



Problematic Internet Use and Mental Health Correlates among Children: A Systematic Review

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ABSTRACT

Problematic Internet use (PIU) among children is a growing concern due to its potential negative impact on mental health and overall well-being. This systematic literature review aimed to identify the association between problematic Internet use (PIU) and mental health challenges among children in order to propose appropriate interventions. A comprehensive search of three electronic databases, Scopus, Web of Science (WOS) and PubMed, yielded 30 relevant articles published between 2013 and 2022. The findings reveal a strong association between PIU and various psychiatric disorders and environmental factors. However, due to the cross-sectional nature of most studies, causal relationships between PIU and its correlations could not be determined. Two studies examining the temporal relationship between PIU and mental health challenges indicated bidirectional associations, emphasising the importance of addressing both PIU and associated mental health issues in intervention and prevention strategies. By incorporating parental involvement, school-based interventions, psychological therapies, public health policy interventions, and multidisciplinary stakeholders, we can effectively promote responsible Internet use, mitigate risk factors, and foster a supportive environment for children. In conclusion, this systematic review underscores the significant association between PIU and mental health problems among children. The findings emphasise the importance of adopting comprehensive approaches considering individual and environmental factors to address PIU effectively.

1. Introduction

Children's lives have been significantly impacted by the rapid advancement of technology and the widespread availability of the Internet. While the Internet offers numerous benefits, it has also raised concerns about its potential adverse effects on children's mental health [1]. Problematic Internet use (PIU) has emerged as a growing public health issue [2]. It is characterised by excessive and

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uncontrollable Internet usage leading to negative consequences. Understanding the association between PIU and children's mental health is crucial for developing effective prevention and intervention strategies [3].

To comprehensively examine the relationship between PIU and mental health among children, this systematic literature review aims to propose appropriate interventions. By synthesising existing research, we seek to identify PIU's correlates and risk factors, the temporal relationship of PIU and mental health problems, and protective factors and interventions against PIU. The review will encompass studies conducted in various countries, considering diverse cultural contexts and populations [4]. A comprehensive search strategy will identify relevant articles published in peer-reviewed journals. The inclusion criteria will involve studies focusing on children aged 18 years or below, exploring the association between PIU and mental health outcomes, including but not limited to depression, anxiety, suicidal behaviours, and sleep problems.

Overall, this systematic literature review is a critical step toward addressing the challenges of PIU and its association with mental health challenges among children. The findings of this review will contribute to our understanding of the complex relationship between PIU and children's mental health, shedding light on potential risk factors, comorbidities, and underlying mechanisms. Moreover, the synthesised evidence will inform future research directions and guide the development of evidence-based interventions to promote healthy Internet use among children and safeguard their mental well-being.

2. Literature Review

Several studies have examined the factors associated with PIU and its impact on mental health outcomes. These studies have identified risk factors and mechanisms that promote healthy Internet use and safeguard mental well-being. One study in China found that parent-child closeness, school climate, and peer relations directly affected PIU, mediated by self-esteem and depression [5]. Another study from the UK identified three independent factors related to PIU: Neglect, Obsession, and Control Disorder. The study highlighted the significant associations between conduct problems, hyperactivity, impact on daily life activities, depression, and poorer physical health with PIU [6]. A study involving Chinese rural adolescents found that PIU caused externalising problem behaviours, and mental health moderated this relationship. The study also suggested that parental knowledge might attenuate the link between PIU and externalising problem behaviours [7].

Furthermore, a study conducted during the COVID-19 pandemic revealed a higher prevalence of PIU and its positive correlation with depression and anxiety among adolescents [8]. Other studies emphasised the mediating effects of depression, anxiety, and insomnia in the relationship between PIU and academic engagement, with variations observed across different developmental stages [9]. Additionally, the association between PIU and mental health comorbidities, such as depression, dysthymia, suicide, social anxiety, panic, and phobias, was identified [10,11].

The literature review underscores the need for intervention strategies and clinical interventions to address the associations between PIU and mental health issues among children and adolescents. It also emphasises the importance of understanding the risk factors and mechanisms to promote healthy Internet use and safeguard mental well-being.

3. Methodology

3.1 Identification

To begin researching the issue of problematic Internet use and mental health in children, the identification phase involves searching for relevant study materials. Searching is done by using keywords such as 'problematic Internet use', 'mental health', and 'children'. The first step is to detect these keywords and find similar phrases in dictionaries, thesauri, encyclopaedias, and previous research. Once all relevant phrases have been determined, search strings are created for Scopus, Web of Science (WOS), and PubMed databases (see Table 1). This advanced search effectively obtained 521 publications from the three databases.

Table 1

The search strings

Scopus	TITLE-ABS-KEY (("problematic internet use" OR piu) AND ("mental health" OR "mental illness" OR "mental disorder" OR "psychiatric illness" OR anxiety OR depression OR well-being OR distress) AND child*) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2013)) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (LANGUAGE , "English"))
Web of Science (WOS)	("problematic internet use" OR piu) AND ("mental health" OR "mental illness" OR "mental disorder" OR "psychiatric illness" OR anxiety OR depression OR well-being OR distress) AND child* (Topic) and 2022 or 2021 or 2020 or 2019 or 2018 or 2017 or 2016 or 2015 or 2014 or 2013 (Publication Years) and Article (Document Types) and English (Languages)
PubMed	("problematic internet use"[All Fields] OR "piu"[All Fields]) AND ("mental health"[All Fields] OR "mental illness"[All Fields] OR "mental disorder"[All Fields] OR "psychiatric illness"[All Fields] OR ("anxiety"[MeSH Terms] OR "anxiety"[All Fields] OR "anxieties"[All Fields] OR "anxiety s"[All Fields]) OR ("depressed"[All Fields] OR "depression"[MeSH Terms] OR "depression"[All Fields] OR "depressions"[All Fields] OR "depression s"[All Fields] OR "depressive disorder"[MeSH Terms] OR ("depressive"[All Fields] AND "disorder"[All Fields]) OR "depressive disorder"[All Fields] OR "depressivity"[All Fields] OR "depressive"[All Fields] OR "depressively"[All Fields] OR "depressiveness"[All Fields] OR "depressives"[All Fields]) OR ("health"[MeSH Terms] OR "health"[All Fields] OR "well"[All Fields] OR "well being"[All Fields]) OR ("distress"[All Fields] OR "distressed"[All Fields] OR "distresses"[All Fields] OR "distressful"[All Fields] OR "distressing"[All Fields])) AND "child*" [All Fields] AND ((clinicaltrial[Filter] OR meta-analysis[Filter] OR randomizedcontrolledtrial[Filter]) AND (english[Filter]))

3.2 Screening

The screening process involves examining relevant research items to determine if they align with the pre-defined research questions. In the first screening stage, 266 publications were eliminated based on the study's inclusion and exclusion criteria determined by the researchers, as outlined in Table 2.

