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The impact of video game addiction on aggressive behaviour among tertiary students in Sri Lanka

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Abstract

This research examines the impact of video game addiction on aggressive behaviour of tertiary students in Sri Lanka. Video game addiction, with its potential adverse impacts has raised concerns among the public, especially regarding its link to aggressive behaviour. Data was gathered from a sample of 382 undergraduates of local non-state universities selected employing cluster sampling technique to examine the correlation between video game addiction and aggression. The survey was conducted to collect data on video game addiction and aggression. Research findings reveal how gaming addiction leads to aggressive behaviour in addicted gamers indicating a strong positive relationship between video game addiction and aggressive behaviour. Therefore, researchers recommend balanced time management practices between game usage and other daily essential activities and promoting awareness about negative behavioural implication of game addiction. It is expected that this study provides insights to stakeholders including teachers, parents, and administrators to better understand the effects of video game addiction, and mitigation strategies to minimise the negative impact on students' behaviour.

Keywords Aggressive behaviour, Tertiary students, Video game addiction

1 Introduction

Video gaming is a popular form of entertainment embraced by the younger generation, and its popularity heightened during the initial outbreak of the COVID-19 pandemic as social distancing and regional travel restrictions were widely implemented. The study by DiFrancisco-Donoghue et al. report a substantial increase in the number of hours spent gaming per day, with casual gamers seeing a 73.5% rise during this period. The increases were even more pronounced during the moderate lockdowns (77.6%) and total lockdowns (77.2%) [1]. As a result many people were more drawn towards technology-based modes of entertainment to cope with the stress and loneliness caused by the lockdown.

The telecommunication provider in US, Verizon has reported a 75% increase in online gaming at the outset of the pandemic). Although engagement in video games has increased during the COVID-19 pandemic due to stay-at-home measures, recent studies suggest that post-pandemic gaming behavior has largely returned to pre-pandemic levels [2] However, concerns about maladaptive gaming behaviors remain, particularly among individuals who use video games as a coping mechanism for unmet psychological needs in their daily lives.

Recent studies on the impact of video games present mixed results [3] On one hand, video games have been shown to offer benefits such as positive impact on brain cognitive function, supporting sustainable education through gamification, and as a therapy for mental health conditions. On the other hand, there is also evidence pointing to potential negative outcomes, such as addiction and its associated mental health risks. These contrasting findings underscore the complex and multifaceted nature of video game impacts, influenced by the context in which they are used and individual player differences [4, 5]. On the other hand, concerns are mounting globally about the excessive usage of video games and the ensuing addiction to them. Addiction to video games is recognised to have an adverse impact on one's physical and emotional well-being, social interactions, and academic achievement [6, 7]. Several studies suggest that video game addiction results in aggression in people, particularly in children and younger people [8–11]. Parents, educators, and academics are becoming increasingly concerned about the intensifying problem of video game addiction and its possible effects on aggressive behaviour. Concerns have been expressed regarding how the video game addiction affects aggressive behaviour among adolescents and would have serious repercussions for both individuals and the larger society.

Several scholars have examined this sphere of study in different cultural contexts. One study report that playing violent video games is linked to aggressive behaviour in American teenage boys [12] discovered that playing violent video games is linked to aggressive behaviour in American teenage boys [14]. Similarly, a study by [9] discovered that violent behaviour among Dutch teenage gamers is related to video game addiction. However, most of the existing literature is predominantly on the Western populations underscoring the gap in exploring how these dimensions are unfolding in developing nations where gaming popularity is heightening. Thus, as a developing nation with significant resource constraints, Sri Lanka provides a unique and underexplored backdrop for investigating the relationship between gaming addiction and aggressive behaviour. Research on the connection between video game addiction and aggressive conduct among tertiary students is lacking within the Sri Lankan context. This attributes to the novelty of as game addiction in Sri Lankan context, partly due to the low level of internet penetration and device ownership, typical factors affecting developing countries due to socio economic status. Furthermore, gaming disorder remain understudied and an evolving research area globally with its recent inclusion in the International Classification of Diseases (ICD-11) and only tentative recognition as a condition warranting further research in the DSM-5. This ambiguity further signifies the need of localized research, particularly in developing regions like Sri Lanka, where such behaviours are underexplored but potentially impactful. By bridging this gap, the proposed study aims to provide insights into the connection between gaming addiction and aggression in a developing-country context, enriching the global understanding of this evolving phenomenon. Other than

that, there are three reasons to explore this research in Sri Lanka as a developing country. First reason is patterns of gaming behaviour and its psychological outcomes can vary between developed and developing countries due to the difference between in socio-economic conditions, cultural norms, digital access, family structures, and educational environments. Another reason is unlike developed countries, Sri Lanka does not posses' adequate mental health support systems, counselling services, and parental monitoring mechanisms and this led to psychological and behavioural effects of gaming addiction, including aggression, could manifest differently. Finally, developing Asian countries similar to Sri Lanka, where gaming is growing increasingly with less empirical research, offer an important opportunity to examine how these behaviours evolve in different developmental and cultural contexts. With this backdrop, Sri Lanka supports a unique context for studying the impact of gaming addiction on aggressive behaviour among tertiary students. Addressing this gap is academically significant and practically significant as it informs educators, policymakers, and mental health practitioners in Sri Lanka where youth digital engagement is accelerating without corresponding research insights.

