

# Internet Addiction among Adolescents May Predict Self-Harm/Suicidal Behavior: A Prospective Study

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**Objective** To explore the role of Internet addiction in the development of self-harm/suicidal behavior among adolescents after 1-year of follow-up.

**Study design** We conducted this 1-year, prospective cohort study of 1861 adolescents (mean age 15.93 years) attending a senior high school in Taiwan; 1735 respondents (93.2%) were classified as having no history of self-harm/suicidal attempts in the initial assessment and were referred to as the “noncase” cohort. The Chen Internet Addiction Scale was used to identify individuals with Internet addiction. The participants were evaluated for self-harm/suicidal behavior again 1 year later and the “noncase” cohort was selected for statistical analysis. To examine the relationship between Internet addiction and self-harm/suicidal behavior, multivariate logistic regression analysis was performed using Internet addiction at baseline as the predictor for newly developed self-harm/suicidal behavior in the next year, after adjustment for potential confounding variables.

**Results** The prevalence rate of Internet addiction at baseline was 23.0%. There were 59 students (3.9%) who were identified as having developed new self-harm/suicidal behaviors on follow-up assessments. After controlling for the effects of potential confounders, the relative risk of newly emerging self-harm/suicidal behavior for participants who were classified as Internet addicted was 2.41 (95% CI 1.16-4.99,  $P = .018$ ) when compared with those without Internet addiction.

**Conclusions** Our findings indicate that Internet addiction is prospectively associated with the incidence of self-harm/suicidal behavior in adolescents. (*J Pediatr* 2018;■■■:■■■-■■■).

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Internet addiction, often referred to as uncontrollable and problematic use of information technologies, is a growing public health issue among adolescents.<sup>1,2</sup> The concept of Internet addiction has been proposed to be a compulsive-impulsive spectrum disorder with clinical manifestations including preoccupation, excessive use, loss of control, withdrawal, tolerance, and harmful effects.<sup>3</sup> In the past decade, many studies have reported an increasing prevalence of Internet addiction in adolescents, varying worldwide from 0.8% to 26.7%.<sup>4</sup> Internet addiction is also associated with emotional and behavioral problems, social isolation, poor family relationships, and dysfunction in daily life.<sup>5-8</sup>

The biopsychosocial process of Internet addiction results in clinical features and difficulties in adolescents who use this technology excessively.<sup>9</sup> Adolescents with Internet addiction have been reported to exhibit withdrawal symptoms of restlessness, irritability, and mood lability after discontinuing use of the Internet.<sup>3,10</sup> In addition, their increased aggression and hostility have been reported to exacerbate the frequency and severity of interpersonal conflicts at home and in school.<sup>11,12</sup> These adolescents also tend to lack real-life relationships and sacrifice study time because of their obsessive use of the Internet, which then contributes to greater social frustration and worse academic performance.<sup>13-16</sup>

Internet addiction among adolescents has been associated with a variety of psychopathologies, including symptoms of attention deficit-hyperactivity disorder, substance abuse, depression, anxiety, aggression, and poor sleep quality.<sup>4-6,17</sup> Although the underlying mechanisms remain unclear, research has demonstrated that patients with addictive or psychiatric disorders share similar personality characteristics and biological substrates such as reward-related neurocircuitry and genetic traits.<sup>18-21</sup> These overlapping neurophysiological and psychosocial risk factors between Internet addiction and these associated psychopathologies may play a role in the manifestation of high-frequency comorbidities. In addition, it has been suggested that Internet

BAI	Beck's Anxiety Inventory
BDI-II	Beck's Depression Inventory-II
CIAS	Chen Internet Addiction Scale
IRR	Incidence rate ratio
PSQI	Pittsburgh Sleep Quality Index
WHOQOL-BREF	World Health Organization Quality of Life-Short Version

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addiction and psychiatric symptoms may interact with each other bidirectionally; this may then amplify the symptoms and worsen the course of both illnesses.<sup>22,23</sup>

Recently, several cross-sectional studies have revealed that adolescents with Internet addiction also have a higher risk of self-harm/suicidal behavior. Lin et al found that in Southern Taiwan, adolescents aged 12-18 years with Internet addiction had higher risks of suicidal ideation and attempts than those without it.<sup>24</sup> Another study on a sample of adolescents aged 15-16 years in Korea reported that the severity of Internet addiction was positively correlated with levels of depression and suicidal ideation.<sup>25</sup> In terms of self-harm, Lam et al found that Internet addiction among adolescents aged 13-18 years increased the risk of self-injurious behavior in China.<sup>26</sup> Another study in Europe reported that pathologic Internet use based on Young's Diagnostic Questionnaire<sup>1</sup> among adolescents with a mean age of 14.9 years was significantly correlated with self-harm/suicidal behavior.<sup>27</sup> Moreover, a positive relationship between the number of symptoms of Internet addiction and temporal changes in the severity of suicidal ideation has been reported among adolescents.<sup>28</sup>