Research article (literature type) was the first criterion selected as it is the primary source of practical information. This study excluded publications in systematic reviews, meta-analyses, meta-synthesis, book series, book chapters, and conference proceedings. Furthermore, the review concentrated exclusively on papers written in English. It is essential to note that the schedule chosen was a ten-year duration, including articles from 2013 to 2022. Otherwise, only participants aged 18 years or below were included to conform to the analysis objective. The second part of the screening process involved the removal of duplicated articles. In this step, 55 articles were removed due to duplicate articles across the three databases.

Table 2
The selection criterion is searching

Criterion	Inclusion	Exclusion
Literature type	Journal (Article)	Conference, Book, Review
Language	English	Non-English
Timeline	2013 – 2022	< 2013
Publication stage	Final	In Press
Age of children	18 years or below	More than 18 years

3.3 Eligibility

In the eligibility stage, we carefully examined 200 articles by thoroughly reviewing their titles and key content to ensure they met the inclusion requirements outlined in Table 2 and aligned with our research aims. 53 reports were omitted because the titles were not significant to the study; 96 articles had abstracts unrelated to the objective; one article was excluded due to failure to access the full text, and the other 20 articles were excluded as the participants were more than 18 years old. After excluding the above articles, the remaining 30 articles were selected for review.

3.4 Data Abstraction and Analysis

An integrative analysis was used as one of the assessment strategies in this study to examine and synthesise a variety of research designs (quantitative, qualitative, and mixed methods). To develop themes, the authors carefully analysed 33 publications for relevant material related to the study's topics. They examined the methodology and research results of significant studies on PIU and mental health in children. The authors collaborated to develop themes based on the evidence presented throughout the study. They kept a log of their data analysis process to document any relevant perspectives, analyses, or ideas. The authors ensured consistency in theme design by comparing the results and discussing any disagreements between themselves. Before undergoing analysis selection, two public health experts from the University of Malaya and the Ministry of Health reviewed and refined the themes for consistency and ensured their validity. This expert review phase established the validity of each subtheme by ensuring clarity, importance, and suitability.

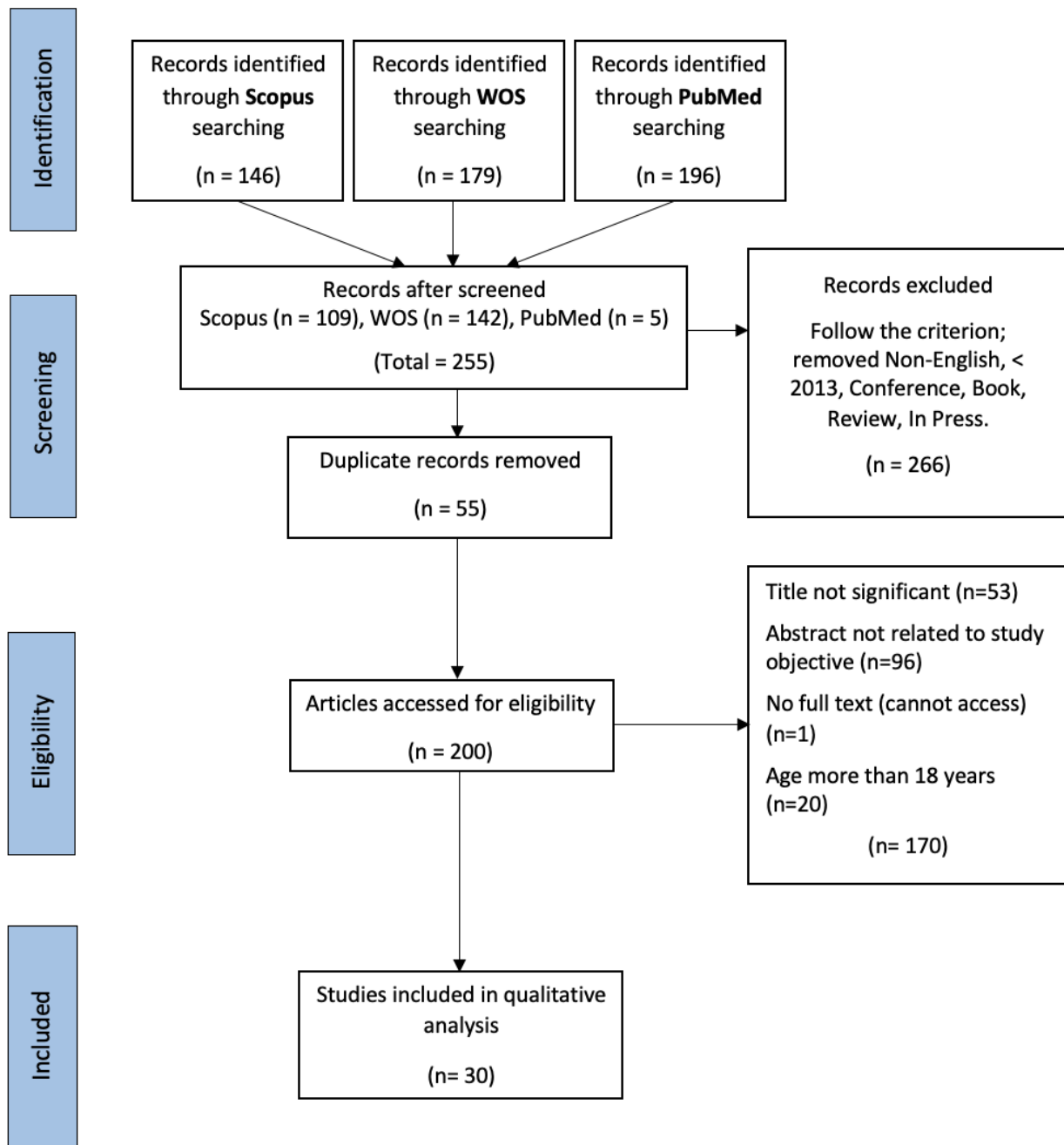


Fig. 1. Flow diagram of the proposed search study [12]

4. Results

Mental health problems associated with PIU are among the most significant public health issues worldwide in the cyber era. The final 30 articles were extracted and analysed to analyse this issue further. All articles were categorised based on three main themes, which are correlates and risk factors of PIU (28 articles - refer Table 3), temporal relationship between PIU and mental health problems (2 articles - refer Table 4), and protective factors and interventions for PIU (20 articles - refer Table 5).

