Original article

Game addiction and severity of ADHD symptoms among adolescent ADHD patients

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Background: Children and adolescents who use the Internet and play games are at risk for the Internet and game addiction because they are still developing and learning new things. Problematic game players are more likely to have attention-deficit hyper activity disorder (ADHD) compared with the general population. The data about game addiction in Adolescents with ADHD in Thailand are still limited.

Objectives: To examine the prevalence of game addiction and its association with the severity of ADHD symptoms and other factors in adolescent ADHD patients attending the Child and Adolescents Outpatient Psychiatric Clinic, King Chulalongkorn Memorial Hospital.

Methods: This cross-sectional descriptive study collected data from 96 adolescent patients who were treated for ADHD at the Child and Adolescents Outpatient Psychiatric Clinic from January to June 2019 using: 1) demographic data questionnaire; 2) Swanson Nolan and Pelham IV Scale (SNAP-IV) Short Form; 3) Game Addiction Screening Test (GAST) Child and Adolescent Version; and, 4) Children's Depression Inventory (CDI) Thai version.

Results: Most of subjects were male (83.3%) aged 14.4 ± 1.7 years. The prevalence of game addiction was 28.1. Game addiction was significantly associated with depression. Personal factors associated with game addiction were playing games on mobile phone or tablet, playing games on computer, favoring first-person shooter (FPS) and multiplayer online battle arena (MOBA) genre of games and the duration of playing games (hours/day). The severity of ADHD symptoms showed no significant association with game addiction.

Conclusion: The prevalence of game addiction in adolescent patients with ADHD was higher than previous studies. Depression and personal factors such as duration of playing games and using mobile phone or tablet for playing were associated with game addiction.

Keywords: Game addiction, attention-deficit hyper activity disorder, ADHD, adolescent.

The Internet is everyone's technology in the 21st Century. Computers become appliances that are used in every home making accessing the Internet easy and convenient. Many electronic devices are developed to meet the needs of using the Internet easily.[1] Youth are now more likely to own their own smartphones and make them be able to access the Internet and games anytime and anywhere provided they have mobile data or WiFi. This might be a potential risk factor for game addiction and may result in the increasing incidence of this condition.

Since the internet and game addiction are more prevalent, the American Psychiatric Association has classified the 'Internet Gaming Disorder (IGD) in the Section III of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) which is for 'emerging measures and models'.[2, 3]

The different prevalence of the Internet and game addiction were reported, for example, an international study found 10.0% of this condition, studies in adolescents in the United States and in children in Singapore found about 9.0%[2, 3] and reports from other countries found only 5.0% in male and 0.3 - 0.5% in female. Currently, there is only a definition for the problematic use of game and the Internet but the definitions of game addiction and tools using to evaluate this condition are various among studies.

In Thailand, no study has investigated the Internet and game addiction at the national level. Several studies examined the computer gaming behavior which is considered a part of internet addiction. One study in 400 high school students in the North reported that

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the prevalence of internet addiction was 14.8 and the associated factor was loneliness. [4] A study of the gaming behavior and computer gaming addiction in patients who were receiving treatment at the outpatient child and adolescent psychiatric clinic found 14.5% of patients having computer gaming addictive behaviors.[5]

A study in the general population found that people who had game addiction were 2 times more likely to have attention deficit hyperactivity disorder (ADHD) as a comorbid disorder.[6] Depression was found to be associated with game addiction. Meta-analysis and systematic review reported that internet addiction including using the internet for playing games was highly associated with ADHD and depression. Therefore, it can be assumed that game addiction may be related to those conditions as well.[7]

The data on the prevalence of game addiction among adolescents with ADHD are limited. The severity of ADHD symptoms in adolescent patients and game addiction were the interesting issue in the international study which previously found that higher severity of ADHD was related to internet and game addiction.[8, 9] The objective of this study was to examine the prevalence of game addiction and its association with severity of ADHD symptoms and other factors in adolescent ADHD patients. The result of this study might be beneficial for prevention of game addiction and better treatment for adolescents with ADHD.

Materials and methods

This cross-sectional descriptive study recruited 96 adolescent outpatients who were treated for ADHD at the Child and Adolescent Psychiatric Clinic of King Chulalongkorn Memorial Hospital from January to June 2019. The inclusion criteria were: 1) adolescent ADHD patients aged 12 to 18 years and their parents; and, 2) able to communicate by listening, speaking, reading and writing in Thai. The exclusion criteria were: 1) patients or parents who were diagnosed by a psychiatrist as having moderate-to-severe intellectual disability and were unable to understand and complete the questionnaires; and, 2) parents who could not give information or answer the questions about the patients. We collected data from all subjects that meet the selection criteria by purposive sampling. This study has been approved by the Ethics Committee, the Institutional Review Board (IRB), Faculty of Medicine, Chulalongkorn University. (COA no. 615/61).

