The Effects of Esports Experience on Hand Function, Strength, Coordination and Pain in Elite League of Legend Players

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Abstract

Introduction: Esports, also called electronic sports, refers to organized multiplayer video game competitions where players or teams compete against each other. With the increasing popularity of e-sports, the fact that these sports involve sitting for long periods of time indicates that they can cause physical problems and may occur in that region as they frequently used the hand region.

Objective: This study aims to assess the relationship between e-sports experience and hand function, strength, coordination and pain in professional e-sports athletes.

Method: Twenty professional esports players (mean age; 18.50±1.90 years) participated voluntarily. Hand grip strength with a Jamar hand dynamometer, hand function disability and symptoms with the Disability of Arm Shoulder and Hand Questionnaire (DASH) and Participants' pain levels with the Visual Analog Scale, hand coordination with The Purdue Pegboard Test were measured.

Results: The results revealed a significant moderate correlation (r=0.443; p<0.05) between the duration of e-sports experience and DASH scores, indicating potential hand function issues. Furthermore, a significant difference in DASH scores was observed based on the duration of e-sports experience (t=-2.203, p=0.041). Additionally, A positive, statistically significant relationship was demonstrated between daily e-sports time in hours and VAS (r=0.472; p=0.035). There was a statistically significant difference regarding dominant hand measurement according to e-sports experience years between the groups (t=-2.101; p=0.049).

Conclusion: These insights are of great importance for a deeper understanding of hand related parameters in e-sports athletes and contribute to the development of effective strategies and interventions for injury prevention and health promotion in this field.

Keywords: Esports, Gaming, Hand, Pain, Coordination, Function.

INTRODUCTION

Esports, also called electronic sports (e-sports) or competitive gaming, refers to organized multiplayer video game competitions where players or teams compete against each other. The popularity of e-sports has risen over the nearly 70-year history of computer gaming. Referred to as e-sports, this new form of professional gaming has emerged as a crucial and immensely popular aspect of video game communities, especially among adolescents and emerging adults. Over the years, the prize money in esports has undergone a remarkable surge, reaching unprecedented heights. Additionally, the number and scale of events have consistently expanded yearly, catering to the growing demand from players and fans alike. Furthermore,

the emergence of e-sports betting has added another dimension to the industry, allowing enthusiasts to engage with their favorite teams and players in a new and exciting way (1-4).

E-sports is characterized by many individuals dedicating long hours to playing computer games. Similar to watching TV, using a computer or smartphone, playing video games is a sedentary activity that involves prolonged periods of inactivity and sitting. These sedentary habits are known to increase the risk of non-communicable diseases and overall mortality (5-9).

Playing video games, in addition to a seated position, demands precise motor skills. Immersion in virtual environments necessitates repetitive movements of the arms, wrists, hands, and fingers, making it comparable to certain forms of office work or even more physically demanding activities. With regards to computer usage, studies have explored the relationship between mouse usage and musculoskeletal symptoms, revealing that mouse use can contribute to discomfort in the neck and wrist, particularly due to arm posture. The risk factors for forearm pain in computer-related jobs, specifically mouse usage, have been highlighted as well (10). Extended computer usage and prolonged sitting have been found to significantly impact the upper extremities, resulting in various musculoskeletal problems. Physiotherapists often encounter issues related to the neck, shoulders, and back, mainly due to the seated position and the choice of chair or table, which can strain the stabilizing muscles, leading to occasional pain (11). Repetitive strain injuries, caused by the impact of fingers on the mouse or keyboard, can also occur, especially if users do not have specialized gaming accessories. Wrist compression can lead to conditions such as carpal tunnel syndrome, resulting in various hand problems. Additionally, a sedentary lifestyle associated with screen-based activities, including playing video games, can contribute to muscle problems like tendon shortening, strength loss, fatigue, and other issues throughout the body, such as circulatory problems, obesity, and more (10,12).

