

# Relationships of Internet Gaming Reasons to Biological Indicators and Risk of Internet Gaming Addiction in Korean Adolescent Male Game Users

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## Research article

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# Abstract

**Background:** There are no standard diagnostic criteria or interventions for internet gaming addiction (IGA) even though IGA is one of the most pervasive public health issues among youth worldwide. Internet gaming reasons or motivations have been studied as a potential predictor of IGA, but the results have been inconsistent and biological indicators of gaming reasons have rarely been studied. We sought to (1) identify categories of internet gaming reasons, (2) examine the relationship of gaming reasons to risk of IGA, and (3) describe biological indicators of gaming reasons. **Methods:** We used a multi-phase cross-sectional design including individual interviews; focus group discussion; and descriptive, comparative analysis. Fifteen Korean adolescent male internet gamers participated in individual interviews and eight participated in a focus group aimed at identifying reasons for internet gaming. Using the identified gaming reasons from these sources we surveyed 225 adolescent game users using a self-report questionnaire. Participants provided blood samples for assessment of norepinephrine (NE) and serum cortisol. **Results:** We identified four major categories of internet gaming reasons: entertainment, getting along with friends, stress relief, and habitual gaming. The habitual group showed significantly greater risk of IGA than the other groups ( $p < .001$ ) and the lowest plasma NE levels ( $p = .035$ ), possibly indicating an alteration in autonomic function. **Conclusion:** Health care providers are encouraged to screen adolescents for excessive internet gaming and to intervene with those who report habitual gaming behaviors. When feasible, assessment of biological indicators, such as plasma NE, may help to identify youth at greatest risk of IGA.

## Introduction

The prevalence of internet gaming addiction (IGA) is increasing and IGA has been a major research focus among several subtypes of internet addiction. However, ambiguous definitions of IGA and lack of standardized diagnostic criteria for the disorder [1-3] have hampered research progress. Internet gaming disorder (IGD) was designated as a condition warranting further study rather than included as a formal disorder in the 2013 *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-V; American Psychiatric Association 2013) [4]. Thus more research is needed to identify clear criteria for diagnosis of IGD. In this paper we used IGA rather than IGD as the focus of our study given that it is narrower and IGA is commonly used in the research literature.

As internet games have universally grown in popularity and IGA has become one of the most pervasive public health issues among youth worldwide [5], internet gaming motivations or reasons have been studied as one potential predictive risk factor for IGA. Understanding motivations or reasons for internet gaming is important because of their predictive and diagnostic value in identifying risk of IGA in internet game users. According to Deci and Ryan [6], game players should enjoy gaming insofar as it satisfies a player's basic psychological need; thus, each player has different motives for playing games on the internet [7-9]. Furthermore, because game motivations can predict hours spent playing games [8, 9], understanding of individual differences in motives may be crucial to predict which gamers are at risk for pathological game use [10].

Yee [9] introduced 10 motivations for online game playing: achievement, consisting of subcomponents of advancement, mechanics, and competition; social, consisting of socializing, relationship, and teamwork; immersion, consisting of discovery, role-playing, customization, and escapism. However, these ten motivations are diverse and often overlap [11], and the empirical results were inconsistent with regard to their relevance to risk of addiction [12]. For example, Caplan et al. [13] reported that immersion predicts problematic Internet use, whereas Zanetta Dauriat et al. [14] suggested that achievement, escapism, and socializing predict addictive gaming. In addition, Kuss et al. [12] indicated that escapism and mechanics significantly predict excessive gaming and proposed them as stronger predictors than time investment in gaming. Furthermore, other dimensions of gaming motivations have been introduced by several researchers [8, 11-13, 15-19]—many of which overlap with those suggested by Yee [9] and do not show consistent results regarding the association of IGA to gaming motivations or reasons [20].

Therefore, although many of the reasons are likely associated with internet gaming behavior, it remains unclear which reasons are most predictive of IGA [21, 22]. Furthermore, objective measures such as biological indicators, i.e. autonomic function, have rarely been studied in relation to gaming reasons. Autonomic functions have been found to be associated with internet gaming behaviors [23-29], but have rarely been assessed in relation to gaming reasons.

