Prevalence, Sex Differences, and Predictors of Gaming Disorder in a Large-Scale Sample of Poor Rural Chinese Adolescents: Longitudinal Observational Study

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Abstract

Background: Gaming disorder is prevalent in the world and poses significant harm. Poor rural adolescents face unique risks due to limited supervision and unequal digital resources, with limited longitudinal research. Existing studies show sex differences in its prevalence, but their manifestations and mechanisms in rural populations remain unclear.

Objective: This study aims to determine the prevalence of gaming disorder among poor rural adolescents in China, identify sex-specific risk and protective factors, and evaluate longitudinal predictors of new-onset gaming disorder over a one-year follow-up period.

Methods: A longitudinal study was conducted among poor rural students. Questionnaires collected demographics, psychological status, and gaming symptoms. Analyses included correlation analysis, followed by multivariate logistic regression to identify baseline associated factors and predict follow-up disorder.

Results: Baseline included 13,931 valid responses (prevalence: 5.2%; males: 6.7%, females: 3.6%). A 1-year follow-up with 3,838 responses showed 5.6% prevalence (males: 7.8%, females: 3.4%). Common baseline factors: longer gaming time, lower self-esteem, higher depression, and greater impulsivity. Sex differences: companionship protected females; age and poor self-regulation posed extra risks for males. Follow-up predictors: baseline longer gaming time, lower self-esteem, and greater impulsivity. Sex differences: baseline companionship protected females; baseline poor self-regulation and disorder history predicted males.

Conclusions: Rural prevalence is lower than urban, with males higher than females. Depression, self-esteem, impulsivity, gaming duration, and caregiver companionship are key factors with sex differences: females rely more on companionship, while males are more vulnerable to poor self-regulation. Interventions should address these differences, strengthening family support and psychological adjustment.

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Keywords: Gaming Disorder; Rural Adolescents; Prevalence; Sex Differences; Longitudinal Study

INTRODUCTION

In 2019, the World Health Organization officially included Gaming Disorder in the International Classification of Diseases-11 (ICD-11), identifying its core features as a shift in gaming priority, loss of behavioral control, and impairment in social functioning. According to the latest meta-analyses, the prevalence of gaming disorder among adolescents in East Asia is approximately 6%, with a rate of about 6.4% reported in China[1,2].

To date, most research on gaming disorder has focused on urban populations. However, children and adolescents in economically underdeveloped rural areas may face unique challenges, such as limited parental supervision resources, lack of guidance on digital device use, and unequal distribution of digital resources between urban and rural areas. These environmental differences may contribute to distinct risk profiles for gaming disorder among rural youth compared to their urban counterparts[3]. Given that gaming disorder has been linked to negative outcomes including poorer sleep quality, impaired emotional regulation, decreased attention in learning, and increased risk of academic disengagement[4], systematically assessing the epidemiology and risk mechanisms of gaming disorder in rural areas holds significant public health importance. Unfortunately, existing studies targeting rural populations are mostly cross-sectional, which only allow identification of baseline associations but fall short of revealing temporal dynamics or causal relationships. This limitation greatly restricts the applicability and scalability of current intervention strategies in rural contexts.

Considerable evidence indicates sex differences in the prevalence of gaming

disorder, with males typically exhibiting higher rates than females[5,6], but the underlying mechanisms remain insufficiently understood. Historically, higher male prevalence has been partly attributed to the predominance of male-targeted game designs that emphasize stimulation and control; however, the marketplace has increasingly supplied games that attract female players, and the number of male and female gamers is now broadly comparable[7]. Crucial questions that remain unanswered include whether the sex disparity observed in prior studies persists within rural samples, whether female students with subthreshold baseline gaming problems are at elevated risk of progression over time, and whether factors such as family support and affective symptoms exert differential effects by sex. These questions warrant targeted longitudinal investigation in rural school-aged populations to clarify sex-specific pathways and inform tailored preventive interventions.

This study aims to determine the prevalence of gaming disorder among poor rural primary and middle school students in China, identify sex-specific risk and protective factors, and evaluate longitudinal predictors of new-onset gaming disorder over a one-year follow-up period. We hypothesize that: (1) the prevalence of gaming disorder in this rural school-age cohort will differ from findings in broader or urban-representative samples; (2) individuals with longer baseline gaming time, more severe depressive state, and higher impulsivity will be more likely to develop gaming disorder subsequently; (3) higher baseline self-esteem and greater caregiver or parental involvement will be associated with lower risk of gaming disorder; and (4) predictive factor patterns will differ by sex. The findings from this longitudinal study are expected to provide empirical evidence to inform precise prevention and intervention strategies for

gaming disorder in rural schools.