The main objective of this study is to determine how video game addiction affects tertiary students' propensity for aggressive conduct, focusing on non-state university students in Sri Lanka. In exploring this, gender is a significant dimension as previous studies show that men and women engage with video games differently. Past studies suggest that men are more likely than women to be exhibit higher level of aggression than women, and that men and women play video games differently and the gender disparities remain in the connection between aggressive behaviour and video game addiction [13]. However, there is limited understanding of whether these gendered patterns extend to moderating the effects of video game addiction on aggression, particularly in a tertiary student population. Hence this study also investigates the moderating role of gender on the relationship between video game addiction and aggressive behaviour of tertiary students.

Recent studies underscore a prevalence of playing digital games among tertiary students, with 33.7% of students playing digital games every day [14]. Even though many studies have investigated the game addiction symptoms of high school students, none have focused on exploring how game addiction relates to aggressive behaviour. This study aims to investigate this unexplored territory in this specific population. This fills the empirical gap in the current literature by examining the impact of video game addiction on aggressive behaviour among non-state university students in Sri Lanka.

By deriving conclusions, this study adds to the existing body of literature on the said subject. Overall, the results of the study will shed light on how video game addiction affects young adults' mental health and wellbeing as well as how the gender factor is connected in this regard. The findings are expected to pave the way to devise strategies, formulate policies and provide insights to relevant authorities.

1.1 Theoretical background & literature review

There are various theoretical explanations for addiction and aggression, with desensitization to violence, arousal theory, and social learning theory are the most relevant to understanding the link between video game addiction and aggression. Desensitisation to violence involves emotional and cognitive processes that reduce sensitivity to violence over time. This phenomenon can significantly impact individual's attitudes, beliefs, and

behaviours towards violence, making them more accepting or tolerant of violent acts [15]. Repeated exposure to violent stimuli leads to decreased emotional responsiveness, as individuals become less emotionally reactive to such stimuli over time [16]. Desensitization to violence has been widely studied in media psychology. For instance, Krahé et al. [17] found that habitual exposure to media violence is associated with reduced physiological arousal and increased aggressive cognitions and behaviours. This suggests that repeated exposure to violent media can make individuals less sensitive to violence and more prone to aggressive thoughts and actions. Similarly, Mrug et al. [18]demonstrated that exposure to real-life and movie violence leads to diminished empathy and reduced emotional reactivity to violence. These studies highlight the complex interplay between media violence exposure and its impact on emotional and cognitive responses to violence. The desensitization process explains the tendency of decreased emotional response and empathy, as well as an increased tolerance for violence and aggressive behaviour [19]. Therefore, understanding desensitization provides a clear foundation for examining the impact of video game addiction on aggression in the current study.

Arousal theory explains that individuals need to maintain an optimal level of arousal to function effectively [20]. The Yerkes-Dodson law, associated with the arousal theory, explains an inverted U-shaped relationship between arousal and performance [21]. In the context of video game addiction, players may experience arousal while playing video games due to excitement, competition, and immersion in the game environment. This heightened arousal can be beneficial up to a point, enhancing engagement and performance. However, excessive arousal, particularly from violent video games, can lead to negative outcomes. Research has shown that exposure to violent video games often induces high levels of arousal, which can contribute to desensitization to violence and increased aggression [22]. Desensitization occurs as players become accustomed to violent content, reducing their emotional responsiveness to real-world violence. Arousal theory helps to contextualize how factors such as game content, duration, frequency of play, and individual characteristics of players interact to influence behaviour. By understanding these interactions, we can better comprehend the dual impact of arousal and desensitization in the context of video game addiction.

Social learning theory, initially developed by Albert Bandura and he proposes that individuals learn new behaviours by observing others and the consequences of their actions [23]. According to this theory, the socialisation process, modelling and reinforcement can shape the behaviour of an individual. Peer influence, family dynamics, cultural factors and socialisation processes can influence the likelihood of engaging in aggressive behaviour among game players [24]. Moreover, video game players may be rewarded for engaging in aggression or violence while playing the game, which can reinforce aggressive behaviour in real life [25]. However, it is important to note that recent research by [26] found no relationship between violent video games and physical aggression, only verbal aggression and hostility. Additionally, video games can act as a cathartic medium, providing an outlet for players to release stress and emotions [26]. Furthermore, video games can also bring about benefits to social functioning. For example [3], found that adolescents play video games as a shared peer activity, which can enhance social interactions and relationships. Therefore, in the context of video game addiction and aggressive behaviour, tertiary students may observe and imitate the behaviours they see in video

games, including acts of violence and aggression, but it is also crucial to consider the potential positive social impacts and the role of video games as a form of escapism.

