

THE RELATIONSHIP BETWEEN THE DURATION OF PLAYING ONLINE GAMES AND THE PRESENCE OF CARPAL TUNNEL SYNDROME SYMPTOMS IN MALE STUDENTS AT SMAN X

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ABSTRACT

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Background : Online games are games played using an internet connection and have recently become popular among teenagers. Playing online games for a long time can have negative impacts on health such as headaches, back pain, and carpal tunnel syndrome. Carpal tunnel syndrome is a collection of symptoms of pain, tingling, and numbness in the wrist area. The purpose of this study was to determine the relationship between the duration of playing online games and the presence of carpal tunnel syndrome symptoms in male students at SMAN X. Method: The research design used was analytic correlation with a cross-sectional approach. The population of this study was 105 people, and 51 people were sampled using a purposive sampling technique. The research instruments were a questionnaire sheet regarding the duration of playing online games and the Boston Carpal Tunnel Questionnaire. Data processing included editing, coding, scoring, tabulation, and data analysis using the non-parametric chi-square test with the SPSS program. Results: The results showed that 31 respondents (60.8%) had frequent online game playing duration and 36 respondents (70.6%) experienced symptoms of carpal tunnel syndrome. From the results of the chi-square statistical test, the P value = 0.003 is smaller than the value of $\alpha = 0.05$ ($0.003 < 0.05$), which means there is a relationship between the duration of playing online games and the prevalence of carpal tunnel syndrome in male students at SMAN X. Conclusion: The findings suggest that adolescents should be encouraged to adopt healthy gaming habits, including taking regular breaks and maintaining ergonomic hand positions during gaming activities. Symptoms of carpal tunnel syndrome can also be minimized by using soft wrist pads and regularly doing physical exercises such as opening and closing the fingers and rotating the wrist several times.

1. INTRODUCTION

In today's era of globalization, technological mastery has become a *prestige* and indicator of a country's progress. One example of the results of technological progress is the internet. People can use the internet for business, communication, and as a medium of entertainment. One function of the internet as a medium of entertainment is playing *online games*. *Online games* are games played using an internet connection and have recently become popular among everyone, from children to adults. Interest in *these online games* can lead to user addiction. *Online game* addiction is not only addictive, but can also have other negative impacts such as isolation from the outside world, decreased performance, decreased physical activity, fatigue, and decreased health (Abrue, 2017).

According to a survey by the Central Statistics Agency (BPS) in Indonesia, the number of *online game players* has increased quite rapidly, with more than 19.8 million *online game users* recorded in 2018 in Indonesia, with the majority of *online game users* being teenagers (Ministry of Health, 2018). Teenagers are considered more likely and more vulnerable to *online game addiction* than adults, because adolescence is a period of instability, making it easier to experiment with new things (Kudus, 2021).

According to data from the *Mobile Marketing Association* (2018), which conducted a study on *gaming* in Indonesia, the number of *mobile gamers* (those who play *games* on *smartphones*) in Indonesia has reached 60 million. This data also indicates that 10 million online gamers experience health problems, the highest prevalence in Southeast Asia.

Based on data from OSHA (*Occupational Safety and Health Administration*) (2014), approximately 900,000 cases of Carpal Tunnel Syndrome

were recorded and are always found in musculoskeletal disease problems. In Indonesia, the prevalence of *Carpal Tunnel Syndrome* is 5-21% in the general population with an prevalence of 5,000 cases per 100,000 people per year. The prevalence of *Carpal Tunnel Syndrome* in East Java varies quite a bit, ranging from 7.8%-42% in *mobile game users* aged 12-45 years (Ni Luh Made Susanthi Pramandani, 2021).

Based on the results of a preliminary study conducted by researchers on November 20, 2023, it was found that of the 15 male students who played *games* at SMAN X, there were 4 male students who experienced wrist pain, numbness, and symptoms consistent with CTS after playing online games, and 7 students who reported wrist pain only. This shows that there are complaints of pain and numbness in the wrist after *playing* online games in *male students* at SMAN X.

