

Effects of Sedentariness and Repetitive Joint Activities on the Health of E-sports Athletes

Mingyuan Bi

Guangdong Country Garden School, Foshan, Guangdong 528000, China

ABSTRACT

As an emerging sport, eSports has received more and more attention, especially the impact of eSports on health is a topic of interest to researchers. Combined with key statistics, Gaming requires competitive rivalry through electronic systems, and athletes need to sit and stand for long periods of time and engage in repetitive joint activities, which also leads to physical injuries and to a certain extent affects their technical and tactical performance as well as their normal lives. This paper first analyzes the characteristics of eSports and the essence of the impact on eSports athletes' health and dissects the health problems it brings and the mechanisms that generate them. Finally, corresponding countermeasures and suggestions are proposed, which are expected to raise the awareness of injury prevention among athletes engaged in e-sports as well as enthusiasts in general, and thus reasonably improve the level of e-sports in China.

KEYWORDS

Sedentary; Repetitive Joint Activities; E-sports Athletes; Health.

1. INTRODUCTION

With the spread of computer technology, e-sports have begun to gain wider popularity and are gradually being recognized as a legitimate sport by a growing number of countries, sports organizations and the public. Esports is a competitive video game activity played via computer, console or mobile device. It typically involves organized online multiplayer matches in which players or teams play against each other to demonstrate their skills, strategies, and teamwork. Compared to traditional sports, eSports relies on physical fitness in terms of reaction speed, dynamic vision, and endurance at rest. In order to achieve better competitive performance, eSports athletes need long hours of training. However, just like other sports competitions, eSports often leads to discomfort in the activities of players' wrists, fingers, necks and other parts of the body due to the specific technical movements of the sport, coupled with the long hours of training and competitions, slowly leading to pain or other physical ailments, which exists to varying degrees, affecting the performance of skills and tactics, and even affecting a normal life. Datas have shown that China's e-sports and gaming users exceed 500 million, with a market size of more than 100 billion yuan, but athletes are also deeply plagued by vision loss, Internet addiction and mental illness.[13] The Internet Society of China organized the "Healthy Gaming Action 2021 National Gaming Theme Seminar" and pointed out that the health strain of the gaming industry population is higher than that of white-collar workers, and that 75% of the gaming population suffers from vision and spinal injuries, chronic illnesses, Internet addiction and mental illnesses.[14] People's Daily reported that e-sports occupational health has become one of the factors hindering the development of the e-sports industry, and that the average retirement age of e-sports players is only 24 years old, and many of them have already suffered from joint wear and tear, diabetes, tenosynovitis, and other diseases.[15] Meanwhile, Zhang et al. (2023)

point out that 60% of e-sports players did not have regular exercise for at least three times a week for more than 30 minutes, and 70% of e-sports players were sedentary, i.e., sitting continuously for more than 5 hours a day.

E-sports as an emerging sport, the study of the injury and disease situation of the program can help to improve the athletes engaged in e-sports as well as the majority of enthusiasts to prevent the awareness of injury and disease, and at the same time help to improve the level of e-sports in China. Therefore, this paper analyzes the physical effects of e-sports on athletes and puts forward countermeasures and suggestions, which are expected to be helpful and useful for related research.

2. CHARACTERISTICS OF E-SPORTS AND PHYSICAL HEALTH OF PERSONNEL

Because of the special characteristics of e-sports, different scholars have different opinions on the definition of e-sports. Most people think that competitive games are eSports. Zhang et al. (2007) define eSports as an intelligent sport between people using high-tech software and hardware as sports equipment. Hamari and Sjöblom (2016) describe eSports as a sport assisted by electronic systems, where players and teams need to interact with each other through human-computer interactions of the eSports system. Among these definitions, eSports definitions mostly emphasize the role of electronic systems in the sport. Other scholars' definitions of eSports focus on the similarities with traditional sports. A widely cited definition of eSports proposed by Wagner (2006) is that eSports is a sport in which people use information and communication technologies to develop and train mental or physical abilities. Meanwhile with the emergence of a number of governing bodies that have pushed the field of eSports forward, eSports has taken on a new definition: an emerging sport that includes tournaments, leagues, fans, teams, team owners, player contracts, sponsors, and so on. This definition deepens the influence of social media on eSports. As a result, some scholars have come up with a more detailed definition of eSports: eSports is the use of video games as spectator-driven sports that showcase specific performances by the players themselves through promotional campaigns, broadcasting infrastructure, teams, tournaments, and leagues, emphasizing both the characteristics as a game and a sport, while also indicating the form of communication of e-sports.

