Review Article

How has Internet Addiction been Tracked Over the Last Decade? A Literature Review and *3C Paradigm* for Future Research

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Abstract

Background: The popularity of the internet aggravated by its excessive and uncontrolled use has resulted in psychological impairment or addiction. Internet addiction is hypothesized as an impulse-control disorder of internet use having detrimental impacts on daily life functions, family relationships, and emotional stability. The goal of this review is to provide an exhaustive overview of the empirical evidence on internet addiction and draw attention to future research themes. **Methods:** We performed a literature search on ScienceDirect and PubMed to review original research articles with empirical evidence published on peer-reviewed international journals from 2010 to 2019. Eight hundred and 26 articles were eligible for analysis. Frequency and descriptive statistics were calculated by Microsoft Excel. **Results:** A substantial contribution has been coming from researchers from China, Turkey, Korea, Germany, and Taiwan respectively. Despite controversies regarding its definition and diagnostic procedures, internet addiction has become the focal point of a myriad of studies that investigated this particular phenomenon from different exposures. Given observed literature review data regarding research design, data acquisition, and data analysis strategies, we proposed the 3C paradigm which emphasizes the necessity of research incorporating cross-disciplinary investigation conducted on cross-cultural settings with conscientious cross-validation considerations to gain a better comprehension of internet addiction. **Conclusions:** The findings of the present literature review will serve both academics and practitioners to develop new solutions for better characterize internet addiction.

Keywords: *3C paradigm, internet addiction, internet use disorder, problematic internet use*

Introduction

The internet has become an indispensable part of modern society and its use has grown exponentially, causing internet addiction to become a growing concern across all age groups and countries.[1] Uncontrolled use of the internet significantly affects not only individuals' quality of life and social functioning but impacts their physical and psychological health.[2,3] Despite its ongoing controversy and debate concerning its conceptualization and classification among the scientific community,[4] internet addiction has received increasing attention over the past decades. Researchers initially considered internet addiction as part of the impulse-control disorder and/or obsessive-compulsive disorder models[5] or belonged to behavioural addiction spectrum,[6] because it exhibits the features of excessive use despite adverse consequences, withdrawal phenomena, and tolerance that typify many substance use disorders.[7] Neither a conclusive nor an agreed-upon definition for this disorder has been reached, making it difficult to establish a coherent picture of the phenomenon. Moreover, central discussions around internet addiction are further complicated by serious flaws in research designs as most studies are reliant on self-reported data recruited via multiple channels particularly prone to selection bias. The present study strives to highlight some key elements believed to cover all critical aspects of internet addiction. We also attempted to single out some key elements in the articles such as: research design, data collection, and data analysis strategies. Critical research priorities are provided to establish a concrete set of research preferences for better-managed prospective investigations. It is expected that such initiatives will, at least in part, orientate current and future research agendas to accommodate research trends across a broader spectrum with better knowledge of internet addiction.

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The following section dedicates to outlining the prevalence and evolution of internet addiction, providing a brief overview of internet-related activities that can be engaged online. This is followed by characterizing associated risk factors and psychiatric comorbidity of internet addiction. Subsequently, the current literature on existing instruments that have been using to measure internet addiction is discussed. Finally, contemporary intervention and treatment are going to be delineated.

Epidemiology

Generally, prevalence estimates are essential to evaluate the demand for consulting, treatment offers and preventive strategies.[8] Yet, epidemiological studies have reported a significant variance in the prevalence rates among adolescents and young people from 6.3 to 37.9% in Asia.[4,9] In the United States, it ranges from 0.3 to 8.2%[7,10] while in Europe, it has been reported to be between 1% and 21.3%.[11,12] The global pooled prevalence in the general population was estimated to be 6.0%,[13] indicating that internet addiction has been an increasingly alarming issue worldwide. People in Asia, particularly males, have been reported to have a relatively higher likelihood of getting addicted in comparison with their counterparts in non-Asian and female populations.[14,15] Internet addiction is more prevalent among younger population[16] and this disorder may be more common among lesbian, gay and bisexual individuals than in the heterosexual population.[17] People living in urban areas are more likely to get addicted than their counterparts residing in non-urban regions.[18-20] Nonetheless, caution is needed when drawing conclusions or comparisons among different countries due to the discrepancy in internet access in the populations studied, differences in recruitment of respondents, age-groups included, and dissimilar set of criteria used.

