
# Linking Esports to health risks and benefits: current knowledge and future research needs

Keyi Yin , Yahua Zi , Wei Zhuang , Yang Gao , Yao Tong , Linjie Song , Yu Liu

PII: S2095-2546(20)30052-1
DOI: https://doi.org/10.1016/j.jshs.2020.04.006
Reference: JSHS 611

To appear in: *Journal of Sport and Health Science*

Received date: 13 January 2020
Revised date: 11 March 2020
Accepted date: 25 March 2020

Please cite this article as: Keyi Yin , Yahua Zi , Wei Zhuang , Yang Gao , Yao Tong , Linjie Song , Yu Liu , Linking Esports to health risks and benefits: current knowledge and future research needs, *Journal of Sport and Health Science* (2020), doi: https://doi.org/10.1016/j.jshs.2020.04.006

# Linking Esports to health risks and benefits: current knowledge and future research needs

Keyi Yin,[1]Yahua Zi,[1] Wei Zhuang,[1] Yang Gao,[1] Yao Tong,[1]Linjie Song,[1] Yu Liu[1,*]

[1]School of Kinesiology,Shanghai University of Sport, Shanghai 200438, China

* Correspondence author
E-mail: yuliu@sus.edu.cn

Running head: eSports and health

Received: 2020-01-13
Revised: 2020-03-11
Accepted: 2020-03-25

Electronic sports (Esports), viewed as competitive and organized video gaming,[1] are becoming accepted as a form of sports.[2–4] Many digital video games associated with Esports are played through various platforms (e.g., computers, consoles, mobile, streaming, or virtual reality)[5] and involve either simulating competitive sports (motion-based) or combative (action-based) activities.[2] Esports have been around for more than 20 years[1]and continue to thrive economically as a highly profitable gaming industry.[2,6] Thanks to the advances in digital media and online game-streaming or cloud gaming technologies, there has been a rapid increase, on a global scale, in the popularity of Esports worldwide,[6] evidenced by the exponential growth in participation, media coverage, viewership, sponsorship, and commercialization.[7–10] Latest statistics on global Esports showed more than $1 billion in market revenue in 2019,with a predicted market growth reaching $1.79 billion by 2022.[11]

Not all video games related to Esports are competitive by design (e.g., exergaming[12]). Those that are (e.g., action-based games), however, have been at the center of scholarly debates with respect to the true athletic nature of sports, cultural values, and moral ethics of Esports play.[3,13,14] These issues have an impact on mainstream sports and sporting communities in general. In health promotion, interactive exercise video games, known as exergaming, combine exercise with game play and have been widely studied, with evidence of health benefits and increased levels of physical activity.[12,15–18] In competitive sports, however, the recognition of Esports as a contested event remains unclear. The International Olympics Committee (IOC) has taken a stance on what sorts of competitive games it will consider to be acceptable in the Olympic Games. While it will not have specific Esports events as part of the Games, it does aim to promote Esports within the spirit and shared values of the Olympics, with a focus on promoting gaming that simulates sports movement and improves the health and well-being of

gamers or competitors at all levels.[19] Likewise, Esports will not be included in the upcoming 19th Asian Games in Hangzhou, China.[20] On the other hand, Esports were included among the competitions that took place in the 2019 Southeast Asian Games, shaping it into a history-making event.[21]

Globally, Esports have been increasingly recognized as a competitive sport activity in various contexts, as evidenced by establishment of Esports Europe (including 23 national Esports organizations).[22] Recognition by the National Basketball Association[23] and the formation of the National Association of Collegiate Esports,[24] as well as the addition of Esports in intercollegiate athletic competitions[10] and sanctioning by the National Federation of State High School Associations,[25] are additional evidence of this growth. Esports, especially some virtual sports and action-based video games (e.g., plat former, shooter, fighting), share some common physical and mental demands with non-digital sports[2,4,26] in that Esports also require motor skills, mental agility, processing speed, executive function, motivation, and, to a lesser extent, physical exertion.[27] Some limited research indicates that action videogames, whether played cooperatively or competitively, are beneficial in building skills related to cognitive ability,[28–30] reading ability,[31,32] reaction time,[33] and sensori motor skills.[34]