Basically, *online games* have many innovations that can be used as a means of entertainment, but many *online game players* start to become addicted and experience physical health problems, such as headaches, back pain, repetitive strain injuries, and *carpal tunnel syndrome*. (November 2019).

Carpal Tunnel Syndrome is a condition in which the *median nerve* of the wrist experiences compression (pressure) within the carpal tunnel by the *flexor tendons* in the area around the *median nerve*, which is often characterized by the appearance of tingling, pain, and numbness. *Carpal tunnel syndrome* can be caused by risk factors such as holding the hand in one position for too long, *repetitive use of flexor muscles*, and exposure to vibration (Mandias & Dengah, 2019). Furthermore, Allen, 2017 in his research added that just 5 hours a day of playing *games* can increase the risk of *Carpal Tunnel Syndrome*. (Allen, 2017). This is related to hand position and repetitive movements such as *tapping*, *swiping*, and

scrolling. Online gamers often engage in static movements, such as flexing their wrists and repeatedly moving their fingers, which increases pressure on the *carpal tunnel*, which compresses the *median nerve*. This can lead to symptoms of *carpal tunnel syndrome*, such as tingling, numbness, and wrist pain (Farhan, 2018).

The impact of *carpal tunnel syndrome* is nerve weakness in the wrist and fingers. If someone with *carpal tunnel syndrome* experiences nerve weakness, activities such as buttoning clothes, writing, grasping objects, and other activities will be impaired (Drăghici et al., 2023) and will result in decreased independence in daily life (Harahap & Ramadan, 2021).

Carpal Tunnel Syndrome often occurs in gamers due to the intensity of continuous gaming without rest and static hand positions. Therefore, it is important to manage time and hand movements while playing games (Ministry of Health, 2023). The risk of *Carpal Tunnel Syndrome* in online gamers can be prevented by reducing the intensity of gaming. Gamers are advised to play games for only 2-3 hours a day (Ministry of Health, 2023). If gamers already experience symptoms of *Carpal Tunnel Syndrome*, symptoms can be minimized by using soft pads on the fingers and wrists to reduce the level of vibration caused by gaming and doing regular physical exercise every time they stop playing. This physical exercise can be done by opening and closing the fingers and rotating the wrist several times (Ministry of Health, 2023).

In accordance with the explanation above, the researcher intends to conduct research on the relationship between the duration of playing online games and the prevalence of *Carpal Tunnel Syndrome* in male students at SMAN X.

2. METHOD

The research design used in this study is a correlative analytical method, with a cross-sectional approach, where data regarding independent variables or risks and

dependent variables or outcome variables and confounding variables will be collected simultaneously (Notoatmodjo, 2014). The researcher used this design to determine the relationship between the duration of playing online games (independent variable) and the prevalence of carpal tunnel syndrome (dependent variable) in male students at SMAN X.

The population in this study was all male students at SMAN X, with a total of 105 students. The sample size was calculated using the Slovin formula with a population of 105 students and a margin of error of 10%.

$$n = N/(1+Ne^2)$$

$$n = 105/(1+105 \times 0.1^2)$$

$$n = 51.2 \approx 51 \text{ respondents}$$

The sample of this study was part of 51 male students who play online games at SMAN X. The inclusion criteria in this study are as follows:

The inclusion criteria were male students who liked playing online games and were willing to be respondents. The exclusion criteria included students who were absent during data collection or who did not complete the questionnaire.

Ethical approval for this study was obtained from the Health Research Ethics Committee of STIKES Hutama Abdi Husada Tulungagung (No: 18/KEPKSTIKesHAH/EC/I/2024).

The sampling technique used in this study was purposive sampling. Purposive sampling is a sampling technique that selects samples from within the population according to the researcher's wishes, so that the sample can be said to represent the characteristics of the population.

