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# Gaming disorder with attention-deficit/hyperactivity disorder and social anxiety disorder comorbidities

## A cross-sectional analysis of differences

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**Abstract**

Problematic gaming is common among adolescents in clinical practice. We aimed to investigate the differences in motivational and psychological factors linked to gaming disorder (GD) with either comorbid attention-deficit/hyperactivity disorder (ADHD) or social anxiety disorder (SAD). We evaluated 90 adolescents for clinical diagnosis of GD according to ICD-11 definition, and for ADHD and SAD using a semi-structured diagnostic interview. The clinician scored the GD symptom measure according to symptoms defined in the ICD-11. Adolescent self-report on problematic gaming was also obtained by using Internet GD Scale-9 item shot form (IGDS-9-SF). Additionally, we used validated instruments to investigate motivational and psychological correlates, including motivations to play online games questionnaire-12 (MPOGQ-12), Barratt impulsivity scale-11-short form (BIS-11-SF), regulation of emotions questionnaire, Rosenberg self-esteem scale (RSE), self-efficacy questionnaire for children (SEQ-C), and social support appraisals scale. GD with comorbid ADHD was significantly positively correlated with achievement ($r = 0.26$, $P = .01$) and immersion ($r = 0.25$, $P = .02$) on MPOGQ, and total impulsivity score ($r = 0.28$, $P = .01$) on BIS-11-SF. Moreover, GD with comorbid ADHD was significantly negatively correlated with internal functional emotion regulation score on regulation of emotions questionnaire ($r = –0.26$, $P = .01$). On the other hand, GD with comorbid SAD was significantly positively correlated with immersion ($r = 0.25$, $P = .02$) on MPOGQ, and significantly negatively correlated with total self-esteem score ($r = –0.24$, $P = .02$) on RSE scale; academic self-efficacy ($r = –0.23$, $P = .03$), social self-efficacy ($r = –0.29$, $P = .01$) and emotional self-efficacy ($r = –0.23$, $P = .03$) scores on SEQ-C; and parent support score ($r = –0.25$, $P = .02$) on social support appraisals scale. Our findings exhibit motivational and psychological differences between ADHD and SAD comorbidities of GD among adolescents. Further studies are needed to explore distinct profiles.

**Abbreviations:** ADHD = attention-deficit/hyperactivity disorder, BIS-11-SF = Barratt impulsivity scale-11-short form, DSM-5 = diagnostic and statistical manual of mental disorders-5th edition, ER = emotion regulation, GD = gaming disorder, ICD-11 = International classifications of diseases-11th revision, IGDS-9-SF = internet gaming disorder scale-9-short form, MPOGQ-12 = motivations to play online games questionnaire-12, REQ = regulation of emotions questionnaire, RSE = Rosenberg self-esteem scale, SAD = social anxiety disorder, SEQ-C = self-efficacy questionnaire for children, SSAS = social support appraisals scale.

**Keywords:** attention-deficit/hyperactivity disorder, gaming disorder, gaming motivation, psychological correlates, social anxiety disorder

### 1. Introduction

Problematic gaming has been increasingly prevalent among adolescents in clinical settings. Gaming disorder (GD) is defined as a recurrent manifestation of gaming behaviors, including a diminished capacity for self-control regarding gaming, prioritization of gaming over other interests and activities, and persistence or intensification of gaming

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*The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2013. All procedures involving human subjects/patients were approved by the Clinical Research Ethical Board of the Gazi University with approval number 21.09.2020/622.*

*Written informed consent for participation in the study and anonymous publication of study findings were obtained from all participants and accompanying parents.*

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activities despite facing adverse consequences, resulting in distress and/or functional impairment.[1] Theoretical frameworks elucidate the intricate interplay of individual, game-specific, and contextual factors contributing to problematic gaming behaviors.[2,3] Clinical observations and expert opinions suggest that unique developmental processes are implicated among problematic gamers with various psychiatric disorders.[4,5] Externalizing and internalizing pathways may both result in GD among adolescents.[4] To establish a foundation for a psychopathology-informed perspective, it may be helpful to investigate the motivational and psychological correlates of GD within the context of psychiatric comorbidities in the clinical setting. This study aims to assess the motivations and psychological correlates associated with GD in conjunction with 2 prevalent comorbidities (i.e., attention-deficit/hyperactivity disorder and social anxiety disorder [SAD]) in a sample of treatment-seeking adolescent gamers while also examining potential differences.