From the definition of scholars, it can be found that eSports is a special kind of sports, which has similarities with traditional sports and is different from general games, thus forming its unique characteristics: (1) long time sitting and standing posture. The characteristics of eSports are mainly based on static sitting posture, compared with other sports that lack conversion between dynamic postures, which also requires eSports participants to maintain a single sitting and standing posture for a long time. (2) Repetitive joint activities. E-sports athletes need to acquire superior hand-cerebral coordination ability, fast reaction ability and skillful operation of mouse and keyboard, which makes e-sports athletes constantly carry out repetitive hand and elbow joint activities. At the same time, sedentary and repetitive joint activities can cause diverse health problems.

Injury symptoms in eSports participants are concentrated in the following areas: neck, elbow, shoulder, wrist, interphalangeal joints, and low back, and most of the injury types are chronic muscle strain. In recent years, with the popularity of e-sports games, many people have developed tenosynovitis of the thumb or fasciitis of the carpal bones, which has brought many inconveniences to their lives and work. Pradnyadewi et al. (2024) find that playing *Mobile Legends* for more than 2.25 hours per day may increase the risk of De Quervain syndrome (DQS), while shorter game duration was associated with a lower risk. Kari and Karhulahti (2016) reach the elite level of athletes who spent about 5.28 hours per day on training and only about 1.08 hours on physical activity. The survey conducted by Wang (2021) on nearly one hundred participants of eSports in colleges and universities shows that in the process of participating in this sport, the participants' sports injuries often occur, of which the serious ones even affect their daily life and study. Mi (2023) studies the physical injuries of college students participating in eSports and concludes that college students'

eSports mainly injure the eyes, neck shoulders and waist, of which these can lead to more serious injuries and cause some damage to health. In e-sports, poor sitting posture and prolonged e-sports can cause more damage to the human body. However, he suggested that effective physical activity is one of the factors that prevent an increase in physical injuries. Zhang (2008) studies the skeletal muscle injuries of high-level e-sports athletes in China and the analysis of related factors and concludes that the injuries of our athletes are higher, mainly in the neck and lower back, which are mainly caused by long time and looking down. Hence, adjusting the training duration and training posture can be effectively alleviated. Jiang and Wang (2017) investigate the hidden worries behind the professionalization of eSports, which can hide huge social problems and health problems behind the competitive sports and can also cause the value issues of the youth.

3. E-SPORTS HEALTH PROBLEMS AND GENERATING MECHANISMS

3.1. Health Problems in E-Sports

Health problems faced by e-sports athletes mainly include eyestrain, neck and back pain, and wrist and hand pain. These problems are associated with prolonged sedentary behavior, repetitive motions, and screen vision. In addition, the nutritional behaviors of e-sports athletes show some negative trends, such as less physical activity, more caffeine and alcohol intake, and lower intake of fruits and vegetables compared to non-sports players (Huth, 2021). Some esports players mitigate the negative effects of being sedentary by engaging in traditional physical activities. However, gaming athletes generally have poor health awareness and low rates of post-injury visits, suggesting the need for more health management and preventative measures.

It is also due to prolonged sitting and standing as well as repetitive joint activities, that e-sports athletes develop different physical injuries. The injuries that occur in this process are often characterized by chronic injuries of the skeletal muscles, mostly in the wrist, shoulder, neck and low back, while acute sports injuries are rarely seen. Such injuries are in fact of the same nature as occupational musculoskeletal injuries and are often used to generalize a series of chronic injuries resulting from a wide range of occupational activities characterized by repetitive motions, long working hours, or mandatory positions. As eSports players, no matter from daily training or competitions, they need to maintain long-term rigid sitting posture, repetitive and cyclic finger and other actions resulting in the organism localized to withstand large-intensity static loads, which is manifested as chronic muscle and joint pain, with the most important chronic strain injuries focusing on the torso and upper limbs.

