

Prevalence and Correlates of Problematic Internet Experiences and Computer-Using Time: A Two-Year Longitudinal Study in Korean School Children

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Objective To measure the prevalence of and factors associated with online inappropriate sexual exposure, cyber-bullying victimisation, and computer-using time in early adolescence.

Methods A two-year, prospective school survey was performed with 1,173 children aged 13 at baseline. Data collected included demographic factors, bullying experience, depression, anxiety, coping strategies, self-esteem, psychopathology, attention-deficit hyperactivity disorder symptoms, and school performance. These factors were investigated in relation to problematic Internet experiences and computer-using time at age 15.

Results The prevalence of online inappropriate sexual exposure, cyber-bullying victimisation, academic-purpose computer overuse, and game-purpose computer overuse was 31.6%, 19.2%, 8.5%, and 21.8%, respectively, at age 15. Having older siblings, more weekly pocket money, depressive symptoms, anxiety symptoms, and passive coping strategy were associated with reported online sexual harassment. Male gender, depressive symptoms, and anxiety symptoms were associated with reported cyber-bullying victimisation. Female gender was associated with academic-purpose computer overuse, while male gender, lower academic level, increased height, and having older siblings were associated with game-purpose computer-overuse.

Conclusion Different environmental and psychological factors predicted different aspects of problematic Internet experiences and computer-using time. This knowledge is important for framing public health interventions to educate adolescents about, and prevent, internet-derived problems.

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Key Words Online sexual exposure, Cyber-bullying, Computer overuse, Longitudinal study, Adolescent.

INTRODUCTION

Concern over the impact of Internet use on adolescents has developed over the last 20 years.^{1,2} The issue can be confusing due to diverging perspectives of the Internet either as a new tool for education and recreation, or as a potential threat to physical and/or psychological well-being.³ Public health officials, educators, law enforcement officers, and parents share

concerns over problematic Internet experiences and computer overuse. They give the most attention to the sexual exploitation of youth and cyber-bullying victimisation.⁴⁻⁸ There are also multiple views on the potential vulnerability of adolescents: one of inexperience (e.g., adolescents with developmental disabilities vulnerable to online fraud) and another of over-experience (technologically knowledgeable adolescents with risk-taking tendencies). These potentially complex risk profiles present a challenge for prevention and protection.

Through the rapid spread of Internet use, new psychological terminology has been coined, such as “Internet addiction,”^{2,9} and “pathological Internet use,”¹⁰ with no universally accepted definitions. Generally, these terms represent the reduced ability of individuals to control their Internet use, resulting in significant distress and/or functional impairment in daily life.^{2,11} Although a strict quantification of daily computer

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use is not sufficient to define these phenomena, it is common in clinical experience to see computer overuse related to adolescents' preoccupation with the Internet, functional impairment, and conflicts at home and at school. Further in-depth investigation of computer overuse is required for the development of strategies to prevent or reduce functional impairment, and to distinguish the pathological entity of "Internet addiction" from problematic computer overuse. However, there is little empirical evidence on risk factors for various problematic Internet experiences and computer overuse in young people. In addition, previous studies have not gathered sufficient information to differentiate between online inappropriate sexual exposure, cyber-bullying victimisation, and computer overuse. To address these deficiencies based on available evidence, we analysed data from a two-year longitudinal study of a large sample of Korean middle-school children.

METHODS

Procedure and participants

The baseline survey in 2004 included 1,173 seventh grade students (age 13–14 years) from three middle schools in Kwangju, South Korea, and their parents. In their classrooms during school hours, and under the direction of the project psychiatrist, each participant provided data and completed all questionnaires, which were appropriately validated for seventh graders. This took an average of 45 minutes. Each parent received a sealed questionnaire and information via the participating young person, completed the questionnaire at home, and returned it in a sealed envelope. Two years later, when the adolescents were in the ninth grade (age 15–16 years), a follow-up school visit was conducted with attempts made to include all previous participants, as well as other current students in that grade. Of 1,173 adolescents who were eligible at baseline, 936 participated in the initial survey, 835 (89.2%) of whom also participated at follow-up. The number of adolescents who had complete data at baseline and follow-up was 566 (67.8%). The remainder had at least one variable missing. Essentially identical procedures were used to identify all psychopathology, although online inappropriate sexual exposure, cyber-bullying victimisation, and computer overuse were only evaluated at follow-up. All participants and parents gave written informed consent at each examination. This study was approved by the Chonnam National University Hospital Institutional Review Board.