A study conducted by Lindberg et al. (13), provides compelling insights into the prevalence and implications of musculoskeletal (MSK) pain in e-sports athletes. This com-prehensive study comprised 188 Danish e-sports athletes aged between 15-35 years and revealed that an alarming 42.6% of the participants reported experiencing MSK pain in the previous week. A key finding was that the most prevalent site of this pain was the back, with a substantial 31.3% of athletes reporting back pain. Moreover, a noteworthy correlation was identified between MSK pain and the volume of e-sports-related training. Intri-guingly, the athletes experiencing MSK pain participated significantly less in e-sports training compared to those who were pain-free. According to a study by Fathuldeen et al. (14), with 116 participants, 86.2% (approx-imately 100 individuals) reported at least one gaming-related musculoskeletal injury. The areas most affected were the lower back (63.8%, equivalent to roughly 74 individuals), neck (50%, about 58 individuals), hand/wrist (44.8%, approximately, 52 subjects), and shoulder (35.3%, 41 subjects).

According to a systematic review, excessive video gaming durations, particularly those exceeding 3 hours per day, have been identified as a predictor for the onset of musculoskeletal disorders. The most reported symptoms of these disorders include neck, shoulder, and back pain. The study further underscores that as video gaming duration increases, so does the likelihood of musculoskeletal disorders, with odds ratios (ORs) significantly increasing between 1.3 to 5.2 in eight out of ten studies that reported ORs. These findings highlight the need for the development of targeted and tailored prevention and health promotion programs specifically for e-sports athletes and gamers in general. This is a crucial public health matter that brings attention to the potential conse-quences of the sedentary lifestyle and repetitive

movements engendered by video gaming (10). Furthermore; a study Ekefjärd et al. (15), conducted a cross-sectional study to determine the prevalence of self-reported musculoskeletal pain among professional gamers, as well as its potential correlation with various lifestyle factors. Out of the 40 professional gamers who responded to their electronic survey, a significant 62.5% (25 subjects) reported experiencing at least one physical symptom in the three months leading up to the survey. The study discovered a notable correlation between the amount of time spent gaming and the reported physical symptoms. More specifically, those who played more than 35 hours per week were eight times more likely to report physical symptoms (OR=8.0; 95% CI 1.4-44.6, p=0.018).

The emergence of e-sports as a prominent form of athletic competition has brought about new challenges in managing the health of e-sports athletes. Despite the increasing popularity of e-sports, the physical ailments experienced by these athletes, often attributed to prolonged sedentary behavior, have been underreported and potentially overlooked (16). Research indicates a high prevalence of musculoskeletal complaints among elite League of Legends players, particularly in relation to hand function, strength, coordination and pain. These findings highlight the need for further investigation into the effects of e-sports experience on the physical well-being of players in order to develop appropriate interventions and support systems to ensure their long-term health and performance (17).

To the best of our knowledge, no previous studies have examined the relationship between e-sports experience and hand function, strength, pain and coordination. Therefore, the primary objective of this study is to investigate the effects of e-sports experience on hand function, strength, coordination and pain among elite League of Legends players. Additionally, this study aims to compare the effects of e-sports experience on hand function, strength, coordination and pain. By specifically focusing on the impact on hand functionality, muscular strength and coordination as well as the presence of pain, this research aims to enhance our understanding of the physiological demands and potential risks associated with participating in competitive e-sports. The findings of this study will provide valuable insights for player health management and contribute to the development of targeted interventions aimed at optimizing performance and minimizing potential adverse effects.

METHOD

Study Design

The present cross-sectional study was conducted at the Sportscare Clinic among elite male e-sports athletes. Before the study, all participants were informed about the study and read and signed the informed consent form. The data collected at the end of the study were analyzed with G*Power 3.0.10 program and power analysis was made. The power of the study was determined as 80% for a sample of 20 people with a 5% margin of error and a defined effect size. Firstly, twenty Elite League of Leg-ends athletes were included to the study according to inclusion criteria. Then, the clinical evaluations are performed. All e-sports athletes were evaluated in terms of hand disability, function, strength and pain by same physiotherapists. The study was approved by the decision of the Interventional Clinical Research Ethics Committee in accordance with the Declaration of Helsinki (protocol number: 158).