METHODS

Participants and procedure

From 2023 to 2024, this study was conducted in selected middle schools across 13 impoverished poor rural counties in Hunan Province, China. A census approach was used to assess all students within the schools who met the inclusion criteria. Data were collected through on-site distribution of paper questionnaires to evaluate participants' self-esteem, emotional status, and gaming disorder symptoms. One year later, in 2025, a subset of participants who completed the baseline assessment underwent a follow-up evaluation using the same procedures, with identity verification to ensure accurate data matching.

The inclusion criteria for this study were: age between 6 and 18 years; long-term residence in poor rural areas of Hunan Province; regular enrollment in rural primary or secondary schools; and voluntary participation of both the student and their primary caregiver, with signed informed consent.

Exclusion criteria included: presence of cognitive or language impairments preventing comprehension or completion of the questionnaire; temporary enrollment in rural schools for less than 6 months; refusal to participate or withdrawal during questionnaire completion for personal reasons.

Ethical Considerations

This study was conducted in accordance with the Declaration of Helsinki as set forth by the World Medical Association. Ethical approval was obtained from the Institutional Review Board of the Children's Hospital affiliated with Xiangya

School of Medicine, Central South University (KS2025-169). Prior to data collection, teachers explained the questionnaire content to participants and their primary guardians. The first section of the questionnaire included informed consent information, and participants or their guardians were free to decline participation or discontinue at any time without penalty.

Methods

A self-developed questionnaire was used to collect demographic information, including age, sex, years of education, only child, and daily time spent playing internet games. The questionnaire also assessed the quality of the relationship between the participant or their primary guardian (rated as very poor, poor, good, or very good), as well as whether the primary guardian is able to provide companionship when needed (hereinafter referred to as companionship).

The Chinese version of the Rosenberg Self-Esteem Scale was used to assess overall self-esteem. This scale consists of 10 items rated on a 4-point Likert scale, with higher scores indicating higher self-esteem. The scale demonstrated good internal consistency with a Cronbach α of 0.88[8]. Depressive mood was measured using the Patient Health Questionnaire-9 (PHQ-9), which includes 9 items rated on a 4-point Likert scale; higher total scores reflect more severe depressive mood. The PHQ-9 showed excellent reliability with a Cronbach α of 0.90[9,10]. Anxious mood was evaluated using the Generalized Anxiety Disorder-7 (GAD-7), a 7-item instrument also scored on a 4-point Likert scale, where higher scores indicate greater anxiety severity. The GAD-7 demonstrated a Cronbach α of 0.92[11]. Impulsivity was assessed by the Brief Barratt Impulsiveness Scale (BBIS), comprising 8 items rated on a 4-point Likert scale and covering two dimensions: Poor Self-Regulation and Impulsive Behavior.

Higher scores indicate greater impulsivity. The total scale's Cronbach α was 0.85, with 0.88 and 0.80 for the two subscales, respectively [12]. Internet Gaming Disorder severity was measured using the Internet Gaming Disorder Scale–Short-Form (IGDS9-SF), which contains 9 items rated on a 5-point Likert scale; higher scores indicate more severe gaming disorder symptoms. In the Chinese context, a cutoff score of 32 has been established, with scores ≥32 suggesting possible gaming disorder. The scale's Cronbach α was 0.91[13].

Quality control

Prior to assessments at each school, five professional psychiatrists provided standardized training to the teachers. The training covered the study objectives, interpretation of questionnaire items, informed consent procedures, on-site guidance protocols, and handling of abnormal situations, enabling teachers to assist psychiatrists in guiding students during questionnaire completion.

To ensure data quality, questionnaires were excluded if they met any of the following criteria: (1) Careless responding—defined as three or more scales having all valid items scored identically, or presence of repetitive response patterns (e.g.,"1234","4321","123") on any core scale; (2) Failed validity check items—questionnaires included lie-detection items requiring the response "most of the time," and deviations from this response were deemed invalid; (3) Implausible key information—age outside the 6–18 range, gaming time outside 0–24 hours, missing data for age, sex, years of education, or gaming time, or inconsistency between age and years of education; (4) More than 10% of items left unanswered.

A total of 6,452 invalid questionnaires were excluded. Data entry was performed using EpiData v3.1 (http://www.epidata.dk). To ensure accuracy, 30%

of entered questionnaires were randomly rechecked, maintaining an error rate below 1%.

