Comprehensive Review of Outcome Metrics and Constructs in Studies Addressing Internet Addiction

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Abstract

Background: This study represents the first step in creating the Internet Addiction (IAD) Core Outcome Set (COS-EPOCH), aimed at identifying and synthesizing outcome measures reported in randomized controlled trials (RCTs) on IAD. Currently, there is a lack of standardized outcome measures for effectively assessing and comparing IAD study results, resulting in data heterogeneity.

Objective: The aim is to identify and synthesize outcome measures reported in randomized controlled trials (RCTs) on IAD.

Methods: Following established guidelines, trial registries and Medline databases were systematically searched, with two reviewers independently screening the literature. Outcome measures were categorized into multiple domains through a consensus process involving experts, ensuring coverage of essential aspects of IAD research.

Results: In the analysis of 86 studies, a total of 222 unique outcome measures were identified and categorized into seven major domains: internet addiction assessment, mental/emotional evaluation, laboratory tests, traditional Chinese medicine indicators, general self-assessment, follow-up measures, and adverse reactions and other specific evaluations. The most commonly reported outcome tools were the IAT, SCL-90, and SDS.

Conclusions: The study highlights significant heterogeneity in reported outcome measures, underscoring the need for COS-EPOCH to standardize these measures in IAD research.

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Abstract

Background: This study represents the first step in creating the Internet Addiction (IAD) Core Outcome Set (COS-EPOCH), aimed at identifying and synthesizing outcome measures reported in randomized controlled trials (RCTs) on IAD. Currently, there is a lack of standardized outcome measures for effectively assessing and comparing IAD study results, resulting in data heterogeneity.
Methods: Following established guidelines, trial registries and Medline databases were systematically searched, with two reviewers independently screening the literature. Outcome measures were categorized into multiple domains through a consensus process involving experts, ensuring coverage of essential aspects of IAD research.
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Keywords: problematic internet use; internet addiction disorder; core outcome assessment; core outcome set

Introduction

In the past few decades, with the rapid development of the Internet, it has become an indispensable part of our lives. Currently, the number of Internet users worldwide has surpassed 4 billion[1]. Internet addiction (IAD), also known as Pathological Internet Use (PIU) or compulsive Internet use, is a growing concern in today's digital age. PIU refers to excessive and uncontrolled use of the Internet that leads to psychological, social, and physical harm [1,2]. Epidemiological studies suggest that young people, especially college students, are particularly susceptible to PIU, with prevalence rates ranging from 1% to 10% globally [3,4]. Those with existing psychological issues, such as anxiety or depression, are at an even higher risk [5,6]. The adverse effects of PIU are manifold, including decreased academic performance, social isolation, and increased risk of mental health disorders. Moreover, prolonged Internet use can lead to physical health problems, such as poor posture and blood clots from extended periods of immobility [7]. Despite its significant impact, there is a lack of standardized outcome measures to effectively assess and compare PIU across studies, highlighting the need for a comprehensive core outcome set.

A number of systematic reviews and meta-analyses have been published, the main purpose of which is to investigate the adverse psychological and spiritual effects of IAD [8-10]. In clinical research, numerous indicators assess the adverse effects associated with PIU; however, a unified quantitative standard for evaluating IAD outcomes is lacking. Existing reviews reveal significant heterogeneity in reported outcomes after synthesis analysis, likely due to varying measurement methods employed for IAD outcome indicators [11-13]. This heterogeneity may stem from variations in the focus, scope, objectives, and context of IAD prevention interventions, as well as the challenges faced by researchers in balancing the depth and comprehensiveness of outcome measures with study feasibility and statistical power. However, if only a portion of eligible trials collected the relevant outcome data for synthesis, such heterogeneity could diminish statistical power and result in study inefficiencies. [14].

A core outcome set (COS) represents a standardized minimum set of outcomes to be measured in research focused on a specific topic—typically a particular disease in clinical research. It serves as the essential and most critical set of indicators that must be reported by clinical trials within a given health or healthcare domain. COS is designed to encompass the most relevant outcomes without limiting researchers' ability to explore additional areas [15]. For instance, in trials assessing pain medications, the primary outcome of greatest relevance is often a measure of pain, while in rehabilitation trials, it might be physical function. Generally, primary outcomes in these fields tend to correspond with one of the COS outcomes, as these are regarded as the most meaningful indicators [16]. The quality of evidence from evidence-based medicine and meta-analyses would be significantly enhanced with greater consistency in disease outcome measures. Such consistency would reduce heterogeneity in final statistical analyses, enabling more precise estimates of intervention effectiveness [17-19].

The first step in the development of COS is to determine the scope of applicability, that is, to determine which populations, interventions, and study designs COS should be applicable [16,20]. Currently, no systematic review has examined the range of outcome indices for PIU. Different outcome indicators are used in clinical studies and by physicians in decision-making, highlighting the need to define a standardized range of outcome indices for PIU. The development of a core

outcome set (COS) begins with a systematic review to identify outcomes already in use and to create a preliminary list of reporting items to consider for inclusion in the COS [16,21,22], and this review served as a starting point for the construction of the IAD's core outcome set.