## 2. Methods

### 2.1. Participants and procedure

In this cross-sectional observational study, we included adolescent gamers who applied to child and adolescent psychiatry outpatient clinics and complained about gaming habits. Based on clinical evaluation and patient history, adolescents with conditions that can disrupt data collection via self-reporting – such as intellectual disability, manic episodes, or psychotic exacerbations – were excluded. The study procedure was discussed entirely with potential participants. Before inclusion, written informed consent was obtained from all participants and accompanying parents regarding participation in the study and publication of study findings anonymously. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2013. All procedures involving human subjects/patients were approved and monitored by the Clinical Research Ethical Board of Gazi University with approval number 21.09.2020/622.

We recruited 90 adolescent participants by consecutive sampling. All of the assessments were conducted through individual clinical sessions with face-to-face interviews. The clinician evaluated the socioeconomic status according to Hollingshead four factor index of social status,[6] GD symptoms and diagnosis according to the ICD-11 definition of GD,[1] and diagnosis of ADHD and SAD according to DSM-5 criteria using Kiddie schedule for affective disorders and schizophrenia-present form.[7] Moreover, we obtained clinician-supervised adolescent self-report-based assessments to evaluate problem gaming severity, motivations, impulsivity, emotion regulation (ER), self-esteem, self-efficacy, and social support, which we describe further.

### 2.2. Measurements

*GD symptoms measure:* The GD symptoms measure consisted of 4 ICD-11 diagnostic requirements for GD.[1] According to clinical interviews with adolescents and accompanying parents, the clinician scored each symptom 0 for no and 1 for yes. The total score ranged between 0 and 4, and higher total scores reflect greater severity of GD symptoms. Adolescents who met all diagnostic requirements and scored 4 were diagnosed with GD.

*Problem gaming severity:* The internet GD scale-short form-9 (IGDS-SF-9), which includes 9 items about the frequency of suggested Internet GD symptoms in DSM-5, was used to assess problem gaming severity.[8] Although we diagnosed GD based on the ICD-11 definition, we used this well-validated and widely used measurement tool to assess the severity of problem gaming in our sample.[9] Total scores range between 9 and 45, and higher scores reflect greater severity of problem gaming.

*Gaming motivation:* Motivations to play online games questionnaire-12 items short form (MPOGQ-12) was used to evaluate gaming motivation in 3 domains: social (e.g., interacting with other players), immersion (e.g., escapism through game narratives), and achievement (e.g., striving for in-game success and advancements). Scores range between 4 and 20 for each dimension; higher scores indicate stronger motivation. The development and adaptation studies have shown the validity and reliability of this tool.[10,11]

*Other measurements:* Barratt impulsivity scale-11-short form (BIS-11-SF) was used to assess impulsivity, in which higher total impulsivity scores reflect higher trait impulsivity in that individual.[12,13] Regulation of emotions questionnaire assesses ER across 4 dimensions, including internal functional (IF), internal dysfunctional, external functional, and external dysfunctional. Higher scores indicate the individual's more frequent use of that regulation strategy.[14,15] Rosenberg self-esteem scale (RSE) was used to measure global self-esteem, in which higher scores indicate a better sense of self-esteem for the individual.[16,17] Self-efficacy questionnaire for children (SEQ-C) was used to evaluate the adolescents' academic, social, and emotional self-efficacy. Higher scores indicate better self-efficacy in that domain.[18,19] Social support appraisals scale assesses perceived social support from 2 sources: parent support and friend support, in which higher scores indicate perceived better support from that source.[20,21]

### 2.3. Analysis

IBM SPSS Statistics version 22.0 (Chicago) was used for data analysis. Descriptive statistics for categorical variables are presented as frequencies (N) and percentages (%), while continuous variables are summarized as means, standard deviations, medians, and ranges. The normality of numerical variables was assessed using the Shapiro–Wilk test and histogram examination. Spearman correlation was applied to determine associations between variables due to non-normal distributions. Statistical significance was set at a $P$-value of <.05.

