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Ergonomic Risk Factors for Carpal Tunnel Syndrome Among Designers

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ABSTRACT

Carpal Tunnel Syndrome (CTS) is a significant occupational disease among intense computer users such as designers and other professionals. The objective of this research is to evaluate the prevalence and risk factors of CTS among designers using a cross-sectional study. In this paper, questionnaires related to ergonomics risk factors were used. A total of 225 questionnaires distributed and Phalen's test were conducted to determine CTS prevalence. The respondents background were from graphics design, multimedia, industrial, automotive, interior, Computer Aided Design (CAD) designers, architects and design engineers. The study showed that 20% of studied professional computer users had a symptom related to CTS. Graphic designers (OR: 2.04, 95% CI: 1.05-53.98) and working more than 6 hours for side jobs in a week (OR: 2.74, 95% CI 1.16-6.49) were found highly associated with risks of CTS in this study. Further study on CTS severity symptoms and functional scale assessment using Boston Carpal Tunnel Questionnaire (BCTQ) suggested for future research for this study. The research is crucial for awareness and ergonomics CTS prevention planning for designers.

Keywords: Ergonomic risk factor, Carpal tunnel syndrome, Phalen's test, Designers, Musculoskeletal disorder, Repetitive strain injury

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is the most common musculoskeletal disease for the upper limbs, with a prevalence rate of 1 to 5 percent in the general population and an occurrence rate of 3.3-3.5 per 100 person-year (Hulkkonen et al., 2019). CTS develops due to high pressure on the median nerve, which produces tissue swelling in the carpal tunnel area. Numbness, tingling, weakness, or muscle injury in the hand and fingers are all possible side effects of CTS. Occupational work which involves repetitive, forceful motions of hand and wrist contribute the most to an increasing risk of developing

CTS (Toosi et al., 2015). The association between musculoskeletal disease such as CTS and computer work has been evaluated in many studies (Baba et al., 2019; Ardahan et al., 2016; Schmid et al., 2015; Huysmans et al., 2018; Labbafinejad et al., 2019). Awkward hand and arm position while performing computer-aided data entry and text processing as well as mouse operation contributed to Musculoskeletal Disorder (MSD) such as Repetitive Strain Injury (RSI) syndrome and CTS (Kluth et al., 2015).

Designers, architects and design engineers are a group of creative people tasked with translating conceptual ideas into finished goods such, for example magazines, furniture, buildings, and even aircrafts. Design experts traditionally use drawing stationeries such as a drawing board or table, T-square, pens, pencils, colour pencils, marker pens, and other design equipment to perform and complete their artworks manually. Aligning with the advent of the digital era in the 1970s, numerous artworks began to be made commercially with the use of computers (Tornincasa et al., 2010). Study conducted by Justice (1990) on early introduction of computer usage in design agencies across the Unites Stated found that designers who worked with computer have less involvement in other stages of creative design process such as design conceptual stage (Justice, 1990). It can be understood that most of daily workings hours are spent on computer. The results came out with 77% recorded complaints of physical ailments including hand and wrist, general fatigue and headaches (Justice, 1990). This study shows that during the early introduction of computer in design industry, the risk of MSDs and CTS were recorded in just 4-5 hours of computer exposure daily.

In a recent census done by American Institute of Graphic Arts (AIGA) with sample size of 9429 user, they found that the exposure of computer expected to upsurge due to long working hours from 40 to 60 hours weekly according to the American Institute of Graphic Arts (AIGA). Research by Sahu et al. (2019) in India among Computer Aided Design (CAD) designers found that professionals who work with CAD software are vulnerable to developing CTS. The study recorded complains of pain in the wrist, shoulder and back as a result of extensive mouse usage (Sahu et al., 2019). Design professionals was found spent the longest time to perform CAD designing tasks on computers compared to other typical office tasks, and they would continue working at home after that (Sahu et al., 2019, Faraji et al., 2013). Occupational health risks is likely to exist among designers, given the significant number of them who work long hours. Although the risks were documented, there are very limited previous research on CTS risk among designers. Therefore, the aim of this paper is to evaluate the prevalence and risk factors of CTS among designers. The association of CTS will be evaluated between possible risk factors such as demographic, industry, design professions, hours of computer exposure and side job factors.

METHODS

This cross-sectional study was done in three establishments and among two design societies focusing on social media platform. One of the entities is an

established automotive company in Malaysia that was equipped with Research and Development (R&D) center that gathered automotive designers as well as CAD designers and design engineers. Two universities with design school were used to recruits designers who are pursuing postgraduate studies. Purposive sampling method was used in this research that underline criterion to participate in this study. Samples were selected based on inclusion criteria that requires only designers in design discipline such as graphic, multimedia, automotive, industrial, interior, architect, CAD designers and design engineers. They should use 50% (about 4 to 5 hours) of their daily working hours dealing with computers and at least diploma and equivalence holder in terms of qualification. Age to participate in this study is between 20 – 60 years old. Whereby the exclusion criteria are participant that have been clinically diagnosed with CTS or any musculoskeletal disorder. Designer in any other design discipline stated in the inclusion criterion as well as age limit. The study stated as voluntary and respondents could withdraw from this study at any stage without any explanation. A total of 225 designers from automotive companies, universities and two design communities in social media platforms responded to this study. All permissions were granted to conduct the study with a few restrictions due to Covid 19 pandemic situation. To avoid direct contact with respondent, online mode was deployed to distributed questionnaires to respondents.

