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RESEARCH ARTICLE

INFLUENCE OF INDUSTRY TYPE ON THE MUSCULOSKELETAL DISORDER PREVALENCE OF THE VIDEO DISPLAY TERMINAL (VDT) USERS

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ABSTRACT

The use of Video Display Terminal (VDT) is widespread and beneficial for improvement of work quality and productivity. Musculoskeletal symptoms or disorders in the upper extremities and neck among employees working at video display terminal workstations has been a topic in occupational health research for many years. This study has developed a MSD prevalence model suitable for computer workplaces in India. A total of about 600 questionnaires were distributed to the VDT users of production, software 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. To check whether the perception level of production, software and service industries regarding MSD causing risk factors, MSD Prevalence level and Job Prevention is different, a hypothesis H_1 was framed and tested. One way ANOVA has been conducted and the result clarifies that the perception of production, service and software industries are significantly different regarding the variable Equipment Layout and Assumed Posture. The Management of software industries has to understand the urgent need to take steps towards reducing the MSD prevalence level, since the VDT users of software industries suffers a lot compared to productions and service sectors. The production and service sectors have to accept the need of document holder and foot rest for VDT work.

INTRODUCTION

The use of Video Display Terminal (VDT) is widespread and beneficial for improvement of work quality and productivity. It is a part of daily working as well as family life for many workers. To optimize the use of VDT technology, to improve the quality of work and life, it must be done in a manner which is safe to all the workers. Medical practitioners do recommend that all the users who use computers regularly should report signs and symptoms as early as possible to prevent serious injury or permanent damage. Symptoms are discomfort, pain, fatigue, swelling, stiffness, or numbness and tingling. The common Musculoskeletal Disorder(MSD)s are carpal tunnel syndrome, carpet layers knee, De Quervains disease, epicondylitis, Hand-arm vibration syndrome, Herniated spinal disc, low back pain, Ranauds phenomenon, Rotator cuff syndrome, Sciatica, Tendinitis Tension neck syndrome, Trigger finger, etc. It is now generally acknowledged within India that MSDs affect large numbers of people across most industries and occupations have the potential to lead to long and serious disability and impose heavy costs on employers and society.

MATERIALS AND METHODS

This study has developed a MSD prevalence model suitable for computer workplaces in India. This model has been tested and validated using regression analysis. By validating the model, the relationship between the eight independent variables and the MSD prevalence level and the also the relationship between the Job Prevention and the MSD prevalence level have been established. It is now understood that by taking care of the eight independent factors in the computer workplaces, the musculoskeletal disorders prevalence level can be reduced to a great extent. The validated survey instrument has been to solicit the respondents like Design Engineers, Systems Engineers, Managers, Data Entry Personnel working in Production, Service and Software industries in order to get the perceptions of the respondents. The study was limited to industries in the state of Tamilnadu in South India. A total of about 600 questionnaires were distributed to the VDT users of production, 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 80 design engineers, 138 systems engineers, 108 managers and 84 data entry personnel. The respondents are also from various age groups, income groups and qualification groups. SPSS version 15.0 was used for all statistical computations. On considering the type of the organizations used for conducting demographic analysis, about 22.7% of the respondents belong to production type of industry, 27.6% of the respondents belong to service type of industry and 49.8% of respondents belong to software industry. This shows majority of respondents come from software industry. For examining the various issues related to MSD prevalence among VDT users using the model developed in this study, the following hypotheses have been developed. By testing

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these hypotheses the issues in reducing MSD are brought out for ergonomically designed VDT workplaces.

RESULTS AND DISCUSSION

To check whether the perception level of production, software and service industries regarding MSD causing risk factors, MSD Prevalence level and Job Prevention is different, a hypothesis H_1 was framed.

H_1: There is significant difference in perceiving the level of MSD causing risk factors, MSD prevalence level and Job Prevention among various types of industry respondents.

The three types of industries like production, software and service were selected and the respondents were grouped based on these type of industries.

Hence the Equipment Layout, Psychosocial Personal Aspect, Assumed Posture and MSD Prevalence Level variables are subjected to analysis of variance and the results are given in Table 3. However, the MSD prevalence variables Equipment Design, Equipment Setup, Work Environment, Psychosocial Work Aspect and Rest Break Frequency have value of significance less than 0.05. Thus the variance violates the homogeneity of variance assumptions. Hence, the results of ANOVA may inflate the type I error with respect to these six variables. For these variables, non-parametric tests of Kruskal-Wallis are suggested. From Table 3, the value of significance infers that out of three variables, Equipment Layout ($p < 0.01$), Assumed Posture and MSD Prevalence Level ($p < 0.05$) are found to be significant. For the significant variable Equipment Layout, the VDT users of software industry felt that they had sufficient space to allow the movement of whole forearm when compared to the remaining type of industries. And also the VDT users of software industry agree the need of foot rest and document holder

