

Will esports result in a higher prevalence of problematic gaming? A review of the global situation

THOMAS CHUNG*, SIMMY SUM, MONIQUE CHAN, ELY LAI and NANLEY CHENG

Student Health Service, Department of Health, Hong Kong SAR, China

(Received: August 23, 2018; revised manuscript received: November 27, 2018; second revised manuscript received: April 8, 2019; accepted: July 24, 2019)

Background and aims: Video gaming is highly prevalent in modern culture, particularly among young people, and a healthy hobby for the majority of users. However, in recent years, there has been increasing global recognition that excessive video gaming may lead to marked functional impairment and psychological distress for a significant minority of players. Esports is a variant of video gaming. It is a relatively new phenomenon but has attracted a considerable number of followers across the world and is a multimillion dollar industry. The aim of this briefing paper is to review the global situation on esports and related public health implications. *Methods:* A non-systematic review was conducted. Information obtained from the Internet and PubMed was collated and presented as genres of games, varieties and magnitudes of impacts, popularity, fiscal impact in monetary terms, government involvement, and public health implications. *Results:* There are several different kinds of esports but there was no clear categorization on the genre of games. Many tournaments have been organized by gaming companies across the world with huge prize pools, and some of these events have government support. Little information on the health effects associated with esports was identified. *Discussion and conclusions:* A majority of the sources of information were from commercial settings, and failed to declare conflicts of interest, which may result in a biased picture of the current situation. When gaming activity is being further promoted under the umbrella of esports, it seems reasonable to expect an increase in problematic gaming and thus increased prevalence of gaming disorder and hazardous gaming. With increasing demand for treatment services for gaming addition/disorder in different countries across the world, it is a significant public health concern. More empirically based research on this topic is needed.

Keywords: esports, video games, problematic gaming, excessive gaming, gaming addiction, gaming disorder

INTRODUCTION

Since 2014, the World Health Organization (WHO) has organized a series of annual expert meetings addressing the public health implications of excessive use of the Internet and other communication and gaming platforms. These activities were undertaken in response to concerns expressed by professional groups, WHO collaborating centers, academics and clinicians, particularly about the adverse health consequences relating to excessive gaming (WHO, 2018a). In 2017, esports attracted a global audience of 385 million people (Warman, 2017) and is a multibillion dollar business (Pei, 2019; Perez, 2018), raising public health concerns (Chung, Sum, & Chan, 2019; DiFrancisco-Donoghue, Balentine, Schmidt, & Zwibel, 2019). We are interested in examining the link between esports and problematic gaming, including Gaming Disorder (GD) and Hazardous Gaming (HG), which have been included in the recently released ICD-11 (WHO, 2018b).

First, it is important to clarify, what exactly is esports? The word “esports” is the short form of “electronic sports,” and is considered to be a variant of video gaming. The Oxford Dictionary also describes esports as a multiplayer

video game played competitively for spectators, typically by professional gamers. While there is no consensus on the definition, it is generally agreed that esports is “competitive gaming.”

Esports also involves organized, multiplayer video game competitions, typically between professional players (one-on-one or in teams), which can be staged in front of a live audience, streamed online, or broadcasted on television (YouGov, 2017). Examples of esports games include League of Legends (LoL), Counter Strike: Global Offensive (CS:GO), and Player Unknown’s Battlegrounds (PUBG).

Similar to other sports, everyone can play esports but only those who have mastered a certain set of skills can play the game well. In terms of esports, high intensity, refined motor skills, as well as rapid and accurate hand–eye coordination are required, like shooting and archery, which both are part of the Olympic Games (Greenhill & Houghton, 2017).

* Corresponding author: Thomas Chung; Consultant Community Medicine; Family and Student Health Services, Department of Health, 4/F Lam Tin Polyclinic, 99 Kai Tin Road, Kwun Tong, Hong Kong SAR, China; Phone: +852 3163 4608; Fax: +852 2717 1720; E-mail: twchung@dh.gov.hk

This is an open-access article distributed under the terms of the [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/), which permits unrestricted use, distribution, and reproduction in any medium for non-commercial purposes, provided the original author and source are credited, a link to the CC License is provided, and changes – if any – are indicated.

There are on-going debates about the similarities and differences between esports and traditional sports. Elite players of online games argue that a high level of cooperation, coordination, and strategic thinking are essential components to winning. Amateur players starting with easy-to-play games and viewing competitions in live streaming have a strong sense of involvement. Both groups will support the notion of this activity as a sport. On the other hand, others may not consider esports as a real sport, as it is contrary to the values of sports involving a pursuit of physical excellence (Moosa, 2017).

At present, the role and impact of esports is unclear, especially with regard to international multisport competitions. Esports was a sports event in the 2018 Asian Games and confirmed as an official medal event in the 2022 Asian Game to be held in Hangzhou, China (Graham, 2017). However, in early October 2018, the International Olympic Committee (IOC) questioned the overall lack of athleticism and physicality of esports. During a recent media interview, the President of the IOC mentioned that the violence, explosions, killing, and discrimination in nature of some of the esports games contravened Olympic values. Esports have also been criticized for a lack of standardized rules for players (BBC, 2018; Menezes, 2018). Thus, whether esports will appear in the 2024 Paris summer Olympic Games is too early to predict. An inconsistent attitude toward esports from sports federations may increase difficulty to identify its position.

In view of the rapid development and public health concerns of gaming, the WHO invited us to prepare a paper on esports to facilitate discussions by experts at the Fourth Meeting on the Public Health Implications of Addictive Behaviors held in Istanbul at the end of 2017. The discussion paper provided an overview of esports, with examples of the most prominent esports activities (including software and competitions), to provide an insight into the scope of esports in different countries, identified public health concerns associated with esports, and attempts to address the issue from a public health perspective. This paper is a modified version of the WHO discussion paper with updated information.

METHODS

This paper is a non-systematic review, based on information retrieved from the Internet and PubMed. With the help of different online search engines (keywords included: “esports,” “e-games competitions”/“tournaments,” “gaming,” “excessive gaming,” “problematic gaming,” and “gaming disorders”), we generated a list of websites and papers that contained a wide variety of information of esports. We extracted and collated information to reflect different genres of games, impact, popularity, governments support in different countries and jurisdictions, and public health implications.

RESULTS

A brief on common esports games

As esports is still in its infancy, there is no clear categorization on the genre of games in esports. Different sources of

information grouped these games in different categories (Discover Esports, 2017; Elliott, Ream, McGinsky, & Dunlap, 2012; Intel, 2016; PricewaterhouseCoopers, 2016). The list of genres of games mentioned below is neither comprehensive nor exhaustive. Some games may be grouped under a different category using other names or descriptions and even fit into more than one genre.

First-person shooter (FPS). Players view the action through the eyes of the character and control who they shoot (Discover Esports, 2017). Examples of popular games in this genre include CS:GO, Call of Duty, and Doom and Halo.

Fighting. Another genre involves a battle game between characters, which is controlled by the players or by the game’s artificial intelligence. These games involve rapid sequence of button presses or mouse movements (Techopedia, 2018a). Examples of popular games include Mortal Kombat and Street Fighter.

Sports games. In sports games, players experience virtual simulations of real sports. The Fédération Internationale de Football Association football game series is one of the most popular sports simulator video games among traditional sport clubs, such as Manchester City, Schalke 04, and Ajax (Varley, 2018). Other types of sports games in esports include American football, hockey, basketball, etc.

Multiplayer online battle arena (MOBA). MOBA is a hero strategic combat between two small teams of players, each trying to defend their home base and destroy the opponent’s base (Giant Bomb, 2018). There are a number of popular MOBA games, with LoL launched (launched in 2009) being one of the most popular esports games in the world. King of Glory, which was launched in 2015, is a popular mobile MOBA game in China.

Massively multiplayer online role-playing game (MMORPG). MMORPG is one of the most structured game types, allowing thousands of people to play online simultaneously. Players develop their characters in the virtual world through various tasks and battles and the gaming world keeps running even when the players are away from their device (Techopedia, 2018b). World of Warcraft is one of the most popular MMORPGs.