The instrument used in this study was a questionnaire with a Likert scale. The independent variable was duration of online game play, measured using a gaming duration questionnaire. The dependent variable was the presence of CTS symptoms, measured using the Boston Carpal Tunnel Questionnaire (BCTQ) (2020).

The Boston Carpal Tunnel Questionnaire (BCTQ) is a standardized instrument that has been widely used to

assess the severity of symptoms and functional status in individuals with Carpal Tunnel Syndrome. Previous studies have reported good validity and reliability of the BCTQ, with Cronbach's alpha values ranging from 0.80 to 0.93. In this study, the instrument was adopted based on previous validation studies and was not revalidated in the study population.

This research was conducted from February to March 2024 at SMAN X.

The steps for collecting data in this study were to obtain research permits from the research location and other related parties, provide an explanation of the research objectives and procedures to respondents, ask respondents to sign a

consent form, then fill out a questionnaire about the duration of playing online games and the Boston Carpal Tunnel Questionnaire (BCTQ) simultaneously (cross-sectional).

To determine whether there is a relationship between the duration of playing online games and the prevalence of carpal tunnel syndrome using a laptop with the SPSS (Statistical Product and Statistics) technique with the Chi-square test. Statistical significance was determined at $\alpha = 0.05$. If $p < 0.05$, H_0 was rejected and H_1 was accepted, indicating a statistically significant association between the variables. If $p \geq 0.05$, H_0 was accepted, indicating no statistically significant association between the variables.

3. RESULTS AND DISCUSSION

RESULT

1. Duration of Playing Online Games

Table 1 Distribution of Online Game Playing Duration

Duration of Playing Online Games	Frequency	Percentage (%)
Normal	8	15.7
Often	31	60.8
Excessive	12	23.5
Total	51	100

Source: Primary Research Data, 2024

Table 1 shows that the majority of respondents had a frequent duration of online gaming, accounting for 31 respondents (60.8%).

2. Carpal Tunnel Syndrome

Table 2 Distribution Frequency Carpal Tunnel Syndrome Symptoms

Carpal Tunnel Syndrome (CTS) Symptoms	Frequency	Percentage (%)
CTS (+)	36	70.6
CTS (-)	15	29.4
Total	51	100

Source: Primary Research Data, 2024

Table 2 shows that most respondents experienced CTS symptoms, accounting for 36 respondents (70.6%).

3. Game Play Duration

Table 3. Duration of Playing Online Games and Carpal Tunnel Syndrome in Male Students at SMAN X

Duration of playing <i>online</i> <i>games</i>	Presence of CTS symptoms					
	CTS (+)		CTS (-)		Total	
	F	%	F	%	F	%
Normal	4	50.0	4	50	8	100
Often	25	80.6	6	19.4	31	100
Excessive	7	58.3	5	41.7	12	100
Total	36	70.6	15	29.4	51	100

Source : Data Study Main Year 2024

The table shows that the highest proportion of CTS symptoms was found among respondents with frequent gaming duration (80.6%).

4. Table 4 Chi-square Test

Variabel	χ^2 (Chi-Square)	df	Sig. (2-sided)
Duration of online gaming and Presence of CTS symptoms	15.327	2	0.000

Based on the results of statistical tests using *the Chi-Square test, the Sig. (2-sided) value* obtained = 0.000, which means $\alpha < p$ (0.05). Because the p value is smaller than 0.05, H_0 is rejected and H_1 is accepted. Thus, the results indicate a statistically significant association between online gaming duration and CTS symptoms among male students at SMAN X.

In addition to the Chi-square analysis, the distribution of CTS symptoms was examined across gaming duration categories. Respondents with longer gaming durations tended to report CTS symptoms more frequently than those with normal gaming durations. The Chi-square test indicated a statistically significant association between online gaming duration and the presence of CTS symptoms ($p = 0.003$).

