The Relationship between Stress, Personality, Dopamine Transporter, and Serotonin Transporter Level with Internet Addiction in Secondary School Students in Padang

Yaslinda Yaunin[1]*, Adnil Edwin Nurdin[1], Eryati Darwin[2], Yanwirasti Yanwirasti[2]

[1]Department of Psychiatry, Medical Faculty of Andalas University, Padang, West Sumatera, Indonesia; [2]Biomedical, Laboratory, Medical Faculty of Andalas University, Padang, West Sumatera, Indonesia

Abstract

BACKGROUND: The unpleasant stress can cause a variety of mental disorder that will lead children to run away from real life and one of the way is using excessive internet. In the past few years, more interested in studying the negative effect of the internet. The development of internet has been very rapid and used to play games and make friendship, but it also has negative impact on people's lives. Young refers to some of the symptoms of internet addiction that resembles the symptoms of substance addiction, causing physical and psychological problems. Several studies have tried to show a relationship between dopamine and internet addiction by measuring the level of dopamine transporter (DAT). Lee et al. (2008) showed that one homozygous short allele from the serotonin transporter (SERt) gene 5-hydroxytryptamine transporter (5 HTT)-linked polymorphic region is more frequent in excessive internet users.

AIM: The aim of this study was to investigate the relationship between stress, personality, DAT, and SERt level with internet addiction in secondary school students.

METHODS: Methods applied in this study were a cross-sectional comparative design conducted in secondary school students in January 2016–March 2017 in Padang. The stress level was assessed using the depression anxiety and stress scale. Personality tests were measured using Minnesota Multiphasic Personality Inventory for Adolescent. Internet addiction was assessed using the Young Internet Addiction Test. Enzyme-linked immunosorbent assay was used to determine peripheral blood DAT and SERt or 5 HTT levels from the students who were diagnosed with stress.

RESULTS: The results showed that personality was negatively associated with internet addiction ($P = 0.271$). Positive significant relationship of internet addiction was showed by association with levels of DAT ($P = 0.001$) and SERt ($P = 0.001$) in blood serum. DAT levels showed high relationship effect of stressed students become addicted to the internet.

CONCLUSION: It is suggested that students were addicted to the internet as a coping mechanism against stress. Personality questionnaire tests failed to identify students who became addicted to the internet. The peripheral blood DAT and SERt level was predictive to identify students addicted to internet use. The present study supported the hypothesis that the DAT plays an important role in internet addiction.

Introduction

The emotional response can be a fear that triggers a light or an angry response initiating a fight response [1]. This unpleasant stress can cause a variety of mental emotional disorder. Stress that cannot be controlled will negatively affect the lives of individuals. Academic self-efficacy will encourage students to take action in the face of challenges.

Wisantyo's research on Public Senior High School 3 Semarang students found that there was very significant relationship between academic self-efficacy and stress [2]. Study of 100 Malaysian government high school students in Kota Bharu (Kelantan) found the prevalence of stress was 26.1% and this figure was relatively higher compared to a population with stress of <10% [3]. The study of Jusuf *et al.* (2012) investigated the incident of stress in high school students in Gorontalo city; they found that stress level of 62.3% of students is not immune to stress; student of class I and III most experience wild stress [4]. Stress disorder will lead children to run away from real life and search for another life that could please them. One from of escapism is excessive internet use.

The development of internet has been very rapid and used to play games, make friendship, looking for jobs, shopping, etc. [5]. However, internet usage also has negative impact on people's lives. Internet addiction is defined as an inability to control internet usage, which causes obstacles in psychological and social functions [6], [7]. While Young refers to some of the symptoms of internet addiction that resembles the symptoms of substance addiction, namely, the feeling withdrawal, tolerance, and pre-occupation with the internet resulting in excessive internet use, causing physical and psychological problems [5], [8].

