Physical Discomfort Caused by the Computer Workstation Accessories

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Abstract: In nature of office environment, most of workers are suffering Musculoskeletal Disorder (MSD) such as neck pain, carpal pain and slip disc. The purpose of this study is to identify the computer workstation accessories, which can affect the physical discomfort. This study was conducted at one of social security agency in Kuala Lumpur, Malaysia. Data was obtained by distributed an adopted questionnaire. The total number of population is 290 workers and the sample size are 165 workers. The result was analysed by using reliability analysis, frequency analysis and multiple regression analysis. Result shows the value of R2 is 65.5% means the variance in physical discomfort can be predicted from the variables of chair design, keyboard and mouse, work surface, breaks time and support accessories. The F-value is 60.432 and its significant is (Sig. = 0.000). It indicates that computer workstation accessories have a moderate association with the physical discomfort of workers. The result also at significant (Sig.=0.00) for keyboard and mouse, break and support accessories as compared to other variable. It indicate these accessories affecting physical discomfort. For the recommendation, guideline or good practice of using computer workstation accessories and enough accessories should be provided in order to avoid a physical discomfort. The employees also can be trained in ergonomic practice as to comfortable use of keyboard and mouse. The body part discomfort levels also could be attributed to rest breaks. For future research, others computer workstation accessories desk and laptop also can be used for the future research.

1 INTRODUCTION

Ergonomics aims at designing the workplace so that it will fit the needs and physical capabilities of employees, instead of physically forcing the worker's body to fit the job (Ikonne, 2014). The efficiency of human–computer interaction, comfort, health, and the user's safety can be improved by applying ergonomic principles. Moreover, ergonomics covers all aspects of a job or tasks. Wrong ergonomics may create physical stresses on joints, muscles, nerves, tendons and bones to the environmental factors, which can affect hearing, vision, and general comfort and health. When there is a mismatch between the physical requirements of the job and the physical capacity of the worker, work- related musculoskeletal disorders (WMSDs) can result. This mismatch is also known as ergonomic hazard.

An ergonomic hazard is a physical factor within the environment that harms the musculoskeletal system. An ergonomic hazard includes forceful exertions, repetitive movement and awkward posture. One method of solving an ergonomic problem or complaint is to adjust the employee's workstation. The employees always have to deal with computer everyday to complete their task from time to time, as well as having to plan to shown condusive working posture. Good ergonomic may influence job satisfaction, which may derive from a wide range of issues in the workplace. If the physical work environment is poorly designed, it could hinder or slow down the employee's performance in the workspace, and this could eventually lead to frustration, which, in turn, affects physical discomfort.

This study was conducted at one of social security agency office in Kuala Lumpur. The workers spend

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most of the day by sitting behind a computer in performing their job. There is several current practices of good ergonomic that help the workers to avoid many physical discomfort specifically at the computer workstation. These practices may include providing relevant education, adhering to ergonomics standard, providing adequate tool and equipment, proper ventilation and humidity.

However, based on cases reported, most of the workers are suffering on neck pain, slip disk and Carpal Tunnel Syndrome (CTS) pain. This is due to poor body posture that affected physical discomfort. Most workers who suffering the pain has to undergo physiotherapy which take longer time to recover. This may cause their work will be affected in term of productivity, quality and performance of workers.

The objective of this study is to determine the which computer workstation accessories can caused a physical discomfort. The computer workstation accessories involved were chair design, keyboard and mouse, work surface, break and support accessories. By designing a job to allow for good posture, less exertion, fewer motions and better heights and reaches, the workstation becomes more efficient. The workers will be more perform with the particular task and job without feel occupational illness. Healthy employees are most valuable asset, creating and fostering the safety and health culture. The company also will lead to better human performance for the organization.

2 LITERATURE REVIEW

2.1 Physical Discomfort

Discomfort is a feeling of being uncomfortable physically or mentally. According to Karakolis & Callaghan (2014) discomfort is seen as an unpleasant state of the human body in reaction to its physical environment. Many ergonomic problems associated with computer workstations occur in the shoulder, elbow, forearm, wrist, and hand. Continuous working on the computer may expose soft tissues in these areas to repetition, awkward postures, and forceful exertions, especially if the workstation is not set up properly. On a longer term, the use of hand tools can also cause musculoskeletal disorders (Kuijt-Evers et., 2004). The past researchers found that physical aspects such as ache, circulation legs cut off, cramped, fatigue, pressing, stiff, unsupported, etc. underlie discomfort, while comfort was related to relaxation and well-being with underlying descriptors such as: at ease, calm, content, luxurious, pleasant, supported and warm (Kuijt-Evers, et al., 2004).