Battle royale games. Another genre involves a survival game in a “players versus players” setting. A large number of players search for weapons and fight to be the last survivor to win (Livingston, 2019). Both battle royale games, such as PUBG and Fortnite, went viral on the esports market in mid-2018 (Hornshaw, 2019).

There are many different tournaments organized by the gaming companies all over the world, some of which are supported by governments. Examples of some popular esports tournaments include The International: DOTA 2 Championships, the League of Legends World Championship, and the Intel Extreme Masters. These tournaments provide live broadcasts of the competition and prize money to competitors (e-Sports Earnings, 2018).

Scope of penetration of esports activities

Live streaming allows viewers to watch competitions live, all over the world at any time. There were many different live-streaming platforms for esports, such as Twitch,

Youtube Gaming, and Steam TV (Brathwaite, 2018). Players and viewers can stream and follow their favorite games and teams. The penetration of esports activities could be reflected by (a) the numbers of players including professionals and amateurs; (b) the number of viewers, audience, spectators, and followers of different kinds of competitions in real life venues, television programs, and online; and (c) money invested and generated.

Global players

There are tens of millions and even up to a hundred million of players participating in various esports games worldwide (Statista, 2017a). As of August 2017, there were 100 million players for LoL (Statista, 2017a).

Global audience

There are hundreds of millions watching esports and the number is increasing: the esports global audience was estimated to be 385 million people in 2017, of which 191 million were esports enthusiasts and 194 million were occasional viewers (Warman, 2017).

Prize pools

With prize pools of up to US\$26 million, esports prizes are considerable and attractive to amateur players looking to turn professional (e-Sports Earnings, 2018).

Global data on revenue

Esports is a fast growing business with significant year-on-year increments in revenue of big companies. A recent esports market report indicated that US\$696 million revenue was generated in 2017, with more than half of these profits generated by China and North America, and revenue is expected to increase to US\$1.5 billion by 2020 (Warman, 2017).

Different countries and jurisdictions have different support from their respective governments in regard to esports: this ranges from a laissez-faire approach (e.g., USA and UK), active government support of events (e.g., Singapore and Hong Kong), and recognition of esports as a traditional sports (e.g., China and Korea) combined with legislative measures to facilitate the development of esports (e.g., Taiwan). Details regarding support from the governments or national organizations as well as penetration of the activities in different places are summarized in Table 1.

Public health concerns associated with esports

Unlike other at-risk behaviors, such as smoking and substances use, engaging in gaming or participating in esports is a normal activity and associated with benefits. For youth workers and parents, esports can be viewed as a means of engaging children and youth (Slessor, 2018). For esports players, they can learn how to collaborate with others and build their sense of responsibility through the completion of different tasks (Freeman & Wohn, 2017; Tang, 2018). It is important to note that gaming is not equivalent to GD. From

a public health perspective, concern only arises when engagement in gaming is excessive and the aim is to minimize harms for both the players (amateur and professional) and viewers (on-site spectators, television audience, and social media followers). However, at present, there is little information on the health effects associated with esports and some of the concerns noted below are drawing reference to problematic gaming.

The notion that problematic computer use meets criteria for an addiction and therefore should be included in official psychiatric classification systems was first proposed by Dr. Kimberly S. Young (1996) who had extensively studied the condition and developed the Internet Addiction Test, which is commonly used (Young, 1998). Since then, a number of surveys and studies have been conducted in different parts of the world. Yet, a systematic review found that among the variables “time spent online” and “the use of specific online applications,” most notably, gaming and social application are the most common indicators of Internet addiction (Kuss, Griffiths, Karila, & Hillieux, 2014). In the most recent iteration of the fifth edition of *Diagnostic and Statistical Manual of Mental Disorders*, released in 2013, Internet Gaming Disorder was included in the Appendix as a condition warranting further research.

In June 2018, the WHO included GD as a mental health condition in the ICD-11 (WHO, 2018c, 2018d). GD (with online and offline variants) is characterized by impaired control over gaming, increasing priority given to gaming over other activities to the extent that gaming takes precedence over other interests and daily activities, and continuation or escalation of gaming, despite the occurrence of negative consequences. It results in significant impairment in personal, family, social, educational, occupational, or other important areas of functioning and would normally have been evident for at least 12 months. HG is also included in ICD-11 (WHO, 2018e). HG refers to a pattern of gaming, either online or offline that considerably increases the risk of harmful physical or mental health consequences to the individual or to others. The increased risk may be from the frequency of gaming, from the amount of time spent on these activities, from the neglect of other activities and priorities, from risky behaviors associated with gaming or its context, from the adverse consequences of gaming, or from a combination of these factors. The pattern of gaming often persists in spite of awareness of increased risk of harm to the individual or others (WHO, 2018e). Surveys in Asian countries have shown that the prevalence rate of GDs/addiction among young people ranged from 10% to 15% and the rate, compared to 1% to 10% in some western countries (Saunders et al., 2017).

Such marked differences in prevalence rates may be due, at least part, to the absence of a standardized assessment tool (Chung, Sum, & Chan, 2018; Chung et al., 2019; Kuss, Griffiths, & Pontes, 2017). A project, under the auspices of the WHO, is currently underway to address this gap in the literature.

Diverging from the traditional categorical conceptualization of pathology, embodied in our extant classification systems, it has been argued that gaming behavior lies along a continuum, from normal gaming to GD

Table 1. Support from governments or national organizations in the development of esports and penetration of esports activities

Countries/ jurisdictions	Governments/national organizations to support esports	Penetration of gaming/esports activities
Australia	The Australian Esports Association (AESA) was formally established as a non-profit association in April 2013. It is a national body that is actively involved in the development of policy, planning, infrastructure, and initiatives for esports in Australia (The Australian Esports Association, 2019)	68% of Australians have been identified as gamers (Brand, 2015) Around 1.5 million of Australians were esports fans in 2016 (Australia’s Broadband Network, 2017)
Canada	Canada’s first esports gaming arena in Richmond, BC, will be set up to open in June 2019 and feature seating for 110 spectators (The Gaming Stadium, 2019)	21.2 million of Canadians were estimated to be gamers in 2018 (Newzoo, 2018a) Game revenue reached US\$2.4 billion in 2018 (Newzoo, 2019)
China	In 2003, the General Administration of Sport of China officially recognized esports as a sports event (Shijia, 2017)	About 560 million people, 70% of the country’s online population play games in China. This accounts for 57% of the global esports audience (Soo & Lee, 2018) About 3.5 billion hr of esports videos were viewed and 11.1 billion esports streams were delivered in China in 2016 (Soo, 2017)
Germany	Germany joined South Korea, China, Russia, Italy, and South Africa by officially recognizing esports. German clubs are able to apply for non-profit status. They will be entitled to reduce corporate and commercial taxes and it is easier for foreign esports players to compete in Germany (Giles, 2018). In November 2017, Germany’s first national esports association – the eSport-Bund Deutschland (ESBD) – was founded in Frankfurt (Vila, 2017)	The number of frequent gamers in Germany was estimated to be 28.9 million in 2016 (Germany Trade and Invest, 2016) More than 20% of Internet users were aware of esports offerings (Germany Trade and Invest, 2016)
Hong Kong	The government viewed esports as a new sector with economic potential. In 2018–2019, the government allocated HKD100 million (US\$12.8 million) to promotion of esports including building facilities, technological development, and talent nurturing (Financial Secretary, the Government of the Hong Kong Special Administrative Region, 2018). An esports and digital entertainment node providing competition venue for esports, the Cyberport Arcade, will be established in the local IT hub Cyberport (The Government of the Hong Kong Special Administrative Region, 2018)	The Hong Kong Tourism Board has organized the “e-Sports & Music Festival Hong Kong” since 2017 (Hong Kong Tourism Board, 2018; Sun, 2017), which has attracted tens of thousands of people (Leung, 2018)
Singapore	Singapore’s Cybersports & Online Gaming Association (SCOGA), a non-profit organization, was founded by a group of enthusiastic gamers and formally registered in February 2008. It has been working with various government bodies to advocate cyber-wellness and launch digital literacy programs (Singapore’s Cybersports & Online Gaming Association, 2019). With the support by the National Youth Council, it launched the Esports Academy in 2017 (Hio, 2017)	SCOGA estimated that over 2 million of the population in Singapore were casual gamers and over 500,000 were esports fans (Media Literacy Council, 2017)
South Korea	In 2000, the government became involved in the Korean e-Sports Association to manage esports and actively promote esports competitions (Mozur, 2014)	The number of gamers in South Korea was estimated to be 28.9 million in 2018 (Newzoo, 2018b) Game revenue reached US\$5.8 billion in 2018 (Newzoo, 2019)
Taiwan	The government supports and facilitates esports development through different measures. Mayor of Taipei promised to support the industry with the policy of “private sector leads, government supports” (Department of Sports, Taipei City Government, 2016). A dedicated esports stadium was opened in Taipei in April 2017 (Wood, 2017)	The number of gamers in Taiwan was estimated to be 14.5 million in 2018 (Newzoo, 2018c) Game revenue reached US\$1.2 billion in 2018 (Newzoo, 2019)