Assessments and measurements

Online inappropriate sexual exposure

We used two questions: 1) "In the past year, did anyone

ever use the Internet to give you sexual information (e.g., a description, picture, or video) that was unwanted or wanted?" 2) "In the past year, have you ever engaged in online sexual activities or sexual talks that were unwanted or wanted?"

Cyber-bullying victimisation

We used four self-report items completed by children about threatening emails/texts, malicious rumours or abuse of personal information involving the use of the Internet and/or mobile phones, to evaluate victimisation from cyber-bullying. Internal consistency for items was found to be satisfactory (Cronbach's alpha 0.67). Until now, no established questionnaire cut-offs existed for characterising cyber-bullying victimisation,¹² and it is defined here on the basis of a score at or above the upper quartile.

Computer-using time

The questionnaire comprised items to determine the duration of computer use per day (estimated separately according to whether it was for the purposes of academic work or for game-playing). In terms of defining 'overuse', there is no current standard. Previous research had found that internet-addicted Korean adolescents spent a mean (SD) 3.64 (2.19) hours per day online compared to 2.44 (1.55) in non-addicted adolescents.¹³ Therefore, for this study, over 3 hours computer use per day was defined *a priori* as computer-overuse.

Bullying

We used two self-report scales completed by the young participants to ascertain 'traditional' (i.e., non-cyber) bullying: the Peer-Victimisation Scale (PVS) and the Bullying Behaviour Scale (BBS).¹⁴ The PVS consists of six compulsory items, three of which refer to being a victim of negative physical actions and three of which refer to being a victim of negative verbal actions. The BBS is based on the PVS; it involves changing the phrasing from passive to active. For the purpose of classification, researchers used a cut-off score of 2.50 or above on both the PVS and the BBS. Korean versions of the PVS and the BBS have been validated.¹⁵ Cut-off scores of 2.60 or above on the PVS and 2.50 or above on BBS were used to categorise victimisation and perpetration, respectively.

Depression

We administered the Children's Depression Inventory (CDI).¹⁶ The CDI requires a third-grade reading level and is suitable for children between the ages of seven and 17. Total scores range from 0 to 54, with higher scores indicating higher levels of depression. Kovacs recommended that scores ≥ 17 in a heterogeneous population be considered indicative of depression and the reliability and validity of the Korean form of

the CDI have been established as acceptable.¹⁷

Anxiety

We used the State-Trait Anxiety Inventory for Children (STAI-C),¹⁸ which includes 20 'State Anxiety' and 20 'Trait Anxiety' items. Responses are scored on a scale of 1 to 3, and total scores range from 20 to 60, with higher scores reflecting greater anxiety. The reliability and validity of the Korean form of the STAI-C have been established.¹⁹ In this study, we defined relative anxiety on the basis of scores at or above the median.

Self-esteem

We used the short version of the Self-Esteem Inventory (SEI).²⁰ The Korean translation includes 25 trait-descriptive sentences, to which subjects respond by indicating whether the sentences describe them.²¹ Total SEI scores range from 0 to 25, with higher scores reflecting higher self-esteem. Scores at or below the median were used to define relative low self-esteem.

Coping strategies

We used the adolescent version of the Ways of Stress Coping Checklist.²² An appropriately modified Korean version has been developed with factor structures of 'problem-solving strategies' and 'passive strategies'.²³ Scores at or above the median defined good problem-solving strategies and passive strategies, respectively.

Psychopathology

The Strengths and Difficulties Questionnaire (SDQ-S) was administered, which includes 25 items, divided into five scales of five items each: hyperactivity, emotional symptoms, conduct problems, peer problems, and prosocial behaviour.²⁴ A score of total difficulties is computed by combining all scales except the prosocial behaviour scale. For each scale except for the prosocial behaviour scale, higher scores indicate more problems. The sum of the scores ranges from 0 to 40. The Korean translation has been evaluated and reported as satisfactory, and we used the same cut-off (≥ 20 for total psychopathology) applied in previous Korean research.²⁵

Attention deficit hyperactivity symptoms

Parents completed the Korean version of DuPaul's Attention Deficit Hyperactivity Disorder Rating Scale (K-ARS).²⁶ K-ARS has an 18-item measure used to assess inattention and hyperactivity. Items are rated on a four-point scale (0=never or rarely, 3=very often). The K-ARS has good reliability and validity among Korean children, with scores ≥ 17 recommended for defining ADHD.²⁶

Height and weight

Routine data were made available from each school on students' height and weight. School health nurses measure height and weight annually, with the student wearing underwear and not wearing shoes. We divided the adolescents into three groups: <10th percentile, 10–90th percentile, and ≥ 90 th percentile, according to their height and weight.