A working position of the workstation was a combination of positions of each part, namely seat, backrest, footrest and monitor post. Working position at workplace must enough provided by organization. The division of labour in sectors and the consequent "obligation" of the worker to perform a task repetitively during the work day or stay for long periods of time in a posture causes pain, physical discomfort and musculoskeletal disorders (Moreira-Silva et al., 2016).

2.2 Chair Design

A higher physical effort is required in standing and working as opposed to sitting, but sitting postures put a lot more stress on the lumbar area than standing or working (CCOHS, 2005). Therefore, effort should be made to support this region of the body whenever sitting for an extended period of time.

An office chair design or desk chair is a type of chair that is designed for use at a desk in an office. It is usually a swivel chair, with a set of wheels for mobility and adjustable height (Odo, 2012). An ergonomic chair should allow for change in supported postures, should be easily adjustable and be capable of supporting the user in neutral posture among others. A correctly adjusted chair has been shown to significantly reduce neck pain in seated workers (Rempel et al., 2006). This is because adjustability chair can be used for every worker that have different type of body size. A prospective study of computer user's postural risk factors for Musculoskeletal Symptoms and Disorders (MSSD) showed that MSSD may be reduced by encouraging specific seated postures (Jefferelli et al., 2016).

2.3 Keyboard and Mouse

Keyboard and mouse is one the factors that can contribute physical discomfort among workers. According to Gerr, Monteilh & Marcus, (2006) repetitive keyboard and mouse use places workers at risk of muscle, tendon, and nerve damage. Repetitive work and computer station were risk factors for musculoskeletal pain. Individual working techniques and workstation layout, such as the keyboard placed too highly and increased neck flexion, were found to be an important consideration in the causality of tension neck syndrome (Saggu, 2015).

From research by Van Vledder (2015), found that poor placement of the keyboard can increase the neck pain. Keyboard placement should be lower than

elbow level to prevent to increase neck pain. A well-designed mouse should not cause undue pressure on the wrist and forearm muscles. A large bulky mouse may keep the wrist continuously bent at an uncomfortable angle.

2.4 Work Surface

Work surface refers to the L-shaped work surface angles across the corner, making a seating area and a space deep enough for the computer keyboard and monitor. Work surface also play important role to prevent physical discomfort among worker at organization. It can cause a neck pain and back pain.

Computer workstations are designed to be attractive and to provide an ergonomic interface with the computer operator for maintaining optimum proficiency over prolonged intervals of time without fatigue or physical discomfort. The workstation typically includes a monitor positioned on a shelf within an open console for viewing above, at or below the operator's eye level, and a keyboard located in front of the monitor on a separate shelf.

2.5 Breaks

A breaks at work is a period of time during a shift in which an employee is allowed to take time off from his or her job. Workers must take a break within 8 hours per day in order to maintain quality and performance of work. This obviously contributed to health problems as employees continued to be in a fixed posture for prolonged periods. According to Rahman, Awalludin, Masood, Hassan (2017), regular rest breaks reduced the neck, shoulder and low back discomfort among computer workers.

2.6 Support Accessories

Support accessories can be classified as document ramp, headphone, speakerphone and others. Accessories must be placed within a comfortable reach of both hands so that there is no unnecessary twisting of any part of the body (Yuanbo, 2004). A document holder can relieve an employee from unnecessary neck movement and poor posture. Document holders that are important for minimizing back and neck bending, especially for those who spend a lot of time on data entry (Shikdar & Al-Kindi, 2007).

Placement of telephone must be closed to computer on side of dominant hand to avoid repeated reaching. This is because keep the telephone cord out of working areas can avoid create a tripping hazard.

Based on the discussion of the literature review, we have constructed a conceptual framework as shown in Figure 1. The diagram in Figure 1 depicted five (5) computer "Workstation Accessories" as the independent variable such as chair design, keyboard and mouse, work surface, break-time and support accessories. Physical discomfort is considered as the dependent variable.

Based on review of the literature, the following theoretical framework is created as shown in Figure 1.

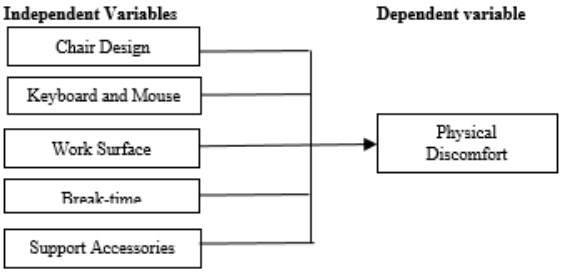

Figure 1: Theoretical Framework

The following hypothesis is developed as stated below:

H1: There is a significant influence between chair design and physical discomfort.