(Continued)

Table 1. (Continued)

Countries/ jurisdictions	Governments/national organizations to support esports	Penetration of gaming/esports activities
United Kingdom	Established in 2016, the British Esports Association is a not-for-profit organization that aims to foster future British talent, increase awareness of esports, and provide expertise and advice. Its mottos are Promote, Improve, and Inspire. With focus on the grassroots level, the association hopes to help educate parents, teachers, media, and the government about esports and its benefits (British Esports Association, 2019)	The UK's esports audience is set to grow from 6.5 million in 2016 to 8 million in 2019, with a cumulative annual growth rate of 7.5% (The UK Interactive Entertainment Association, 2016)
United States	The US Government recognizes esports players as professional athletes, issuing professional players P-1 visas (Lejacq, 2013; Tassi, 2013)	The number of gamers in America was estimated to be 178.7 million in 2018 (Newzoo, 2018d) Game revenue reached US\$31.5 billion in 2018 (Newzoo, 2019)

(Carragher, Krueger, Eaton, & Slade, 2015; Conway et al., 2019; Eaton, Rodriguez-Seijas, Carragher, & Krueger, 2015; Orsolya & Zsolt, 2017). The upper end of this continuum could also include excessive gaming, problematic gaming, and HG. It is estimated that GD affects only a small proportion of gamers (Anderson et al., 2010; Holtz & Appel, 2011; WHO, 2018d). Yet, the rapidly expanding industry of esports has attracted a sizeable following. Out of the estimated 7.7 billion people in the world, of which nearly 30%, 2.2 billion people are the active gamers and will further increase to 2.73 billion by 2021 (Statista, 2017b). In light of these number, the minority of gamers is sizeable and of significant public health concern (Chung et al., 2018).

A large number of studies have concluded that excessive video game play can lead to a wide variety of negative physical and psychosocial consequences (Griffiths, Kuss, & King, 2012), such as cessation of hobbies or external activities/social isolation (Yilmaz, Yel, & Griffiths, 2018), sleep disruption (King et al., 2013), obesity due to physical inactivity (Calvert, Staiano, & Bond, 2013), poor academic performance (Wright, 2011), irritability (Wong & Lam, 2016), aggression (Coyne, Warbuton, Essig, & Stockdale, 2018; Lemmens, Valkenburg, & Peter, 2011), deep-vein thrombosis (Chang, Burbridge, & Wong, 2013), family conflicts (Schneider, King, & Delfabbro, 2017), low daily life satisfaction (Mentzoni et al., 2011), and attention problems (Lau, Ip, Wong, & Ho, 2017; Nikkelen, Valkenburg, Huizinga, & Bushman, 2014; Swing, Gentile, Anderson, & Walsh, 2010).

A number of studies and reviews have been conducted to determine whether video games with violent content cause aggressive behaviors in players, especially in younger children and adolescents (Anderson et al., 2010; Anderson, Bushman, et al., 2017; Anderson, Suzuki, et al., 2017; Bavelier et al., 2011; Boxer, Groves, & Docherty, 2015; Byron Review, 2008; Calvert et al., 2017; DeCamp & Ferguson, 2017; Exelmans, Custers, & Van de Bulck, 2015; Ferguson, 2015; Greitemeyer & Mügge, 2014; Holtz & Appel, 2011; Huesmann, 2010; Kepes, Bushman, & Anderson, 2017; Kühn et al., 2019; Lobel, Engels, Stone, Burk, & Granic, 2017; Markey, 2015; Prescott, Sargent, & Hull, 2018). These studies have found that males are more

prone to aggression than females (Verheijen et al., 2018) and ethnic and cultural differences are apparent (Anderson et al., 2010; Prescott et al., 2018). A recent paper reviewing meta-analyses and research on violent screen media conducted over the past 60 years, with an emphasis on violent video game research, concluded that short-term and long-term harmful effects are apparent (Anderson, Bushman, et al., 2017). As the esports contain violent elements, including shooting and killing enemies, we join others' calls in the literature for high quality, longitudinal, and large-scale studies using validated tools to fully explore the association between esports and health (Anderson, Bushman, et al., 2017; Byron Review, 2008; Ferguson, 2015; Prescott et al., 2018).

Problematic gaming was also found to be positively related to depression and impulsivity, and negatively related to the quality of interpersonal relationships (Ryu et al., 2018). Those with more gaming symptoms evidenced greater levels of depression, academic declines, worsened relationships with parents over time, along with increased aggressive tendencies. Problematic gaming is comorbid with several other mental health problems (Gentile et al., 2011), such as anxiety disorder (Park, Jeon, Bae, Seong, & Hong, 2017), substance-use behaviors (Van Rooij et al., 2014), obsessive-compulsive disorder (Andreassen et al., 2016), and suicidal ideation (Messias, Castro, Saini, Usman, & Peebles, 2011).

There is a dearth of published research reporting the potential harms associated with esports, although some esports interviews and news reports have, anecdotally, referred to some common health concerns, such as musculoskeletal problems, visual disturbance, and mental fatigue (Cheshire, 2019; Chua, 2017; Erzberger, 2018; Lagunas, 2019).

Professional players need to achieve good results at international tournaments, so they spend long hours training, which occupy most of their daily lives. It is very common for professional players to suffer from occupational strain as they have to sit for long periods, from 12 to 15 hr without much gross motor movements (Ashton, 2017; Chua, 2017; Jacobs, 2015). Training in esports mainly focuses on repeated fine motor activities. Physical ailments

like deep vein thrombosis, carpal tunnel, or back strains are common, as a result of a mostly sedentary lifestyle and demanding schedule (Griffiths et al., 2012). To become a professional player, esports trainees have to get engaged in esports in systematically and intensively around 15–17 years of age. Consequently, some teenagers may choose to drop out of school (Leung, 2018). Very few players reach a professional level of gaming. Of the estimated 1.5 billion contemporary gamers, only a few thousand achieve professional competitive status (Nielsen & Karhulathi, 2017). If trainees fail to achieve profession status, uncertain career paths and low education level may be barriers hampering success and progression (Sacco, 2015).

Esports fans are not only gamers but also dedicated viewers. An average viewer watches 19 sessions per month, with an average of 2.2 hr per session (Superdata, 2014), excluding time spent playing and other screen use, the associated long duration of screen time or sedentary lifestyle increases the risk of obesity (Department of Health, The Government of the Hong Kong Special Administrative Region, 2014; Robinson et al., 2017).

DISCUSSION

In recent decades, research and clinical evidence have accumulated on the adverse health effects associated with problematic gaming. Esports, which is considered to be a variant of video gaming, has been growing rapidly in recent years with enormous number of players and viewers around the globe. Similar to excessive video gaming, where a minority of players will experience adverse health consequences, we predict that a minority of those participating in esports will encounter negative health impacts and we predict an increase in the prevalence of GD or HG.