## 3. Results

### 3.1. Descriptive findings of the study sample

Table 1 presents the characteristics of the study sample and a descriptive analysis of the scale measurements. Ninety adolescents (78 males and 12 females) with a mean age of 14.56 (minimum–maximum: 11.29–17.26) were included in the study. All of the participants completed assessments and no missing data was found to deal with. When we evaluated the 3 core symptoms of GD, %52 (N = 47) of the adolescents had impaired control over gaming (e.g., onset, frequency, intensity, duration, termination, context), %43.3 (N = 39) had increasing priority given to gaming to the extent that other interests and activities are neglected, %36.7 had continuation or escalation of gaming despite facing negative consequences. In terms of requirements of GD diagnosis according to ICD-11, %22.2 (N = 20) of the adolescents exhibited all 3 core symptoms. In the end, 19 adolescents (21.1% of the total sample) who also met the criteria of significant functional impairment were diagnosed with GD. GD with comorbid ADHD and *GD with comorbid SAD* were found in 11 (12.2% of the total sample) and 4 (4.4% of the total sample) of these adolescents, while 4 adolescents (4.4% of the total sample) had GD without comorbidity. Moreover, *ADHD without comorbid GD* was detected in %53.3 (N = 48), and *SAD without comorbid GD* in %8.9 (N = 8) of the total sample, while 14.4% (N = 13) of the adolescents got no diagnosis (see Table 2).

**Table 1**

**Characteristics of the study sample and descriptive analysis of scale measurements (N = 90).**

| | Mean | Standard deviation | Median | Minimum–maximum |
|---|---|---|---|---|
| Age | 14.57 | 1.389 | 14.47 | 11.29–17.26 |
| School grade | 9.04 | 1.348 | 9.00 | 6.00–12.00 |
| SES of the family | 28.30 | 15.039 | 23.75 | 3.00–64.50 |
| GD symptoms measure | 1.84 | 1.490 | 2.00 | .00–4.00 |
| IGDS-SF-9 total score | 25.50 | 8.137 | 24.00 | 11.00–42.00 |
| MPOGQ-12 Social | 11.78 | 4.016 | 12.00 | 4.00–20.00 |
| MPOGQ-12 immersion | 10.84 | 4.292 | 10.00 | 4.00–20.00 |
| MPOGQ achievement | 13.49 | 4.257 | 14.00 | 4.00–20.00 |
| BIS-11-SF total impulsivity | 34.56 | 7.534 | 34.00 | 17.00–59.00 |
| REQ internal functional ER | 13.38 | 3.543 | 14.00 | 4.00–20.00 |
| REQ internal dysfunctional ER | 14.23 | 4.839 | 14.00 | 6.00–25.00 |
| REQ external functional ER | 10.08 | 3.586 | 10.00 | 4.00–20.00 |
| REQ external dysfunctional ER | 11.72 | 4.424 | 11.00 | 5.00–24.00 |
| RSE global self-esteem | 26.32 | 7.063 | 26.00 | 11.00–40.00 |
| SEQ-C academic self-efficacy | 18.46 | 5.236 | 18.00 | 9.00–31.00 |
| SEQ-C social self-efficacy | 22.17 | 5.997 | 23.00 | 8.00–33.00 |
| SEQ-C emotional self-efficacy | 18.04 | 5.745 | 17.00 | 7.00–35.00 |
| SSAS friend support | 69.88 | 13.803 | 71.00 | 23.00–93.00 |
| SSAS parent support | 45.06 | 10.382 | 47.50 | 15.00–60.00 |

ADHD = attention-deficit/hyperactivity disorder, BIS-11-SF = Barratt impulsivity scale-11-short form, ER = emotion regulation, GD = gaming disorder, IGDS-SF-9 = Internet gaming disorder scale-short form-9, MPOGQ-12 = motivations to play online games questionnaire-12 items short form, REQ = regulation of emotions questionnaire, RSE = Rosenberg self-esteem scale, SAD = social anxiety disorder, SEQ-C = self-efficacy scale for children, SES = socioeconomic status of the family, SSAS = social support appraisals scale.