DISCUSSION

A. Duration of Playing Online Games

Based on the results of the research that has been conducted, table 4.3 shows that the data on the duration of playing *online games* for the majority of

respondents is in the frequent category, namely 31 respondents (60.8%).

Duration is the length of time something lasts, from start to finish. *Online gaming, on the other hand*, is a physical activity performed using a *gaming application* played over the internet, either on a computer or *smartphone*. (Zamaludin et al., 2023) . So, the duration of playing *online games* is the length of time a person spends playing *online games* using a device, be it a *game console*, computer, or *smartphone*, from start to finish without doing other activities. According to Surbakti (2017), the duration of playing *online games* is divided into three categories, including the duration of playing *online games normally* (1-3 hours), *the duration of playing online games frequently* (4-7 hours) and *the duration of playing online games excessively* (>7 hours).

According to Surbakti (2017), several factors influence the duration of *online gaming*, including internal factors, psychological state, game type, and environmental factors. Researchers found that, after examining the consistency of

facts and theories, the duration of *online gaming* varies from person to person, depending on the influencing factors. Similarly, internal factors, including age and gender, significantly influence the duration of *gaming*.

games by age in table 5 in the appendix, the results show that almost half of the respondents aged 15-16 years have *excessive game playing duration*, namely 4 respondents (26.6%), while no respondents aged > 18 years have *excessive game playing duration*.

The results of this study are in accordance with Sarwono's (2017) theory which states that teenagers aged 15-18 years have a tendency to play *games* for >3 hours a day.

Sarwono's theory (2017) states that the psychological stages of adolescence are divided into three, namely early adolescence (12-14 years), *middle adolescence* (15-18 years), and late adolescence (19-21 years). *Middle adolescence* This is the stage of adolescence when a person needs friends. Teenagers at this stage feel happy and confused about making the right choices. Psychological changes in *mid-adolescence* lead to a tendency to play *online games* for longer periods of time than in early or late adolescence.

Sarwono also stated that as adolescents grow older, their psychological state matures. By late adolescence, adolescents develop a more focused interest in themselves, develop an ego to seek new experiences, and develop critical thinking skills in determining what is right.

This is in accordance with research conducted by Nurazmi, Elita, and Dewi (2018) which stated that *online game players* are dominated by teenagers aged 15-18 years with a total of 250 people (93.6%) out of 267 people. This research is in line with research conducted by Jaya (2018) which stated that 45.3% of 3,264 students who played *online games* during the last month said they did not want to

stop. These students played *online games* for 4-5 days per week with an intensity of 4 hours a day (Nurazmi, 2018). According to Jaya (2018), playing *online games* cannot be done in a short time, most *online game players* who are addicted will play *online games* continuously for more than 5 hours to complete the missions given by *the game* (Jaya, 2018).

According to researchers, after observing the alignment of facts and theories, it can be concluded that age is a significant factor influencing the duration of *online gaming* among adolescents. During middle adolescence, adolescents focus on enjoying their teenage years by playing games. This allows them to explore *new experiences*, make new friends, and increase their sense of satisfaction with their teenage years. As adolescents approach adulthood, their focus shifts from gaming to thinking about the future. Therefore, as adolescents age, their online gaming duration *decreases*, and conversely, online gaming duration increases during middle adolescence.

Gaming can also be influenced by environmental factors, one of which is easy access to technology. Rapid technological advances have made it easier for teenagers to access *online games* using *smartphones* and other devices. Furthermore, many places offer *online gaming facilities, such as internet cafes and PS/PS rentals, which offer 24-hour online gaming*.

Based on the duration of *online gaming used, the results of the study showed that respondents who used smartphones mostly* had durations in the frequent category, namely 25 respondents (60.8%), and a small portion had durations in the normal category, namely 3 respondents (7.9%). Meanwhile, respondents who used *game consoles* mostly had durations in the normal category, namely 3 respondents (60%), and none had durations in the *excessive gaming category*.