Socio-demographic characteristics

Data were recorded on gender, family structure, number of friends, birth order, weekly pocket money, five levels of socioeconomic status, and five levels of academic achievement. We categorised family structure according to whether the participant was living with one or both parents. 'Number of friends' was grouped into "0", "1–2", "3–4", "5–9", and "10+". Birth order was divided into whether or not the participant had siblings. Weekly pocket money was categorised by USD equivalence into five groups (<5, 5–9, 10–14, 15–19, and 20+).

Statistical analysis

Statistical analyses were conducted using Stata 11 (Stata-Corp, College Station, TX, USA). Unadjusted logistic regression analyses were carried out to examine associations between environmental and psychological variables at baseline with respect to online inappropriate sexual exposure, cyberbullying victimisation, and computer-using time at follow-up. Multivariable logistic regression models were then used to test the independence of these associations. These models were assembled as follows: first, environmental factors (sociodemographic and anthropometric measures) were entered simultaneously to investigate their mutual independence; next, the two variables measuring perpetration of, and victimisation by, traditional bullying at baseline were entered, adjusted for each other and the previously entered variables; next, the psychological variables were entered separately, adjusted for previous traditional bullying and environmental factors, but not adjusted for each other, because of the risk of colinearity.

Imputation of missing data

We imputed data on children who participated at follow-up and had missing data points. We describe the extent and distribution of missing data in Table 1. To minimise the impact of missing data, we used multiple imputations (MI) by chained equation, combined using Rubin's rules in Stata to impute missing data.²⁷ Thirty copies of the data were formed in the imputation process, each with missing data imputed. The MI data augmentation procedure used here assumes that the data have a multivariate normal distribution. Suitable transformations were necessary for this assumption to hold. After im-

Table 1. Descriptive statistics and data completeness for the study sample

Characteristics at age 13	Informant	Mean (SD) or (%)	Range	Number (%)	Instruments or examples of items
Low academic level	Parent	7.7	-	835 (100)	Five-level achievement
Height, cm	Teacher	155.5 (6.80)	127–175	833 (99.8)	By school nurse
Weight, kg	Teacher	46.8 (8.90)	24–84	830 (99.4)	By school nurse
Number of friends	Self	3.7 (3.16)	0–30	835 (100)	Grouped into 0, 1–2, 3–4, 5–9, and over 10
Weekly pocket money	Self	17.9 (4.17)	0–90	835 (100)	<5, 5–9, 10–14, 15–19, and over 20 USD
Low economic status	Parent	12.1	-	830 (99.4)	Five-level economic status
First born child	Parent	49.5	-	580 (69.5)	
Single parent	Parent	9.5	-	831 (99.5)	
Perpetration of bullying	Self	11.9 (3.20)	6–24	834 (99.9)	Bullying Behaviour Scale
Victimization of bullying	Self	11.1 (3.20)	6–24	834 (99.9)	Peer-Victimization Scale
Depression	Self	14.6 (6.29)	0–46	834 (99.9)	Children's Depression Inventory
Anxiety	Self	66.0 (12.26)	39–114	833 (99.8)	State-Trait Anxiety Inventory for Children
Self esteem	Self	13.5 (4.80)	1–25	830 (99.4)	Short version the Self-Esteem Inventory
Passive Coping strategy	Self	24.0 (6.53)	12–48	830 (99.4)	Ways of Coping Checklist
Total psychopathology	Self	13.5 (4.80)	1–32	819 (98.1)	Strengths and Difficulties Questionnaire
Attention-deficit hyperactivity disorder symptoms	Parent	8.3 (7.11)	0–40	570 (68.3)	Korean version of ADHD Rating Scale

putation, the complete data were transformed back to their original scale prior to any analyses being performed. All subsequent analyses were conducted using imputed data.

