results of this t test, it is understood that even though the male and female VDT workers perceive the same level of MSD prevalence, the female VDT users perceive the higher level of Assumed posture than the male VDT users, meaning that the women while using computers alter their body posture in a better way when compared to men. The findings of this test imply that the male computer users have to use their body posture in a proper way to reduce the MSD prevalence.

Influence of Physical Activity on the level of MSD (H_2)

Physical activity has no significant effects on musculoskeletal symptoms in any body region (Klussman 2008). It is also understood that computer users doing no or less physical exercise are at higher risk of MSD related to neck (Korhonen *et al*., 2003). In order to check whether there is significant difference in the perception level of VDT users doing physical exercise and VDT users not doing physical exercise on the MSD causing risk factors, MSD prevalence and Job Prevention, the following hypothesis has been proposed and tested.

H_2: There is a significant difference in the level of MSD causing risk factors, the MSD prevalence and Job Prevention between VDT users doing physical exercise and VDT users not doing physical exercise.

The respondents were divided into two groups as VDT users practicing Physical Activity and VDT users not practicing physical activity. To predict the significant difference between these two independent sample means (H_2), a two sample t-test was performed and the results are presented in Table 2.

Table 2. Results of t-test between VDT users practicing and non practicing physical activity among VDT users

Variable	Physical activity present N = 215		Physical activity absent N = 195		t	SIG
	Mean	S.D	Mean	S.D		
Equipment Design	3.5752	.73087	3.4803	.72196	1.320	0.188
Equipment Setup	3.2760	.74418	3.1983	.57287	1.190	0.235
Equipment Layout	3.4558	.78405	3.4308	.75161	0.329	0.742
Work Environment	3.7023	.88090	3.6427	.81685	0.708	0.479
Psychosocial Work Aspect	3.5860	.82925	3.4333	.87677	1.812	0.071
Psychosocial Personal Aspect	3.7081	.74177	3.7731	.63620	-0.947	0.344
Rest Break Frequency	3.4574	.70092	3.4017	.70255	0.802	0.423
Assumed Posture	3.2806	.81287	3.2632	.85366	0.211	0.833
MSD Prevalence Level	2.1470	.74726	2.2682	0.70035	1.695	0.091
Job Prevention	1.6541	0.74696	1.7840	.78660	1.710	0.088

It can be seen from Table 2 that the practice of doing physical exercise shows significant difference at 90% confidence level for the variables Psychosocial Work Aspect, MSD prevalence level and Job Prevention. The VDT users practicing physical activity perceive higher level of Psychosocial Work Aspect when compared to VDT users not practicing physical activity. It shows that the VDT users doing physical activity influences their work to a great extent rather than VDT users not doing physical activity. It is also noted that the VDT users doing physical activity are capable of learning new things through work compared to VDT users not doing physical activity.

With regard to MSD prevalence, the VDT users not doing physical activity perceive higher level of MSD prevalence when compared with VDT users doing physical activity. This result is in consistent with the findings made in the study of Korhonen *et al*. (2003). For the significant variable Job Prevention, the VDT users doing physical exercise perceive lower level of Job Prevention compared to VDT users not doing physical activity. The significance on Job Prevention based on physical activity is in consistent with the findings made by Bostrom *et al*. (2008) since his study shows relationship between Physical Activity and generally reduced productivity.

H_3: There is a significant difference in the level of MSD causing risk factors, the MSD prevalence and Job Prevention between age group of the respondents.