In general, teenagers today use *smartphones* as a means of communication because they are considered more effective and easy to carry. In addition, *smartphones* can be purchased at affordable prices compared to other devices. When teenagers do not have devices such as computers and *game consoles*, they must go to internet cafes or PS rental places to play *games*. Places such as internet cafes and PS rental places implement a pay-per-use system. Therefore, the duration of playing games on computers and *game consoles* tends to be normal. Meanwhile, there are no restrictions on *smartphone use*, both for playing *online games* and accessing other devices. This reason causes teenagers to tend to use smartphones compared to other devices. The results of this study are in line with the theory of Surbakti (2017), which states that smartphones can increase a person's gaming time.

This research is supported by research conducted by Jarmi and Rahayuningsih (2017) on children aged 17-18 years at SMAN 1 Banda Aceh City which showed that the duration of playing *online games* in the duration range of >3 hours was 60.9% of students with the majority using *smartphones* to access *online games* as much as 65.8% (Jarmi & Rahayuningsih, 2017). In addition, the results of research conducted by Marhaeni, Adnyana, and Widiyanti (2020) found that more students played *online games* using *smartphones* with frequent durations in a day and a small portion used *Playstation devices* with normal durations (Marhaeni et al., 2020).

Based on the facts and theories above, it can be concluded that environmental factors, such as easy access to technology, significantly influence the duration of gaming among adolescents. Easily accessible gaming facilities lead to increased frequency of gaming among adolescents. Therefore, the easier access to gaming facilities, the more time adolescents spend playing.

B. Presence of Carpal Tunnel Syndrome Symptoms in Male Students at SMAN X

Most male students at SMAN X experienced *carpal tunnel syndrome symptoms*, namely 36 respondents (70.6%). *Carpal Tunnel Syndrome* (CTS) is a common medical condition that causes pain, numbness, and tingling in the affected individual's hands and arms. *Carpal tunnel syndrome* occurs when the *median nerve* is compressed or compressed as it passes through the wrist. It is also a *neuropathy* caused by prolonged repetitive movements in a monotonous position.

Harahap (2021) suggests that several factors contribute to *carpal tunnel syndrome*, including body mass index (BMI) and a history of medical conditions such as fractures and diabetes. Other factors include the duration and frequency of *online gaming*. The duration and frequency of *online gaming* can increase the risk of *carpal tunnel syndrome* due to *repetitive motions*. These *repetitive motions* involve repeated movements in the same position, such as pressing, scrolling, and bending the wrist and fingers.

These *repetitive movements* can compress the *median nerve*, causing pain, stiffness, and tingling in the wrist and fingers (Harahap & Ramadan, 2021).

Another theory that aligns with the above is Lazuardi's (2017) vibration theory. According to this vibration theory, *carpal tunnel syndrome symptoms* can also be caused by the effects of long-term use of vibrating devices on the wrist. The use of electronic devices such as *smartphones*, computers, and *game consoles* that produce vibrations can cause *epineural edema* in the *median nerve*.

Carpal tunnel syndrome based on the devices used in table 8 in the appendix, it can be seen that most respondents who use *smartphones* experience Presence of CTS symptoms

namely 28 respondents (73.7%).

The longer and more frequently a person is exposed to vibration on their wrist, the greater their risk of developing CTS (Carpal Tunnel Syndrome). This is because vibration reduces the elasticity of the muscles and tendons around the wrist and causes swelling of the median nerve in the wrist area. This swelling can cause pain, stiffness, and tingling.

This is similar to research conducted by Woo et al. in 2017 in the journal *Muscle. and Nerve* entitled “*Effects of Excessive Use of Electronic Devices by University Students in Relation to Clinical Status and Anatomical Variations of the Median Nerve and Transverse Carpal Ligament*”, states that excessive use of electronic devices can affect the median nerve in the carpal tunnel and the transverse carpal ligament, causing numbness, tingling, and pain in the hands, especially when using electronic devices (Woo, Aljomaa et al., 2017).

