BMC Public Health

RESEARCH

Open Access

Gaming disorder and psychological distress among Iranian adolescents: the mediating role of sleep hygiene

Leila Molaeipour[1], Reza Jabarbeigi[2], Tina Lari[3], Mehdi Osooli[4,5] and Elahe Jafari[2,3*]

Abstract

Background Evidence on psychological outcomes of gaming disorder (GD) is still scarce. This study aimed to investigate the mediating role of sleep hygiene in the relationship between GD and psychological distress (depression and anxiety) among Iranian adolescents.

Methods This was a cross-sectional study among school students in Qazvin city, Iran. We administered GD, anxiety, and depression questionnaires in a paper-and-pencil format. GD was measured using the GD S4-SF scale, and anxiety and depression were evaluated using the DASS-21. We assessed sleep health as a mediator using the Sleep Hygiene Behaviors scale. Covariance-Based Structural Equation Modeling (CB-SEM) was employed for data analysis, accounting for sex and physical activity as the main confounders. Statistical significance was determined using various fit indices and confidence intervals.

Results The sample consisted of 600 adolescents (41% female). CB-SEM revealed a positive but not statistically significant association between GD and depression, along with a negative statistically significant association with anxiety. Notably, sleep hygiene was identified as a partial mediator in the relationship between GD and depression, indicating that poor sleep practices may exacerbate depressive symptoms among adolescents with GD. However, no mediating effect was observed for anxiety.

Conclusion Our data supported a mediating role for sleep hygiene in the association between GD and depression among participants. Our results highlight the critical need for targeted policy interventions to improve sleep hygiene among adolescents with GD.

Keywords Sleep hygiene, Depression, Anxiety, Adolescence, Gaming disorder

*Correspondence:
Elahe Jafari
elhejafari@gmail.com
[1] Department of Biostatistics and Epidemiology, School of Health, Guilan University of Medical Sciences, Rasht, Iran
[2] Non-Communicable Diseases Research Center, Research Institute for Prevention of Non-Communicable Diseases, Qazvin University of Medical Sciences, Qazvin, Iran
[3] Department of Epidemiology, School of Public Health, Iran University of Medical Sciences, Tehran, Iran
[4] Division of Clinical Epidemiology and Pharmacoepidemiology, Department of Medicine Solna, Karolinska Institutet, Stockholm, Sweden
[5] Center for Primary Health Care Research, Lund University, Malmö, Sweden

Introduction

In recent years, most people have spent significant time on smartphones, social media, and online games on various electronic devices [1]. The World Health Organization (WHO) has recently included gaming disorder (GD) in the International Classification of Diseases (ICD-11) [2]. According to the definition, GD is a pattern of behavior in digital or video gaming that includes losing control of gaming activities and putting gaming ahead of other activities to the point where it gets in the way of daily tasks and interests. GD also encompasses the

continuation or escalation of gaming despite the occurrence of negative consequences [3].

GD can affect physical activity, sleep quality, quality of life, education, and social relations [4, 5]. Moreover, GD is associated with self-esteem issues [6], anxiety, and depression [7, 8]. Internet gaming disorder (IGD) is linked to increased family conflicts and poor relationships [9]. GD may affect the well-being of children as well as their parents [10]. The symptoms of GD are linked to various motivational factors, including the desire to avoid negative emotions, engage in escapism, relieve stress, and participate in in-game social interactions [11, 12].

In a recent meta-analysis, the prevalence of IGD among adolescents ranged from 0.6% to 19.9% [13]. Some research has shown that the tests for GD and IGD are stable across different groups of people and situations, which is called factorial invariance [14]. In contrast, other research highlights inconsistent and lower levels of agreement between the two measures [15]. Additionally, findings reveal a 73% overlap in the diagnostic criteria for IGD and GD [16]. However, this partial overlap does not warrant the interchangeable use of these terms, as each set of criteria addresses distinct facets of GD [17].

Assessing sleep hygiene as a determinant of mental health, well-being, and individual functional performance is essential [18]. GD is strongly correlated with insomnia among adolescents [19]. Most of the existing research has focused on IGD. However, studying GD as a whole lets researchers get a more complete picture of the problem, fill in any gaps in our knowledge, and come up with more effective ways to prevent and treat it. To our knowledge, evidence of the mediating role of sleep hygiene in the association between GD and psychological distress (depression and anxiety) among adolescents is still scarce. Therefore, this study aimed to determine the mediating role of sleep hygiene between psychological distress (depression and anxiety) and GD among Iranian adolescents in the city of Qazvin.