Baer studied 102 adolescents as outpatients in a psychiatric clinic at a Canadian Hospital found that approximately 94% of teens spent more than 2 h/day in front of a screen. Two hours/day is a recommended time by the American Academy of Pediatrics (AAP, 2001). It is suspected that adolescent with a psychiatric disorder will spend more time on computers/online games than the general population. Dependence on the internet in this study also aimed to investigate emotional and functional obstacles related to this problematic use of internet [9].

Kuss et al., (2013) determined that 4% of high school students in the United States were classified as internet addict [13].

Certain personality traits or personality disorders also affect someone using the internet. Shaw and Black found that 52% in their study met criteria for borderline personality disorder was found in 24%, narcissistic 19%, and antisocial 19%, while others impaired avoiding, passive aggressive, and obsessive compulsion [11].

Other researchers pointed out that besides the impact on academic performance, internet addiction also affected physical health (sleep disturbance, grave time, dry eyes, and metacarpal syndromes) and mental fitness. Communication through the internet is considered important for teens who lack the ability to socialize as friends in the real world. Ayas and Horzum conducted a cross-sectional study on 292 students (2009–2010) in Trabzon (Turkey). The result showed an association between internet addiction and depression, loneliness, and self-esteem [12].

Several studies have tried to show a relationship between dopamine and internet addiction by measuring the level of dopamine transporter (DAT). Liu and Lou (2015) conducted a study of 33 teenagers with internet addiction and 33 healthy teens as controls. It turned out that dopamine levels in peripheral blood in teenagers who were addicted to the internet had significant differences [13]. Hou *et al*. (2012) stated that the expression of DAT levels in the striatum area decreased significantly and they suspected that internet addiction disorder was associated with a dysfunction of the dopaminergic system in the brain [14]. Previously, researchers have shown that changes in DAT concentration in the striatum occur in chronic substance addicts. In recent years, DAT has been used as an important clinical guide to determining brain structure changes in patients with substance-related addiction [14], [15].

Serotonin (5-hydroxytryptamine [5HT]) system changes have also been investigated in relation of aggressive behavior and internet addiction. Lee *et al*. (2008) showed that one homozygous short allele from the serotonin transporter (SERt) gene 5HT transporter (5HTT)-linked polymorphic region is more frequent in excessive internet users. They also revealed that there was a serotonin system dysfunction in internet addiction disorders, as well as research into other addictive behavioral disorders. It is, therefore, reasonable to hypothesize that internet addiction is also associated with neurobiological aspects of serotonin system dysfunctions as well as in substance addictive disorders [16].

The aim of this study was to investigate the relationship between stress, personality, DAT, and SERt level with internet addiction in secondary school students in Padang, West Sumatera, Indonesia.

Methods

Before the study was conducted, an ethical clearance was approved by the Ethics Commission Research of Medical Faculty, Andalas University in Padang, West Sumatera, Indonesia. This study was a cross-sectional comparative study which was conducted between January 2016 until March 2017 in Padang, West Sumatera, Indonesia. The study population were secondary senior high school student whose had internet access and meet stress criteria according to the depression anxiety stress scale (DASS).

Our inclusion criteria were as follows: (1) The 2nd year student in senior high school in Padang and meet stress criteria and (2) willing to participate in this study. Exclusion criteria were as follows: (1) Having a fever or disease that requires treatment; (2) female students were currently menstruating; (3) already having severe emotional distress before (such as depression or learning disorder that needs of treatment by doctors and/or psychologists); and (4) being or just experiencing severe life trauma such as death of person that loved and losing valuable items.

Young internet addiction questionnaire was given to determine student who was internet addicted and non-internet addicted. Peripheral blood sample was taken and then using the enzyme-linked immunosorbent assay (ELISA) system in Biomedical Laboratory of Medical Faculty, Andalas University in Padang to measure the level of DAT and SERt or 5 HTT.