The subjects were asked to complete 4 questionnaires as follows:

1) The demographic questionnaire consisted of 2 parts which were:

1.1 Family general information and family factors, which the parents had to give the information about the parents' marital status, educational level, family income, family activity, parents' game playing, allowance to play games, time limits of playing games, punishment and their expectation of playing games.

1.2 Patient general information and patient factors, which the patients had to give the information about their sex, age, education, favored genre of games, location and duration of playing, people they played with, having games in their private room and devices used for playing games.

2) Game Addiction Screening Test (GAST): Child and Adolescent Version [10], was developed by Pornnoppadol C. and the Child and Adolescent Mental Health Rahanagarindra Institute, used for identifying children and adolescents who have game addiction and problematic game playing. This child-rated 16-item questionnaire, with the total score of 48, showed good validity and good internal consistency (Cronbach's alpha 0.92). The patients were categorized into 3 groups: non-problematic game playing (< 24 in male and < 16 in female), some problematic game playing (24 - 32 in male and 16 - 22 in female) and problematic game playing (> 32 in male and > 22 in female). The latter two groups were classed as having game addiction. In this study we categorized into 2 groups: non-problem game playing (< 24 in male and < 16 in female) and problematic game playing (> 24 in male and > 16 in female) because of a few sample.

3) Swanson, Nolan, and Pelham IV Scale (SNAP-IV) Short Form Thai-version [11], translated and developed by Pityaratstian N. This 26-item parent-rated questionnaire showed good validity and good internal consistency (Cronbach's alpha 0.9 – 1.0) with the AUC of 0.7 - 0.8. The tool was effectively used for screening and assessing the severity of ADHD symptoms, which consisted of 3 groups; inattention, hyperactivity-impulsivity and opposition-defiance. The severity of each group of symptoms were categorized into no clinical significance, mild, moderate and severe symptoms.

4) Children's Depression Inventory (CDI) Thai version [12], used for depression screening, was translated by Trangkasombat U. from the original

version in English by Maria Kovacs, which was modified from the Beck Depression Inventory, a popular tool for assessing depression in adults. This questionnaire had been validated in Thai children which showed good validity, reliability (Cronbach's alpha 0.83), sensitivity (78.7%), specificity (91.3%) and accuracy (87.0%). It consisted of 27 questions about depressive symptoms in children in the past 2 weeks. The total score was 52 and person who had 15 or higher was categorized as having depression.

Statistical analysis

The data were analyzed using Statistical Package for the Social Science for Windows (SPSS) version 22.0 and STATA version 11.0. Data were expressed as mean ± standard deviation (SD). Chi-square test was used for identifying the association between categorical independent and dependent factors. One way analysis of variance (ANOVA) and *t* - test were used for examining the difference of game addiction scores between various factors. The association between game addiction score and severity of ADHD was examined using Pearson's correlation coefficient. Predictors of game addiction were analyzed using linear regression analysis. A *P* - value of less than 0.05 was considered statistically significant.

Results

The majority of the patients were male (83.3%) with average age of 14.4 ± 1.7 years and currently studying in junior high school (63.5%); 94.7% of them played games, among which the first-person shooter (FPS) genre was most favored (60.4%). They mostly played games on mobile phone or tablet (82.3%), in their home (52.7%), with their siblings (58.3%) and had no console or specialized gaming devices in their private room (64.6%). Most parents were married and living together (69.8%), had at least Bachelor's degree (45.8%), never played games (52.1%) and never set their child's the time limit of game playing (54.2%) (Table 1).

Table 1. Demographic data and personal information of subjects.

Demographic data and general information	N or Mean	%
Gender		
Male	80	83.3
Female	16	16.7
Age (years)Min, Max = 12, 18	14.4 ± 1.7	
Education (n = 96)		
Junior high school	61	63.5
Higher than junior high school	35	36.5
Game playing		
Yes (can choose more than 1 answer)	90	94.7
Online games	74	
Offline games	25	
No	5	5.3
Favored genre of games (can choose more than 1 answer)		
FPS (first-person shooter)	58	60.4
MOBA (multiplayer online battle)	43	44.8
Horror, Survival	27	28.1
Simulation	22	22.9
Casual	16	16.7
RPG (role playing game)	15	15.6
Sandbox	10	10.4
RTS (real-time strategy)	8	8.3
Device used for playing (can choose more than 1 answer)		
Mobile phone and / or tablet	79	82.3
Computer	50	52.1
Play station	11	11.5

Table 1. (Con) Demographic data and personal information of subjects.