The popularity of professional Esports continues to soar, with players predominantly being younger individuals, including school-aged children and adolescents[5,35] and college athletes.[10,36,37] Given the speed at which many games associated with Esports are played and the psychological intensity of the competition, contenders or athletes undertake extensive training to establish proficiency in the use of control devices (e.g., keyboards, mice, or console controllers). They must also hone the essential neurological skills, including effective hand-eye coordination, development of fast reaction times, and rapid decision-making in a virtual competitive

environment, that are critical for winning and success in Esports games.[13,38,39] Theintensity of training required for competitive Esports games paradoxically necessitates sitting in the same position for hours at a time in front of a computer or television screen, enduring high levels of stress, visual attention, blue light (from light-emitting diodes), and repetitive small-muscle movements, which together equate to a sedentary and, consequently, unhealthy lifestyle.[40–42]

**1. Current knowledge**

The digital gaming characteristics of Esports make it easy to identify potential adverse health effects that may result from the sustained and stressful training and fierce competition encountered by high-level Esports game players.[43–45] This is especially evident when considering that the fact that most participants are young school-aged children and adolescents[5] who compete in a physically and mentally demanding environment, exposing them to negative risks with harmful outcomes.[46]

Some commonly identified negative health outcomes documented to date include stress,[47] sleep disturbances,[48] vision problems,[49] musculoskeletal pain,[50] overuse injuries,[51,52] metabolic disorders[53] or weight gain,[54] and other behavioral problems (i.e., addiction, violence, aggression).[55–57] For example, a recent survey showed that college students who spent a significant amount of daily time (from 5.5 to 10 hours) in front of screens playing Esports suffered from eye fatigue as well as neck, back, wrist, and hand pains.[51]

In regard to energy expenditure, there is some evidence that active games (e.g., exergaming) tend to increase energy expenditure or physical activity levels,[58–60] suggesting that active video games focusing on fitness or exercise can contribute to health-enhancing physical activity and fitness. However, relatively little is known about the energy levels expended among athletes engaging in high-level gaming competitions. In fact, one study showed that 40% of

collegiate varsity Esport players reported not participating in any other form of physical activity.[51]

Given the rapidly expanding popularity of Esports video games (e.g., Dota 2, Fortnite, League of Legends) and accelerating growth in the Esports industry, scientific research addressing the public health implications of the Esports phenomenon is significantly lacking.[40,41,61] There is also a lack of knowledge about the potential health benefits of Esports, along with the behavioral risks it carries with it, includingaddiction,[46,62] overuse injuries,[50–52]overweight/obesity,[53,54] and doping behaviors,[63] all of which can result from the highly competitive nature and lucrative rewards system inherent in Esports.

**2. Gaps in knowledge and research needs**

The lack of knowledge about Esports stems from the dearth of substantial health research into this phenomenon.[64,65] More information and research is needed on the following aspects of Esports:

- Health issues related to participation in competitive action-based Esports video gaming in more advanced virtual and augmented reality Esports environments
- Psychosocial, physical, and cognitive effects of Esports competition among players of various ages
- Mental health issues resulting from competitive video gaming, including gaming addiction, burnout, cyber bullying, intimidation, and discrimination
- Whether participation in the Esports genre of sports simulation or motion-based video gaming leads to increased motivation to engage in traditional sports or physical activity

- Acute or chronic adverse health risks associated with excessive and prolonged Esports training and playing
- Levels of physical fitness and oxidative stress that occur among competitive Esports athletes
- Mechanisms underlying overuse injuries in Esports
- Potential gender gaps and differences regarding Esports training and competition
- Impact of physical inactivity or prolonged sitting during digital game play, including overweight, obesity, and cardiovascular risk
- Associations between levels of energy expenditure during Esports gaming and health consequences
- Long-term health consequences of video game playing
- Extent to which active games can serve as a healthier alternative to sedentary screen time.