4.1 Correlates and Risk Factors of PIU

In this theme, we will examine the different factors that may contribute to PIU in children, which includes both psychological and environmental factors. The articles related to this theme are summarized below and grouped into either psychological correlates or a combination of psychological and environmental correlates of PIU.

Table 2
 Correlates and risk factors of PIU

Reference	Authors	Title	Year	Age	Findings
Psychological correlations of PIU - 16 articles					
[13]	El Fiky R., Mansour M., Fekry M., ElHabiby M., Elkholy H., Morsy M.	Occurrence of problematic Internet use and its correlates among Egyptian adolescent students in international schools in Cairo	2022	11 to 18	<ul style="list-style-type: none"> 42.3% mild Internet addiction (IA); 35.1% moderate IA; 3.6% severe IA. Psychiatric disorders are prevalent among students, including major depressive episodes (9.3%) and alcohol dependence (4.4%). Those with severe or moderate addiction had higher rates of psychiatric disorders, especially disordered gamers (92.3%) and problematic social media users (60%).
[10]	Khalil S.A., Kamal H., Elkholy H.	The prevalence of problematic internet use among a sample of Egyptian adolescents and its psychiatric comorbidities	2022	14 to 18 (mean age, 16.1 ± 1.2 years)	<ul style="list-style-type: none"> A majority of surveyed adolescents had Internet (65.5%), gaming (61.3%), and Facebook (92.8%) addiction, often accompanied by mental health conditions such as depression and anxiety.
[14]	Fan B., Wang W., Wang T., Xie B., Zhang H., Liao Y., Lu C., Guo L.	Problematic internet use, non-medical use of prescription drugs, and depressive symptoms among adolescents: A large-scale study in China	2020	12 to 18	<ul style="list-style-type: none"> PIU, frequent opioid and frequent sedative misuse can lead to depression (PIU unstandardized β estimate = 0.26, 95% CI = 0.25–0.27), (opioid unstandardized β estimate = 2.77, 95% CI = 1.90–3.63; sedative unstandardized β estimate = 4.45, 95% CI = 3.02–5.88). Opioid misuse partially mediated the connection between PIU and depression.
[15]	Min Kim K., Kim H., Choi J.-W., Yeon Kim S., Won Kim J.	What types of internet services make adolescents addicted? Correlates of problematic internet use	2020	12 to 18	<ul style="list-style-type: none"> 5.2% of the population have PIU. Boys have a higher rate of PIU at 7.7% compared to girls at 3.8%. Pornography has the highest odds ratio for PIU at 4.526-fold. Depressive episodes, suicidal ideation, and attempts are linked to higher odds ratios for PIU at 1.725-, 1.747-, and 1.361-fold, respectively.

[16]	Onat M., Özyurt G., Öztürk Y., Pekcanlar Akay A.	The relationship between problematic internet use, sleep quality and impulsivity in adolescents with major depressive disorder	2019	12 to 18 (mean age, 14.70 ± 1.48 years)	<ul style="list-style-type: none"> • The depression group had significantly higher scores on the Barratt Impulsiveness (BIS-11) scale, Pittsburgh Sleep Quality Index (PSQI), and Young's Internet Addiction Test (IAT) compared to the control group. • The IAT had a positive correlation with both BIS-11 and PSQI scores. Additionally, there was a positive correlation between BIS-11 and PSQI scores.
[17]	Erceg T., Flander G.B., Brezinščak T.	The relationship between compulsive internet use and symptoms of depression and anxiety in adolescence	2018	11 to 18	<ul style="list-style-type: none"> • Children who exhibit more compulsive Internet usage tend to experience higher levels of symptoms related to anxiety and depression.
[18]	Takahashi M., Adachi M., Nishimura T., Hirota T., Yasuda S., Kuribayashi M., Nakamura K.	Prevalence of pathological and maladaptive internet use and the association with depression and health-related quality of life in Japanese elementary and junior high school-aged children	2018	6 to 15	<ul style="list-style-type: none"> • Pathological Internet use in children leads to more severe depression and lower quality of life compared to adaptive use.
[19]	Li J.-B., Lau J.T.F., Mo P.K.H., Su X.-F., Tang J., Qin Z.-G., Gross D.L.	Insomnia partially mediated the association between problematic Internet use and depression among secondary school students in China	2017	12 to 15	<ul style="list-style-type: none"> • 23.5% experience moderate to severe depression, 37.2% suffer from insomnia, 8.1% struggle with Internet addiction, and 25.5% have an addiction to online social networking. The latter two are linked to depression and insomnia, increasing the risk of these conditions. • Insomnia partially mediated the effects of IA (60.6%) and social networking addiction (44.8%) on depression.
[20]	Lee J.-Y., Kim S.-W., Kang H.-J., Kim S.-Y., Bae K.-Y., Kim J.-M., Shin I.-S., Yoon J.-S.	Relationship between problematic internet use and post-traumatic stress disorder symptoms among students following the Sewol ferry disaster in South Korea	2017	8 to 18	<ul style="list-style-type: none"> • PIU had a significant and independent link with exhibiting high symptoms of post-traumatic stress disorder (PTSD).