Participants

The study included 20 elite male e-sports athletes who play League of Legends in Istanbul. Inclusion criteria were determined as being an e-sports player for at least one year, aged between 18 and 25, and belonging to the group of professional e-sports athletes. Players were

excluded from the study if they had had a history of systemic diseases, surgery related to hand fractures or injuries, or recent receipt of local steroid injection or physiotherapy within the past six months and the presence tumor.

Assessment Procedures

After informed consent, a structured questionnaire was filled out through face-to-face to collect their socio-demographic conditions (age, gender, body mass index, presence of chronic diseases, hand dominance and training habits). Additonally, 20 professional male e-sports athletes were questioned in terms of previous injuries and surgery they had experienced in the last 6 months initially. All athletes were evaluated in terms of hand disability, function, strength, and pain. All measurements were made by determining the rest times when e-sports players were not involved in training or competition. The same physiotherapist carried out the evaluations at the same time intervals in a quiet room, closed to external stimuli, with suitable lighting and ventilation. Before assessment, athletes were rested for 2 hours.

Upper Extremity Disability Evaluation

Hand function was assessed using The Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire is a reliable and validated instrument. This questionnaire evaluates all upper extremity functions and consists of a total of thirty questions. 21 of the questions of the questionnaire question the ability to perform functional activities, 5 of them about pain and 4 of them about the psychosocial effects of the disease. Each question is scored using a 5-point Likert scale with a range of 1-5. The total score of the questionnaire varies between 0-100 points, higher scores indicate better functional status (18,19).

Pain Assessment

Hand pain was assessed using a Visual Analogue Scale (VAS) a widely recognized tool for pain assessment. The athletes were asked to mark their current level of pain on the VAS, providing a visual measure of their pain experience. Participants were asked to indicate pain severity they felt on a 10 cm horizontal line, ranging from 0 to 10. Zero shows no pain and 0 is intolerable pain. Pain intensity was recorded by measuring the value of the marked place in cm. Higher values indicate more severe pain (20,21).

Strength Measurements

Handgrip strength was evaluated using a Jamar Hand Dynamometer, which is a standardized and validated tool. For each of the tests of hand strength, the subjects were seated with their shoulder adducted and neutrally rotated, elbow flexed at 90°, forearm in a neutral position and wrist between 0° and 30° dorsiflexion and between 0° and 15° ulnar deviation. The testing protocols consisted of two maximal isometric contractions for 5 s, alternating from left to right with a 1-minute rest between measurements and the highest value was used for determination of maximal grip strength. The process was repeated on the dominant and non-dominant sides, and the averages were recorded in kg (22).

Manual dexterity and Coordination Assessment

The Purdue Pegboard Test was used to assess hand coordination and manual dexterity. The test has five more subtests. While one of them involves mathematical addition, in the other tests the athletes do the tasks actively. While scoring the test, the pins, washers and nuts inserted in the given time were counted. For this evaluation, three different measurements were taken from the athletes and the highest value of measurements was recorded (23).

Statistical Analysis

The data were analyzed using SPSS version 27.0 Significance was set at 0.05 (p ≤ 0.05) a priori. The Kolmogorov–Smirnov test was used to test the normality of data distribution. While descriptive statistics for normally distributed numerical variables are given with mean and standard deviation. Parametric methods were used for measurement values suitable for normal distribution. Parametric methods, including the Independent Sample T-Test, were used for measurement values suitable for normal distribution while non-parametric methods, the Mann-Whitney U-Test method was used for the measurement values that did not conform to the normal distribution. Additionally, relationships between variables were calculated with Pearson correlation test in normally distributed data. In cases where at least one quantitative variable did not show a normal distribution, the "Spearman" correlation coefficient was used.

RESULTS

Bu bölüm Times New Roman ve 12 punto ile yazılmalıdır. Her başlıktan ve paragraftan sonra alt boşluk eklenerek yeni paragrafa geçilmelidir.The data on the physical characteristics of the athletes included in the study are shown in Table 1. According to the table, it was observed that the mean age of the participants was 20.85±2.32 (years). It was found that participants 55.0% were above 21 years and 70.0% had the right-hand dominant. Also, Table 1 showed that 60.0% (n=12) of participants were overweight. 60.0% of all athletes included in the study had e-sports experience of above 4 years, 55.0% (n=11) had a daily e-sport activity time of above 9 hours, and all athletes do not participate in any sports activity. Table 1 also indicated that 50.0% of all athletes slept below 7 hours daily (Table 1).