Methods

Participants

Qazvin is located in the northwest part of Iran. Ten high schools were selected from the comprehensive list of all high schools in Qazvin, ensuring representation from various areas of the city. All adolescents and their parents were required to sign an informed consent prior to their participation in the study. Following their consent, participants were requested to complete a form that outlined the study objectives and included the questionnaires. Two research associates conducted interviews and filled out the questionnaires using a paper-and-pencil format. The study was approved by the Ethics Committee of Qazvin University of Medical Sciences (no. IR.QUMS.REC.1403.200) and the Organization for Education in Qazvin.

Exposure

We measured GD as our main exposure using the GD S4-SF, a brief self-report scale consisting of four items based on DSM-5 criteria. Participants responded using a five-point Likert scale, ranging from 1 (never) to 5 (very often). A higher total score reflects a greater severity of GD [20].

Outcome

We used the Depression, Anxiety, and Stress Scale-21 (DASS-21) to evaluate the study outcomes: depression and anxiety. Respondents rated all 21 items using a four-point Likert scale that ranges from 0 (not applicable to me at all, never) to 3 (applied to me very much, or most of the time, almost always). The total score for each subscale, which is the sum of the items, ranges from 0 to 21; a higher score indicates a greater level of distress in that area. The Persian version of the DASS-21 has demonstrated very good to excellent internal consistency, with Cronbach's alpha ranging from 0.84 to 0.91 [21].

Mediator

We examined the mediating role of sleep health in the relationship between GD, depression, and anxiety. The Sleep Hygiene Behaviors assessment, validated for psychometric reliability in Persian [22], consists of three items and uses a five-point Likert scale ranging from 1 (never) to 5 (always). A higher score reflects better sleep hygiene practices. The three items focus on (1) establishing a calming atmosphere in the bedroom, (2) steering clear of hunger or thirst before sleep, and (3) refraining from engaging in stress-inducing activities prior to bedtime [23].

Confounders

Physical activity

The individual and social/relational factors play a significant role as barriers and facilitators of physical activity. Therefore, we considered psychological distress as a potential antecedent influencing the level of physical activity. We also did extra tests to see how physical activity might affect the relationship between the mediator and the outcome. It is generally accepted that at least 180 min per week should be dedicated to exercise in the form of three 60-min sessions of moderate intensity [24].

Sex

We have established evidence for sex differences in psychological distress (outcome) and sleep hygiene (mediator)[25]. We standardized the mediator and outcome

variables, stratifying them based on sex as described above. Some evidence suggests a moderating effect of sex in the exposure-mediator and exposure-outcome paths [26]. Consequently, we included an interaction term between sex and GD in all analyses.

Statistical analysis

This study utilized Covariance-Based Structural Equation Modeling (CB-SEM) to estimate parameters and to test hypotheses regarding the relationships illustrated in Fig. 1. We first examined the paths between GD and psychological distress. Subsequently, we included sleep hygiene as a mediator in the models. We incorporated the covariance into the model and analyzed the residual matrix to assess the correlation of the residual covariance between variables. We considered sex and physical activity as confounding variables, retaining them in the final model if they were statistically significant. All factor loadings, measurement errors, covariances, and path coefficients were estimated using the Maximum Likelihood (ML) estimator. We evaluated model fit using the Standardized Root Mean Square Residual (SRMR) and Root Mean Square Error of Approximation (RMSEA), both of which should be less than 0.08. And also using the Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), and Goodness-of-Fit Index (GFI), all expected to exceed 0.9 [27]. Finally, we reported non-standardized and standardized beta coefficients (Stand. Beta), standard deviations (SD), and P-values for each direct, indirect, and total effect within the examined paths. Effects were deemed significant if the confidence interval did not encompass zero. We used STATA version 17 and R Studio version 4.2.2 (Lavaan Package 0.6–12) to clean and manage the data and conduct the statistical analysis. We used the open-source SEM diagram for path visualization [28].

Results

Characteristics of participants

The study sample included 600 participants, of whom 246 (41.0%) were female (Table 1). Over half (54.7%) of the participants engaged in less than 180 min of physical activity per week. The mean age was 16.3 years (95% CI [16.1, 17.2]). Nearly half of participants' fathers the