**Table 2**

**Diagnoses of gaming disorder and psychiatric disorders in the study sample (N = 90).**

| | N (%) |
|---|---|
| Gaming disorder | 19 (21.1) |
| Gaming disorder with comorbid attention-deficit/hyperactivity disorder | 11 (12.2) |
| Gaming disorder with comorbid social anxiety disorder | 4 (4.4) |
| Gaming disorder without comorbidity | 4 (4.4) |
| Attention-deficit/hyperactivity disorder without comorbid gaming disorder | 48 (53.3) |
| Social anxiety disorder without comorbid gaming disorder | 8 (8.9) |
| None | 13 (14.4) |

### *3.2. Correlates of GD with comorbid ADHD and GD with comorbid SAD*

Next, we examined the correlates of *GD with comorbid ADHD* and *GD with comorbid SAD,* comparing to the correlates of getting no diagnosis, GD without comorbidity, ADHD without GD, and SAD without GD (see Table 3). On the GD symptoms measure, significant positive correlations were found for GD without comorbidity, *GD with comorbid ADHD*, and *GD with comorbid SAD* ($r = 0.30$, $P < .01$; $R = 52$, $P < .01$; and $R = 30$, $P < .01$, respectively). When the severity of problem gaming was evaluated, both GD with comorbid ADHD and GD with comorbid SAD were positively correlated with IGDS-SF-9 total scores significantly ($r = 0.47$, $P < .01$ and $r = 0.27$, $P = .01$, respectively). In contrast, GD without comorbidity was not associated with IGDS-SF-9 total scores ($P > .05$). Lastly, getting no diagnosis was associated with lower scores on the GD symptoms measure and IGDS-SF-9 total scores ($r = –0.31$, $P < .01$ and $r = –0.32$, $P < .01$, respectively).

In terms of gaming motivation, both *GD with comorbid ADHD* and *GD with comorbid SAD* showed significantly higher immersion motivation ($r = 0.25$, $P = .02$; and $r = 0.25$, $P = .02$, respectively), while this was not the case for GD without comorbidity, ADHD without GD and SAD without GD. Moreover, significantly higher achievement motivation was found only for *GD with comorbid ADHD* ($r = 0.26$, $P = .01$). Interestingly, GD without comorbidity did not have significant correlations with any of the 3 gaming motivation types ($P > .05$ for all) and getting no diagnosis was associated with significantly lower social motivation in our sample ($r = –0.24$, $P = .02$).

When we evaluated the psychological correlates, *GD with comorbid ADHD* was related to significantly higher total impulsivity and lower IF ER ($r = 0.28$, $P = .01$; and $r = –0.26$, $P = .01$, respectively). Such relationships seem unique for this condition as they did not emerge for GD without comorbidity, *ADHD without GD,* and *GD with comorbid SAD*. On the other hand, *GD with comorbid SAD* was related to significantly lower global self-esteem; academic, social, and emotional self-efficacy; and parent support ($r = –0.24$, $P = .02$; $r = –0.23$, $P = .03$; $r = –0.29$, $P = .01$; $r = –0.23$, $P = .03$; and $r = –0.25$, $P = .02$, respectively). Such relationships did not emerge for *GD without comorbidity*, *SAD without GD,* and *GD with comorbid ADHD*.

