Determinants of Computer Ergonomic Hazards among Office Workers in Klang Valley, Malaysia

Halimi Poniran1*, Noor Nasyikin Md Zain1, Noor Malinda Mohamed Mohan1, Fazilah Tamsir1 and Noor Ayuernie Ibrahim1

1Faculty of Business & Accountancy, Universiti Selangor, 40000 Shah Alam, Selangor Malaysia.

ABSTRACT

Extent of computer usage in public and private sectors had been greatly increased in recent decades carrying the risk of several health hazards. Due to the impact of computer ergonomic hazards on office workers, this study is conducted to evaluate the awareness and determinants of computer ergonomic hazards among office workers in Klang Valley. A total of 340 office workers from 4 district areas were selected using online survey. Independent sample t-test and standard multiple regression was used to analyse the data. The finding of this study reveals that the respondents possess a high level of awareness of computer ergonomics hazards especially the long hours of computer usage can affect their health conditions. Consistent with the Activity Theory, this study suggests that the design of workstation has an impact on computer ergonomic hazards. This study gives the office management as well as policy-makers the opportunity to take necessary steps such as arranging training and development programmes, prepare guidelines on the awareness of computer ergonomic hazards, and redesign the workstation’s furniture and setup following worldwide prominent ergonomic standard and guidelines.

Keywords: Computer Ergonomic Hazards; workstation design; workplace environment; activity theory.
1. INTRODUCTION

The advancement in information and communication technology has brought about increasingly innovative ways of doing business in the workplace. According to [1], the need to use computers increases as computer technology advance, software, and computer packages are being developed in this era. However, working on computer for prolonged periods of time can actually be harmful to the overall health. Therefore, the presence of appropriate working workstation and their compliance with standards are the most important factors in exploring many health concerns regards to occupational hazards [2].

Computer ergonomic hazards linked to the usage of technological equipment often go unnoticed until the user experienced some discomfort [3]. This is because such hazards usually occur gradually over a long period of time. According to [4], there are certain percentage of the employee workforce who made use of computers experienced pain in the neck, by [5] who also discovered that the largest increase in back-ache was seen among computing back, hand, arm, tingling, numbness and exhaustion. This was supported professionals and technicians. According to [6], working in an unpleasant and distressed condition, can cause various discomfort in the body organs. If people work for a long time in such situations, they may suffer from discomforts in the musculoskeletal system and ultimately experience the occupational burnout. Therefore, the presence of inappropriate working environment conditions and their non-compliance with standards are the most important factors in exploring many health concerns and occupational diseases [7].

It has been discovered that high performance (requirements) with high technology can exercise a dangerous influence on human personality and that anyone who is constantly working or playing with computers is at risk [8]. Among the key issues related to optimal human interaction with computers were the physical layout of the computing environment, lighting levels and sound levels, chair and table setting [9]. However, computer ergonomic hazards experienced by office workers have not been given much attention in Malaysia. The question to be asked is, are the office workers aware of ergonomics of computer uses? Due to the impact of computer ergonomic hazards on office workers, the present study aims at identifying the determinants of computer ergonomic hazards. Specifically, the study intends to examine the influence of workstation design and workplace environment towards computer ergonomic hazards.

2. LITERATURE REVIEW

Ergonomic is a scientific study of people, their work and their environment [10]. Ergonomics is essentially about “fitting work to people” [11]. It is the process of designing or arranging workplaces, products and systems so that they fit the people who use them [11]. Ergonomics is a tool which business owners and managers can use to help prevent the injuries in the office [12]. Ergonomics attempts to reduce the risk of injury by adapting the work to fit the person instead of giving the person to adapt to the work [13]. In addition to injury prevention, ergonomics is also concerned with enhancing work performance, by removing the barriers that exist in many work places that prevent employees from performing to the best of their abilities. Therefore, another benefit of applying ergonomics to office work is that it helps people work more effectively, efficiently and productively at their jobs [14].

In recent years, the main focus of office ergonomics has been on computer work due to the rapid increase in computer use in the modern office and the associated increase in injuries. Computer ergonomics is a field of study which aims to reduce the effects of working at a computer for an extended period of time by improving the placement of computer monitor, desk, keyboard as well as accessories that can be used [15]. Among the computers, laptop also is found to be not ergonomically designed for prolonged use because of the monitor and keyboard that are close together where they cannot both be in a good position at the same time [16].