1.1.1 Video game addiction and its impact on tertiary students

Online gaming wasn't commonplace before the 2000s. Instead, four friends would use controllers to play multiplayer games together in the same room. The first commercial first-party online gaming service was SegaNet, used in the Sega Dreamcast released in 1998. Online gaming gained significant popularity with the launch of Xbox Live for the original Xbox in 2001, which had built-in networking hardware. Sony's PlayStation 2, released in 2000, required an additional physical add-on for online play. Sony later introduced the PlayStation Network in 2006 with the PlayStation 3, allowing players to compete against friends and strangers globally.

Several studies have pinpointed the rising tendency of video game usage worldwide. The Entertainment Software Association (ESA) reports that 62% of American adults and 76% of kids play video games [27]. In Australia, around 91% of households own a video game device, indicating high market penetration. Computer games are a favourite family pastime for 77% of parents and their children [27, 31]. Another study by the European Game Developers Federation reports that 53% of the population aged between 6 and 64 years play video games, with an average of 9 h per week [28]. In the United States, 91% of children and adolescents between the ages of 2 and 17 play video games, with 99% of adolescent boys and 94% of adolescent girls participating [29]. In 2015, gamers spent $23.5 billion on video games in the US and globally [30].

The increasing prevalence of video game addiction is becoming a significant public health issue. This is partly due to the complexity of digital gaming and its immersive nature. While the ICD-11 offers diagnostic criteria for gaming disorder, there is a significant diagnostic overlap with other mood disorders, such as depression and anxiety, which can lead to misdiagnosis [31] https://doi.org/10.7717/peerj.10827. Additionally, there is a need for more evidence-based treatment and prevention methods to address this growing concern.

Nowadays, gaming is more than simply a pastime; it is a means to define oneself and influence other decisions people make, such as the brands and technology they choose [32]. Concerns regarding video game addiction have arisen mainly due to the rising popularity of video games and the accessibility to gaming platforms. Addiction to video games can have a significant impact on social behaviours, physical and mental health, and even finances [33]. Thus, the prevalence of video game addiction among tertiary students, its risk factors, and its effects on their general well-being are noteworthy for investigation. Several studies have revealed that the young generation is highly susceptible to video game addiction. For instance, found that the global prevalence of gaming disorder is approximately 3.05%. This is consistent with findings from [34], who discovered that 3.3% of teenagers and young adults in Germany had a video game addiction. These figures highlight the importance of addressing video game addiction as a public health concern.

1.1.2 Risk factors of video game addiction

Several risk factors have been identified for video game addiction. These include:

1. *Age* Video game addiction is more common in younger people than in older people [35]. However, it is important to note that younger players also experience benefits from gaming, such as improved social functioning. For example, Kowert et al. [2] https://doi.org/10.1016/j.chb.2014.05.004 found that younger players use gaming as a shared peer activity, which can enhance social interactions and relationships [3]
2. *Gender* Men are more prone than females to develop a video game addiction [8].
3. *Personality characteristics* Those who exhibit specific characteristics, such as neuroticism, impulsivity, and sensation seeking, are more prone to become addicted to video games [35].
4. *Social Factors* Social issues including peer pressure and social isolation can fuel a person's addiction to video games [35].

In developing nations like Sri Lanka, where access to technology is growing, video game addiction is more common and has a larger possibility to evolve within this arena [36]. The Sri Lanka Chapter of the Internet Society has identified gaming addiction as a significant social issue, particularly noting an increase during the pandemic due to higher demand for devices and internet connections [37, 38]. Video game addiction can have a significant impact on a person's physical and mental health [39]. In Sri Lanka, this issue is compounded by the lack of widespread awareness and resources to address it. Video game addiction is related to a sedentary lifestyle, resulting in obesity and other health issues [35]. Additionally, it can lead to vulnerabilities in terms of well-being, social life and finances. In the Sri Lankan context, these impacts are particularly concerning given the limited access to mental health services and support systems. Furthermore, a video game addiction can result in subpar academic results, social isolation, and lowered self-esteem [8]. Aggressive behaviours in teenagers and young adults have been linked to video game addiction [40]. Given the potential for violent video games to desensitise players to violence and increase the likelihood of aggressive acts, this is especially concerning [41].

1.2 Relationship between video game addiction and aggressive behaviour

Past research on video game addiction and its influence on adolescents' aggressive behaviour is being studied in different contexts. Buss and Perry have developed a scale to measure aggression based on four factors: physical aggression, verbal aggression, anger, and hostility [42]. This self-reporting instrument referred to as Aggression Questionnaire contains 29 items, measured based on a Likert scale from 1 to 5 on the above-mentioned four factors [42]. This scale is used in numerous studies across diverse domains to measure aggression, including research related to video games and aggression [43, 44]. Previous research by Yilmaz et al., has found a moderate positive significant relationship between online game addiction and aggression tendencies [43]. The American Psychological Association (APA) suggests video game addiction as a predictor of aggressive behaviour [44].

