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# Problematic Internet use and daily difficulties among adolescents with school refusal behaviors
## An observational cross-sectional analytical study

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**Abstract**

Problematic Internet use (PIU) is common and likely to coexist with mental health problems among adolescents with school refusal behavior. To date, no study has revealed to what extent PIU relates to the daily burden compared with other mental health problems. This study has examined the association between daily difficulties and PIU among adolescents with school refusal behaviors.

This cross-sectional study involved all first-visit patients, regardless of diagnosis, aged 10 to 18 years at 2 child/adolescent psychiatric outpatient clinics in Yokohama City, Japan, from April 2016 to March 2018. The Questionnaire-Children with Difficulties (QCD) were obtained from parents. Simultaneously, the severity of PIU was evaluated using the Internet Addiction Test and depressive and anxiety symptoms were evaluated using the Patient Health Questionnaire-9 and General Anxiety Disorder-7 scale in the 2 weeks before the first-visit. From 684 first-visit patients, 227 with school refusal behaviors were enrolled in the study.

PIU was observed in 40% of adolescents with school refusal behaviors. The QCD scores among patients with PIU were significantly lower than those in patients without PIU. Linear regression analysis revealed relationships between PIU and lower QCD scores throughout the day (except at night) and the total score of the day, after controlling for confounders such as depressive and anxiety symptoms.

In conclusion, among adolescents with school refusal behaviors, PIU may affect their parent-assessed daily difficulties particularly experienced throughout the day.

**Abbreviations:** IAT = Internet Addiction Test, MAR = missing at random, MICE = multiple imputations by chained equations, MNAR = missing not at random, QCD = Questionnaire-Children with Difficulties.

**Keywords:** adolescents, Internet addiction, parent-assessed difficulties, school refusal

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## 1. Introduction

Problematic Internet use (PIU) is likely to coexist with school refusal behaviors and social withdrawal.[1–4] Some young individuals with school refusal behaviors experience prolonged social withdrawal.[5] The more time spent by young individuals connected to the Internet, the more disconnected they become from the real world. A previous study demonstrated that compared with the general population, individuals with PIU probably experience more social recognition in the online than in the offline world.[6] Thus, the tendency toward social withdrawal may be sustained by PIU. Previous studies revealed that almost one-third of youth with hikikomori (a form of prolonged social withdrawal) refused to attend school in their early teens,[7] and the number of students with school refusal for more than 30 days/year has tripled in the past decade in Japan.[8]

PIU among adolescents is strongly related to mental health problems.[9] Therefore, the burden of mental health problems and comorbid PIU must be acknowledged, and support must be offered to adolescents and their families. Although assistance and understanding from family is needed, the parent–child relationship deteriorates because of PIU along with prolonged school refusal behavior.[10] A previous study revealed a correlation between persistent PIU and poor parent–child relationships.[11]

Adolescents with PIU often experience loss of control, anger, symptoms of distress, social withdrawal, and familial conflicts. Furthermore, extreme PIU can result in mental health problems, that is, depression and anxiety.[9,12] PIU affects mental health status and quality of life, affecting lifestyle, hygiene, and sleeping habits.[13,14] A frank discussion regarding the daily burden along

with the specific time periods during the day may help clinicians counsel patients and their parents.[15,16] However, no studies regarding adolescents with school refusal behaviors have revealed to what extent PIU relates to daily burden along with the specific time periods assessed by their parents.

We assumed that parents were concerned that the coexistence of PIU with school refusal behaviors made it difficult for their children to maintain their daily life, such as sleeping habits, interfered with their schoolwork and friendships, and family relationships. Hence, we assumed that the more the parents view only PIU as a problem, without understanding and supporting comorbid anxiety and depression, the worse the parent–child relationship may become. Consequently, it is expected to lead to deterioration in the child's daily functioning. First, we hypothesized that adolescents with school refusal behaviors may exhibit some difficulties in their parent-assessed daily burden at specific time periods throughout the day due to PIU. Second, we hypothesized that the coexisting anxiety and depression may exacerbate daily burden in adolescents with school refusal behavior synergistically with PIU.

