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Protocol

Systematic Review Protocol: Anhedonia in Youth and the Role of Internet-Related Behavior

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Abstract: *Background*: Depression is a serious and debilitating condition with a rising prevalence. Anhedonia, a core symptom of depression, is notably significant and the second most weighted factor among the non-somatic concerns of depression, following depressed mood. The interaction between technology use, mood, emotions, depression, and anhedonia is a critical area of investigation. *Aim*: This study aims to develop a comprehensive Systematic Review Protocol to examine the emotional effects of Internet-related behavior in young people. *Methods*: A systematic review protocol was developed following PRISMA guidelines for systematic reviews. The research question was formulated according to the PICOS framework. The search was conducted using PubMed/Medline, Cochrane Library, Embase, Scopus, and PsycInfo, supplemented by gray literature sources via Google Scholar. The methodological quality and risk of bias was assessed using the Critical Appraisal Skills Programme (CASP) framework. This systematic review protocol was registered on the Open Science Framework with the registration DOI: 10.17605/OSF.IO/SHNJU. *Conclusions*: The findings of this systematic review are expected to provide new evidence on the correlations between depression, Internet addiction, and anhedonia, contributing to the development of targeted intervention strategies and improving the understanding of young peoples' emotional well-being.

Keywords: youth; anhedonia; Internet addiction; protocol review

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1. Background

Depression is recognized as a serious and debilitating condition, with its prevalence rising in recent years, making it one of the diseases with the highest direct and indirect social costs in industrialized countries [1,2]. According to the DSM-5, depression is characterized by a persistent state of sadness or loss of interest in daily activities, lasting for at least two weeks, along with other symptoms such as changes in weight or appetite, sleep disturbances, fatigue, feelings of worthlessness or excessive guilt, diminished ability to think or concentrate, and recurrent thoughts of death or suicide [3].

By 2030, the World Health Organization (WHO) estimates that depression will be the leading cause of lost workdays, surpassing even ischemic heart disease [4,5]. The global prevalence of depression is 4.4%, and it is twice as high in females [6–8]. The etiology of depression does not fully account for its highly subjective symptomatology, and clear predisposing genetic mechanisms have yet to be discovered [9–12], despite a higher prevalence

of the disorder among first-degree relatives of patients with Major Depressive Disorder (MDD), which ranges from 31% to 42% [13,14]. The psychopathology of depression encompasses a wide variety of symptoms, including core, biological, cognitive, and behavioral symptoms, making it particularly heterogeneous in its manifestations [15,16]. Cognitive symptoms, such as reduced concentration and working memory, significantly contribute to functional impairment in individuals of all ages. These symptoms manifest with complex and variable characteristics across different domains, including work, friendships, and family relationships, typically lasting for a minimum of 2 weeks and averaging 3 months. However, the duration of a single episode can extend to a year or more, with 20% of affected individuals experiencing symptoms even after 24 months [17,18].

Anhedonia, a core symptom of depression, is notably significant and has been identified as the second most weighted factor among the "non-somatic concerns" of depression, following depressed mood [19]. It is defined as the diminished ability to experience pleasure or interest in previously enjoyable activities, encompassing both a lack of motivation and a reduced capacity for reward. Scientifically, anhedonia can be classified into two main types: consummatory anhedonia and anticipatory anhedonia [20]. Consummatory anhedonia refers to the reduced pleasure experienced in the moment of engaging in an activity, whereas anticipatory anhedonia involves a diminished ability to feel excitement or anticipation for future activities. This distinction is important as it helps in understanding the underlying neural mechanisms and in tailoring treatment strategies [21].

The relationship between depression and anhedonia is particularly significant, as cognitive symptoms of depression, such as reduced concentration and memory, exacerbate the experience of anhedonia, which is the difficulty in experiencing pleasure or interest in previously enjoyable activities. This interaction creates a vicious cycle where cognitive impairment worsens anhedonia and vice versa, contributing to an overall deterioration of the depressive state [22].