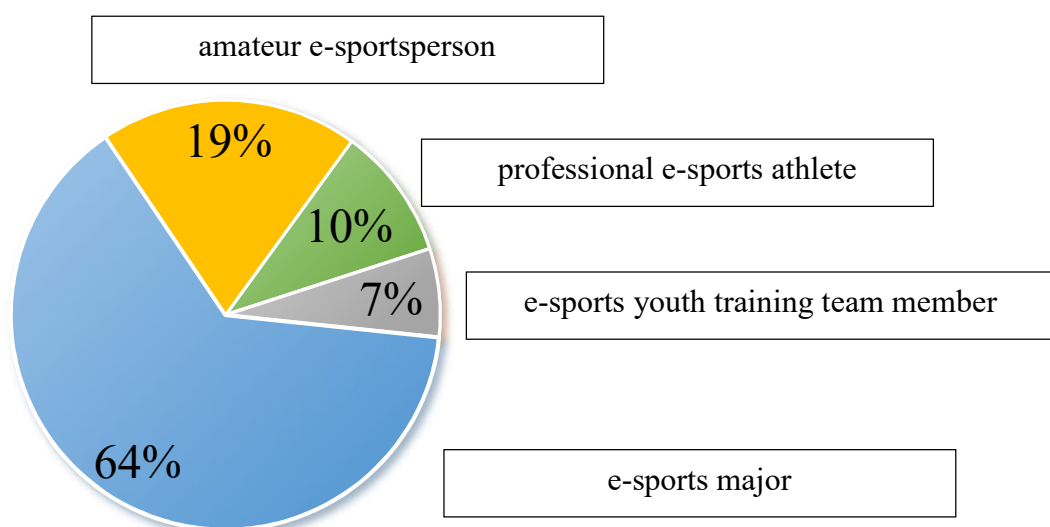


Figure 1. Proportional distribution of survey respondents

In e-sports, there is a greater chance of neck flexion, and it is necessary to keep the posture of neck flexion for a long time for e-sports training and competitions, and the neck muscles are in a state of continuous tension. For example, when gazing down at the screen, the muscles at the back of the neck need to exert continuous force to maintain the posture of the head, which can easily lead to neck muscle strain. Simultaneously, incorrect sitting posture, such as hunching over, can increase the burden on the neck, triggering discomfort such as neck pain and stiffness.

Zhang et al. (2023) find that their survey subjects, including 18 professional e-sports athletes, 12 e-sports youth training team members, 115 e-sports majors, and 35 amateur e-sportspersons, with an average age of (18.65 ± 2.21) years old, and a male-to-female ratio of about 66% and 34%, respectively, had the largest number of neck injuries, accounting for 73.0% of the total number of injuries; and according to the injury part categorization, the injuries shown in the table below occurred in the past one year of e-sports activities. A total of 37 people had musculoskeletal injuries of varying degrees of severity, reaching one fifth of the total number of people; and the total number of symptoms was 196, with episodes mainly concentrated in one or two times per week.

Table 1. Proportion of cases with symptomatic parts

Parts	Shoulder	Elbow	Wrist	Fingers	Lumbar	Back	Spine
Percentage	54.1%	24.3%	45.9%	56.8%	59.5%	35.1%	27.0%

3.2. Mechanisms of Health Problems in E-Sports

Gugliotti et al. (2019) compare postural changes in college eSports athletes while competing in eSports gaming chairs versus non-gaming chairs. The results of the study showed that 34% of the 40 eSports athletes surveyed would experience neck and back pain while competitively gaming, which was caused by the abnormal postural positioning they sustained during gaming. Long-term accumulation may lead to diseases such as cervical spondylosis, which affects the normal movement and nerve function of the neck, and in turn affects the training and competition performance of eSports athletes. And the sport emphasizes athletes' hand speed, i.e., the number of mouse clicks per minute. Repeated keyboard and mouse clicks make wrists and fingers susceptible to musculoskeletal injuries. For example, frequent clicking of the mouse buttons and tapping of the keyboard can fatigue the flexor and extensor muscles of the hand, which can easily lead to diseases such as tenosynovitis and carpal tunnel syndrome. Finger joints can also suffer from pain and swelling due to overuse. Injuries to the hand will directly affect the operation accuracy and speed of e-sports athletes, thus affecting the competition results. Meanwhile, single-factor analysis of the research by Zhang et al. (2023) shows that the type of player, regular movement, equipment, type of project, mouse use time, years of training, training frequency, daily training hours, continuous training hours are all influential factors in the emergence of musculoskeletal injuries, especially the last three, which are closely related to the training and use of the action, and the improvement of which will inevitably need to be implemented as per this point. By combining the risk levels of the influencing factors, it is worthwhile to explain which factors play a greater role through statistical significance, and the results are shown in Table 2.