These research and knowledge gaps create significant barriers to addressing this emerging public health need and determining how to safely promote Esports for either competition or leisure. To narrow these gaps, a strategic research agenda should be developed to better understand the benefits of Esports (its ability to promote health, well-being, physical activity) and identify strategic and preventive solutions to ameliorate its adverse health impacts among various levels of professional athletes and amateur players alike.[64]

The following list describes some of the epidemiological and experimental research that is needed to advance the field of scholarship in Esports. Knowledge gained from this line of research can help to create guidelines and strategies that promote healthy participation in Esports and the well-being of its players.

- Epidemiologic research that tracks the prevalence of health risk factors associated with the sedentary nature of Esports performed on various platforms (computers, consoles, or virtual reality environments)
- Studies that identify the determinants of psychological and physiological factors that either facilitate or impede healthy behaviors resulting from game playing, with a distinction made between serious play (i.e., for winning) and leisure/fitness[61]
- Comparative studies between traditional sports and Esports in regard to factors that influence performance
- Development of exergaming-based physical activity interventions aimed at reducing sedentary behavior among Esports players
- Development of training strategies that promote mutual respect and fair play and reduce cyber bullying among Esports players
- Mechanistic studies that seek to determine the mechanism(s) of injuries associated with repetitive joint movements or sustained sedentary time during gaming
- Development of preventive and therapeutic interventions that help rehabilitate players and athletes with chronic musculoskeletal pain or overuse injuries[51]
- Development of exercise-based relaxation techniques that reduce stress, burnout, and anxiety; improve the mental health, sleep quality, and well-being of Esports players; and optimize their competitive performance
- Development and evaluation of safety interventions or workstation modifications that address computer- or console-related injuries, including the negative effects of blue light that causes symptoms of digital eyestrain due to extended exposure from the play screen, carpal tunnel syndrome, repetitive strain injury, and back pain

- Policies and initiatives that promote consensus around the promotion of healthy electronic gaming in Esports
- Development of interventions that help increase motivation to transfer gaming activities or movement skills related to Esports into participation in real-world sports activities

**3. Conclusion**

Playing and competing in Esports games have significant ramifications for the players' health. With the popularity of Esports continuing to grow rapidly worldwide, research that focuses on understanding the health risks and benefits associated with Esports competition and participation has lagged. Insufficient attention has been given to the development and evaluation of preventive interventions that address the harms that video games associated with Esports may entail. Similarly, gaps exist in our knowledge of ways to promote safe and healthy digital gaming among an ever-growing population of younger Esports athletes. These gaps need to be filled through systematic scientific research so that evidence-based guidelines and intervention strategies, involving healthy diet, regular exercise, and sleep hygiene, can be developed – a public health approach that moves toward better integration of Esports gaming and Esports fitness.

**Acknowledgment**

The authors of this manuscript would like to thank Peter Harmer for the helpful and constructive comments that have contributed greatly to improving the final version of the paper.

**Authors' contributions**

All authors have contributed significantly for the paper. YL was responsible for the overall content of the article. KY drafted the manuscript. All authors were involved in the literature search, data interpretation, and writing, editing, and critical revision of multiple versions of the manuscript. All authors have read and approved the final version of the manuscript, and agree with the order of the presentation of the authors.

**Competing interests**

The authors declare that they have no competing interest.