Methods

Study design and registration

This systematic review will serve as the first step to construct the core index set of IAD, and serve as the groundwork for the future core index set of IAD. Systematic review is a way to study literature science, which helps to determine the scientific nature of the existing literature, draw and determine new evidence, and is the manifestation of evidence-based medicine [23]. A systematic review is a method that thoroughly collects all relevant studies on a specific clinical issue, rigorously evaluates and analyzes each one using a standardized approach, selects studies that meet quality criteria, and derives comprehensive conclusions through qualitative or quantitative analysis. Systematic reviews are applicable not only in clinical research but also in fields such as basic research, policy analysis, economic research, and more [24].

The Systematic Review of Core Outcome Assessment (COMET) manual 22 recognizes scope review as an effective method for identifying existing outcome knowledge during COS development [25]. We are doing this at the Comet Registry at :(www.comet-initiative.org). Guidelines for conducting a scoping review were followed [26], along with guidelines for reporting scoping reviews (PRISMA-ScR) [27] (Table S1). Institutional Review Board approval was not required.

Information sources and search strategy

Eight databases, including PubMed, Cochrane Library, Embase, Web of Science, CNKI, Wanfang, VIP, and SinoMed, were searched for clinical randomized controlled trials (RCTs) on the treatment of Internet addiction. The database was retrieved until 08/2024. Search terms include: Problem Internet use, Internet addition, Network addiction, IAD, PIU, etc. To avoid missed detection, intervention types were not defined. In the search strategy for PIU, the "OR" operator was used to combine all subheadings and titles with the abstract terms. The search strategy included keywords related to study design and interventions, such as 'randomized controlled trial', 'clinical trial', 'double-blind method', and 'single-blind method'. The complete search strategy, including all keywords and Boolean operators used, is detailed in Table 1.

Studies were screened based on their titles and abstracts and evaluated against defined inclusion and exclusion criteria. Data were extracted using a pre-designed table, capturing authorship details and relevant outcome indicators. Abstracts were assessed against both general and IAD-specific criteria. For selected trials, the original study reports were reviewed, applying the same eligibility criteria for confirmation. Uncertain articles were then examined in full, and those not meeting the inclusion criteria were excluded, finalizing the set of studies that met all inclusion requirements.

Table 1. Search strategy

#1	Randomized-controlled-trial in pt
#2	Randomized-controlled-trials
#3	Random-allocation
#4	Clinical trail
#5	Double-blind-method
#6	Single-blind-method
#7	# 1 or # 2 or # 3 or # 4 or # 5 or #6
#8	Problem Internet use
#9	Internet addition
#10	Network addiction
#11	IAD
#12	PIU
#13	# 8 or # 9 or # 10 or # 11 or # 12
#14	English in la
#15	#7 and #13 and #14

Inclusion and exclusion criteria

Inclusion and exclusion criteria were developed according to PICOS principles.
The inclusion criteria for registered studies were:

- P: Patients who met the diagnostic criteria for PIU in each country. Between the ages of 18 and 40.
- I/C: Interventions are not defined.
- O: No outcome measures were defined
- S: Any type of randomized trials conducted in any country.Trials in any stage of research, except withdrawn (e.g., recruiting, active, and complete).

The exclusion criteria for registered studies included:

- Non-randomized trials.
- Studies on pathologic internet use such as spending time and time to sleep but without a specific definition of PIU were also excluded.
- Studies with abstracts written in English language but with full-text in other languages were excluded. In addition, articles with only abstracts were also removed because detailed data could not be obtained so the methodologic quality of them could not be assessed.

Data extraction

All articles were independently reviewed by two investigators who were unaware of each other's actions. After the review, the full text of the literature is extracted to ensure the transparency of the whole process [28]. Put the extracted data into the data development tool recommended by the Comet Collaboration group -- Microsoft Excel [28]. Extracted data including the trial registration number, name of public or scientific research, research abbreviations, start date and end date, the types of RCT studies, national participants, interventions, inclusion criteria, sample size, participants' age, report of major and minor results, the results of measurement tools, definition, evaluation time point, and so on a series of information.

Data analysis

At present, COS for the treatment of IAD has not been established, nor is there a set of comprehensive and verified indicators for reference. All results were refined through a consensus process with members of the steering group, which consisted of academics with expertise in each outcome area and one researcher with expertise in developing COS [29]. Steering group members were asked to review and comment on the outcome areas, results consolidation, and definitions. This process is repeated until all members of the steering group reach a final consensus on the outcome area and outcome based on 100% agreement on the outcome area and outcome definition.

