Review article

Problematic internet use and cannabis consumption: A scoping review

Kellie-Anne Bélisle [a], Anne-Marie Auger [a], Catherine Hudon [a,b], Isabelle Dufour [a],
Roni Deli Houssein [a], Rasoamiadana Volanirina Rasolofomamonjy [a], Magaly Brodeur [a,b,*]

[a] *Department of Family Medicine and Emergency Medicine, Université de Sherbrooke, Sherbrooke, Canada*
[b] *CHUS Research Center, Université de Sherbrooke, Sherbrooke, Canada*

A B S T R A C T

Objectives: As a growing body of research has linked cannabis consumption and problematic Internet use (PIU), more insight is needed to interpret this association. This scoping review aims to summarize the available literature on PIU and cannabis consumption and to underlie future avenues of research.
Methods: We conducted an electronic search including all papers published from database inception until May 2023, using keywords related to PIU and cannabis use in the following databases: Academic Search Complete, APA PsychInfo, PubMed, SocINDEX, MEDLINE, CINAHL, and Psychology and Behavioral Sciences Collection. Studies eligible for this review had to meet the following criteria: (1) the primary theme had to be related to both PIU and cannabis consumption, (2) articles were published in a peer-reviewed journal, (3) articles were available in English or French, and (4) articles were not systematic reviews.
Results: After screening 12,165 articles, 48 articles were retained for full-text reading and seven articles were included in this review.
Conclusion: The available articles reveal a potential association between cannabis use and PIU, though operationalization heterogeneity challenges a conclusive interpretation of the results. Further research with improved measurement consistency is required to draw more robust conclusions.

1. Introduction

Around the world, 219 million people (4.3 % of the world's population) consume cannabis (United Nations Office on Drugs and Crime, 2023). Cannabis consumption has been associated with many risk factors, such as impaired driving, damaged cognitive development, impaired psychomotor performance, and the development of chronic health issues (chronic bronchitis, lung inflammation, etc.), as well as mental health issues, such as the aggravation of schizophrenia (World Health Organization, 2016). People with cannabis use disorder are particularly more prone to develop concomitant mental health disorders, such as anxiety disorders, depressive disorders, and psychotic disorders (Connor et al., 2021; Perales et al., 2021). Furthermore, intake of other drugs such as cocaine, or alcohol consumption can result in the development of behavioral addictions defined by preoccupation with and decreased control over a range of rewarding but destructive

behaviors other than substance use (Connor et al., 2021; Perales et al., 2021; Sinclair et al., 2016).

Due to technological advancements in our societies, behavioral addictions have started to emerge worldwide (Niewiadomska et al., 2016). One is problematic Internet use (PIU), described as a behavioral addiction characterized by health or daily life disruptions due to excessive or impulsive Internet use (Lanthier-Labonté et al., 2020). Past literature used a variety of terms to describe behavioral addiction regarding online activities, such as "Internet addiction," "pathological Internet use," "screen time sedentary behaviors" (STSB) and "heavy Internet use." (Lanthier-Labonté et al., 2020). Due to the lack of a standardized definition of Internet addiction in the literature, this research employed "problematic Internet use" to encompass all forms of Internet or cyber addiction.

PIU can concern online activities, such as dating applications, social media, online shopping, video watching, and information research

(Petry, 2016). As these online activities can be seen as inoffensive, the consequences related to PIU can be devastating, as they can lead to social isolation, family problems, psychological distress, and suicide (Kim et al., 2016; Lopez-Fernandez and Kuss, 2020).