There have been several different proposals about internet addiction classifications. For instance, Young and colleagues[21] perceived internet addiction as an umbrella term for a wide variety of behaviors that divided into five different forms of addictive behavior (i.e., the computer itself, the search for information, cyber sexuality, cyber contracts, and net compulsions including contact with the web through online games, shopping, etc., Davis[6] asserts that pathological internet use consists of two distinct forms: general and specific. While the former refers to a broader set of behaviors, the latter involves engagement with either specific internet functions or applications. Given the ever-increasing ubiquity of internet technology, smartphone use, and web-based application, individuals are susceptible to develop potentially addictive online behaviors. Internet gaming disorder (IGD) was the only internet-related condition officially recognized in the diagnostic manual as a legitimate disorder. IGD is reported to be more frequent in males than in females and tended to be higher among younger rather than older people,[22] yet its prevalence is still inconclusive. The ever-growing prevalence of using social networking sites (SNSs) predominantly among the tech-savvy has raised concerns over its addictive usage. Andreassen and Pallesen[23] defined SNSs addiction as being overly concerned about SNSs due to an uncontrollable urge in which excessive use leads to negative consequences in real-life areas. Yet, little insight into the behavioral characteristics of those who lose control over their SNS use and develop problematic SNS use has led to prevalence rates that varied significantly across studies [Appendix 1]. Cybersex addicts were portrayed as one who uses the internet for sexual purposes for more than 11 hours per week.[24] Afterward, it was defined as any use of internet pornography that creates interpersonal, vocational, or personal difficulties.[25] Although excessive use of the internet for sexual purposes may have positive experiences for individuals, it can either be disordered or addictive.[26] Online shopping addiction refers to a tendency of excessive, compulsive and problematic shopping behavior via the internet that results in consequences associated with economic, social, and emotional problems.[27] The two best distinctions between normal urges to buy and shopping addiction are the negative consequences of the behavior and the fact that items purchased compulsively will not be used as much as expected. Gambling disorder, on the other hand, is fully recognized as a behavioral addiction, characterized by persistent and recurrent maladaptive patterns of gambling behavior, leading to impaired functioning.[28] The online form of gambling consists of wagering and gambling through internet-integrated devices enables bet anonymously and provides continuous instant feedback.[29] These conveniences raise concerns that online gambling could become a contributing factor to the development of gambling disorder and bring about individuals who would otherwise not regularly gamble, to develop a pathological use of internet gambling platforms.[30]

Risk factors for internet addiction

Exploring the patterns of internet addiction and associated factors are necessary to develop preventive measures and treatment protocols. Numerous studies have identified risk factors associated with internet addiction, generally categorized into individual and contextual factors. Specifically, the relationship between personality traits of internet addicts and psychosocial factors has been investigated and reported to have a positive association with neuroticism, extraversion, and openness but a negative relationship with agreeableness and conscientiousness.[31,32] Poor academic performance[33] and insecure attachment styles[34] were also found to have an association with internet addiction. Rather, family-related factors such as low family functioning,[35,36] poor parent-adolescent relationships,[37] low parental monitoring,[33] and parent marital conflict[38,39] have been intensively discussed in previous studies. Referring to cultural and economic

attributes, internet addiction was found to be positively related to economic well-being, social progress, and human development, whilst negatively related to human well-being, health, safety and security.[40]

Psychiatric comorbidity of internet addiction

The co-occurrence of internet addiction and psychiatric symptoms have been reported in the literature, including, but not limited to personality disorders,[41,42] attention deficit and hyperactivity disorder (ADHD),[43,44] hostility,[45] anxiety,[46,47] loneliness,[48,49] low self-esteem,[46,50,51] poor self-control,[51] impulsivity,[52] depression,[46,53,54] alexithymia,[55] and sensation-seeking.[56] Cross-sectional studies on samples of patients reported high comorbidity with psychiatric disorders such as anxiety disorder,[46] problem gambling,[57,58] suicidal ideation,[59,60] self-injurious and risk-taking behaviour,[61,62] eating disorders,[63] and obesity-related problems.[64] Adolescents with internet addiction are more likely to have limited extracurricular activities, and may engage in high-risk behaviours.[65,66] Other severe consequences of internet addiction have also been reported such as sleep deprivation,[59,67] deficient working memory and execution dysfunction.[68] The picture may be more complex, requiring practical responses from supporting agencies such as nursing, psychology, counselling, and social workers.