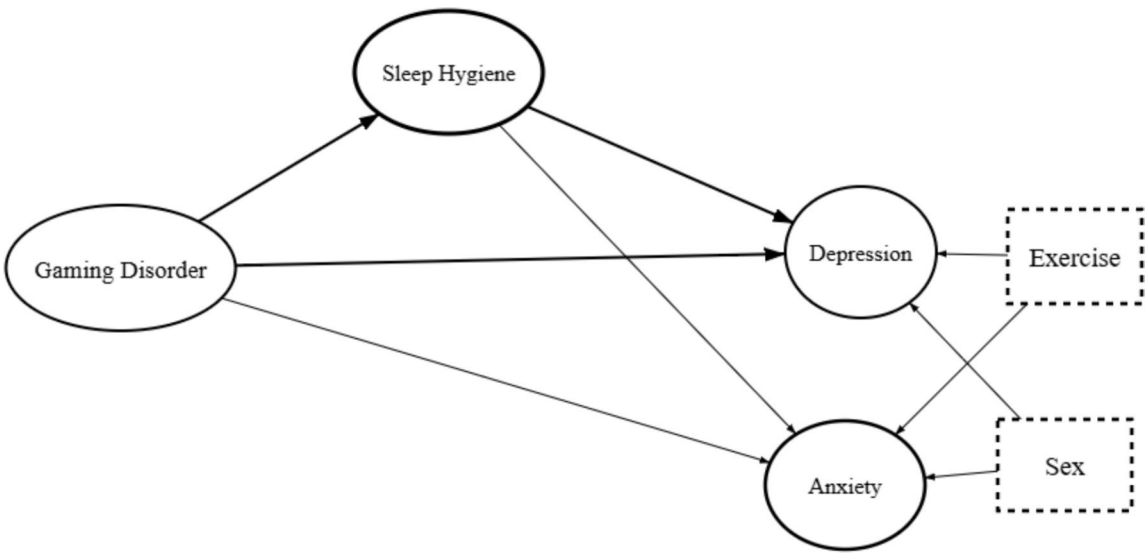

Fig. 1 Simplified Directed acyclic graph (DAG) of hypothetical structures in the relationship between gaming disorder and psychological distress

Table 1 Mean (95% Confidence Interval) of Gaming Disorder, sleep hygiene, depression, and anxiety stratified by sex and level of physical activity among 600 high school students in Qazvin, Iran year 2024

Variables		Number of participants (%)	Gaming Disorder, mean (95% CI)	Sleep hygiene, mean (95% CI)	Depression, mean (95% CI)	Anxiety, mean (95% CI)
Sex	Male	354 (59.0)	7.84 (7.5, 8.2)	9.4 (9.1, 9.7)	16.4 (16.1, 16.7)	17.9 (17.5, 18.3)
	Female	246 (41.0)	7.32 (6.9, 7.7)	8.8 (8.4, 9.1)	16.4 (16.1, 16.8)	15.8 (15.3, 16.3)
No of minutes of physical activity per week	< 180	322 (54.7)	7.6 (7.3, 8.0)	8.7 (8.4, 9.0)	16.3 (16.0, 16.7)	16.8 (16.3, 17.2)
	≥ 180	267 (45.3)	7.5 (7.1, 7.9)	9.6 (9.3, 9.9)	16.5 (16.2, 16.9)	17.4 (16.9, 17.9)

(47.1%) and mothers (45.1%) had high school diplomas as their highest completed education. Females had lower sleep hygiene scores (8.8, 95% CI [8.4, 9.1]) compared to males (9.4, 95% CI [9.1, 9.7]). However, males had a higher anxiety level (17.9, 95% CI [17.5, 18.3]) than females (15.8, 95% CI [15.3, 16.3]). The depression scores were similar between males (16.4, 95% CI [16.1, 16.7]) and females (16.4, 95% CI [16.1, 16.8]).

Participants with less than 180 min of physical activity per week had a lower sleep hygiene score (8.7, 95% CI [8.4, 9.0]) compared to those with ≥ 180 min of activity (9.6, 95% CI [9.3, 9.9]). Anxiety was also higher among those with higher physical activity (17.4, 95% CI [16.9, 17.9]) than participants with a lower level of physical activity (16.8, 95% CI [16.3, 17.2]). However, depression scores were similar between participants with a high (16.5, 95% CI [16.2, 16.9]) and those with a low physical activity (16.3, 95% CI [16, 16.7]) score.

Findings of the research model

Table 2 and Fig. 2 report the final SEM analysis results. Assessing the confounding effects of sex and physical activity on each hypothesized path indicated a confounding role of sex in the model. The goodness of fit of the SEM based on the ML estimator indicated excellent fit based on all tests (CFI: 0.956, TLI: 0.945, GFI: 0.948: RMSEA: 0.037, and SRMR: 0.041).

The total effect of GD on depression was not statistically significant (β: 0.2, 95% CI [−0.1, 0.3]). However, GD had a statistically negative total effect on anxiety (β: −0.3, 95% CI [−0.5, −0.2]).