Gaming addiction is a hotly debated topic among scholars, with ongoing discussions about the specific behaviours that qualify as addiction. The World Health Organization's [45] [Inclusion of "gaming disorder" in ICD-11 (who.int)] ICD-11 defines gaming disorder as a pattern of gaming behaviour characterized by impaired control over gaming, increasing priority given to gaming over other activities, and continuation or escalation

of gaming despite negative consequences. This behaviour must be evident for at least 12 months and significantly impair personal, family, social, educational, or occupational functioning. Contrary to the American Medical Association's earlier, more conservative benchmark of playing for more than two hours each day constituting addiction, the ICD-11 provides a more comprehensive and widely accepted framework. The American Psychiatric Association's DSM-5 also recognizes Internet Gaming Disorder as a condition requiring further study, emphasizing significant impairment in personal, social, educational, or occupational functioning over a prolonged period [46, 47]. Much of the past literature has indicated that video game addiction should be considered as a risk factor for aggression [26].

These included intense urges and obsession with playing online games, withdrawal symptoms that appeared when the player did not play the game, increasing amounts of time spent playing online, and futile attempts by the player to stop. These result in hours playing online games, but gamers continue to play it; they lie to their friends and family about how much time they spend playing games; they use gaming to relieve tension and feelings of guilt; they risk losing their friendships or their relationships by bugging their friends to play games online with them [48].

It can be identified that most past researchers have focused on Western contexts, particularly in countries such as the US, and have concentrated on different age categories, such as adolescents and school children. Hence, there is a lack of studies conducted on tertiary students in the South Asian context. This study aims to fill this gap by exploring the impact of video game addiction on aggressive behaviour among tertiary students in Sri Lanka, providing valuable insights into a non-Western context.

Hence, considering the above findings of the literature, we propose the following hypothesis for the study:

H_1 There is a significant relationship between aggressive behaviour of tertiary students and video game addiction.

1.2.1 Role of gender in video game addiction

Even though some studies report that video games increase aggression, there is limited information on how video game addiction impacts aggression and other related factors [43]. Recent research on the effects of video games on male gamers has yielded contradictory results [13]. Several studies suggest that men are more negatively affected by video games than women [13].

Many studies have looked at how particular game elements, such as game character's gender and adversary attributes can affect how aggressively players behave in different ways depending on their gender. Aspects of games, including whether avatars wear black or white robes, have been discovered to affect players' views and behaviour [15].

Research has shown that overall, men tend to exhibit more aggressive behaviour in video games compared to women. However, this pattern can change depending on factors within the game itself. For instance, one study found that women who used a female avatar in a game showed more aggressive conduct than those who used a male avatar in a competitive reaction time test where they had to penalise an opponent [17]. Conversely, another study indicated that both male and female players who controlled a male avatar exhibited more aggressive behaviour than those who controlled a female avatar

[18]. These contradictory findings suggest that elements of the video game, beyond violent content, may also influence the cognitive consequences for players.

Gamers may exhibit different levels of aggression depending on the gender of their gaming opponent [14]. used a word completion task in which participants filled in the blank letters to create either an aggressive or non-aggressive word to assess players' aggressive cognitions after playing a game. Alarmingly, the study disclosed that participants' hostile thoughts grew when they were in control of a female avatar engaged in combat with a male foe [13]. It is important to consider whether these differences are influenced by moral considerations regarding violence against women. Overall, the evidence points out a connection between players' cognitive outcomes and the gender traits of both their characters and fellow players. The goal of the current study was to further shed light on how players' gender biases and sensitivity to violence, as well as the gender of players in video games, affect cognitive outcomes.

Therefore, considering the existing literature findings, we postulate the following hypothesis:

H_2 There is a significant association between gender and aggressive behaviour among tertiary level students.

Based on the above review of extant literature, the conceptual framework of the study was derived as illustrated in Fig. 1. The conceptual framework consists of the independent variable of game addiction and the dependent variable of aggressive behaviours of tertiary students. Game addiction is measured using the six dimensions: Salience, Tolerance, Mood modification, Relapse, Withdrawal and Problem. Moreover, the variable of