Measurement of internet addiction

A growing body of research has examined the validity of different measurement scales in different populations, particularly focusing on their psychometric properties and measuring the invariance of these assessment tools to identify internet addicts. Self-reported questionnaires on addictive disorders are often used to assess internet addiction at the general population level. Yet, their reliability and validity have not been adequately determined in terms of having clear diagnostic criteria. To date, multidimensional instruments such as the Internet Addiction Test (IAT), the Chen Internet Addiction Scale (CIAS), and uni-dimensional instruments such as the Compulsive Internet Use Scale (CIUS) have been widely adopted to measure the internet addiction.[69] While the IAT has received overwhelming support for its validity and reliability,[70] yet its accuracy is lower in comparison with CIUS in general population.[71] Differences in the underlying psychometric constructs must be taken into consideration when administering the IAT in different cultural contexts. Consequently, most of the existing scales for internet addiction require further validation.

Intervention and treatment

The response is more effective if the addiction is detected and properly diagnosed as early as possible. However, the evidence-based interventions for internet addiction are sparse, mainly based on strategies previously used in the treatment of substance use disorders. Cognitive-behavioural therapy is currently the most common psychological intervention tested, together with family-based intervention and counselling programs.[72] Further research is required to better clarify formal diagnosis and treatment for internet addiction.

Methodology

This literature review sought to map contemporary research patterns and provide recommendations for future investigation on internet addiction over the last decade. However, attention was paid only to empirical studies conducted using international or national community or clinical samples. In November 2019, a literature search was performed using two scientific databases: PubMed and ScienceDirect. These two databases had also been used in a prior study[73] for their systematic review of longitudinal research trends in adolescence and emergent adulthood.

The following terms were entered to perform a search through titles and abstracts in the respective databases: "internet AND (addiction* OR ((problematic OR excessive OR pathological AND use)) and "disorder OR compulsive*". All searches were confined to full-text English papers published between January 2010 and December 2019. The year 2010 was selected as the earliest date for studies, as we firmly believe an emphasis on the last ten years would be the most illustrative and informative to understand existing patterns of internet addiction. Furthermore, given the release of Diagnostic and Statistical Manual of Mental Disorders (DSM-5)[28] and the inclusion of gaming disorder in the 11th revision of the International Classification of Diseases (ICD-11) as a clinical illness,[74] research trends and patterns discovered within this period are especially important. Publications that were not obtained in the initial search were added after reviewing the reference lists of all retrieved articles.

Once duplicates were removed, the remaining articles were then screened out based on following criteria: (1) contain quantitative, qualitative or mixed approaches; (2) published between January 2010 and December 2019; (3) include general or clinical samples; (4) provide a full-text article and (5) published in English. Articles in languages other than English and those that did not assess internet addiction empirically were not considered. Publications such as theoretical papers, opinion, comments, perspectives, letters to the editor, short communications, conference proceedings, dissertations, and any content derived from sources other than peer-reviewed journals without a clear relationship to internet addiction were also excluded. The extracted data for each publication included: (i) study location, or, in case of not being clearly stated, the country of the first and/or co-author (s), (ii) publication types, (iii) type of study design, (iv) research methods employed and (v) journals that published those manuscripts. Frequency and descriptive statistics were then calculated to derive tables and figures. The whole process for selecting appropriate research articles is presented in Figure 1 as follows.

Findings and Discussion

Number of scholarly articles published

Once duplicates and non-relevant articles were eliminated, 826 valid articles remained for further analysis, including 318 indexed in Science Direct and 508 in PubMed [Figure 2].

There was a steady increase in the number of published articles on internet addiction over the last decade. The year with the highest number of publications was 2018 (n = 131), followed by the year 2014 (n = 111). A tentative explanation could be due to research interest stimulated by the inclusion of IGD in Section 3 of the DSM-5. This pattern then recurred in 2018, just one year before gaming disorder is formally recognized as a mental health disorder in the ICD-11. The increase in the number of articles highlights the awareness and importance of this area among the scientific community, clinics, and international bodies worldwide. However, a vast majority of the current literature is primarily centered on adolescents or young students, arguing that they are the most vulnerable groups to potentially develop problematic internet use due to their ever-growing internet use. Yet, their left-behind counterparts (i.e., emerging adults and the elderly), deserve to be assessed thoughtfully as well. Therefore, studies on widening samples across different age groups are necessary to examine whether the association between internet addiction and certain factors is consistent across the general population.

