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Effects of Computer Workstation Design on the Body Discomfort of Online Gamers

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Abstract

With the fast rise of e-sports, gaming setups have been a new field of discovering which standards fit the comfort of online gamers. This led to the interest in conducting this study to determine the effects of workstation designs on online gamers and the body discomfort they encounter. The researchers used data from 50 online gamers respondents in National Capital Region in the Philippines, which was analyzed using correlation analysis and a chi-square test. RULA was also used to evaluate the MSD risk of respondents. Results have shown that using a side chair, gaming keyboard, mechanical keyboard, and laptop keyboard significantly differs in a person's body posture and that most online gamers feeldiscomfort in their mid-back due to their body posture. The desk, chair, keyboard, and mouse are significantly associated with a person's body discomfort. The findings indicate that different workstation designs affect the body discomfort online gamers encounter.

Keywords
Body discomfort, RULA, online gamers, workstation design

1. Introduction
A few companies historically monopolized the gaming industry. However, in recent years, companies like Apple and Google have risen through the ranks partly due to their app store revenues from game sales (Chikhani 2015). The gaming industry is widespread nowadays as many companies develop games, whether a console, mobiles, or pc games. Their goal is to satisfy their customers, who are online gamers, by creating a new game that ensures to be on-trend; or updating the present game that most online gamers are playing. Online gamers are content with their gaming experiences because they see it as a way to unwind and communicate with people worldwide. Nevertheless, there is a risk for online gamers who tend to stay in front of their desks over time by playing online games for hours as they may feel body discomforts such as stress injuries and ailments.

Due to the prolonged time of people playing online games, their bodies may feel discomfort. Discomfort may come from excessive force, repetition of movements, and awkward posture. Wrong ergonomics may cause stresses on the body that may affect a person's hearing, vision, general comfort, and health, but with the use of ergonomic principles, discomfort may be lessened, and health may improve (Jusoh, et al. 2021)

Despite the high significance in alleviating discomfort through quality outputs, the specificity of ergonomic techniques and their versatility in any work environment has yet to be discovered. Variations of designs and style have yet to be distinguished for accurate validity in assessments (Joshi & Despande 2019). Numerous tools have been utilized to determine the significance of comfort, yet contrasts using RULA play a determining factor (Sharan & Ajeesh 2012). Lastly, the study has yet to discover its adverse effects on online gamers and how this can be differentiated with workers.

Previous research has proved that workstation design can affect employees' or workers' physical discomfort when they are in the same position for a long time. However, they could not distinguish the specific effects of workstation designs for online gamers. There was also a lack of information about techniques to assess workstation design for online gamers who spend a lot of time playing online games. In addition, studies have left unspecified results on what parts were significantly or moderately levitated despite discussions about workers being prone to higher risk levels and response to immediate changes. Moreover, in re-iterating the growing concept of online gaming, a shift to more ergonomic concerns relating to limited gaming spaces and performance-based techniques in amplifying mobility demand further inquiry.

The study aims to determine workstation design's effects on online gamers' body discomfort. The researcher's main objectives are to identify the relationship between body discomfort and body posture, the differences between the workstation design and body posture, and the relationship between workstation design and body discomfort. The findings of this study will benefit online gamers in being more aware of the factors they need to consider to enhance their workstation design. Through this research, the human-computer interaction and general comfort and health of a person may be improved by recommending suitable gaming equipment for effective productivity. This research will also help online gamers understand the risks of musculoskeletal disorders due to workstation design-related body discomfort. Identifying the risk may help gamers be more mindful of the symptoms they might be already experiencing, as it is essential for a person's well-being and minimizing the possibility of disorders.