## 4. Discussion

In this cross-sectional study, we explored the motivations and psychological characteristics associated with *GD with comorbid ADHD* and *GD with comorbid SAD* in a clinical sample of adolescents. Our findings suggest that ADHD and SAD comorbidities have distinct motivational and psychological profiles. *GD with comorbid ADHD* was associated with achievement and immersion motivations, impulsivity, and difficulties in ER. In contrast, *GD with comorbid SAD* was linked to only immersion motivation, low self-esteem, and less perceived family support.

The manifestations of GD have previously been associated with both motivational constructs of achievement and immersion.[22–24] Drawing upon the push–pull-mooring theory, it is posited that the achievement motivation exhibited by gamers may be interpreted as a pull effect stemming from in-game rewards and accomplishments.[25] Conversely, motivations related to immersion appear to exert a push effect that diverts individuals from real-world frustrations.[25] Moreover, it was reported that need satisfaction in gaming and daily need frustrations contribute to problematic gaming behaviors based on the self-determination theory.[26] By integrating these theoretical frameworks with our empirical findings, we propose that adolescents experiencing *GD with comorbid ADHD* may derive a sense of competence through achievements attained via competition with other gamers and the enhancement of gaming skills, thereby addressing a fundamental psychological requirement through the "pull effect" of gaming.[25,27] The pull effect of in-game success and rewards may overcome the self-control of adolescents who have *GD with comorbid ADHD* due to high impulsivity, proposed as the principal element in the comorbidity observed between GD and ADHD in previous research.[28]

Furthermore, daily need frustrations may serve to exacerbate maladaptive gaming behaviors through the mechanism known as "the push effect," which elucidates the heightened immersion motivations observed in both *GD with comorbid ADHD* and *GD with comorbid SAD* within our investigation.[25,26] While we did not directly measure the daily need frustration, it must be taken into account to comprehend problem gaming among adolescents with ADHD and SAD. Both of these conditions are associated with functional impairments across diverse domains as delineated by the DSM-5-TR criteria, rendering individuals affected by these disorders more vulnerable to encountering heightened instances of daily need frustrations.[29] It is reasonable to posit that frequent frustration of the psychological needs (i.e., competence, relatedness, and autonomy) may create a predisposition to and maintenance of problem gaming, especially when other factors (e.g., problems with self-control, regulating emotions functionally, self-esteem, self-efficacy in social,

**Table 3**

**Correlates of gaming disorder and psychiatric comorbidities in the study sample (N = 90).**

| | None | | GD without comorbidity | | GD with ADHD | | ADHD without GD | | GD with SAD | | SAD without GD | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *r* | *P* | *r* | *P* | *r* | *P* | *r* | *P* | *r* | *P* | *r* | *P* |
| GD symptoms measure | **–0.31** | **.00** | **0.30** | **.00** | **0.52** | **.00** | **–0.27** | **.01** | **0.30** | **.00** | 0.10 | .36 |
| IGDS-SF-9 total score | **–0.32** | **.00** | 0.17 | .11 | **0.47** | **.00** | –0.14 | .18 | **0.27** | **.01** | 0.16 | .12 |
| MPOGQ-12 Social | **–0.24** | **.02** | 0.03 | .76 | 0.18 | .09 | –0.01 | .95 | 0.18 | .10 | 0.06 | .58 |
| MPOGQ-12 Immersion | –0.04 | .73 | –0.02 | .84 | **0.25** | **.02** | –0.20 | .06 | **0.25** | **.02** | 0.20 | .06 |
| MPOGQ Achievement | –0.11 | .32 | 0.14 | .18 | **0.26** | **.01** | –0.16 | .12 | 0.15 | .17 | 0.09 | .42 |
| BIS-11-SF total impulsivity | **–0.23** | **.03** | 0.09 | .43 | **0.28** | **.01** | –0.04 | .72 | 0.06 | .58 | 0.13 | .24 |
| REQ internal functional ER | 0.07 | .54 | –0.12 | .26 | **–0.26** | **.01** | 0.12 | .26 | –0.07 | .53 | –0.08 | .45 |
| REQ internal dysfunctional ER | –0.19 | .07 | –0.03 | .76 | –0.03 | .76 | –0.01 | .90 | 0.09 | .40 | **0.39** | **.00** |
| REQ external functional ER | 0.04 | .74 | –0.14 | .19 | –0.02 | .88 | 0.05 | .61 | –0.05 | .63 | 0.17 | .12 |
| REQ external dysfunctional ER | –0.11 | .32 | 0.07 | .51 | 0.04 | .71 | –0.01 | .89 | –0.11 | .33 | **0.21** | **.05** |
| RSE global self-esteem | –0.12 | .28 | –0.05 | .63 | –0.11 | .30 | **0.27** | **.01** | **–0.24** | **.02** | –0.15 | .16 |
| SEQ-C academic self-efficacy | 0.17 | .12 | –0.17 | .10 | –0.09 | .39 | 0.02 | .87 | **–0.23** | **.03** | 0.02 | .86 |
| SEQ-C social self-efficacy | 0.05 | .66 | –0.15 | .32 | –0.05 | .67 | **0.22** | **.04** | **–0.29** | **.01** | –0.04 | .70 |
| SEQ-C emotional self-efficacy | –0.03 | .76 | –0.11 | .32 | **–0.14** | .20 | **0.24** | **.02** | **–0.23** | **.03** | –0.16 | .14 |
| SSAS friend support | 0.11 | .32 | –0.07 | .50 | 0.01 | .94 | 0.07 | .53 | –0.19 | .07 | –0.13 | .22 |
| SSAS parent support | 0.15 | .16 | 0.19 | .07 | –0.06 | .59 | –0.09 | .38 | **–0.25** | **.02** | –0.06 | .57 |