The respondents were grouped under different age groups and the descriptive statistics for the different age groups of the respondents is presented in Table 3. The Table 3 represents the mean and the S.D of MSD variables based on the age of the VDT users. Among the total of 410 respondents, 84 belonged to the age group of upto 25 years, 131 fall between 25 – 30 years, 77 fall between 30 - 35 years,

Table 3. Descriptive statistics for the different age groups of the respondents

Variable	N = 84 <25years		N = 131 25 - 30years		N = 77 30 - 35years		N = 67 35-40years		N = 51 > 40 years	
	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Equipment Design	3.63	0.69	3.52	0.78	3.47	0.74	3.60	0.69	3.38	0.66
Equipment Setup	3.26	0.53	3.25	0.74	3.20	0.63	3.17	0.80	3.33	0.56
Equipment Layout	3.49	0.62	3.37	0.87	3.58	0.75	3.33	0.79	3.52	0.69
Work Environment	3.65	0.77	3.55	0.94	3.90	0.93	3.66	0.82	3.69	0.53
Psychosocial Work Aspect	3.50	0.75	3.45	0.85	3.62	0.82	3.46	0.96	3.60	0.94
Psychosocial Personal Aspect	3.77	0.65	3.77	0.78	3.65	0.56	3.62	0.73	3.89	0.65
Rest Break Frequency	3.50	0.57	3.49	0.70	3.26	0.69	3.35	0.79	3.53	0.76
Assumed Posture	3.30	0.83	3.34	0.89	3.28	0.73	3.19	0.83	3.16	0.84

Table 4. Results of Levene's test of Homogeneity of variances for various age groups

Variable	Levene's statistics	df1	df2	SIG	Remark
Equipment Design	1.149	4	405	0.333	NS
Equipment Setup	3.606	4	405	0.007	S
Equipment Layout	2.729	4	405	0.029	S
Work Environment	5.127	4	405	0.000	S
Psychosocial Work Aspect	1.809	4	405	0.126	NS
Psychosocial Personal Aspect	0.844	4	405	0.498	NS
Rest Break Frequency	2.164	4	405	0.072	NS
Assumed Posture	0.799	4	405	0.526	NS
MSD prevalence level	0.593	4	405	0.668	NS
Job Prevention	0.682	4	405	0.605	NS

Table 5. ANOVA Summary Table for age groups

Variable		Sum of squares	df	Mean square	F	SIG
Equipment Design	Between groups	2.634	4	.659	1.248	0.290
	Within groups	213.717	405	.528		
	Total	216.351	409			
Psychosocial Work Aspect	Between groups	1.998	4	.499	0.682	0.605
	Within groups	296.679	405	.733		
	Total	298.676	409			
Psychosocial Personal Aspect	Between groups	2.814	4	.704	1.470	0.211
	Within groups	193.886	405	.479		
	Total	196.701	409			
Rest Break Frequency	Between groups	3.942	4	0.985	2.023	0.090
	Within groups	197.267	405	0.487		
	Total	201.209	409			
Assumed Posture	Between groups	1.693	4	.423	.610	0.656
	Within groups	281.116	405	.694		
	Total	282.809	409			
MSD Prevalence Level	Between groups	6.111	4	1.528	2.965	0.020
	Within groups	208.686	405	0.515		
	Total	214.796	409			
Job Prevention	Between groups	6.572	4	1.643	2.822	0.025
	Within groups	235.8.4	405	0.582		
	Total	242.377	409			

Influence of Age group on the level of MSD (H_3)

Individual factors like age play a significant role in causing MSD [Ming Z *et al.* (2004), Demure *et al.* (2000), Karlqvist *et al.*(1996)]. In order to check whether age plays a significant role on the perception level of the MSD causing risk variables, MSD prevalence level and Job Prevention, the following hypothesis (H_3) has been developed and tested using one way ANOVA.

years. In general, VDT users who are below 25 years and the VDT users between the age 25 – 30 years have given higher scores for the variable Psychosocial Personal Aspect. For the VDT users who are between 30 -35 years and 35 – 40 years, Work Environment has received highest score. The variable Psychosocial Personal Aspect has received the highest score of 3.89 for the VDT users of group >40 years. The variable Equipment Setup has received the least score for all the age groups except for the group >40 years. The variable

Assumed Posture has received the least score of 3.16 for the age group >40 years. The test of homogeneity was conducted and the results are given Table 4. From the results of Levene's test of homogeneity, the significance values of the variables Equipment design, Psychosocial Work Aspect, Psychosocial Personal Aspect, Rest Break Frequency, Assumed Posture, MSD prevalence level and Job Prevention are found to be greater than the criterion value of 0.05, meaning non-violation of assumption of homogeneity of variance. One way ANOVA has been performed on those variables and the results of ANOVA are given in Table 5.