RESULTS

Sample description and prevalence of problematic internet experience and computer-using time

The adolescents at baseline comprised 443 boys (47.5%) and 489 girls, and those at follow-up comprised 382 boys (45.8%) and 453 girls. The prevalence of online inappropriate sexual exposure and cyber-bullying victimisation at follow-up were 264 (31.6%) and 169 (19.2%), respectively. The mean (SD) durations of academic- and game-related computer-use at follow-up were 1.35 (0.88) and 2.03 (1.30) hours per day, respectively. The prevalence of computer overuse (>3 hours/day) for academic purposes was 71 (8.5%), and for game-playing, it was 182 (21.8%). There were no school differences in sample characteristics (data not shown).

Baseline factors associated with online inappropriate sexual exposure, cyber-bullying victimisation, and computer-using time at follow-up

As summarised in Table 2, unadjusted analyses indicated the following baseline factors were associated with online inappropriate sexual exposure at follow-up: higher than average height, heavier than average weight, more weekly pocket money, having older siblings, depression, and use of a passive coping strategy. Baseline factors associated with cyber-bully-

ing victimisation at follow-up were: male gender, previous perpetration of traditional bullying, previous victimisation by traditional bullying, higher depression, higher anxiety, use of a passive coping strategy, and higher ADHD symptoms. Baseline factors associated with academic-purpose computer use at follow-up: female gender and lower academic level. The following factors were significantly associated with game-related computer use at follow-up: male gender, lower academic level, having older siblings, and previous victimisation by traditional bullying.

Multi-variable regression models of problematic internet experiences

After adjustment for other environmental factors (as summarised in columns 1 and 2 of Table 3), more weekly pocket money and having older siblings remained associated with online inappropriate sexual exposure, and male gender remained associated with cyber-bullying victimisation. After adjustment for previous bullying experience and environmental factors, higher depression and higher anxiety remained associated with online inappropriate sexual exposure and cyber-bullying victimisation, and passive coping strategies remained associated with online inappropriate sexual exposure.

Multi-variable regression models of computer use

After adjustment for other environmental factors (as summarised in columns 3 and 4 of Table 3), female gender remained associated with academic-purpose computer-using

Table 2. Associations between characteristics at age 13 years with involvement in problematic internet experiences and computer-overuse by age 15 years*