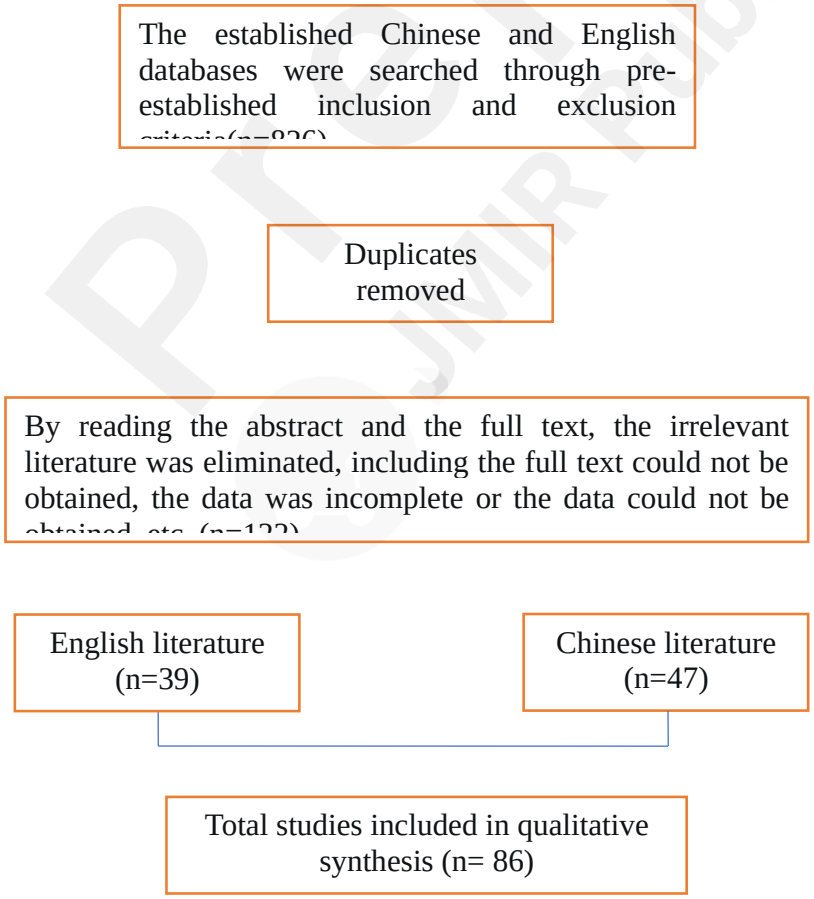

Figure 1. PRISMA diagram of study selection for inclusion into the review.

Results

Study characteristics

A total of 845 relevant literatures were obtained in the initial examination. According to the inclusion and exclusion criteria, 86 eligible literatures were finally included after re-screening by reading the full text, including 39 English literatures and 47 Chinese literatures (**Figure 1**).

Among the included literatures, the country with the most studies on PIU is China, followed by the United States. There are many different kinds of interventions, including medication, acupuncture, psychological intervention, cognitive behavioral therapy, transcranial direct current stimulation, emotional training, conventional educational therapy, and vipassanic cognitive therapy. Among the 86 studies, the most frequently used interventions were cognitive psychotherapy and electroacupuncture, which were used 26 times each, this was followed by medication, which was used 19 times (**Table 1**).

author	Intervention		Primary outcome measures
	The experimental group	The control group	
Peng Zhao	Vipassana cognitive therapy	Conventional treatment	SCL-90, ABS, PSSS, SES, SCCS, AOS
Ai-wu Chen	Conventional treatment and psychological treatment	Psychological treatment	CIAS-R
Ming-xiao Guo	Systematic nursing intervention	Routine nursing treatment	FACES-Ⅱ, Degree of Internet addiction withdrawal and psychological status
Yan-hua Cao	Psychological cognitive nursing + Medical therapy (paroxetine)	Medical therapy (paroxetine)	IAT, SCSQ
Zhi-xiao Xu	Routine treatment + group psychological intervention	Conventional treatment	SCL-90, GSES, CIAS-R
Song-you Ynag	—	—	AOS, SCL-90
Wei Chen	—	—	IAT, SCL-90
Li-ying Wang	Cognitive behavioral therapy	Waiting for treatment	CIAS-R, SCL-90, CSQ
Yan-ling Kong	Vipassana cognitive therapy	General health education	TSCS, CSES
De-zhao Zhou	Psychological + drug therapy (escitalopram + lorazepam) + acupuncture + ear pressure therapy	Psychological + drug therapy (Escitalopram + lorazepam)	CIAS-R, Degree of illness grading table, SCL-90, HAMD, HAMA
Hui-min Ren	Comprehensive psychological	Comprehensive psychological	SDS, SAS, SCL-90