The results of ANOVA show that the level of MSD prevalence level and Job Prevention differs significantly for various age groups since the value of significance is less than 0.05. The age group (35 – 40 years) perceives the higher level of MSD prevalence when compared to remaining age groups. It is noted that the age group (30 – 35 years) perceives higher degree of Job Prevention when compared to other groups. The significant variables are subjected to Tukey's Post-hoc test to identify the sub groups within the main age groups. The results of post-hoc test on variables MSD Prevalence and Job Prevention are given in Table 6 and Table 7. From the post-hoc results, it is noticed that none of the variables formed into subgroups, indicating that there exists a single group. Even though ANOVA results predicted the significant difference ($\alpha = 0.05$) at 95% confidence level for the variables MSD prevalence level and Job Prevention, among various age groups, the result of Tukey's post-hoc test proves that age has no significant influence on those variables. The results of ANOVA also suggest that no significant difference exists in the degree of Equipment Design, Psychosocial Work Aspect, Psychosocial Personal Aspect and Assumed Posture on the basis of age, because the value of significance is greater than 0.05 for these variables.

Table 6. MSD Prevalence Level

GE	N	Subset for alpha = 0.05
	1	1
<25years	84	2.0794
25-30years	131	2.1255
> 40 years	51	2.1939
30-35years	77	2.3579
35-40years	67	2.3847
Sig.		.073

Table 7. Job Prevention

AGE	N	Subset for alpha = 0.05
	1	1
<25years	84	1.5860
25-30years	131	1.6209
35-40years	67	1.7944
> 40 years	51	1.8257
30-35years	77	1.9120
Sig.		.071

However, the MSD prevalence variables Equipment Setup, Equipment Layout, and Work Environment have value of significance less than 0.05 for Levene's test violating the homogeneity of variance assumptions. Hence, the results of ANOVA may inflate the type I error with respect to these two variables.

Table 9. Results of Kruskal-Wallis test for the non parametric variables for age groups

Variable	N = 84 <25 years	N= 131 25 – 30 years	N = 77 30 – 35 years	N = 67 35 – 40 years	N = 51 > 40 years	Chi-square	SIG
	Mean Rank	Mean Rank	Mean Rank	Mean Rank	Mean Rank		
Equipment Setup	206.79	207.10	198.62	196.31	221.75	1.708	0.789
Equipment Layout	206.03	199.37	226.74	183.90	216.67	5.608	0.230
Work Environment	199.14	190.60	239.12	206.17	202.60	8.694	0.069

The non-parametric tests of Kruskal-Wallis are conducted for these variables and the results are given in Table 9. Results of Kruskal-Wallis test shows that the value of significance for Equipment Setup, Equipment Layout and Work Environment were insignificant due to age group, since value of significance is more than the criterion value of 0.05. It means the levels of Equipment Setup, Equipment Layout and Work Environment were unaffected by the age group. The two sample t-test result confirms that the female VDT users perceive the higher level of Assumed Posture than the male VDT users, meaning that the women while using computers alter their body posture in a better way when compared to men and imply that the male computer users have to use their body posture in a proper way to reduce the MSD prevalence. The result of independent samples t-test confirms that the practice of doing physical exercise shows significant difference at 90% confidence level for the variable Psychosocial Work Aspect, MSD prevalence level and Job Prevention. It is also noted that the VDT users doing physical activity are capable of learning new things through work compared to VDT users not doing physical activity and also the VDT users doing physical exercise perceive lower level of Job Prevention compared to VDT users not doing physical activity. The result of one way ANOVA shows that the level of MSD prevalence and Job Prevention differs significantly for various age groups at 0.05 level. The age group (35 – 40 years) perceives the higher level of MSD prevalence when compared to remaining age groups. It is noted that the age group (30 – 35 years) perceives higher degree of Job Prevention when compared to other groups.