This study aimed to identify the differences of daily burden during each time period of the day, comparing adolescents with PIU with those without PIU, and determine the synergistic effects on daily burden between PIU and 2 co-occurrences of depressive or anxiety symptoms among adolescents with school refusal behaviors.

Regression analysis was performed with difficulties in daily functioning as the dependent variable and PIU, age, sex, diagnosis of attention deficit/hyperactivity disorder, pervasive developmental disorder, and depressive and anxiety symptoms as the independent variables.

## 2. Materials and methods

### 2.1. Subjects and procedures

This cross-sectional study was conducted at 2 psychiatric outpatient clinics in Yokohama City, Japan. The sample comprised first-visit psychiatric referrals, regardless of diagnosis, aged from 10 to 18 years who were treated at Yokohama City University Hospital and Yokohama City University Medical Center between April 2016 and March 2018 (a 24-month timeframe). Both hospitals have inpatient psychiatric units for children and adolescents with mental illness and play a core role in the mental health system in Yokohama City (estimated population 3,734,012 in 2017 and an area of 437.4 km$^2$) and neighboring towns. Almost three-quarters of patients here are referred from nonpsychiatric primary care practices and have no prior psychiatric history.

This study was conducted according to the Declaration of Helsinki as revised in 2013 and was approved by the ethics committees of Yokohama City University Hospital and Yokohama City University Medical Center (Approval No. B160301009). Since 2015, both hospitals have routinely administered self-report questionnaires to patients and their parents during their first referral for mental health status assessment. Although the need for informed consent was waived by the ethics committees, the patients and their families were informed that they could decline participation without compromising the medical care they would receive. Information about this study was available on the web, after which the patients and their parents were informed that they could refuse

participation in the study. This article does not disclose personal identifiable data of any participant in any form. Patient confidentiality is strictly observed. None of the patients ultimately declined to participate.

Participants were selected using consecutive sampling. All first-visit patients were asked to complete a self-report questionnaire prior to a routine clinical interview, and parents were asked to report patient background information through survey forms. Trained psychiatrists diagnosed patients based on the International Classification of Diseases version 10 (ICD-10) criteria.

The inclusion criterion was school refusal behaviors with >30 days/year absence from school, and age between 10 to 18 years. Absence from school for >30 days/year is defined as "truancy, school absenteeism, or school refusal" by the Ministry of Education, Culture, Sports, Science, and Technology of Japan.[8] The eligibility criterion was any psychiatric disorder, except moderate-to-severe or profound intellectual disability, diagnosed using the ICD-10, and insufficient information about school attendance.

From 684 consecutive samples, the following were excluded: 73 patients with moderate or severe intellectual disabilities, 379 patients without school refusal behaviors, and 5 patients with insufficient information regarding school attendance. Finally, 227 patients with school refusal behaviors were analyzed in this study (Fig. 1).

### 2.2. Measures

The difficulties in daily functioning were obtained from surveys from parents. Afterward, self-report questionnaires comprising items regarding PIU severity and depressive and anxiety symptoms in the 2 weeks before the first-visit were obtained from patients. In addition, we collected data on demographic characteristics from medical records. The difficulties in daily functioning were considered as the primary outcome.

### 2.3. Difficulties in daily functioning

The parent-assessed children with difficulties questionnaire (The Questionnaire-Children with Difficulties [QCD]) is widely used to evaluate parental perceptions of their child's daily behaviors in the morning, at school, after school, in the evening, and at night.[15–17] The QCD is practical for sharing information among caretakers because it enables the evaluation of life function at different periods of the day. Questions are designed to be practical and easy to understand, such as washing one's face, brushing one's teeth, and getting dressed (see Table S1, Supplemental Digital Content, http://links.lww.com/MD/G622). The internal consistency and validity of QCD have been previously demonstrated.[18] Regarding the reliability of QCD, Chronbach alpha for the total score was .876, and the subscores ranged from .569 to .775.