The questionnaire used in the study was adapted by previous research questionnaires related to CTS (Chowdhury N. 2015, Sellschop, 2015). Test-retest and Cronbach alpha was used in pretesting to determine the questionnaire's reliability and validity. The questionnaires captured demographics information of the participant, computer task and experiences such as hours of computer usage, resting time between jobs, input devices, supporting aids during computer work and hobby. In this study, Phalen's test was used to screen for CTS symptom. Phalen's test has been introduced in 1951 by Phalen and it became most common test applied to test wrist-flexion (Palumbo et al., 2002). Participant were asked to be seated to begin the test. Dorsum of hands were placed together with light pressure; forearm in horizontal position and participant need to hold for 30 to 60 seconds on that position (Palumbo et al., 2002). If sensations occurred in less than 30 seconds, they are required to end the procedure immediately. Positive results were associated with symptoms such as tingling and discomfort in the thumb, index, middle and lateral half of the ring fingers (Palumbo et al., 2002). Those with positive results from the Phalen's Test will be classified as participant with CTS symptom. The study was evaluated by Universiti Putra Malaysia (UPM) Ethics Committee and the board agreed to grant a permission to conduct this study.

STATISTICAL ANALYSIS

The prevalence of CTS was analysed using descriptive statistics with 95% confidence interval. To determine the relationship between CTS and the risk factors a multivariate test (binary logistic regression) was used in this study. All statistical analysis was done in SPSS software version 24.

Table 1. Prevalence of carpal tunnel syndrome by demographic (n = 225).

	N	CTS (%)		*P* Value
		Yes	No	
Gender				
Male	118	19 (8.4)	99 (44.0)	0.154
Female	107	26 (11.6)	81 (36.0)	
Age				
> 30 Years	131	28 (12.0)	103 (46.2)	0.630
< 30 Years	94	18 (8.0)	76 (33.8)	
Education Level				
Diploma and equivalence	35	6 (2.7)	29 (12.9)	0.709
Degree and above	190	39 (17.3)	151 (67.1)	
Duration of Service				
< 10 Years	160	33 (14.7)	127 (56.4)	0.770
> 10 Years	65	12 (5.3)	53 (23.6)	
Employment Type				
Fulltime	179	34 (15.1)	145 (64.4)	0.551
Freelance	46	11 (4.9)	35 (15.6)	

RESULTS

In this study, gender distribution for all 225 respondents indicates 118 (52.4%) male designers compared to total number of 107 are female. 94 (41.2%) of the respondents were from younger age group below 30 years old with 53 designers are female. Also, 95.6% of the designers were free from any medical condition namely thyroid, diabetes and arthritis. Whereby for body mass index (BMI) among these design professionals indicates 52.2% have normal BMI which is below 25. Designers with bachelor's degree qualification dominated at 58.2% of total respondent. In terms of years of working experiences, the average years in this study was 8.5 years.

Designers spent on average 39 hours a week on computers at workplace with 75 percentile spent 45 hours a week. Also, 100 (44.5%) of those designers were found to have a side job after normal working hours. The mean hours designers spent for side job was 1 to 3 hours a week after normal nine to five working hours. The input device that was highly used by these design professionals is mouse and only 36 designers used stylus pen frequently in their daily work. Wrist support was not a common among designers with 64.2% used the desk surface to support the wrist. 82% of respondents does simple exercise or stretching between computer jobs. This study found that 165 of studied designers implement healthy lifestyle by having at least two sessions of exercise or physical activities in a week. 50.9% of the designers does not involve extensive use of hands or risky extreme hobbies such as online gaming or extreme biking that could increasing risk of CTS.

The prevalence of CTS among 225 designers participated in this research is 20% based on positive symptoms from the of Phalen's test. 11.6% of female designers were screened with CTS symptoms whereby the prevalence for male designers is at 8.4%. The study showed that prevalence of CTS is higher with age ranging 30 to 60 years old compared to young designers below 30 years old. Table 1 shows the prevalence of CTS by demographic factors,

Table 2. Association between design work characteristics and carpal tunnel syndrome (n = 225).