Ergonomic Recommendations

The ergonomic recommendations for an individual VDT users based on the results of this study are as follows:

- The study has proved that the female VDT users alter their working posture in a better way when compared to male VDT users. It is advised as common that the VDT users have to concentrate on their body posture while doing work to avoid MSD.
- The VDT users are instructed to practice physical activity since it influence the reduction of MSD prevalence level.
- The workers of age group (35-40 years) have to take care of their health, since they are suffering the lot due to health problems relating to MSD.

Limitations

Limitation of the study concerns the use of a single source of data i.e. a questionnaire survey. Therefore, the problem of common method variance is a possibility. Validity and reliability are closely related. Researchers (Cubin and Babble, 1984, Grinnell, 1988) often use a rifle target to illustrate the relationship between these two properties of a measuring instrument. Reliability is a function of consistency of the shots, while validity is a function of shots being arranged around the bull's eye. Thus, an instrument that is valid is always reliable; an instrument that is not valid may or may not be reliable; an instrument that is not reliable is never valid (Grinell 1988). Because we cannot have validity without reliability. In social science study, it is necessary for the researcher to make trade offs between explanatory power and the scope of a research project. Although this study attempts to reasonably infer the causal relationships from the treatment to dependent variables, the ambiguity about the direction of causal influence are still regarded as potential threats to internal validity. Use of questionnaires which rely on symptoms reporting can overestimate the magnitude of the problem as presence of musculoskeletal disorders. The presence of symptoms alone may

therefore be an unstable predictor of musculoskeletal disorders in a working population (Gerr *et al.*, 1996). However medical examination is essential to establish a clinical diagnosis. The questionnaire responses are collected only from the VDT users of Chennai, TamilNadu.

Scope for future research

This study investigated both MSD critical risk factors responsible for MSD prevalence among VDT users and also this study has confirmed the positive relationship between the MSD prevalence level and Job Prevention. For future research, several research areas can be derived from this study. A generalized model can also be developed in order to suit any type of industries involving VDT work to test the prevalence of MSD. The responses can be collected from the VDT users all over India and the results made can infer the perception of VDT workers of whole India. This work can be extended to the laptop users by the future researchers. The role of teamwork in reducing stress and improving musculoskeletal health can be studied. The influence of individual factors like sleeping hours and leisure time on MSD prevalence can be studied as a further research. A main health problem associated with VDT work i.e. eye strain can also be included in the future study. To improve our understanding of the etiology of MSD symptoms among VDT users, the best way forward for the future research might be to combine multidisciplinary research efforts of observational (field based) and experimental research. The experimental research may include Visual Analogue scale (VAS) for measuring the factors. Electromyography (EMG) measurements can be done to record the muscle load to predict the musculoskeletal symptoms in various body regions. The standardized clinical examination can also be included by the future researches to record the level of MSD prevalence among VDT users.

Conclusion

The study critically examined MSD Prevalence Level issues among VDT users from the VDT user's perspectives. The two sample t-test result confirms that the female VDT users perceive the higher level of Assumed Posture than the male VDT users, meaning that the women while using computers alter their body posture in a better way when compared to men and imply that the male computer users have to use their body posture in a proper way to reduce the MSD prevalence. The result of independent samples t-test confirms that the practice of doing physical exercise shows significant difference at 90% confidence level for the variable Psychosocial Work Aspect, MSD prevalence level and Job Prevention. It is also noted that the VDT users doing physical activity are capable of learning new things through work compared to VDT users not doing physical activity and also the VDT users doing physical exercise perceive lower level of Job Prevention compared to VDT users not doing physical activity. The result of one way ANOVA shows that the level of MSD prevalence and Job Prevention differs significantly for various age groups at 0.05 level. The age group (35 – 40 years) perceives the higher level of MSD prevalence when compared to remaining age groups. It is noted that the age group (30 – 35 years) perceives higher degree of Job Prevention when compared to other groups. As a whole, the study suggests that MSDs are a common problem among those who use computer intensively. Results of this study can contribute to the development of appropriate hazard-prevention programs for workers who frequently use computers.