### 2.4. Problematic internet use

We used the Internet Addiction Test (IAT), widely used in Asia, which is translated and validated in Japan.[19,20] The items were developed based on the following concepts: preoccupation with the Internet, needing to spend increasingly long periods online, making repeated attempts to reduce Internet use, suffering withdrawal symptoms when reducing Internet use, time management problems, environmental distress (e.g., family, school, work, and friends), deception regarding time spent
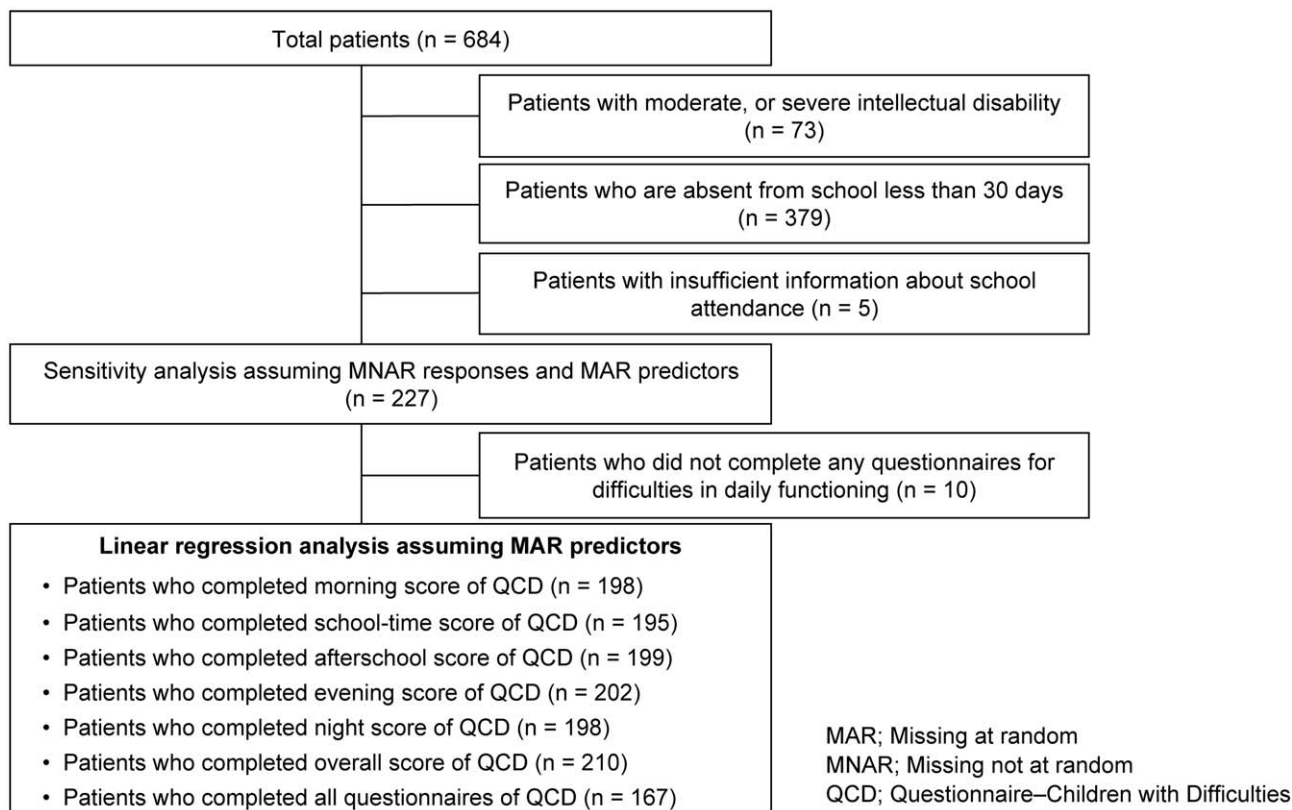
**Figure 1.** The flow diagram of samples analyzed for sensitivity analysis.

