

Correlation Analysis Between Ergonomics and Stress at the Workplace

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Abstract: The occurrence of work stress is quite rampant in manufacturing organizations which involved blue collar workers. The literature revealed that poor ergonomics workstation environment is among the major contributor to the work stress problems. Thus, this study aims to examine the relationship between ergonomics workstation factors and the work stress outcomes. Five hundred samples of production operators were derived from eleven manufacturing electronics organizations which were registered with Malaysian International Chamber of Commerce and Industry (MICCI) by using proportionate stratified random sampling. Questionnaires were used for the data collections process. The Pearson correlation analysis shows that all ergonomics workstation factors have high significant correlation with the work stress outcomes.

Key words: Ergonomics, stress, workstation, production operators, MICCI, contributor

INTRODUCTION

Awareness on the work process and technology forces towards human beings brought to the continuous research on ergonomic concept and stress at the workplace. In many countries, the ergonomic application level and the awareness about its importance are still low even though its impact is so huge on the occupational safety and health (Shikdar and Sawaqed, 2003). An effective ergonomic process can minimize stress at the workplace (Tarcan *et al.*, 2004). An ergonomically designed workstation is one of the strategies to use to minimize work stress (Jamieson and Graves, 1998). Stress is an individual's feedback towards his/her environment (Piko, 2006). An individual could experience stress if he/she perceives negatively towards his/her work environment. A physical workstation environment includes many aspects like humidity system, lighting, work area design, acoustic system, etc. Research shows that workstation environment that characterized by extreme heat, dim lighting and congested works area can be associated to stress at the workplace (Sutton and Rafaeli, 1987). So, in the process of designing a workstation, ergonomic factors must be taken into consideration (Yeow and Sen, 2003). The failure to implement the ergonomic principles at the workplaces could lead to emotional depression, physical exhaustive, productivity and products quality declining (Shikdar and Sawaqed, 2003).

Today's workplace stress level is greater than what was experienced by the past generation (Minter, 1999).

This situation, always occurs in the manufacturing industries where production operators have to work in shift system where latter leads to chronic stress problem. In such situation, added by low ergonomic awareness, studies on ergonomic would really help the sector to understand the principles lie underneath it (Yeow and Sen, 2003). Malaysia as a developing country that relies on manufacturing industries faces similar phenomenon. The manufacturing sector reported the highest number of industrial accidents from 1999-2003 compared to other industries. The blue collar workers are exposed more to the health risk related to work as compared to the white collar and professional workers (Cooper and Williams, 1991). The main issues of the blue collar workers are exposure to chemical substances, dust, psychological work stress and ergonomics problem (Liang and Xiang, 2004). Besides that, the blue collar workers also are exposed to noise, air pollution, physical burden, unsatisfactory shiftwork, long working period, poor social interaction at the workplace and bad relationship with the superiors (McLean, 1974). Thus, evaluation on stress among the blue collar workers is really significant.

All the negative forces and health issues face by individuals and organizations show us that works stress must be minimized. Based on this reason, this study is undertaken since its contributions are significant and able to produce more productive and competitive manpower. Moreover, literatures shown that study in this field are very few. For example, information on ergonomic application in developing countries where the knowledge and awareness towards the importance of ergonomic are

still low is hard to be obtained even though ergonomic is a very interesting disciplines to study (Shahnavaz, 1996).

This research's main objective is to study the relationship between factors of ergonomic workstation with work stress. It is also undertaken to examine the most significant factor in the ergonomic workstation variables that influences the stress level in organizations.

MATERIALS AND METHODS

Sample: The population of this study is 51,000 production operators from the multinational electronic manufacturing companies that are registered with Malaysian International Chamber of Commerce and Industry (MICCI). The sample size is determined by using Krejcie and Morgan (1970)'s table. Since, the population of this study is big, the researchers decided to use 500 samples in order to minimize sampling error. Samples selection was started as the researchers sent out letters to the companies that registered with MICCI seeking for their consent to use their employees as the respondents of the study. Out of 33 companies, 11 organizations agreed to participate. To determine the number of respondents to be derived from each company, the researchers used the proportionate stratified random sampling technique.