[21]	Seyrek S., Cop E., Sinir H., Ugurlu M., Şenel S.	Factors associated with Internet addiction: Cross-sectional study of Turkish adolescents	2017	12 to 17	<ul style="list-style-type: none"> • A study found that 1.6% of students had Internet addiction, while 16.2% showed possible signs. • IA was linked to depression, anxiety, attention disorders, hyperactivity, and smoking. • No significant relationship was found with age, sex, BMI, school type, or socioeconomic status.
[22]	Alpaslan A.H., Soylu N., Kocak U., Guzel H.I.	Problematic Internet use was more common in Turkish adolescents with major depressive disorders than controls	2016	12 to 18	<ul style="list-style-type: none"> • People with major depressive disorder (MDD) have higher rates of PIU than those without (controls). • There is no connection between the risk of suicide and Young Internet Addiction Test scores in MDD cases, but MDD patients with PIU have higher scores on the hopelessness subscale.
[23]	Cho S.-M., Sung M.-J., Shin K.-M., Lim K.Y., Shin Y.- M.	Does psychopathology in childhood predict internet addiction in male adolescents?	2013	less than 16	<ul style="list-style-type: none"> • 3.6% of subjects had internet addiction, linked to withdrawal, anxiety/depression, and future risk.
[24]	Bozkurt H., Coskun M., Ayaydin H., Adak I., Zoroglu S.S.	Prevalence and patterns of psychiatric disorders in referred adolescents with Internet addiction	2013	10 to 18	<ul style="list-style-type: none"> • Participants spent an average of 53.7 hours per week on the internet and had an average YIAS score of 85. • All had at least one psychiatric disorder, with 88.3% having two or more. • Common disorders included behavioural disorder, n = 52 (86.7%) and anxiety disorder, n = 43 (71.7%), with ADHD (n = 53; 83.3%) being the most prevalent.
[25]	Park S., Hong K.- E.M., Park E.J., Ha K.S., Yoo H.J.	The association between problematic internet use and depression, suicidal ideation and bipolar disorder symptoms in Korean adolescents	2013	13 to 18 (mean age, 13.87 ± 1.51 years)	<ul style="list-style-type: none"> • 9.4% children had PIU, which was significantly linked to depression (OR = 5.00, 95% CI = 2.88-8.66, p < 0.001), suicidal thoughts (OR = 5.82, 95% CI = 3.30-10.26, p < 0.001), and possibly bipolar disorder (OR = 3.05, 95% CI = 0.96-9.69, p = 0.059). • PIU predicted depression and suicidal ideation, and vice versa.

[26]	Masoudnia E.	Problematic cyberspace uses and risk of depression disorder among adolescents in Yazd	2013	15 to 18	<ul style="list-style-type: none"> • 21.7% children had problematic cyberspace use, which was strongly linked to depression and related symptoms such as sadness and negative self-image. • Self-blame, lethargy, and isolation were also associated with this behaviour. • Problematic cyber use explained 23.7% of the variation in depression.
[27]	Tan, YF; Chen, Y; Lu, YG; Li, LP	Exploring Associations between Problematic Internet Use, Depressive Symptoms and Sleep Disturbance among Southern Chinese Adolescents	2016	12 to 15	<ul style="list-style-type: none"> • 17.2% children had PIU, with 40.0% experiencing sleep disturbance and 54.4% showing symptoms of depression. • There was a significant link between PIU, sleep disturbance, and depression. • Depression had a greater impact on sleep disturbance than PIU.
Psychological & environmental correlations of PIU - 12 articles					
[5]	Wang H.	The Effects of School Climate, Parent-Child Closeness, and Peer Relations on the Problematic Internet Use of Chinese Adolescents: Testing the Mediating Role of Self-Esteem and Depression	2022	12 to 18 (mean age, 14.86 ± 1.64 years)	<ul style="list-style-type: none"> • Chinese children PIU is influenced by their relationship with parents, school environment, and friendships. • These associations are mediated by self-esteem and depression.
[28]	van Rooij A.J., Ferguson C.J., van de Mheen D., Schoenmakers T.M.	Time to abandon internet addiction? Predicting problematic internet, game, and social media use from psychosocial well-being and application use	2017	12 to 15	<ul style="list-style-type: none"> • Problematic Internet use is linked to negative effects on social interactions, gaming, and depressive mood. • Social media overuse is associated with social networking, Twitter, and instant messaging. • Problematic gaming is linked to male gender, online and offline gaming, and depressive mood.
[29]	Chen I.-H., Chen C.-Y., Pakpour A.H., Griffiths M.D., Lin C.-Y., Li X.-D., Tsang H.W.H.	Problematic internet-related behaviours mediate the associations between levels of internet engagement and distress among schoolchildren during COVID-19 lockdown: A longitudinal structural equation modelling study	2021	6 to 12 (mean age, 10.32 ± 0.84 years)	<ul style="list-style-type: none"> • Schoolchildren spent more time on their smartphones and social media during school suspension, but not on gaming. • Those who increased their Internet use by 15-30 mins daily experienced higher psychological distress. • Problematic social media use was more strongly linked to distress during the school suspension ($\beta = 0.584$) than at the baseline ($\beta = 0.451$; $P < 0.001$).

[30]	Mohammed A.M., El-Hameed M.Y.A., Mohammed I.S.	Study of the psychological aspect of children with internet addiction	2020	6 to 16	<ul style="list-style-type: none"> • Patient group had varying levels of depression (mild: 32.5%, moderate: 50%, severe: 17%), while the control group showed no depression symptoms. Anxiety levels were also observed (mild: 37.5%, moderate: 60%, severe: 2.5%) in the patient group, with no anxiety symptoms in the control group. • Positive family history of excessive Internet use was strongly associated with Internet addiction in children. • Internet addiction correlated with depression and anxiety, creating a vicious cycle.
[31]	Seo J., Lee C.-S., Lee Y.-J., Lee M.-S., Bhang S.-Y., Lee D.	The mediating effect of depressive symptoms on the relationship between adverse childhood experiences and problematic internet Use in children and adolescents	2020	9 to 18	<ul style="list-style-type: none"> • Adverse Childhood Experiences (ACEs) can increase the chances of developing depressive symptoms (standardized regression weight, 0.36; $P < 0.01$), which can lead to PIU (standardized regression weight, 0.40; $P < 0.01$). • Depressive symptoms also mediated the connection between ACEs and PIU.
[32]	Mo P.K.-H., Li J.-B., Jiang H., Lau J.T.F.	Problematic internet use and smoking among Chinese junior secondary students: The mediating role of depressive symptomatology and family support	2019	12 to 13	<ul style="list-style-type: none"> • PIU (ORa = 2.07, 95% CI = 1.48, 2.90) and probable depression (ORa = 1.33, 95% CI = 1.05, 1.69) increase the risk of smoking among junior school students. Having family support (ORa = 0.85, 95% CI = 0.77, 0.94) is a protective factor against smoking. • Lower family support and probable depression mediate the relationship between Internet addiction and smoking, while lower family support alone mediates the relationship between social networking addiction and smoking.
[33]	Akgün Kostak M., Dindar İ., Zafer Dinçkol R.	Loneliness, Depression, Social Support Levels, and Other Factors Involving the Internet Use of High School Students in Turkey	2019	14 to 17	<ul style="list-style-type: none"> • Younger male students who use the Internet more at home and on mobile phones in the mornings and evenings, show signs of depression and loneliness, have more siblings, and have a mother with higher education levels are more likely to have PIU.