Number of regions (geospatial coverage)

A total of 826 articles were published by authors from 54 different countries [Figure 3]. We took into account the geographical location of the first author or co-author(s) to avoid the misrepresentation that each paper was single-authored.

The most productive countries were China (n = 174, c = 21.06%), Turkey (n = 83, c = 10.05%), Korea (n = 64, c = 7.45%), Taiwan (n = 58, c = 7.02%), Germany (n = 56, c = 6.78%), and the United States (n = 46, c = 5.57%). China has published more than one-fifth of the total articles during the studied timespan, presumably indicating the current situation of internet addiction in this country. In contrast, 36 nations that each published fewer than ten articles (n = 110, c = 13.32%) exhibit a huge disparity in the number of publications compared to the countries in the top five. The previous finding raises a pivotal research agenda for internet addiction experts and practitioners to explore. Therefore, it seems important and beneficial to investigate internet addiction in regions that have not been studied or have been insufficiently studied and then compare the results with previous studies conducted worldwide. Such collaboration is essential to facilitate cross-national and cross-cultural studies employing interdisciplinary approaches to improve the understanding of internet addiction. The European Cooperation in Science and Technology Action Program (COST) under Horizon 2020 can be singled out as a vivid example of its strong commitment to developing fruitful collaborations among

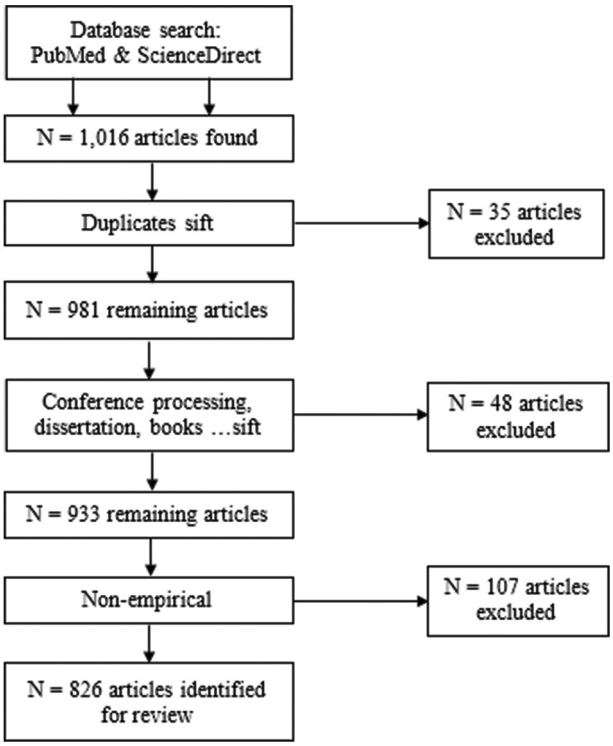

Figure 1: Flowchart of article selection

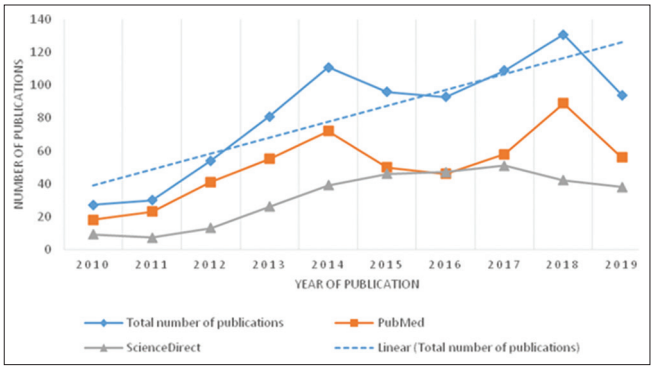

Figure 2: Number of scholarly articles on internet addiction

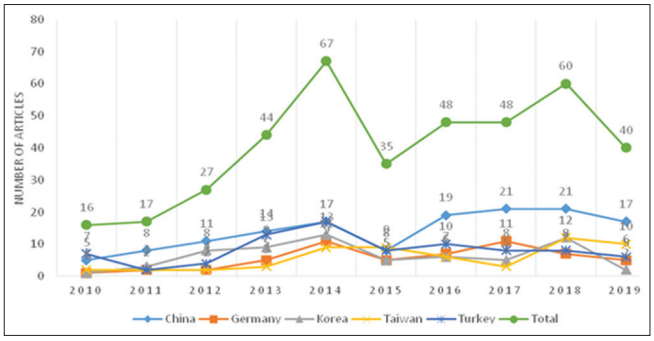

Figure 3: Top 5 countries with highest number of publications

researchers, experts, and different stakeholders regarding internet addiction.[75] Likely, the number of publications from this continent would increase considerably in the future.

Common research methods employed

Regarding the research design, the vast majority of studies on internet addiction are cross-sectional (n = 709; c = 85.84%), mostly gathering samples among individuals who may or may not fully represent attributes of the general population. Cross-sectional studies are primarily performed to estimate the prevalence and examine relevant risk factors for internet addiction. This type of study does not have an inherent temporal dimension as it only evaluates subjects at one point in time. By contrast, cohort and case-control studies (n = 51, c = 6.17%) enable researchers to assess the history of the treatment-seekers and endeavour to examine the causal relationship between risk factors and internet addiction. Although cohort and case-control studies have inherent limitations in showing the correlations among different variables and more susceptible to recall and selection bias, they can provide valid results to address important clinical research questions. Yet, interpretation drawn from case-control research should be thoughtfully verified by replication in other designs such as prospective cohort studies. Furthermore, cross-sectional, in comparison with longitudinal studies (n = 66; c = 7.99%) have inherent limitations in determining cause and effect's relationship as they cannot fully ascertain whether a factor was either presented before or after the onset of internet addiction. Therefore, future works would be better suited using alternative methodological approaches to enhance the robustness of the findings and conduct more longitudinal studies to provide valuable insight into the predictors and outcomes.