It has been argued that esports players are different from other gamers, as they are more disciplined and adopt measures to render themselves less likely to develop adverse health problems related to problematic gaming (Media Literacy Council, 2017). On the other hand, it has been suggested that professional video game players can be affected by problematic use due to high levels of stress (Bányai, Griffiths, Király, & Demetrovics, 2018). A recent literature review reported that the appropriate length of time spent playing video games depends on the age of the player, his/her individual characteristics, the culture that he/she lives in, and his/her broader life content (Kardefelt-Winther, 2017). There is a need for the medical field to build on the knowledge of problematic gaming and conduct further research into the adverse health consequences associated with esports, for both players and viewers.

Large-scale surveys and analyses have been produced by private firms specializing in market search and opinion polling, such as Newzoo, Statista, Pew Research Centre, focusing on esports' market share, profit, and revenue. By contrast, few papers have been published in the academic sector, medical community or health-related disciplines on the potential adverse impacts, and effects of esports. This imbalance of information might result in a bias picture.

During our review process, we observed that many publications did not explicitly mention conflicts of interest, such as the sources of research funding and the relationship with the funder. Hence, the collation and interpretation of information should be treated cautiously. Many game companies diminish or deny GD as an important clinical and public health problem (Rumpf et al., 2018). Being a business anticipating huge monetary returns, the industry is promoting video gaming in the name of esports, although whether esports should be considered as a sport is still open to debate.

Identifying relevant sources of information for this paper was not as straightforward as for a scientific or medical review paper. Although there is a lot of piecemeal information about esports on the Internet and in other various sources, it is very difficult to identify and collate the relevant information in a systematic way using appropriate references. Most of the currently available information is also commercially driven or released by the industry without any declaration of conflicts of interest.

The majority of references used in this briefing paper is from the English media, literature, websites, and other communication channels.

Due to the above limitations, the information in this paper is neither comprehensive, nor exhaustive. We hope that this briefing paper can give readers an overview on the global situation of esports and possible adverse health consequences.

CONCLUSIONS

With the rise of esports under the umbrella of gaming, it seems reasonable to expect an increase in problematic gaming and thus increased prevalence of GD and HG. With the increasing demand for treatment services for gaming addiction/disorder in different countries around the world, especially in Asian countries (Hsu, 2018; Saunders et al., 2017), this is a significant public health concern.

Children and adolescents are particularly vulnerable to risky and addictive behaviors (Potenza, 2013). Excessive time spent gaming/engaging in esports may affect their learning, psychological well-being, and development. Experts from different disciplines should systematically examine study the potential negative consequences of esports. Given the recent addition of GD and HG in ICD-11, it is especially timely to call for global public health action to develop strategies in prevention of the onset and progression of problematic gaming (including esports; Chung et al., 2018). Joint efforts from experts in the medical field, health-related disciplines, sports science and gaming, and esports industries, providing support for professional players and viewers, can make esports not only fun but also safer and healthier (King, 2018).

Funding sources: This work was based on the paper commissioned by the World Health Organization (WHO) in preparation for the fourth WHO meeting on public health implications of addictive behaviors, held in Istanbul, Turkey

from November 29, 2017 to December 1, 2017. Further information and editing were prepared by the Student Health Service of the Department of Health, HKSAR Government. There was no external funding source for this task.

Authors' contribution: TC conceived the review. All authors contributed to the writing and editing of the manuscript.

Conflict of interest: The authors do not have any financial or other relations with the gaming or esports industry that may gain or lose financially from the content of this paper. They also declared and confirmed that there is no conflict of interest in submitting this paper and they have not received any fund or sponsorship from any institutions or groups.

Acknowledgements: The authors would like to express their sincere gratitude to Natacha Carragher for her contributions to provide critical feedback and proofreading for this paper. All the authors belong to the Student Health Service, Department of Health, Hong Kong SAR, China.

REFERENCES

- Anderson, C. A., Bushman, B. J., Bartholow, B. D., Cantor, J., Christakis, D., Coyne, S. M., Donnerstein, E., Brockmyer, J. F., Gentile, D. A., Green, C. S., Huesmann, R., Hummer, T., Krahe, B., Strasburger, V. C., Warburton, W., Wilson, B. J., & Ybarra, M. (2017a). Screen violence and youth behavior. *Pediatrics*, *140*(Suppl. 2), S142–S147. doi:10.1542/peds.2016-1758T
- Anderson, C. A., Shibuya, A., Ihori, N., Swing, E. L., Bushman, B. J., Sakamoto, A., Rothstein, H. R., & Saleen, M. (2010). Violent video game effects on aggression, empathy, and prosocial behavior in eastern and western countries: A meta-analytic review. *Psychological Bulletin*, *136*(2), 151–173. doi:10.1037/a0018251
- Anderson, C. A., Suzuki, K., Swing, E. L., Groves, C. L., Gentile, D. A., Prot, S., Lam, C. P., Sakamoto, A., Horiuchi, Y., Krahe, B., Jelic, M., Liuqing, W., Toma, R., Warburton, W. A., Zhang, X. M., Tajima, S., Qing, F., & Petrescu, P. (2017b). Media violence and other aggression risk factors in seven nations. *Personality and Social Psychology Bulletin*, *43*(7), 986–998. doi:10.1177/0146167217703064
- Andreassen, C. S., Billieux, J., Griffiths, M. D., Kuss, D. J., Demetrovics, Z., Mazzoni, E., & Pallesen, S. (2016). The relationship between addictive use of social media and video games and symptoms of psychiatric disorders: A large-scale cross-sectional study. *Psychology of Addictive Behaviors*, *30*(2), 252–262. doi:10.1037/adb0000160
- Ashton, G. (2017). What is the optimum training time for esports players? *The Esports Observer*. Retrieved April 8, 2019, from <https://esportsobserver.com/optimum-player-training-time/>
- Australia's Broadband Network. (2017). *nbnTM future of sport report*. Retrieved April 8, 2019, from <https://www.nbnco.com.au/content/dam/nbnco2/documents/nbn%20Future%20of%20Sport%20report%20-%20HR.pdf>
- Bányai, F., Griffiths, M. D., Király, O., & Demetrovics, Z. (2018). The psychology of esports: A systematic literature review. *Journal of Gambling Studies*, *35*(2), 351–365. doi:10.1007/s10899-018-9763-1
- Bavelier, D., Green, C. S., Han, D. H., Renshaw, P. F., Merzenich, M. M., & Gentile, D. A. (2011). Brains on video games. *Nature Reviews Neuroscience*, *12*(12), 763–768. doi:10.1038/nrn3135
- BBC. (2018). *Esports 'too violent' to be included in Olympics*. Retrieved April 8, 2019, from <https://www.bbc.com/news/newsbeat-45407667>
- Boxer, P., Groves, C. L., & Docherty, M. (2015). Video games do indeed influence children and adolescents' aggression, prosocial behavior, and academic performance: A clearer reading of Ferguson. *Perspectives on Psychological Science*, *10*(5), 671–673. doi:10.1177/1745691615592239
- Brand, J. E. (2015). *Digital Australia report 2016*. Eveleigh, Australia: Interactive Games & Entertainment Association. Retrieved April 8, 2019, from <https://www.igea.net/wp-content/uploads/2015/07/Digital-Australia-2016-DA16-Final.pdf>
- Brathwaite, B. (2018). Breaking down the major streaming platforms in esports. *The Esports Observer*. Retrieved April 8, 2019, from <https://esportsobserver.com/breakdown-streaming-platforms/>
- British Esports Association. (2019). *About the British esports association*. Retrieved April 8, 2019, from <http://www.britisheports.org/about-us.html>
- Byron Review. (2008). *Safer children in a digital world: The report of the Byron review*. Retrieved April 8, 2019, from <https://www.iwf.org.uk/sites/default/files/inline-files/Safer%20Children%20in%20a%20Digital%20World%20report.pdf>
- Calvert, S. L., Appelbaum, M., Dodge, K. A., Graham, S., Nagayama Hall, G. C., Hamby, S., Fasig-Caldwell, L. G., Citkowitz, M., Galloway, D. P., & Hedges, L. V. (2017). The American Psychological Association task force assessment of violent video games: Science in the service of public interest. *American Psychologist*, *72*(2), 126–143. doi:10.1037/a0040413
- Calvert, S. L., Staiano, A. E., & Bond, B. J. (2013). Electronic gaming and the obesity crisis. *New Directions for Child and Adolescent Development*, *2013*(139), 51–57. doi:10.1002/cad.20031
- Carragher, N., Krueger, R. F., Eaton, N. R., & Slade, T. (2015). Disorders without borders: Current and future directions in the meta-structure of mental disorders. *Social Psychiatry and Psychiatric Epidemiology*, *50*(3), 339–350. doi:10.1007/s00127-014-1004-z
- Chang, H. C. L., Burbridge, H., & Wong, C. (2013). Extensive deep vein thrombosis following prolonged gaming ('gamer's thrombosis'): A case report. *Journal of Medical Case Reports*, *7*, 235–236. doi:10.1186/1752-1947-7-235
- Cheshire, T. (2019). Chinese students could be playing games with their eyesight. *Sky News*. Retrieved April 3, 2019, from <https://news.sky.com/story/chinese-students-could-be-playing-games-with-their-eyesight-11599031>
- Chua, K. (2017). 5 most common health concerns for esports athletes. *Rappler*. Retrieved April 8, 2019, from <https://www.rappler.com/technology/features/181571-esports-common-health-concerns>
- Chung, T., Sum, S., & Chan, M. (2018). Time to call for global public health approach in prevention of the onset of progression of problematic gaming. Commentary on: Policy responses to problematic video game use: A systematic review of current measures and future possibilities (Király et al., 2018). *Journal of Behavioral Addictions*, *7*(3), 548–552. doi:10.1556/2006.7.2018.86
- Chung, T. W. H., Sum, S. M. Y., & Chan, M. W. L. (2019). Adolescent Internet addiction in Hong Kong: Prevalence,

