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Analysis of Ergonomic Risk Factors on Workspace Design for Work from Home (WFH) Initiative

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Abstract:- There has been an introduction of working from home concept all over the world due to the COVID-19 pandemic which began in 2019. Many companies were forced by the government to close their premises during the enforcement of the Movement Control Order (MCO). Consequently, IT companies had to implement work from home concept among their IT employees(Nurhamiza, 2020). Even after MCO ended, this work from home concept was still retained as it helped the management to save electricity and rental cost(Anderson, 2009). At the same time, IT companies were required to maintain their employees' safety and health in terms of ergonomic risk factors even when they work from home. Data collection for this research was carried out by conducting interviews and adapted self-administered questionnaires. Then, the data were used to propose the most significant ergonomic factors which affected workspace design at home. This helped to achieve all three main objectives in this research. Findings of this research showed that an employee must consider the main ergonomic factors such as furniture, interaction between supervisor and employee, and motivation factors when designing a workspace at home, whereas the rest five factors were optional. Finally, this research findings can help to contribute in designing a workspace with minimal ergonomic effects at home among IT or software employees without affecting employee's safety and healthcare.

Keywords*:* Chi Square Analysis Test, Ergonomics, Mixed Method, Workspace design at home.

1. Introduction

Work From home (WFH) concept was introduced all over the world due to the COVID-19 pandemic. Many companies were forced by the governments to close their premises and their employees had to work from home. In America, millions of employees were forced to work from home (Anderson, 2009) and this causes them to have flexible working hours and experience different working environment. For many professionals such as teachers and engineers, this gives them either a positive or negative experience.

However, there are some factors which could affect the productivity of the employees who work from home compared to when they work from office. Even though some people work better if they work from home, some become less productive (Anderson, 2009). There are teleworking challenges faced by teleworkers such as from caring to children to adjusting virtual collaborations with coworkers (Anderson,2009). Those who are working in IT industries, such as employees from Dell and Xerox, promote this way of working due to the fact they are technology and computer based (Brooks, 2014). However, this working from home benefits the employees as there is a possibility of employees having a work life balance (Watson, 2003).

This research will provide a clear understanding of how this WFH concept affects productivity of the employees in a company. Besides, the productivity level of employees may be influenced by their level of motivation, working environment and health condition. In order to energise and sustain employees' behaviour, motivation can be outlined as a group of forces (Allent, 2014).

The work-from-home initiative introduced by the government may affect the productivity of many employees in a given organization because it does not ensure that employees have an adequate workspace at home, which is

classified as a proper home office with minimal ergonomic impact. Previous researchers mainly studied the causes that affect the productivity of employees who works from home (Nurhamiza, 2020), and there are other researches related to the productivity of employees for the organization such as Yahoo on the prohibition of working from home (Nurhamiza, 2020), but there is a lack of research on the design of the workspace at home with considering the ergonomic factors.

The main challenge faced by employees who are working from home is ergonomic factor. A survey reported that twenty five percent of employees who worked remotely lack of proper work surfaces, and twenty three percent reported that they had bad postures of sitting.An employee may suffer from musculoskeletal disorders due to working posture problems (Salwa et al,2019). It is important to assess workplace pushing and pulling activities to manage musculoskeletal disease among employees (Harikrishnan, 2023). The issue is employees cannot create the best and comfortable home office at home.Similarly, some of the SME's in Indonesia could not afford to create an ergonomic working environment due to financial problems (Silviana et al,2021). A survey reported that ninty four point seven percent of the workers did not report any accidents to their management at their workspace (Chong et al, 2024). A statistical data has identified and tabulated the causes that contributed to health issues, and the reported main cause of accidents due to lack of proper spatial arrangement in a workspace (Chong et al, 2024). As a result, the safety of employees in a workspace is important to prevent any physical injuries.

The problem is that every employees cannot set up the best and most comfortable home office in their home as they are lacking of knowledge regarding on ergonomic factors which affects the workspace design at home (Wilson,1995). As a result, employees working remotely may find it difficult to perform their task due to lack of suitable furniture designs and other factors which affecting their health. This factor is the management programme which considers the ergonomic factors (Wilson,1995). Ergonomic workstation or workspace able to create an enjoyable learning environment and enhancing the motivation of an employee (Ikmal et al,2015).

This proves that an appropriate workspace design at home with minimal ergonomic effects for the employees who works from home is required to ensure the health and safety of employees was secured at home.There are few essential objectives to undergo this research such as to identify the ergonomic factors affecting work from home initiatives, to analyse whether the ergonomic factors identified have a relationship with the workspace at home and to propose the most significant ergonomic factors affected with workspace at home.