Table 2. Summary p-values of influencing factors and risk factors for musculoskeletal injuries

Factor	Player Type	Equipment	Training Frequency	Daily Hours	Continuous Hours	Pro Player	Training Frequency
Impact	0.000	0.008	0.000	0.000	0.000		
Hazard	Logistic Regression					0.012	0.042

All of the influencing factors related to external conditions, except for equipment, were basically only significant at the 0.05 level of significance, which shows that the individual behavioral actions of the e-sports athlete are the key, which are imposed on the equipment, and the nature of the equipment also determines the operating space. Variables such as *years of training* were more closely related to the individual, with a *p*-value of 0.028, while daily and continuous training hours showed repetitive movements in the time dimension, which can exacerbate musculoskeletal injuries. Further, from the Logistic model only lists the case of variables with a *p*-value less than 0.05, *professional players* actually belong to the risk factors of injury, intuitively reflecting the characteristics of the work and mission of professional players, and complete the task more diligently, and thus may ignore physical health, and did not pay attention to their sedentary and repetitive joint activities, coupled with the increase in the frequency of training, and chances are that this will worsen the muscle strain injury.

The intrinsic cause, long-term maintenance of a single posture and long-term static load will inevitably lead to mechanical deformation of muscle tendons and ligaments and other soft tissues, triggering intravascular blood circulation, and structural changes are bound to affect the function. Physiology believes that long-term static muscle contraction can cause muscle fiber metabolism, mitochondrial damage and microcirculation obstruction, which directly leads to muscle metabolism disorders; and changes in muscle anatomy and physiology will make the joints, angles, moments, and related muscle strength will be affected, which a series of impacts will make the body's energy transfer obstacles to achieve smooth This series of effects will cause obstacles to energy transfer, preventing smooth circulation, leading to microcirculation obstruction, poor blood flow, and a decrease in the recovery ability of muscle tissues that do not receive nutrients, resulting in chronic injuries. Moreover, a long-term questionnaire survey of Internet users who often play games has found that other factors can also cause health problems for these game participants: personal factors (age, gender, height, weight, smoking history, etc.) and gaming habits (operating habits, keyboard position, seat height, angle of vision to the screen, etc.) can lead to injuries, and can even have a great impact on the daily diet and work and rest. The impact on your diet and daily routine can also be significant. In the long run, it may also cause other chronic diseases, which will not only affect the athletes' competitive status and performance, but also jeopardize their lives and health in the long run.

4. CONCLUSION AND RECOMMENDATIONS

As an emerging sport, although e-sports has similarities with traditional sports, its athletes often suffer from physical injuries due to their own characteristics. Long-time training and competitions make players discomfort in the wrist, fingers, neck, back and other parts of the body, and even cause pain or diseases, such as chronic muscle strain, tenosynovitis, cervical spondylosis, etc., which affects technical and tactical play and normal life. Maintaining a fixed posture for a long time, such as bowing the head, hunching over, etc., strains the neck and back muscles, and frequent operation of the hands causes excessive pressure on the muscles, tendons and joints.

The health conditions and behavioral patterns of e-sports athletes are multifaceted, including both physical pain due to prolonged sedentary and repetitive movements and unhealthy nutritional behaviors. Injuries involve multiple parts of the body, including decreased physical fitness due to long-term physical inactivity and lack of exercise, repetitive mechanical maneuvers or static loads due to poor training arrangements and prolonged forced positions, and a weak sense of health prevention.