online, and using the Internet for mood modification. The total IAT score ranges from 20 to 100 (see Table S2, Supplemental Digital Content, http://links.lww.com/MD/G623). In this study, we defined patients with an IAT score of ≥50 as exhibiting PIU according to previous Japanese studies.[21]

### 2.5. Depressive symptoms

Clinical depressive symptoms were assessed using the Patient Health Questionnaire-9 (PHQ-9) scale. The PHQ-9 is a self-administered questionnaire comprising nine items that evaluate the presence of major depressive disorders, as defined by the DSM-IV, during the past 2 weeks (see Table S3, Supplemental Digital Content, http://links.lww.com/MD/G624). The PHQ-9 is now widely used to detect depression worldwide, including Japan.[22–24] The summed PHQ-9 score ranges from 0 to 27. The original study that developed the PHQ-9 defined cut-off points of 10 and 20 for moderate and severe depression, respectively.[22] However, we defined a PHQ-9 score of ≥14 as moderate-to-severe depressive episode in this study. A PHQ-9 score of <14 was defined as a mild depressive episode or asymptomatic according to a previous study conducted in Japan.[24] A PHQ-9 score of ≥14 was also confirmed among Taiwanese adolescents with sensitivity of 72.2% and specificity of 94.0% in screening for major depressive disorders.[25] A PHQ-9 score of ≥14 was defined as positive for depressive symptoms in this study.

### 2.6. Anxiety symptoms

Clinical anxiety symptoms were assessed using the General Anxiety Disorder-7 (GAD-7) scale. The GAD-7 comprises seven items that evaluate the presence of generalized anxiety disorder, as defined in DSM-IV, during the past 2 weeks (see Table S4, Supplemental Digital Content, http://links.lww.com/MD/G625). The GAD-7 is now used worldwide to detect the presence of general anxiety disorders and anxiety symptoms.[26,27] It has been translated into Japanese.[28] The summed GAD-7 score ranges from 0 to 21. The original study that developed the GAD-7 defined cut-off points of 10 and 15 for moderate and severe anxiety, respectively.[29] However, a recent study showed that the cut-off point should be 11 points when screening for moderate-to-severe anxiety in adolescent populations.[27] In this study, a GAD-7 score of ≥11 was defined as moderate-to-severe anxiety symptoms, and a GAD-7 score of <11 as mild anxiety episode or asymptomatic according to a previous study.[27] A GAD-7 score of ≥11 was defined as positive for depressive symptoms in this study.

### 2.7. Other demographic characteristics

Data on sex, age, and diagnosis were collected from the medical database, and school attendance data were collected using a life-status interview sheets completed by the parents. This study primarily focused on the following diagnoses: mental and behavioral disorders due to psychoactive substance use (F10–19 in ICD-10), neurotic disorders (F40–48), mood disorders (F30–39), pervasive developmental disorder (F84), and attention deficit/hyperactivity disorder (F90), which are demonstrated to have a positive association with Internet addiction in a previous study.[9,30] However, the diagnostic group of mental and behavioral disorders due to psychoactive substance use (F10–

### 2.8. Statistical analysis

First, we calculated the QCD scores in each of the six subcategories, the total QCD scores, and other patients' characteristics with school refusal behaviors and compared them between patients with and without PIU. We analyzed 112 out of total 227 patients (49.3%) who completed the IAT, QCD, GAD-7, and PHQ-9. Statistical comparisons were made using unpaired *t* tests checking the normality of the data with a histogram and Pearson Chi-Squared tests of independence.