Statistical analysis

Statistical analyses were conducted using SPSS v26.0 (https://www.ibm.com/products/spss-statistics). The prevalence of gaming disorder was calculated for the total sample and by sex at baseline and follow-up. The Kolmogorov-Smirnov test was used to assess normality of continuous variables. Categorical variables (e.g., only-child status, relationship with caregiver) were analyzed using chi-square tests. Normally distributed continuous variables (e.g., age, PHQ-9 scores) were compared using independent samples t-tests, while non-normally distributed variables were analyzed with rank-sum tests (Z tests). Furthermore, the False Discovery Rate (FDR) multiple testing correction method was employed to control the false positive rate of differences in variable comparisons between different sex individuals at baseline, and a post-correction P-value less than .05 was considered statistically significant. Spearman's rank correlation was employed to examine associations between gaming disorder indicators and other variables. Multivariate logistic regression was performed to identify factors associated with baseline gaming disorder and to predict follow-up gaming disorder. First, baseline gaming disorder status was set as the dependent variable, with variables showing significance in univariate analyses included as independent variables to identify associated factors. Next, follow-up gaming disorder status was the dependent variable, with baseline gaming disorder and its independent associated factors included as predictors to explore risk factors. The statistical significance level for correlation and regression was set at $P<.05$ for two-tailed tests.

RESULTS

Prevalence of gaming disorder and sex differences

At baseline, a total of 13,931 valid questionnaires were collected, and 3,838 valid follow-up questionnaires were obtained one year later. The overall prevalence of gaming disorder at baseline was 5.2% (725/13931), with males showing a significantly higher rate (489/7304, 6.7%) than females (236/6627, 3.6%)（χ^2=69.16, P<.001）. At the one-year follow-up, the overall prevalence was 5.6% (215/3838). Among those who had gaming disorder at baseline, the follow-up prevalence was 7.0% (17/226). The prevalence among males remained significantly higher (148/1892, 7.8%) compared to females (67/1946, 3.4%) （χ^2=34.80, P<.001）; however, within the female subgroup, participants with baseline gaming disorder exhibited a higher follow-up prevalence (8/89, 9.0%) than their male counterparts (9/154, 5.8%), but this difference was not significant (χ^2=0.86, P=0.36).

Sex differences in baseline demographic and clinical variables

When grouped by sex, males showed a higher proportion of only child compared to females (χ^2=71.75, $P_{after\ FDR}$<.001), a greater percentage reporting “very good” relationships with their primary guardian (Z= -4.69, $P_{after\ FDR}$<.001), and longer daily gaming time (Z= -2.83, $P_{after\ FDR}$=.008). Males also scored higher on the total IGDS9-SF scores (Z= -18.79, $P_{after\ FDR}$<.001) and self-esteem scores (t_{13929}= -9.89, $P_{after\ FDR}$<.001). Conversely, males had significantly lower scores on GAD-7 scores (Z= -13.57, $P_{after\ FDR}$<.001), PHQ-9 scores (Z= -9.27, $P_{after\ FDR}$<.001), poor self-regulation scores (t=3.81, $p_{after\ FDR}$<.001), and the total BBIS impulsivity scale (t_{13929}=2.51, $P_{after\ FDR}$=.01). No significant sex differences were observed for

age, years of education, companionship, or impulsive behavior (See Table 1).

Correlation analysis of gaming disorder indicators

Baseline gaming disorder indicators were significantly correlated with multiple factors (see Figure 1), including age, years of education, relationship with primary guardian, companionship, only child, gaming time, poor self-regulation, impulsive behavior, BBIS scores, self-esteem scores, GAD-7 scores, and PHQ-9 scores, with all correlations reaching statistical significance (P<.05). Subgroup analyses by sex revealed that all aforementioned variables remained significantly associated with gaming disorder in both males and females (P<.05). Additionally, male was positively correlated with gaming disorder in the overall sample (r=.07, P<.001).

Identification of factors associated with gaming disorder

Multivariate logistic regression models employing backward stepwise selection (Wald test) were used to identify factors associated with gaming disorder at baseline and at follow-up, as shown in Figure 2.

Baseline Gaming Disorder Identification Factors:

In the overall sample, male (OR=2.50, 95% CI=2.10–2.98, P<.001), gaming time (OR=1.11, 95% CI=1.10–1.13, P<.001), PHQ-9 scores (OR=1.12, 95% CI=1.10–1.13, P<.001), impulsive behavior (OR=1.11, 95% CI=1.00–1.15, P<.001), and self-regulation (OR=1.06, 95% CI=1.03–1.10, P<.001) were identified as risk factors. Protective factors included self-esteem scores (OR=0.95, 95% CI=0.93–0.97, P<.001) and having companionship (OR=0.74, 95% CI=0.62–0.89, P=.001).