2. Literature Review

People have been using technology in the long run as this is a wide range of tools for their convenience. Everyone uses technology for many purposes, such as entertainment, education, business, etc. Nowadays, most internet users are fond of playing online games, which is considered a popular recreational activity. Gamers play online games for various purposes, including stress relief, competitions, leisure, entertainment, social contact, and even mental escape from the actual world (Castillo et al. 2018). Some gamers stream their game sessions online to gain money from subscribers, viewers, and advertisements (Law 2022). According to the Statistical Research Department (2022), as of March 2020, 81% of males and 73% of females in the Philippines aged 25 to 34 were the most likely to play online games. There could be a possibility that the percentage changed as most Filipinos stayed at home for more than two years due to lockdown. Over time, online gamers stayed longer in front of their desks to consume time by amusing themselves through online games. This is proved by Combs (2021), which states that gamers who play for more than seven hours per week are 44%, while 25% play more than 12 hours per week. Due to this prolonged time, online gamers may experience discomfort playing online games. For this reason, many online gamers are investing and spending money on gaming, especially add-ons or accessories for their devices that improve the gaming experience (Briggs 2021). This includes online gamers' furniture and devices: gaming chairs, gaming desks, mice, keyboards, and monitors.

According to Smith (2018), a gaming chair is a modern advancement in the gaming world that has allowed players or gamers to prevent different injuries and improve their performance. It is mainly because of the gaming chair's exceptional comfort to its users, enabling them to assume proper posture. The unique adjusting capabilities of the gaming chair ensure that the body is safe and comfortable. A gaming chair allows users to adjust their sitting positions regularly. Most importantly, users can avoid risky sitting habits such as sitting in the same place over a long haul and being too close to their PC Screen. It is wise to remember that straining causes serious harm to the body, and users can avoid such by investing in a gaming chair. Furthermore, a gaming chair is specifically suited to help the body function naturally as a person plays.

Similarly, in a study by Karoney et al. (2010), the awareness of the physical and psychological effects of prolonged computer usage and the application of ergonomics in the workstation was determined. The majority (89.8%) of the respondents felt that protracted computer use harmed their health, with only 12.4% having received formal training in applying ergonomics in workstations. Results from each workstation dictate that the most used ergonomic measure is the foot placement on the floor: 100% (181), followed by correct monitor placement with 94.4% (171) fulfilling the requirements. The least applied ergonomic measures were non-reflecting wall paint: 5% (9) and adjustable desk 9.9% (18). The findings related to the duration of computer usage are essential because a long period has been essentially associated with eyestrain, neck or upper extremity pain, back pain, and psychological distress. As for ergonomics' primary intent, a suitable workstation should suit the human body's capabilities. Environmental variability at the workplace significantly impacts the quality of life and physical symptoms.

A study by Procci (2017) stated that a stagnant type of work might result in musculoskeletal disorders involving the neck, shoulder, wrists, and hands. It may also result in computer vision syndrome, including blurry vision, dry eyes, sore eyes, headaches caused by lighting issues, and poor workstation design. According to Lee et al. (2019), online gaming for four hours or more may increase physical and ocular discomfort. The study has two domains: the physical discomfort domain and the ocular discomfort domain. In the physical discomfort domain, neck discomfort after playing has the highest score, followed by shoulder discomfort, headache, and back discomfort. With these results, the study has concluded that long hours of online gaming can cause physical and ocular discomfort and that a person may also experience changes in binocular functions. Specifically, since a gamer maintains the same posture for an extended time, the neck and shoulder of the gamer can be affected. Ocular fatigue, dryness in the eyes, and blurred vision are the significant visual symptoms that gamers experience.

Similarly, based on a study by Ayenigbara (2018), many physical health disorders are caused by long-term video gaming. Video gaming could cause strain injuries, skin disorders, and pain in the upper body area. The corner, pupil, and iris are not bound to be used for long gaming time, especially on electronic devices, which is why extensive staring on the screen causes eye strain. Moreover, it can also result in headaches, dizziness, nausea, and vomiting. A pre-diagnosed epilepsy patient may also experience seizures, so being 10 feet or more away from an electronic device may lessen the risk of a seizure happening. The social environment that can be found in gaming may cause gamers to disregard symptoms often.