	Online inappropriate sexual exposure		Cyber-bullying victimization		Academic-purpose computer-overuse		Game-purpose computer-overuse	
	OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value	OR (95% CI)	p value
Environmental factors								
Male	0.99 (0.77, 1.29)	0.984	1.76 (1.35, 2.28)	<0.001	0.67 (0.52, 0.87)	0.003	1.92 (1.43, 2.57)	<0.001
Low academic level	0.92 (0.82, 1.04)	0.195	1.08 (0.96, 1.22)	0.217	1.19 (1.02, 1.34)	0.020	1.23 (1.08, 1.40)	0.001
Height, ≥90 percentile	1.12 (1.01, 1.25)	0.027	1.01 (0.92, 1.12)	0.826	1.06 (0.96, 1.17)	0.256	1.09 (0.99, 1.21)	0.073
Weight, ≥90 percentile	1.10 (1.01, 1.20)	0.027	1.07 (0.98, 1.16)	0.116	1.06 (0.98, 1.14)	0.147	1.02 (0.94, 1.11)	0.647
Fewer friends, 5 groups	0.98 (0.86, 1.12)	0.790	1.01 (0.89, 1.14)	0.889	0.98 (0.86, 1.11)	0.741	1.03 (0.89, 1.19)	0.674
Higher weekly pocket money, 5 groups	1.09 (1.01, 1.17)	0.025	1.03 (0.96, 1.11)	0.343	0.95 (0.89, 1.02)	0.138	1.04 (0.96, 1.12)	0.338
Lower economic status, 5 groups	0.93 (0.79, 1.10)	0.415	1.04 (0.88, 1.23)	0.628	1.11 (0.95, 1.31)	0.198	1.11 (0.93, 1.34)	0.251
Birth order, not first one	1.37 (1.01, 1.86)	0.041	1.20 (0.91, 1.58)	0.200	1.00 (0.76, 1.33)	0.987	1.75 (1.27, 2.43)	0.001
Single parent	1.37 (0.86, 2.18)	0.179	0.88 (0.56, 1.39)	0.580	1.10 (0.69, 1.74)	0.698	1.40 (0.85, 2.30)	0.181
Bullying experience								
Perpetration group	1.01 (0.71, 1.43)	0.965	1.52 (1.11, 2.08)	0.009	0.97 (0.69, 1.35)	0.838	1.09 (0.77, 1.55)	0.624
Victimization group	1.09 (0.84, 1.43)	0.501	1.37 (1.09, 1.73)	0.008	1.08 (0.82, 1.42)	0.982	1.06 (0.79, 1.43)	0.682
Psychological factors								
Depression	1.36 (1.03, 1.78)	0.028	1.61 (1.22, 2.01)	0.001	0.99 (0.77, 1.29)	0.987	1.06 (0.79, 1.44)	0.685
Anxiety	1.29 (0.99, 1.66)	0.053	1.57 (1.20, 2.05)	0.001	0.95 (0.74, 1.22)	0.676	1.09 (0.82, 1.46)	0.541
Lower Self esteem	1.27 (0.96, 1.67)	0.093	1.15 (0.89, 1.50)	0.281	0.91 (0.60, 1.38)	0.649	0.93 (0.59, 1.47)	0.764
Passive coping strategy	1.63 (1.21, 2.19)	0.001	1.34 (1.01, 1.77)	0.040	0.95 (0.63, 1.43)	0.802	0.96 (0.59, 1.55)	0.859
Total psychopathology	0.93 (0.61, 1.44)	0.755	1.34 (0.88, 2.04)	0.172	1.08 (0.82, 1.42)	0.982	1.06 (0.79, 1.43)	0.682
ADHD symptoms	1.25 (0.82, 1.90)	0.299	1.61 (1.03, 2.51)	0.038	0.99 (0.77, 1.28)	0.982	1.14 (0.86, 1.50)	0.366

*analysis with imputed data. ADHD: attention-deficit hyperactivity disorder, CI: confidence interval, OR: odds ratio

time, and male gender, lower academic achievement, higher than average height, and having older siblings remained associated with game-related computer-using time.

DISCUSSION

In a prospective longitudinal study of middle school students in South Korea, we investigated the prevalence of and factors predicting later involvement in problematic Internet experience and computer overuse.

The prevalence of online inappropriate sexual exposure was 31.6%. One 2001 telephone survey reported that 19% of young people who used the Internet regularly were targets of unwanted sexual solicitation within a year.⁴ In 2007, 43% of young clients who received treatment for Internet-related problems reported the intentional use of pornography.⁵ Our observed prevalence fell between these results. One possible explanation is that online inappropriate sexual exposure represents a relatively new and growing phenomenon affected by

time trends as well as by assessment methods and settings. The rapidly increasing availability of Internet sites presents increasing opportunities for online inappropriate sexual exposure. The prevalence of cyber-bullying victimisation in the present study was 19.2%, compared to previous reports of 6.6% to 15.6%, depending on the assessment method/criteria, age groups, and time trends.^{6,7,28,29} Our relatively high prevalence may reflect the high levels and duration of Internet usage in Korea, with more than 95% of people under the age of 20 having used the Internet for over two years.³⁰

The prevalence of computer overuse as defined in this study (>3 hours/day) was 8.5% for academic purposes and 21.8% for game playing. As discussed earlier, a drawback with prevalence studies in this field has been the application of relatively vague terminology to describe levels of Internet use, such as 'borderline', 'excessive', 'at risk', and 'addictive', which have not been operationally defined or clinically validated.³¹ International prevalence rates for Internet addiction have ranged from 1.5% to 8.2%,³² and previous studies have found the

Table 3. Multi-variable logistic regression of associations between characteristics at age 13 with involvement in problematic internet experiences and computer-overuse by age 15 years