For direct effects, the relationship between GD and depression was not statistically significant (β: 0.1, 95% CI [−0.1, 0.2]). However, the direct effect of GD on anxiety was statistically significant (β: −0.3, 95% CI [−0.5, −0.1]). Sleep hygiene had a significant negative direct effect on depression (β: −0.9, 95% CI [−1.2, −0.6]), while its effect on anxiety was not statistically significant (β: 0.2, 95% CI [−0.3, 0.8]).

Different sleep hygiene habits had different indirect effects on depression and anxiety. The effect on depression was statistically significant (β: 0.1, 95% CI [0.0, 0.2]), which suggests some mediation. The effect on anxiety was not significant (β: 0.0, 95% CI [−0.1, 0.1]).

Discussion

This study included a sample of female and male high school students in the city of Qazvin, Iran, to investigate the potential mediating effects of sleep hygiene in the relationship between GD and depression and anxiety. GD had a direct negative effect on anxiety. Sleep hygiene was negatively associated with depression. GD had an indirect effect on depression, which may indicate that sleep hygiene mediates the relationship between GD and depression.

Sleep hygiene is crucial for improving sleep quality. Previous studies have shown that poor sleep hygiene practices are associated with declined sleep quality among adolescents [29] and are a major risk factor for insomnia [30]. Behavioral treatments for insomnia often include sleep hygiene recommendations [31]. We don't see the usual pattern of full mediation, where a significant total effect becomes non-significant after controlling for the mediator. This is because the total effect of GD on depression wasn't significant before sleep hygiene was added. Instead, our results support an indirect-only mediation, which means that GD's

Table 2 Total, direct, and indirect effects of gaming disorder on anxiety and depression using structural equation models (SEM) among 600 high school students in Qazvin, Iran year 2024

Effect	Beta (95% CI)	Stand. Beta
Total Effect		
Gaming Disorder → Depression	0.2 (−0.1, 0.3)	0.2
Gaming Disorder → Anxiety	**−0.3 (−0.5, −0.2)**	**−0.3**
Direct Effects		
Gaming Disorder → Depression	0.1 (−0.1, 0.2)	0.1
Gaming Disorder → Anxiety	**−0.3 (−0.5, −0.1)**	**−0.3**
Gaming Disorder → Sleep Hygiene	**−0.1 (−0.3, −0.2)**	**−0.2**
Sleep Hygiene → Depression	**−0.9 (−1.2, −0.6)**	**−0.7**
Sleep Hygiene → Anxiety	0.2 (−0.4, 0.8)	0.2
Indirect Effect		
Gaming Disorder → Sleep Hygiene → Depression	**0.1 (0.0, 0.2)**	**0.1**
Gaming Disorder → Sleep Hygiene → Anxiety	0.0 (−0.1, 0.1)	−0.0

(Standardized Beta: Stand. Beta; The model was controlled for sex)