In sex subgroup analyses, common identification factors for gaming disorder included gaming time (female: OR=1.11, 95% CI=1.08–1.14, P<.001; male:

OR=1.11, 95% *CI*=1.09–1.13, *P*<.001), self-esteem scores (female: *OR*=0.95, 95% *CI*=0.92–0.98, *P*=.002; male: *OR*=0.95, 95% *CI*=0.92–0.97, *P*<.001), PHQ-9 scores (female: *OR*=1.14, 95% *CI*=1.11–1.16, *P*<.001; male: *OR*=1.11, 95% *CI*=1.09–1.13, *P*<.001), and impulsive behavior (female: *OR*=1.16, 95% *CI*=1.10–1.22, *P*<.001; male: *OR*=1.10, 95% *CI*=1.06–1.14, *P*<.001). Differences included that companionship was a protective factor for females (*OR*=0.71, 95% *CI*=0.52–0.97, *P*=.03), whereas age (*OR*=1.08, 95% *CI*=1.02–1.15, *P*=.02) and poor self-regulation (*OR*=1.07, 95% *CI*=1.03–1.11, *P*=.001) were additional risk factors for males.

Predictors of Gaming Disorder at One-Year Follow-Up:

In the overall sample, male (*OR*=2.89, 95% *CI*=2.12–3.96, *P*<.001), baseline gaming time (*OR*=1.08, 95% *CI*=1.05–1.10, *P*<.001), baseline poor self-regulation (*OR*=1.18, 95% *CI*=1.11–1.25, *P*<.001), and baseline impulsive behavior (*OR*=1.21, 95% *CI*=1.14–1.28, *P*<.001) were risk factors. Protective factors included baseline self-esteem scores (*OR*=0.92, 95% *CI*=0.89–0.95, *P*<.001) and having companionship at baseline (*OR*=0.47, 95% *CI*=0.35–0.64, *P*<.001).

In sex subgroup analyses, common predictors included baseline gaming time (female: *OR*=1.08, 95% *CI*=1.03–1.12, *P*<.001; male: *OR*=1.08, 95% *CI*=1.05–1.11, *P*<.001), baseline self-esteem scores (female: *OR*=0.94, 95% *CI*=0.90–0.99, *P*=.02; male: *OR*=0.90, 95% *CI*=0.87–0.94, *P*=.02), and baseline impulsive behavior (female: *OR*=1.35, 95% *CI*=1.22–1.50, *P*<.001; male: *OR*=1.18, 95% *CI*=1.10–1.26, *P*<.001). Differences included that companionship at baseline was a protective predictor for females (*OR*=0.48, 95% *CI*=0.28–0.82, *P*=.007), whereas poor self-regulation at baseline (*OR*=1.23, 95% *CI*=1.14–1.32, *P*=.007)

and baseline gaming disorder history (*OR*=0.38, 95% *CI*=0.18–0.82, *P*=.01) were predictors for males.

DISCUSSION

This study represents the first large-scale longitudinal investigation in China focusing on the prevalence, influencing factors, and sex differences of gaming disorder among rural primary and secondary school students. Key findings indicate that among valid baseline samples, the overall prevalence of gaming disorder was 5.2%, with males significantly higher than females. At the one-year follow-up, based on follow-up samples, the overall prevalence was 5.6%, with males continuing to exhibit a higher rate than females. However, among females with gaming disorder at baseline, the proportion remaining with gaming disorder at follow-up was higher than that of their male counterparts. There are common cross-sex risk factors for gaming disorder at both the baseline and follow-up stages: longer gaming duration, lower self-esteem, higher depression scores, and greater impulsivity. Sex-specific differences were primarily observed in protective factors and long-term predictive effects — caregiver companionship exhibited a significant protective effect for females, whereas poor self-control at baseline was a unique long-term predictor for males. Additionally, a history of gaming disorder at baseline had a sex-specific impact on follow-up outcomes for males.

The baseline (5.2%) and one-year follow-up (5.6%) prevalence rates of gaming disorder among rural students in this study were notably lower than the 12.2% reported in urban Chinese samples[14]. This discrepancy may be attributed to limited internet infrastructure, fewer gaming devices, and

economic constraints restricting frequent gaming in rural areas. Regarding sex differences, males consistently exhibited significantly higher prevalence rates across all stages, aligning with most prior research. This pattern may reflect males’greater preference for competitive, task-oriented games and gaming motivations centered on achievement and self-affirmation[15]. Importantly, females with baseline gaming disorder showed higher rate at follow-up, suggesting that although females initially have lower prevalence, they face a greater risk of chronicity. This may be linked to a higher propensity among females for comorbid internalizing problems such as depression and anxiety[16], and a greater likelihood of using gaming as an alternative emotional regulation strategy in the absence of external support—highlighting the need for early identification and sustained intervention tailored to females.