	intervention and traditional Chinese medicine treatment	intervention	
Zhi Shao	—	—	CIAS-R
Yuan Zhang	Transcutaneous acupoint electrical stimulation	None-transcutaneous acupoint electrical stimulation	IAT, Traditional Chinese medicine syndrome, SDS, SAS, BIS-II
Jiang Yuan	Medication (scopolamine)+ Psychological intervention	Psychological intervention	Self-made Scale for Internet Addiction (Self-made), SDS, SAS
Fang Ji	Psychiatric routine nursing + cognitive, emotional and behavioral nursing intervention	Routine psychiatric care	SDS
Bing-hong Yue	Routine drug treatment and psychological intervention nursing	Individual psychotherapy	SDS, SAS, SCL-90
Gulzade Uysal	Health Network Use Plan	—	IAT
Fatemeh Shahrajabian	Cognitive training + emotional training	—	Go/No-go task, IAT, WMS
Maryam Kooraki	Psychodrama learning	Waiting for treatment	IAT
Yong-xin Yang	Psychological treatment / Behavioral therapy / Family therapy / Drug treatment / Comprehensive treatment		IAT, Overall performance assessment score
Ya-song Du	Cognitive behavioral therapy	—	IAT, TMDS,
Diana Guertler	—	—	IAT
Bong, S. H.	Cognitive behavioral therapy+ music therapy	Cognitive behavioral therapy	IAT, SAPS, STAIC, BIS-II
Doug Hyun Han	Drug treatment (Bupropion)	The placebo	IAT, BDI,
Yang Yang	Electric acupuncture	Psychological intervention	IAT, BIS-II, Go/No-go task
Yan-hui Lu	Routine treatment and nursing + health education intervention	Routine treatment and nursing + general education intervention	IAT, SCL-90, WHOQOL-BREF
Qin-Xue Liu	Cognitive behavioral therapy	Waiting for treatment	APIUS
Jeong Ha Park	Drug therapy (Atoroxetine)	Drug therapy (methylphenidate)	IAT, BDI
Roya Sadeghi	Lecture, discussion	—	IAT
Mahnaz Solhi	Education propaganda	—	IAT
Ming-chao Li	Psychological counseling and	Routine education and treatment	Effective rate of treatment

	conventional educational treatment					
Dieris-Hirche, J.	Psychological intervention + Cognitive behavioral therapy + Social consulting		Waiting for treatment			AICA-S, iSOCRATES, CIUS, GAD, GSES, BFI, EQ-5D-5L
Gui-feng Wu	Cognitive behavioral therapy + acupuncture treatment group		Cognitive behavioral therapy	acupuncture treatment group		SCL-90
Qing-shan Liu	Psychotherapy + other therapy		mental nursing			IAT, Symptom self-rating Scale, SDS, SAS, SAD
Gui-xiang Wang	Comprehensive nursing care		Routine nursing mode			HAMD, HAMA
Dan Wang	Psychological treatment	Behavioral therapy	Family therapy	Drug therapy	Comprehensive treatment	IAT, Overall performance assessment score
Ya-hong Li	Electric acupuncture		Psychological intervention			ISS Self-Rating Scale for Internet Addiction, SAS, SDS
Xi-xi Chen	Electric acupuncture		Psychological intervention			IAT, SCL-90, HAMD
Yuan Zhang	Electric acupuncture		Sham- Electric acupuncture			IAT, Traditional Chinese medicine syndrome, SDS, SAS, BIS-II, CGI, VAS
Tian-min Zhu	Electric acupuncture+ Psychological intervention		Electric acupuncture	Psychological intervention		IAT, VAS, SAS
Tian-min Zhu	Electric acupuncture+ Psychological intervention		Psychological intervention			IAT, SAS, HAMA
Tian-min Zhu	Electric acupuncture+ Psychological intervention		Psychological intervention			ISS Self-Rating Scale for Internet Addiction, SAS, SDS, HAMD, SRSHS
Wenliang Su	Lab Health Online self-help center□HOSC□		Online self-help center for Health in natural environment□HOSC□			IAT
Gulzade Uysal	STEP customizes the empowerment plan (STEP)		—			Internet Addiction Self-Rating Scale (Nicki)
Wei Chen	—		—			IAT, SCL-90
Jian-ming Li	—		—			SAS, SDS, SCL-90
Ben-hong Zhong	—		—			IAT, SCL-90
Park, J. H.	Drug treatment (Atoroxetine)		Drug treatment (Methylphenidate)			IAT, K-ARS, BIS-II
Xiao-yan Zhi	Clinical comprehensive intervention method		General routine intervention			BPRS, WHOQOL-BREF
Xiao-yan Zhi	Clinical comprehensive		General routine intervention			BPRS, WHOQOL-BREF,