Results

Data collection in the field was conducted on the 2nd year students from 11 senior high school in Padang starting in February 2016 until June 2016. At the start of the study, we used the questionnaire from the DASS. A total of 681 students participated at the start of the study and it was found that 42.88% of the students (n = 292)

experienced stress, whereas 57.12% (n = 398) did not. After applying the inclusion and exclusion criteria, we got 147 students as sample for further investigation. The internet addiction questionnaire from Young was administered to determine the number of stressed students with addiction to the internet. The results revealed that 79 students (35 males and 44 females) with stress were also addicted to the internet, whereas 68 students (32 males and 36 females) with stress showed no internet addiction.

Table 1: The difference of personality between stress students and internet addiction with stress students not internet addiction

Personality	Stress and internet addiction		Stress not internet addiction		p-value
	f	%	f	%	
Adaptive	62	78.48	57	83.82	0.271
Maladaptive	17	21.52	11	16.18	
Total	79	100	68	100	

The 79 stressed students and internet addiction and 68 students stress not internet addiction give the Minnesota Personality Inventory to Adolescent (MMPI-A) questionnaire for determined personality trait and the result is shown in Table 1. Maladaptive personality in stress students and internet addiction was found 17 students (21.52%) while stress students were not addicted to internet only 11 students (16.18%) (Table 2).

Table 2: The difference of DAT levels between stress and internet addiction students and stress not internet addiction students

Parameters	n	DAT level		p-value
		Mean	Standard deviation	
Stress and internet addiction	79	13.28 nmol/L	11.01 nmol/L	0.001
Stress not internet addiction	68	9.83 nmol/L	6.29 nmol/L	

DAT: Dopamine transporter.

The average DAT in stress and addicted students was obtained 13.28 ± 11.01 nmol/L compared to stress not addicted students with average DAT. 9.83 ± 6.29 nmol/L statistical analysis found that $P = 0.001$ ($P < 0.05$) means that in this study, there were significant differences in the level of DAT in peripheral blood between students stress and internet addiction and stress students not internet addiction (Table 3).

Table 3: The difference of 5 HTT level between stress and internet addiction students and stress not internet addiction students

Parameters	n	5 HTT level		p-value
		Mean	Standard deviation	
Stress and internet addiction	79	18.37 nmol/L	19.61 nmol/L	0.001
Stress not internet addiction	68	12.96 nmol/L	12.08 nmol/L	

5HTT: 5-hydroxytryptamine transporter.

SERt levels was examined in Biomedical Laboratory of Faculty of Medicine Andalas University with the ELISA system.

It is not found that the average value of SERt in stressed and internet addicted students was higher: 18.37 ± 19.61 nmol/L, compared to stressed not addicted to internet with an average SERt 12.96 ± 12.08 nmol/L with analysis statistic obtained $P = 0.001$ ($P < 0.05$) means that in this study, there were significant differences in SERt levels (5 HTT) in peripheral blood between students stress internet addiction with stressful students not internet addiction.

To determine the most related factors that influenced students become addicted to internet among personality, DAT or SERt analysis by logistic regression is shown in Table 4. It is found that in the logistic regression analysis, it was obtained that 5 HTT value was higher 0.534; personality value 0.499 and the lowest DAT value was 0.053 so that is means DAT levels play the most role in a student who was stressed being addicted to the internet.

Table 4: The logistic regression analysis

Parameters	B	SE	Wald	df	Sig.	Exp(B)
Step 1(a)						
DAT	−0.049	0.037	1.815	1	0.178	0.952
5 HTT	−0.010	0.017	0.387	1	0.534	0.990
Personality(1)	0.308	0.437	0.497	1	0.481	1.361
Constant	0.296	0.533	0.307	1	0.579	1.344
Step 2(a)						
DAT	−0.060	0.032	3.656	1	0.056	0.941
Personality(1)	0.295	0.436	0.456	1	0.499	1.343
Constant	0.276	0.527	0.274	1	0.601	1.318
Step 3(a)						
DAT	−0.062	0.032	3.751	1	0.053	0.940
Constant	0.533	0.370	2.072	1	0.150	1.704

DAT: Dopamine transporter, 5 HTT: 5-hydroxytryptamine transporter.

