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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. 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.

Keywords: Ergonomics, Stress, Workstation, Production Operators.

1. 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 & 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 & 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 and 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 & Rafaeli, 1987). So, in the process of designing a workstation, ergonomic factors must be taken into consideration (Yeow & Nath Sen, 2003; Mohamad Khan *et al*., 2005). The failure to implement the ergonomic principles at the workplaces could lead to emotional depression, physical exhaustive, productivity and products quality declining (Shikdar & 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 & Nath 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 to 2003 compared to other industries (Mohamad Khan *et al*., 2005). The blue collar workers are exposed more to the health risk related to work as compared to the white collar and professional workers (Cooper & Williams, 1991). The main issues of the blue collar workers are exposure to chemical substances, dust, psychological work stress and ergonomics problem (Liang & 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.

2. Methodology

2.1 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's (1970) 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. (1) strictly disagree, (2) disagree, (3) not sure, (4) agree and (5) 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 & Ehrenberg (2002).

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 more than 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 more than 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.

Table 1: Collinearity Statistics**

Model		Collinearity Statistics	
		Tolerance	**VIF**
1	(Constant)		
	Body posture	.770	1.299
	Health	.767	1.304
	Tools	.832	1.203
	Chair	.847	1.181
	Work area	.826	1.211
	Humidity	.845	1.183
	Acoustic	.858	1.165
	Lighting	.875	1.143
	Shiftwork	.858	1.165

Working hour	.814	1.229

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

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 the table, it could be concluded that the instrument used is valid and reliable.

Table 2: Loading for Each Construct (Construct Validity) and Reliability

Constructs	**Loading**	**α**
Body postures	.38 – .65	.79
Health	.42 – .68	.73
Tools	.41 – .67	.86
Working chair	.70 – .81	.84
Work area design	.48 – .57	.70
Humidity	.31 – .67	.78
Noise	.48 – .57	.71
Lighting	.48 – .74	.75
Shiftwork	.58 – .72	.75
Working hours	.56 – .71	.77
Somatic complaints	.43 – .68	.85
Job dissatisfaction	.50 – .83	.84
Intention to quit	.50 – .78	.84

Loading based on varimax rotation

3. Results

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 jobholders are women.

3.1 Correlations analysis on ergonomics workstation factors and work stress

Table 3 exhibits the ergonomics workstation factors relationship with the stress outcomes ($p<0.01$). 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 ($r = 0.165$).

Table 2: Respondents' Demographic Information

	Frequency	%
Gender		
Male	92	18.4
Female	408	81.6
Age		
< 25 years old	188	37.6
26 – 30 years old	132	26.4
31 – 35 years old	64	12.8
36 – 40 years old	53	10.6
41 – 45 years old	49	9.8
> 46 years old	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 – RM1500	146	29.2
RM1501 – RM2000	19	3.8
RM2001 – RM2500	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 hours – 45 hours	29	5.8
46 hours – 55 hours	323	64.6
56 hours – 65 hours	130	26.0
66 hours – 75 hours	13	2.6
76 hours – 85 hours	5	1.0

Table 3: Correlations between Independent Variables and Dependent Variables

	1	2	3	4	5	6	7	8	9	10	11
1. Stress	1										
2.Body postures	.306**	1									
3. Health	.710**	.375**	1								
4. Tools	.208**	.230**	.172**	1							
5. Chair	.188**	.293**	.154**	.209**	1						
6. Work area	.258**	.111*	.108*	.243**	.160**	1					
7. Humidity	.365**	.231**	.299**	.162**	.127**	.247**	1				
8. Acoustics	.165**	.132**	.144**	.196**	.241**	.289**	.119**	1			
9. Lighting	.211**	.055	.181**	.219**	.148**	.188**	.102*	.150**	1		
10.Shiftwork	.217**	.017	.099*	.166**	.113*	.111*	.103*	.098*	.220**	1	
11.Working hours	.314**	.102*	.235**	.228**	.138**	.191**	.164**	.151**	.183**	.325**	1

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

4. Discussion and Conclusion

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.

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 ($p<0.01$).

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