	intervention method			
Hui-min Zheng	Comprehensive psychological treatment	Individual psychotherapy		SAS, SDS, SCL-90
Klaus Wölfling	Cognitive behavioral therapy	Waiting for treatment		AICA-S
Ren-zhihui Tang	Transcutaneous acupoint electrical stimulation + behavioral therapy	Transcutaneous acupoint electrical stimulation	behavioral therapy	CIAS-R, VAS, SCL-90 BIS-II
Xu-Hui Zhou	Drug treatment (Triselin)	The placebo		CIAS-R, SAS, SDS, TESS
Yue-xian Shi	Psychological intervention + medication	Drug treatment (Paroxetine + quetiapine)		General condition determination, Motivation Level, HAMD
Lin Zhang	Behavioral therapy + psychological care	Behavioral therapy		SAS, SDS, SCL-90
Yan-hui Lu	Behavioral therapy	General health education		FACES-Ⅱ, CIAS-R□SCL-90
De-zhao Zhou	Acupuncture plus auricular pressure therapy + conventional psychological therapy + drug therapy (escitalopram + lorazepam)	Conventional psychotherapy + drug therapy (escitalopram + lorazepam)		CIAS-R, SCL-90, HAMD, HAMA
Gui-feng Zhang	Acupuncture + behavior therapy	Acupuncture	Behavior therapy	SCL-90
Fatemeh Joonbakhsh	Cognitive behavioral therapy	Waiting for treatment		IAT
Lu-Lu Wu	Transcranial direct current stimulation	Sham -Transcranial direct current stimulation		Effective rate
Beutel, M.	Cognitive behavioral therapy	Waiting for treatment		Self-made self-rating scale for Internet addiction
Susanne Jager	Cognitive behavioral therapy	Waiting for treatment		AICA, GAF, BDI
Li Hui	Electroacupuncture + psychological intervention	Electroacupuncture	Psychological intervention	IAT, SCL-90
Sung Yong Park	Cognitive behavioral therapy	Virtual Reality Therapy		IAT
Wenliang Su	Health online self-help center	The natural environment		IAT
Birte Walther	Special Courses (Homemade)	Regular courses		Self-made survey scale
Wenjie Yang	Cognitive behavioral therapy	Waiting for treatment		IAT, IAIMS
YANG Yang	Electric acupuncture	Psychological intervention		IAT, BDI-II
ZHU Tian-min	Electric acupuncture	Psychological intervention		IAT, WMS

	+Psychological intervention			
Alavi, S. S.	Cognitive behavioral therapy	Waiting for treatment		IAT, WHOQOL-BREF, SCL-90
Drks	Network psychological intervention	Waiting for treatment		iSOCRATES, EQ-5D-5L, GAF
Chi, Ctr Inr	Electric acupuncture	Psychological intervention	Waiting for treatment	IAT, SCL-90, PSQI, SDS, SAS
Chi, Ctr Trc	Electric acupuncture+ Cognitive behavioral therapy	Electric acupuncture	Psychological intervention	SCL-90, HAMA, BDI-II
Mozhan Naderi	Transcranial direct current stimulation	Sham -Transcranial direct current stimulation		IAT
Kristiana Siste	Cognitive behavioral therapy + cognitive training	Cognitive behavioral therap	—	KDAI, GAMES, MoCA-Ina, TMT-B, SOGS, SDQ,
Wei Peng	Electroacupuncture + psychological intervention	Electroacupuncture	Psychological intervention	IAT, SDS, HAMD
Xueqing Zhang	the exercise group the tai chi group	Waiting for treatment		IAT□fatigue symptoms
Fatemeh Shahrajabian	eWMT	—		inhibition, attention, and working memory
Yu Pu	SFGC	Waiting for treatment		CIAS-R, EEG results
Haosen Ni	MM training+PMR training	Waiting for treatment		DSM-5-TR, gaming craving
Christina R Galanis	explanation of problem gaming	—		AQ, USS
JinDong Liu	Mindfulness training + agomelatine tablets	agomelatine tablets		HAMA, HAMD, The Internet use questionnaire score
Wenting Cai	Song scheeren+Repetitive transcranial magnetic stimulation treatment	Song scheeren		Young-IAT, SDS, SAS, SCL-90
Wenfang Hu	Repetitive transcranial magnetic stimulation treatment	The liver resolve depression capsule		IAT, VAS, SCL-90

SCL-90: Symptom checklist-90; ABS: Affective Balance scale; PSSS: Perceived Social Support Scale; SEC: Self-esteem scale; SCCS: Self-Consistency and Congruence Scale; AOS: Acceptance of Others; GSES: General Self-Efficacy Scale; CIAS-R: Revised Chen Internet Addiction