**References**


1. Wagner M. On the scientific relevance of eSport. In: Arreymbi J, Clincy VA, Droegehorn OL, editors. *Proceedings of the 2006 International Conference on Internet Computing and Conference on Computer Game Development*. Las Vegas, NV: CSREA Press;2006:.p.37–442.
2. Hamart J, Sjöblom M. What is eSports and why do people watch it? *Internet Res* 2017;27:211–32.
3. Kane D, Spradley BD. Recognizing eSports as a sport. *Sport J* 2017.
4. Jenny SE, Manning RD, Keiper MC, Olrich TW. Virtua(ly) athletes: where eSports within the definition of "Sports." *Quest* 2017;69:1–18.
5. Center on Media and Child Health. *Video Games*. Available at: https://cmch.tv/parents/video-games/. [accessed 03/03/2020].
6. Chikish Y, Carreras M, Garci J. eSports: A new era for the sports industry and a new impulse for the research in sports (and) economics? In: Sports (and) Economics, Publisher: FUNCAS (Spanish Savings Banks Foundation); 2019.p.477–508.
7. Statista. *eSports audience size worldwide from 2012 to 2020, by type of viewers*. Available at: https://www.statista.com/statistics/490480/global-esports-audience-size-viewer-type/.[accessed 02/03/2020].
8. eSport Group. *Three trends to watch in esports commercialization*. Available at: http://www.esportsgroup.net/2017/03/three-trends-watch-esports-commercialization/. [accessed 03/03/2020].
9. Jenny SE, Keiper MC, Taylor BJ, Williams DP, Gawrysiak J, Manning RD, et al. eSports venues: A new sport business opportunity. *J Appl Sport Manag*2018;10:34–49.
10. Keiper MC, Manning RD, Jenny SE, Olrich T, Croft C. No reason to LoL at LoL: the addition of esports to intercollegiate athletic departments. *J Study Sports Athletes Edu* 2017;11:143–60.
11. Statista. *eSports market revenue worldwide from 2012 to 2022*. Available at: https://www.statista.com/statistics/490522/global-esports-market-revenue/. [accessed 03/03/2020].

12. American College of Sports Medicine. *Exergaming*. Available at: https://healthysd.gov/wp-content/uploads/2014/11/exergaming.pdf. [accessed 03/03/2020].
13. van HilvoordeI. Sport and play in a digital world. *Sport Ethics Philos* 2016;10:1–4.
14. Hallmann K, Giel T. eSports – Competitive sports or recreational activity? *Sport Manage Rev* 2018;21(1):14–20.
15. Hernández-Jiménez C, Sarabia R, Paz-Zulueta M, Paras-Bravo P, Pellico A, Ruiz Azcona L, et al. Impact of active video games on body mass index in children and adolescents: Systematic review and meta-analysis evaluating the quality of primary studies. *Int J Environ Res Public Health* 2019;16:2424; doi:10.3390/ijerph16132424.
16. Jenny SE, Schary DP, Noble KM, Hamill SD. The effectiveness of developing motor skills through motion-based video gaming: A review. *Simul Gaming* 2017;48:722–34.
17. Street TD, Lacey SJ, Langdon RR. Gaming Your Way to Health: A Systematic Review of Exergaming Programs to Increase Health and Exercise Behaviors in Adults. *Games Health J* 2017;6:136–46.
18. Staiano AE, Galvert SL. Exergames for physical education courses: physical, social, and cognitive benefits. *Child Dev Perspect* 2011;5:93–8.
19. International Olympic Committee. *Declaration of the 8th Olympic Summit*. Available at: https://www.olympic.org/news/declaration-of-the-8th-olympic-summit. [accessed 03/03/2020].
20. 19th Asian Games Hangzhou 2022. *The 19th Asian Games Hangzhou 2022 Organising Committee*. Available at: https://www.hangzhou2022.cn/En/. [accessed 03/03/2020].
21. South China Morning Post. *Southeast Asian Games 2019 (SEA Games*). Available at: https://www.scmp.com/topics/southeast-asian-games-2019-sea-games/. [accessed 03/02/2020].
22. The European Esports Federation. *Esports Europe*. Available at: https://esportseurope.org/. [accessed 04/03/2020].
23. NBA 2K League.*2019 NBA 2K League Qualifier: Everything You Need To Know*. Available at: https://2kleague.nba.com/news/2019-qualifier/. [accessed 2/3/2020].
24. AACRAO. *Video gaming: the newest college sport*. Available at: https://www.aacrao.org/resources/newsletters-blogs/aacrao-connect/article/video-gaming-the-newest-college-sport. [accessed 03/03/2020].