Principles of ergonomics suggests working with natural postures, keep work element within easy reach, work at proper heights, minimizing pressure points, provide clearance, work with comfortable weather [17]. Otherwise, it might hazards to the employees. Computer ergonomic hazards are associated with use of computer, including improper posture, prolonged and uninterrupted work, and poor design of computer workstation [18]. Besides, computer ergonomic hazards include repetitive and forceful movements, vibration temperature extremes and
awkward postures that arise from improper work methods and improperly designed work stations, tools and equipment [19]. Ergonomic injuries include strains which can be caused by performing the same motion over and over again such as eye lesions, headache, and musculoskeletal diseases such as carpal tunnel syndrome, tenosynovitis, tendinitis, and synovitis [20].

To understand more about the determinants of computer ergonomic hazards, this study focuses on the perspective of workstation design and workplace environment towards computer ergonomic hazards. Fig. 1 shows the research framework for this study. Building upon Activity Theory [21],[22], this study attempt to sketch a new framework for understanding how office workers interact with computer with the aim to reach specific outcomes related to their computer usage. Activity Theory aimed at elucidating and explaining the relationships between “subjects,” “objects,” and “tools” used to transform these objects [21],[22]. Subjects, objects and tools constitute what can be termed “activity system.” In plain words, every activity – which consists of a set of intentionally performed goal-directed actions [23] – can be captured as an interaction between a subject and an object with the aim of transforming the object through the use of various tools [24].

2.1 Workstation Design towards Computer Ergonomic Hazards

The term “workstation” has been used loosely to refer to everything from a mainframe computer terminal to a PC connected to a network [25]. Workstation should be designed in a form to increase the comfort of a user working for long periods at a computer [26]. According to Occupational Safety and Health Academy (OSHA) (2017), workstation design ergonomics involves the designing of workstations, work practices, and work flow to fit the employees’ capabilities. It also involves a design that reduces risk factors that may contribute to common work related injuries and illnesses, such as sprains and strain and cumulative trauma disorders (CTDs) [27]. These are common employees’ safety issues that occur as a result of accumulated strain on the employee for a period of time [28]. For example, the design of work spaces that make employees to work in awkward postures some portion/all the time may result in excessive effort, fatigue and discomfort of the employee.

Discomfort and an improper position in the workstation can negatively affect overall health and productivity. Poor workstation design, awkward and repetitive body movements and other ergonomic hazards induce or contribute to a staggering number of cumulative trauma disorders (CTD) which affect hands, wrists, elbows, arms, shoulder, the lower back and the cervical spine area [29]. As a result, occupational health and safety problems are continuously increasing. This, obviously, can lead to reduced and affect human performance and dissatisfaction of employee in the organization itself. Contrary, a good computer ergonomic workplace design not only maximise the capabilities of workers by increasing productivity and job satisfaction, but also benefits the employer by decreasing the cost for health [30]. In other word, ergonomics enables “fitting the task to the worker” [31].

Based on these discussions, this study conjectures that workstation design is one of the important determinants in computer ergonomic hazards. Therefore, this study conjectures the following hypothesis.

H1: There is a significant relationship between workstation design and computer ergonomic hazards.

2.2 Workplace Environment towards Computer Ergonomic Hazards

Workplace environment is one of the risk factors for the computer ergonomic hazards [32]. Adverse workplace environmental conditions can require more energy and time, which certainly does not support obtaining an efficient and productive work system design [33]. Workers need a comfortable work environment to be able to work optimally and productively; therefore the work environment must handle and designed so that it is conducive for workers to carry out activities in a safe and comfortable atmosphere [34]. The workplace environmental evaluation carried out by measuring workplace conditions and knowing workers’ responses to exposure to the work environment [35]. A working environment said to be good if, under certain conditions, humans can carry out their activities optimally [36]. Contrary, incompatibility of the work environment with humans who work in the environment can see its impact within a specified period. Work environment factors, tools, and methods significantly affect productivity. To get high productivity, these factors must be compatible with the abilities, abilities, and limits of human workers [37].
Fig. 1. Conceptual framework

According to [38], the physical workplace environment, such as the office layout, shared office space, as well as situational aspects, such as ambient noise, lighting, room temperature and air humidity, may also represent risk factors for health and have an influence on the employees' work performance and well-being. Similarly, [39] agreed that the environment or visual of the work that can affect the well-being of office works in many ways such as, glare from luminaries or windows may cause discomfort and reduced performance in visually demanding work tasks. Therefore, the organization should cover all aspects of the workplace environment, such as workstation arrangement, task demands, and the worker's perceived visual comfort [39].

Based on the discussions, this study assumes that workplace environment is one of the predictors in computer ergonomic hazards. Therefore, this study predicts the following hypothesis.

H2: There is a significant relationship between workplace environment and computer ergonomic hazards.