Scale; CSQ: Coping Style Questionnaire; IAT: Internet Addiction Test; SDS: Self-rating depression scale; SAS: Self-rating Anxiety Scale; WHOQOL-BREF: World Health Organization Quality of Life Assessment; FACES-Ⅱ: Intimacy and Adaptability Scale; TSCS: Tennessee Self-Concept Scale; CSES: Core Self-evaluations Scale; SCSQ: Simplified Coping Style Questionnaire; HAMD: Hamilton Depression Scale; HAMA: Hamilton Anxiety Scale; SAD: Social Avoidance and Distress Scale; BIS: Barratt Impulsiveness Scale-II; VAS: Visual analogue scale; SRHMS: Self-rated Health Measurement Scale; CGI: Clinical General Impression Scale; BPRS: Brief Psychiatric Rating Scale; TESS: Treatment Emergent Symptom Scale; TMDS: Time Management Propensity Scale; BID: Beck Depression Inventory; GAF: Global Assessment Function; APIUS: Adolescent Pathological Internet Use Scale; WMS□Wechsler Memory Scale; SAS-SV: Smartphone Addiction Scale; STAIC: State Trait Anxiety Inventory for Children; PSQI: Pittsburgh sleep quality index; CIUS: Compulsive Internet Use Scale; GAD: General Anxiety Disorder; GSES: General Self-Efficacy Scale; BFI: The Big Five Inventory; EQ-5D-5L: EuroQol Five Dimensions Questionnaire; AQ: Attribution Questionnaire
; USS: Universal Stigma Scale

Outcome domains

A total of 222 primary outcome indicators were included in the 86 included literatures. After further analysis, 222 outcome indicators could be classified into 7 categories of indicator domains. The outcome indicators included in the literature were classified into 7 types, including efficacy observation of Internet addiction, mental/emotional measurement, laboratory examination, TCM indicators, general self-test, follow-up, adverse reactions and other special measures (**Figure 2**).

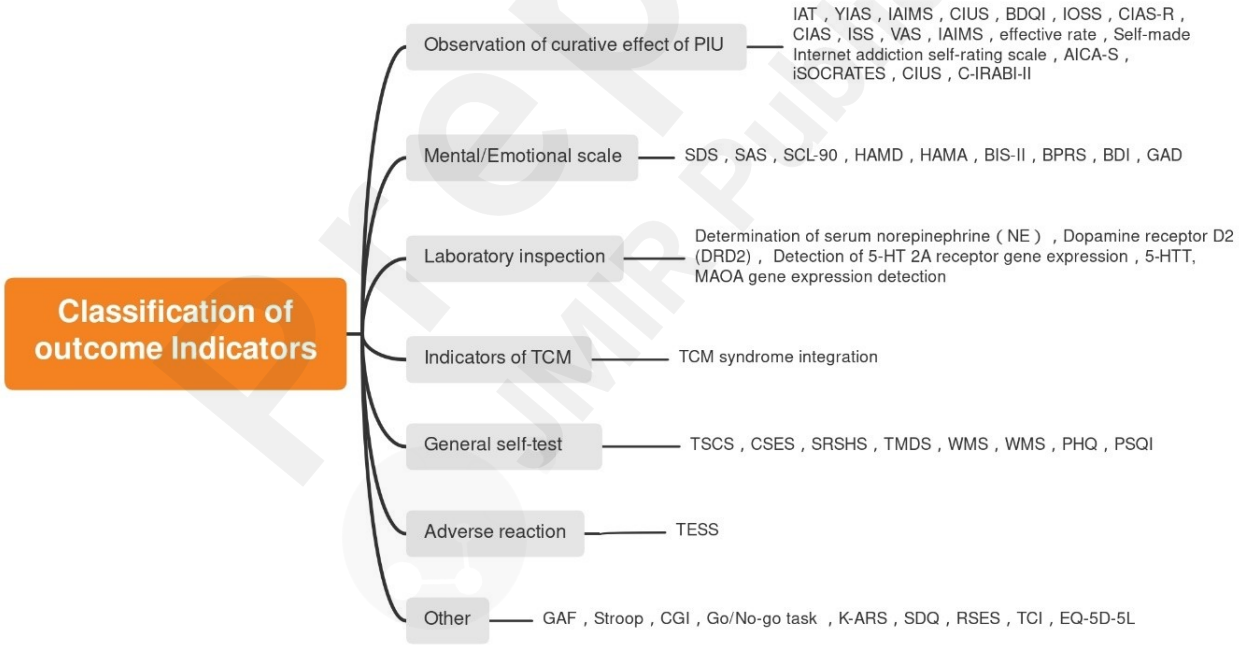

Figure 2. Classification of outcome Indicators

A total of 222 outcome indicators were reported in 86 literatures. The number of indicators in a single study was at least 1 and up to 9. The combination of Internet addiction Diagnosis Scale (IAT) and mental health symptom Checklist 90 (SCL-90) was used most frequently, and 25 studies used the evaluation indicator IAT. The remaining 61 literatures used more than 3 outcome indicators, and only two studies used only one evaluation indicator. Just ordered by frequency according to the index,

evaluation index of the top 10: Internet Addiction Diagnostic Scale (IAT), Symptom Checklist-90 (SCL-90), Self-rating anxiety Scale (SAS), Self-rating depression scale (SDS), Self-rating Internet Addiction Scale (CIAS-R), Hamilton Depression Scale (HAMD) score, Barratt impulsiveness scale, The World Health Organization Quality of Life Rating Scale brief version (WHOQOL-BREF), Hamilton Anxiety Scale (HAMA) score, and Beck Depression Scale (BDI-II) were used. (Figure 3)