Second, the associations between primary outcomes (total QCD scores and scores in 6 categories) and PIU among patients with school refusal behaviors were evaluated using linear regression analysis. The linear regression model included 5 covariates for adjustments (i.e., age, sex, diagnosis of attention deficit/hyperactivity disorder, pervasive developmental disorder, and depressive and anxiety symptoms). The interaction terms between PIU and each of the depressive and anxiety symptoms were also employed. In the regression analysis, multiple imputations by chained equations (MICE) assuming the presence of missing at random (MAR) predictors were employed to handle missing predictors to check the robustness. Moreover, regression analysis was performed as sensitivity analysis with imputed responses and predictors from MICE by assuming the presence of missing not at random (MNAR) responses and MAR predictors. The normal assumption of the errors was evaluated using residual analysis, but the results were not shown. We defined the level of significance at $\alpha = 0.05$. No adjustments were made for multiple comparisons. All analyses were performed using SPSS version 23.0 (SPSS, Chicago, IL), R version 3.5.1 (R, Foundation for Statistical Computing, Vienna, Austria), and the R packages "MICE" (version 3.8.0; https://www.jstatsoft.org/v45/i03/) and "miceMNAR" (version 1.0.2; https://cran.r-project.org/src/contrib/Archive/miceMNAR/).

## 3. Results

### 3.1. Demographic characteristics

Among the 227 patients with school refusal behaviors, the distribution of diagnoses was as follows: organic, including symptomatic mental disorders (F00–09; n=1; 0.4%), mental and behavioral disorders due to psychoactive substance use (F10–19; n=1; 0.4%), schizophrenia and related disorders (F20–29; n=9; 4.0%), mood disorders (F30–39; n=18; 7.9%), neurotic disorders (F40–48; n=73; 32.2%), eating and other somatic disorders (F50–59; n=17; 7.5%), trichotillomania (F63; n=1; 0.4%), mild mental retardation (F70; n=3; 1.3%), specific developmental disorders of scholastic skills (F81; n=5; 2.2%), pervasive developmental disorders (F84; n=20; 8.8%), and attention deficit/hyperactivity disorders (F90; n=4; 1.8%).

Among the 112 patients with school refusal behaviors who completed the questionnaire, 46 (41.1%) were classified as exhibiting PIU, with an IAT score of ≥50. Compared with patients without PIU, patients with PIU exhibited a significantly lower QCD total score of the day and QCD score (in the morning, during school-time, and in the evening) and significantly higher PHQ-9 and GAD-7 scores and were more frequently diagnosed with mood disorders. The demographic characteristics of the patients are shown in Table 1.

### 3.2. The association between difficulties in daily functioning and PIU

Linear regression analysis of the difficulties in children's daily functioning was performed to simultaneously estimate the main and interactive effects between PIU and depressive or anxiety symptoms. The linear regression analysis revealed relationships between PIU and lower QCD scores throughout the day, except at night.

Using MICE by assuming the presence of MAR predictors for regression analysis, the presence of PIU was also associated with lower QCD scores (in the morning, during school-time, after

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### Table 1

**Demographic characteristics of patients with school refusal.**

|  |  | With problematic Internet use (IAT ≥ 50) | Without problematic Internet use (IAT < 50) | *P* value |
|---|---|---|---|---|
|  | Total* | 46 | 66 |  |
|  | Sex; Boys (%) | 17 (37.0) | 31 (47.0) | .34 |
|  | Age (years); Mean (SD) | 14.1 (2.0) | 13.2 (1.8) | <.05 |
| Diagnosis (ICD-10) | Mood disorder (%) | 12 (26.1) | 6 (9.1) | <.05 |
|  | Neurotic disorder (%) | 29 (63.0) | 44 (66.7) | .69 |
|  | AD/HD (%) | 2 (4.3) | 2 (3.0) | 1.00 |
|  | PDD (%) | 7 (15.2) | 13 (19.7) | .62 |
| QCD; Mean (SD) | Morning | 5.0 (3.0) | 6.3 (2.9) | <.05 |
|  | During school | 4.3 (2.1) | 5.2 (2.2) | <.05 |
|  | After school | 4.7 (2.2) | 5.2 (2.4) | .21 |
|  | Evening | 6.6 (3.0) | 7.9 (2.9) | <.05 |
|  | Night | 4.2 (2.5) | 4.6 (2.3) | .40 |
|  | Overall behavior | 2.2 (1.3) | 2.2 (1.4) | .86 |
|  | Total score | 26.9 (10.9) | 31.5 (10.5) | <.05 |
| GAD-7; Mean (SD) | Total score | 8.9 (4.6) | 7.0 (5.2) | <.05 |
| PHQ-9; Mean (SD) | Total score | 13.1 (6.0) | 9.6 (5.9) | <.05 |