Hence, this study aimed to fill this gap in the literature by examining reasons for internet gaming, and the relationships of gaming reasons with risk of IGA and with two biological indicators: plasma norepinephrine (NE) and serum cortisol—because these compounds reflect and are representative of autonomic responses to stimuli [30-32]. Although the terms “motivations” and “reasons” were used interchangeably for internet gaming in previous studies, we use “internet gaming reasons” in this paper to refer to both motivations and reasons for excessive gaming.

## Methods

### Study design

This study is a multi-phase cross-sectional study that included individual interviews, focus group discussions, survey questionnaire, and biological analysis. It was a part of larger study that examined the role of autonomic nervous system in development of IGA among adolescent males

[28, 33, 34]. The current study focuses on identifying categories of gaming reasons and their relationships to IGA risk and to biological indicators (NE and cortisol levels). Although IGA risk and plasma NE and cortisol levels are measured in our previous studies, the research question and study sample are different. For example, the current study included only adolescents currently engaged in internet gaming.

## **Participants and procedures**

All study participants were male high school students (adolescents) who came to a regional health center in a city in South Korea in response to an advertisement about the study. Convenience and snowball sampling methods were used to recruit the sample. This study had three phases. In the first phase 15 adolescent males were interviewed individually; the second phase involved eight participants in a focus group discussion; and in the third phase 225 participants completed a questionnaire and provided a sample of blood.

Gaming reasons were generated in the first and the second phases of the study. Participants in the first phase were interviewed individually to describe gaming reasons. Participants in the second phase (focus group) were asked to affirm or revise/add to the gaming reasons obtained in the first phase. Both interviews and the focus group were conducted in a private room, and responses were incorporated into the questionnaire used in phase three. Participants in the third phase first completed the questionnaire in a private room and then blood samples were drawn. All participants fasted for 12 hours before blood sampling. In addition, participants were instructed not to smoke, drink caffeinated beverages, or engage in internet gaming for 24 hours prior to data collection. This study was approved by the Institutional Review Board of a University. Informed consent was obtained from all participants and their legal guardians.

The sample size for the third phase was determined using one-way ANOVA analysis based on a medium effect size 0.25 [12, 14], an alpha level of 0.05, and a power of 0.80 using the G-power software [35]. A minimum sample size of 180 was estimated and it was determined that and our sample size of 225 should provide ample power to detect statistically significant findings. The study sample was limited to male participants because male adolescents are known to be more commonly addicted to internet gaming than are their female counterparts [36] and because reasons for gaming may differ by gender [9]. The flowchart for sampling procedures is depicted in Figure 1.

## **Measures**

Measures for phase three of the study consisted of demographic characteristics; internet gaming-related information, including gaming reasons; an IGA risk assessment scale; and biological indicators. These measures were assembled into a single questionnaire. The demographic and internet gaming-related items were generated from the literature (excluding gaming reasons) and content validity and reliability of the items were established by four content experts.

### ***Demographic characteristics***

Demographic items included participant age as well as information about smoking, drinking, and sleep time. Data related to current smoking and to alcohol drinking were obtained using yes/no responses. Sleep time was obtained using two categories; six hours or more a day and less than six hours a day.

### ***Internet gaming-related information***

Internet gaming-related information included amount of time spent on internet gaming (minutes per day) and duration of internet gaming participation (years). Participants were asked to select one of four reasons that best described why they engaged in internet gaming. The categories included (1) entertainment, (2) getting along with friends (or friendship), (3) stress relief, and (4) habitual gaming. The four categories were derived from individual interviews with 15 participants in the first phase and from the focus group interview with 8 participants in the second phase of this study. These interviews were performed by the principal investigator to identify perceived internet gaming reasons expressed in the adolescents' own words. In the first phase, participants were asked to describe as many gaming reasons as possible in response to the question, "Why do you play internet games?" The duration of each interview ranged from 5 to 30 minutes. Overall, 36 statements were derived and analyzed by two independent coders of the research team, they having experience with content analysis. In the second phase, the team verified statements derived in the first phase and conducted a 45-minute focus group interview in which 8 adolescents were asked about their agreement with the 36 statements and whether they could think of additional reasons for playing internet games. During the discussion, participants were instructed to respond to questions by providing the first thought or feeling coming to their mind based on their real

experiences and views. Participants' responses were simple and brief, e.g., "because it's fun," "to play with friends," or "just to do." The 32 statements generated from the focus group discussion were similar to those generated in the first phase. A total of 68 statements were categorized by the two independent coders of the research team initially and then validated by subjects who participated in the focus group discussion.