Table 1. Descriptive statistics of type of industry

Variable	*N = 93* *Production*		*N = 113* *Service*		*N = 204* *Software*	
	Mean	S.D	Mean	S.D	Mean	S.D
Equipment Design	3.4659	0.87386	3.3953	0.74741	3.6340	0.62341
Equipment Setup	3.2115	0.75467	3.3215	0.73183	3.2059	0.58450
Equipment Layout	3.1900	0.82591	3.4779	0.75708	3.5408	0.72334
Work Environment	3.5771	1.09251	3.4631	0.76821	3.8350	0.73202
Psychosocial Work Aspect	3.1828	1.00754	3.6239	0.91742	3.6029	0.69423
Psychosocial Personal Aspect	3.6774	0.75414	3.8496	0.69480	3.7059	0.65972
Rest Break Frequency	3.2079	0.80294	3.5457	0.70297	3.4690	0.62830
Assumed Posture	3.0645	0.84307	3.3422	0.83981	3.3284	0.81009

Table 1 represents the mean and standard deviation of MSD variables based on the type of industries selected for survey. Among the 410 respondents, 93 VDT users are from the Production industry, 113 VDT users are from the service industry and 204 from the software industry. Among the production industries and service industries, the variable Psychosocial Personal Aspect has received the highest score when compared to other variables. The variable Work Environment has scored the highest mean of 3.8350 among software industries. When comparing the production industries, the variable Assumed Posture has scored the least mean of 3.0645. The variable Equipment Setup has scored the least mean of 3.3215 and 3.2059 respectively among the service and software industries. One way ANOVA was performed in order to check whether different types of industry respondents perceive the level of MSD prevalence differently. Prior to conducting one way ANOVA analysis, Levene's test was performed to test the homogeneity of variables. The results of Levene's test shows that Equipment Layout, Psychosocial Personal Aspect, Assumed Posture and MSD prevalence level are greater than the criterion value of 0.05, meaning non-violation of assumption of homogeneity of variance.

Table 2. Results of Levene's test of Homogeneity of variances for type of industry groups

	Levene Statistic	df1	df2	Sig.	Remarks
Equipment Design	11.071	2	407	0.000	S
Equipment Setup	3.043	2	407	0.049	S
Equipment Layout	1.499	2	407	0.225	NS
Work Environment	13.938	2	407	0.000	S
Psychosocial Work Aspect	10.852	2	407	0.000	S
Psychosocial Personal Aspect	0.417	2	407	0.659	NS
Rest Break Frequency	3.120	2	407	0.045	S
Assumed Posture	0.016	2	407	0.984	NS
MSD Prevalence Level	0.698	2	407	0.498	NS
Job Prevention	5.489	2	407	0.004	S

in VDT workplace rather than the other two industries. Hence it is suggested that the VDT user belonging to service and production industries should understand the importance of document holder and foot rest in their workplace.

Table 3. ANOVA Summary table for type of industry groups

Variable		Sum of squares	df	Mean square	F	SIG
Equipment Layout	Between groups	8.045	2	4.022	7.021	0.001
	Within groups	233.165	407	0.573		
	Total	241.210	409			
Psychosocial Personal Aspect	Between groups	1.958	2	0.979	2.046	0.131
	Within groups	194.743	407	0.478		
	Total	196.701	409			
Assumed Posture	Between groups	5.210	2	2.605	3.819	0.023
	Within groups	277.599	407	0.682		
	Total	282.809	409			
MSD Prevalence Level	Between groups	4.126	2	2.063	3.985	0.019
	Within groups	210.670	407	.518		
	Total	214.796	409			

The VDT workers of service industries perceive the higher level of Assumed posture than the production and software VDT workers, meaning that the service industry VDT users while using computers alter their body posture in a better way when compared to other two industries. The findings of this test imply that the computer users of production and software unit have to use their body posture in a proper way to reduce the MSD prevalence. With regard to MSD prevalence, the VDT users belonging to software industries perceive the higher level of MSD prevalence rather than the production and service industries. In order to explain how much exactly the effect of industry type on MSD perception level for these three variables, a

post-hoc test was performed. It is also clearly understood that the variable Psychosocial Personal Aspect ($p > 0.05$) was found to be having insignificant difference between the types of industry.