List of Abbreviations

VDT – Video Display Terminal
MSD – Musculoskeletal Disorder
ANOVA – Analysis of variance
SPSS – Statistical Package for Social Sciences

REFERENCES

Demure, B., Luippoid, R. S., Bigelow, C., Ali, D., Mundt, K. A., Liese, B. "Video diplay terminal workstation improvement program I: Baseline associations between musculoskeletal discomfort and ergonomic features of workstations", J. Occup Environ Med, Vol. 42, pp. 783-91.

Eltayeb, S., Bart Staal, J., Amar, A . H., Salwa, S. A. and Rob A de Bie, "Complaints of the arm, neck and shoulder among computer office workers in Sudan: a prevalence study with validation of an Arabic risk factors questionnaire", Environmental Health, Vol. 7, pp. 33, 2008.

Gerr, F., Marcus, M., Ensor, C., Kleinbaum, D., Cohen, S., Edwards, A., Gentry, E., Ortiz, D. and Monieth, C. "A Prospective Study of Computer Users: Study Design and Incidence of Musculoskeletal Symptoms and Disorders", American Journal of Industrial Medicine Vol. 41, pp. 221-235, 2002.

Karlqvist, L. K., Hagberg, M., Koster, M., Wenemark, M. and Nell, R. "Musculoskeletal symptoms among computer assisted design (CAD) operators and evaluation of a self-assessment questionnaire", Int J Occup Environ Health, Vol. 2, pp. 185-94, 1996.

Karlqvist, L., EwaWigaeus Tornqvist, Mats Hagberg, Maud Hagman and Allan Toomingas, "Self-reported working conditions of VDU operators and associations with musculoskeletal symptoms: a cross-sectional study focusing on gender differences", International Journal of Industrial Ergonomics, Vol. 30, pp. 277-294, 2002.

Klussmann, A., Hansjuergen Gebhardt, Falk Liebers and Monika A Rieger, "Musculoskeletal symptoms of the upper extremities and the neck: A cross-sectional study on prevalence and symptom-predicting factors at visual display terminal (VDT) workstations", BMC Musculoskeletal Disorders, Vol. 9, pp. 96, 2008.

Klussmann, A., Hansjuergen Gebhardt, Falk Liebers and Monika A Rieger, "Musculoskeletal symptoms of the upper extremities and the neck: A cross-sectional study on prevalence and symptom-predicting factors at visual display terminal (VDT) workstations", BMC Musculoskeletal Disorders, Vol. 9, pp. 96, 2008.

Korhonen, T., Ketola, R., Toivonen, R., Luukonen, R., Hakkanen, M. and Viikari Juntura, E. "Work related and individual predictors for incident neck pain among office employees working with video display units", Occup Environ Med, Vol. 60, pp. 475-82, 2003.

Marcus, M. and Gerr, F. "Upper extremity musculoskeletal symptoms among female office workers: associations with video display terminal use and occupational psychosocial stressors", American Journal of Industrial Medicine, Vol. 29, pp. 161-170, 1996.

Ming, Z., Narhi, M. and Sivola, J. "Neck and shoulder pain related to computer use", Pathophysiology, Vol. 11, pp. 51-6.

Raymond Dahlberg, Lena Karlqvist and Carina Bildt, Karin Nykvist, "Do work technique and musculoskeletal symptoms differ both men and women performing the same type of work tasks?" Applied Ergonomics, Vol. 35, pp. 521-529, 2004.

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