3. RESEARCH METHODOLOGY

This study employs a cross-sectional research design using quantitative approach [40]. Besides, self-administered questionnaire has been adopted to collect data about the underlying constructs proposed in the theoretical model. The cross-sectional is used since the data was collected at one particular time across the selected respondents [41]. The use of such methods may gather accurate, less bias, and high quality data.

3.1 Data Collection Procedure

The sampling frame of this study is office workers in the area of Klang Valley. Specifically, there are four districts area involved in this study namely as Klang, Shah Alam, Subang Jaya, and Petaling Jaya. This study follows decision model table proposed by [42] to determine the necessary sample size because their sample decision model is claimed to be able to provide a good sampling decision. Since the population of the office workers in Klang Valley is more than 100 thousand, this study requires at least 384 sample size to establish as representatives of this study’s population. The convenience sampling method is used in collecting the data based on who are conveniently available to provide it [40]. A total of 342 valid questionnaires were acquired from the online survey, making a return rate of 89.1% out of 384 targeted respondents. After checking all the survey received, there are two (2) surveys were partially completed and thus excluded from the total returned eligible for analysis. The final number of accepted surveys used in the data analysis was 340 surveys.

3.2 Survey Instruments

The survey questionnaire consists of four (4) sections. Section A contains of five (5) personal information questions that related to gender, age, race, district, and daily computer usage. Section B focused on dependent variable to be tested which is the computer ergonomic hazards faced by the respondents adapted from ergonomic questionnaire developed by [43]. Further, Section C and Section D consists of items regards to
independent variables. Standard Nordic questionnaire adapted from [44] is used to evaluate workstation design. While workplace environment which consists of room temperature, visual, indoor air quality, acoustics, and lighting were operationalized based on the work of [45]. All constructs is measured on a five-point Likert scale with the anchors of (1) “strongly disagree” to (5) “strongly agree”.

As a preliminary analysis of the data collected, the reliability assessment of the scales was carried out by calculating the values of the Cronbach’s alpha for each subscale separately. According to [40], reliability coefficient test indicates how well the items in a set which positively correlated from one another. Variables can be considered as reliable if the Cronbach’s alpha value was set to 0.7 and above [46],[47]. Table 1 depicts that all variables measuring computer ergonomic hazards (workstation design and workplace environment) ranging from values 0.937 to 0.955. Besides, the highest Cronbach’s Alpha value is obtained for the subscales of items in the workplace environment construct (α = 0.983). Hence, the internal consistencies of all constructs are considered acceptable since each reliability testing exceeds the suggested threshold.

Further, the assessment of normality of the metric variables in this study involves empirical measures of a distribution’s shape characteristics (skewness and kurtosis). Table 1 shows that the normality assessment values for workstation design, workplace environment, and computer ergonomic hazards are between ±2.00 as suggested by [46]. Therefore, this assessment confirmed that the data of this study is normally distributed.

Next, multicollinearity testing was done to examine the relationships among the independent variables. Multicollinearity exists when the independent variables are highly correlated, with r value of more than 0.9 [47]. The correlation coefficient results between the variables are indicated in Table 2. All the independent variables show at least some positive relationship with the dependent variable, and the correlations between independent variables are less than 0.7.

To further check for multicollinearity, a collinearity diagnostics test (tolerance and VIF values) was conducted. As shown in Table 3, the tolerance values are greater than 0.10 and the VIF values are lower than 10; hence, no multicollinearity problem exists [47].

### Table 1. Reliability and normality results

<table>
<thead>
<tr>
<th>Variables</th>
<th>Cronbach's Alpha</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workstation Design</td>
<td>0.937</td>
<td>-0.018</td>
<td>0.015</td>
<td>10</td>
</tr>
<tr>
<td>Workplace Environment</td>
<td>0.983</td>
<td>0.168</td>
<td>-0.073</td>
<td>10</td>
</tr>
<tr>
<td>Computer Ergonomic Hazards</td>
<td>0.955</td>
<td>1.630</td>
<td>1.954</td>
<td>7</td>
</tr>
</tbody>
</table>

### Table 2. Pearson correlation coefficient results

<table>
<thead>
<tr>
<th></th>
<th>Workstation Design</th>
<th>Workplace Environment</th>
<th>C. Ergonomic Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workstation Design</td>
<td>1</td>
<td>0.528**</td>
<td>0.197**</td>
</tr>
<tr>
<td>Workplace Environment</td>
<td>0.528**</td>
<td>1</td>
<td>0.156</td>
</tr>
<tr>
<td>C. Ergonomic Hazards</td>
<td>0.197**</td>
<td>0.156</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note: Correlation is significant at **1% level, *5% level and *10% level, respectively, using two-tailed tests*