Thus, the position of the computer monitor is an essential part of the ergonomic design for the computer workstation. A poorly positioned monitor could introduce awkward and uncomfortable postures, eventually leading to a painful musculoskeletal disorder (MSD). When sitting upright, the eyes (horizontal eye level) should meet slightly above or at the upper 1/4th of the monitor. If possible, the monitor should also be tilted somewhat back. This adjustment ensures that you limit the movement of the neck to look at the various things on the monitor, but more specifically, that an individual should not use the upper neck to look up. Monitor distance has everything to do with how far away you are from the computer screen. The point is that a minor miscalculation in viewing distance can disrupt all the ergonomic efforts (Middlesworth 2019).

3. Methods

Survey questionnaires were developed and distributed to online gamers for data collection. The survey was distributed online for 100 participants within the National Capital Region. The survey is divided into three parts. The first part of the survey is about the demographics of the respondents, which covers the gender, age, and hours spent playing online games per day. In the second part of the survey, the respondents selected the type of device they use in their workstation design: chair, desk, monitor, keyboard, and mouse. The last part of the survey was used to assess the body discomfort the respondents experienced while playing online games. Respondents had based their level of body discomfort on a scale of 1 to 5 using the Corlett and Bishop's Body Part Discomfort Scale. Scale 1 as "No Discomfort" to Scale 5 as "Extremely Discomfort." The respondents also provided a picture of themselves on their workstations to evaluate biomechanical and postural stresses using Rapid Upper Limb Assessment (RULA), as shown in Figure 1.

Figure 1. Body Posture of Online Gamers

3.1. Rapid Upper Limb Assessment (RULA)

The Rapid Upper Limb Assessment (RULA) is the ergonomic tool used for this research. This is a rapid tool for determining biomechanical and postural stresses in the neck, trunk, and upper extremities. The RULA score system determines the urgency of investigation needed by evaluating an individual's force, posture, and movement when standing or sitting. This tool requires minimal time, effort, and equipment to assess the posture sustained for the longest time. RULA Assessment requires evaluating postural angles of six different body positions. The upper arm position, lower arm position, wrist position, and wrist twist must be examined for the arm and wrist analysis. The neck, trunk, and leg position must be examined for the neck, trunk, and leg analysis. The position score, muscle use score, and force or load score are utilized to get the final RULA score. The final RULA score indicates the level of MSD risk associated with the evaluated task.

3.2. Corlett and Bishop Body Discomfort Questionnaire

Corlett and Bishop's body map questionnaire is a subjective symptom survey tool that evaluates the respondent's direct experience of discomfort at different body parts. This tool is a subjective survey since different gamers may experience various symptoms. In this study, the researchers assessed the level of discomfort of respondents in their head and neck, shoulder, arm, middle back, lower back, buttock, thigh, knee, and leg and foot. The respondents evaluated their level of discomfort using a 5-point Likert scale (1-not comfortable, 2-barely uncomfortable, 3-quite comfortable, 4-very uncomfortable, 5-extremely uncomfortable).

3.3. Correlation Analysis

Correlation analysis was used in the study to determine the relationship of body posture as reflected in their RULA score to the body discomfort of the respondents using the Corlett and Bishop body map questionnaire. Correlation analysis is a statistical method used to measure the strength between the linear relationship of two variables and compute their association. It calculates how much change happened in one variable as the other changes. Between the two variables, if it resulted in a low correlation, they would appear that they are weakly related. On the other hand, if

it resulted in a high correlation, the two variables have a strong relationship. All p-values less than 0.05 are considered significant, while p-values with a greater value than 0.05 are insignificant.

3.4. Chi-Square Test

Chi-square test was also used in the study to determine the significant association between the body discomfort and the use of the different workstation paraphernalia such as type of device used, type of desk, type of chair, type of keyboard, and type of mouse. Correlation analysis is a statistical method used to measure the strength between the linear relationship of two variables and compute their association. It calculates how much change happened in one variable as the other changes. Between the two variables, if it resulted in a low correlation, they would appear that they are weakly related. On the other hand, if it resulted in a high correlation, the two variables have a strong relationship. All p-values less than 0.05 are considered significant, while p-values with a greater value than 0.05 are insignificant.