### ***Internet Gaming Addiction***

To assess risk of internet gaming addiction, we used the Online Game Addiction Scale for Adolescents developed by the Korean Agency for Digital Opportunity and Promotion [37]. This scale is currently used to screen for IGA among adolescents in Korea. The scale is a 20-item self-report measure; each item is rated on a 4-point Likert scale ranging from 1="not at all" to 4="always." The total score for the scale ranges from 20 to 80, with higher overall scores indicating greater risk of IGA. Cronbach's alpha in the current study was 0.945, indicating high internal consistency.

### ***Biological indicators***

Peripheral venous blood samples for plasma NE and serum cortisol assays were drawn from participants by professional nurses following standard laboratory procedures for assays. For each subject, 5 milliliters (mL) of venous blood was extracted using a heparin anticoagulation vacuum tube. Levels of plasma NE were measured by high-performance liquid chromatography (HPLC, Agilent 1200 series, Agilent Technology, USA). Serum cortisol levels were analyzed by chemiluminescent immunoassay using ADVIA Centaur and ADVIA Centaur XP systems (ADVIA Centaur XP, Siemens, USA). The ADVIA Centaur cortisol assay is a competitive immunoassay using direct chemiluminescent technology.

### **Statistical analysis**

Statistical analysis was performed to examine the relationship of gaming reasons to IGA risk and biological indicators. Data were analyzed using IBM SPSS statistics ver. 20.0 (IBM Co., Armonk, NY, USA). Descriptive statistics such as frequency, percentage, mean, and standard deviation were used to summarize the subjects' demographic and internet gaming-related characteristics. ANOVA was used to compare differences in levels of plasma NE and serum cortisol and IGA risk based on the four

categories of internet gaming reasons, with Scheffe post-hoc tests. Analyses of categorical variables by the four gaming reason groups were analyzed using  $\chi^2$ -tests. A  $p$ -value of  $<.05$  was considered statistically significant.

## Results

### Reasons for Internet gaming

A total of 68 statements related to internet gaming reasons were categorized into four reasons. Each category of reasons and related statements are summarized in Table 1. Among a total of 68 statements, 27 items (39.7 %) were categorized as entertainment and included reasons such as “there are no leisure activities to do,” “playing games is fun,” and “eliminating boredom;” 17 items (25.0 %) were categorized as friendship (e.g., “making friends,” “maintaining friendship,” and “enjoying gaming with friends”); 13 items (19.1 %) were categorized as stress relief (e.g., “getting rid of stress,” “reducing tension,” and “relaxing”); 11 items (16.2%) were categorized as habitual gaming (e.g., “no other special reasons,” “habitually,” and “immersing myself in gaming regardless of my will”).

### *Internet gaming reasons, risk of Internet gaming addiction, and biological indicators*

As shown in Table 2, the mean age of the 225 subjects was  $16.62 \pm 1.03$  years, and mean age was not significantly different among the internet gaming reason groups. Among the four groups, habitual gaming group showed significantly greater IGA risk than entertainment and friendship groups in terms of IGA scores ( $F=9.120$ ,  $p<.001$ ). Daily internet gaming time was also significantly longer in habitual gaming group than the other groups ( $F=4.958$ ,  $p=.002$ ). Plasma NE levels were lowest in the habitual gaming group among four gaming reason groups ( $F=2.909$ ,  $p=.035$ ). Serum cortisol levels were slightly higher in the stress relief group than in the other groups, but the differences were not statistically significant ( $F=0.606$ ,  $p=.612$ ). Duration of internet gaming and other individual behaviors such as smoking cigarettes, drinking alcohol, and sleep time did not significantly differ among the groups.

## Discussion

In this study, we identified four major groups of internet gaming reasons: entertainment, getting along with friends (or friendship), stress relief, and habitual gaming. Furthermore, we investigated whether risk of IGA and biological indicators (i.e., NE and cortisol levels) differed according to the reasons for gaming in male adolescent game users. Entertainment, friendship, and stress relief

were reported in earlier studies as common reasons for internet gaming [9, 11, 12, 38]. However, habitual gaming has not been reported as an Internet gaming reason.