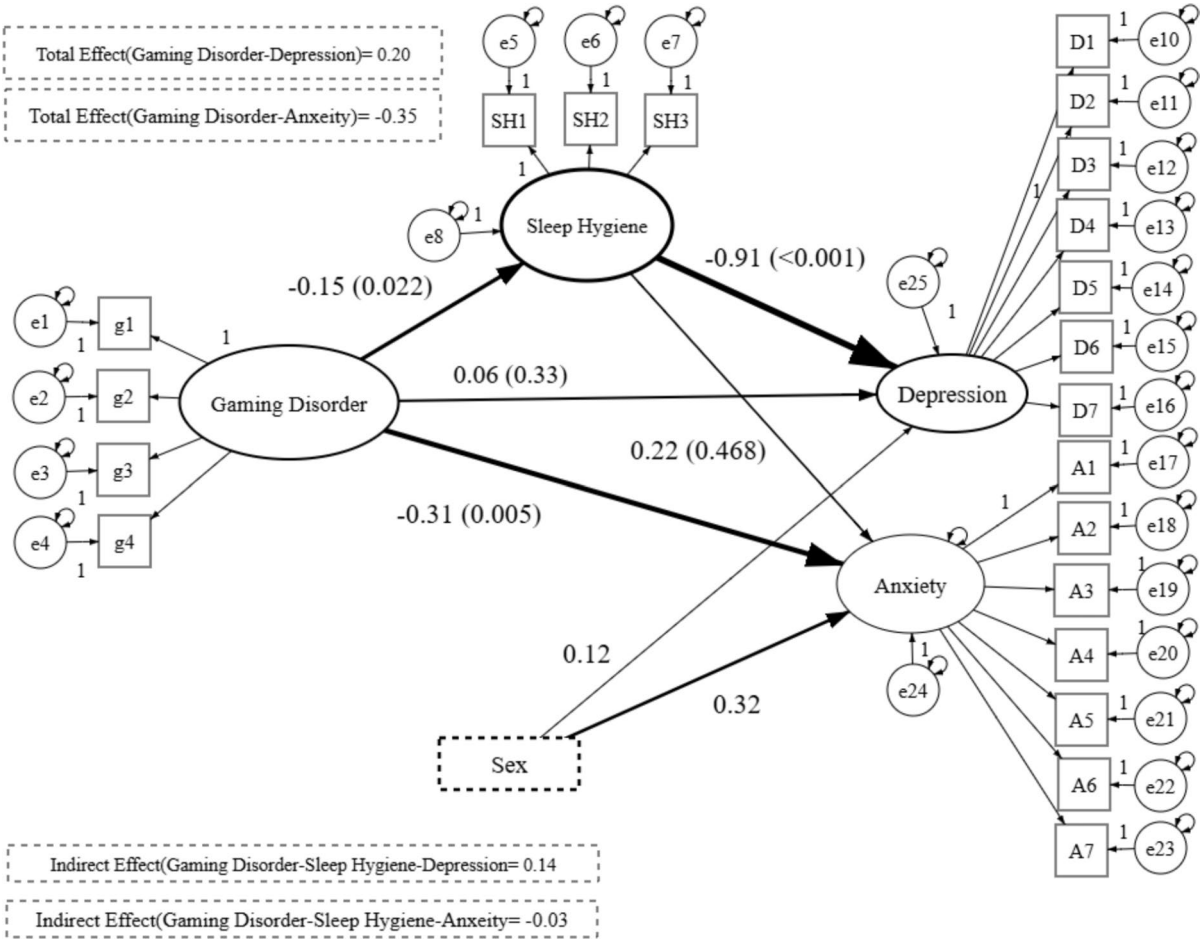

Fig. 2 Conceptual framework of the proposed model for mediating role of sleep hygiene in the association between gaming disorder and psychological distress (depression and anxiety) among Iranian adolescents in Qazvin, Iran

effect on depression shows up through good sleep hygiene instead of a direct path.

In mediation analysis, "partial mediation" in mediation analysis happens when the direct effect stays the same but becomes less important when the mediator is added. "Indirect-only" mediation happens when the direct effect is not important, but the indirect path through the mediator is important. This is exactly what we see when we look at how GD affects depression. Hence, our data suggest that GD influences depression largely by affecting sleep hygiene rather than by a direct mechanism. These findings highlight the indirect link between GD and depression, with sleep hygiene playing a key mediating role [32]. Combined with evidence showing the relationship between sleep hygiene and depression, these results suggest that GD may affect adolescents through multiple pathways. Therefore, family members and guardians should monitor the time and frequency of their children engaging in gaming, both online and offline [33, 34].

Our findings suggest that we can understand the mechanism of GD's effects on depression through the lens of sleep hygiene. One legitimate explanation could be the reward system. Many popular games have re-login bonuses, called contingent bonuses, that reward players with free virtual goods every time/day they log in [35], which are based on principles of behavioral economics [36]. Operant conditioning of a given behavior with positive reinforcement, in this case, frequent logins by associating them with a reward (e.g., a gift of in-game goods). During reward claims, users associate positive feedback with logging behavior and tend to associate this positive feeling with gaming. As a result, users play more frequently and longer [37–39]. The orbitofrontal cortex, like the amygdala and the hippocampus, plays an important role in such arousal-inducing behaviors [40]. Over time, more and more of the substance (or any other thing that can lead to dependence and addiction) is needed to get the desired effect. This leads to a decrease in the effectiveness of the brain's natural reward system, which in

turn activates an anti-reward system, making it more challenging for the addict to find biological reinforcers that provide positive feelings [41]. Griffiths' Components Model of Addiction outlines six key elements of gaming addiction: salience, mood modification, tolerance, withdrawal, conflict, and relapse [42]. Salience makes gaming the central focus of life, often at the expense of sleep. Mood modification temporarily alleviates negative emotions but disrupts sleep patterns. Tolerance leads to longer gaming sessions, further impairing sleep. Withdrawal symptoms, such as irritability and anxiety, worsen sleep disturbances. Conflict arises from struggles to balance gaming with responsibilities, which increases stress. Relapse occurs when excessive gaming resumes during stressful periods, perpetuating poor sleep and depressive symptoms. These components underscore the complex relationship between gaming and sleep, highlighting broader impacts.

In addition, sleep deprivation exacerbates maladaptive emotional regulation, leading to elevated neural and behavioral responses to negative and aversive experiences [43]. Individuals may engage in self-regulation strategies that involve problematic gaming behaviors, which can ultimately compromise their mental well-being and contribute to poor sleep hygiene. After adding sleep hygiene to the model, the relationship between GD and anxiety was no longer statistically significant. In addition, the results of direct effects indicated a (weak to medium) negative relationship between GD, anxiety, and sleep hygiene.