Table 1. Characteristics of Esports Players

Variable (N=20)	n	%
Age [$\overline{X} \pm SD \rightarrow 20.85\pm2.32$ (years)] ≤20 ≥21	9 11	45.0 55.0
Gender **Male**	20	100.0
Dominant hand Right Left	14 6	70.0 30.0
BMI [$\overline{X} \pm SD \rightarrow 20.85\pm2.32$ (kg/m^2)] Normal (18.5 kg/m^2 ≤ BMI ≤24.9 kg/m^2) Overweight (25.0 kg/m^2 ≤ BMI ≤29.9 kg/m^2)	8 12	40.0 60.0
E-sports experience [$\overline{X} \pm SD \rightarrow 3.80\pm1.32$ (years)] ≤3 year ≥4 year	8 12	40.0 60.0
Daily E-sports time [$\overline{X} \pm SD \rightarrow 8.63\pm1.46$ (hours)] ≤8 hour ≥9 hour	9 11	45.0 55.0
Physical activity No	20	100.0
Daily sleep time [$\overline{X} \pm SD \rightarrow 7.80\pm1.56$ (hours)] ≤7 saat ≥8 saat	10 10	50.0 50.0

Data expressed as mean ± standard deviation fand percentages (**%**), SD: Standard deviation. n: number of participants, BMI: Body mass index.

As shown in Table 2, a statistically significant difference was found in terms of DASH scores according to e-sports experience duration classes (t=-2.203; p=0.041). E-sports players with four and more than four years of sports experience had worse scores in terms of disability compared to those with three and less than three years of sports experience. However, Table 2 also revealed that there was no statistically significant difference in Purdue Pegboard measurement values according to e-sports experience (p>0.05). It was determined that the e-sports experience duration was similar regarding the specified features. Moreover, as seen in Table 2, there was a statistically significant difference regarding dominant hand measurement according to e-sports experience between groups while (t=-2.101; p=0.049). It was found that those with four and more than four years of e-sports experience had significantly higher dominant hand strength than those with three and less than three years of experience. Contrarily, there is no statistically significant difference in terms of VAS scores according to e-sports experience between groups. (p>0.05, Table 2).

Table 2. Comparison of Hand Disability, Function, Strength And Pain Scores By Esports Experience İn Years

Sports Experience	≤3 years (n=8)		≥4 years (n=12)		t/z value P value
Variable (N=20)	$\overline{X} + SD$	Median	$\overline{X} + SD$	Median	
DASH score	2.01±1.65	2.5	3.85±2.09	3.8	t=-2.203 **p=0.041**
Purdue Pegboard score	29.38±4.66	29.0	27.58±3.06	26.0	Z=-0.794 p=0.427
VAS score	2.75±0.71	3.0	3.50±1.00	3.5	t=-1.831 p=0.084
Dominant hand grip strength (kg)	38.50±2.84	39.0	40.58±1.61	41.3	t=-2.101 **p=0.049**
Non- dominant hand grip strength (kg)	36.94±2.31	36.8	38.88±3.06	39.0	Z=-1.129 p=0.256

Data expressed as mean ± standard deviation and median. "Independent Sample-t" test was used to compare the measurement values for normal distribution. Mann-Whitney U" test was used for it did not conform to the normal distribution. VAS: Visual Analogue Scale, DASH: Disabilities of the Arm, Shoulder and Hand.

A positive, weak, and statistically significant relationship was found between e-sports experience in years and DASH (r=0.443; p=0.049). Also, there was a positive, moderate, and statistically significant relationship between e-sports experience in years and VAS (r=0.591; p=0.006). As e-sports experience years increase, VAS score will increase. A positive, weak, and statistically significant relationship was demonstrated between daily e-sports time in hours and VAS (r=0.472; p=0.035, Table 3).