### Table 3. Collinearity diagnostics results

<table>
<thead>
<tr>
<th>Variables</th>
<th>Collinearity Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tolerance</td>
</tr>
<tr>
<td>Workstation Design</td>
<td>0.792</td>
</tr>
<tr>
<td>Workplace Environment</td>
<td>0.976</td>
</tr>
</tbody>
</table>
4. RESULTS AND DISCUSSION

Fig. 2a depicts unsurprisingly that female are more than the male as 62.7% of the study’s participants were female as compared to 37.3% males. Further, Fig. 2b shows that majority of the respondents are between 22 and 24 years old. They make up more than half (57.3%) of the total responses to the survey given. The race status of the respondents as depicted in Fig. 2c shows that 188 (55.3%) of respondents are Malay, while Chinese make up the second largest respondents in this study with 26% of participation. Indian respondents are the least participate in this study (18.7%). In terms of district area of working (Fig. 2d), majority of the respondents (30.7%) currently worked in Shah Alam, followed by Subang Jaya (28.6%). There are almost equal participation from respondents worked in Klang and Petaling Jaya. Finally, Fig. 2e shows that majority of the respondents in this study have been used computer between 4 to 6 hours on a daily basis (67.3%). While there are 18.7% of respondents working using computer between 7 to 9 hours. Respondents with daily usage of computer are only 6.7%. This group of respondent can be considered as heavy usage of computer in their daily work.

4.1 The Awareness of Computer Ergonomic Hazards

This section reports and discusses the findings of the study which relate to the awareness of computer ergonomics hazards by the office workers in Klang Valley. One sample t-test was conducted to test whether the mean of overall perceived awareness of computer ergonomic hazards is significantly equal to or different from a specified constant. Table 4 shows the mean result of 4.065 for computer ergonomic hazards which indicates that respondents considered themselves as aware of the hazards from computer ergonomic and it is statistically significant at 1% level. Overall, majority of the respondents were aware that the long hours of computer usage can affect their health condition. Besides, respondents also revealed they know that staying in the same position and using the same muscle for hours at a time is not good for their back and neck. In addition, respondents also strongly agreed that poor ergonomic position can cause ergonomic pain.

An independent samples t-test was conducted to compare the awareness of computer ergonomics hazards among office workers in different gender. Table 5 shows that there is a significant difference in the level of awareness of computer ergonomics hazards between male and female office workers in Klang Valley (T(2, 340)=89.773, p value >.10). This result indicates that the awareness on computer ergonomic hazards between male and female is different. The mean value result shows that female officer workers had slightly higher awareness on computer ergonomic hazards than male office workers. This result is consistent with [48] who found that females were more exposed to the knowledge of computer ergonomic hazards as compare to males.

4.2 Determinants of Computer Ergonomic Hazards

This section reports and discusses the findings of the study which is to identify the determinants of computer ergonomic hazards among office workers in Klang Valley. The results in Table 6 shows that the regression model (F (2, 340) = 30.193, p value = 0.000) is significant at the 1% level, but the overall fit of the model is moderate with R² value of 29.1% of the variation in the computer ergonomic hazards. Approximately, 29.1% of the total variability in the computer ergonomic hazards is accounted for by the predictor variables collectively in the model. The other 70.9% may be due to other factors which not explained by the model.

With reference to Table 6, result shows that the relationship between workstation design and computer ergonomic hazards is positive (t = 7.234; p =.000) and it is statistically significant at 1% level. Therefore, this finding leads to the acceptance of H1. This signifies that when the design of workstation has an impact on computer ergonomic hazards. Perhaps, inappropriate design, poor computer facilities, repetitive work, and close distance of the monitor screen cause ergonomic hazards such as shoulder and neck pain, musculoskeletal disorder problems, and body posture. This result is consistent with previous studies where they suggested that poor workstation design, awkward and repetitive body movements and other ergonomic hazards induce or contribute to a staggering number of hazards which affect hands, wrists, elbows, arms, shoulder, the lower back and the cervical spine area [27,28,29].

Further, as it can be observed from the results in Table 6, workplace environment were positively related to computer ergonomic hazards (t =
1.676; \( p > .05 \), but it is not significant. Therefore, \( H_2 \) was not supported. This result indicates that workplace environment does not contribute to the computer ergonomic hazards. Perhaps, the respondents are able to work in whatever condition of workplace environment and it is not an important factor for ergonomic in the workplace. This result is contradicted with previous studies as majority of works suggested that environment can affect the well-being of office workers in many ways such as discomfort and reduced performance [39].