Table 4. Results of Tukey's post-hoc test for the variable Equipment Layout for industry type groups

Industry type	N	Subset for alpha = 0.05	
		1	2
Production	93	3.1900	
Service	113		3.4779
Software	204		35408

For the variable Equipment Layout, the result of Post-hoc analysis is shown in Table 4. It is clear that the three types of Industry form two different subsets. The production type of industry formed one subset and the remaining two types of industry formed another subset. It is also clear that the significant difference in the level of Equipment Layout is due to the significant difference in the perception of VDT users of production industry and the remaining types of industry.

Table 5. Results of Tukey's post-hoc test for variable Assumed Posture for type of industry groups

Industry type	N	Subset for alpha = 0.05	
		1	*2*
Production	93	3.0645	
Service	113		3.3284
Software	204		3.3422

For the variable Assumed Posture, the result of Post-hoc analysis is shown in Table 5. It is clear that the three types of Industry form two different subsets. The production type of industry formed one subset and the remaining two types of industry formed another subset. It is also clear that the significant difference in the level of Assumed Posture is due to the significant difference in the perception of VDT users of production industry and the remaining types of industry.

Table 6. Results of Tukey's post-hoc test for the variable MSD Prevalence Level for type of industry groups

Industry type	N	Subset for alpha = 0.05	
		1	2
Service	113	2.0482	
Production	93	2.2628	2.2628
Software	204		2.2767

Table 7. Results of Kruskal-Wallis test for the variables that violated homogeneity of variance for type of industry groups

Variable	N = 93 Production	N = 113 Service	N = 204 Software	Chi-square	SIG
	Mean Rank	Mean Rank	Mean Rank		
Equipment Design	200.91	181.28	221.00	8.588	0.014
Equipment Setup	208.61	214.66	199.01	1.395	0.498
Work Environment	199.78	171.56	226.91	16.429	0.000
Psychosocial Work Aspect	168.18	219.56	214.73	12.471	0.002
Rest Break Frequency	169.56	226.78	210.10	12.875	0.002
Job Prevention	232.18	182.46	206.10	9.251	0.010

For the variable MSD Prevalence Level, post-hoc analysis is done and the results are shown in Table 6. From the post-hoc analysis, it is clear the VDT users of service industry and production industry formed subset-1 and the VDT users of production and software industry formed subset-2. The significant difference in the level of MSD Prevalence is due to the significant difference in perception of VDT users belonging to service industry and software industry. Kruskal Wallis test (non-parametric) was performed for the variables Equipment Design, Equipment Setup, Work Environment, Psychosocial Work Aspect, Rest Break Frequency and Job Prevention since they violated the homogeneity of variance test and the results are given in Table 7. Results of Kruskal-Wallis test shows that the value of significance for Equipment Setup was insignificant due to industry type group, since value of significance is more than the criterion value of 0.05. It means the levels of Equipment Setup was unaffected by the industry type group. The significant variables from Kruskal-Wallis test are Equipment Design ($P < 0.05$), Work Environment ($P < 0.001$), Psychosocial Work Aspect ($P < 0.01$) and Rest Break Frequency ($P < 0.01$) and Mann Whitney test was performed on these variables as a post-hoc test.

Table 8. Result of Post-hoc Test (Mann – Whitney) Tests for groups Production and Service type of industry

Variable	Mann Whitney U	Wilcoxon W	Z	Asymp. Sig.
Equipment Design	4834.500	11275.500	-0.996	0.319
Work Environment	4721.500	11162.500	-1.261	0.207
Psychosocial Work Aspect	4009.000	8380.000	-2.961	0.003
Rest Break Frequency	3856.000	8227.000	-3.327	0.001
Job Prevention	4008.500	10449.500	-2.981	0.003

Table 8 shows the result of post hoc procedures using Mann-Whitney test for the variables Equipment Design, Work Environment, Psychosocial Work Aspect and Rest Break Frequency for comparison between type of industry for Production group and Service group. It is clear from the significant values that there is significant difference between these groups on variable Psychosocial Work Aspect ($p< 0.01$) and Rest Break Frequency ($p < 0.01$) and Job Prevention ($p < 0.01$). There is no significant difference in the level of Equipment Design and Work Environment for the pair of type of industry including production and service type.

Table 9. Result of Post-hoc Test (Mann – Whitney) Tests for groups Production type of industry and Software type of industry

Variable	Mann Whitney U	Wilcoxon W	Z	Asymp. Sig.
Equipment Design	8639.500	13010.500	-1.253	0.210
Work Environment	8421.000	12792.000	-1.566	0.117
Psychosocial Work Aspect	7261.000	11632.000	-3.305	0.001
Rest Break Frequency	7542.000	11913.000	-2.875	0.004
Job Prevention	8251.000	29161.000	-1.817	0.069

Table 9 shows the result of post hoc procedures using Mann-Whitney test for the variables Equipment Design, Provision of Training, Work Environment, Psychosocial Work Aspect and Rest Break Frequency for comparison between type of industry for Production group and Software group. It is clear from the significant values that there is significant difference between these groups on variable Psychosocial Work Aspect ($p < 0.01$), Rest Break Frequency ($p < 0.01$). While comparing Production and Software group, there is insignificant difference in the level of Equipment Design, Work Environment and Job Prevention.