Concerning data acquisition methods, a substantial amount of research administered surveys (n = 649; c = 78.57%) by applying validated instruments to design self-reported questionnaires either used in the classroom or online environment through crowd-sourcing platforms or some cloud-based survey services to gather the data. Data collected in experimental settings have been used in 92 articles (c = 11.14%), particularly prevalent among brain imaging and neuroimaging studies. Interviews, either face-to-face or in diagnostic form, have been detected in 25 papers (c = 3.02%), showed great promise for the detection of psychiatric comorbidities as they provide greater diagnostic accuracy and contribute to a more exhaustive evaluation. Research that analysed secondary data were reported in 34 studies (c = 4.11%), while the mixed method was employed in 22 studies (c = 2.66%), and only 4 papers (c = 0.48%) applied focus group discussion, a qualitative approach to collecting data.

In terms of analytical techniques, a wide variety of data analysis strategies have been performed to evaluate internet addiction, depending on the type of data collected that allegedly supported researchers dealing with missing data issues and testing the proposed hypotheses or coming into further multivariate analyses [Table 1]. Apart from using traditional approaches to examine the association of possible factors with internet addiction, there is a need for analysis strategies that integrate quantitative and qualitative or mixed approaches and make it possible to identify solve complicate methodological settings. Methods dealing with massive datasets are also required as modern research is increasingly familiar with panel or longitudinal data collecting and processing a large sample of respondents. A prior study[76] provides an approach to examine the severity of internet addiction among college students by using their behaviour data on campus, which can easily be collected through handheld and smart devices.

We observe a growing interest in utilizing structural equation modelling or moderation and mediation analyses to evaluate the mediating role of associated variables. Likewise, latent profile analysis has sufficient flexible capabilities compared to cluster analysis to capture complex contextual effects that are difficult to assess using classical techniques, as it explores patterns of multiple variables rather than the relationship between two variables.[77] Given the drawback of statistical methods, a recent study[78] has employed a machine learning approach with a relatively larger dataset, which subsequently yielded its efficiency and provided a new view for researchers in this area.

A plethora of articles have been published in flagship journals of psychiatry, psychology and human-computer behaviour [Table 2], with only one exception from PLoS One, an interdisciplinary journal that covers primary research from any discipline within science and medicine.