Spearman correlation analysis is used for statistical evaluation.

Statistically significant results and *P* values are shown in bold color.

ADHD = attention-deficit/hyperactivity disorder, BIS-11-SF = Barratt impulsivity scale-11-short form, ER = emotion regulation, GD = gaming disorder, IGDS-SF-9 = internet gaming disorder scale-short form-9, MPOGQ-12 = motivations to play online games questionnaire-12 items short form, REQ = regulation of emotions questionnaire, RSE = Rosenberg self-esteem scale, SAD = social anxiety disorder, SEQ-C = self-efficacy scale for children, SSAS = social support appraisals scale.

academic, and emotional areas, perceived social support) are concurrently present.

Emotional dysregulation, an associated clinical feature of ADHD, is also linked with an elevated risk of problematic gaming behaviors among children and adolescents.[30–32] Adolescents with ADHD may demonstrate negative urgency (i.e., emotional impulsivity), leading to impulsive gaming-related decisions during negative affective states and when maladaptive cognitions are activated.[28,33–36] Furthermore, a previous case report defined an externalizing pathway of problematic gaming in an adolescent patient, in which both impulsivity and emotional dysregulation contributed to problem gaming through a developmental cascade pattern.[4] It is noteworthy that IF ER strategies, which encompass reevaluation of problems, reappraisal of thoughts, goals, and plans, and focusing on alternative solutions, were previously found to have a protective effect against problem gaming.[32] In conjunction with previous reports, our findings support that adolescents who have *GD with comorbid ADHD* may be immersed in the gaming world to manage their difficult emotions due to a diminished utilization of IF ER. Hyperfocus, a prolonged state of attention, particularly during enjoyable activities, may contribute to excessive immersive gaming experiences in GD-ADHD comorbidity.[37]

Interestingly, *GD with comorbid SAD* did not exhibit an association with elevated levels of social motivation. Social motivation in gaming is considered more adaptive for adolescents and is typically linked to healthier gaming behaviors in general, although contradictory reports exist.[23] However, socializing through gaming may become maladaptive if there is a consistent preference for online social interactions rather than real-world social relationships. In such cases, individuals primarily motivated by social factors are prone to develop maladaptive beliefs, such as believing that successful social interactions are possible solely in gaming environments and/or lacking social self-efficacy in real-life situations.[38] Collectively, our results are consistent with prior research that indicates socially anxious adolescents utilize gaming as a means of evading negative emotions through immersion rather than as a replacement for feelings of loneliness and socializing.[38]