Data was collected via questionnaire distributions. The instrument was adapted from previous related research and there were also new questions developed by the researchers. Every item uses 5-point Likert scales, i.e.:

- Strictly disagree
- Disagree
- Not sure
- Agree
- Strictly agree

Part I of the questionnaire contains items related to ergonomic workstation factors in the organizations. It consists of human variables body posture and health; machine variables tools suitability and maintenance; work area variables chair and work area design and environment variables humidity, acoustic, lighting, shiftwork and working hour. All items are adapted from Brief and Aldag (1976), Tate *et al.* (1997), Hedge and Erickson (1997), Miles (2000), Hildebrandt *et al.* (2001) and Tarcan *et al.* (2004).

In Part II, the questionnaire lists the physiological (somatic complaints), psychological (fatigue and job dissatisfaction) and behavioral (intention to quit) elements. Modifications on the items are based on Karasek (1979) and Ekman and Ehrenberg (2002).

Table 1: Collinearity statistics

Model 1	Collinearity statistics**	
	Tolerance	VIF
Constant		
Body posture	0.770	1.299
Health	0.767	1.304
Tools	0.832	1.203
Chair	0.847	1.181
Work area	0.826	1.211
Humidity	0.845	1.183
Acoustic	0.858	1.165
Lighting	0.875	1.143
Shiftwork	0.858	1.165
Working hour	0.814	1.229

**Statistics shows the collinearity analysis after the factor analysis being carried out

Table 2: Loading for each construct (construct validity) and reliability

Constructs	Loading	α
Body postures	0.38-0.65	0.79
Health	0.42-0.68	0.73
Tools	0.41-0.67	0.86
Working chair	0.70-0.81	0.84
Work area design	0.48-0.57	0.70
Humidity	0.31-0.67	0.78
Noise	0.48-0.57	0.71
Lighting	0.48-0.74	0.75
Shiftwork	0.58-0.72	0.75
Working hours	0.56-0.71	0.77
Somatic complaints	0.43-0.68	0.85
Job dissatisfaction	0.50-0.83	0.84
Intention to quit	0.50-0.78	0.84

Loading based on varimax rotation

EDA process was performed to the actual data by checking the missing data and outlier. This process also validated the assumptions of multivariate analysis like linearity, homocedasticity and multicollinearity. Table 1 shows that the multicollinearity problem does not appear in the independent variables of the research. The tolerance value showed that all independent variables reach a value >0.760 and the VIF approaching 1. The condition index and eigenvalue also supports this circumstance where none of the independent variables' eigenvalues approaches 0.

The condition index shows only the working hour variable has value >30. However, it is acceptable because its tolerance and VIF values are 0.814 and 1.229, respectively. These two statistical approaches are sufficient to confirm that the multicollinearity problem does not exist.

Once, the EDA was performed and the multivariate assumptions were fulfilled, the researchers analyzed the validity (loading factor) and reliability (cronbach alpha) of every variable. The results are shown in Table 2. From Table 2, it could be concluded that the instrument used is valid and reliable.

RESULTS AND DISCUSSION

Table 3 shows the detailed analysis on the respondents' backgrounds. Majority of the respondents are women (81.6%) and it is normal as majority of manufacturing operator job holders are women.

Correlations analysis on ergonomics workstation factors and work stress: Table 4 shows the ergonomics workstation factors relationship with the stress outcomes

Table 3: Respondents' demographic information

Repondents	Frequency	Percentage
Gender		
Male	92	18.4
Female	408	81.6
Age (Years)		
<25	188	37.6
26-30	132	26.4
31-35	64	12.8
36-40	53	10.6
41-45	49	9.8
>46	14	2.8
Education attainment		
LCE/SRP/PMR	96	19.2
MCE/SPM	316	63.2
HSC/STPM	41	8.2
Diploma	47	9.4
Monthly gross salary		
<RM1000	332	66.4
RM1000-1500	146	29.2
RM1501-2000	19	3.8
RM2001-2500	3	0.6
Shiftwork		
Yes	421	84.2
No	79	15.8
Works shift schedule		
Morning and evening	31	7.4
Morning and night	123	29.2
Morning, evening and night	91	21.6
Evening and night	3	0.7
Night	173	41.1
Total of working hour per week		
36-45 h	29	5.8
46-55 h	323	64.6
56-65 h	130	26.0
66-75 h	13	2.6
76-85 h	5	1.0

($p < 0.01$). Among the factors, the health factor has the strongest relationship with the stress outcomes at the workplace ($r = 0.710$). It is followed by humidity ($r = 0.365$), working hour ($r = 0.314$), body postures aspect ($r = 0.306$), work area design ($r = 0.258$), shiftwork ($r = 0.217$), lighting ($r = 0.211$), tools ($r = 0.208$), chair ($r = 0.188$) and acoustic system ($r = 0.165$).