Cannabis use and, more specifically, cannabis use disorder often seem to be associated with PIU (Kuss and Lopez-Fernandez, 2016; Lanthier-Labonté et al., 2020; Weinstein and Lejoyeux, 2010). The relationship between PIU, alcohol, and cannabis consumption in youth has been systematically reviewed by Lanthier-Labonté et al. (2020), who identified that some groups, such as teenage cannabis users, are more at risk of presenting PIU (Fernández-Aliseda et al., 2020; Lanthier-Labonté et al., 2020; Rücker et al., 2015). However, our knowledge of the association between cannabis and PIU in an age-diverse population remains limited (Baroni et al., 2019). The relationship between cannabis use and PIU, as well as the associated risks, remains difficult to grasp, given the scarcity of studies exploring the mechanisms underlying this association among the adult and youth population (Baroni et al., 2019). As such, this scoping review aims to describe the present literature regarding PIU and cannabis consumption within the broader population. Considering that public health concerns are growing about cannabis use and, more recently, PIU, it is crucial to examine possible links between these two risky behaviors to better understand their relationship and to highlight future research avenues on this important topic.

2. Methodology

As a scoping review, this article is based on the methodological framework developed by Arksey and O'Malley (2005) and refined by Levac et al. (2010) in accordance with PRISMA guidelines (Tricco et al., 2018). The purpose of scoping reviews is to provide a comprehensive overview of the literature on a new subject of research and to uncover potential gaps that merit further research. Five key steps are required for conducting scoping reviews: (1) identifying the research question, (2) identifying relevant studies, (3) selecting studies, (4) charting the data, and (5) collating, summarizing, and reporting results (Arksey and O'Malley, 2005; Levac et al., 2010). The main question directing this review is: "What is the state of knowledge regarding PIU and cannabis consumption?"

2.1. Literature research

An electronic literature search including all papers published from database inception to May 2023 was initiated through the following databases via the EBSCOhost search engine: Academic Search Complete, APA PsychInfo, PubMed, SocINDEX, MEDLINE, CINAHL, and Psychology and Behavioral Sciences Collection. The search strategy was developed by K-AB in collaboration with an academic health librarian using controlled vocabulary (MeSH) and keywords relevant to the concepts of "problematic Internet use" and "cannabis" under the supervision of A-MA and MB. The complete search strategy is presented in Fig. 1.
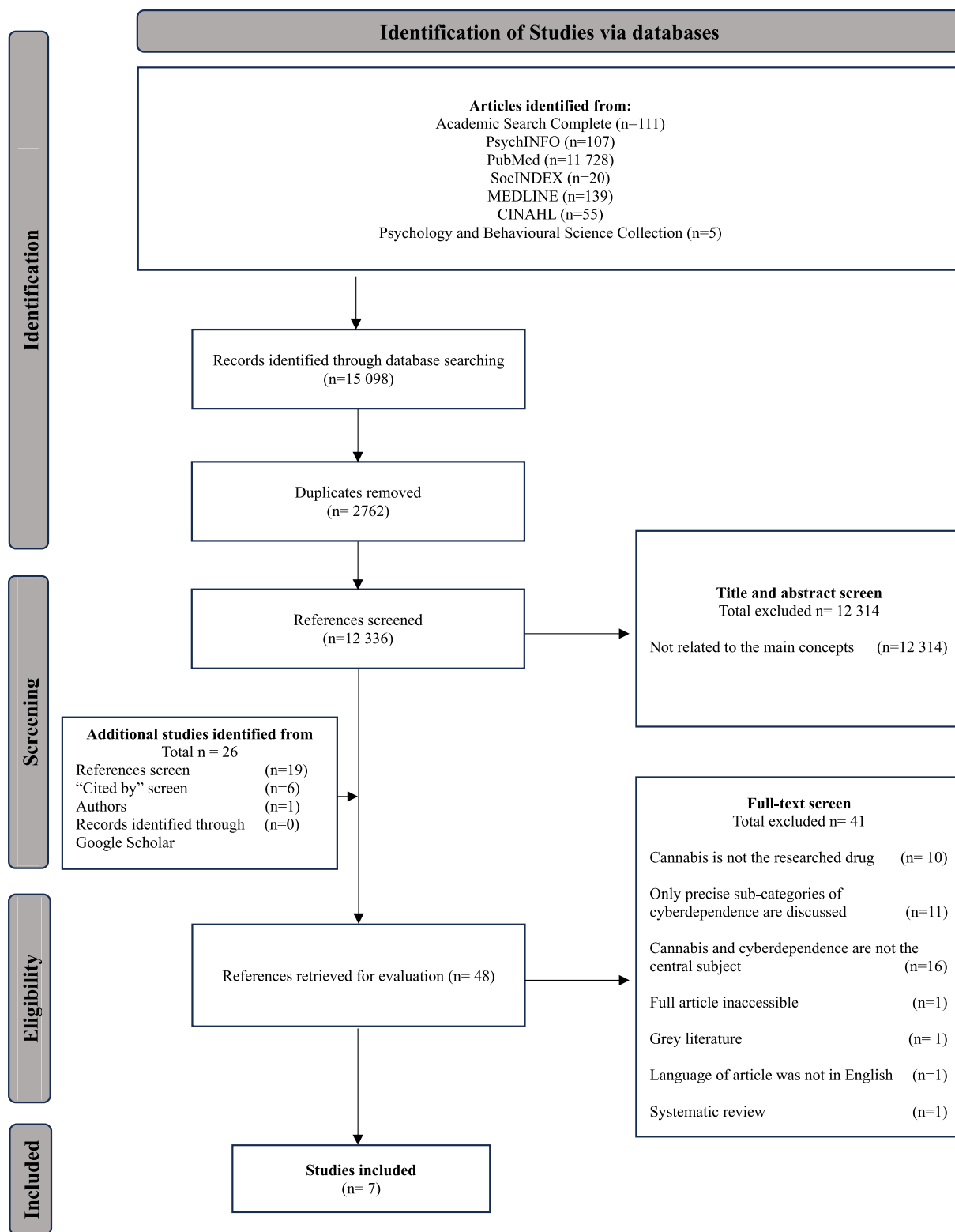
2.2. Study selection