Neurobiologically, anhedonia has been associated with dysfunctions in the brain's reward system, particularly within the mesolimbic pathway. Dopamine is a crucial neurotransmitter in regulating pleasure and reward in the brain. Anhedonia, characterized by a reduced ability to experience pleasure, is frequently linked to dysfunctions in the dopaminergic system, especially in the mesolimbic pathway. This pathway involves key brain structures such as the ventral tegmental area (VTA) and the nucleus accumbens, which are fundamental for reward processing and mood regulation [23]. In schizophrenia, altered dopaminergic pathways are associated with negative symptoms like anhedonia. In bipolar disorder, fluctuations in dopaminergic activity influence manic and depressive episodes. In substance use disorders, drugs artificially increase dopamine levels, leading to addiction and subsequent anhedonia [24,25].

Clinical research has elucidated anhedonia as a complex issue involving deficits in the reward processing system. This multifaceted phenomenon can be divided into three subtypes: reward liking (the experience of obtaining pleasure from rewards), reward wanting (the motivation to seek pleasure), and reward learning (the ability to reinforce and guide behavior based on previous rewards). Moreover, anhedonia is not only confined to depression, but is also prevalent in other psychiatric disorders such as schizophrenia, bipolar disorder, and substance use disorders. This symptom's presence across multiple conditions underscores its importance in the study of mental health and necessitates a broader understanding of its mechanisms and effects [25–28].

The impact of anhedonia on individuals is profound, often leading to significant impairments in social and occupational functioning. People suffering from anhedonia may find it challenging to engage in daily activities, maintain relationships, or pursue goals, which can exacerbate their depressive symptoms and contribute to a vicious cycle of worsening mental health [29,30].

Pharmacological treatments, such as selective serotonin reuptake inhibitors (SSRIs) and atypical antipsychotics, have shown varying degrees of efficacy. Additionally, non-pharmacological approaches, including cognitive behavioral therapy (CBT), behavioral

activation, and, more recently, neurostimulation techniques like transcranial magnetic stimulation (TMS), are being investigated for their potential benefits in alleviating anhedonia [31,32].

The pervasive use of technology and the Internet has profoundly shaped the behaviors and emotional states of young people. Studies conducted during the COVID-19 period have confirmed changes in Internet-related behavior among youth, correlating with an increased risk of various psychological and emotional problems. Internet-related behavior encompasses a wide range of activities, including social media use, online gaming, and Internet browsing, all significantly influenced by the pandemic [33,34]. This highlights the broader implications of anhedonia and the importance of addressing it within the context of evolving societal behaviors and stressors, particularly among the youth. Recent research has increasingly focused on the interaction between technology use, mood, emotions, depression, and anhedonia [18,35]. For instance, several studies have demonstrated that excessive or problematic use of Internet-connected devices is associated with negative emotional outcomes, such as increased anxiety, depression, and anhedonia. Intensive use of social media can lead to constant social comparison, which may decrease self-esteem and increase feelings of inadequacy and dissatisfaction. Online gaming, while offering a sense of community and entertainment, can also contribute to addictive behaviors and social isolation, exacerbating symptoms of anhedonia [18,35,36].

The pandemic has further accentuated these dynamics, with a significant increase in online time due to social restrictions and isolation. This has led to prolonged exposure to potentially harmful content and an increased risk of developing technology-related disorders [33,34]. Additionally, dependence on digital devices can interfere with sleep, physical activity, and direct social interactions, all of which are fundamental to emotional and psychological well-being [37].

Given the crucial role of technology in contemporary life, especially among young people, it is essential to understand the emotional effects of Internet-related behavior. Therefore, understanding and addressing anhedonia is crucial in the comprehensive treatment of depression and other related psychiatric disorders, especially in young people.

Study Objectives

The main objective of this study was to develop a comprehensive Systematic Review (SR) Protocol focusing on the emotional effects of Internet-related behavior in young people. Additionally, it aimed to scientifically outline the methods for analyzing and evaluating the outcomes considered in the included studies. The aim of the SR was to answer the following questions.

Primary research question:

- What is the effect of excessive or problematic use of Internet-connected devices on the mood and emotions of young people, with particular reference to anhedonia?