In addressing the complex interplay between GD and sleep hygiene among adolescents [44], it is imperative to explore community-based interventions to effectively mitigate existing challenges. Schools represent a critical environment for implementing targeted educational programs that raise awareness about the detrimental effects of GD on sleep hygiene and psychological distress. Such programs can empower students and parents alike to establish healthy boundaries around gaming, promote balanced lifestyles, and foster open dialogues about mental well-being. Additionally, the incorporation of peer support groups within school settings can enhance social cohesion and provide adolescents with a platform to share experiences and strategies for healthier gaming habits. By emphasizing grassroots initiatives, we can create a supportive framework that not only addresses the immediate concerns of GD but also promotes long-term improvements in sleep hygiene and reduces psychological distress among young individuals.

The main limitation of this study was its relatively small and non-representative sample. Our results may have low generalizability to high-resource settings. Given that Iran is a resource-limited country, with very expensive and low-speed internet, such socioeconomic factors in addition to other cultural conditions may significantly influence the engagement of adolescents in GD and especially IGD, which in turn may affect their outcomes. It is essential to replicate our study in countries with more active gaming communities and in high-resource settings. Additionally, as our study is cross-sectional, we cannot infer definitive causality. The observed 'indirect-only' mediation model should be interpreted as an association rather than a proven cause-and-effect pathway. Cohort studies are needed to ascertain temporality, to monitor the outcomes of adolescents with GD over time, and to document their mental health outcomes.

Conclusion

This study was a survey on GD and its psychological impacts among high school students in the city of Qazvin, Iran. Our findings indicated a correlation between GD and depression, highlighting the negative effects of GD on psychological distress among adolescents. However, the indirect effect of GD on sleep hygiene suggested that improving sleep health might help keep teens with GD from experiencing mental distress.

Abbreviations

CFI	Comparative Fit Index
CB-SEM	Covariance-Based Structural Equation Modeling
GD	Gaming Disorder
GFI	Goodness-of-Fit Index
DASS-21	Depression, Anxiety, and Stress Scale-21
ML	Maximum Likelihood
RMSEA	Root Mean Square Error of Approximation
SD	Standard deviations
Stand. Beta	Standardized beta coefficients
SRMR	Standardized Root Mean Square Residual
TLI	Tucker–Lewis Index

Acknowledgements

Authors would like to acknowledge the school officials, study participants and their parents/guardians for their kind cooperation.

Authors' contributions

E.J. and L.M. contributed to the conception. E.J., L.M. and M.O. contributed to the design of the study. R.J. and T.L. contributed in data collection under supervision of E.J., L.M. contributed to data analysis and the interpretation of findings. E.J. and L.M. drafted the manuscript. M.O. contributed in interpretation of the findings and revised the drafted manuscript. All authors reviewed manuscript draft, helped in revision, and approved the final version of the manuscript before submission, and committed to full responsibility for maintaining the accuracy and integrity of the study. The title page lists all of the writers as co-authors, indicating that they all fulfilled the requirements for authorship.

Funding

The Vice Chancellor of Research at Qazvin University of Medical Sciences provided financial assistance for the project (28/20/27371).

Data availability

The data that support the findings of this study are available from the corresponding author upon formal request.

Declarations

Ethics approval and consent to participate
The study was conducted according to the guidelines of the Declaration of Helsinki. The Qazvin University of Medical Sciences institutional review board and ethics committee examined and approved the study protocol (protocol code: IR.QUMS.REC.1403.200). We obtained an informed consent from each participant and at least one of their parents/guardians. Participants were informed about the study's goals, and that participation was entirely optional, and that all collected information would be kept private and anonymously.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 26 October 2024 Accepted: 20 February 2025
Published online: 03 March 2025