Discussion

The number of students participating at the start of the study was 681 students, 292 (42.88%) students experiencing stress and 389 (57.12%) students not experiencing stress. This figure was more than double of the estimate provided by the WHO of stress in adolescents in the world with around 20% and also higher than Yusoff's (2010) study found for stress prevalence 26.1% [3]; but it was lower than Jusuf *et al*. results (2012) in Gorontalo city which was 62.3% [4].

Determining the personality of students using MMPI-A in stressed students with internet addiction found maladaptive personality in 17 students. This is a difference to the research of Shaw and Black (2008) which found 52% in their study met the criteria for personality disorder [11]. In this study, there are differences in numbers between maladaptive personality stress students and internet addiction and stress student not internet addicted but statistically, there is no significant difference. This is most likely due to the fact that the population and sample in this study are students in public and private high schools who still have good communication and relationship families, a good educational environment and not had severe psychosocial stressor.

The DAT levels in stressed students and internet addiction were 13.28 ± 11.01 nmol/L and were higher than stressed students without internet addiction (9.83 ± 6.29 nmol/L with $P = 0.001$). Dopamine as a neurotransmitter which plays a role in regulating moods, emotions and motivation, and reward processed. Dopamine functions related to positive and negative reward depending on the component that has an abnormality [15]. Dopamine

also can be mentioned as a pleasure center. Hou *et al.* (2012) stated that expression of DAT levels in striatum area decreased significantly and it was thought that internet addiction was associated with dopaminergic dysfunction in the brain [14]. The last few years DAT has been used as on the clinical guideline in determining brain structured changes in substance addicted patients [15]. Liu and Lou also found that dopamine levels in peripheral blood of adolescents who were addicted to the internet differed significantly compared to healthy adolescent as controls [13]. The results of this study indicate a recurring tendency to use internet until there is satisfaction and pleasure in stress and internet addicted group of students.

In this study, the mean level of SERt (5 HTT) in stressed students with internet addiction (18.37 ± 19.61 nmol/L) was higher than in stressed students not internet addicted (12.96 ± 12.08 nmol/L, *P* = 0.001). Serotonin functions as an inhibitory control or inhibition of excessive aggressive impulses. This study alone with Lee *et al.* (2008) showed that SERt level was higher in excessive internet user. They also showed the existence of a system dysfunction in internet addiction disorders, as well as other addictive behavior studies. Therefore, it is reasonable to say that it is related to serotonin system dysfunction as an aspect of neurobiological [16].

From the third variable in our study, personality, we were not able to show a significant difference for DAT and 5 HTT. There were significant differences between stress student and internet addiction and stress student not internet addict. After multivariate analysis using logistic regression, the highest level of 5 HTT was obtained: 0.534, personality: 0.499 and the lowest DAT value: 0.053. This implies that DAT levels may play the most important role in a student who is stressed becoming addicted to the internet.

Conclusion

Significant differences were found in peripheral blood DAT levels in students who were stressed and internet addicted compared with students who were stressed not internet addicted and also SERt (5 HTT) levels higher in students who were stressed and internet addicted. There is no difference in internet addicted based on personality. The most related factor in students who were stressed and internet addicted is level of DAT.

Further research is needed to look at the causes of a student become stressed and stress differences experienced by students based on "intelligence level" and the use of counseling teachers in schools for students who face problems.

Declarations

Authors' contributions

YY (author): Design the study, collecting and analyzed data, and make the manuscript. AEN (coauthor): Contribute the theory of psychiatry, the design study, and correcting the results of this study and the manuscript. ED and YW (coauthor): Contribute design study, data analyzed, draft writing, and review draft. All of the authors have read and approved the manuscript.

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Ethics approval and consent to participate

Ethical clearance was approved by the Ethics Commission Research of Medical Faculty, Andalas University in Padang, West Sumatera, Indonesia. The parents of students with age ≤16 years read, signed the informed consent, and agreed for their children to participate in this study.

Availability of data and materials

Wish to share by contact the email correspondence: linda_yns@yahoo.co.id

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