[6]	El Asam A., Samara M., Terry P.	Problematic internet use and mental health among British children and adolescents	2019	10 to 16	<ul style="list-style-type: none"> • Three factors were identified: Neglect, Obsession, and Control Disorder. • PIU was influenced by several factors, including conduct problems, hyperactivity, depression, negative impact on daily life activities, and poorer physical health. • Males scored higher on PIU than females.
[34]	Lee J.-Y., Kim S.-Y., Bae K.-Y., Kim J.-M., Shin I.-S., Yoon J.-S., Kim S.-W.	Prevalence and risk factors for problematic Internet use among rural adolescents in Korea	2018	13 to 18	<ul style="list-style-type: none"> • 21.6% students had PIU. • Being male, experiencing academic stress, early Internet exposure, depression, and Strengths and Difficulties Questionnaire (SDQ-P) difficulties were all associated with PIU.
[35]	Fuchs M., Riedl D., Bock A., Rumpold G., Sevecke K.	Pathological Internet Use - An Important Comorbidity in Child and Adolescent Psychiatry: Prevalence and Correlation Patterns in a Naturalistic Sample of Adolescent Inpatients	2018	12 to 17 (mean age, 15.1 ± 1.4 years)	<ul style="list-style-type: none"> • High levels of PIU among young inpatients with links to psychopathology such as suicidality, identity issues and peer victimization • Compared to a matched school sample, the inpatient sample showed significantly higher addictive and PIU.
[36]	Kim B.-N., Park S., Park M.-H.	The relationship of sexual abuse with self-esteem, depression, and problematic internet use in Korean adolescents	2017	12 to 18 (mean age, 14.06 ± 1.37 years)	<ul style="list-style-type: none"> • Children who have experienced sexual abuse are more likely to have lower self-esteem ($\beta=-0.11$; 95% CI=-0.20,-0.04; $p=0.009$), more depressive symptoms ($\beta=-0.34$; 95% CI=-0.40,-0.27; $p=0.008$), and PIU ($\beta=0.20$; 95% CI=0.12-0.27; $p=0.012$). The abuse leads to lower self-esteem, which in turn leads to higher levels of depressive symptoms. • Depressive symptoms are positively associated with PIU ($\beta=0.23$; 95% CI=0.16-0.29; $p=0.013$).
[37]	Park S.	Associations of physical activity with sleep satisfaction, perceived stress, and problematic Internet use in Korean adolescents	2014	12 to 18 (mean age, 15.06 ± 1.75 years)	<ul style="list-style-type: none"> • Being physically active can lead to better sleep quality, less stress, and reduced excessive Internet use. • Improved sleep and reduced stress levels inversely and partially mediated the relationship between physical activity and Internet use ($Z = '4.315, p < 0.001$).

4.2 Temporal Relationship between PIU and Mental Health Problems

This theme focuses on the temporal relationship between PIU and mental health consequences among children, including depression, anxiety, and other psychiatric disorders. The following are the summary of article results related to the theme.

Table 3
 Temporal relationship between PIU and mental health problems

Ref.	Authors	Title	Year	Age	Analysis methodology	Result	Conclusion
[38]	Morita M., Ando S., Kiyono T., Morishima R., Yagi T., Kanata S., Fujikawa S., Yamasaki S., Nishida A., Kasai K.	Bidirectional relationship of problematic Internet use with hyperactivity/inattention and depressive symptoms in adolescents: a population-based cohort study	2022	8 to 13 (mean age, 9.7 ± 0.4 years)	Cross-lagged panel analysis	<ul style="list-style-type: none"> • PIU at timepoint 1 was linked to hyperactivity/inattention at timepoint 2 ($\beta = 0.03$; 95% confidence interval (CI) 0.01–0.06), and vice versa ($\beta = 0.07$; 95% CI 0.04–0.10). This link was still present even after accounting for depressive symptoms. • PIU at timepoint 1 was associated with depressive symptoms at timepoint 2 ($\beta = 0.05$; 95% CI 0.01–0.12), and the reverse was also true ($\beta = 0.05$; 95% CI 0.02–0.07). • These links persisted even after adjusting for hyperactivity/inattention and screen time. 	There is a two-way connection between PIU and symptoms of depression, which persists even after accounting for factors such as hyperactivity, inattention, and screen time.