Characteristics at age 13	Associations with problematic internet experiences and computer-overuse at age 15 years (odds ratio, 95% CI)			
	Problematic internet experiences		Computer-overuse	
	Sexual exposure	Victimization	Academic	Game
Environmental factors [†]				
Male gender	0.9 (0.7, 1.2)	1.7 (1.3, 2.3)**	0.6 (0.5, 0.8)**	1.8 (1.3, 2.5)**
Low academic level	0.9 (0.8, 1.0)	1.0 (0.9, 1.2)	1.2 (1.1, 1.4)	1.2 (1.1, 1.4)*
Height, ≥90 percentile	1.1 (0.9, 1.2)	0.9 (0.8, 1.1)	1.1 (0.9, 1.2)	1.2 (1.0, 1.3)*
Weight, ≥90 percentile	1.1 (1.0, 1.2)	1.0 (1.0, 1.2)	1.1 (1.0, 1.2)	0.9 (0.8, 1.0)
Higher weekly pocket money, 5 groups	1.1 (1.0, 1.2)*	1.0 (0.9, 1.1)	1.0 (0.9, 1.0)	1.0 (0.9, 1.1)
Birth order, not first one	1.4 (1.0, 1.9)*	1.2 (0.9, 1.5)	1.0 (0.7, 1.3)	1.7 (1.2, 2.3)*
Bullying behaviour/experience at age 13 [‡]				
Perpetration group	0.9 (0.6, 1.3)	1.3 (0.9, 1.8)	1.0 (0.7, 1.4)	1.8 (0.6, 1.3)
Victimization group	1.1 (0.8, 1.5)	1.2 (0.9, 1.5)	1.0 (0.8, 1.4)	1.3 (0.9, 1.7)
Psychological factors at age 13 [§]				
Depression	1.5 (1.1, 2.0)*	1.6 (1.1, 2.1)*	1.0 (0.7, 1.3)	1.0 (0.7, 1.3)
Anxiety	1.3 (1.0, 1.8)*	1.5 (1.1, 1.9)*	1.1 (0.8, 1.4)	1.0 (0.7, 1.5)
Passive coping strategy	1.6 (1.2, 2.2)**	1.3 (1.0, 1.7)	1.0 (0.8, 1.4)	1.0 (0.7, 1.4)
ADHD symptoms	1.4 (0.9, 2.1)	1.3 (0.8, 2.1)	1.0 (0.6, 1.5)	0.8 (0.4, 1.4)

* $p \leq 0.05$, ** $p \leq 0.001$, [†]mutually adjusted for other environmental factors but not for any other covariates, [‡]mutually adjusted and adjusted for all environmental factors but not for psychological factors, [§]individually entered and adjusted for both bullying measures and all environmental factors. ADHD: attention-deficit hyperactivity disorder, CI: confidence interval

prevalence of pathological gaming to be 7.6–9.9%.³³ There are justifiable general concerns regarding the use of self-reported information, because of the risk of dishonest responses about adverse consequences, and misinterpretation of questionnaire items. For this reason, in our study we only used the reported time of computer use to evaluate overuse. This does not allow direct comparison with prevalence studies of Internet addiction; however, the high prevalence of game-related computer-using time does suggest the need for prevention programs.

The association between online inappropriate sexual exposure and higher weekly pocket money may reflect greater opportunities for using commercial gaming centres or Internet cafes. Many commercial broadband gaming centres in Korea, whose connection speed allows a higher level of activities, lack the closer monitoring of adolescent Internet use that may occur in the home. One study found that, in adolescents who had experienced online sexual harassment, being solicited while accessing the Internet away from home was associated with stronger feelings of vulnerability or potential embarrassment, due to others being aware of this experience. The study also found that these stronger feelings could be due to guilt, because these may be young people whose families object to them going online.⁴ Adolescents with an older sibling were

also more likely to report online inappropriate sexual exposure, possible explanations being earlier exposure and an older sibling's influence on computer use habits.