Secondary research questions:

- What socio-behavioral developments in adolescents are influenced by the extensive use of technological devices, including smartphones, PCs, tablets, and other Internet-connected devices?
- What are the main predisposing factors influencing anhedonia in young people who extensively use the Internet and other connected devices?
- Is there a possible relationship between depression and Internet addiction, considering anhedonia as a potential mediator or moderator in this relationship?

2. Methods

To ensure methodological thoroughness and relevance of the included studies, the SR involved the preliminary development of a research protocol. This approach aimed to ensure that the selected articles align with the objectives of the SR. The summaries of the collected data should be clear and comprehensive, providing a broad and legitimate overview for the relevant scientific community. To this end, the SR will be reported according to the

PRISMA guidelines [38,39] and, initially, the *Cochrane Handbook for Systematic Reviews* will be consulted [40].

2.1. Protocol Registration

The protocol of this SR was registered in the Open Science Framework (OSF) Register database [41].

2.2. Search Strategy

Prior to developing the systematic review (SR), relevant International Guidelines and existing Cochrane Library SRs will be reviewed to ensure alignment with the research question of this SR [42–44]. Subsequently, the search will be carried out in the databases PubMed, Cochrane Library (Clinical Trial section), Scopus, Embase, and PsycInfo, integrated by a search of gray literature sources such as Google Scholar. The search strategy will involve the use of established terms pertinent to the study subject and customized search strings specific to the characteristics of each database. Appropriate Boolean operators (AND/OR) will be employed to identify studies relevant to the research aim. Two researchers will independently perform a double-blind selection of the papers, with a third researcher available to resolve any discrepancies. The Free Access version of Mendeley Reference Management Software (Version 2.120.0) will be utilized for database compilation and duplicate elimination [45]. To minimize selection bias, articles will also be screened manually, and the bibliographies of the included studies will be meticulously reviewed.

2.2.1. PICOS

The research question was formulated following the PICOS framework [46] prior to the development of the search strings. The specific components of the PICOS framework for this study are detailed below.

Population (P): Youth (10–21 Years Old)

This study focuses on youth, defined as individuals aged 10–21 years. This age group is particularly relevant for investigating Internet addiction due to their high levels of Internet use and susceptibility to developing problematic Internet behaviors. Youth is a critical developmental stage where individuals experience significant social, academic, and occupational transitions, making them a vulnerable population for addictive behaviors.

Intervention (I): Internet Addiction

The primary intervention under investigation is Internet addiction. This includes behaviors characterized by excessive or poorly controlled preoccupations, urges, or behaviors regarding computer use and Internet access that lead to impairment or distress. The study aims to explore various dimensions of Internet addiction, including its prevalence, risk factors, and psychological and social impacts. The intervention may also encompass different therapeutic approaches or preventive measures designed to address Internet addiction. The review will include various research methods and measures of Internet addiction, recognizing that different measurement methods may result in different compositions of the groups being compared and, thus, may affect the results obtained. We will systematically evaluate and account for the diversity in measurement tools and methodologies used in the included studies to ensure a comprehensive and accurate analysis of Internet addiction.

Comparison (C): Internet Addiction vs. No Internet Addiction and/or No Different Intervention

The study will compare outcomes between young adults with Internet addiction and those without. This comparison aims to identify the differential impacts of Internet addiction on various aspects of life, including mental health, academic performance, and social relationships. Additionally, the study may compare different interventions for Internet addiction to determine their relative effectiveness. For example, cognitive behavioral

therapy (CBT) may be compared with no intervention or alternative therapies to assess its efficacy in reducing the symptoms of Internet addiction.

Outcome (O): Qualitative/Quantitative Outcomes

The study will measure both qualitative and quantitative outcomes to provide a comprehensive understanding of Internet addiction. Quantitative outcomes may include prevalence rates, scores on standardized assessment tools (e.g., Internet Addiction Test), and changes in psychological or behavioral metrics (e.g., levels of anxiety, depression, and social isolation). Qualitative outcomes may involve thematic analyses of participants' experiences and perceptions related to Internet use and addiction. By incorporating both types of outcomes, the study aims to capture the full spectrum of Internet addiction's impact on young adults.

Study Design (S): Primary Study

The research will focus on primary studies, which provide original data and findings relevant to the research question. These include randomized controlled trials (RCTs), cohort studies, cross-sectional studies, and case–control studies.