Following the database search, all identified literature was imported into Zotero reference management software (v6). The search generated 12,165 articles, of which 2762 remained after duplicates were removed. Titles and abstracts were screened by K-AB to determine eligibility for a full-text review. To be selected, the studies had to meet the following inclusion criteria: (1) the primary theme had to be related to both PIU and cannabis consumption, (2) articles were published in a peer-reviewed journal, (3) articles were available in English or French, and (4) articles could not be systematic reviews. All articles were subjected to full-text screening by K-AB and approved by A-MA and MB. A total of 48 articles were retained for full-text review, and the final selection was made by a collaborative consensus with A-MA and MB. Research was also done on Google Scholar but was limited to the first 10 pages of results for additional articles, whereby none were found. Following the full-text review, seven articles were included in the review. The references, authors, and "cited by" of each included article were scanned for additional studies relevant to the review. The flowchart of the study selection and screening process is shown in Fig. 2.

2.3. Data extraction and analysis

To support the full-text screening and the descriptive analysis, a charting form was used to facilitate team discussion and approval. We extracted the following information for each article: authors, year of

Keywords	
Cyberdependence	*Cannabis*
(cyberaddict* OR cyberdepend* OR "online addict" OR "technology addict*" OR"internet addict*" OR "internet use" OR "internet user*" OR "internet usage" OR "internet depend*" OR "internet behav*" OR "internet habit*" OR "internet utilization" OR "internet utilisation" OR "web use" OR "web user*" OR "web usage*")	("cannabis consum*" OR "marijuana consum*" OR "cannabis use" OR "cannabis user*" OR "marijuana use" OR "marijuana user*" OR "cannabis abuse*" OR "marijuana abuse*" OR "cannabis misuse*" OR "marijuana misuse*" "cannabis consum*" OR "marijuana consum*" OR "cannabis use" OR "cannabis user*" OR "marijuana use" OR "marijuana user*" OR "cannabis abuse*" OR "marijuana abuse*" OR "cannabis misuse*" OR "marijuana misuse*" OR "marijuana smoking" OR hemp* OR marij* OR canna* OR phytocanna* OR hashish* OR hops* OR Utica* OR Tetrahydrocan* OR "cannabis addict*" OR "marijuana addict*" OR "cannabis disord*" OR "marijuana disord*" OR "cannabis depend*" OR "marijuana depend*")
Databases searched	
Academic search complete, APA PsychInfo PubMed SocINDEX MEDLINE CINAHL Psychology and Behavioral Sciences Collection	