References

1. Mérelle SY, Kleiboer AM, Schotanus M, Cluitmans TL, Waardenburg CM, Kramer D, Van de Mheen D, van Rooij T. Which health-related problems are associated with problematic video-gaming or social media use in adolescents? A large-scale cross-sectional public health study. Clin Neuropsychiatry. 2017;14(1):11–9.
2. Organization WH: ICD-11 for Mortality and Morbidity Statistics. Mental, behavioural or neurodevelopmental disorders. Retrieved January 30, 2019. In.; 2018.
3. Kircaburun K, Pontes HM, Stavropoulos V, Griffiths MD. A brief psychological overview of disordered gaming. Curr Opin Psychol. 2020;36:38–43.
4. Sugaya N, Shirasaka T, Takahashi K, Kanda H. Bio-psychosocial factors of children and adolescents with internet gaming disorder: a systematic review. BioPsychoSocial medicine. 2019;13(1):3.
5. Torres-Rodríguez A, Griffiths MD, Carbonell X, Oberst U. Internet gaming disorder in adolescence: Psychological characteristics of a clinical sample. J Behav Addict. 2018;7(3):707–18.
6. Wartberg L, Kriston L, Zieglmeier M, Lincoln T, Kammerl R. A longitudinal study on psychosocial causes and consequences of Internet gaming disorder in adolescence. Psychol Med. 2019;49(2):287–94.
7. Teng Z, Pontes HM, Nie Q, Griffiths MD, Guo C. Depression and anxiety symptoms associated with internet gaming disorder before and during the COVID-19 pandemic: A longitudinal study. J Behav Addict. 2021;10(1):169–80.
8. Fumero A, Marrero RJ, Bethencourt JM, Peñate W. Risk factors of internet gaming disorder symptoms in Spanish adolescents. Comput Hum Behav. 2020;111:106416.
9. Bonnaire C, Phan O. Relationships between parental attitudes, family functioning and Internet gaming disorder in adolescents attending school. Psychiatry Res. 2017;255:104–10.
10. Wartberg L, Kriston L, Kramer M, Schwedler A, Lincoln TM, Kammerl R. Internet gaming disorder in early adolescence: Associations with parental and adolescent mental health. Eur Psychiatry. 2017;43:14–8.
11. Bäcklund C, Elbe P, Gavelin HM, Sörman DE, Ljungberg JK. Gaming motivations and gaming disorder symptoms: A systematic review and meta-analysis. J Behav Addict. 2022;11(3):667–88.
12. Heng S, Zhao H, Wang M. In-game social interaction and gaming disorder: a perspective from online social capital. Front Psych. 2021;11:468115.
13. Fam JY. Prevalence of internet gaming disorder in adolescents: A meta-analysis across three decades. Scand J Psychol. 2018;59(5):524–31.
14. Wang H-Y, Cheng C. Psychometric evaluation and comparison of two gaming disorder measures derived from the DSM-5 and ICD-11 frameworks. Front Psych. 2020;11:577366.
15. Higuchi S, Osaki Y, Kinjo A, Mihara S, Maezono M, Kitayuguchi T, Matsuzaki T, Nakayama H, Rumpf H-J, Saunders JB. Development and validation of a nine-item short screening test for ICD-11 gaming disorder (GAMES test) and estimation of the prevalence in the general young population. J Behav Addict. 2021;10(2):263–80.
16. Tuncturk M, Karacetin G, Ermis C, Ciray RO, Can M, Yesilkaya C, Atay A, Alkas GE, Kasap D, Guney O: Rate of Overlap between ICD-11 Gaming Disorder and DSM-5 Internet Gaming Disorder along with Turkish Reliability of the Gaming Disorder Scale for Adolescents (GADIS-A). Dubai Medical Journal 2023, 6(4).
17. Starcevic V, Choi TY, Kim TH, Yoo S-K, Bae S, Choi B-S, Han DH. Internet gaming disorder and gaming disorder in the context of seeking and not seeking treatment for video-gaming. J Psychiatr Res. 2020;129:31–9.
18. Irish LA, Kline CE, Gunn HE, Buysse DJ, Hall MH. The role of sleep hygiene in promoting public health: A review of empirical evidence. Sleep Med Rev. 2015;22:23–36.
19. Wei Q, Zhang S, Pan Y, Hu H, Chen F, Yin W, Lin Q, Pan S, Tham C, Wu J. Epidemiology of gaming disorder and its effect on anxiety and insomnia in Chinese ethnic minority adolescents. BMC Psychiatry. 2022;22(1):260.
20. Pontes HM, Schivinski B, Sindermann C, Li M, Becker B, Zhou M, Montag C. Measurement and Conceptualization of Gaming Disorder According to the World Health Organization Framework: the Development of the Gaming Disorder Test. Int J Ment Heal Addict. 2021;19(2):508–28.