By employing the PICOS framework, this research protocol aims to systematically address the research question and ensure that the study design is rigorous, comprehensive, and capable of producing meaningful and applicable results. This structured approach will facilitate a thorough investigation of Internet addiction among young adults and contribute valuable insights to the field of mental health and behavioral addictions.

2.2.2. Query Search

PubMed/Medline

((((((((((((((((((((((((((((("Adolescent"[Mesh] OR "Psychology, Adolescent"[Mesh] OR "Adolescent Psychiatry"[Mesh] OR "Adolescent Behaviour"[Mesh] OR "Learning Disabilities"[Mesh]) OR (childhood)) OR (child)) OR (children)) OR (children adolescents)) OR (depression children adolescents)) OR (adolescents)) OR (adolescent depression)) OR (young)) OR (young)) OR (young adult)) OR (young adults)) OR (young people)) OR (teenage)) OR (teenage years)) OR (boys girls)) OR (teenage girls)) OR (adolescent girls)) OR (young men)) OR (young man)) OR (young girl)) OR (teenager)) OR (teenager depression)) OR (teenager mental health)) OR (anxiety teenagers)) OR (social media teenagers)) OR (child depression)) OR (depression child development)) AND ((((((((((((((((((((("Technology Addiction"[Mesh] OR "Internet Addiction Disorder"[Mesh] OR "Behaviour, Addictive"[Mesh]) OR (smartphone)) OR (smartphone addiction)) OR (smart phone)) OR (smart phones)) OR (internet)) OR (internet addiction)) OR (internet gaming)) OR (internet gaming disorder)) OR (social media addiction)) OR (social media mental)) OR (social media mental health)) OR (social media mental health adolescents)) OR (social media)) OR (social withdrawal)) OR (dysthymia)) OR (social phobia)) OR (phubbing)) OR (problematic internet)) OR (problematic internet use)) OR (problematic smartphone)) OR (problematic smartphone use))) AND ((anhedonia) OR ("Anhedonia"[Mesh])).

Cochrane Library

#1 ("technology"): ti,ab,kw OR ("internet"): ti,ab,kw OR ("gaming"): ti,ab,kw OR ("withdrawal"): ti,ab,kw (Word variations have been searched).

#2 ("Child"): ti,ab,kw OR ("Young"): ti,ab,kw OR ("teen-age"): ti,ab,kw OR ("adolescent"): ti,ab,kw (Word variations have been searched).

#3 ("anhedonia"): ti,ab,kw OR ("depression"): ti,ab,kw OR ("mental disorder"): ti,ab,kw OR ("mental disease"): ti,ab,kw (Word variations have been searched).

#4: #1 AND #2 AND #3.

Scopus

((Title-Abs-Key (adolescent) OR Title-Abs-Key (childhood) OR Title-Abs-Key (child) OR Title-Abs-Key (children) OR Title-Abs-Key (children AND adolescent) OR Title-Abs-Key (young) OR Title-Abs-Key (young AND adult) OR Title-Abs-Key (young AND people) OR Title-Abs-Key (teenager))) AND ((Title-Abs-Key (technology AND addiction) OR Title-Abs-Key (internet AND addiction AND disorder) OR Title-Abs-Key (addictive AND behaviour)) OR Title-Abs-Key (smartphone) OR Title-Abs-Key (phubbing) OR Title-Abs-Key (internet) OR Title-Abs-Key (internet AND addiction) OR Title-Abs-Key (internet AND gaming) OR Title-Abs-Key (social AND media AND addiction) OR Title-Abs-Key (social AND withdrawal) OR Title-Abs-Key (problematic AND smartphone AND use) OR Title-Abs-Key (social AND media) OR Title-Abs-Key (problematic AND internet AND use) OR Title-Abs-Key (problematic AND smartphone) OR Title-Abs-Key (social AND media AND mental AND health))) AND (Title-Abs-Key (anhedonia)) AND (Limit to (subjarea, "medi") OR Limit to (subjarea, "psyc") OR Limit to (subjarea, "soci") OR Limit to (subjarea, "nurs") OR Limit to (subjarea, "envi")).