Fig. 1. Search strategy developed using the concepts of "problematic Internet use" and "cannabis".

Identification of Studies via databases

Identification

Articles identified from:
Academic Search Complete (n=111)
PsychINFO (n=107)
PubMed (n=11 728)
SocINDEX (n=20)
MEDLINE (n=139)
CINAHL (n=55)
Psychology and Behavioural Science Collection (n=5)

Records identified through database searching
(n=15 098)

Duplicates removed
(n= 2762)

Screening

References screened
(n=12 336)

Title and abstract screen
Total excluded n= 12 314

Not related to the main concepts   (n=12 314)

Additional studies identified from
Total n = 26
References screen   (n=19)
"Cited by" screen   (n=6)
Authors   (n=1)
Records identified through   (n=0)
Google Scholar

Eligibility

References retrieved for evaluation (n= 48)

Full-text screen
Total excluded n= 41

Cannabis is not the researched drug   (n= 10)

Only precise sub-categories of
cyberdependence are discussed   (n=11)

Cannabis and cyberdependence are not the
central subject   (n=16)

Full article inaccessible   (n=1)

Grey literature   (n= 1)

Language of article was not in English   (n=1)

Systematic review   (n=1)

Included

Studies included
(n= 7)

Fig. 2. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram illustrating the selection process of studies on the association between Problematic Internet Use and cannabis use/dependence.

publication, study location, number of participants, age of participants, aim of the study, definition of the main concepts (cannabis and PIU), methodology, outcome measures, and important results. The extraction was completed by K-AB and validated by A-MA and MB. The results were then summarized, and narrative synthesis was used to report the findings (Popay et al., 2006).

2.4. Ethics statement

This research project has been ethically and scientifically approved by the Research Ethics Committee and by the CIUSSS de l'Estrie - CHUS scientific evaluation committee on July 19, 2023 (reference number: 2024–5139-CyberD-Cannabis).

3. Results

The characteristics of the seven included articles are presented in Table 1.

3.1. Study characteristics

Four studies were conducted in Europe, including one in Spain (Perales et al., 2021), one in Italy (Baroni et al., 2019), one in Switzerland (Rücker et al., 2015) and one in Poland (Niewiadomska et al., 2016). Three studies were conducted in Canada (Doggett et al., 2019, 2021; 2020; Neilson and Lin, 2019). All studies were published between 2015 and 2021, with a majority published after 2018 ($n = 5$). The number of participants in the selected studies ranged from 183 to 50,801. Four articles focused on an adolescent population with an age range of 12–17, and all were high school students (Doggett et al., 2019, 2021; Niewiadomska et al., 2016; Rücker et al., 2015). Perales et al. (2021) used a sample of university students, with an average age of 21 years. Baroni et al.'s (2019) sample was composed of individuals aged 18 and over attending a rehab program for drug addictions. Finally, Neilson and Lin (2019) used a random sample of Canadians living in private residences aged 12 and over.

3.2. Methodology

All seven studies were quantitative. Four were cross-sectional (Doggett et al., 2019; Neilson and Lin, 2019; Perales et al., 2021; Rücker et al., 2015), one was longitudinal and cross-sectional (Doggett et al., 2021), and two were not precise about their methods but were quantitative (Baroni et al., 2019; Niewiadomska et al., 2016). In three studies, participants responded to a questionnaire in a pen-and-paper format during class time (Doggett et al., 2019, 2021; Perales et al., 2021), while in one study, the questionnaire was filled out on school computers (Rücker et al., 2015). Two articles used interviews, one by phone or in person (Neilson and Lin, 2019), while the other did not specify the type of interview (Niewiadomska et al., 2016). Lastly, one article used online platforms for the completion of self-assessment questionnaires (Baroni et al., 2019).