There would be room for future studies to combine expertise across different fields and use a much more integrative and inclusive approach to investigate internet addiction. Therefore, multidisciplinary and interdisciplinary journals hold great promise for further examination.

Table 1: Top 10 most popular techniques for data analysis on internet addiction

Data analysis methods	Frequency
t-test, *F*-test, Chi squared test	364
Regression analysis (Multiple, Logistic, Hierarchical)	337
Correlation analysis (Pearson's, Spearman's, Canonical)	274
ANOVA, MANOVA	126
Factor analysis (EFA, CFA)	107
Structural equation modeling	92
Mediation and moderation analysis	27
ANCOVA, MANCOVA	25
Latent profile/class analysis	15
Cluster analysis	5

Common research topics on internet addiction

In accordance with present research strategies, 826 articles were deliberately classified and then assigned into six categories, namely epidemiological studies - the most commonly investigated topic (n = 384; c = 46.60%), comorbidity studies (n = 283; c = 34.34%), scale measurement studies (n = 80; c = 9.71%), neuroimaging or brain imaging studies (n = 50; c = 6.07%), intervention and treatment studies (n = 23; c = 2.79%), and gene studies (n = 4; c = 0.48%).

The overrepresentation of epidemiological and comorbidity studies reflects the proliferation of internet addiction among psychiatry and psychology disciplines, where so much effort has been dedicated to shedding light on different perspectives on this fairly new topic of interest. Moreover, given that internet addiction is yet to be formally included in any of the official diseases' classifications, it is not surprising that extensive research on its comorbidity and epidemiology dimensions have significantly outweigh other research topics. Likewise, there have been some initial efforts into the heritability of internet addiction by employing a gene approach to evaluate the molecular genetics of this particular behaviour.[79,80] It is recommended that these topics should be supported with a more detailed analysis in prospective studies.

Additionally, the geographic information system is employed to report maps of internet addiction and then can inform researchers, community organizers, and policymakers on the *status quo* of internet addiction.[81,82] An effort has also been paid to apply behavioural economic framework into internet addiction to examine whether the relationship between internet addiction and behavioural economic indicators is similar to other addictive behaviours.[83] These pilot results are expected to support future research that applies behavioral economic models to understand the etiology, developmental course, and to guide prevention and treatment approaches of internet addiction. Furthermore, a scant amount of research has underlined the importance of internet addiction to consumer behavior,[84] particularly paying attention to estimating the association between internet addiction and customers' electronic word-of-mouth behavior in the context of the hotel and restaurant industry.[84,85] Also, an ecological model called Process-Person-Context-Time has been proposed to examine online activities and internet addiction.[86] Moreover, the application of big data approaches to addiction research for cognition, neuroimaging, and genetics has been introduced. Big data can afford greater replicability of findings, especially in conjunction with the application of artificial intelligence. The advent of machine learning may improve the diagnosis and classification of individual patients based on data patterns that were not consciously considered by clinical in the past.[87] This advanced technology has been used to detect internet addiction[78] by combining grid search and support vector machines to improve detection capabilities.

Table 2: Top 10 journals publishing the most articles on internet addiction

Journal	Number of articles
Computers in Human Behavior	110
Cyberpsychology, Behavior, and Social Networking	67
Psychiatry Research	43
Journal of Behavioral Addictions	40
Addictive Behaviors	35
PLoS One	26
International Journal of Environmental Research and Public Health	17
Comprehensive Psychiatry	16
Asian Journal of Psychiatry	13
Frontiers in Psychology	12

Future research direction

Although there are major questions remain unanswered regarding the inconclusiveness of internet addiction's definitions as well as the dearth of globally accepted measurements and the variations in prevalence estimates, the association between internet addiction and various cyber-psychosocial-related problems such as cyber-crime, cyber-harassment, cybersecurity,[88] and cyber-bullying[89] is tentative and requires further investigation [Figure 4]. The 15th ed.ition of the World Economic Forum's Global Risks Report[90] contemplates that technological risks can generate a broad-based movement for various collaborators, including scientists and mental health experts, to address. Furthermore, the role of science has evolved to address multifaceted issues, become more interconnected, interdisciplinary, collaborative and data-intensive. As such, collaboration among scholars and experts play a significant role in determining research preferences and allocation of funds and investment for internet addiction research.