The scope of this research was conducted in IT Companies, at Bukit Mertajam,Penang,Malaysia. The sample size was selected based on the population of IT companies surrounding Bukit Mertajam, Penang, Malaysia. Data collection for this research was carried out by conducting interviews and adapted self-administered questionnaires. Mixed Method were conducted in this research.

Before allowing employees to work from home, employers must consider several ergonomic factors such as lighting, spatial arrangements, furniture, temperature, noise, interaction between supervisor and employee, Stress Level Management Programmeme and motivation (Robinson,1991). Hameed (2009) stated that five ergonomic factors which need to be considered to ensure a conducive working environment in every employee's home include Lighting, Spatial Arrangements, Furniture, Temperature and Noise. Another three factors that employers need to consider to ensure employees' welfare are interaction between supervisor and employee, stress level management and motivation (Ghafoor, 2015).

Simplifying the content on previous paragraphs (Robinson, 1991): Types of ergonomic factors are as shown below (Robinson, 1991) :

1. Noise
2. Lighting
3. Temperature
4. Furniture
5. Spatial Arrangement

6. Interaction between Supervisor and Employee

7. Stress Level Management programme

8. Motivation

2. Methodology

In this research, the researcher collected data via mixed method. Mixed methods strategies are less well known than either the quantitative or qualitative approaches. The concept of mixing different methods originated in 1963 in a study on the validity of psychological traits, (Campbell, 1963). This research followed the convergent parallel mixed method mode, so both quantitative and qualitative methods were use to collect the data regarding on whether the ergonomic factor has relationship with the workspace design at home. Then, the quantitative data were analysed separately to produce statistical results, whereas qualitative data were analysed separately to produce qualitative findings. Then, the researcher proceeded with interpretation of either qualitative findings confirms or disconfirms the statistical results produced by quantitative findings.

Next, a sample size selection is very important when conducting a mixed method strategies in a research. Unquestionably, the sample size for the qualitative data collection is smaller than that for the quantitative data collection: one other approach taken by some mixed method researchers is not to consider the unequal sample size a problem. Aside from the small number that characterizes qualitative research, how many sizes and participants should have? First of all, there is no specific sample size or answer to this question as sample size depends on the research design being used in such mixed method study (Creswell, 2013). Students and scholars appear to assume the existence of a formulaic solutions, as in conducting a power analysis to determine the sample size in an experiment or survey. For mixed method studies (again as with multiple experiments) no such formulas exist to choose a sample size for qualitative data collection (Creswell, 2013). This means that there is no specific sample size as it can be any sample size according to the population.

In many experiments or quantitative analysis under mixed method approach, only a convenience sample is possible because the investigator must use naturally formed groups (e.g. a classroom, an organization, a family unit) or volunteers (Creswell, 2013). When individuals are not randomly assigned, the procedure is called a quasi-experiment. In this research, the target population for this study involved employees in only one IT Company due to the naturally forrmed only one IT company in surrounding area of Bukit Mertajam, Penang Malaysia.

The IT Company consisted of 25 IT Engineers such as Desktop Engineers, Notebook Engineers, Workstation Engineers and Server Configuration Engineers, Inventory Engineers, Training Executive Engineer, Team Leader and Image, and OFA Engineers. As the IT company consists of 25 IT Engineers, the sample size used to collect quantitative data in this research was 25.

In this research, the researcher collected the quantitative data first by distributing the adapted self- administered questionnaires to 25 employees and this data were analysed using the Chi-Square Analysis test to determine whether the ergonomic factors has the relationship with the workspace design at home quantitatively. Self-administered questionnaires which were used to obtain quantitative data were adapted from Marie Ann's thesis (Robinson, 1991). Then, qualitative data were collected by interviewing three employees and then verify the qualitative findings either confirms or disconfirms the statistical results produced through quantitative findings. Both quantitative data and qualitative data were collected from employees from IT company in surrounding area of Bukit Mertajam, Penang Malaysia.

In this research, the researcher approached side-by-side comparison where the researcher first reported the quantitative statistical results, and then discussed the qualitative findings which either confirmed or disconfirmed the statistical results. IBM SPSS tool was the research analysis tool used to analyse the quantitative results through Chi Square Test to produce statistical results in this research. The test is also referred to as the Chi-Square test for independence, also called Pearson's Chi-square test (Hameed, 2009). IBM

SPSS Tool were used to calculate correlation or significant values and relationship under quantitative analysis of mixed method (Creswell, 2013), with the alpha value set at 0.05.