3.3. Gender

Participants' gender or sex was asked in every study through self-reported questionnaires or interviews. Three studies assessed for 'sex' (i.e., male or female) (Baroni et al., 2019; Doggett et al., 2021; Neilson and Lin, 2019) and three other studies assessed for 'gender' (i.e., men or women) (Doggett et al., 2019; Niewiadomska et al., 2016; Rücker et al., 2015). Only one study assessed gender as a non-binary construct (Perales et al., 2021). Out of the seven studies, four measured gender differences and their relationship with PIU and cannabis consumption (Baroni et al., 2019; Doggett et al., 2019; Neilson and Lin, 2019; Perales et al., 2021). Perales et al. (2021) found no significant differences between men and women regarding the strength of the relationship between cannabis abuse/dependence and MultiCAGE scores for an array of problematic behaviors. Similarly, Neilson and Lin (2019) found no sex differences regarding sedentary behavior and cannabis use. Baroni et al.'s (2019) findings showed no sex-related differences regarding their scores to the "Questionario sull'Utilizzo delle Nuove Tecnologie"(-QUNT), although men who used cannabis had slightly higher scores on the 'social withdrawal' and 'abstraction from reality' items. Lastly, Doggett et al. (2019) observed that "for each additional hour of average STSB, the likelihood of more frequent cannabis use increased by 5% for males, and 3% for females", however they did not specify whether the difference between them was significant. They also observed a significant association between watching/streaming TV shows/movies or playing video games and frequent cannabis use among females but not males.

3.4. Cannabis and PIU conceptualization

The selected studies did not all define or assess the use of cannabis and PIU in the same manner. For example, Perales et al. (2021) and Baroni et al. (2019), were interested in cannabis *dependence,* involving a strong desire to take the drug, difficulty regulating its use, and persistent usage despite its harmful effects. However, only Perales et al. (2021) used validated instruments to measure dependence to cannabis (i.e., Severity of Dependence Scale and Cannabis Abuse Screening Test). In Baroni et al.'s study there is no mention of an assessment of the level of dependance. Rather, given the sample consisted of individuals following a drug rehabilitation program, the authors imply the existence of substance dependance among their sample. On the other hand, Doggett et al. (2019), Doggett et al. (2021), Neilson and Lin (2019), Niewiadomska et al. (2016), and Rücker et al. (2015) were interested in the *consumption or use* of cannabis by looking at frequency of use only. Doggett et al. (2019), Doggett et al. (2021) and Neilson and Lin (2019) assessed cannabis use over the past 12 months, while Niewiadomska et al. (2016) and Rücker et al. (2015) measured use in the past 30 days. Only Niewiadomska et al. (2016) employed a validated instrument section (i.e., Maudsley Addiction Profile) which explores the frequency of substance use, amount consumed, and route of administration (Marsden et al., 1998).