- psychosocial correlates, and prevention. *Journal of Adolescent Health*, 64(Suppl. 6), S34–S43. doi:10.1016/j.jadohealth.2018.12.016
- Conway, C. C., Forbes, M. K., Forbush, K. T., Fried, E. I., Hallquist, M. N., Kotov, R., Mullins-Sweatt, S. N., Shackman, A. J., Skodol, A. E., South, S. C., Sunderland, M., Waszczuk, M. A., Zald, D. H., Afzail, M. H., Bornovalova, M. A., Carragher, N., Docherty, A. R., Jonas, K. G., Krueger, R. F., Patalay, P., Pincus, A. L., Tackett, J. L., Reininghaus, U., Waldman, I. D., Wright, A. G. C., Zimmermann, J., Bach, B., Bagby, R. M., Chmielewski, M., Cicero, D. C., Clark, L. A., Dalgleish, T., DeYoung, C. G., Hopwood, C. J., Ivanova, M. Y., Latzman, R. D., Patrick, C. J., Ruggero, C. J., Samuel, D. B., Watson, D., & Eaton, N. R. (2019). A hierarchical taxonomy of psychopathology can transform mental health research. *Perspectives on Psychological Science*, 14(3), 419–436. doi:10.1177/1745691618810696
- Coyne, S. M., Warbuton, W. A., Essig, L. W., & Stockdale, L. A. (2018). Violent video games, externalizing behavior, and prosocial behavior: A five-year longitudinal study during adolescence. *Developmental Psychology*, 54(10), 1868–1880. doi:10.1037/dev0000574
- DeCamp, W., & Ferguson, C. J. (2017). The impact of degree of exposure to violent video games, family background, and other factors on youth violence. *Journal of Youth and Adolescence*, 46(2), 388–400. doi:10.1007/s10964-016-0561-8
- Department of Health, The Government of the Hong Kong Special Administrative Region. (2014). *e-Report: Report of advisory group on health effects of use of Internet and electronic screen products*. Retrieved April 8, 2019, from http://www.studenthealth.gov.hk/english/internet/report/files/e_report.pdf
- Department of Sports, Taipei City Government. (2016). *Mayor attend eSports award ceremony, promises support for industry*. Retrieved April 8, 2019, from <http://english.sports.gov.taipei/ct.asp?xItem=239286154&ctNode=9999&mp=104062>
- DiFrancisco-Donoghue, J., Balentine, J., Schmidt, G., & Zwibel, H. (2019). Managing the health of the eSport athlete: An integrated health management model. *BMJ Open Sport & Exercise Medicine*, 5, e000467. doi:10.1136/bmjsem-2018-000467
- Discover Esports. (2017). *What are the game types?* Retrieved April 8, 2019, from <https://discoveresports.com/what-are-the-game-types/>
- Eaton, N. R., Rodriguez-Seijas, C., Carragher, N., & Krueger, R. F. (2015). Transdiagnostic factors of psychopathology and substance use disorders: A review. *Social Psychiatry and Psychiatric Epidemiology*, 50(2), 171–182. doi:10.1007/s00127-014-1001-2
- Elliott, L., Ream, G., McGinsky, E., & Dunlap, E. (2012). The contribution of game genre and other use patterns to problem video game play among adult video gamers. *International Journal of Mental Health and Addiction*, 10(6), 948–969. doi:10.1007/s11469-012-9391-4
- Erzberger, T. (2018). Mental health issues remain pervasive problem in esports scene. *ESPN*. Retrieved April 3, 2019, from http://www.espn.com/esports/story/_id/24427802/mental-health-issues-esports-remain-silent-very-real-threat-players
- e-Sports Earnings. (2018). *Largest overall prize pools in eSports*. Retrieved April 8, 2019, from <https://www.esportsearnings.com/tournaments>
- Exelmans, L., Custers, K., & Van de Bulck, J. (2015). Violent video games and delinquent behavior in adolescents: A risk factor perspective. *Aggressive Behavior*, 41(3), 267–279. doi:10.1002/ab.21587
- Ferguson, C. J. (2015). Do angry birds make for angry children? A meta-analysis of video games influences on children's and adolescent's aggression, mental health, prosocial behavior, and academic performance. *Perspectives on Psychological Science*, 10(5), 646–666. doi:10.1177/1745691615592234
- Financial Secretary, the Government of the Hong Kong Special Administrative Region. (2018). *The 2018-19 budget: Innovation and technology*. Retrieved April 8, 2019, from <https://www.budget.gov.hk/2018/eng/budget13.html>
- Freeman, G. Z., & Wohn, D. Y. (2017). Understanding eSports team formation and coordination. *Computer Supported Cooperative Work*, 27(3–6), 1019–1050. doi:10.1007/s10606-017-9299-4
- Gentile, D. A., Choo, H., Liau, A., Sim, T., Li, D., Fung, D., & Khoo, A. (2011). Pathological video game use among youths: A two-year longitudinal study. *Pediatrics*, 127(2), e319–e329. doi:10.1542/peds.2010-1353
- Germany Trade and Invest. (2016). *The gaming industry in Germany*. Retrieved April 8, 2019, from http://www.gtai.de/GTAI/Content/EN/Invest/_SharedDocs/Downloads/GTAI/Fact-sheets/Business-services-ict/fact-sheet-gaming-industry-en.pdf
- Giant Bomb. (2018). *Definition of multiplayer online battle arena*. Retrieved April 8, 2019, from <https://www.giantbomb.com/multiplayer-online-battle-arena/3015-6598/>
- Giles, T. (2018). Germany recognizes eSports as an official sport. *The Sport Digest*. Retrieved April 8, 2019, from <http://thesportdigest.com/2018/02/germany-recognizes-esports-as-an-official-sport/>
- Graham, B. A. (2017). eSports to be a medal event at 2022 Asian Games. *The Guardian*. Retrieved April 8, 2019, from <https://www.theguardian.com/sport/2017/apr/18/esports-to-be-medal-sport-at-2022-asian-games>
- Greenhill, A., & Houghton, R. (2017). *eSports and streaming in the UK in 2017 white paper*. Retrieved April 8, 2019, from <http://www.britisheports.org/assets/esportswhitepaperfinalpdf.pdf>
- Greitemeyer, T., & Mügge, D. O. (2014). Video games do affect social outcomes: A meta-analytic review of the effects of violent and prosocial video game play. *Personality and Social Psychology Bulletin*, 40(5), 578–89. doi:10.1177/0146167213520459
- Griffiths, M. D., Kuss, D. J., & King, D. L. (2012). Video game addiction: Past, present and future. *Current Psychiatry Reviews*, 8(4), 308–318. doi:10.2174/157340012803520414
- Hio, L. (2017). First e-sports academy here a game changer. *The Straits Times*. Retrieved April 8, 2019, from <https://www.straitstimes.com/singapore/first-e-sports-academy-here-a-game-changer>
- Holtz, P., & Appel, M. (2011). Internet use and video gaming predict problem behavior in early adolescence. *Journal of Adolescence*, 34(1), 49–58. doi:10.1016/j.adolescence.2010.02.004
- Hong Kong Tourism Board. (2018). *e-Sports & music festival Hong Kong*. Retrieved April 8, 2019, from <http://www.discoverhongkong.com/us/see-do/events-festivals/highlight-events/e-sports-music-festival.jsp>
- Hornshaw, P. (2019). The history of battle Royale: From mod to worldwide phenomenon. *Digital Trends*. Retrieved April 8,