Higher depression, higher anxiety, and passive coping strategies were also associated with online inappropriate sexual exposure. Some people use the Internet to avoid emotional difficulties in their lives, as illustrated by previous findings that both men and women with cybersex problems were more likely to exhibit maladaptive coping, conditioned behaviour, intimacy dysfunction, and addictive behaviour.³⁴ Some have suggested that adolescents use the Internet as a coping mechanism against underlying psychological development issues, and the Identity and Intimacy issues from Eriksonian crises were found to be related to Internet dependence.³⁵ As far as we are aware, there has been little longitudinal research into risk factors for online inappropriate sexual exposure. One cross-sectional study in adults found that subjective arousal and psychological symptoms such as depression, interpersonal sensitivity, and paranoid thinking were correlated with cybersex.³⁶ Adolescents have to handle physical and psychological development issues such as sexual arousal and problems in academic work or relationships. These may increase the risk of online inappropriate sexual exposure if vulnerable people use the Internet to achieve positive emotional episodes

and reduce depression and anxiety. One study reported that 25% of solicited young people reported high levels of distress after such incidents.⁴ Our study suggests that the vulnerable adolescents who passively cope with stress might benefit from educational interventions on how to avoid and/or cope with online inappropriate sexual exposure and that encourage help-seeking behaviour in the same way that is used to deal with bullying.³⁷

Our study found that male gender was associated with cyber-bullying victimisation. However, in other research into cyber-bullying, gender differences have been inconsistent.^{28,29,38} Cyber-bullying is, in some respects, a form of indirect bullying (not face to face), which might be expected to appeal more to girls. However, the technological aspect of cyber-bullying might appeal more to boys. In this regard, our results suggest a need for further research in order to provide information for prevention and intervention programs. The association with depression at baseline is consistent with previous cross-sectional evidence,^{7,28} but has received little longitudinal investigation to date. Higher anxiety was associated with cyber-bullying victimisation, which, like depression, may reflect social avoidance, resulting in increased Internet exposure and likelihood of bullying through this medium.

Female gender was found to be associated with academic-purpose computer-using time, while male gender was associated with game-related computer-using time. Early popular stereotypes and research on computer attitudes described the typical people affected by Internet addiction as technologically sophisticated male loners.¹ More recently, it has been suggested that men and women use the Internet differently, and that males are more likely to meet criteria for Internet addiction than females.³⁹ It has been proposed that males, compared to females, may be more prone to problematic Internet use because they are more likely to use the application for games, cybersex, and gambling activities that are associated with compulsive or problematic use.¹⁰ Conversely, women with Internet addiction tend to seek close friendships online.⁹ Our findings are consistent with gender differences in Internet use and vulnerability to adverse exposure/experiences that need to be taken into account in future research.

Lower academic level was associated with game-related computer overuse. In Taiwan, potential risk factors for Internet addiction in adolescents have been identified to be low participation in school communities, greater substance-use experience, high family conflict, and low family function.⁴⁰ The school milieu and ethos in the current school setting might have contributed to the association between computer overuse and academic achievement. The association between game-related computer overuse and above average height is less easily explained and could represent type 1 statistical er-

ror, given the number of exposure-outcome relationships examined. However, it is possible that above average height indicates more rapid growth and more advanced pubertal stages, which may themselves influence computer use and the likelihood of an adolescent challenging their parents' regulation. This finding requires independent replication, although a similar process may account for higher game-related overuse in participants with an older sibling.⁴

Certain limitations should be considered. First, we used time spent on the computer as an index of the level of preoccupation with computer use or Internet use, without taking into account tolerance, withdrawal, or adverse consequences. Studies with case-control design, comparing problematic users with non-problematic users, generally agree that problematic users spend significantly more time on the Internet.^{9,10} We took three hours per day as a definition of problematic computer overuse. We calculated cut-offs for these aspects of use separately, so that some adolescents with combined computer overuse (e.g., academic-purpose for two hours and game-purpose for two hours) might have been missed, although this situation occurred in less than 5% of the sample. Second, the problematic Internet experiences measured were not necessarily representative of all problematic Internet experiences, and the measures used to assess cyber-bullying victimisation asked about e-mail, chat room, text message, and phone media only (not social networks, for example, which were less of a feature at the time of the study, but have clearly emerged rapidly since that time). Third, the adolescents in this study cannot be assumed to be nationally or internationally representative, and further research is required to investigate the extent to which such associations are specific to particular schools, settings or cultures.

Clinical implications

This study used longitudinal data with environmental and psychological factors being measured at age 13 years, before online sexual harassment, cyber-bullying victimisation, and computer-using time was measured at age 15 years. Some familial factors are associated with problematic Internet experiences and computer-using time, suggesting that recent approaches aimed at reducing Internet-related problems should focus education on family monitoring and supervising their adolescents. Obviously, professional advice and family Internet policies need to take into account the culture of their society and their family.

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