Table 3. Relationships Between E-Sports Experience İn Years And Daily E-Sports Duration İn Hours Measurement Values

Correlation* (N=20)	E-sports experience (years)		Daily E-sports time (hours)	
	r	p	r	p
DASH score	0.443	**0.049**	0.423	0.063
Purdue Pegboard score	-0,197	0.406	0,283	0,241
Dominant hand strength	0.186	0.490	0.086	0.544
Non- dominant hand strength	0,122	0,637	-0,156	0,516
VAS score	0.591	**0.006**	0.472	**0.035**

*Pearson correlation coefficient was determined when examining the relationships of two quantitative variables with normal distribution. In cases where at least one quantitative variable did not show a normal distribution, the "Spearman" correlation coefficient was used. DASH: Disabilities of the Arm, Shoulder and Hand, VAS: Visual Analogue Scale.

DISCUSSION

The current study aimed to examine the association between e-sports experience and hand function, disability, strength, and pain. The findings of the study revealed some interesting insights into the literature. Specifically, individuals with four or more years of e-sports experience exhibited significantly higher scores on DASH questionnaire than those with three or fewer years of experience. This suggests that a longer duration of e-sports engagement may increase the likelihood of experiencing hand function problems and upper extremity injuries. Moreover, the study also found a significant difference in dominant hand strength between individuals with longer versus shorter e-sports experience. However, no significant differences were observed in non-dominant hand strength, hand function, or pain levels between the two groups.

The world of e-sports has seen exponential growth in recent years, with professional players competing at the highest levels and capturing the attention of millions of fans worldwide (24). However, behind the thrilling matches and electrifying moments lies a physical challenge that many e-sports athletes face musculoskeletal pain (25). Engaging in long hours of practice and intense gameplay sessions can take a toll on the body, resulting in various musculoskeletal issues. The repetitive movements and prolonged periods of static positioning can lead to discomfort and pain in different areas of the body, particularly the neck, shoulders, wrists, and hands. Recognizing the prevalence of musculoskeletal pain in e-sports players, it is crucial to address these issues proactively (10). The survey study conducted by Lindberg et al. (13), on 188 athletes examined the effect of e-sports experience on musculoskeletal health in e-sports players. Its objective was to assess the relationship between e-sport experience and musculoskeletal pain. The findings revealed no statistically significant association between sports experience duration and pain ($p > 0.05$). However, it was observed that athletes with pain reported significantly lower e-sports training hours during the e-sport experience period (mean difference -5.6 hours/week; 95% CI -10.6 to -0.7, $p=0.035$). No statistically significant relationship was found between e-sport experience and musculoskeletal pain ($p > 0.05$). However, it was observed that athletes with pain reported significantly lower e-sports training hours during the e-sport experience period (mean difference -5.6 hours/week; 95% CI -10.6 to -0.7, $p=0.035$). In the referenced study conducted by Fathuldeen et al. (14), which utilized self-reported pain locations and a questionnaire to assess the prevalence of musculoskeletal injuries in e-sports players, the most frequently reported pain regions were the lower back (63.8%), neck (50%), hand/wrist (44.8%), shoulder (35.3%), and upper back (27.6%). Additionally, the study examined the duration of participating in competitive video games among the respondents, revealing that 15.5% had been involved for 1-5 years, 17.2% for 6-10 years, and a majority of 67.2% for more than 10 years. In this research, participants with an e-sports experience duration of ≤3 years had an average VAS value of 2.75±0.71, while those with ≥4 years of experience had a higher average VAS value of 3.50±1.00. However, this difference was not statistically significant ($t=-1.831$, $p=0.084$, Table 2). Furthermore, there was a positive, moderate, and statistically significant relationship between e-sports experience in years and VAS ($r=0.591$, $p=0.006$, Table 3). Additionally, a positive, weak, and statistically significant relationship was found between daily e-sports time (hours) and VAS ($r=0.472$, $p=0.035$, Table 3). Considering the specific findings of the second study, which identified hand/wrist pain as a prevalent issue in e-sports players, and the established relationships in this research, it becomes evident that prolonged gaming can lead to increased discomfort and potential functionality issues in the hand and wrist. In a other study conducted by Di Francisco et al. (17), an electronic survey about the health habits and lifestyles of e-Sport athletes revealed that players practiced between 3 to 10 hours per day. The most frequently reported complaints were eye fatigue (56%), neck and back pain (42%), and hand and wrist