- 2019, from <https://www.digitaltrends.com/gaming/history-of-battle-royale-games/>
- Hsu, T. (2018). Video game addiction tries to move from basement to doctor's office. *The New York Times*. Retrieved April 8, 2019, from <https://www.nytimes.com/2018/06/17/business/video-game-addiction.html>
- Huesmann, L. R. (2010). Nailing the coffin shut on doubts that violent video games stimulate aggression: Comment on Anderson et al. (2010). *Psychological Bulletin*, 136(2), 179–181. doi:10.1037/a0018567
- Intel. (2016). *eSports: The global scene in numbers*. Retrieved April 8, 2019, from https://simplecore.intel.com/newsroom/wp-content/uploads/sites/11/2016/03/IEM2016_eSports_FactSheet.pdf
- Jacobs, H. (2015). Here's the insane training schedule of a 20-something professional gamer. *Business Insider*. Retrieved April 8, 2019, from <https://www.businessinsider.com/pro-gamers-explain-the-insane-training-regimen-they-use-to-stay-on-top-2015-5>
- Kardefelt-Winther, D. (2017). *How does the time children spend using digital technology impact their mental well-being, social relationships and physical activity? An evidence-focused literature review* (Innocenti Discussion Paper 2017-2). Florence, Italy: UNICEF Office of Research-Innocenti. Retrieved April 8, 2019, from <https://www.unicef-irc.org/publications/pdf/Children-digital-technology-wellbeing.pdf>
- King, D. L. (2018). Comment on the global gaming industry's statement on ICD-11 gaming disorder: A corporate strategy to disregard harm and deflect social responsibility? *Gaming Industry Response Consortium*, 113(11), 2145–2146. doi:10.1111/add.14388
- King, D. L., Gradisar, M., Drummond, A., Lovato, N., Wessel, J., Micic, G., Douglas, P., & Delfabbro, P. (2013). The impact of prolonged violent video-gaming on adolescent sleep: An experimental study. *Journal of Sleep Research*, 22(2), 137–143. doi:10.1111/j.1365-2869.2012.01060.x
- Kepes, S., Bushman, B. J., & Anderson, C. A. (2017). Violent video game effects remain a societal concern: Reply to Hilgard, Engelhardt, and Roudier (2017). *Psychology Bulletin*, 143(7), 775–782. doi:10.1037/bul0000112
- Kühn, S., Kugler, D. T., Schmalen, K., Weichenberger, M., Witt, C., & Gallinat, J. (2019). Does playing violent video games cause aggression? A longitudinal intervention study. *Molecular Psychiatry*, 24, 1220–1234. doi:10.1038/s41380-018-0031-7
- Kuss, D. J., Griffiths, M. D., Karila, L., & Hillieux, J. (2014). Internet addiction: A systematic review of epidemiological research for the last decade. *Current Pharmaceutical Design*, 20(25), 4026–4052. doi:10.2174/13816128113199990617
- Kuss, D. J., Griffiths, M. D., & Pontes, H. M. (2017). Chaos and confusion in DSM-5 diagnosis of Internet gaming disorder: Issues, concerns, and recommendations for clarity in the field. *Journal of Behavioral Addictions*, 6(2), 103–109. doi:10.1556/2006.5.2016.062
- Lagunas, K. M. (2019). Are esports good for your health? *Deutsche Welle*. Retrieved April 3, 2019, from <https://www.dw.com/en/are-esports-good-for-your-health/a-47408527>
- Lau, Y. L., Ip, P., Wong, W., & Ho, F. (2017). *Overuse of digital devices and inferior physical fitness among Hong Kong Children*. Li Ka Shing Faculty of Medicine, The University of Hong Kong. Retrieved April 8, 2019, from <https://www.med.hku.hk/f/news/2375/4608/ASPR%20ppt%20v4.3e.pdf>
- Lejacq, Y. (2013). Score! Professional video gamers awarded athletic visas. *NBC News*. Retrieved April 8, 2019, from <https://www.nbcnews.com/technology/score-professional-video-gamers-awarded-athletic-visas-6C10679998>
- Lemmens, J. S., Valkenburg, P. M., & Peter, J. (2011). The effects of pathological gaming on aggressive behavior. *Journal of Youth and Adolescence*, 40(1), 38–47. doi:10.1007/s10964-010-9558-x
- Leung, K. (2018). Hong Kong e-sports fanatic who dropped out of high school eyes pro career in gaming. *South China Morning Post*. Retrieved April 8, 2019, from <https://www.scmp.com/news/hong-kong/hong-kong-economy/article/2160320/hong-kong-e-sports-fanatic-who-dropped-out-high>
- Livingston, C. (2019). The battle royal games of 2019. *PC Gamer*. Retrieved April 8, 2019, from <https://www.pcgamer.com/battle-royale-games-2018/>
- Lobel, A., Engels, R. C., Stone, L. L., Burk, W. J., & Granic, I. (2017). Video gaming and children's psychosocial wellbeing: A longitudinal study. *Journal of Youth and Adolescence*, 46(4), 884–897. doi:10.1007/s10964-017-0646-z
- Markey, P. M. (2015). Finding the middle ground in violent video game research: Lesson from Ferguson (2015). *Perspectives on Psychological Science*, 10(5), 667–70. doi:10.1177/1745691615592236
- Media Literacy Council. (2017). *Real life stories of change: The fine line between excessive gaming & eSports*. Retrieved April 8, 2019, from <https://www.betterinternet.sg/campaign2017/line-between-excessive-gaming-esports.html>
- Menezes, J. D. (2018). ESports will not be added to Olympics because 'killer games are too violent' says IOC president Thomas Bach. *Independent*. Retrieved April 8, 2019, from <https://www.independent.co.uk/sport/olympics/olympics-esports-wont-be-added-killer-games-too-violent-ioc-president-thomas-bach-a8522301.html>
- Mentzoni, R. A., Brunborg, G. S., Molde, H., Myrseth, H., Skouerøe, K. J. M., Hetland, J., & Pallesen, S. (2011). Problematic video game use: Estimated prevalence and associations with mental and physical health. *Cyberpsychology, Behavior, and Social Networking*, 14(10), 591–596. doi:10.1089/cyber.2010.0260
- Messias, E., Castro, J., Saini, A., Usman, M., & Peebles, D. (2011). Sadness, suicide, and their association with video game and Internet overuse among teens: Results from the youth risk behavior survey 2007 and 2009. *Suicide and Life-Threatening Behavior*, 41(3), 307–315. doi:10.1111/j.1943-278X.2011.00030.x
- Moosa, T. (2017). eSports are real sports. It's time for the Olympic video games. *The Guardian*. Retrieved April 8, 2019, from <https://www.theguardian.com/commentisfree/2017/aug/11/esports-olympic-video-games-ioc-gaming>
- Mozur, P. (2014). For South Korea, e-Sports is national pastime. *The New York Times*. Retrieved April 8, 2019, from <https://www.nytimes.com/2014/10/20/technology/league-of-legends-south-korea-epicenter-esports.html>
- Newzoo. (2018a). *Canada games market 2018*. Retrieved April 8, 2019, from <https://newzoo.com/insights/infographics/canada-games-market-2018/>
- Newzoo. (2018b). *South Korea games market 2018*. Retrieved April 8, 2019, from <https://newzoo.com/insights/infographics/south-korea-games-market-2018/>