Our results support the hypothesis that biological indicators of IGA risk may differ by gaming reasons. Specifically, habitual game users showed significantly higher internet gaming time and IGA scores and lower NE levels than subjects in the other gaming reason groups. Research on instrumental behavior theory suggests that in contrast to goal-directed action habitual control of action is characterized by involuntary, compulsive behavior [39, 40]. Habitual control of action is one important indicator of addiction [32], and therefore, a habitual gaming pattern may be an indicator of the severity of the risk of addiction in heavy gamers. Our results seem to be consistent with those of earlier studies of alcohol abusers. In these studies, automatically activated motivations toward alcohol-related stimuli were associated with higher levels of addictive behaviors [41, 42].

A possible mechanism supporting this conclusion is explained by instrumental behavior theory. Based on this theory, behavior directed at obtaining rewards and avoiding punishment is controlled by a goal-directed system and a habit system [39]. Initial behavioral control is mainly goal-directed, but with repetition of an action, there is a gradual shift to habitual control [43]. During early engagement in internet gaming, adolescents may have specific goals or motivations for gaming such as entertainment, socialization, or escaping from reality. Goal-directed gaming activities seem to be initiated to achieve desirable outcomes and may be reinforced by the incentive value of the rewarding outcomes [44-46]. Over time, however, actions can become more and more habitual, and eventually they can be automatically evoked by triggering stimuli or motivations regardless of the possible outcomes [46, 47]. Some studies on addiction have shown that brain activity and structure are involved in changes from goal-directed behavior to habitual behavior [48-50]. Adolescents, in particular, are more likely to develop habits because their executive inhibition skills are not yet fully developed [41, 42].

Under this line of reasoning, habitual gaming behavior would not be an initial motivation or reason for internet gaming but might be a consequence of gaming activities repeated for specific reasons. Schwabe and colleagues [32, 51-54] suggested that this transition from voluntary, goal-directed action to habitual control of action is stimulated by prolonged stress. There is strong evidence that stress and related hormones (e.g., glucocorticoid and norepinephrine) are important risk factors for development of a variety of addictions [32, 51, 52, 54, 55].

Notably, in our study, plasma NE levels were found to differ according to gaming reasons, which may support our assumption that the mechanism of habituation results from excessive internet gaming and stress-related physiological responses. Unexpectedly, plasma NE levels were lower in the habitual gaming group than in the other groups, but these results were consistent with those of previous studies reporting associations of lower NE levels with internet addiction [29] and IGA groups [28]. Given these consistent results in both past and present studies, lower plasma NE levels in excessive internet gamers may be involved in the development of IGA, although the mechanisms of this involvement are unclear. In contrast, serum cortisol levels were not significantly different among the four groups in our study. Our physiological results are the first reported with regard to internet gaming reasons or motivations. However, we are unable to explain the mechanism for this as it was not a part of this study. Further studies are needed to better understand the mechanisms underlying this relationship.

Despite notable strengths of the study, the results should be evaluated within the context of several limitations. For example, we recognize that our study may not have included all reasons for internet gaming. In addition, our lack of attention to game genre is another limitation as is the use of a cross-sectional design that limits the generalizability of the findings to other population groups. Longitudinal studies with random samples conducted in other countries with culturally relevant interventions are recommended.

## Conclusions

Our findings that the habitual internet gaming group had the highest IGA risk and the lowest plasma NE levels have the potential to impact the clinical care of adolescent males. Health care workers can incorporate these findings in their health screenings of adolescent boys and initiate early preventive interventions with those who report excessive internet game playing. Information about reasons for engaging in internet gaming can be used by researchers who are interested in further investigation into the mechanisms underlying IGA. The study findings also have the potential to influence decisions about including IGA as a formal disorder in the DSM-5—a step that would encourage further research aimed at developing interventions for adolescents, regardless of where they live in the world.

## Abbreviations

DSM-V: Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition; IGA: Internet Gaming Addiction; IGD: Internet Gaming Disorder; KADO: Korean Agency for Digital Opportunity and Promotion; NE: Norepinephrine,

## **Declarations**

### **Ethics, consent and permissions**

This study was approved by the Institutional Review Board of Yonsei University Wonju College of Medicine with reference number of YWMR-12-0-015. We obtained written informed consent from each participant and his legal guardian. Participation was voluntary, and Participants could withdraw at any time from the study.