5. Results and Discussion

5.1. Demographic Profile

Table 1 presents the data for the demographic profile of 100 respondents that are online gamers. The respondents consist of 80 males and 20 females. 40% of the respondents are over theage of 20, 38% are 20 years old, and 22% are under the age of 20. In terms of the hours spent playing online games per day, 44% play for 3-4 hours, 30% play for 1-2 hours, 16% play 5-6 hours,while the remaining 10% play for more than 7 hours per day.

Table 1. Demographic Profile

Category	Subcategory	N	%
Gender	Male	80	80%
	Female	20	20%
Age	Below 20	22	22%
	20	38	38%
	Above 20	40	40%
Hours Spent Playing Online Games Per Day	1-2 hours	30	30%
	3-4 hours	44	44%
	5-6 hours	16	16%
	7 hours above	10	10%

On the other hand, the different workstation designs used by the respondents while playing online games are shown in Table 2. The data shows that 48% of the respondents use a computer as their device, while 52% use a laptop. Regarding the desks used by the respondents, 70% use a computer desk, 16% use a gaming desk, 10% use an adjustable desk, and 4% use a lap desk. Regarding chair types used by the respondents, 32% use an office chair, 24% use an ergonomic chair, 22% use a gaming chair, and the remaining 22% use a side chair. Regarding the different types of keyboards used by the respondents, mechanical keyboards are used by 46, whereas gaming keyboards are used by 30%, laptop keyboards are used by 16%, and membrane keyboards are used by 8%. Lastly, a gaming mouse was used by 56%, a wireless mouse by 38%, a wired mouse by 12%, and the respondents used an ergonomic mouse or a touchpad by the remaining 4%.

Table 2. Respondents' Workstation Design

Category	Subcategory	N	%
Device	Computer	48	48%
	Laptop	52	52%
Desk	Gaming Desk	16	16%
	Computer Desk	70	70%
	Adjustable Desk	10	10%
	Lap Desk	4	4%
Chair	Gaming Chair	22	22%
	Ergonomic Chair	24	24%
	Office Chair	32	32%

	Side Chair	22	22%
Keyboard	Gaming Keyboard	30	30%
	Membrane Keyboard	8	8%
	Mechanical Keyboard	46	46%
	Laptop Keyboard	18	16%
Mouse	Gaming Mouse	56	56%
	Ergonomic Mouse	2	2%
	Wired Mouse	12	12%
	Wireless Mouse	28	28%
	Touchpad	2	2%

5.2. Correlation Analysis

Table 3 shows the correlation between the body posture (RULA) and body part discomfort taken from the Corlett and Bishop's Body Part Discomfort Scale. The RULA score and the discomfort score of the upper back, upper arms, lower arms, wrist, buttocks, thigh, and legs have a calculated Pearson correlation value of 0.174, 0.048, 0.067, 0.126, 0.074, 0.075, 0.201 respectively, indicating no significant relationship with each other. On the other hand, the posture score and discomfort score between mid-back ($r=0.384$, $p=0.002$), neck ($r=0.335$, $p=0.006$), and lower back ($r=0.476$, $p<0.001$) resulted to moderate association. This means that gamers' poor posture during online gaming significantly contributed to their neck, mid-back, and lower back discomfort.

Table 3. Correlation Analysis Result

Relationship	Pearson Correlation	p-value	Remarks
RULA Score and Neck	0.335	0.006	Significant
RULA Score and Upper Back	0.174	0.228	Not Significant
RULA Score and Upper Arms	0.048	0.742	Not Significant
RULA Score and Mid Back	0.384	0.002	Significant
RULA Score and Lower Back	0.476	<0.000	Significant
RULA Score and Lower Arms	0.067	0.599	Not Significant
RULA Score and Wrist	0.126	0.385	Not Significant
RULA Score and Buttocks	0.074	0.611	Not Significant
RULA Score and Thighs	0.075	0.603	Not Significant
RULA Score and Legs	0.201	0.162	Not Significant

5.3. Chi-Square Test Result

Table 4 shows the result of the chi-square test. The chi-square test was employed to determine the association between the body discomfort and the different types of workstation designs used by online gamers. The result revealed that workstation paraphernalia that have significant association with body discomfort of online gamers are desk ($\chi^2=15.57$, $p=0.623$), chair ($\chi^2=24.41$, $p<0.001$), keyboard ($\chi^2=26.05$, $p<0.001$), and mouse ($\chi^2=22.51$, $p<0.001$).