AD/HD = Attention deficit/hyperactivity disorder coded by F90 in the International Classification of Disorders, 10th version (ICD-10), GAD-7 = Generalized Anxiety Disorder-7, ICD-10 = International Statistical Classification of Disease, 10th Revision, PDD = Pervasive developmental disorder coded by F84 in ICD-10, PHQ-9 = Patient Health Questionnaire-9, QCD = Questionnaire: Children with Difficulties.
* Excludes 115 participants for whom data on IAT, QCD, GAD-7, and PHQ-9 were not collected.

**Table 2**

**Associations between difficulties in children's daily functioning and PIU[*].**

| | | β | lower-limit 95% CI | upper-limit 95% CI | *P* value |
|---|---|---|---|---|---|
| QCD | | | | | |
| Morning[†] | A | 0.02 | −1.60 | 1.64 | .98 |
| | D | −1.72 | −3.30 | −0.13 | <.05 |
| | PIU | −1.34 | −2.61 | −0.07 | <.05 |
| | A × PIU | −0.34 | −2.90 | 2.22 | .79 |
| | D × PIU | 1.40 | −1.06 | 3.86 | .27 |
| During school[‡] | A | −0.11 | −1.19 | 0.97 | .84 |
| | D | −1.05 | −2.13 | 0.04 | .06 |
| | PIU | −1.12 | −1.99 | −0.26 | <.05 |
| | A × PIU | −0.12 | −1.81 | 1.57 | .89 |
| | D × PIU | 0.52 | −1.11 | 2.15 | .53 |
| After school[§] | A | −0.12 | −1.35 | 1.11 | .85 |
| | D | −0.86 | −2.15 | 0.43 | .19 |
| | PIU | −1.05 | −2.03 | −0.06 | <.05 |
| | A × PIU | 0.48 | −1.45 | 2.41 | .63 |
| | D × PIU | 0.79 | −1.11 | 2.69 | .41 |
| Evening[¶] | A | 0.15 | −1.41 | 1.72 | .85 |
| | D | −1.68 | −3.21 | −0.15 | <.05 |
| | PIU | −1.88 | −3.08 | −0.68 | <.05 |
| | A × PIU | 0.29 | −2.13 | 2.72 | .81 |
| | D × PIU | 0.96 | −1.34 | 3.26 | .41 |
| Night[#] | A | 0.01 | −1.31 | 1.33 | .99 |
| | D | −1.54 | −2.85 | −0.22 | <.05 |
| | PIU | −0.09 | −1.12 | 0.94 | .86 |
| | A × PIU | −1.05 | −3.10 | 0.99 | .31 |
| | D × PIU | 1.46 | −0.53 | 3.46 | .15 |
| Overall behavior[?] | A | −0.24 | −0.89 | 0.41 | .46 |
| | D | −1.15 | −1.80 | −0.51 | <.05 |
| | PIU | −0.15 | 0.49 | 1.67 | .59 |
| | A × PIU | 0.16 | −0.92 | 1.23 | .77 |
| | D × PIU | 0.39 | −0.62 | 1.39 | .45 |
| Total score[+] | A | 0.83 | −4.92 | 6.58 | .78 |
| | D | −7.75 | −13.41 | −2.09 | <.05 |
| | PIU | −5.14 | −9.74 | −0.53 | <.05 |
| | A × PIU | −3.52 | −12.91 | 5.88 | .46 |
| | D × PIU | 5.59 | −3.14 | 14.32 | .21 |

QCD = Questionnaire: Children with Difficulties, 95% CI, 95% confidence interval, â, Standardized coefficient, A = Anxiety symptoms (GAD-7 ≥ 11), D = Depressive symptoms (PHQ-9 ≥ 14), PIU = Problematic Internet use.