### **Consent to publish**

Not applicable

### **Availability of data and material**

The datasets used and/or analyzed during the current study are available only upon reasonable request and after compliance with the policies and procedures of the Basic Science Research Program through the National Research Foundation of Korea and the Ministry of Education, Science and Technology (NRF) for data sharing.

### **Competing interests**

The authors declare no conflict of interest.

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### **Authors' contributions**

N.K. conceived and designed the study and drafted the manuscript. I.D.K. was involved in participant recruitment, data collection, and theoretical interpretation of the results. M.J.K and T.L.H. provided significant input on the content of the manuscript. H.K. contributed to the acquisition and analysis of data. All authors read and approved the final manuscript.

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## Tables

TABLE 1. FOUR INTERNET GAMING REASONS IN MALE ADOLESCENTS

Categories	n (%)	Statement summary
Entertainment	27 (39.7)	<ul style="list-style-type: none"> <li>. There are no leisure activities to do</li> <li>. Playing games is fun</li> <li>. Eliminating boredom</li> <li>. Passing time</li> <li>. Playing games as a hobby</li> <li>. Relieving boring</li> </ul>
Friendship	17 (25.0)	<ul style="list-style-type: none"> <li>. Making friends</li> <li>. Maintaining friendship</li> <li>. Enjoying gaming with friends</li> <li>. Being with friends.</li> <li>. Sharing consensus with friends</li> <li>. Bonding of sympathy with friends</li> </ul>
Stress relief	13 (19.1)	<ul style="list-style-type: none"> <li>. Getting rid of stress</li> <li>. Reducing tension</li> <li>. Relaxing</li> <li>. Forgetting something to do</li> </ul>
Habitual gaming	11 (16.2)	<ul style="list-style-type: none"> <li>. No other special reasons</li> <li>. Habitually</li> <li>. Immersing myself in gaming regardless of my will</li> <li>. Just to do so</li> <li>. Being addicted without noticing</li> </ul>
Total	68 (100%)	

TABLE 2. DIFFERENCES OF INTERNET GAMING ADDICTION RISK AND BIOLOGICAL INDICATORS ACCORDING TO THE GAMING REASONS

N=225

Internet gaming reasons	Entertainment <sup>□</sup> (n=65)	Friendship <sup>□</sup> (n=77)	Stress relief <sup>□</sup> (n=30)	Habitual gaming <sup>□</sup> (n=53)	$\chi^2/F$	<i>p</i>	
Variables	n (%) / M±SD	n (%) M±SD	n (%) M±SD	n (%) M±SD			
Age (years)	16.60±1.04	16.71±1.04	16.50±0.82	16.58±1.12	0.377	.770	
Smoking cigarettes (n=167)	No	47 (28.1)	62 (37.1)	24 (14.4)	34 (20.4)	5.054	.168
	Yes (n=58)	18 (31.0)	15 (25.9)	6 (10.3)	19 (32.8)		
Drinking alcohol (n=169)	No	53 (31.4)	60 (35.5)	22 (13.0)	34 (20.1)	5.218	.156
	Yes (n=56)	12 (21.4)	17 (30.4)	8 (14.3)	19 (33.9)		
Sleep time (hours per day) (n=147)	≤ 6	43 (29.3)	45 (30.6)	25 (17.0)	34 (23.1)	5.958	.114
	> 6 (n=78)	22 (28.2)	32 (41.0)	5 (6.4)	19 (24.4)		
Internet gaming time (minutes per day)	162.92±129.79	161.17±123.26	139.67±76.36	233.21±150.66	4.958	.002 <sup>†</sup> □>□□	
Duration of internet gaming (years)	7.48± 2.56	7.14±2.54	6.93±2.21	7.38± 2.21	0.454	.715	
IGA score	31.88±11.17	36.21±10.82	38.57±13.29	42.85±11.90	9.120	<.001 <sup>†</sup> □>□□	
NE (pg/ml)	416.29±280.69	391.78±243.53	348.53±195.26	297.02±157.66	2.909	.035 <sup>†</sup> □<□	
Cortisol (mg/dl)	2.24±0.42	2.24±0.41	2.36±0.49	2.25±0.49	0.606	.612	