[39]	Kojima, R; Shinohara, R; Akiyama, Y; Yokomichi, H; Yamagata, Z	Temporal directional relationship between problematic internet use and depressive symptoms among Japanese adolescents: A random intercept, cross-lagged panel model	2021	12 to 15	Random intercept, cross-lagged panel analysis	<ul style="list-style-type: none"> As students progressed to higher grade levels, their mean score on the Internet Addiction Test also increased: from 28.0 at T1, to 30.7 at T2, and 32.6 at T3. There was a one-way positive link between PIU at T2 and depressive symptoms at T3, but not the other way around. No causal relationship was observed between PIU at T1 and depressive symptoms at T2 or vice versa. 	PIU precedes the onset of depressive symptoms. Therefore, addressing PIU can be a promising preventive measure for children depression.
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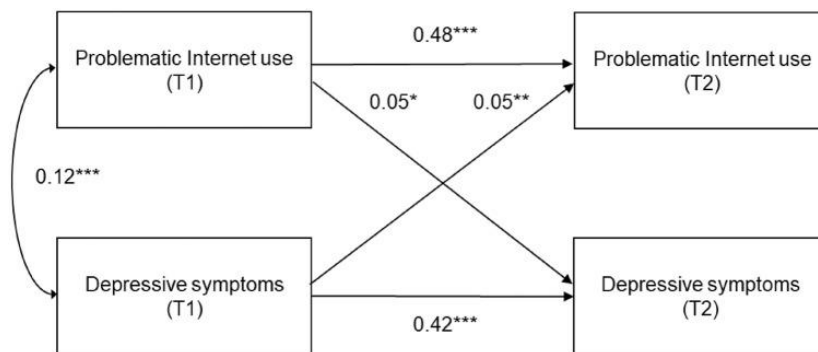


Fig. 1. Cross-lagged model of relations between PIU and depressive symptoms [38]

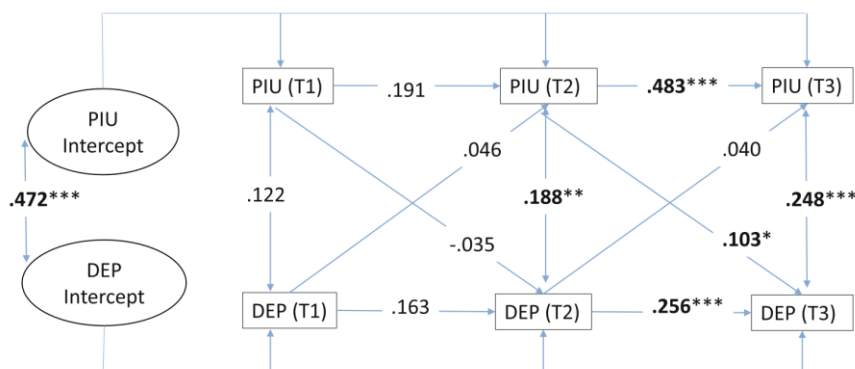


Fig. 2. Cross-lagged panel model with a random intercept and standardised regression coefficients. Notes. PIU = problematic Internet use, DEP = depressive symptoms. *p < 0.05, **p < 0.01, ***p < 0.001 [39]

4.3 Protective Factors and Interventions for PIU

This theme examines the strategies that can be used to prevent or reduce problematic Internet use among children, such as parental involvement, school-based interventions, and psychological therapies and public health policy intervention. The following are the summary of article recommendations related to the theme.

Table 4
 Protective factors and interventions for PIU

Reference	Authors	Title	Year	Age	Findings & Recommendation
[5]	Wang H.	The Effects of School Climate, Parent-Child Closeness, and Peer Relations on the Problematic Internet Use of Chinese Adolescents: Testing the Mediating Role of Self-Esteem and Depression	2022	12 to 18 (mean age, 14.86 ± 1.64 years)	<ul style="list-style-type: none"> • Chinese children PIU is influenced by their relationship with parents, school environment, and friendships. • These associations are mediated by self-esteem and depression. • Enhance the bond between parents and children, foster a positive school environment, and improve relationships with peers.
[30]	Mohammed A.M., El-Hameed M.Y.A., Mohammed I.S.	Study of the psychological aspect of children with internet addiction	2020	6 to 16	<ul style="list-style-type: none"> • Positive family history of excessive Internet use was strongly associated with Internet addiction in children • Internet addiction correlated with depression and anxiety, creating a vicious cycle. • Preventing PIU among family members can lower the likelihood of PIU among children.
[31]	Seo J., Lee C.-S., Lee Y.-J., Lee M.-S., Bhang S.-Y., Lee D.	The mediating effect of depressive symptoms on the relationship between adverse childhood experiences and problematic internet Use in children and adolescents	2020	9 to 18	<ul style="list-style-type: none"> • Adverse Childhood Experiences (ACEs) can increase the chances of developing depressive symptoms, which can lead to PIU • Depressive symptoms also mediated the connection between ACEs and PIU. • Preventing PIU among children with ACEs requires effective management of depression.
[14]	Fan B., Wang W., Wang T., Xie B., Zhang H., Liao Y., Lu C., Guo L.	Problematic internet use, non-medical use of prescription drugs, and depressive symptoms among adolescents: A large-scale study in China	2020	12 to 18	<ul style="list-style-type: none"> • PIU, frequent opioid and frequent sedative misuse can lead to depression. • Opioid misuse partially mediated the connection between PIU and depression. • Multidisciplinary health intervention programs to prevent adolescents from engaging in PIU and non-medical use of prescription drugs (NMPUD).