Based on these findings, it is clinically important to further explore the association between Internet addiction and suicidality in a longitudinal investigation. If Internet addiction among adolescents is predictive of suicidality, then it would be necessary to target Internet addiction in this population to reduce the incidence of self-harm/suicidal behavior. The existing literature lacks studies assessing a prospective relationship between Internet addiction and suicidality; therefore, the aim of the present 1-year follow-up study was to examine the role of Internet addiction in the development of self-destructive behavior among adolescents.

## Methods

This prospective study was conducted at a vocational high school with predominantly male students in Taipei City, Taiwan from September 2006 to September 2008. Before the recruitment, the principal investigator met with the principal of the school, the director of general affairs, the director of counseling, and the school nurses to describe the procedures of this study. We explained the aim of this study, procedures, questionnaires, confidentiality, the ways to refer to school psychologists or clinicians if a participant with suicidal risk were identified during the study, and the alternative ways of evaluating mental disorders if the students or parents were not willing to be recruited for the screening in this study and answered questions from teachers, students, and parents at school. Parental consent was obtained. All participants provided signed informed consent after the procedures for data collection and ensuring confidentiality of the responses had been thoroughly explained to them. The Institutional Review Board of Tri-Service General Hospital, National Defense Medical Centre, Taipei, Taiwan approved the study protocol. Questionnaires were in their classrooms after school.

A total of 1947 first-year students (1590 male, 357 female) were recruited to participate in this investigation. At base-

line, the respondents completed the Chen Internet Addiction Scale (CIAS),<sup>29,30</sup> Pittsburgh Sleep Quality Index (PSQI),<sup>31-33</sup> Beck's Depression Inventory-II (BDI-II),<sup>34</sup> Beck's Anxiety Inventory (BAI),<sup>35</sup> World Health Organization Quality of Life-Short Version (WHOQOL-Bref),<sup>36,37</sup> and a set of self-reported questions about self-harm/suicidal behavior in the previous 6 months. We also collected the respondents' demographic data including age and sex.

The cohort was then followed up for 1 year, and the participants were invited to complete the questionnaire about self-harm/suicidal behavior again at the end of the follow-up period.

## Measures

The CIAS consists of 26 items designed to identify people with Internet-related symptoms and problems.<sup>29</sup> The items are classified into four factors, including symptoms of tolerance, compulsive use and withdrawal, interpersonal and health-related problems, and time management problems.<sup>29</sup> Respondents are required to rate each item on a 4-point scale. The CIAS has been widely used in adolescents to screen and diagnose Internet addiction with cut-off scores of 57/58 and 63/64, respectively.<sup>30</sup> In this study, a total CIAS score higher than 63 indicated Internet addictions.

The PSQI, a 19-item questionnaire, is a self-rated inventory that assesses general sleep quality over a 1-month period.<sup>31,32</sup> It has 7 components of sleep patterns: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. A total score of the 7 components  $\geq 5$  indicates poor sleep quality. The PSQI has been well validated and it is extensively used in children and adolescents.<sup>33</sup>

The BDI-II is a self-administered questionnaire which is used to measure the severity of depression in adults and adolescents. The BDI-II is a revision of the BDI, which was published in 1996 to correspond more closely to the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV) criteria for 2-week major depressive episodes.<sup>34</sup> The BDI-II is composed of 21 items with a total score ranging from 0 to 63, with a score  $\leq 9$  being considered minimal depression, 10-18 mild depression, 19-29 moderate depression, and 30-63 severe depression.

The BAI was developed with the primary purpose of discriminating anxiety from depression.<sup>35</sup> This self-reported scale consists of 21 anxiety symptoms, most of which represent an individual panic symptom. Respondents rate each item to indicate how much they were bothered by the particular symptom "during the past week, including today." Each response is scored on a 0-3 scale from "not at all" to "severely." The severity of anxiety was then classified according to the suggested cut-off scores, with 0-7 as "minimal," 8-15 as "mild," 16-25 as "moderate," and 26-63 as "severe."

The WHOQOL-Bref, a simplified form of the original WHOQOL-100, was developed by the WHOQOL group as a more practical version for use in clinical and epidemiologic surveys.<sup>36</sup> This inventory contains 26 items, including 2 general items and the other 24 items classified into 4 domains: physical, psychological, social relationships and environment. Each

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