**Notes:** n=number, M: mean, SD: standard deviation, IGA: internet gaming addiction, NE: norepinephrine.

Scheffe test

## Figures

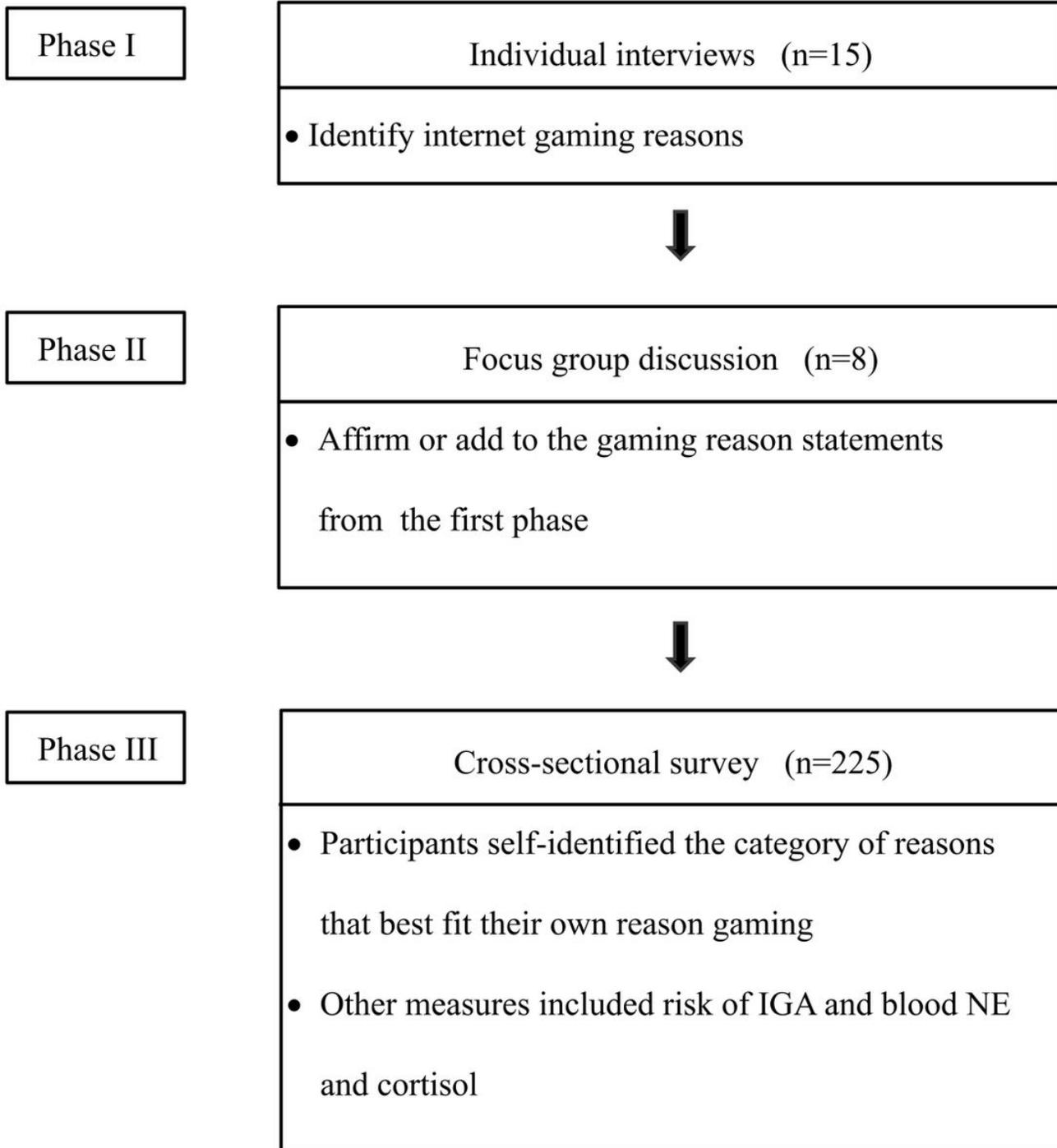


Figure 1

Flow chart of selection process of the study participants and data collection IGA: internet gaming addiction, NE: norepinephrine.

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [supplement1.doc](#)