The outcome of Pearson correlation analysis shows that the health factor has the strongest relationship with the stress outcomes at the workplace. This finding aligns with Wickens *et al.* (2004) where they stressed that the employees' health level is closely related to the stress outcomes at the workplace. It is followed by humidity, working hour, body postures aspect, work area design, shiftwork, lighting, tools, chair and acoustic system. This finding supports Tarcan *et al.* (2004) who stated that ergonomic workstation could minimize the stress problem at the workplace.

In addition to this statement, Clark (2002) and Leaman (1995) also view that the extreme organizational temperature could minimize the stress outcomes at the workplace. Shiftwork, also must be given attention as several literatures pointed out that it relates closely to work stress at the workplace (Costa, 2003; Kundi, 2003). The finding also supports Ahasan (2002), Clark (2002) and Tucker (2003). They make a point that long working hour without proper rest would increase depression and lead to stress.

Two factors of the ergonomic workstation have weakens relationship with the stress outcomes at the workplace, i.e., chair and acoustic factors. This finding contradicts with Beckett (1995) and Aaras *et al.* (2001) who point that ergonomic chairs and comfortable work area could minimize work. This is due to the fact that production operators' jobs need them to move speedily. This situation makes them ignore the comfortness in their working area and chairs. Thus, chairs and work area that meet their minimum needs are more than sufficient.

Table 4: Correlations between independent variables and dependent variables

Variables	1	2	3	4	5	6	7	8	9	10	11
Stress	1										
Body postures	0.306**	1									
Health	0.710**	0.375**	1								
Tools	0.208**	0.230**	0.172**	1							
Chair	0.188**	0.293**	0.154**	0.209**	1						
Work area	0.258**	0.111*	0.108*	0.243**	0.160**	1					
Humidity	0.365**	0.231**	0.299**	0.162**	0.127**	0.247**	1				
Acoustics	0.165**	0.132**	0.144**	0.196**	0.241**	0.289**	0.119**	1			
Lighting	0.211**	0.055	0.181**	0.219**	0.148**	0.188**	0.102*	0.150**	1		
Shiftwork	0.217**	0.017	0.099*	0.166**	0.113*	0.111*	0.103*	0.098*	0.220**	1	
Working hours	0.314**	0.102*	0.235**	0.228**	0.138**	0.191**	0.164**	0.151**	0.183**	0.325**	1

n = 500; * $p < 0.05$ (2-tailed); ** $p < 0.01$ (2-tailed)

CONCLUSION

Overall, the findings of this research are important to organizations which are in need of healthy and competent human resources in line with the aspiration of a dynamic human capital development.

IMPLICATIONS

Lastly, this research has implications to the organizational management. Among all, the management must evaluate every factor of the workstation in the research because it could minimize the negative effect of work stress. Detail assessment should be done to human resources' health factors, humidity, working hour, body postures aspect, work area design, shiftwork, lighting, tools, chair and acoustic system as all these factors are correlated significantly with the stress outcomes at the workplace ($p < 0.01$).