To summarize, first objective which is to identify the ergonomic factors that affects the workspace design at home was achieved through qualitative analysis by obtaining the results from interviewing the three employees and the second objective which was to analyse whether the ergonomic factors have relationship with the workspace design at home via side-side by comparison analysis under the mixed method approach.

3. Results

3.1 Quantitative Findings

The asymptotic values for noise factor, temperature factor, lighting factor, spatial arrangement factor, interaction between supervisor and employee factor, motivation factor, stress level management factor and furniture factor are , 0.35,0.33, 0.22, 0.53, 0.00,0.01, 0.56,0.00 respectively.If the p-value is smaller than alpha value which is 0.05, then it will reject the null hypothesis (H0) that asserts that the two variables are independent of each other. So, this means that H1 will be accepted, which asserts that the two variables have relationship with each other (Hameed, 2009).

As shown in Table 4.1 from IBM SPSS, it shows that Asymptotic Significance is referring to p-value. P-value for the noise, temperature, lighting, spatial arrangement and stress level management factors are 0.350, 0.33, 0.22, 0.53, 0.56 respectively. This shows that these five ergonomic factors such as spatial arrangement, noise, temperature, stress level management and lighting factors did not have relationship with the workspace design at home. P-value for the interaction between supervisor and employee, motivation and furniture factors are 0.00, 0.01, and 0.00 respectively. This shows that three factors such as furniture factor, interaction between supervisor and employee factor and motivation factor have relationship with the workspace design at home.

3.2 Qualitative Findings

As per Qualitative Analysis, all the three respondents mentioned that all eight ergonomic factors have relationship with the workspace design at home.

4. Discussion

Qualitative findings confirmed the statistical results produced by the quantitative findings for the first three factors such as furniture factor, interaction between supervisor and employee factor, and motivation factor have relationship with the workspace design at home.

Qualitative findings disconfirmed the statistical results produced by the quantitative findings for the rest of five factors such as noise factor, spatial arrangement factor, lighting factor, temperature factor and stress level management factor have no relationship with the workspace design at home.

In previous study, it stated that five important ergonomic factors which required to be considered to ensure a conducive working environment in every employee's home included lighting, spatial arrangements, furniture, temperature and noise (Hameed, 2009). Another study shows that there is another three main factors that employers need to consider to ensure employees' welfare are interaction between supervisor and employee, stress level management and motivation (Ghafoor, 2015). In this research, it consists of all the eight factors which stated on previous studies but it shows that an employee must consider the main ergonomic factors such as furniture, interaction between supervisor and employee and motivation factors when designing a workspace at home while at the same time has a flexibility to consider or not consider spatial arrangement, temperature, lighting, noise and stress level management factors. Therefore, spatial arrangement, temperature, lighting, noise and stress level management factors are optional factors for an employee to consider when designing a workspace at home depending on their job requirements and needs.

Third objective which is to propose the most significant factors affected the workspace design at home was achieved in the discussion between quantitative and qualitative findings. By following this data and results, an employee can design a workspace at home with minimal ergonomic effects as this research helps to reduce the

exposure of main ergonomic factors that lead to high ergonomic effects among the employees who work at that workspace at home.

5. Conclusion

The prime contribution of this study is to help the IT companies to design workspace at home with the consideration of the risk ergonomic factors. By considering the ergonomic effects in the workspace design at home, it helps the corporate companies to secure their employee's health and welfare. By creating a safe workspace at home with minimal ergonomic effects, it helps the employees to do multi-task jobs and they can spend time with family. Also, it helps them to save their time by travelling to the office and save petrol and toll cost. The corporate companies can save their rental and electricity cost too as there is no need of any physical offices for their employees.

There are some limitation of the study such as this research scope only covers the IT sector employees and this research findings is based on risk ergonomic factors only

Future research should aim to deepen understanding of the relationship between interior workspace at home and employees' well-being. One open-ended question is what combination of conditions causes negative experience of open-plan workspace at home and should the scope be widened for many other sectors employees.

In addition, future research on interior workspace should address other factors specifically on employee's work stress, strategies to enhance their well-being by facilitating restoration, relatedness and health-supporting behaviour.