Individual psychological characteristics demonstrated stable effects in identifying and predicting gaming disorder. Depressive symptoms were significant risk factors across sex subgroups, supporting the “emotion escape model” [17], which suggests that individuals may immerse themselves in gaming to temporarily avoid negative emotions. Impulsivity and poor self-control were significantly associated with both cross-sectional and longitudinal outcomes, consistent with the I-PACE model[18], which posits that executive function deficits undermine resistance to immediate rewards, exacerbating dependence on highly stimulating gaming environments. Moreover, self-esteem served as a cross-sex protective factor, particularly pronounced in females. Individuals with higher self-esteem may exhibit greater psychological resilience when facing peer pressure or identity challenges, reducing reliance on gaming for self-worth—corroborating the buffering effect of self-esteem in adolescent

internet addiction [19]. Thus, psychological interventions targeting emotional regulation, self-control, and self-evaluation may offer effective pathways for preventing and treating gaming disorder.

Gaming duration significantly predicted gaming disorder across sex subgroups, consistent with previous studies[20,21]. Excessive gaming not only increases exposure to virtual environments but also diminishes real-life social and emotional interactions, reinforcing immediate reward mechanisms and deepening immersion[18], thereby intensifying dependence. For males, a baseline history of gaming disorder was a unique predictor—those with prior history showed lower incidence at follow-up, possibly due to enhanced parental and school management of gaming time and behavior during recovery[22], reducing relapse risk. This underscores the importance of tailoring intervention strategies to individual history and sex differences.

Guardian companionship emerged as a significant protective factor at both baseline and follow-up, especially for females. Stable emotional support and supervision reduce adolescents' reliance on virtual worlds, consistent with family functioning research indicating that positive parent-child interactions, emotional support, and behavioral monitoring lower the risk of internet addiction[23,24]. For impoverished rural students, the importance of caregiver companionship is even more pronounced: rural left-behind children commonly experience emotional support deficits[25], and unmet emotional needs may drive compensatory gaming behaviors, where immediate feedback and a sense of belonging reinforce usage. This finding aligns with Attachment Theory, which posits that secure attachment reduces dependence on alternative emotional sources. For females, lack of companionship significantly elevates risk,

underscoring the buffering role of emotional support[26].

This study highlights significant sex differences in predictors of gaming disorder. For females, caregiver companionship was the most salient protective factor, indicating that familial emotional support and presence effectively mitigate the risk of gaming dependence when vulnerability arises. Females with access to emotional support, particularly during adversity, may better regulate negative emotions and reduce the likelihood of gaming addiction[26]. Conversely, poor self-control was a significant risk predictor for males. Due to higher extraversion and lower self-regulation, males are more prone to engage in high-stimulation, immediate-feedback gaming activities, increasing addiction risk[27]. This pattern aligns with male behavioral tendencies to regulate emotions through external stimulation (Roberts & Mroczek, 2008). The distinct pathways observed between males and females suggest that future research and intervention strategies should fully consider sex differences, avoiding one-size-fits-all approaches.

LIMITATIONS

Limitations of this study include: First, all data were self-reported, which may introduce recall bias or social desirability effects, potentially affecting objectivity; Second, to ensure project feasibility, the number of assessment scales was limited, restricting comprehensive examination of gaming disorder-related factors, including family parenting styles and school interventions; Third, only one follow-up after one year was conducted, limiting insights into the long-term dynamic changes and sustained effects of influencing factors on gaming disorder among rural students. Future research could improve by incorporating

multi-informant data (e.g., parent reports, teacher evaluations), expanding assessment dimensions, and increasing the frequency and duration of follow-ups.

CONCLUSION

This study conducted the first large-scale longitudinal survey on gaming disorder among rural primary and secondary school students in China, finding that its prevalence was lower than in urban areas, with males showing significantly higher prevalence than females. Depression, self-esteem, impulsivity, gaming duration, and caregiver accompaniment were identified as important influencing factors, with sex differences observed in both protective factors and predictive factors. Females were more reliant on the protective effect of caregiver accompaniment, while males were more susceptible to the impact of insufficient self-control. The study emphasizes that interventions should address sex differences, strengthen family support, and promote psychological adjustment. Future research should integrate multi-source data and long-term follow-up to deepen understanding of the development of gaming disorder and refine intervention strategies.

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DATA AVAILABILITY

The data sets generated and analyzed in this study are available from the

corresponding author on reasonable request.

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AUTHORSHIP CONTRIBUTION STATEMENT

CW and YL contributed equally to the study, including study concept and design, data collection, analysis, and manuscript writing/revision. YL, SL and YS performed statistical analysis and data interpretation. QH contributed to study design, data interpretation, and manuscript revision. CW, GY, XD,EH and JL were involved in data collection, analysis, and manuscript revision. QH, GY, JL and XD supervised the study, obtained funding, and provided critical manuscript revision. All authors had full access to all data and are responsible for the integrity and accuracy of the data and analysis.

CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

ABBREVIATIONS

ICD-11: International Classification of Diseases-11

FDR: False Discovery Rate

PHQ-9: Patient Health Questionnaire-9

GAD-7: Generalized Anxiety Disorder-7

BBIS: Brief Barratt Impulsiveness Scale

IGDS9-SF: Internet Gaming Disorder Scale–Short-Form

Companionship: the primary guardian is able to provide companionship when needed

REFERRENCES

1. Li L, Griffiths MD, Niu Z, Mei S. Fear of Missing Out (FoMO) and Gaming Disorder among Chinese University Students: Impulsivity and Game Time as Mediators. Issues Ment Health Nurs 2020 Dec;41(12):1104–1113. PMID:32634040

2. Liao Z, Chen X, Huang Q, Shen H. Prevalence of gaming disorder in East Asia: A comprehensive meta-analysis. J Behav Addict 2022 Sept 26;11(3):727–738. PMID:35932469

3. Lenzi M, Elgar FJ, Marino C, Canale N, Vieno A, Berchialla P, Stevens GW, Boniel-Nissim M, Van Den Eijnden RJ, Lyyra N. Can an equal world reduce problematic social media use? Evidence from the Health Behavior in School-aged Children study in 43 countries. Information, Communication & Society Taylor & Francis; 2023;26(14):2753–2774. doi: 10.1080/1369118X.2022.2109981

4. Petrescu T-C, Błachnio A, Enea V. Internet gaming disorder in children and adolescents: A systematic review of familial protective and risk factors. Addict Behav 2025 Aug;167:108345. PMID:40154103

5. Liao Z, Huang Q, Huang S, Tan L, Shao T, Fang T, Chen X, Lin S, Qi J, Cai Y, Shen H. Prevalence of Internet Gaming Disorder and Its Association With Personality Traits and Gaming Characteristics Among Chinese Adolescent Gamers. Front Psychiatry 2020;11:598585. PMID:33312143

6. Yang X, Jiang X, Mo PK-H, Cai Y, Ma L, Lau JT-F. Prevalence and Interpersonal Correlates of Internet Gaming Disorders among Chinese Adolescents. Int J Environ Res Public Health 2020 Jan 16;17(2):579. PMID:31963197

7. Aurora Big Data. May 2017 Honor of Kings Research Report. Aurora Big Data. 2017. Available from: https://www.afenxi.com/44812.html [accessed Aug 16, 2025]

8. Shen Z-L, Cai T-S. Disposal to the 8th item of Rosenberg Self-Esteem Scale (Chinese version). Chinese Mental Health Journal Chinese Mental Health; 2008; doi: 10.3321/j.issn:1000-6729.2008.09.009

9. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. Journal of general internal medicine Wiley Online Library; 2001;16(9):606–613. doi: 10.1046/j.1525-1497.2001.016009606.x

10. Zhang Y-L, Liang W, Chen Z-M, Zhang H-M, Zhang J-H, Weng X-Q, Yang S-C, Zhang L, Shen L-J, Zhang Y-L. Validity and reliability of Patient Health Questionnaire-9 and Patient Health Questionnaire-2 to screen for depression among college students in China. Asia Pac Psychiatry 2013 Dec;5(4):268–275. PMID:24123859

11. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. Archives of internal medicine American Medical Association; 2006;166(10):1092–1097. doi: 10.1001/archinte.166.10.1092

12. Steinberg L, Sharp C, Stanford MS, Tharp AT. New tricks for an old measure: the development of the Barratt Impulsiveness Scale-Brief (BIS-Brief). Psychol Assess 2013 Mar;25(1):216–226. PMID:23148649

13. Qin L, Cheng L, Hu M, Liu Q, Tong J, Hao W, Luo T, Liao Y. Clarification of the Cut-off Score for Nine-Item Internet Gaming Disorder Scale-Short Form (IGDS9-SF) in a Chinese Context. Front Psychiatry 2020;11:470. PMID:32528331

14. Wang H, Zhou X, Lu C, Wu J, Deng X, Hong L. Problematic Internet Use in high school students in Guangdong Province, China. PLoS One 2011 May 6;6(5):e19660. PMID:21573073

15. Mihara S, Higuchi S. Cross-sectional and longitudinal epidemiological studies of Internet gaming disorder: A systematic review of the literature. Psychiatry Clin Neurosci 2017 July;71(7):425–444. PMID:28436212

16. Rose AJ, Rudolph KD. A review of sex differences in peer relationship processes: potential trade-offs for the emotional and behavioral development of girls and boys. Psychol Bull 2006 Jan;132(1):98–131. PMID:16435959

17. Kardefelt-Winther D. A conceptual and methodological critique of internet addiction research: Towards a model of compensatory internet use. Computers in human behavior Elsevier; 2014;31:351–354. doi: 10.1016/j.chb.2013.10.059