Based on the facts and theories above, it can be concluded that the duration and frequency of gaming, as well as prolonged exposure to vibration in the wrist area, are factors that significantly influence the occurrence of carpal tunnel syndrome. Researchers argue that more frequent exposure to continuous vibration in the wrist can increase the risk of Carpal Tunnel Syndrome (CTS). This is due to the repetition and combined exposure of both forces. Continuous repetition of vibration can double the risk of developing Carpal Tunnel Syndrome (CTS).

The longer a person is exposed to vibration from online gaming devices, the greater the risk of developing Carpal Tunnel Syndrome.

C. Relationship Between the Duration

of Playing Online Games and the Presence of Carpal Tunnel Syndrome Symptoms

The findings of this study revealed a statistically significant association between the duration of online gaming and the presence of Carpal Tunnel Syndrome (CTS) symptoms among male students at SMAN X ($p = 0.003$). This finding indicates that students who spend longer periods playing online games tend to report CTS symptoms more frequently than those who spend less time gaming. The results suggest that prolonged gaming activities may contribute to the occurrence of musculoskeletal complaints, particularly those affecting the wrist, hand, and fingers. Although the present study cannot establish causality due to its cross-sectional design, the observed association highlights the importance of considering gaming duration as a potential factor related to CTS symptoms among adolescents.

Based on the distribution of respondents, the majority of students reported playing online games for 4–7 hours per day. At the same time, a large proportion of respondents experienced symptoms commonly associated with CTS, including wrist pain, numbness, tingling sensations, burning sensations, hand weakness, and discomfort during daily activities. These findings indicate that prolonged exposure to repetitive hand movements may place excessive mechanical stress on anatomical structures within the wrist. As gaming activities become increasingly popular among adolescents, prolonged and repetitive use of smartphones, tablets, computers, and gaming consoles may increase the likelihood of developing upper-extremity musculoskeletal symptoms.

The relationship identified in this study can be explained through several physiological and biomechanical mechanisms. During online gaming

activities, players continuously perform repetitive movements involving the fingers, thumb, and wrist. These movements include tapping, swiping, clicking, gripping, and maintaining static hand positions for prolonged periods. Repetitive movements may increase friction between tendons and surrounding tissues within the carpal tunnel. Continuous tendon activity can contribute to inflammation and swelling of the flexor tendons, thereby reducing the available space within the carpal tunnel and increasing pressure on the median nerve. Compression of the median nerve may subsequently produce symptoms such as numbness, tingling, pain, decreased sensation, and reduced hand function, which are characteristic manifestations of CTS.

In addition to repetitive movements, prolonged gaming sessions often involve poor ergonomic postures. Many adolescents play games while sitting in non-ergonomic positions, bending their wrists excessively, or maintaining static postures for several hours without sufficient rest. Sustained wrist flexion or extension has been shown to increase intracarpal tunnel pressure and may contribute to nerve compression. Furthermore, prolonged static muscle contraction can reduce blood circulation to the muscles and soft tissues of the upper extremities, resulting in muscle fatigue and discomfort. These physiological responses may explain why students who engage in longer gaming durations tend to report more CTS-related symptoms.

The findings of this study are consistent with previous research investigating the association between electronic device use and CTS symptoms. Haditya et al. (2024) reported a significant relationship between online gaming duration and CTS symptoms, indicating that individuals who played games for longer periods were more likely to experience symptoms associated with

median nerve compression. Similarly, Ratnawati et al. (2020) found that intensive gaming behavior among adolescents was associated with an increased occurrence of wrist discomfort and CTS-related complaints. Mandias and Dengah (2019) also reported that prolonged internet and smartphone use may contribute to musculoskeletal disorders affecting the upper extremities. The consistency of these findings strengthens the assumption that excessive gaming duration may be associated with an increased likelihood of CTS symptoms.