Currently, there is neither a single term to unify the concept nor an agreed-upon consensus on diagnostic procedures and definition, making it troublesome to early diagnose and propose sound treatment and intervention arrangements for treatment-seekers. Furthermore, there is a paucity of assessment tools to screen, diagnose and measure internet addiction cross-culturally. Consequently, research is needed to fully describe, from different perspectives, the spectrum of disorders and clinical courses that comprise internet addiction across genders, age groups, and cultures, to attain consensus on the diagnostic thresholds and criteria. Nevertheless, it is ambiguous how internet addiction performs over time. There is an imperative need for longitudinal population-based analysis of incidence, comorbidity, and remission, using extended cohorts (e.g., older adults). Such investigations would accommodate new data about the crucial developments over a lifespan and may introduce novel

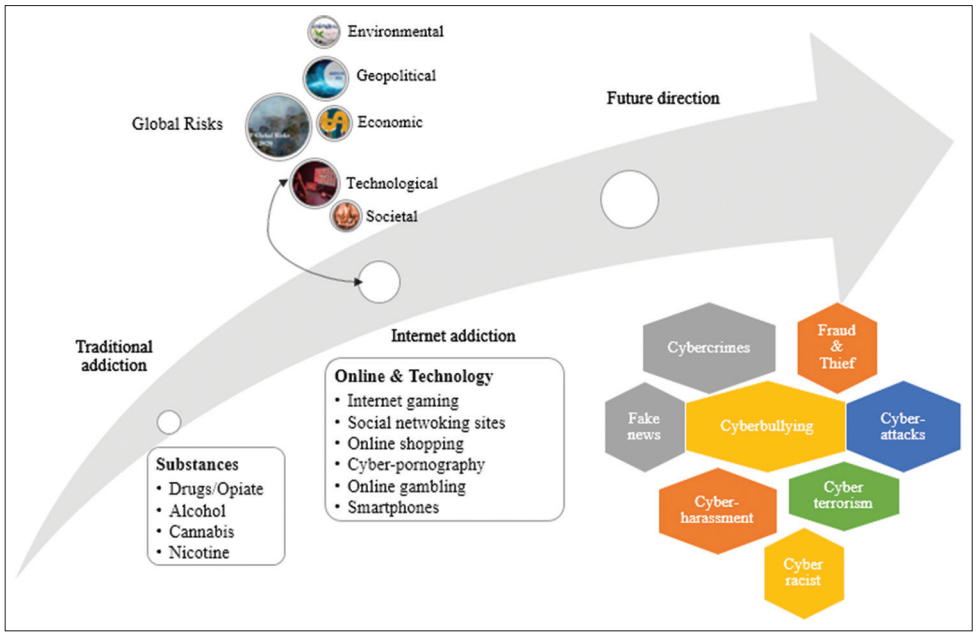

Figure 4: The trend of research on human addiction

theories bonding these behaviors and disorders. Furthermore, effective intervention and treatment therapy have not been proved. Early detection of susceptible individuals, aiming at early intervention strategies, could diminish the burden of diseases and help to deter improper functional consequences. To date, cognitive behavioral therapy seems to yield the best results. However, due to study limitations, clear evidence needs to be revealed by further testing.[91]

The 3C paradigm for future research

The aforementioned justifications allow us to formulate the *3C paradigm* for future research which accentuates the significance of incorporating a wide range of researchers from multiple disciplines.