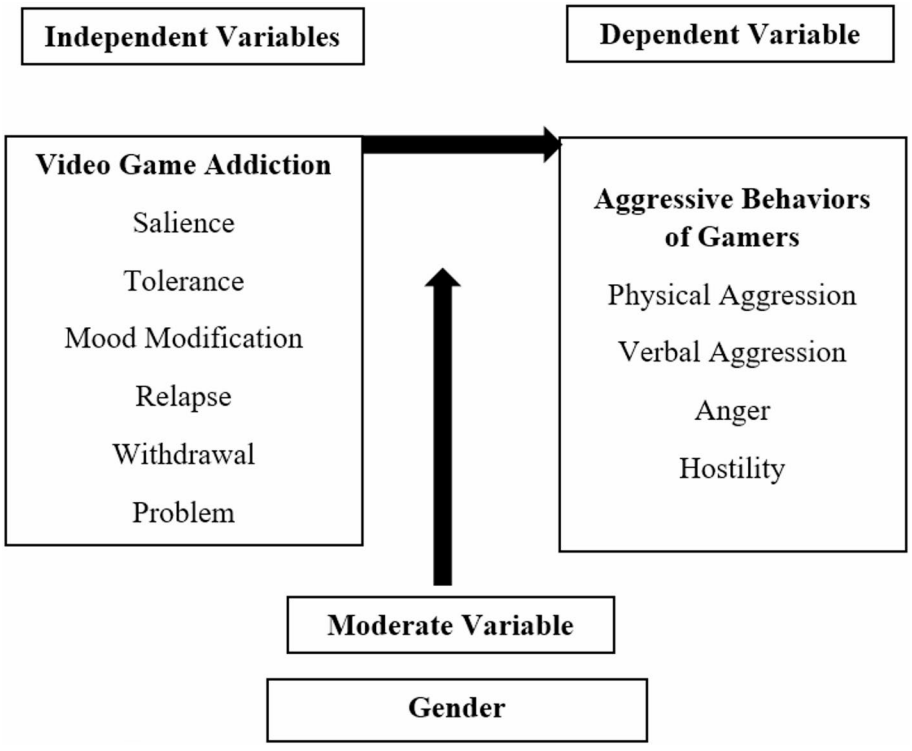

Fig. 1 Conceptual framework

aggressive behaviour is measured using the four dimensions: Physical aggression, Verbal aggression, Anger and Hostility.

2 Research methodology

This study received approval from the ethics committee of the Sri Lanka Institute of Information Technology, Pro Vice-Chancellor (Research & International) office (PVC/RI/EC/2023/12). This research was conducted during the period from November 2023 to February 2024 involving students from two non-state universities in Sri Lanka. The population for the current study is 66,000 non-state university students and it is divided into two clusters: University A with 28,000 students and University B with 38,000 students covering the geographical area of Colombo, Sri Lanka. (Identified as University A and University B). The survey questionnaire comprised three sections with demographic information, video game addiction, and aggressive behaviour of the video game players. Accordingly, six dimensions of the video game addiction measurement scale developed by Abbasi et al., [53] and the four dimensions of the aggressive behaviour measurement scale developed by Ajavakom (2020) were considered [48].

2.1 Participants

The study involved students from two non-state universities in Sri Lanka (University A and University B), with a total population of 66,000 students. University A comprised 28,000 students, and University B comprised 38,000 students, covering the geographical area of Colombo, Sri Lanka. The study was conducted from November 2022 to February 2023.

2.2 Measures

The survey questionnaire included sections on demographic information, video game addiction, and aggressive behavior. Video game addiction was assessed using six dimensions: salience, tolerance, mood modification, relapse, withdrawal, and problem, with a total of 18 items. The study utilised the Video Game Addiction Scale developed by Abbasi et al. [53] and the Aggression Scale developed by Ajavakom [48]. While these scales have been validated in prior international research, reliability testing was conducted to confirm their suitability for the Sri Lankan context. The results indicated high internal consistency (Cronbach's alpha = 0.972 for the Video Game Addiction Scale and 0.966 for the Aggression Scale), confirming the contextual reliability and applicability of the instruments within the Sri Lankan tertiary student population.

3 Results

3.1 Demographic characteristics of the respondents

The questionnaire survey was distributed to respondents using a cluster sampling technique with the target of collecting a total of 382 responses. Table 1, illustrates the demographic characteristics of the 370 respondents, representing a response rate of 97%.

According to Table 1, the majority of respondents were male (87.8%), with 97.6% reporting gaming activity and 85.7% purchasing games. Additionally, 61.9% played games daily, spending predominantly 2–4 h (48.6%) daily on gaming. Player Unknown's Battlegrounds (PUBG) was recorded as the most popular game among tertiary students since it represents 30.3% of the total sample. Secondly, 106 respondents were playing a

Table 1 Demographic information of survey respondents

		Frequency	Percentage
Gender	Male	325	87.8%
	Female	45	12.2%
		370	100%
Game Play or Not	Yes	361	97.6%
	No	9	2.4%
	Total	370	100%
Game Buy or Not	Yes	317	85.7%
	No	53	14.3%
	Total	370	100%
Playing Frequency	Everyday	229	61.9%
	Once a week	18	4.9%
	2 to 4 times per week	41	11.1%
	5 or more times per week	62	16.8%
	Once a month	20	5.4%
	Total	370	100%
Time Spending for Gaming	Less than 2 h	55	14.9%
	2–4 h	180	48.6%
	5–7 h	86	23.2%
	8–10 h	32	8.6%
	More than 10 h	17	4.6%
	Total	370	100%
Name of the Game	Player Unknown's Battlegrounds (PUBG)	112	30.3%
	Garena Free Fire	106	28.6%
	Call of Duty (COD)	49	13.2%
	Cricket	25	6.8%
	Need for speed	12	3.2%
	Other	66	17.8%
	Total	370	100%
Money Spending for Gaming	LKR 0 - LKR 2000 ($0 - $5.48)	249	67.3%
	LKR 2001 – LKR 3500 ($5.43 - $9.50)	62	16.8%
	LKR 3501 – LKR 7000 ($9.51 - $19.01)	39	10.5%
	More than LKR 7001 (More than $19.02)	20	5.4%
	Total	370	100%