[32]	Mo P.K.-H., Li J.-B., Jiang H., Lau J.T.F.	Problematic internet use and smoking among Chinese junior secondary students: The mediating role of depressive symptomatology and family support	2019	12 to 13	<ul style="list-style-type: none"> • Lower family support and probable depression mediate the relationship between internet addiction and smoking, while lower family support alone mediates the relationship between social networking addiction and smoking. • Efforts to decrease smoking should focus on addressing issues related to PIU, symptoms of depression, and enhancing family support.
[33]	Akgün Kostak M., Dindar İ., Zafer Dinçkol R.	Loneliness, Depression, Social Support Levels, and Other Factors Involving the Internet Use of High School Students in Turkey	2019	14 to 17	<ul style="list-style-type: none"> • Younger male students who use the internet more at home and on mobile phones in the mornings and evenings, show signs of depression and loneliness, have more siblings, and have a mother with higher education levels are more likely to have PIU. • It is recommended that experts in internet usage provide training programs to children and family members.
[17]	Erceg T., Flander G.B., Brezinščak T.	The relationship between compulsive internet use and symptoms of depression and anxiety in adolescence	2018	11 to 18	<ul style="list-style-type: none"> • Children who exhibit more compulsive Internet usage tend to experience higher levels of symptoms related to anxiety and depression. • This provides practical implications for creating prevention and intervention programs for children
[34]	Lee J.-Y., Kim S.-Y., Bae K.-Y., Kim J.-M., Shin I.-S., Yoon J.-S., Kim S.-W.	Prevalence and risk factors for problematic Internet use among rural adolescents in Korea	2018	13 to 18	<ul style="list-style-type: none"> • Being male, experiencing academic stress, early Internet exposure, depression, and difficulties were all associated with PIU. • It is necessary to create measures to prevent PIU in rural children in Korea.
[18]	Takahashi M., Adachi M., Nishimura T., Hirota T., Yasuda S., Kuribayashi M., Nakamura K.	Prevalence of pathological and maladaptive internet use and the association with depression and health-related quality of life in Japanese elementary and junior high school-aged children	2018	6 to 15	<ul style="list-style-type: none"> • Pathological Internet use in children leads to more severe depression and lower quality of life compared to adaptive use. • It is crucial to offer educational and preventive measures to children to help them avoid problematic Internet use and related risks.
[35]	Fuchs M., Riedl D., Bock A., Rumpold G., Sevecke K.	Pathological Internet Use - An Important Comorbidity in Child and Adolescent Psychiatry: Prevalence and Correlation Patterns in a Naturalistic Sample of Adolescent Inpatients	2018	12 to 17 (mean age, 15.1 ± 1.4 years)	<ul style="list-style-type: none"> • High levels of PIU among young inpatients with links to psychopathology such as suicidality, identity issues and peer victimization. • Inpatient psychiatric patients need intervention to prevent PIU.

[19]	Li J.-B., Lau J.T.F., Mo P.K.H., Su X.-F., Tang J., Qin Z.-G., Gross D.L.	Insomnia partially mediated the association between problematic Internet use and depression among secondary school students in China	2017	12 to 15	<ul style="list-style-type: none"> • Insomnia partially mediated the effects of IA and social networking addiction on depression. • Developing and implementing interventions that address PIU, insomnia, and depression together could be a practical solution.
[20]	Lee J.-Y., Kim S.-W., Kang H.-J., Kim S.-Y., Bae K.-Y., Kim J.-M., Shin I.-S., Yoon J.-S.	Relationship between problematic internet use and post-traumatic stress disorder symptoms among students following the Sewol ferry disaster in South Korea	2017	8 to 18	<ul style="list-style-type: none"> • PIU had a significant and independent link with exhibiting high symptoms of post-traumatic stress disorder (PTSD). • To prevent the development of PTSD symptoms after a disaster, children and adolescents with PIU need close follow-up and special support.
[21]	Seyrek S., Cop E., Sinir H., Ugurlu M., Şenel S.	Factors associated with Internet addiction: Cross-sectional study of Turkish adolescents	2017	12 to 17	<ul style="list-style-type: none"> • IA was linked to depression, anxiety, attention disorders, hyperactivity, and smoking. • There is a need for public health policies that focus on preventing psychological issues among children.
[36]	Kim B.-N., Park S., Park M.-H.	The relationship of sexual abuse with self-esteem, depression, and problematic internet use in Korean adolescents	2017	12 to 18 (mean age, 14.06 ± 1.37 years)	<ul style="list-style-type: none"> • Children who have experienced sexual abuse are more likely to have lower self-esteem, more depressive symptoms, and PIU. • Children who have experienced sexual abuse require programs that focus on enhancing their self-esteem, preventing PIU, and conducting mental health screenings.
[37]	Park S.	Associations of physical activity with sleep satisfaction, perceived stress, and problematic Internet use in Korean adolescents	2014	12 to 18 (mean age, 15.06 ± 1.75 years)	<ul style="list-style-type: none"> • Improved sleep and reduced stress levels inversely and partially mediated the relationship between physical activity and Internet use. • Engaging in physical activity can enhance the mental health of children.
[23]	Cho S.-M., Sung M.-J., Shin K.-M., Lim K.Y., Shin Y.-M.	Does psychopathology in childhood predict internet addiction in male adolescents?	2013	less than 16	<ul style="list-style-type: none"> • 3.6% of subjects had Internet addiction, linked to withdrawal, anxiety/depression, and future risk. • To prevent Internet addiction, clinicians should take into account childhood anxiety, depression, and withdrawal.
[24]	Bozkurt H., Coskun M., Ayaydin H., Adak I., Zoroglu S.S.	Prevalence and patterns of psychiatric disorders in referred adolescents with Internet addiction	2013	10 to 18	<ul style="list-style-type: none"> • All PIU children had at least one psychiatric disorder, with 88.3% having two or more. • It is important to assess for other psychiatric disorders when evaluating IA because they may impact its management and prognosis.

[26]	Masoudnia E.	Problematic cyberspace uses and risk of depression disorder among adolescents in Yazd	2013	15 to 18	<ul style="list-style-type: none"> • 21.7% children had problematic cyberspace use, which was strongly linked to depression and related symptoms such as sadness and negative self-image. • To prevent negative effects on the mood and health of adolescents caused by PIU, it appears essential to implement behavioural and cognitive interventions aimed at altering their online behaviour.
[39]	Kojima, R; Shinohara, R; Akiyama, Y; Yokomichi, H; Yamagata, Z	Temporal directional relationship between problematic internet use and depressive symptoms among Japanese adolescents: A random intercept, cross-lagged panel model	2021	12 to 15	<ul style="list-style-type: none"> • PIU precedes the onset of depressive symptoms. • Addressing PIU can be a promising preventive measure for children depression.
[27]	Tan, YF; Chen, Y; Lu, YG; Li, LP	Exploring Associations between Problematic Internet Use, Depressive Symptoms and Sleep Disturbance among Southern Chinese Adolescents	2016	12 to 15	<ul style="list-style-type: none"> • There was a significant link between PIU, sleep disturbance, and depression. • The results are crucial for healthcare providers and policymakers as they provide valuable insights for preventing and addressing the issue.