25. ESPORTS. *List of varsity esports programs spans North America*. Available at: https://www.espn.com/esports/story/_/id/21152905/college-esports-list-varsity-esports-programs-north-america. [accessed 03/03/2020].
26. Schütz M. *Science shows that eSports professionals are real athletes*. Available at: https://www.dw.com/en/science-shows-that-esports-professionals-are-real-athletes/a-19084993. [accessed 03/03/2020].
27. Bányai F, Griffiths MD, Király O, Demetrovics Z. The psychology of esports: A systematic literature review. *J Gambl Stud* 2019;35:351–65.
28. Eichenbaum A, Bavelier D, Green CS. Video games: play that can do serious good. *Am J Play* 2014;7:50–72.
29. Bediou B, Adams DM, Mayer RE, Tipton E, Green CS, Bavelier D. Meta-analysis of action video game impact on perceptual, attentional, and cognitive skills. *Psychol Bull* 2017;144:77–110
30. Granic I, Lobel A, Engels RC. The benefits of playing video games. *Am Psychol* 2014;69:66–78.
31. Franceschini S, Gori S, Ruffino M, Viola S, Molteni M, Facoetti A. Action video games make dyslexic children read better. *Curr Biol* 2013;23:462–6.
32. Franceschini S, Trevisan P, Ronconi L, Bertoni S, Colmar S, Double K, et al. Action video games improve reading abilities and visual-to-auditory attentional shifting in English-speaking children with dyslexia. *Sci Rep*2017;7:5863.doi:10.1038/s41598-017-05826-8.
33. Dye MW, Green CS, Bavelier D. Increasing speed of processing with action video games. *Curr Dir Psychol Sci* 2009;18:321–6.
34. Burks R. *Video games sharpen eye-hand coordination skills: Study*. Available at: http://www.techtimes.com/articles/18125/20141019/study-finds-that-video-games-boost-eye-hand-coordination-skills.htm. [accessed 03/03/2020].
35. Hester B. *Teens spend 25 times more of their time playing video games than going to the movies.* Available at: http://www.ign.com/articles/2016/12/21/teens-spend-25-times-moreof-their-time-playing-video-games-than-going-to-the-movies. [accessed 3/3/2020].
**36.**Sorokanich B. *South Korean university now accepts gamers as student athletes*. Available at: https://gizmodo.com/south-korean-university-now-accepts-gamers-asstudent-a-1547111361. [accessed 03/03/2020].

37. National Association of Collegiate Esports. *Championing Collegiate Esports Nationwide*. Available at: https://nacesports.org/about/. [accessed 03/02/2020].
38. Funk DC, Pizzo AD, Baker BJ. eSport management: Embracing esport education and research opportunities. *Sport Manage Rev* 2018;21:7–13.
39. Lewis JM, Trinh P, Kirsh D.A corpus analysis of strategy video game play in Starcraft: Brood War. Proceedings of the 33rd annual conference of the cognitive science society, 2011.
40. Zwibel H, DiFrancisco-Douoghue J, DeFeo A, Yao S. An osteopathic physician's approach to the sports athlete. *J Am Osteopath Assoc* 2019;119:756–62.
41. Chung T, Sum S, Chan M, Lai E, Cheng N. Will esports result in a higher prevalence of problematic gaming? A review of the global situation. *J Beh Add* 2019;8:384–94.
42. DiFrancisco-Donoghue J, Balentine JR. Collegiate esport: where do we fit in? *Curr Sports Med Rep* 2018;17:117–8.
43. Marshall C. *The Shanghai Dragons'training schedule raises concerns for player health*. Available at: https://www.heroesneverdie.com/2018/5/22/17363192/shanghai-dragons-trainingschedule-12-hours. [accessed 03/03/2020].
44. Miner P. *A glimpse into mental health issues in eSports: Part One: - The Pressure to Win*. Available at: https://estnn.com/a-glimpse-into-mental-health-issues-in-esports-part-one-the-pressure-to-win/ .[accessed 03/03/2020].
45. Erzberger T. *Mental health issues remain pervasive problem in esports scene*. Available at: https://www.espn.com/esports/story/_/id/24427802/mental-health-issues-esportsremain-silent-very-real-threat-players. [accessed 03/03/2020].
46. Anderson CA, Bushman BJ, Bartholow BD, Cantor J, Christakis D, Coyne S, et al. Screen violence and youth behavior. *Pediatrics* 2017;140(Suppl. 2):S142–7.
47. Smith MJ, Birch P, Bright D. Identifying stressors and coping strategies of elite Esports competitors. *Int J Gaming Computer-Mediated Simulations* 2019;11:22–39.
48. Peracchia S, Curcio G. Exposure to video games: effects on sleep and on post-sleep cognitive abilities. A sistematic review of experimental evidences. *Sleep Sci* 2018;11:302–14.
49. Rechichi C, De Mojà G, Aragona P. Video game vision syndrome: A new clinical picture in children? *J Pediatr Ophthalmol Strabismus* 2017;54:346–55.
50. Zwibel H, DiFrancisco-Douoghue J, DeFeo A, Yao S. An osteopathic physician's approach to the sports athlete. *J Am Osteopath Assoc* 2019;119:756–62.