Source: Authors' compilation based on the survey data (2023)

Garena Free Fire which contributed to 28.6% of the entire population. The respondents playing Call of Duty (COD), Cricket, Need for Speed, and Other accounted for 13.2%, 6.8%, 3.2%, and 17.8% out of the total population respectively.

In the end, 67.3% of the participants spend LKR. 0 - LKR. 2000 (USD 0 - USD 5.48) amount of money on gaming. The second highest number of respondents was recorded as a percentage of 16.8% in the monthly spending of Rs. 2001 – Rs. 3500 ($5.43 - $9.50) with 62 responses out of the entire population. Finally, the lowest responses of 20 out of 370 responses was recorded in More than Rs. 7001 (More than $19.02) monthly spending for games percentage of 5.4%.

As per the Pan European Game Information (PEGI) 16 and 18 ratings and the Entertainment Software Rating Board (ESRB), Player Unknown's Battlegrounds (PUBG), Garena Free Fire, and COD are considered violent games [47].

3.2 Structural model results

This research depicted a moderation analysis within a Structural Equation Modeling (SEM) framework. The researchers used the bootstrapping technique to assess the association between video game addiction and aggressive behavior. Using 5,000 sub-samples and a significance level of 0.05, the beta value, t-statistic, and p-value were calculated and presented in Table 2.

The above results revealed that all six dimensions of video game addiction; salience ($\beta = 0.167$, $t = 22.137$, $p < 0.001$), tolerance ($\beta = 0.170$, $t = 21.568$, $p < 0.001$), mood modification ($\beta = 0.161$, $t = 20.964$, $p < 0.001$), relapse ($\beta = 0.179$, $t = 24.789$, $p < 0.001$), withdrawal ($\beta = 0.153$, $t = 9.405$, $p < 0.001$), and problem ($\beta = 0.184$, $t = 23.411$, $p < 0.001$) states a significant positive effects on aggressive behaviour among gamers. These findings suggest that people are more tend to act aggressively as their gaming addiction grows and they find it difficult to control their gaming behaviours. Problem and relapse demonstrated comparatively greater effects among these variables, indicating that repeated excessive play and loss of control are the main causes of violent inclinations.

Additionally, the overall video game addiction showed a very significant relationship on aggression ($\beta = 0.946$, $t = 27.278$, $p < 0.001$), offering strong support for the Behavioural Addiction Theory [38]. According to both ideas, aggressive scripts and unfavourable emotional consequences are reinforced by repeated exposure to game cues.

Interestingly, the interaction effect of gender (G) and video game addiction (VGA) on aggression was not statistically significant, with a beta value of –0.076 and a P value of 0.548, suggesting that gender may not significantly moderate the relationship between video game addiction and aggression in this context. The final structural model (see Fig. 2) illustrates the paths and relationships among the different dimensions of video game addiction and aggressive behaviors, emphasizing the significant impact of overall addiction and specific factors like relapse and problem dimensions. These results highlight the complex interplay between video game addiction and aggressive behaviors.

4 Discussion

According to the findings of the study, aggressive behaviour and video game addiction are significantly positively correlated among Sri Lankan students attending private universities. This is in line with the results of past studies on the relationship between online game addiction of high school students and loneliness, aggression and depression tendency, which present a moderately positive significant relationship between online game addiction and tendency towards aggression. In addition, this result is in line with other studies that revealed a connection between excessive video game usage and

Table 2 Path coefficients of the relationships

Relationship	Beta value	T statistic	*P* value
S -> ABG	0.167	22.137	0.000
T -> ABG	0.170	21.568	0.000
M -> ABG	0.161	20.964	0.000
R -> ABG	0.179	24.789	0.000
W -> ABG	0.153	9.405	0.000
P -> ABG	0.184	23.411	0.000
VGA -> ABG	0.946	27.278	0.000
G x VGA -> ABG	–0.076	0.601	0.548

Source: Authors' Compilation based on Smart PLS Output (2023)