- Cross-disciplinary collaborations between scientists from different disciplines have become increasingly important,[92] being a way to learn about cutting-edge knowledge directly from experts and to work towards more integrative and inclusive approaches. Researchers are suggested to cooperate and establish an agreement regarding diagnostic criteria and measures to improve the reliability across studies and to develop effective and efficient treatment approaches for treatment seekers.[93] For research on internet addiction, it is suggested to involve not only academic institutes and research centers but also nursing agencies and public health institutions, particularly where there is a call for projects centered on clinical assessment, intervention, and treatment. While such practices enable the synthesis of ideas and knowledge from many expertise, still, when conducting cross-disciplinary research, institutional or funding-related factors, as well as the conceptual and methodological differences between knowledge domains, must be taken into account
- The cross-cultural study is mainly concerned with looking at how our knowledge about people from one particular culture, and their behavior may or may not be the same as people from another culture. Examining internet addiction at a global scale is valuable in the era of globalization and corporate multi-nationalism.[70] Similarly, studies that assess the commonalities and differences between collectivist and individualist cultures are required as prior studies[94,95] have shown that countries in Asia with collectivist cultures are more likely to report higher levels of internet addiction. Finally, researching countries or territories with common cultural determinants such as China, Hong Kong, Taiwan and Macau or conducting research among Spanish or Portuguese communities would also be beneficial and helpful to observe different patterns of internet addiction
- Cross-validation refers to the methods and procedures used to validate results so that they can be generalized. It is useful to check whether a proposed research can generate similar results with the same variables in different samples. Presently, significant efforts have been devoted to examine the reliability and validity of the existing diagnostic instruments and to validate the conceptual model of internet addiction in different populations. Prospective studies should investigate the types of cyberspace activities as previous studies demonstrated that men and women often engage in different types of online activities, i.e., men are more likely to use the internet for playing games, while women mostly use it for social networking and shopping purposes.[96-98] Further in-depth investigations are also required into the validation of clinical instruments, prevalence estimates, and brain-based biology

mechanisms to establish a proper conceptualization and more concrete operationalization.

Conclusion

The goal of this review is to provide an exhaustive overview of the empirical evidence on internet addiction and draw attention on future research topics. We found that the number of journal articles on internet addiction has steadily increased with a substantial contribution from China, Turkey, Korea, Germany, and Taiwan respectively. Internet addiction has predominantly been scrutinized from a psychological, psychiatric and behavioral addiction point of view with considerable amount of research exploring epidemiological, neurobiological, comorbidity, measurement scales to intervention and treatment. Nonetheless, research on internet addiction has been impeded by the use of inconsistent and non-standardized criteria to assess and identify internet addicts or their addictive behavior. Currently, the diagnostic and research landscape appears particularly broad, and diagnostic criteria used to identify internet addiction are not globally agreed upon. Future investigation is prescribed to collaborate cross-disciplines research into cross-cultural studies employing cross-validation methods to allow better generalization of the findings and to gain a deeper insight into the concept of internet addiction.

Several limitations should be addressed in this review. First, the present study considered solely scientific articles confined by a specific interval. Therefore, a more extended timespan could result in meaningful contributions from articles published outside of the range considered in the present study. Second, the search was performed using general and more frequent terms reported in the titles and abstracts of journal articles. Future searches using other specific terms may result in obtaining additional papers on internet addiction. Specific terms relating to internet gaming disorder, shopping addiction, and social networking addiction or any other internet-specific problematic use can also be utilized to generate meaningful information. Finally, the selected databases, although they are the principal bibliography recognized by the global scholarly community, are not the only ones to address these issues. ProQuest, Embase, Medline, Scopus, and PsycINFO are also a great source of literature. Given the present limitations, the findings of this literature review will serve both internet addiction academics and practitioners to develop new solutions based on the challenges identified.

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Conflicts of interest

There are no conflicts of interest.

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Appendix 1: Prevalence estimates on different types of internet addiction

Types of Internet addiction	Area	Sample/population	Prevalence rate	Reference
Internet gaming disorder	Europe	12,938 adolescents (aged 14-17 years)	1.6%	[99]
	China	1,718 adolescents	2.0%	[14]
	Australia	1,287 adolescents	1.8%	[100]
Smartphone addiction	Switzerland	1,519 students	16.9%	[101]
	India	1,304 adolescents	39.0-44.0%	[102]
	USA	3,425 university students	20.1%	[103]
Social networking site addiction	Hungary	5,961 adolescents aged 15-22 years	4.5%	[104]
	Singapore	1,110 college students	29.5%	[105]
Online shopping addiction	South Korea	598 online shoppers aged 20-69 years	12.5%	[106]
	Germany/ Switzerland	122 treatment-seeking patients with buying-shopping disorder aged 20-68 years	33.6%	[107]
Cybersex addiction	South Africa	539 adult outpatients with current obsessive-compulsive disorder	3.3% (current), 5.6% (lifetime)	[108]
Problematic online gambling	International	975 gamblers aged 17-80 years	14.0%	[109]