pain (36% and 32%, respectively). Interestingly, 40% of the participants did not engage in any form of physical exercise. The current study indicated a positive, moderate, and statistically significant correlation between the duration of e-Sport experience and VAS scores (r=0.591, p=0.006, Table 3). Additionally, there was no statistically significant difference in VAS scores when comparing participants with ≤3 years and those with ≥4 years of e-sports experience (t=-1.831, p=0.084, Table 2). These results highlight the influence of experience as a crucial factor in the health and pain status of e-sports athletes. This study contributes valuable insights in this regard, its under-scores the significance of experience in the field of e-sports connection between extended e-sports engagement and the escalation in self-reported pain levels.

Esport require rapid speed and reaction time, fine motor hand–eye coordination and demand high amounts of executive function and simultaneous actions. Therefore, hand function including manual dexterity and hand coordination skills enable e-sports athletes to execute complex and precise movements with speed and accuracy significantly impacting their overall performance and game outcomes (23). Tarannum et al. (27), explored the disparities in hand dexterity and skill between college students who actively engaged in mobile gaming and those who did not. The researchers utilized the Jebsen Taylor Hand Function Test to assess hand dexterity. The results revealed that gamers exhibited higher levels of right-hand dexterity, with an average value of 37.803 seconds (±3.4313), and left-hand dexterity, with an average value of 50.02 seconds (±4.101). In contrast, this study findings showed that non-gamers displayed right hand dexterity with an average value of 38.15 seconds (±4.3043), and left-hand dexterity with an average value of 50.921 seconds (±6.1409). The observed differences in hand coordination between the groups were statistically significant (p=0.001) for both right and left-hand dexterity. Furthermore, the statistical analysis confirmed that there were no significant differences in hand function including coordination between groups according to the experience for both dominant and non-dominant measurements (p=0.252, Table 2). Enhancing hand coordination and manual dexterity consider a crucial factor in optimizing e-sports performance. Additionally, the correlations between e-sports experience and daily e-sports time with the Purdue Pegboard Test measurements were non-significant (p>0.05, Table 3).

Upper extremity injuries in the esports players most likely result from chronic microtraumas rather than acute processes. Thus, the general health, upper extremity function and performance of the players are affected due to upper extremity disabilities as well as training effectiveness may be affected (28). Andersen et al. (29), examined the effects of different strength training frequencies and durations on neck and shoulder pain, as well as DASH scores, in office workers. The study included a total of 447 participants who were randomly allocated to one of four groups: 1WS: 1 hours training once a week; 3WS: 20 min training three times a week; 9WS: 7 min training nine times a week of supervised high-intensity strength training and a reference group without training. The results of the study revealed significant reductions in DASH scores among participants in the 1WS and 3WS groups compared to the reference group. Specifically, the 1WS group experienced an average decrease of 4 in DASH scores (p<0.05), while the 3WS group had a greater reduction with an average decrease of 7 (p<0.05). These findings suggest that engaging in specific strength training programs for one hour per week or three times a week for 20 minutes each can lead to significant improvements in functional disability, as measured by DASH scores. In line with these findings, this study focusing on e-sports athletes revealed a positive, albeit weak, but statistically significant correlation between the duration of e-sports experience in years and DASH scores (r=0.443; p=0.049, Table 3). This means that in e-sports experience increases, DASH scores may also increase, indicating a higher level of disability in the hands.

Additionally, a noteworthy observation from the study was the significant difference in DASH scores concerning e-sports experience duration. Participants with ≥4 years of e-sports experience had significantly higher DASH scores than those with ≤3 years, suggesting more hand problems (t=-2.203, p=0.041, Table 2). This finding establishes an association between extended e-sports participation and increased hand issues. These trends suggest that both prolonged experience in e-sports and extended daily engagement might potentially exacerbate hand problems, with the function parameter being negatively affected.