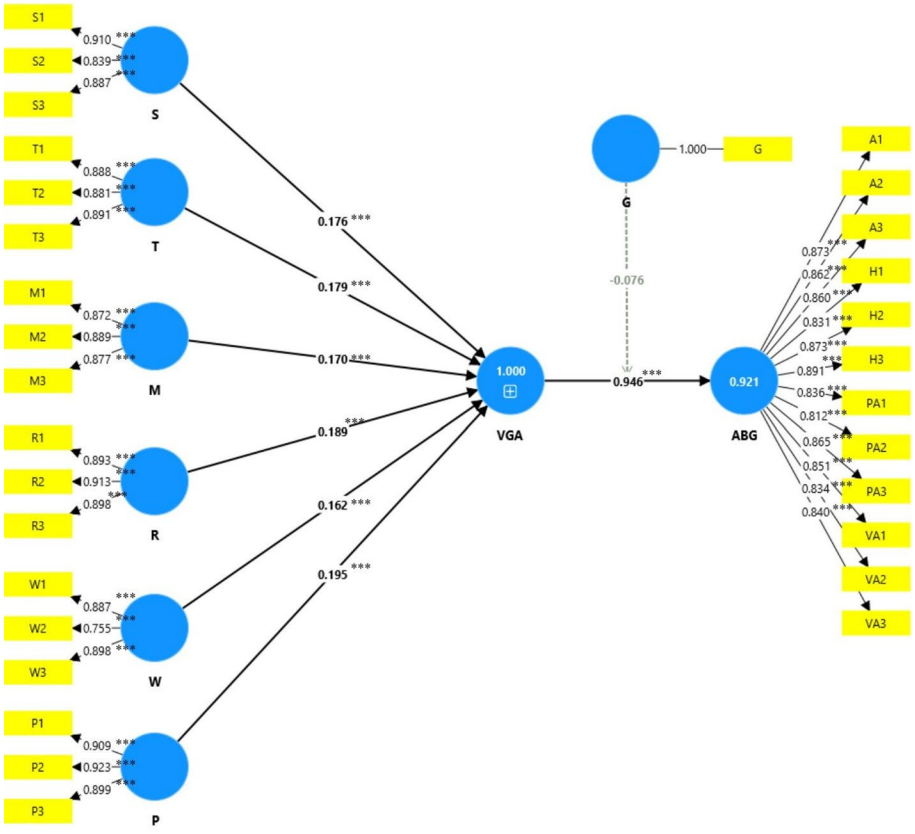

Fig. 2 PLS results of the Structural Model, Source: Generated through Smart PLS (2023)

detrimental mental health effects, such as hostility. With a significant beta value, t-statistic, and p-value, the study's methods and analysis support the hypothesis that video game addiction has a beneficial effect on violent behaviour. It is interesting to note that the study showed no statistically significant link between gender and aggressive behaviour, suggesting that aggressiveness and video game addiction are not moderated by gender. Given that males may be more inclined to display aggressive behaviour in reaction to violent video games, this conclusion is important.

Previous study's results showed that of aggressive behaviour of university students can be predicted from only one aggressive game addiction variable and of aggressive behaviour of those students can be predicted from only three game addiction variables (salience, mood modification and withdrawal) (salience, (except other effects [50]. The lack of gender effects shown in this study, however, raises the possibility that video game addiction is a more important predictor of violent behaviour than gender. The findings of this study have various ramifications for comprehending the connection between violent conduct and video game addiction.

The strong positive correlation observed between these variables underscores the need for increased awareness and interventions to address video game addiction and its potential negative impacts on mental health. Given the popularity of video games among younger generations, who could be more susceptible to the harmful consequences of excessive screen time, this is especially crucial. Second, the absence of gender differences seen in this study indicates that therapies focused on combating violence and video game addiction should be directed at everyone, regardless of gender. This study emphasises

the necessity for inclusive therapies that tackle the root causes of aggressiveness and video game addiction rather than only focusing on particular demographic groups. The majority of the students preferred playing adventure, shooting, and street fighter games. The findings of this study depict the majority of the students play PUBG, Garena Free Fire, and Call of Duty which are categorised as violent games. This result closely aligns with the past study conducted by [26] affirming that video game choices as violent and non-violent using Pan European Game Information (PEGI) 16 and 18 ratings. Also, the majority of them engage in video gaming because of boredom, for relaxation and escape, intellectual challenge, a desire to complete a game, and to reduce stress [51].

The study's findings also align with the social learning theory, which contends that people pick up knowledge from their surroundings, including media exposure. Excessive exposure to violent video games may desensitise players to violent material and increase their propensity for aggressive conduct in the event of video game addiction and aggressive. Similarly, arousal theory also aligns with the study findings. There is a significant relationship between aggression and video game addiction found in this study lends validity to the arousal theory. Several theoretical frameworks, in addition to the social learning theory, might aid in illuminating the connection between violence and video game addiction. For instance, the Generic Aggression Model postulates that aggressive conduct is impacted by both situational and dispositional factors, such as exposure to violent media and unique personality qualities, including situations and situations in which aggression is appropriate. The results of this study support the notion that excessive video game use may be a situational factor that contributes to aggressive behaviour among some individuals.

The result of a previous study that the t-test also showed gender differences in time spent playing video games. Female students spend less time playing video games [52]. The absence of gender differences seen in this study shows that therapies focused on combating violence and video game addiction should be directed at everyone, regardless of gender.