[*] Linear regression analysis was performed using multiple imputations by chained equations assuming the presence of missing at random predictors.

[†] Excludes 19 patients for whom data on the QCD morning score were not collected.

[‡] Excludes 21 patients for whom data on the QCD school-time score were not collected.

[§] Excludes 18 patients for whom data on the QCD after-school score were not collected.

[¶] Excludes 15 patients for whom data on the QCD evening score were not collected.

[#] Excludes 19 patients for whom data on the QCD night score were not collected.

[?] Excludes 7 patients for whom data on the QCD overall behavior score were not collected.

[+] Excludes 50 patients for whom data on the QCD total score were not collected.

school, and in the evening) and the total QCD scores of the day, but was not associated with QCD scores at night or with the overall behavior score, even after controlling for potential confounders (Table 2).

Associations were observed in the morning (standardized coefficient [β]=−1.34, 95% confidence interval [95% CI]=−2.61 to −0.07, $P<.05$), during school (β=−1.12, 95% CI=−1.99 to −0.26, $P<0.05$), after school (β=−1.05, 95% CI=−2.03 to −0.06, $P<.05$), in the evening (β=−1.88, 95% CI=−3.08 to −0.68, $P<.05$), and for the total score of the day (β=−5.14, 95% CI=−9.74 to −0.53, $P<.05$). No interactive effects between PIU and depressive symptoms or anxiety symptoms were observed.

The sensitivity analysis, using MICE by assuming the presence of MNAR and MAR predictors, revealed associations between the QCD scores and PIU as follows: in the morning (β=−1.17, 95% CI=−2.41 to −0.06, $P=.06$), during school (β=−1.02, 95% CI=−1.89 to−0.15, $P=.02$), after school (β=−0.89, 95% CI=−1.87 to −0.09, $P=.08$), in the evening (β=−1.88, 95% CI=−3.08 to −0.68, $P<.01$), at night (β=0.03, 95% CI=−0.99 to −1.05, $P=.96$), in the overall score (β=−0.10, 95% CI=−0.71 to −0.51, $P=.75$), and the total score of the day (β=−4.40, 95% CI=−8.20 to −0.60, $P=.02$).

## 4. Discussion

To the best of our knowledge, previous studies have not investigated the relationship between parent-assessed difficulties and Internet addiction in adolescents with school refusal behaviors. This is the first study to reveal the relationship

between parent-assessed difficulties in daily functioning and PIU among adolescents with school refusal behaviors. This study revealed that adolescents with PIU showed higher depressive and anxiety symptoms and also difficulties in daily functioning in comparison to patients without PIU. Additionally, linear regression analysis, considering confounders, such as depressive or anxiety symptoms, revealed a distinctive relationship between PIU and difficulties in daily functioning, especially from the morning to evening. However, no interaction effect was observed between PIU and comorbid symptoms, such as depressive or anxiety symptoms.

School refusal behavior and PIU appear to overlap in terms of behaviors that may represent a dissociative response to painful emotional states.[12] Adolescents may temporarily soothe themselves by school refusal behaviors to avoid psychological distress such as bullying, academic difficulties, and poor school climate.[31,32] However, school refusal behaviors can lead to social avoidance and family conflicts.[33] Comorbid psychiatric disorders and low self-esteem affect the quality of life among adolescents with school refusal behaviors.[34] In difficult situations, such adolescents may use the Internet excessively to avoid implicit pressure from their stresses. This unfavorable cycle caused by PIU deteriorates family relationships. In the present study, parental assessments of the difficulty in daily functioning were worse for those with PIU in comparison to those patients without PIU, considering the co-occurrence of anxiety and depressive symptoms. This suggests that PIU may worsen the parents' impression of the daily functioning of adolescent patients with school refusal behaviors.