5. Discussion and Conclusion

The studies' results have explicitly established connections between PIU and various psychiatric disorders and environmental factors in children. Those with severe Internet addiction, moderate addiction, disordered gamers, and problematic social media users had a significantly higher incidence of psychiatric disorders, including depression, dysthymia, suicide, social anxiety, panic, and phobias. The relationship between PIU and other issues, such as opioid/sedative misuse and ADHD, was also noted in this study which correlates with other existing studies [40,41]. PIU was also associated with an increased risk of suicidal ideation and attempts and comorbidities like dysthymia and phobias. Furthermore, PIU was linked to other environmental factors, including adverse childhood experiences, sexual abuse, and family support [42]. Interestingly, physical activity exhibited a negative correlation with PIU, which could imply that it is a protective factor against PIU, as supported in other studies [43,44]. It is crucial to address the association between PIU and mental health problems from multiple angles, including individual and environmental perspectives [45]. Most of the studies included were cross-sectional, so a causality relationship between PIU and their correlations could not be inferred.

To consider the consequence, the temporal relationship between PIU and mental health problems, specifically hyperactivity/inattention and depressive symptoms, is explored in two specific studies. Both studies highlight the temporal relationship between PIU and mental health problems, specifically hyperactivity/inattention and depressive symptoms. The bidirectional associations found in the first study suggest that addressing PIU and associated mental health issues is crucial for effective intervention and prevention strategies. This two-way connection is aligned with a recent study which concluded a reciprocal relationship between shyness, depression and Internet gaming disorder [45]. The second study emphasises the importance of targeting and reducing PIU to mitigate

the risk of developing depressive symptoms in adolescents. Although cross-legged panel analysis (CLPA) is a reliable approach for examining reciprocal causal inferences over time, it is crucial to consider potential factors that may cause false causal relationships [46]. These findings underscore the need for comprehensive approaches that address PIU as a potential risk factor for mental health problems and prioritise early intervention and prevention efforts.

Based on the findings, several protective factors and strategies can be implemented to prevent or reduce PIU among children. These strategies include:

- i. Enhancing parent-child relationships through open communication, trust-building, and fostering a supportive environment can mitigate the risk of excessive Internet use. Preventing PIU among family members can reduce the likelihood of PIU among children. Parental involvement should focus on monitoring and setting limits on Internet use while promoting healthy offline activities [47].
- ii. School-based interventions can be effective by implementing school-based programs that address the consequences of excessive Internet use and provide students with the necessary skills to navigate the digital world responsibly. These interventions can focus on promoting a positive school climate, peer relationships, and self-esteem, which were found to impact PIU directly [48,49].
- iii. Psychological therapies should target issues such as depression, anxiety, ADHD, and low self-esteem through therapy sessions that can help individuals develop healthier coping mechanisms and reduce their reliance on excessive Internet use as a form of escape or distraction [50].
- iv. Public health policies can be critical in preventing and addressing PIU among children. These interventions may include educational campaigns to raise awareness about the risks and consequences of excessive Internet use, providing resources and support for parents and educators, and implementing regulations that promote responsible Internet use among children [51,52].
- v. Multidisciplinary interventions: As some articles suggest, PIU can be associated with other issues such as substance misuse, smoking, or post-traumatic stress disorder. Implementing multidisciplinary health intervention programs that address these co-occurring problems can be beneficial. These programs should involve collaboration between healthcare professionals, educators, and psychologists to provide comprehensive support and treatment for individuals at risk of or already experiencing PIU [53].

These above strategies are aligned with the ecological framework proposed by Bronfenbrenner (Figure 4). This framework helps understand human development and how people interact with their surroundings. It emphasizes the need to consider various factors that impact an individual's growth and behaviour [54].

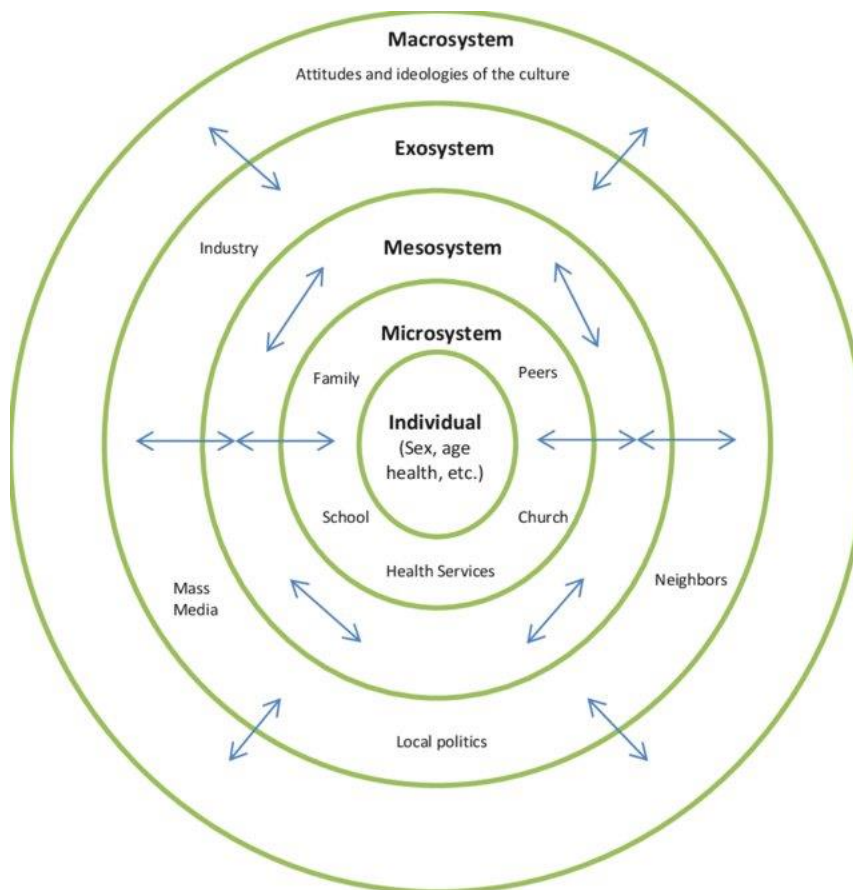


Fig. 3. Bronfenbrenner's ecological framework [54]

In conclusion, a comprehensive approach involving parental involvement, school-based interventions, psychological therapies, public health policy interventions, and family-based interventions is crucial in preventing or reducing problematic Internet use among children. By addressing risk factors, promoting healthy coping mechanisms, and creating a supportive environment, we can foster responsible and balanced Internet use habits among children while mitigating the negative impact on mental health.

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