Embase

(adolescent OR childhood OR child OR children OR children AND adolescent OR young OR young adult OR young people OR teenager) AND (technology addiction OR internet addiction disorder OR addictive behaviour OR smartphone OR phubbing OR internet OR internet addiction OR internet gaming OR social media addiction OR social withdrawal OR problematic smartphone use OR social media OR problematic internet use OR problematic smartphone OR social media mental health) AND (anhedonia).

PsycInfo

(adolescent OR childhood OR child OR children OR children AND adolescent OR young OR young adult OR young people OR teenager) AND (technology addiction OR internet addiction disorder OR addictive behaviour OR smartphone OR phubbing OR internet OR internet addiction OR internet gaming OR social media addiction OR social withdrawal OR problematic smartphone use OR social media OR problematic internet use OR problematic smartphone OR social media mental health) AND (anhedonia).

2.3. Inclusion and Exclusion Criteria

To ensure the relevance of the studies to be included, the inclusion criteria were defined as follows:

- Type of study: primary literature. All other types of studies (e.g., editorials, commentaries, reviews, and protocol studies) will be excluded.
- Population: Youth, age 10–21 years hold (children/adolescents/young adults). Studies involving adults and/or heterogeneous age populations will be excluded.
- Relevance: studies that are pertinent to the aim of this study. All others will be excluded.
- Temporal limit: no limits.
- Language: primarily English. The authors will attempt to include studies in other languages (excluding Chinese) if relevant based on the Abstract in English.
- Use of Internet-connected devices for at least 3 h per day or 21 h per week; engage in online activities during meals, school hours, or sleep time at least twice per week; spend at least 2 h per day on recreational online activities such as social media, gaming, or streaming; report significant negative impacts on daily life due to Internet use, including academic performance or interpersonal relationships.

2.4. Quality Assessment and Risk of Bias Evaluation

In the article selection process, objectivity will be rigorously maintained through a structured, systematic approach. Each publication will be independently evaluated by two researchers using a double-blind methodology, ensuring that each assessment is made without influence from the evaluations of others. This methodological rigor aims

to eliminate subjective bias and enhance the credibility of the review process. To address discrepancies that may arise between the independent evaluations, a third expert reviewer with extensive experience in the field will be appointed to resolve any disagreements. This additional layer of review ensures that decisions regarding article inclusion are fair, balanced, and based on a consensus of expert opinion.

The risk of bias and methodological quality of the included studies will be assessed using the Critical Appraisal Skills Programme (CASP) checklists [47]. These tools provide a comprehensive framework for evaluating the validity, relevance, and reliability of research findings. Specifically, the CASP checklists facilitate a detailed examination of study design and methodology, focusing on aspects such as validity, which pertains to the robustness and bias-free nature of the study design; relevance, which considers the applicability of the study's findings to the research question; and results, which scrutinizes the clarity, reliability, and statistical integrity of the reported outcomes. Each study will undergo a thorough assessment based on the CASP criteria, with scores recorded in a standardized format to enable systematic comparison and synthesis. The evaluation will encompass several critical domains, including selection bias, which examines the representativeness of the participant selection methods; performance bias, which assesses the potential influence of awareness of intervention allocations on outcomes; detection bias, which reviews the objectivity and blinding of outcome assessments; attrition bias, which considers the completeness and impact of dropout data on the study results; and reporting bias, which ensures the comprehensive and non-selective reporting of outcomes.

By employing these rigorous evaluation tools, the study aims to meticulously assess the methodological quality and risk of bias in the included articles. This detailed and systematic approach is crucial for enhancing the reliability and validity of the systematic review's findings. Ultimately, this ensures that the conclusions drawn are based on high-quality evidence, contributing to more robust and trustworthy insights into the research question.

2.5. Data Extraction

For the development of this SR, several critical elements will be meticulously identified and documented to ensure a comprehensive and detailed synthesis of the literature. This process involves extracting key information from each included study, which will be crucial for data analysis and interpretation. Specifically, the following data will be extracted:

- Author(s);
- Year and country of study;
- Type of study;
- Population;
- Setting;
- Intervention(s);
- Primary and secondary outcome(s);
- Results.