Table 4. Chi-Square Test Result

Workstation Paraphernalia	Variables	Body Discomfort (Yes)	Body Discomfort (No)	Total	Chi-square (λ^2)	P-value
Device	Computer	12%	36%	48%	0.242	0.623
	Monitor	10%	42%	52%		
Desk	Gaming Desk	4%	12%	16%	15.574	0.001
	Computer Desk	16%	54%	70%		
	Adjustable Desk	0%	10%	10%		
	Lap Desk	2%	2%	4%		
Chair	Gaming Chair	8%	14%	22%	24.406	<0.001
	Ergonomic Chair	4%	20%	24%		
	Office Chair	4%	28%	32%		

	Side Chair	6%	16%	22%		
Keyboard	Gaming Keyboard	28%	2%	30%	26.052	<0.001
	Mechanical Keyboard	50%	2%	52%		
	Membrane Keyboard	6%	0%	6%		
	Laptop Keyboard	10%	2%	12%		
Mouse	Gaming Mouse	27%	1%	28%	22.508	<0.001
	Ergonomic Mouse	1%	0%	1%		
	Wired Mouse	6%	1%	6%		
	Wireless Mouse	12%	2%	14%		
	Touchpad	1%	0%	1%		

The present study's finding is similar to the result of previous research. For instance, a study by Jusoh et al. (2021) found that workstation design and use of different paraphernalia had a significant effect on the body discomfort of users, especially in situations involving repeated actions, uncomfortable positions, and activities requiring a lot of force that are considered ergonomic hazards. The study showed that keyboard, mouse, break and support accessories such as headphones and document ramps cause physical discomfort on the workers wherein, keyboard and mouse have a high beta value which shows that this factor plays a significant role in the persons' physical discomfort.

Similarly, a study by Procci (2017) stated that a stagnant type of work might result in musculoskeletal disorders involving the neck, shoulder, wrists, and hands. It may also result in computer vision syndrome, including blurry vision, dry eyes, sore eyes, headaches caused by lighting issues, and poor workstation design. According to Lee et al. (2019), online gaming for four hours or more may increase physical and ocular discomfort. The study has two domains: the physical discomfort domain and the ocular discomfort domain. In the physical discomfort domain, neck discomfort after playing has the highest score, followed by shoulder discomfort, headache, and back discomfort. With these results, the study has concluded that long hours of online gaming can cause physical and ocular discomfort and that a person may also experience changes in binocular functions. Specifically, since a gamer maintains the same posture for an extended time, the neck and shoulder of the gamer can be affected. Ocular fatigue, dryness in the eyes, and blurred vision are the significant visual symptoms that gamers experience.

6. Conclusion

In the present study, the researchers could determine the effects of workstation design on the body discomfort of online gamers. The researchers distributed survey questionnaires to 100 online gamers in NCR, Philippines. The data gathered shows that online gamers use workstation designs such as laptops, computer desks, office chairs, mechanical keyboards, and gaming mice to play online games. The Rapid Upper Limb Assessment (RULA) is used to evaluate MSD risk in the posture of online gamers by assessing each respondent's body posture and calculating the RULA score. The data gathered is used for correlation analysis and the chi-square test. A significant relationship between body discomfort and body posture was determined using correlation. The relationship between the body posture and neck, mid-back, and lower back have been found to have a moderate correlation. In addition, a significant association between workstation design and body discomfort was determined using the chi-square test. The desk, chair, keyboard, and mouse have a significant association with body discomfort, which means that these workstation designs affect the body discomfort of online gamers. Thus, it is recommended for online gamers to choose a workstation design appropriate for their body type. Gamers should be aware of the risks they may face when using the different types of workstation designs, and they have to improve their general comfort and reduce the risks of having MSD or any discomfort in the body.

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Biography

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