H2: There is a significant influence between keyboard and mouse and physical discomfort.

H3: There is a significant influence between work surface and physical discomfort.

H4: There is a significant influence between breaks and physical discomfort.

H5: There is a significant influence between support accessories and physical discomfort.

3 METHODOLOGY

The population of this study is 290 workers. Based from the Krejcie and Morgan (1970), the sample size of this study is 165 respondents. The sampling technique was convenience sampling because convenient accessibility. This sampling design is simplicity of sampling and the ease of research.

Questionnaire was used as a way to collect the primary data. The questionnaire was adopted from Guideline for Preventing Muscoloskeletal Injuries, Worksafe BC (2010). The data study was gathered

only for once over a period in data collection. The type of question used in questionnaire is closed-ended questionnaires. The category scale used was a nominal scale and a five-point Likert Scale. Collected data from questionnaire was analyzed by using Statistical Package for Social Science (SPSS) version 23 for Windows.

4 DATA FINDINGS AND ANALYSIS

4.1 Frequency Analysis

The demographic profile of the respondents consists of gender, age, education level, marital status, current position, working experience and tenure of particular job/task. The summary of the demographic profile is shown in Table 1.

Table 1: Respondents demographic profile

Items	Description	Frequency	Percentage (%)
Gender	Male	90	54.5
	Female	75	45.5
Age	Below 20 years	5	3.0
	21 – 30 years	84	50.9
	31 – 40 years	37	22.4
	41 – 50 years	31	18.8
	51 – 60 years	8	4.8
Education Level	Secondary school	18	10.9
	Diploma/STPM	53	32.1
	Bachelor	67	40.6
	Master	25	5.2
	PHD	2	1.2
Marital Status	Single	72	43.6
	Married	80	48.5
	Divorce	13	7.9
Current Position	Executive	52	31.5
	Non Executive	111	67.3
Working Experience	Below 5 years	35	21.2
	6 – 10 years	69	41.8
	11 – 15 years	30	18.2
	16 – 20 years	17	10.3
	Above 20 years	14	8.5
Number of months working	Below 6 months	13	7.9
	7 – 12 months	61	37.0
	13 – 18 months	36	21.8
	19 – 24 months	21	12.7
	Above 24 months	34	20.6

Based on Table 1 shows the majority of the respondent is male with 54.5%. The remaining 45.5% respondents are female. For the age category, the majority of the respondents is 21 to 30 years old with the highest percentage of 50.9%. This is followed by the respondents whose age are between 31 to 40 years old with the percentage of 22.4%. The minority of the respondents is 51 – 60 years old and below 20 years old with only one respondent which recorded the percentage of 4.8% and 3.0%.

For educational qualification, the majority of the respondents chooses bachelor with a record of 40.6%. Others consist of respondents who have educational qualification which is lower than diploma such as skills certificate and SPM or they also have better education such as PHD. Then this is followed by the respondents who have diploma and master which recorded a total number of 32.1% and 15.2% respondents respectively.

From the table, it also shows that of the respondent was married as it recorded the highest percentage with 48.5%. This is followed by the respondents who are single and divorced who recorded 43.6% and 7.9% respondents respectively.

Besides that, as for current position the majority of the respondent chooses non executive with 67.3% respondents as compared to executive position which is lower than non executive with 31.5% of respondent. As for the amount of years of working, the majority of the respondents has years from 6 to 12 years of working experience with 41.8%. The minority of the respondents is those who have above than 20 years of working experience. The minority had the percentage of 8.5%. As for the number of months have been working in the particular task, the majority of the respondents that the highest percentage with 37.0%. The minority had the percentage of 7.9%.

4.1.1 Reliability Analysis

The reliability analysis indicates how well the items in the set are correlated to one another. From a pilot study, 31 respondents were picked in gathering the information. The result showed closed to the actual result. Table 1 showed the result of the reliability test. All of the five (5) variables have good internal consistency.

Table 2: Table of Cronbach Alpha for actual result

Variable	Cronbach Alpha	N of Items
Physical Discomfort	0.926	11
Chair Design	0.892	5
Keyboard and mouse	0.863	5
Work Surface	0.837	5
Breaks	0.894	2
Support Accessories	0.715	2

All items of dependent variable and independent variable does not discard because the value of Cronbach Alpha for all variable are above than 0.06 and are consider reliable for all item.

4.1.2 Multiple Regression Analysis

Multiple regression analysis was used to identify the computer workstation accessories affecting the physical discomfort or workers. Table 3 shows the result of the multiple regression analysis.