Demographic data and general information	N or Mean	%
Place of playing games		
Private room	17	18.7
Home	48	52.7
School	7	7.7
Home and school	13	14.3
A friend's house	3	3.3
Game café	3	3.3
Having gaming device in private room		
Yes	34	35.4
No	62	64.6
Duration of playing games (hours / day)		
During school days	2.6 ± 2.1	
During weekends	4.3 ± 3.5	
During semester holidays	5.7 ± 4.7	
Family members playing games (can choose more than 1 answer)		
No	24	25.0
Siblings	56	58.3
Father	12	12.5
Mother	5	5.2
Parents' marital status		
Married	67	69.8
Divorced	7	7.3
Widowed	10	10.4
Separated	4	4.2
Single	8	8.3
Parents' education		
Lower than bachelor degree	32	33.4
Bachelor degree	44	45.8
Master degree or higher	20	20.8
Family income (baht / month)(n = 87)		
≤ 25,000	18	20.7
25,001 - 50,000	28	32.2
50,001 - 100,000	32	36.8
> 100,000	9	10.3
Frequency of family activities		
Everyday	26	27.0
Frequent but not everyday	43	44.8
Infrequent	23	24.0
Rarely or never	4	4.2
Frequency of parents' game play		
Everyday	12	12.5
Frequent but not everyday	15	15.6
Infrequent	19	19.8
Rarely or never	50	52.1
Playing games with parents		
Playing together	3	3.1
Playing on one's own	43	44.8
Parents have never played games	50	52.1
Time limit for playing games by parents		
No time limit	52	54.2
Having time limit	44	45.8
During school days (hours / day)	1.7 ± 1.3	
During weekends (hours / day)	2.9 ± 1.4	
During semester holidays (hours / day)	3.3 ± 2.0	
Parents' expectation on benefits of playing games (can choose more than 1 answer)		
For relieving stress	62	64.6
As a leisure activity	37	38.5
In order to get along with friends	27	28.1
To promote development	27	28.1
As a reward	11	11.5

Results from GAST showed average score of 16.6 ± 9.0 and when using the different cut-off score for male and female adolescents; 28.1% of ADHD patients were found having game addiction. The average score of SNAP-IV in inattentive symptoms, hyperactivity-impulsivity symptoms were 14.1 ± 5.3 and 9.7 ± 5.3, respectively. Results from CDI found 45.3% of patients had depression (Table 2).

No significant association was found between game addiction and severity of ADHD ($P > 0.05$), when the severity was classified into no-to-mild and moderate-to-severe group (Table 3).

In terms of personal factors, favoring first person shooting (FPS) and multiplayer online battle arena (MOBA) genre of games and having depression were significantly associated with problematic game playing ($P < 0.05$). Almost all adolescents having problematic game playing used mobile phone or tablet for playing. The significant difference of the average GAST score was found between many personal factors including favoring FPS and MOBA genre of games, using mobile phone or tablet for playing games, using computer for playing games and having depression ($P < 0.05$) (Table 4).

Significant correlation between duration of playing games (during school days, weekends and semester holidays) and GAST score was found ($P < 0.05$) (Table 5).

Statistically significant factors associated with game addiction were entered into the multivariate linear regression analysis. The remaining predictors of game addiction were duration of playing games on weekends, using mobile phone or tablet for playing, having depression, favoring FPS genre of games and using computer for playing ($P < 0.05$) (Table 6) which could predict the variance of GAST score by 45.6% (R square = 0.456).

Table 2. Game addiction, ADHD symptoms and depression.

Game addiction, ADHD symptoms and depression	N	%
Game addiction (GAST)		
Problematic game playing	27	28.1
Non-problem game playing	69	71.9
Severity of inattention symptoms		
No clinical significance	44	45.9
Mild	22	22.9
Moderate	22	22.9
Severe	8	8.3
Severity of hyperactivity-impulsivity symptoms		
No clinical significance	71	73.9
Mild	17	17.7
Moderate	6	6.3
Severe	2	2.1
Severity of opposition / defiance symptoms		
No clinical significance	44	45.8
Mild	29	30.2
Moderate	18	18.8
Severe	5	5.2
Depression (CDI)		
Yes	43	45.3
No	52	54.7

Table 3. Association between severity of ADHD symptoms and game addiction.