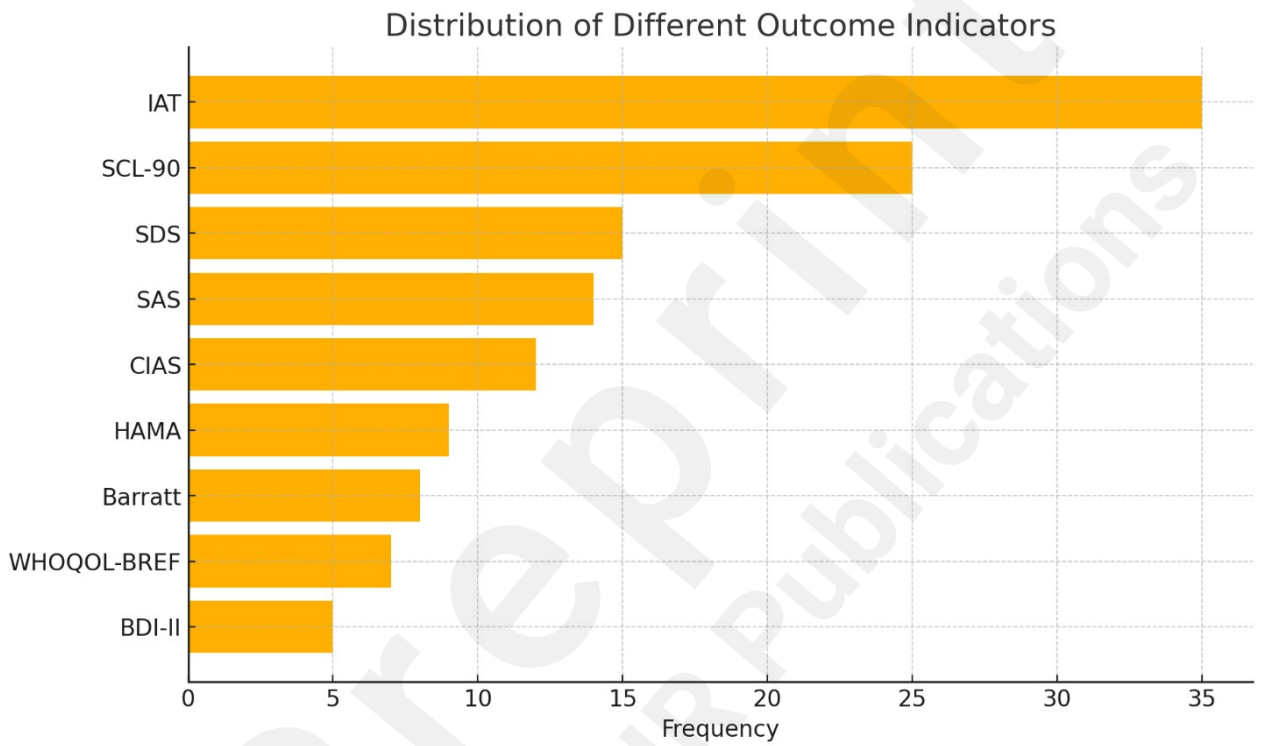

Figure 3. The top 10 most frequently used outcome indicators

DISCUSSION

Review findings suggest considerable heterogeneity in the reporting of outcomes in PIU prevention interventions. Among the 86 included studies, a total of 222 outcome indicators were used. These indicators were divided into seven broad categories; however, no single study reported outcomes in all seven categories, which is unsurprising given the diversity of outcome domains identified in this review. Some studies reported only one outcome indicator, while others reported more than three, highlighting the variability in measurement approaches. This heterogeneity suggests scope for streamlining the outcomes that are collected and reported in PIU prevention interventions to better facilitate comparability across studies.

But none of the studies included looked at outcomes based on the age of PIU patients, such as adolescents and adults, who may have different reasons for switching to PIU [30]. Previous studies have shown a positive correlation between PIU and depression. However, most of the included studies did not measure depression as an outcome indicator, which I think is important [31-34]. Most

studies only use the IAT Addiction Scale as the sole outcome indicator, which is the simplest and most intuitive measure, but it is far from sufficient, at least for adolescent patients. Some studies take the academic performance of college students and even middle school students as one of the outcome indicators, which is worthy of encouragement, because many studies show that academic performance is closely related to PIU, which should not be ignored [35].