18. Brand M, Wegmann E, Stark R, Müller A, Wölfling K, Robbins TW, Potenza MN. The Interaction of Person-Affect-Cognition-Execution (I-PACE) model for addictive behaviors: Update, generalization to addictive behaviors beyond internet-use disorders, and specification of the process character of addictive behaviors. Neurosci Biobehav Rev 2019 Sept;104:1–10. PMID:31247240

19. Kim H-K, Davis KE. Toward a comprehensive theory of problematic Internet

use: Evaluating the role of self-esteem, anxiety, flow, and the self-rated importance of Internet activities. Computers in Human Behavior Elsevier; 2009;25(2):490–500. doi: 10.1016/j.chb.2008.11.001

20. Kuss DJ, Griffiths MD, Karila L, Billieux J. Internet addiction: a systematic review of epidemiological research for the last decade. Curr Pharm Des 2014;20(25):4026–4052. PMID:24001297

21. Lemmens JS, Valkenburg PM, Gentile DA. The Internet Gaming Disorder Scale. Psychol Assess 2015 June;27(2):567–582. PMID:25558970

22. Przybylski AK, Weinstein N. Digital Screen Time Limits and Young Children's Psychological Well-Being: Evidence From a Population-Based Study. Child Dev 2019 Jan;90(1):e56–e65. PMID:29235663

23. Ko C-H, Wang P-W, Liu T-L, Yen C-F, Chen C-S, Yen J-Y. Bidirectional associations between family factors and Internet addiction among adolescents in a prospective investigation. Psychiatry Clin Neurosci 2015 Apr;69(4):192–200. PMID:24836367

24. Shek DTL, Zhu X, Ma CMS. The Influence of Parental Control and Parent-Child Relational Qualities on Adolescent Internet Addiction: A 3-Year Longitudinal Study in Hong Kong. Front Psychol 2018;9:642. PMID:29765349

25. Fan F, Su L, Gill MK, Birmaher B. Emotional and behavioral problems of Chinese left-behind children: a preliminary study. Social psychiatry and psychiatric epidemiology Springer; 2010;45(6):655–664. doi: 10.1007/s00127-009-0107-4

26. Mikulincer M, Shaver PR. Attachment in adulthood: Structure, dynamics, and change. Guilford Publications; 2010. ISBN:1-60623-610-5

27. Anderson EL, Steen E, Stavropoulos V. Internet use and problematic internet use: A systematic review of longitudinal research trends in adolescence and emergent adulthood. International Journal of adolescence and youth Taylor & Francis; 2017;22(4):430–454. doi: 10.1080/02673843.2016.1227716

Table 1 legends here.

Table 1 Sex Differences in Baseline Demographic and Clinical Variables

Variables		Female (n=6627) mean SD/n(%)	Male (n=7304) mean SD/n(%)	$t/\chi^2/Z$	$p_{after\ FDR}$ value
Age		12.11 1.57	12.12 1.57	-0.26	0.85
Years of education		6.33 1.58	6.28 1.58	1.86	.08
Only-child	No	5525(83.4%)	5677(77.7%)	71.7	<.001
	Yes	1101(16.6%)	1627(22.3%)		
Relationship with primary guardian	Very poor	25(0.4%)	43(0.6%)	-4.69	<.001
	Poor	92(1.4%)	93(1.3%)		
	Good	1709(25.8%)	1615(22.1%)		
	Very good	4801(72.4%)	5553(76.0%)		
Companionship	No	1137(17.2%)	1286(17.6%)	0.49	0.54
	Yes	5490(82.8%)	6018(82.4%)		
Daily gaming time		2.60 3.55	2.83 3.77	-2.83	.008
Self-esteem scores		28.15 4.91	28.96 4.75	-9.89	<.001
GAD-7 scores		4.86 4.48	4.04 4.39	-13.5	<.001

PHQ-9 scores	5.37 5.43	4.66 5.16	7 -9.27	<.001
IGDS9-SFscores	14.51 6.91	16.70 7.97	- 18.7 9	<.001
Poor self-regulation	9.17 2.65	9.00 2.84	3.81	<.001
Impulsive behavior	8.20 2.51	8.20 2.66	.03	0.98
BBIS scores	17.37 4.13	17.19 4.26	2.51	.01

Note: PHQ-9: Patient Health Questionnaire-9; GAD-7: Generalized Anxiety Disorder-7; BBIS: Brief Barratt Impulsiveness Scale; IGDS9-SF: Internet Gaming Disorder Scale–Short-Form; Companionship: the primary guardian is able to provide companionship when needed

Figure 1 legends here!

Figure 1 The variables associated with gaming disorder in the baseline overall sample (A), as well as in males and females (B).