PIU may be an avoidance behavior to escape reality in adolescents with school refusal behaviors.[35] A previous study reported a relationship between PIU and social withdrawal with poor mental health.[2] Some adolescents with school refusal behaviors who have poor interpersonal relationships at school may gain peer approval and confidence in the virtual reality world. The present study reflects parent-assessed daily difficulties during or after school, even considering other mental health problems.

Problematic smartphone use, such as "phubbing," which is the act of snubbing someone personally in favor of a smartphone, can interfere with intimate connectedness in real life.[36] Furthermore, PIU can worsen the parent–child relationship.[11] The relationship between parents who blame their children's PIU and adolescents who avoid their parents may further deteriorate, especially in the morning and evening when most families spend time together, as the present study suggests. Providing adolescents and their parents with family therapy to satisfy psychological needs and to improve parent–adolescent communication may be effective.[37,38]

The present study first revealed that school refusal adolescents with PIU showed parent-assessed difficulties in daily functioning in comparison to patients without PIU, aside from the association of depression and anxiety. For example, the present study indicated that parent-assessed difficulties during the daytime when adolescents are expected to attend school are strongly related to PIU. On the other hand, depression may have a stronger relationship with parent-assessed difficulties than PIU from evening through the next morning. From the results of the current study, clinicians can understand relationship between the pattern of daily life functioning at each timeframe and psychopathology, such as depression, anxiety disorders, and Internet addiction among adolescents with school refusal behaviors. Hence, this is the strength of this study.

However, the study had several limitations. First, the causal relationship between school refusal, PIU, and mental health problems could not be clarified in this study. Young individuals may initially refuse school to avoid aversive stimuli there and subsequently discover the many positive amenities of staying at home, such as playing online games.[35] The increase in online social relationships has led to reduced seeking of real-world life experiences.[39] Furthermore, mental health problems such as depression, anxiety, and developmental disorders have strong relationship with school refusal behaviors.[31,40–42] Young individuals disconnected with the real world due to PIU may hesitate to seek help from others, even from their families, when mental health problems arise. Second, almost 50% of the patients or parents did not complete the questionnaires. Third, we could not confirm the presence of a causal relationship between the parent-assessed daily difficulties in functioning and PIU. Further longitudinal studies should be performed. Fourth, the developmental disorders were only diagnosed by psychiatrists using the ICD-10 without standardized measures. Nevertheless, a previous study demonstrated a relationship between AD/HD symptoms and PIU.[43] Fifth, the sensitivity analysis revealed that PIU was not significantly associated with any difficulties in the specific time periods (e.g., in the morning and after school). Therefore, the results of this study need to be interpreted with caution. Sixth, the social isolation among adolescents or lack of support, which are important components of the cognitive-behavioral model of PIU, are insufficiently assessed.[44] Seventh, this study did not fully assess addiction and related disorders. The subjects in this study were characterized by an extremely small number of psychoactive drug addiction because of the strict control of illicit drugs in Japan. Thus, future studies with other cultural backgrounds would be needed. Eighth, the validity of the QCD has been tested for symptoms of oppositional defiant disorder, attention deficit/hyper activity disorder, autistic spectrum disorder and symptoms of depression.[15–18] However, there are no studies that have compared the scores using rating scales for other children's daily functioning. Furthermore, the results should be interpreted cautiously because the QCD includes over all behavior subscores, such as items 19 and 20, which are not timeframe constructs. Finally, the findings cannot be generalized as we used consecutive sampling strategy, which is not a random sampling.

In conclusion, among adolescents with school refusal behaviors, PIU may affect their parent-assessed daily difficulties. These PIU-induced daily difficulties were present nearly throughout the day, except at night, and were distinctive compared to depressive and anxiety symptoms. Clinicians should support adolescents and their parents based on the characteristics of their daily life difficulties related to PIU.

## Author contributions

**Conceptualization:** Junichi Fujita, Kumi Aoyama, Kazuya Asanuma, Yuichi Takahashi.
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