References

[1] Anderson, D., & Kelliher, C. (2009). 'Flexible working and engagement: the importance of choice'. Strategic HR Review, 8(2), 13-18.
[2] Allen T., Cho E., Meier L. L. (2014). Work–family boundary dynamics. Annual Review of Organizational Psychology & Organizational Behavior, 1(1), 99-121.
[3] Creswell, J.W. (2013). Planning, conducting, and evaluating quantitative and qualitative research (Forth ed.). Upper Saddle River, NJ: Merrill.
[4] Campbell, D., & Stanley, J. (1963). Experimental and quasi-experimental designs for research. I N.L.Gage.
[5] Courtney, E. (2020). The Benefits of Working From Home: Why The Pandemic Isn't the Only Reason to Work Remotely.
[6] Conklin, E. (1978). Interior Landscaping (4th ed.). Arboriculture.
[7] Ghafoor, A. (2015, July 15). Impact of working environment on employee's productivity: A case study of Banks and Insurance Companies in Pakistan. European Journal of Business and Management, 7(1), 329-345.
[8] Chong, C.B., Musab, A.R., Mohd Zahirasri, M.T., Dayang, R.A.B., Syafiie, S. (2024). An Accident Prediction Model Based on ARIMA in Kuala Lumpur, Malaysia, Using Time Series of Actual Accidents and Related Data. Pertanika Journal of Science and Technology, 32(3), 1103-1122.
[9] Hameed, A. (2009, January 10). Impact of Office Design on Employees' Productivity: A Case study of Banking Organizations of Abbottabad, Pakistan, Journal of Public Affairs, Administration and Management, 3(1), 1-13.
[10] Ikmal, H.G., Nur Haizal,M.Y.,Rozimah, Y., Siti Zawiah, Md.D. (2015). A Brief Review of Ergonomic Workstation For Disability Student. Jurnal Teknologi UTM, Science and Engineering, 77(27), 19-23.
[11] Khedkar, E.B., & Pawar, P.Y. (2015). Review of literature on organizational ergonomics. International Journal of Advanced Research in Computer Science and Management Studies, 5(3), 150-162.
[12] Latham, G.P. (2005). Work Motivation Theory and Research at the Dawn of the Twenty-First Century. Annual review of psychology, 56, 485 - 516.
[13] Hedge, A., Sterling, E.M., & Sterling, T.D. (2012). Evaluating office environments: The case for a macroergonomic systems approach. New York: North Holland.

[14] Harikrishnan, T.S., Nasrull, A.R. (2023). A Systematic Review of Ergonomic Risk Assessment Methods for Pushing and Pulling Activities at Workplace. Pertanika Journals of Science & Technology, 31(6), 3157 - 3178.
[15] Labitoria, C. (2021, October 28). These 10 well-known companies offerfully remote or hybrid work arrangements. Retrieved April 08, 2023, from https://www.hcamag.com/asia/news/general/these-10-well-known-companies- offer-fully- remote-or-hybrid-work-arrangements/314599
[16] Nurhamiza, M. (2020). Are Malaysians ready for Telecommuting?.Journal of Critical Reviews, 7(18), 3979-3900.
[17] Olafsen, A. H., Deci, E. L., & Halvari, H. (2018). Basic psychological needs and work motivation: A longitudinal test of directionality. Motivation and emotion, 42, 178-189.
[18] Robinson M. A. (1991). Ergonomic modernization of an office environment and its effect on physical discomforts, job satisfaction, work environment satisfaction, and job performance. Unpublished thesis, University of Southern California. LA, CA.
[19] Schlachter.S., McDowall.A., Cropley.M.,Inceoglu.I. (2018). Voluntary work-related
[20] Silviana, Andy, H., Naif, F., Dadang, H. (2021). Designing The Ergonomic Press and Molding Machine of Cassava Chips for Sustainable Development in SMEs. Pertanika Journals Science & Technology, 29(3), 1595 - 1608.
[21] Salwa, M. Nazreen, H., Khairul, S., Nur Syamimi, J., Farid, S. (2019). Ergonomic Posture Assessment of Butchers : A Small Enterprise Study In Malaysia Food Industry. Jurnal Teknologi UTM, Science and Engineering, 81(6), 89-102.
[22] Schieman, S., & Young, M. (2010). Is there a downside to schedule control for the work- family interface?. Journal of Family Issues, 31(10), 1391-1414.
[23] Sundstrom, E. (1986). Work Places: The psychology of the physical environment in offices and factories. Cambridge, London: Cambridge University Press.
[24] Wilson. (1995). Participatory ergonomics: Evidence and implementation lessons. Journal of Applied Ergonomics, 68, 289-293.
[25] Watson, I., & Lightfoot, D. (2003). 'Mobile working with Connexions'. Facilities, 21(13/14), 347-352.