Note: PHQ-9: Patient Health Questionnaire-9 scores; GAD-7: Generalized Anxiety Disorder-7 scores; BBIS: Brief Barratt Impulsiveness Scale scores; Companionship: the primary guardian is able to provide companionship when needed; Not Sig.: Not significant; F: female; M: male

Figure 2 legends here!

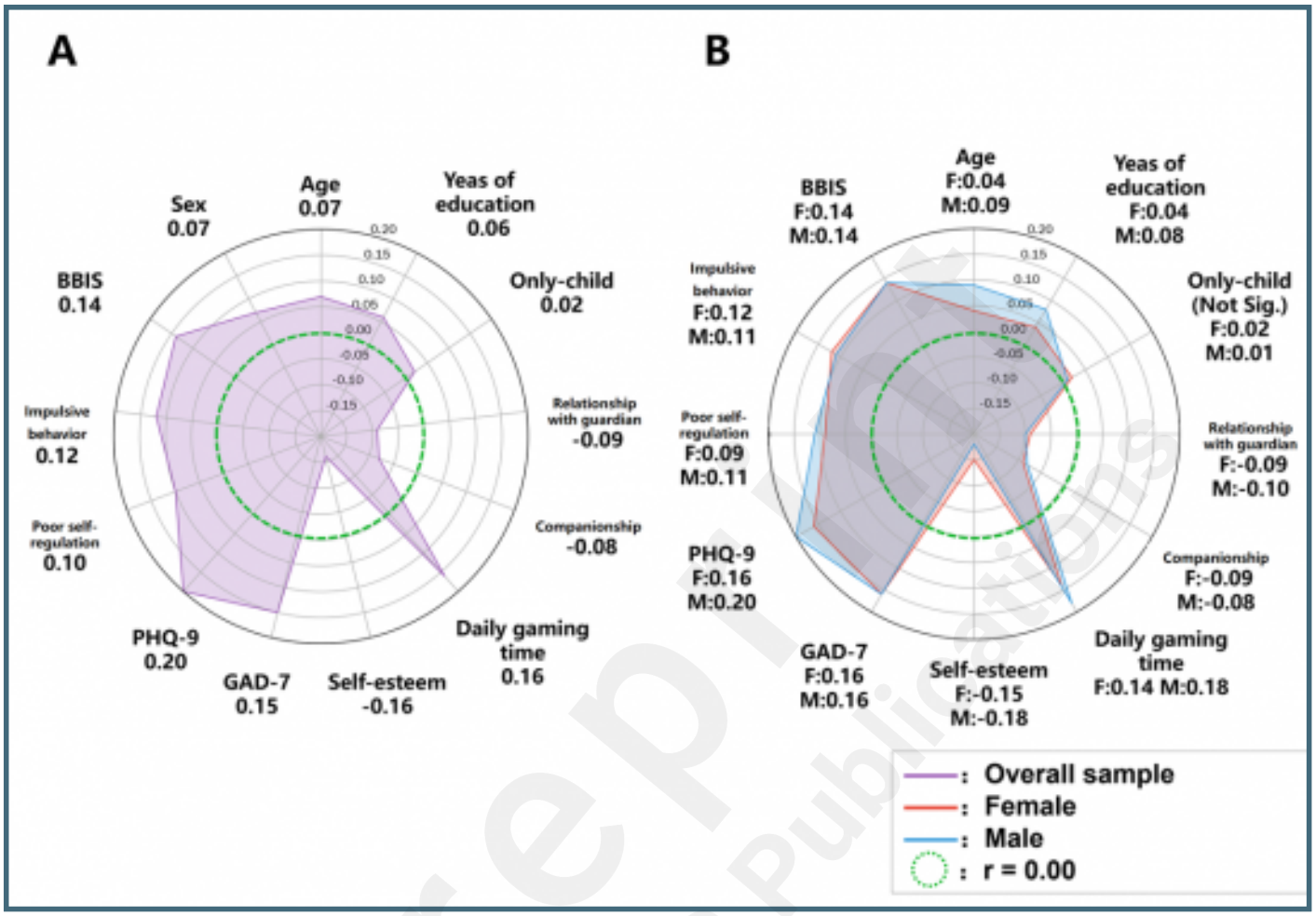
Figure 2 OR for identifying factors of gaming disorder at baseline (A) and OR for predicting factors of gaming disorder at follow-up (B)

Note: PHQ-9: Patient Health Questionnaire-9 scores; Companionship: the primary guardian is able to provide companionship when needed; OR: Odds Ratio

Supplementary Files

Figures

The variables associated with gaming disorder in the baseline overall sample (A), as well as in males and females (B).



OR for identifying factors of gaming disorder at baseline (A) and OR for predicting factors of gaming disorder at follow-up (B).