51. Di Francisco-Donoghue J, Balentine J, Schmidt G, Zwibel H. Managing the health of the eSport athlete: an integrated health management model. *BMJ Open Sport Exerc Med* 2019;5:e000467.doi: 10.1136/bmjsem-2018-000467
52. Bräutigam T. *Esports needs to face its injury problem*. Available at: https://esportsobserver.com/esports-needs-face-injury-problem/. [accessed 03/02/2020].
53. Calvert SL, Staiano AE, Bond BJ. Electronic gaming and the obesity crisis. *New Dir Child Adolesc Dev* 2013;(139):51–7.
54. Vandwater EA, Shim MS, Caplovitz AG. Linking obesity and activity level with children's television and video game use. *J Adolesc* 2004;27:71–85.
55. Prescott AT, Sargent JD, Hull JG. Meta analysis of the relationship between violent video game play and physical aggression over time. *Proc Natl Acad Sci U S A* 2018;115:9882–8.
56. Anderson CA, Bushman BJ. Effects of violent video games on aggressive behavior, aggressive cognition, aggressive affect, physiological arousal, and prosocial behavior: a meta-analytic review of the scientific literature. *Psychol Sci* 2001;12:353–9.
57. World Health Organization. *Gaming disorder*. Available at: https://www.who.int/features/qa/gaming-disorder/en/ [accessed 03/02/2020].
58. Lyons EJ, Tate DF, Ward DS, Bowling JM, Ribisl KM, Kalyararaman S. Energy expenditure and enjoyment during video game play: differences by game type. *Med Sci Sports Exerc* 2011;43:1987–93.
59. Canabrava KLR, Faria FR, Lima JRP, Guedes DP, Amorim PRS. Energy expenditure and intensity of active video games in children and adolescents. *Res Q Exerc Sport* 2018;89:47–56.
60. Smallwood SR, Morris MM, Fallows SJ, Buckley JP. Physiologic responses and energy expenditure of Kinect active video game play in schoolchildren. *Arch Pediatr Adolesc Med* 2012;166:1005–9.
61. Polman R, Trotter M, Poulus D, Borkoles E. eSport: Friend or Foe? In: Göbel S, editors. Serious Games. JCSG 2018. Lecture Notes in Computer Science, vol 11243. Springer, Cham.
62. Ferguson CJ, Coulson M, BarnettJ. A meta-analysis of pathological gaming prevalence and comorbidity with mental health, academic and social problems. *J psychiatr Res* 2011;45:1573–8.
63. Crossley R, 2016. ESL *Reveals Plan to Clean Up Doping, Corruption, and Cheating in*

*Esports*. Available at: http://www.gamespot.com/articles/esl-reveals-plan-to-clean-up-dopingcorruption-and/1100-6439781/. [accessed 04/03/2020].

64. Pereira AM, Brito J, Figueiredo P, Verhagen E. Virtual sports deserve real sports medical attention. *BMJ Open Sport Exerc Med* 2019;5:e000606. doi: 10.1136/bmjsem-2019-000606.
65. Reitman JG, Anderson-Coto MJ, Wu M, Lee JS, Steinkuehler C. Esports research: A literature review. *Games Cult* 2020;15:32–50.