The strength parameter holds significant importance for e-sports and e-sports athletes. E-sports is a competitive activity that requires high-performance abilities, making power a critical factor in enabling players to excel during gameplay with long hours. Additionally, e-sports athletes engage in intense movements requiring prolonged concentration, highlighting the significance of power as an indicator of fatigue resistance (30). In study conducted by Fifolato et al. (31), which aimed to investigate the association between hand muscle strength, fatigue resistance, work ability, and hand dysfunction, several measurement methods were utilized. The results revealed moderate correlations between muscle strength (abduction: r = 0.49, adduction: r = 0.40, internal rotation: r = 0.44) and hand grip strength (r = 0.68) with Functional Impairment Test Hand and Neck/Shoulder/Arm (FIT-HANSA), indicating a positive association between power and fatigue resistance. Furthermore, hand grip strength showed a moderate correlation (r = -0.52) with hand dysfunction, highlighting its impact on functional abilities. In this study, there was a significant impact of power on hand function (p < 0.01, r = 0.72, Table 3), suggesting that enhanced strength levels were related to better hand function performance. When the relationship between e-sports experience and dynamometer measurements for the dominant hand was examined that statistically significant differences were found between both groups (t=- 2.101, p=0.049, Table 3). These differences demonstrate higher measurements for participants with ≥4 years of e-sports experience compared to those with ≤3 years of experience. Interestingly, the correlations between the duration of e-sports experience (in years) and daily e-sports duration (in hours) with dynamometer measurements were generally weak and non-significant (r<0.35 and p>0.05, Table 2). This result suggests that the duration of e-sports experience may impact dominant hand strength more than non-dominant hand strength, possibly due to the greater usage and control often exercised by the dominant hand in e-sports activities.

The current study provides valuable insights into the relationship between e-sports experience and hand function, disability, strength, coordination, manual dexterity and pain in male e-sports players. The fast-paced nature of e-sports competitions often means players must perform rapid and repetitive actions, such as clicking buttons or moving the mouse with precision. These repetitive movements can lead to overuse injuries and strain on the muscles and tendons involved, resulting in pain and reduced performance. Moreover, the competitive nature of e-sports can drive players to push their limits and ignore warning signs from their bodies. Players may disregard discomfort or pain in order to meet training demands or compete in important tournaments, further exacerbating the risk of musculoskeletal injuries. Understanding the health parameters (function, disability, pain, strength, coordination) of body regions for potential musculoskeletal injuries and seeking timely medical attention can prevent minor discomfort from escalating into chronic conditions that may affect both performance and long-term well-being (12, 32,33).

To the best of our knowledge, there is no study in the literature showing that investigates the association between e-sports experience and hand function, disability, strength, hands' skills (coordination & manual dexterity) and pain in esports players. Additionally, this study is also the first study to examine hand function, disability, strength, hands' skills (coordination

&manual dexterity) and pain with comparing experience duration among esports athletes. However, the few limitations should be acknowledged when interpreting the findings. Although the sample size obtained because of power analysis has been reached, only 20 participants limit the generalizability of the results and makes it difficult to draw definitive conclusions. A larger ample size in future studies would increase statistical power and better represent the e-sports population. Additionally, future research should aim to include a more diverse sample of e-sports players to provide a more representative picture of the population. Lastly, future studies should focus on exploring a wider range of variables, including reaction time, visual acuity, and mental health measures, which could lead to a more comprehensive understanding of the factors influencing e-sports performance and player well-being. In summary, while the study contributes valuable information to the understanding of the e-sports population, future research could build on this study findings by addressing these limitations and exploring a wider range of variables.

CONCLUSION

This study contributes valuable insights into the relationship between e- sports experience, hand function, and perceived pain among e-sports players. By understanding these outcomes, strategies can be developed to promote the well-being of e- sports players, optimize their performance, and ensure the sustained growth and success of the e-sports industry. Furthermore, the study shed light on the role of experience in e-sports. On the other hand, health parameters (function, disability, pain, strength, coordination) are a real concern for e-sports players due to the physical demands and prolonged hours of gameplay. By prioritizing proper ergonomics, self-care, and seeking professional guidance when needed, players can mitigate the risk of musculoskeletal injuries, promote longevity in their careers, and ensure a sustainable and healthy future in the dynamic world of e-sports.

Declarations

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