	CTS (%)		OR	95% CI	*P* Value
	Yes	No			
Industry Category					
Arts	37 (16.4)	120 (53.3)	2.31	1.01-5.27	0.046*
Non-Arts	8 (3.6)	60 (26.7)			
Design Profession					
Graphic Designer	21(9.3)	54 (24.0)	2.04	1.05-3.98	0.036*
Other design profession	24 (10.7)	126 (56.0)			
Hours of computer work per week					
<40 hours	40 (17.8)	154 (68.4)	1.24	0.44-3.43	0.563
>40 hours	5 (2.2)	26 (11.6)			
Side Job					
Yes	27 (12.0)	73 (32.4)	2.20	0.23-0.89	0.021*
No	18 (8.0)	107 (47.6)			
Hours of side job per week					
> 6 hours	35 (15.6)	163 (72.4)	2.74	1.16-6.49	0.022*
< 6 hours	10 (4.4)	17 (7.6)			

Significant is *p < 0.05.

which are gender, age, education level, duration of service and employment type. However, demographic factors were not found to have any statistically significant risk of CTS among these design professionals.

Table 2 shows the summary of analysis on the association between respective designers work characteristics with CTS. Designers from art fields were found to be associated with CTS with odd ratio of 2.31 compared to other fields such as automotive, architecture and manufacturing. Graphic designers were found to have significant association with prevalence of CTS with higher risk (OR 2.04) compared to others design professions that includes in this study. Spending <40 hours in a week shows OR 1.24 however it is not significantly associated with risk of CTS. Designers who had side jobs, were found to have 2.20 times risk that also statically significant with CTS risk. Designers who worked more than 6 hours for side jobs in a week were associated with risk of CTS as high as 2.7 times.

DISCUSSION

The prevalence of CTS among designers based on Phalen's test screening was found as high as 20% that could be implied that 1 out of every 5 designers suffers from this ergonomics disease. Studies in health among nurses (Ithnin et al., 2012), government servants (Shamsul et al., 2009), dentists (Munirah et al., 2014) and computer professionals (Ali et al., 2006) found 7.5%, 18%, 21.2% and 13.1% prevalence of CTS within respective populations. Therefore, the prevalence of 20% could be classified as substantial occupational disease for design population.

Designers from arts industries such as art and entertainment, advertising and publishing have higher risks to develop CTS compared to designers from

automotive, construction, architecture and manufacturing. Designers in art industries, such as in advertising and publishing have more frequent and tight deadlines compared to designers in other industries (Najmuldeen, 2021). Graphic designers found to be at higher risk of developing CTS compared to other design profession. Graphic designers mostly use mouse as input devices to operate software such as Adobe Illustrator, Adobe Photoshop and Adobe InDesign. Research performed by Tunmibi (2021) on RSI risk among graphic designers found interesting facts; as majority of graphic designers become so immersed in their computer job that they lose track of time. Graphic designers are so focused with completing the tasks before the deadline and did not observe taking a break between jobs (Tunmibi et al., 2012). Study by Kluth (2015) also confirmed that intense used of computer usage and mouse could lead to of RSI (Mohamad et al., 2010) which elevated risk of CTS.

In this research, we found that 86.5% of the designers usually work between 30 to 40 hours a week with computer whereby 31 designers usually spent between 40-50 hours weekly to complete their artworks. During early introduction of computer for design, just 4-5 hours of computer exposure was identified as one of the risk of CTS among designers (Justice, 1990). Study done by B. Blatter (2002) found that working with computers for more than 20 hours per week increases the risk of being ill and working with computers for more than 30 hours per week increases the risk of having CTS (Blatter et al., 2002). In this study, the mean of working with computers was 39 hours weekly potentially increased the risk of CTS among designers. Occupational health difficulties are likely to exist among design professionals, given the significant number of them who work long hours. Designers in general could potentially experience hand or finger pain, burning, tingling and numbness sensation and its generally normal symptoms of tired hand. In the worst case, all the symptoms mentioned could lead to symptoms of chronic disorder such as CTS or possibility of wrist tendinitis (Pastel, 2012).

In this study, the researchers identified that designers who had side jobs and spent more than 6 hours in a week were associated with risks of CTS. In the United State, almost all designers responded to 9429 sample size census stated to have side job according to the American Institute of Graphic Arts (AIGA). During computer introduction in design tasks in the late 80s, designers who are assigned with computer design spent almost the entire working hours with their computers (Justice, 1990). Current study demonstrated the situation is still very much the same where 73.9% designers were found to spend 80-90% of their working hours with computer. In this paper the maximum hours in which designers worked with computer in a week were as high as 58 hours including additional hours of side job. The demand of freelancing or side job in this social media era are numerous especially for graphic and multimedia designers. Digital poster, infographic, photo editing, short video for instance were in demand especially for companies with digital platform such as Facebook and Instagram (Dewi et al., et al., 2021). These side jobs opportunities contributed to long hours of time spent with computer among designers where it certainly elevated risk of CTS (Dogru, 2015).

CONCLUSION

There was a relatively high prevalence of CTS among graphic designers compared to other design professions. Having side jobs and working extra 6 hours weekly after normal working hours were associated with CTS. Evaluation on CTS's symptoms severity as well as functional level in daily life with CTS using Boston Carpal Tunnel Questionnaire (BCTQ) will be the way forwards for this research. This study can be considered as crucial step increase the awareness towards ergonomics prevention and planning for these design professionals.

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