- Newzoo. (2018c). *Taiwan games market 2018*. Retrieved April 8, 2019, from <https://newzoo.com/insights/infographics/taiwan-games-market-2018/>
- Newzoo. (2018d). *U.S. games market 2018*. Retrieved April 8, 2019, from <https://newzoo.com/insights/infographics/us-games-market-2018/>
- Newzoo. (2019). *Top 100 countries/markets by game revenues*. Retrieved 3 April, 2019, from <https://newzoo.com/insights/rankings/top-100-countries-by-game-revenues/>
- Nielsen, R. K. L., & Karhulahti, V. M. (2017). *The problematic coexistence of internet gaming disorder and esports*. Paper presented at FDG '17 Proceedings of the 12th International Conference on the Foundations of Digital Games [52] Association for Computing Machinery, Hyannis, MA.
- Nikkelen, S. W., Valkenburg, P. M., Huizinga, M., & Bushman, B. J. (2014). Media use and ADHD-related behaviors in children and adolescents: A meta-analysis. *Developmental Psychology, 50*(9), 2228–2241. doi:10.1037/a0037318
- Orsolya, K., & Zsolt, D. (2017). Inclusion of Gaming Disorder in ICD has more advantages than disadvantages: Commentary on: Scholars' open debate paper on the World Health Organization ICD-11 Gaming Disorder proposal (Aarseth et al.). *Journal of Behavioral Addictions, 6*(3), 280–284. doi:10.1556/2006.6.2017.046
- Park, S., Jeon, H. J., Bae, J. N., Seong, S. J., & Hong, J. P. (2017). Prevalence and psychiatric comorbidities of Internet addiction in a nationwide sample of Korean adults. *Psychiatry Investigation, 14*(6), 879–882. doi:10.4306/pi.2017.14.6.879
- Pei, A. (2019). Here's why esports can become a billion-dollar industry in 2019. *CNBC*. Retrieved April 2, 2019, from <https://www.cnbc.com/2019/01/20/heres-why-esports-can-become-a-billion-dollar-industry-in-2019.html>
- Perez, M. (2018). Report: Esports to grow substantially and near billion-dollar revenues in 2018. *Forbes*. Retrieved April 2, 2019, from <https://www.forbes.com/sites/mattperez/2018/02/21/report-esports-to-grow-substantially-and-near-a-billion-dollar-revenues-in-2018/#5410056a2b01>
- Prescott, A. T., Sargent, J. D., & Hull, J. G. (2018). Metaanalysis of the relationship between violent video game play and physical aggression over time. *Proceedings of the National Academy of Sciences of the United States of America, 115*(40), 9882–9888. doi:10.1073/pnas.1611617114
- Potenza, M. N. (2013). Biological contributions to addictions in adolescents and adults: Prevention, treatment, and policy implications. *The Journal of Adolescent Health, 52*(2 Suppl. 2), S22–S32. doi:10.1016/j.jadohealth.2012.05.007
- PricewaterhouseCoopers. (2016). *The burgeoning evolution of eSports: From the fringes to front and center*. Retrieved April 8, 2019, from <https://www.pwc.se/sv/pdf-reports/the-burgeoning-evolution-of-esports.pdf>
- Robinson, T. N., Banda, J. A., Hale, L., Lu, A. S., Fleming-Milici, F., Calvert, S. L., & Wartella, E. (2017). Screen media exposure and obesity in children and adolescents. *Pediatrics, 140*(Suppl. 2), S97–S101. Retrieved from https://pediatrics.aappublications.org/content/pediatrics/140/Supplement_2/S97.full.pdf
- Rumpf, H. J., Achab, S., Billieux, J., Bowden-Jones, H., Carragher, N., Demetrovics, Z., Higuchi, S., King, D. L., Mann, K., Potenza, M., Saunders, J. B., Abbott, M., Ambekar, A., Aricak, O. T., Assanangkornchai, S., Bahar, N., Borges, G., Brand, M., Chan, E. M., Chung, T., Derevensky, J., Kashef, A. E., Farrell, M., Fineberg, N. A., Gandin, C., Gentile, D. A., Griffiths, M. D., Goudriaan, A. E., Grall-Bronnec, M., Hao, W., Hodgins, D. C., Ip, P., Király, O., Lee, H. K., Kuss, D., Lemmens, J. S., Long, J., Lopez-Fernandez, O., Mihara, S., Petry, N. M., Pontes, H. M., Rahimi-Movaghar, A., Rehnein, F., Rehm, J., Scafato, E., Sharma, M., Spritzer, D., Stein, D. J., Tam, P., Weinstein, A., Wittchen, H. U., Wölfling, K., Zullino, D., & Poznyak, V. (2018). Including gaming disorder in the ICD-11: The need to do so from a clinical and public health perspective. *Journal of Behavioral Addictions, 7*(3), 556–561. doi:10.1556/2006.7.2018.59
- Ryu, H., Lee, J. Y., Choi, A., Park, S., Kim, D. J., & Choi, J. S. (2018). The relationship between impulsivity and Internet gaming disorder in young adults: Mediating effects of interpersonal relationships and depression. *International Journal of Environmental Research and Public Health, 15*(3), pii: E458. doi:10.3390/ijerph15030458
- Sacco, D. (2015). Why do esports pros retire so young and what can they do next? We ask Snoopeh. *Esports News UK*. Retrieved April 8, 2019, from <https://esports-news.co.uk/2015/06/26/esports-retire-young-career-snoopeh/>
- Saunders, J. B., Hao, W., Long, J., King, D. L., Mann, K., Fauth-Bühler, M., Rumpf, H. J., Bowden-Jones, H., Rahimi-Movaghar, A., Chung, T., Chan, E., Bahar, N., Achab, S., Lee, H. K., Potenza, M., Petry, N., Spritzer, D., Ambekar, A., Derevensky, J., Griffiths, M. D., Pontes, H. M., Kuss, D., Higuchi, S., Mihara, S., Assanangkornchai, S., Sharma, M., Kashef, A. E., Ip, P., Farrell, M., Scafato, E., Carragher, N., & Poznyak, V. (2017). Gaming disorder: Its delineation as an important condition for diagnosis, management, and prevention. *Journal of Behavioral Addictions, 6*(3), 271–279. doi:10.1556/2006.6.2017.039
- Schneider, L. A., King, D. L., & Delfabbro, P. H. (2017). Family factors in adolescent problematic Internet gaming: A systematic review. *Journal of Behavioral Addictions, 6*(3), 321–333. doi:10.1556/2006.6.2017.035
- Shijia, O. (2017). Esports-next frontier in video gaming. *China Daily*. Retrieved April 8, 2019, from http://www.chinadaily.com.cn/china/2017-05/29/content_29540601_4.htm
- Singapore's Cybersports & Online Gaming Association. (2019). *About us*. Retrieved April 8, 2019, from <http://scoga.org/about/>
- Slessor, C. (2018). High school eSports league: How gaming is changing the modern-day classroom. *ABC*. Retrieved April 8, 2019, from <https://www.abc.net.au/news/2018-05-14/high-school-esports-league-helping-teachers-reach-students/9717146>
- Soo, Z. (2017). The phenomenal rise of e-sports in China where gamers outnumber the US population. *South China Morning Post*. Retrieved April 8, 2019, from <http://www.scmp.com/news/china/society/article/2104805/chinas-e-sports-phenomenon-just-imagine-americas-entire-capital>
- Soo, Z., & Lee, A. (2018). Gaming addiction debate reignites with Tencent in spotlight after mobile games compared to 'opium'. *South China Morning Post*. Retrieved April 8, 2019, from <http://www.scmp.com/tech/article/2136128/gaming-addiction-debate-reignites-tencent-spotlight-after-mobile-games-compared>
- Statista. (2017a). *Number of players of selected eSports games worldwide as of August 2017 (in million)*. Retrieved April 8, 2019, from <https://www.statista.com/statistics/506923/esports-games-number-players-global/>
- Statista. (2017b). *Number of active video gamers worldwide from 2014 to 2021 (in millions)*. Retrieved April 8, 2019, from