Heterogeneity in the outcomes reported and collected in PIU prevention interventions currently poses a significant challenge in evaluation and knowledge synthesis and is likely leading to research waste. This heterogeneity is reflected in the number of individual outcomes included across studies and the low frequency with some outcomes are reported, and it is disappointing not to be able to harmonize outcome indicators for the same disease. Although it is inconceivable that all or many studies will be able to measure and report all identified outcomes, the lack of minimal consistency in the measurement and reporting of most outcomes affects our ability to compare and contrast across studies to determine the effectiveness of interventions, as well as future clinical observations of efficacy for the disease. The results of this comprehensive and wide-ranging review will inform the development of COS, ultimately with the aim of reducing data collection and reporting discrepancies, as well as reducing barriers to data synthesis, so that future researchers can achieve consistency in outcome metrics for PIUs studies. This will ultimately allow for a more comprehensive and robust analysis of the components of the most effective PIU prevention interventions and a better understanding of which populations they are most effective for, or more specific outcome indicators for populations at specific stages. While COS offers significant benefits in suggesting a minimum set of results to be collected in a particular field, it is important that innovations in measurement (e.g., the use of simple tools or techniques) continue to reduce the burden on trials and responders. This will ensure that the benefits of COS are realized while minimizing the tradeoffs that researchers face between the power and breadth measured in the study.

This heterogeneity poses significant challenges for synthesizing evidence and limits the ability to draw comprehensive conclusions about the effectiveness of different interventions. The lack of standardized outcome measures hampers the comparability of studies, reducing the statistical power of meta-analyses and contributing to research waste. For instance, the use of diverse psychological scales and diagnostic tools for PIU leads to variations in reported outcomes, making it difficult to aggregate data across studies [36, 37].

Moreover, the diversity in intervention types and study populations adds another layer of complexity. Interventions targeting different age groups, such as adolescents versus adults, may require different outcome measures [38]. Adolescents might be more affected by interventions aimed at improving academic performance and social skills, while adults may benefit more from interventions targeting workplace productivity and mental health. Cultural and contextual differences also play a role in how PIU is manifested and measured, necessitating adaptable outcome sets that can be applied across various settings [39].

This review represents the first phase in the development of the core Result set (COS EPOCH) of PIU. According to COMET guidelines, the results identified in this review will form the basis of a consensus process for establishing PIU intervention recommended outcomes and outcome

measurement tools [40]. The COMET Guide provides comprehensive guidance on the development of COS, which includes recommendations on best practices for building consensus through the use of Delphi techniques and face-to-face consensus meetings with relevant stakeholders. A Delphi study would assess the importance of different outcomes, using a priori criterion to prioritize outcomes. Representatives of relevant stakeholder groups will then attend face-to-face consensus meetings to discuss the findings of the Delphi study and agree on the final inclusion of COS [19].

This study has several limitations. First, the interventions included were not considered, which may influence the outcome indicators. Second, social and environmental factors were overlooked; studies vary by country or region, and the participants included differ, meaning the outcome indicators determined via the Delphi method may be insufficient. Third, it is challenging to control survey error in this study, as it is essentially a secondary analysis based on published studies, which may contain various issues, such as article quality control and patient selection bias. Our findings also underscore the need for systematic updates to trial registration records, including comprehensive information on collected and reported results, publication status, and trial progress, as more complete data can yield more authoritative outcomes. Within the scope of our study and available resources, we have included trial registration records or other unreported results from related publications that we were able to locate in our review.

Future studies should address these limitations by incorporating a COS tailored for PIU. The development of COS will involve stakeholders from various backgrounds, including clinicians, researchers, and patients, to ensure the relevance and comprehensiveness of the selected outcomes. A well-developed COS will facilitate more consistent and reliable data collection, enabling better synthesis of evidence and more robust conclusions regarding the effectiveness of PIU interventions [41-45].

The findings also underscore the importance of updating trial registration records with complete information on collected and reported outcomes. Accurate and detailed trial records will enhance the transparency and reproducibility of research, providing a more reliable basis for systematic reviews and meta-analyses. Additionally, harmonizing outcome measures across studies will reduce discrepancies in data reporting and minimize barriers to data synthesis.

The strengths of this review include adherence to published scope review guidelines and COMET program guidelines [27,35]. Another important advantage is that we searched both clinical trial registries and published academic literature, and also searched and included Chinese and English literature, making our inclusion broader and more comprehensive

CONCLUSIONS

This review identifies significant heterogeneity in outcomes measured and reported in PIU intervention trials. Seven result domains were identified and a large number of results are currently reported in relatively few studies. As Internet use becomes an integral part of humanity, more and more people are suffering from PIUs, and effective and efficient interventions are needed. The results of this scoped review will support the development of COS EPOCH, with the aim of guiding PIU intervention studies and facilitating the synthesis of knowledge between studies to ensure that

investigators obtain a more comprehensive domain of indicators in trials involving patients with PIU.

CONFLICT OF INTEREST

The authors declare that they have no competing interests. The authors declare that they have no personal financial interests.

AUTHOR CONTRIBUTIONS

TMM, YM and JLS: conceptualization and methodology. DPW and YM: funding acquisition. TMM : supervision. YM, JLS and DPW: investigation. TMM: writing – original draft. All authors contributed to the article and approved the submitted version.

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