REFERENCES

- Aaras, A., G. Horgen, H.H. Bjorset, O. Ro and H. Walsoe, 2001. Musculoskeletal, visual and psychosocial stress in VDU operators before and after multidisciplinary ergonomic interventions. A 6 years prospective study-part II. *Applied Ergon.*, 32: 559-571.
- Ahasan, R., 2002. Human adaptation to shift work in improving health, safety and productivity-some recommendations. *Work Study*, 51: 9-16.
- Beckett, R., 1995. Are you sitting comfortably?. *Facilities*, 13: 26-27.
- Brief, A.P. and R.J. Aldag, 1976. Correlates of role indices. *J. Applied Psychol.*, 61: 468-472.
- Clark, J., 2002. *Stress: A Management Guide*. Spiro Press, USA., ISBN-13: 9781904298298, Pages: 188.
- Cooper, C.L. and J. Williams, 1991. A validation study of the OSI on a blue-collar sample. *Stress Med.*, 7: 109-112.
- Costa, G., 2003. Factors influencing health of workers and tolerance to shift work. *Theor. Issues Ergon. Sci.*, 4: 263-288.
- Ekman, I. and A. Ehrenberg, 2002. Fatigue in chronic heart failure: Does gender make a difference?. *Eur. J. Cardiovasc. Nursing*, 1: 77-82.
- Hedge, A. and W.A. Erickson, 1997. A study of indoor environment and sick building syndrome complaints in air-conditioned offices: Benchmarks for facility performance. *Int. J. Facil. Manage.*, 1: 185-192.
- Hildebrandt, V.H., P.M. Bongers, F.J.H. van Dijk, H.C.G. Kemper and J. Dul, 2001. Dutch musculoskeletal questionnaire: Description and basic qualities. *Ergonomics*, 44: 1038-1055.
- Jamieson, D.W. and R.J. Graves, 1998. Determining Ergonomic Factors in Stress from Work Demands of Nurses. In: *Contemporary Ergonomics*, Hanson, M.A. (Ed.). Taylor and Francis, London, UK., pp: 162-166.
- Karasek, R.A., 1979. Job demands, job decision latitude and mental strain: Implications for job redesign. *Admin. Sci. Q.*, 24: 285-307.
- Krejcie, R.V. and D.W. Morgan, 1970. Determining sample size for research activities. *Educ. Psychol. Measur.*, 30: 607-610.
- Kundi, M., 2003. Ergonomic criteria for the evaluation of shift schedules. *Theor. Issues Ergon. Sci.*, 4: 302-318.
- Leaman, A., 1995. Dissatisfaction and office productivity. *Facilities*, 13: 13-19.
- Liang, Y. and Q. Xiang, 2004. Occupational health services in PR China. *Toxicology*, 198: 45-54.
- McLean, A.A., 1974. *Occupational Stress*. Thomas Publ., Springfield, IL., USA.
- Miles, A.K., 2000. The ergonomics and organizational stress relationship. Ph.D. Thesis, The Florida State University, USA.
- Minter, S.G., 1999. Too much stress?. *Occup. Hazards*, 61: 49-52.
- Piko, B.F., 2006. Burnout, role conflict, job satisfaction and psychosocial health among hungarian health care staff: A questionnaire survey. *Int. J. Nursing Stud.*, 43: 311-318.
- Shahnavaz, H., 1996. Making ergonomics a world-wide concept. *Ergonomics*, 39: 1391-1402.
- Shikdar, A.A. and N.M. Sawaqed, 2003. Worker productivity and occupational health and safety issues in selected industries. *Comput. Ind. Eng.*, 45: 563-572.
- Sutton, R.I. and A. Rafaeli, 1987. Characteristics of work stations as potential occupational stressors. *Acad. Manage. J.*, 30: 260-276.
- Tarcan, E., E.S. Varol and M. Ates, 2004. A qualitative study of facilities and their environmental performance management of environmental quality. *Manage. Environ. Qual: Int. J.*, 15: 154-173.
- Tate, U., A. Whatley and M. Clugston, 1997. Sources and outcomes of job tension: A three-nation study. *Int. J. Manage.*, 3: 350-358.
- Tucker, P., 2003. The impact of rest breaks upon accident risk, fatigue and performance: A review. *Work Stress: Int. J. Work Health Organiz.*, 17: 123-137.
- Wickens, C.D., J.D. Lee, Y. Liu and S.E. Gordon-Becker, 2004. *An Introduction to Human Factors Engineering*. 2nd Edn., Pearson Education, Upper Saddle-River.
- Yeow, P.H.P. and R.N. Sen, 2003. Quality productivity, occupational health and safety and cost effectiveness of ergonomic improvements in the test workstations of an electronic factory. *Int. J. Ind. Ergon.*, 32: 147-163.