21. Asghari A, Saed F, Dibajnia P. Psychometric properties of the Depression Anxiety Stress Scales-21 (DASS-21) in a non-clinical Iranian sample. Int J Psychol. 2008;2:82–102.
22. Strong C, Lin CY, Jalilolghadr S, Updegraff JA, Broström A, Pakpour AH. Sleep hygiene behaviours in Iranian adolescents: an application of the Theory of Planned Behavior. J Sleep Res. 2018;27(1):23–31.
23. Alijanzadeh M, Yahaghi R, Rahmani J, Yazdi N, Jafari E, Alijani H, Zamani N, Fotuhi R, Taherkhani E, Buchali Z. Sleep hygiene behaviours mediate the association between health/e-health literacy and mental wellbeing. Health Expect. 2023;26(6):2349–60.
24. Aguilar Cordero MJ, OrtegónPiñero A, Mur Vilar N, Sánchez García JC, GarcíaVerazaluce JJ, GarcíaGarcía I, Sánchez López AM. Physical activity programmes to reduce overweight and obesity in children and adolescents; a systematic review. Nutr Hosp. 2014;30(4):727–40.
25. Rajab AM, Rajab TM, Basha AC, Al-Khani AM, Ali MA, Enabi S, Zaghloul MS, Almazrou A, Saquib J, Saquib N. Gender Differences in Sleep and Mental Health among Saudi Adolescents. Sleep Disord. 2021;2021:5513817.
26. Lemmens JS, Valkenburg PM, Peter J: Psychosocial causes and consequences of pathological gaming. In.: Elsevier Science; 2011: 144–152.
27. MacCallum RC, Hong S. Power Analysis in Covariance Structure Modeling Using GFI and AGFI. Multivar Behav Res. 1997;32(2):193–210.
28. Rundquist S, Sachs MC, Eriksson C, Olen O, Montgomery S, Halfvarson J, Group SS. Drug survival of anti-TNF agents compared with vedolizumab as a second-line biological treatment in inflammatory bowel disease: results from nationwide Swedish registers. Aliment Pharmacol Ther. 2021;53(4):471–83.
29. LeBourgeois MK, Giannotti F, Cortesi F, Wolfson AR, Harsh J. The relationship between reported sleep quality and sleep hygiene in Italian and American adolescents. Pediatrics. 2005;115(Supplement_1):257–65.
30. Rosenberg RS, Van Hout S. The American Academy of Sleep Medicine inter-scorer reliability program: sleep stage scoring. J Clin Sleep Med. 2013;9(1):81–7.
31. Morin CM, Hauri PJ, Espie CA, Spielman AJ, Buysse DJ, Bootzin RR. Nonpharmacologic treatment of chronic insomnia. Sleep. 1999;22(8):1134–56.
32. Wang HR, Cho H, Kim D-J. Prevalence and correlates of comorbid depression in a nonclinical online sample with DSM-5 internet gaming disorder. J Affect Disord. 2018;226:1–5.
33. Hill D, Ameenuddin N, Reid Chassiakos YL, Cross C, Hutchinson J, Levine A, Boyd R, Mendelson R, Moreno M, Swanson WS: Media and young minds. Pediatrics 2016, 138(5).
34. Kuss DJ, Griffiths MD. Internet gaming addiction: A systematic review of empirical research. Int J Ment Heal Addict. 2012;10(2):278–96.
35. Butler C: Applied Behavioral Economics: A Game Designer's Perspective: Investigating the Gamification of Modern Games and How Similar Techniques Can be Leveraged in Non-Game Environments. Gamification in education and business 2015:81–104.
36. Johnson D, Klarkowski M, Vella K, Phillips C, McEwan M, Watling CN. Greater rewards in videogames lead to more presence, enjoyment and effort. Comput Hum Behav. 2018;87:66–74.
37. Hursh SR. Behavioral economics. J Exp Anal Behav. 1984;42(3):435–52.

38. Skinner B: Contingencies of reinforcement. Appleton-Century-Croft.[GN] (1984) The evolution of behavior. J Exp Anal Behav 1969.
39. Staddon JE, Cerutti DT. Operant conditioning. Annu Rev Psychol. 2003;54(1):115–44.
40. Volkow ND, Fowler JS, Wang G-J. The addicted human brain: insights from imaging studies. J Clin Investig. 2003;111(10):1444–51.
41. Koob GF, Le Moal M. Addiction and the brain antireward system. Annu Rev Psychol. 2008;59(1):29–53.
42. Griffiths M. A 'components' model of addiction within a biopsychosocial framework. J Subst Use. 2005;10(4):191–7.
43. Gujar N, Yoo S-S, Hu P, Walker MP. Sleep deprivation amplifies reactivity of brain reward networks, biasing the appraisal of positive emotional experiences. J Neurosci. 2011;31(12):4466–74.
44. Firdos S, Al-Omar S, Aldossary F, Alshamrani T, Alhussain M, Al-Otaibi T, Alhusain I. Exploring the impact of gaming habits on sleep patterns among young adults in Saudi Arabia: a cross-sectional study. Cureus. 2024;16(3):e56224.

Publisher's Note