Severity of ADHD symptoms	N	Problematic game playing		*P*-value
		Yes	No	
Inattention				
No significance to mild	66	17	49	0.444
Moderate to severe	30	10	20	
Hyperactivity-impulsivity				
No significance to mild	88	25	63	1.000[a]
Moderate to severe	8	2	6	
Opposition / Defiance				
No significance to mild	73	20	53	0.778
Moderate to severe	23	7	16	

[a] Fisher's exact test

Table 4. Association between personal factors and problematic game playing.

Factors			N	Problematic game playing		*P*-value	GAST score		*P*-value
				Yes	No		Mean	SD	
Gender									
Male			80	20	60	0.139[a]	17.4	8.6	0.072
Female			16	7	9		12.9	10.2	
Education									
Junior high school			61	21	40	0.07	18.3	8.8	0.017*
Higher than junior high school			35	6	29		13.7	8.6	
Having depression									
Yes			43	16	27	0.05*	18.9	8.7	0.018*
No			52	10	42		14.6	8.9	
Favored genre of games									
FPS	Yes		58	21	37	0.03*	19.3	7.8	< 0.001*
	No		38	6	32		12.4	9.1	
MOBA	Yes		43	18	25	0.007*	19.8	8.9	0.001*
	No		53	9	44		14.0	8.3	
Horror, Survival	Yes		27	9	18	0.478	18.1	8.5	0.297
	No		69	18	51		16.0	9.2	
Simulation	Yes		22	6	16	0.919	18.4	7.4	0.3
	No		74	21	53		16.1	9.4	
Device used for playing									
Mobile phone / tablet		Yes	79	26	53	0.035[a]	18.0	8.3	0.001*
		No	17	1	16		10.2	9.3	
Computer		Yes	50	15	35	0.67	18.5	7.4	0.028*
		No	46	12	34		14.5	10.1	
Play station		Yes	11	5	6	0.282[a]	18.2	10.4	0.541
		No	85	22	63		16.4	8.8	
Having console or specialized gaming device in private room									
Yes			34	10	24	0.835	17.5	8.0	0.491
No			62	17	45		16.1	9.5	

[a] Fisher's exact test, * $P < 0.05$

FPS = first person shooting, MOBA = multiplayer online battle arena

Table 5. Pearson's correlation coefficient between factors and GAST score.

Factors	*r*	*P* - value
Duration of playing games during school days	0.42	< 0.001*
Duration of playing games during weekends	0.48	< 0.001*
Duration of playing games during semester holidays	0.43	< 0.001*
Inattentive symptoms severity score	0.04	0.676
Hyperactive-Impulsive symptoms severity score	0.09	0.380
Opposition / defiance symptoms severity score	0.12	0.229
Depression (CDI) score	0.18	0.078

*$P < 0.05$

Table 6. Association between GAST score and personal factors.

Factors	b	S.E (b)	*P* - value	95% CI
Duration of playing games during weekends	0.92	0.22	< 0.001*	0.70, 1.14
Using mobile phone or tablet for playing	6.41	1.99	0.002*	5.42, 7.40
Having depression	4.54	1.46	0.003*	3.08, 6.00
Favoring FPS genre of games	4.31	1.59	0.008*	2.72, 5.90
Using computer for playing	3.48	1.47	0.020*	2.01, 4.95

*$P < 0.05$, FPS = first person shooting

Discussion

This study collected data from adolescent patients who were receiving ADHD treatment and their parents. Most patients were male, consistent with the epidemiological data of ADHD. In terms of controlling game play, it was found that most parents did not give their children time limits for playing games. Parents who limit playing time could not control their children's gaming behavior effectively, which was demonstrated by the patients' average play time exceeded more than the limited time given by parents. Most parents did not play games and almost all of those who played games did not play with their children. Therefore, it can be assumed that problems of controlling gaming behavior among subjects might be potential risks leading to game addiction. In terms of the favored genre of games, FPS was found to be the most favorite one, which was consistent with the previous study.[2] The next favored game genres were MOBA and Horror which were different from the past report that role playing game (RPG) was the second most popular genre. Nowadays, Apex Legend, Free Fly, PUBG (FPS genre), ROV, LOL (MOBA genre), Dead by Day Light and Identity V (Horror genre) are the famous names of popular games being played in early 2019 while RPG games have become less popular in this period. Because the above mentioned games must be played on the mobile phones, tablets or computers, those devices were found to be mostly used for playing among the subjects.