Table 10. Result of Post-hoc Test (Mann – Whitney) Tests for groups Service and Software type of industry

Variable	Mann Whitney U	Wilcoxon W	Z	Asymp. Sig.
Equipment Design	9209.500	15650.500	-3.011	0.003
Work Environment	8223.500	14664.500	-4.274	0.000
Psychosocial Work Aspect	11183.000	32093.000	-0.448	0.654
Rest Break Frequency	10520.000	31430.000	-1.310	0.190
Job Prevention	10168.000	16609.000	-1.767	0.077

Table 10 shows the result of post hoc procedures using Mann-Whitney test for the variables Equipment Design, Work Environment, Psychosocial Work Aspect and Rest Break Frequency in comparison between type of industry for Service group and Software group. It is clear from the significant values that there is significant difference between these groups on variable Equipment Design ($p < 0.01$) and Work Environment ($p < 0.01$). While comparing Service and Software group, there is insignificant difference in the level of Psychosocial Work Aspect, Rest Break Frequency and Job Prevention.

Conclusion

This research work has developed a MSD risk factor model to test the prevalence of MSD among VDT users. The instrument framed in this study is an easy assessment of the MSD symptoms among VDT users. The study has established the relationship between the ergonomic risk factors and the prevalence of MSD among the VDT users. The study has established the relationship between the prevalence of MSD and Job Prevention. The study has brought out various insights of ergonomic problems leading to the prevalence of MSD, which will help the VDT users to overcome the MSD related issues. Thus, the present research has contributed to the literature on the ergonomic field.

Recommendations

The Ergonomic recommendations for the management from the results of this study are i) The Management of software industries has to understand the urgent need to take steps towards reducing the MSD prevalence level, since the VDT users of software industries suffers a lot compared to productions and service sectors and 2)The production and service sectors has to accept the need of document holder and foot rest for VDT work. The Ergonomic Recommendations for an individual VDT users based on the results of this study are that the VDT workers of production and software industries are instructed to change their working posture to overcome MSD problem.

Limitations of the study

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 tradeoffs 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. 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.

REFERENCES

Aaras, A, Horgen, G, Bjorset, H. H., RoO and Walsoe, H. 2001 "Musculoskeletal visual and psychosocial stress in VDU operators before and after multidisciplinary ergonomic interventions. A 6 years prospective study - Part II", Applied Ergonomics, Vol. 32, pp. 559-571.

Andy, P. F., 2005, "Discovering statistics using SPSS' Edition 2, Sage Publications", p.612.

Bergqvist, U., Wolgast, E., Nilsson, B., Voss, M. 1995 "Musculoskeletal disorders among visual display terminal workers: individual, ergonomic, and work organizational factors". Ergonomics; Vol. 38, pp. 763-776.

Bostrom, M., Lotta Dellve, Sara Thomee and Mats Hagberg, 2008 "Risk factors for generally reduced productivity – a prospective cohort study of young adults with neck or upper-extremity musculoskeletal symptoms", Scand J Work Environ Health, Vol. 34(2), pp. 120-132.

Cagnie, B., Danneels, L., Van, D., Tiggelen, V., De loose and Cambier, D. 2007 "Individual and work related risk factors for neck pain among office workers - A cross sectional study", European Spine Journal, Vol. 16, pp. 679-686,.

Dinesh Bhanderi, S. K., Choundhary, Lata Parmar and Vikas Doshi, 2008 "A Study of Occurrence of Musculoskeletal Discomfort in Computer Operators", Indian Journal of Community Medicine, Vol. 33, No.1.

Eltayeb, S., Bart Staal, J., Amar, A . H., Salwa, S. A. and Rob A de Bie, 2008 "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.

Gerr, F., Marcus, M., Ensor, C., Kleinbaum, D., Cohen, S., Edwards, A., Gentry, E., Ortiz, D. and Monieth, C. 2002 "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.

Grandjean, E., Hunting, W. and Pidermann, M. 1983 "VDT workstation design: Preferred settings and their effects", Human Factors, Vol. 25, pp. 161-175.

Karlqvist, L., EwaWigaeus Tornqvist, Mats Hagberg, Maud Hagman and Allan Toomingas, 2002 "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.

Raymond Dahlberg, Lena Karlqvist and Carina Bildt, Karin Nykvist, 2004 "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.

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