The results of this study are also supported by occupational health theories explaining that repetitive work-related activities involving the hands and wrists are important risk factors for CTS. Although gaming is generally considered a recreational activity rather than an occupational task, the biomechanical demands imposed on the hand and wrist may be comparable to repetitive occupational activities. Therefore, excessive gaming behavior may expose adolescents to similar ergonomic risks traditionally observed in occupations requiring repetitive hand movements, such as computer operators, assembly-line workers, and office employees.

Another important consideration is the increasing prevalence of digital technology use among adolescents. In recent years, online gaming has become one of the most common recreational activities worldwide. The widespread availability of smartphones and internet access has enabled adolescents to engage in gaming activities for extended periods each day. Consequently, the potential health consequences associated with excessive gaming have become an emerging public health concern. While many studies have focused on psychological and behavioral impacts of gaming, the physical health effects, particularly musculoskeletal disorders such as CTS, have received comparatively

less attention. Therefore, the findings of this study contribute valuable evidence regarding the potential physical health consequences of prolonged gaming among adolescents.

Despite the significant association observed in this study, several factors that may influence CTS symptoms were not examined. Variables such as age, body mass index (BMI), duration of smartphone use outside gaming activities, ergonomic posture, previous musculoskeletal disorders, hand dominance, and physical activity levels may also contribute to the occurrence of CTS symptoms. These variables may act as confounding factors and should be included in future studies to provide a more comprehensive understanding of the relationship between gaming behavior and CTS symptoms.

Several limitations should also be acknowledged when interpreting the findings. First, the cross-sectional design only measures exposure and outcome simultaneously and therefore cannot establish temporal relationships or causality. Second, data were collected using self-reported questionnaires, which may be affected by recall bias and subjective interpretation of symptoms. Third, the study was conducted in a single school with a relatively limited sample size, which may restrict the generalizability of the findings to broader adolescent populations. Future studies employing longitudinal designs, larger sample sizes, and objective clinical assessments of CTS are recommended to strengthen the evidence regarding the effects of prolonged gaming on musculoskeletal health.

Nevertheless, the present study provides important evidence that longer durations of online gaming are associated with a higher presence of CTS symptoms among male students. These findings highlight the importance of promoting healthy gaming behaviors, including regular rest breaks, ergonomic

positioning of the hands and wrists, stretching exercises, and increased awareness of musculoskeletal health. Such preventive measures may help reduce the occurrence of CTS symptoms and support healthier gaming practices among adolescents.

Although a significant association was identified, the present study did not control for potential confounding variables such as body mass index, ergonomic posture, duration of smartphone use outside gaming activities, previous musculoskeletal disorders, and physical activity level. Future studies should incorporate multivariable analyses to adjust for these factors. Another limitation of this study is that the gaming duration questionnaire and the adapted BCTQ were not revalidated in the study population before data collection.

4. CONCLUSION

Based on the research results presented in the previous chapter, the researchers can draw the following conclusions:

- a. The results of the identification of the duration of playing online games among male students at SMAN X concluded that the majority of respondents had a frequent duration of playing online games (4-7 hours), namely 31 respondents (60.8%).
- b. The presence of carpal tunnel syndrome symptoms among male students at SMAN X showed that the majority of respondents experienced carpal tunnel syndrome, namely 36 respondents (70.6%).
- c. This study found a statistically significant association between the duration of online gaming and the presence of Carpal Tunnel Syndrome (CTS) symptoms among male students at SMAN X ($p = 0.003$). Students who spent longer

periods playing online games were more likely to experience CTS symptoms compared with those who played for shorter durations. These findings suggest that prolonged gaming activities may be related to musculoskeletal complaints involving the wrist and hand. However, because this study used a cross-sectional design, the results should be interpreted as an association rather than evidence of a causal relationship.

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