The prevalence of game addiction among adolescent ADHD patients in this current study was 28.1 which was higher than the prevalence in the general population. International study found only about 10.0%[1] and the past studies in Thailand found 15.0 - 20.0%.[13, 14] Several previous studies reported that people with game addiction was 2 times more likely to have ADHD as a comorbid disorder.[15, 16] A result from a survey, conducted in schools under the Office of the Basic Education Commission in 6 provinces in Thailand including Bangkok, Samut Prakan, Sa Kaeo, Roi Et, Phayao and Nakhon Si Thammarat showed that 27.2% of students with hyperactive symptoms were likely to have game addiction problem.[17] It may be inferred that the subjects in this study at King Chulalongkorn Memorial Hospital were similar to the samples in those six provinces. However, one foreign study did not demonstrate any association between game addiction and ADHD[18] which may be caused by the influence from the different personal factors including ethnicity, parenting style and cultural factors.

The association between severity of ADHD symptoms and game addiction was not found in

this study. It was inconsistent with the studies by Wang BQ, *et al*. [8] and Mathews CL, *et al*.[9] where the associations between the severity of ADHD symptoms and game addiction were exhibited. The ADHD subjects in the past studies were newly diagnosed and never received any treatment before, contrary to this study which patients had already received treatment for ADHD. Both medication use and parenting adjustment may be a factor preventing such association to be found. Medication may effect to addiction symptoms too. And we didn't collect data about medication in this study.

Depression was found associated with game addiction in ADHD patients as also shown in the previous studies by Starcevic V, *et al*.[15] and Schou Andreassen C, *et al*.[19] Therefore, the association found could not conclude that whether the depression was related to game addiction or related to ADHD. In order to find the conclusion of the relationship between ADHD, depression and game addiction, a research with a different design and samples should be conducted.

Regarding personal factors, duration of playing, favoring FPS and MOBA genre of games, using mobile phone and tablet for playing and using computer for playing were associated with game addiction. The difference of GAST score between factors were significant but if we classified patients into having game addiction and not having game addiction, the association weakened for some factors. This may be caused by the classification lacking the degrees of game addiction. Gender may be one of the factors because the cut-off score of game addiction for female was lower than male. In multiple comparison may found the association by chance in less significance factors such as having depression and using computer for playing.

It was found that the duration of playing games during weekends was associated with game addiction. Gentile reported that adolescents who like to play games tended to favor FPS genre.[2] Studies about MOBA and Horror game type were not prevalent because both types of games had only been popular in the last 5 years. These might be new knowledge that needed to be further investigated. The existing knowledge that children and adolescents were more likely to become addicted to games due to easier access to games from mobile phones and portable computers[1] was consistent with the result of this study. Regarding the duration of playing games, which was previously found to be a risk factor for game addiction[13], it was debated whether to include the time spent playing games in the diagnostic criteria for game addiction[2, 3] Griffiths reported that the relationship between duration of playing game and addiction [20] was unclear but the result from this current study supported that longer duration of playing games were associated with game addiction.

Others factors such as having family member to play games with, having gaming device in private room and frequency of family activity were not associated with game addiction in contrast to a study in Thailand by Pornnoppadol C, *et al*.[10] Because those factors did not have clear measurement method, so different assessments might result in different answers from the subjects' perspectives and affect the association of those factors with game addiction. And nowadays they play on smart mobile phone more than console.

Interestingly, the results were both consistent and inconsistent with the previous studies as mentioned previously and some factors had never been studied before such as genre of games. There were still few researches on game addiction and we cannot understand all aspects of this condition. Since the characteristics of games changed rapidly with times, further study should aware of these changes and include other relevant factors.

The strength of this study was the assessment of personal factors related to game addiction that has never been studied before. There were some limitations in this study. First, we collected data only from patients who were receiving treatment at a tertiary hospital, which the patients may have different characteristics from other sites and may not represent all ADHD patients. Second, due to the cross-sectional descriptive design, the result indicated only current game addiction and severity of ADHD symptoms at that time and the association found did not exhibit causal relationship. Lastly, other factors that may influence the game addiction such as psychiatric comorbidity was not evaluated.

Conclusion

This current study found that the prevalence of game addiction among adolescent ADHD patients was higher than previous studies in the general population. There was no association between game addiction and severity of ADHD. Depression and personal factors including duration of playing games, favoring FPS and MOBA types of games, using mobile phone

or tablet for playing games and using computer for playing games were significantly associated with game addiction. The difficulty in controlling game play was found such as playing games longer than the time limited by parents and longer duration of playing games. The results can be applied to improve the care of adolescents and families who visit and receive treatment at the Child and Adolescent Psychiatric Clinic. There are some factors such as genre of games that need further study.

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Conflict of interest

The authors, hereby, declare no conflict of interest.

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