GD has been linked to diminished self-esteem across various cultures and age demographics in prior research.[39] Our results indicate that self-esteem deficits represent a prominent psychological trait associated with *GD with comorbid SAD*. In conjunction with the higher immersion, this observation implies that adolescents with SAD may seek to address unfulfilled self-esteem needs through gaming, which may be associated with increased vulnerability for GD according to the self-esteem maintenance model of GD.[40–42] Specifically, immersion in gaming may provide temporary relief for self-esteem issues in gamers with SAD, though avoidance can worsen social anxiety and problem gaming by limiting real-life learning experiences.[43,44] Thus, distinguishing between adaptive and maladaptive need satisfaction in gaming seems critical for clinicians. Furthermore, as demonstrated by the negative relationship between *GD with comorbid SAD* and perceived lower parent support within our investigation, the quality of the parent-child relationship seems vital for adolescents with this condition.[44] The tendency to immerse in excessive gaming sessions may amplify disengagement from the familial milieu and exacerbate maladaptive gaming behaviors among adolescents with SAD when social support from parental figures is perceived as low.

Several clinical implications can be mentioned in light of our research. First, healthcare professionals must acknowledge that although need satisfaction within gaming can be harmless to most gamers, it may turn detrimental when it overshadows the satisfaction of needs in real-life activities and interactions.[45] Second, distinctions between the 2 comorbidities may influence the treatment approach. For *GD with comorbid ADHD*, providing satisfaction of competence needs through activities enjoyed by the adolescent in real life may be more adaptive compared to in-game achievements. Moreover, patients may benefit from psychopharmacological treatment for impulsivity and psychotherapy for enhancing emotional awareness and more functional ER. For *GD with comorbid SAD*, treatment should aim to help problems related to self-esteem and self-efficacy. In addition, perceived parent support may be increased in therapy with parents on parent-child relationships. For both conditions, functional impairment due to the symptoms of the disorder (i.e., ADHD, SAD) may be helpful in the treatment of GD.

This study provides valuable insights into GD with different comorbidities, with a critical strength of using face-to-face clinical interviews with adolescents and their parents, enhancing

the reliability of the data collected. However, the cross-sectional design limits our ability to draw causal conclusions about the relationships between the variables. Future research should use longitudinal studies to explore how these relationships evolve and identify potential causative pathways. Moreover, our sample was small and exclusively composed of treatment-seeking adolescents, which may limit the generalizability of our findings to a broader adolescent population. Future studies should include more extensive and diverse samples to confirm and expand these findings. Although we applied a variety of measurements related to psychological characteristics, we had limited consideration of other potential confounders, including socioeconomic status, parental monitoring, and peer influences. These confounding factors should be considered in future studies. In addition, we evaluated the psychological characteristics based on adolescent self-reported measures, which are subject to response bias. Future studies may incorporate more objective measures, such as parent and teacher reports.

In conclusion, our findings emphasize the requirement for understanding how different motivational and psychological features may interact to shape GD with comorbid ADHD and GD with comorbid SAD. In terms of gaming motivations, GD with comorbid ADHD is characterized by higher achievement and immersion, while GD with comorbid SAD is related to only immersion. Psychological profiles seem distinct as well, including higher impulsivity and ER problems for GD with comorbid ADHD, while problems related to self-esteem, self-efficacy, and social support for GD with comorbid SAD. This study provides important preliminary insights into the motivational and psychological factors differentiating GD with ADHD versus GD with SAD. Our findings suggest that the clinical approach to an adolescent with GD must be tailored according to individual characteristics, including effective treatment of the psychiatric comorbidities. However, limitations related to sample size, correlation-based findings, and lack of a control group mean that the results should be interpreted cautiously. Further research into assessment and intervention strategies according to the distinct profiles associated with psychiatric comorbidities is needed.

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## Author contributions

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