Therefore, in order to improve the health status of e-sports athletes, a multidisciplinary approach is needed, including the provision of appropriate physical activity, improvement of nutritional behaviors, enhancement of health awareness, and the provision of effective health management and preventive measures. Health education needs to be used as a starting point to raise awareness of injury prevention; only when musculoskeletal muscles are fully relaxed can injuries caused by failure to take reasonable rest be circumvented; in practice, reasonable skill training methods and physical quality training

methods are adopted to ensure the physical and mental health of e-sports athletes, and internal and external factors support each other in order to promote e-sports athlete health (Zhang et al., 2023).

In particular, eSports athletes should maintain correct sitting posture, such as keeping the neck straight and avoiding prolonged head bowing or hunching over. Ergonomic chairs and equipment can be used to reduce the pressure on various parts of the body. During training and competition, adjust posture regularly and move parts such as the neck, back and hands to relieve muscle tension. Learn and apply psychological adjustment methods, such as deep breathing, meditation, relaxation training, etc., to alleviate the psychological pressure brought about by competitions and contests. Reasonably arrange the training and competition schedule, avoid excessive training and competition, and allow enough time for physical and mental rest and adjustment.

REFERENCES

- [1] Gugliotti, M., Karp, P., Werner, W., & Khalique, D. (2019). Comparison of postural changes in esports athletes in gaming and non-gaming chairs. A case series. *Medicine & Science in Sports & Exercise*, 51(6S), 352. DOI: 10.1249/01.mss.0000561565.52319.23.
- [2] Hamari, J., & Sjöblom, M. (2016). What is eSports and why do people watch it? *Internet Research*, 27, 211–232. DOI:10.1108/IntR-04-2016-0085.
- [3] Huth, C. (2021). Nutritional behaviour of (Non-)eSports players – a comparative study. *Quality in Sport*, 7(02), 38–44.
- [4] Jiang Minglang, Wang Jianli (2017). The hidden concerns behind the professionalization of electronic sports *Science Popularization Countryside*, (20), 231+239.
- [5] Kari, T., & Karhulahti, V. (2016). Do E-Athletes Move?: A Study on Training and Physical Exercise in Elite E-Sports. *International Journal of Gaming and Computer-Mediated Simulations (IJGCMS)*, 8(4), 53–66. DOI: 10.4018/IJGCMS.2016100104.
- [6] Mi Pengcheng (2023). Research on the current situation and countermeasures of physical injuries among college students participating in electronic sports Southwest Medical University.
- [7] Pradnyadewi, P. P., Dewi, A. A. N. T. N., Wahyuni, N., & Nugraha, M. H. S. (2024). Duration of playing mobile legends on the incidence of De Quervain syndrome among e-sport players. *Physical Therapy Journal of Indonesia*, 5(1), 43–46. DOI: 10.51559/ptji.v5i1.186.
- [8] Wagner, M. (2006). On the scientific relevance of eSports. *Proceedings of the 2006 International Conference on Internet Computing & Conference on Computer Games Development, ICOMP2006*. Retrieved from: https://www.researchgate.net/publication/220968200_On_the_Scientific_Relevance_of_eSports.
- [9] Wang Dehai (2021). *Neijiang Technology*, 42 (03), 121-122.
- [10] Zhang Enming (2008). Analysis of Skeletal Muscle Injuries and Related Factors in High level Electronic Sports Athletes in China Beijing Sport University.
- [11] Zhang, L., Wu, J., & Li, Y. (2007). Research on current situation of E-sports in Urumqi, Xinjiang. *International Journal of Sports Science and Engineering*, 2, 57–61. Retrieved from: <http://www.worldacademicunion.com/journal/SSCI/SSCIvol02no01paper08>.
- [12] Zhang Weichao, Li Xun, Wang Xiaoqiang, Yan Hongqiao, Song Yuanyuan, Li Xinying, Zhang Wenhua & Ma Guo'ao (2023). Analysis of Musculoskeletal and Neurological Injuries and Influencing Factors in Electronic Sports Athletes (eds.) *Abstract Collection of Papers from the 13th National Sports Science Conference - Poster Exchange (Sports Medicine Branch) (1)*, 218-220 Shandong Sport University.
- [13] https://politics.gmw.cn/2021-05/18/content_34851962.htm.
- [14] <https://www.isc.org.cn/article/39807.html>.
- [15] <http://health.people.com.cn/n1/2021/0519/c14739-32107334.html>.