- <https://www.statista.com/statistics/748044/number-video-gamers-world/>
- Sun, N. (2017). Hong Kong's first e-sports and music festival debuts with gaming showdown. *South China Morning Post*. Retrieved April 8, 2019, from <https://www.scmp.com/news/hong-kong/economy/article/2105264/hong-kongs-first-e-sports-and-music-festival-debuts-gaming>
- Superdata. (2014). *eSports digital games market trends brief*. Retrieved April 8, 2019, from <https://www.slideshare.net/superdata/superdata-research-esports-brief>
- Swing, E. L., Gentile, D. A., Anderson, C. A., & Walsh, D. A. (2010). Television and video game exposure and the development of attention problems. *Pediatrics*, *126*(2), 214–221. doi:10.1542/peds.2009-1508
- Tang, W. (2018). Understanding esports from the perspective of team dynamics. *The Sport Journal*. Retrieved April 8, 2019, from <http://thesportjournal.org/article/understanding-esports-from-the-perspective-of-team-dynamics/>
- Tassi, P. (2013). The U.S. now recognizes eSports players as professional athletes. *Forbes*. Retrieved April 8, 2019, from <https://www.forbes.com/sites/insertcoin/2013/07/14/the-u-s-now-recognizes-esports-players-as-professional-athletes/#76fc75813ac9>
- Techopedia. (2018a). *Fighting games*. Retrieved April 8, 2019, from <https://www.techopedia.com/definition/27154/fighting-game>
- Techopedia. (2018b). *Massively multiplayer online role-playing game (MMORPG)*. Retrieved April 8, 2019, from <https://www.techopedia.com/definition/1919/massively-multiplayer-online-role-playing-game-mmorpg>
- The Australian Esports Association. (2019). *Introduction*. Retrieved April 8, 2019, from <http://www.aesa.org.au/about/#intro>
- The Gaming Stadium. (2019). *CBC: Richmond esports arena will be 1st in Canada*. Retrieved April 2, 2019, from <https://thegamingstadium.com/news/>
- The Government of the Hong Kong Special Administrative Region. (2018). Promoting development of e-sports industry. Retrieved April 8, 2019, from <http://www.info.gov.hk/gia/general/201803/28/P2018032800307.htm>
- The UK Interactive Entertainment Association. (2016). *Ukie whitepaper: Growing the UK as an esports hub*. Retrieved April 8, 2019, from http://ukie.org.uk/ukie_files/ukie-whitepaper-growing-uk-esports-hub
- Van Rooij, A. J., Kuss, D. J., Griffiths, M. D., Shorter, G. W., Schoenmakers, M. T., & van de Mheen, D. (2014). The (co-) occurrence of problematic video gaming, substance use and psychosocial problems in adolescents. *Journal of Behavioral Addictions*, *3*(3), 157–165. doi:10.1556/JBA.3.2014.013
- Varley, C. (2018). Football and gaming are becoming inseparable. *BBC*. Retrieved April 8, 2019, from <https://www.bbc.co.uk/bbcthree/article/e93c2303-15e9-4c48-a7fb-9c5362427910>
- Verheijen, G. P., Burk, W. J., Stoltz, S. E. M. J., van den Berg, Y. H. M., & Cillessen, A. H. N. (2018). Friendly fire: Longitudinal effects of exposure to violent video games on aggressive behavior in adolescent friendship dyads. *Aggressive Behavior*, *44*(3), 257–267. doi:10.1002/ab.21748
- Vila, F. S. (2017). Will German eSports be recognized as a sport? *Deutsche Welle*. Retrieved April 8, 2019, from <http://www.dw.com/en/will-german-esports-be-recognized-as-a-sport/a-41817810>
- Warman, P. (2017). Esports revenue will reach \$696 million this year and grow to \$1.5 billion by 2020 as brand investment doubles. *Newzoo*. Retrieved April 8, 2019, from <https://newzoo.com/insights/articles/esports-revenues-will-reach-696-million-in-2017/>
- Wong, I. L. K., & Lam, M. P. S. (2016). Gaming behavior and addiction among Hong Kong adolescents. *Asian Journal of Gambling Issues and Public Health*, *6*(1), 6. doi:10.1186/s40405-016-0016-x
- Wood, J. (2017). Blizzard opens its esports stadium in Taiwan, and what it means for Overwatch growth. *The Lines*. Retrieved April 8, 2019, from <https://www.thelines.com/blizzard-esports-stadium-taiwan/>
- World Health Organization [WHO]. (2018a). *Excessive internet use – developing policies and programmes to address a growing problem*. Retrieved April 8, 2019, from http://www.who.int/substance_abuse/excessive_internet_use/en/
- World Health Organization [WHO]. (2018b). *ICD-11 for mortality and morbidity statistics (2018): Gaming disorder*. Retrieved April 8, 2019, from <https://icd.who.int/browse11/l-m/en/#http://id.who.int/icd/entity/1448597234>
- World Health Organization [WHO]. (2018c). *WHO releases new International Classification of Diseases (ICD 11)*. Retrieved April 8, 2019, from [http://www.who.int/news-room/detail/18-06-2018-who-releases-new-international-classification-of-diseases-\(icd-11\)](http://www.who.int/news-room/detail/18-06-2018-who-releases-new-international-classification-of-diseases-(icd-11))
- World Health Organization [WHO]. (2018d). *Gaming disorder*. Retrieved April 8, 2019, from <http://www.who.int/features/qa/gaming-disorder/en/>
- World Health Organization [WHO]. (2018e). ICD-11 for mortality and morbidity statistics (2018): Gaming disorder. *Hazardous Gaming*. Retrieved November 14, 2018, from <https://icd.who.int/browse11/l-m/en#http%3a%2f%2fid.who.int%2fid%2fentity%2f1586542716>
- Wright, J. (2011). The effects of video game play on academic performance. *Modern Psychological Studies*, *17*(1), 37–44. Retrieved from <https://scholar.utc.edu/cgi/viewcontent.cgi?article=1197=mps>
- Yilmaz, E., Yel, S., & Griffiths, M. D. (2018). The impact of heavy (excessive) video gaming students on peers and teachers in the school environment: A qualitative study. *Addicta: The Turkish Journal on Addictions*, *5*(2), 147–161. doi:10.15805/addicta.2018.5.2.0035
- YouGov. (2017). *Just a game? Understanding the existing and future UK eSports market*. Retrieved April 8, 2019, from https://yougov.co.uk/news/2017/09/27/just-game-understanding-existing-and-future-uk-esp/?utm_medium=Media&utm_source=press&utm_campaign=eSports-report
- Young, K. (1996, August 11). *Internet addiction: The emergence of a new clinical disorder*. Paper presented at 104th annual meeting of the American Psychological Association, Toronto, Canada.
- Young, K. (1998). Internet addiction: The emergence of a new clinical disorder. *CyberPsychology & Behavior*, *1*(3), 237–244. doi:10.1089/cpb.1998.1.237