5 Conclusion

The findings of this study underscore the significant relationship between video game addiction and aggressive behaviour among non-state university students in Sri Lanka. Results of the current study revealed that video games, like Garena Free Fire, PUBG, and COD, which are categorised as violent according to PEGI 16 and 18 ratings, can exacerbate aggressive tendencies in addicted players. The immersive and competitive nature of these games, combined with their violent content likely contribute to increased levels of aggression among players.

Without the gamer realising the possible harm while playing, video game addiction can and will potentially hurt the addicted players. So, in accordance with the literature analysis conducted for this study, the results of this research study have demonstrated a substantial relationship between aggressive behavior and video game addiction, although the gender does not moderate this relationship. Hence, the parents, teachers, or anybody else who suspects their friends or kids have a problem with video games should have observed their conduct to see whether they are acting aggressively toward others.

Everyone has been directly affected by the social distancing measures necessitated by the COVID pandemic, which started in 2019. For psychological relief, especially for

loneliness and anxiety, children and teenagers started to use video games more often, as a way of using their leisure time while being socially distanced. This new trend has led to the popularity of a new phenomenon termed as Internet Gaming Disorder (IGD). Most parents who used to supervise their children and control their gaming habits, were unable to do so due to increased stress from work and the pandemic which worsened the problem. There are huge deficits in evidence, trends, and implementation on IGD in mental health as the number of cases has increased during the pandemic and has led to worrying consequences. This includes educating children and their parents on how best to deal with stress and set time boundaries on gaming. The most susceptible children and young people will also require specialised treatment, for example, cognitive-behavioral therapy (CBT), which works well and forms habits for dealing with gaming and mental health problems. Limiting the availability of batteries for devices is not the same as controlling violent video games, and alternatives that do not include aggression are often endorsed. Joint efforts among parents, teachers, medical practitioners, and other educators should be encouraged.

Finally, the study's findings suggest further research to better understand the relationship between video game addiction and aggressive behaviour. Future research could explore potential causal relationships between these factors and the potential moderating factors that may impact this relationship. In conclusion, this study provides evidence of a significant positive correlation between video game addiction and aggressive behaviour among non-state university students in Sri Lanka. These findings highlight the need for increased awareness and interventions to address video game addiction and its potential negative impacts on mental health. As video games continue to grow in popularity, it is essential to understand their potential impacts on mental health and develop effective interventions to promote healthy use.

5.1 Limitations and directions for future research

It is important to acknowledge several inherent limitations of the current study. Firstly, the study's sample size was restricted to students from two non-state universities in Sri Lanka, potentially limiting the generalisability of the findings to the broader higher education sector in the country. Future research endeavours should prioritise replicating these findings across diverse contexts and populations to ascertain the extent of their applicability. Secondly, subsequent investigations could benefit from exploring a wider range of behaviours rather than focusing solely on aggressive behaviour. Thirdly, researchers are encouraged to expand the scope of inquiry beyond the parameters delineated here, considering factors such as the overall health status of tertiary-level students and their educational backgrounds. Acknowledging the demographic composition of the sample, it is important to note that the gender distribution was predominantly male (87.8%). This imbalance reflects the higher level of gaming engagement typically observed among male students within the selected non-state universities in Sri Lanka. However, this gender disparity is recognized as a limitation of the present study, as it may influence the generalizability of findings. Future research should therefore aim for a more balanced gender representation to ensure broader applicability of the results.

Moreover, the reliance on self-reported data introduces the possibility of response bias and social desirability effects. Participants may have underreported their video game usage or aggressive behaviours due to social pressures or the perceived stigma associated

with these behaviours. Furthermore, the cross-sectional form of the study makes it difficult to determine the relationship between violent conduct and video game addiction. Hence, future studies can focus on causal associations between these factors with longitudinal studies that track individuals throughout time. Finally, since this study did not incorporate a qualitative approach, the validity of the findings rests solely on our interpretation and understanding of the dataset, as well as our ability to explore key challenges. Therefore, future researchers are strongly encouraged to enhance the validity of study findings using a qualitative research approach or mixed methods.

Acknowledgements
We would like to express our deepest and sincere gratitude to Ms. Gayendri Karunarathna for proof reading our research article and providing necessary guidance for language editing. We particularly need to thank all participants of the questionnaire surveys for devoting their valuable time to make this research successful.

Author contributions
Consent to participate : The study was conducted with equal participation by all authors.

Funding
No funding was received to assist with the preparation of this manuscript.

Data availability
The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
This study received approval from the ethics committee of the Sri Lanka Institute of Information Technology, Pro Vice-Chancellor (Research & International) office (PVC/RI/EC/2023/12) and relevant survey procedures were in line with the requirements of the Declaration of Helsinki. Written informed consent for participation in this study was provided by the participants.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 4 August 2025 / Accepted: 23 December 2025
Published online: 30 January 2026

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