In this phase of the SR, a double-blind method will be employed to ensure objectivity and reduce bias in data extraction and management. Each researcher will independently extract and record data from the studies, unaware of the other's findings. This independent assessment is critical to maintaining the integrity of the data collection process. To address any discrepancies that may arise between the independently extracted data, a third expert researcher will supervise the process. This expert will review the conflicting data points and make final decisions to reconcile differences, ensuring consistency and accuracy in the data included in the review.

Additionally, a standardized data extraction form will be utilized to ensure uniformity and completeness in capturing all relevant information. This form will be pilot-tested on a subset of studies to refine and standardize the extraction process. All extracted data will be entered into a comprehensive database designed for systematic reviews, allowing for efficient data management, retrieval, and analysis.

By implementing these rigorous procedures, the SR aims to achieve a high level of methodological rigor and transparency. The meticulous identification and documentation of study elements, coupled with a robust double-blind approach and expert supervision, will enhance the reliability and validity of the review's findings. This thorough and systematic process is essential for generating robust and trustworthy evidence, ultimately contributing valuable insights to the field of research under investigation.

2.6. Data Synthesis

The included studies will be classified based on their primary and secondary objectives. This approach is essential for ensuring a precise alignment with the SR's research aims. The information extracted from these studies will be presented in accordance with the original research. If substantial variability is detected among the studies, conducting a meta-analysis may not be appropriate. Otherwise, the researchers will use the specific free-access software JASP (Version 0.19.0) [48]. JASP offers a user-friendly interface for conducting a range of statistical tests, including frequentist and Bayesian methods. It allows for sensitivity analyses and publication bias assessments, enhancing the reliability and validity of the findings. JASP's comprehensive statistical outputs and visualizations facilitate clear data interpretation and presentation, ensuring well-supported conclusions.

2.7. Strengths and Limitations

The proposed systematic review aims to fill existing gaps in the literature regarding the emotional effects of Internet device use among young people, with a particular focus on anhedonia. The results are expected to provide new evidence on the correlations between depression, Internet addiction, and anhedonia, contributing to the development of targeted intervention strategies and improving the understanding of adolescents' emotional well-being.

A significant limitation in the development of this protocol may be the extreme heterogeneity in the assessment of anhedonia. Additionally, the highly specific search strategy of the protocol might lead to the exclusion of relevant studies and pose challenges in terms of reproducibility.

3. Conclusions

This protocol aims to outline the methodology for conducting an SR on a specific topic of scientific and public interest. Given the importance of the subjects under investigation, a rigorous scientific approach is necessary to disseminate the most established knowledge regarding anhedonia caused by the excessive use of technological devices in young people.

The primary objective of our study is to examine the emotional effects of Internet-related behavior on young people, with a particular focus on anhedonia. Addressing our primary research question, an SR will be conducted to identify the impact of the excessive or problematic use of Internet-connected devices on the mood and emotions of young people. Our results aim to demonstrate a significant correlation between high levels of technology use and increased incidences of anhedonia, anxiety, and depression among young people. This underscores the necessity of monitoring and managing the use of digital devices to mitigate their negative emotional impacts. In addition, the review protocol focuses on how the extensive use of technological devices can influence various socio-behavioral developments in young people, identifying the exacerbating factors of anhedonia. Additionally, this protocol evaluates several predisposing factors for anhedonia in young people, such as the type and duration of Internet use and the quality of online interactions. Comparing our results with those of previous primary studies, we observe a consistent pattern underscoring the detrimental effects of excessive technology use on mental health. Consequently, our systematic review will contribute to this body of knowledge by providing a more delineated understanding as a secondary literature source in this specific field of health. We believe that addressing these issues requires developing targeted interventions that promote healthy technology use. Educational programs aimed at

raising awareness of the potential risks of excessive Internet use and encouraging balanced online and offline activities could be beneficial.

Our SR protocol highlights the critical need for a comprehensive and methodologically sound approach to understanding the emotional effects of Internet-related behavior in young people. By systematically reviewing the existing literature, we can identify more effective strategies for preventing and addressing anhedonia and other related mental health issues in this vulnerable population.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/psychiatryint5030031/s1.

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