Table 3: Summary of Multiple Regression Analysis Summary

	Summary				**ANOVA**
R .809[a]	**R2** .655			**F** 60.432	**Sig** .000[a]
Dimensions	**Unstandardized Coefficients B**	**T**	**Sig**	**Tolerance**	**Collinearity Statistics VIF**
Chair Design	-.095	-1.156	.249	.178	5.621
Keyboard and Mouse	.384	4.167	.000	.191	5.244
Work Surface	.104	1.212	.227	.242	4.126
Breaks	.156	3.718	.000	.551	1.817
Support Accessories	.210	3.984	.000	.487	2.055

Note: [a]Predictors (constant), Chair, Keyboard and Mouse, Work Surface, Breaks, Accessories

R^2 is the proportion of variance in the dependent variable (physical discomfort) which can be predicted from the independent variables (chair design, keyboard and mouse, work surface, breaks and support accessories). This value indicates that 65.5% of the variance in physical discomfort can be predicted from the variables of chair design, keyboard and mouse, work surface, breaks and accessories. The remaining 34.5% of the model will be explained by other factors. R^2 is also called the coefficient of determination. The R-value in the table is the multiple correlation coefficients between all of the predictor variables and the dependent variable.

Table 4: ANOVA

Model	Sum Squares	Df	Mean Square	F	Sig
Regression	61.484	5	12.297	60.431	.000 b
Residual	32.354	159	.203		
Total	93.837	164			

a. Dependent Variable: Physical Discomfort
b. Independent Variable: Chair, Keyboard and Mouse, Work Surface, Breaks and Accessories

The F-value in the Table 4 is 60.432 and its marginal significant is (Sig. V = 0.000). That means model is valid and the result of relationship not by chance. These values are used to answer the research objective, which was to identify the computer workstation accessories affecting physical discomfort of workers. If the sig-value is greater than 0.05, it showed that the independent variables can be predict by the dependent variable.

Further analysis through regression, produces standardizes measures (Beta Weights) of the strength of each dimension's association with physical discomfort. β is the values for the regression equation for predicting the dependent variable from the independent variable. The result of the four independent variables is chair design (β -0.095, $p<0.000$), keyboard and mouse (β 0.384, $p<0.00$), work surface (β 0.104, $p<0.00$, breaks (β 0.156, $p<0.000$) and support accessories (β 0.210, $p<0.000$). This result indicates that keyboard and mouse has a higher Beta value that provides a strong evidence of being the factor that influences the physical discomfort.

The results also shows that the collinearity statistic for dependent variable and independent variable. It consists of tolerance value and VIF value. The tolerance value of more than 0.2 means that there is no duplication for each variable in which the respondents did not feel confused between the

variable. There is no similarity between the variable which enable the respondent to clearly distinguish them. A tolerance value under 0.2 usually means that the variable ha correlated with their independent variable and should not be included. It can be concluded that the variable has correlated with their independent variable and should not be included. The tolerance value of this study is more than 0.2 with the value of chair design is 0.179. keyboard and mouse is 0.191, work surface is 0.242 while the value of break is 0.551 and support accessories is 0.487. That means the highest tolerance value is breaks which is 0.551 and consider more than 0.2 as compared to other independent variable.

5 CONCLUSION AND RECCOMENDATION

From the result, it indicates keyboard and mouse, break, and support accessories are significant with 0.00 as compared to other variable namely chair design is 0.249 and work surface is 0.227. It means keyboard and mouse, break and support accessories are affecting physical discomfort.

Thus, an organization can provide a guideline or good practice of using computer workstation accessories in order to improve the level of computer workstation accessories. Ergonomic should be used in organization when designing any workstation in order to increases efficiency of the worker. An organization needs to provide their employees guidelines for comfortable use of a keyboard and a mouse (shikdar & al-kindi, 2007). The optimal posture of the wrist is to keep the wrist straight and free from extension as to minimize stress. The employees must be trained in ergonomic practice as to comfortable use of keyboard and mouse.

In order to encourage ergonomic practice among employee, the organization should provide enough accessories such as document ramp, headset, speakerphone and footrest in designed computer workstation to better maintain and follow ergonomic standards (kearney, 2008). Accessories must be placed within a comfortable reach of both hands so that there is no unnecessary twisting of any part of the body.

For breaks, computer users should take a minimum 15 minute break from working after 2 hour of continuous computer work. It found that at least some improvement in body part discomfort levels could be attributed to rest breaks (Barredo & Mahon, 2007).

As a recommendation for future research, work environmental factors such as facilities design and lighting can be selected to be one of the variables to determine the physical discomfort. Thus, for other computer workstation accessories desk and laptop also can be used for future research.

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