![Fig. 2a. Gender of respondents](image1.png)

![Fig. 2b. Age group of respondents](image2.png)

![Fig. 2c. Race of respondents](image3.png)

![Fig. 2d. District area of respondents](image4.png)

![Fig. 2e. Daily computer usage](image5.png)

Table 4. Awareness of computer ergonomic hazards perceived by the office workers

<table>
<thead>
<tr>
<th>Computer Ergonomic Hazards</th>
<th>n</th>
<th>Mean</th>
<th>One Sample T-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>t-statistic</td>
</tr>
<tr>
<td></td>
<td>340</td>
<td>4.065</td>
<td>89.773</td>
</tr>
</tbody>
</table>

Note: Result is significantly different at \( 1\% \) level and \( 5\% \) level, respectively, using two-tailed tests.
Table 5. The Awareness of computer ergonomic hazards among office workers in different gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>n</th>
<th>Computer Ergonomic Hazards</th>
<th>Independent Samples t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
</tr>
<tr>
<td>Male</td>
<td>127</td>
<td>3.982</td>
<td>0.524</td>
</tr>
<tr>
<td>Female</td>
<td>213</td>
<td>4.112</td>
<td>0.568</td>
</tr>
</tbody>
</table>

Note: Result is significantly different between mean at the 1% level and 5% level, respectively, using two-tailed tests

Table 6. Determinants of computer ergonomic hazards

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Std. Beta Coefficient</th>
<th>t-statistic</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td></td>
<td>4.175</td>
<td>.000***</td>
</tr>
<tr>
<td>Workstation Design</td>
<td>H₁</td>
<td>0.509</td>
<td>7.234</td>
</tr>
<tr>
<td>Workplace Environment</td>
<td>H₂</td>
<td>0.118</td>
<td>1.676</td>
</tr>
</tbody>
</table>

Model Summary

| R² value     | 29.1% |

Anova Results

| F-value | 30.193 |
| Sig. value | .000*** |
| Obs.     | 340    |

Note: Association is significant at 1% level, 5% level, respectively, using two-tailed tests

5. CONCLUSION

When a worker understands and learns about ergonomics, it helps to improve the working environment. Consequently, the workers can work comfortably and use a minimum amount of energy effectively. This study highlighted the awareness of computer ergonomics hazards among office workers in Klang Valley, and the results showed that they possess a high level of awareness of computer ergonomics hazards in which the mean score is 4.065. Further, this study clearly shows that female officer workers had slightly higher awareness on computer ergonomic hazards than male office workers. Further, this study discovers that workstation design has an impact on computer ergonomic hazards. This signifies that inappropriate design, poor computer facilities, repetitive work, and close distance of the monitor screen cause ergonomic hazards such as shoulder and neck pain, musculoskeletal disorder problems, and body posture. The influence of workplace design towards computer ergonomic hazards is consistent with the Activity Theory [21],[22] that argued the interaction of office workers with computer and poor workstation design caused ergonomic hazards.

The findings of the study will be helpful for the office management in order to know the awareness level of their workers and take necessary steps such as arranging training and development programmes. The management should hence design and implement training curricula that will empower their workers with the skills and abilities to make them cope with computer ergonomic. In addition, the management also may prepare guidelines to make awareness about computer ergonomic hazards and improve them. The redesign of workstation’s furniture and setup could also be advised to the management whereby the workstation furniture (chair and desk) could be based on user’s anthropometric measurements and following various ergonomic guidelines and suggestions. Placement of monitor and other accessories should be adjusted in order to maintain postural guideline following worldwide prominent ergonomic standard and guidelines for computer workstation setup.

However, the findings need to be interpreted with consideration for its limitations. First, the responses of this survey are representative of office workers in four district areas of Klang Valley only. One area for further research might be to conduct the study using a larger sample and a broader geographical base. Second, the selection for the determinants of computer ergonomic hazards is not exhaustive. There may be other predictors that may contribute or be a
reason of ergonomic hazards which might provide more insight. Thus, further research may consider to include other predictors such as human factor, knowledge, or attitude towards computer ergonomic safety to enrich findings in various perspectives. Third, the self-reported behavior on which this study relied are vulnerable to response bias. There is an uncertainty regarding the accuracy of responses because self-reports of computer ergonomic hazards and their awareness may be less accurate. To reduce response bias, it is suggested for future research to use in-depth techniques applied to secondary data sources such as interviews or observations. This might help researcher to explore certain aspects that cannot be discover using survey questionnaire.

CONSENT

As per international standard or university standard, participant’s written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

18. Bommisetty U, Rajamane M. Impact of recent advances in ergonomic design and digital human models in industrial