The conceptualization of PIU also varied within the selected studies. Perales et al. (2021), Baroni et al. (2019), Rücker et al. (2015), and Niewiadomska et al. (2016) described PIU as a behavioral problem/addiction relating to use of the Internet or online activities that affect one's functioning, such as social, work, and psychological spheres while also producing symptoms similar to those of drug addiction. Of these, Perales et al. (2021), Rücker et al. (2015), and Niewiadomska et al. (2016) used validated questionnaires to measure PIU (namely, the MultiCAGE CAD-4, and the French and Polish adaptations of the Internet Addiction Test, respectively). Baroni et al. (2019) used the QUNT, a self-assessment questionnaire which was developed by the authors for that research study, and contains questions related to social networks, time spent online, abstraction from reality, loss of control, ludopathy, and addiction to social networks. However, the QUNT is not mentioned to be a validated measure. Moreover, Doggett et al. (2019), Doggett et al. (2021), and Neilson and Lin (2019) conceptualized PIU as "excessive screen time sedentary behavior" (STSB), which refers to the act of engaging in screen time activities while being sedentary (e.g., watching TV, playing video games, etc.), and mainly focused on the time spent in front of a screen. Only Neilson and Lin (2019) established a cut-off for STSB to be considered excessive, which they set at 35 h per week of combined STSB activities, based on evidence from a large, pooled analysis of prospective studies (Ekelund et al., 2016). The definitions used in the included articles for each term are described in Table 2.

3.5. PIU and cannabis consumption

In six articles, the authors aimed to explore the association between PIU and cannabis consumption (Baroni et al., 2019; Doggett et al., 2019; Neilson and Lin, 2019; Niewiadomska et al., 2016; Perales et al., 2021; Rücker et al., 2015) while Doggett et al. (2021) wondered if the relationship between cannabis consumption and STSB could be mediated by internalized symptoms (anxiety, depression, etc.). Six studies found an association between cannabis use and PIU (Baroni et al., 2019; Doggett et al., 2019, 2021; Neilson and Lin, 2019; Niewiadomska et al., 2016; Perales et al., 2021). Additionally, Doggett et al. (2021) also found an indirect association between cannabis use and PIU through a partial mediator (internalized symptoms), while Rücker et al. (2015) found a link between cannabis and PIU only through tobacco use.

Perales et al. (2021) aimed to study cannabis use problems and their association with non-substance-related behavioral problems. Their results indicated that out of all the behaviors assessed cannabis abuse was only significantly associated with a higher risk of problematic

Table 1

Summary of characteristics and main findings of studies on the association between Problematic Internet Use and cannabis use/dependence selected for the scoping review (database inception – May 2023).

Authors, year	Country	Population/ sample	Methodology	Assessment Tools	Objectives	Estimates of interest	Conclusion
Perales et al. (2021)	Spain	$N = 856$ Sex/Gender: Male = 37.6 % Female = 62.4 % Age: ~21.1 years Students at the University of Granada.	Cross-Sectional Study Quantitative	PIU: MultiCAGE CAD-4 scale. Cannabis: SDS and CAST	Explore the independent association between cannabis use problems and an array of non-substance-related behavioral problems.	Mixed-effect regressions: CAST and Multi-CAGE CAD-4 Videogaming (IRR $= 1.07, p < 0.01$) CAST and M Multi-CAGE CAD-4 Internet (IRR $= 1.00, p = 0.94$)	Videogaming was the only MultiCAGE dimension clearly associated with cannabis abuse and dependence according to mixed-effect regressions. No significant differences were detected between males and females in the strength of relationships between cannabis abuse/ dependence and MultiCAGE scores, despite differences on individual scores.
Doggett et al. (2021)	Canada	$N = 28,269$ Sex/Gender: Male = 46.3 % Female = 53.7 % Age: ~ 13–14 years High school students	Cross-sectional and longitudinal study Quantitative	PIU: Hours per day spent on screen-related activities. Cannabis: Frequency of cannabis use in the last 12 months	Explore the potential mediation of internalized symptoms in the relationship between STSB and cannabis use.	Mediation: Direct path STSB and cannabis use (β $= 0.90, p < 0.01$) Indirect path STSB and cannabis use – through internalized symptoms (β $= 0.03, p < 0.01$)	Internalized symptoms partially mediated the association between STSB and cannabis use, but STSB also mediated the association between internalized symptoms and cannabis use.
Doggett et al. (2019)	Canada	$N = 44,011$ Sex/Gender: Male = 50.0 % Female = 50.0 % Age: ~ 14 to 18 years High school students	Cross-sectional study Quantitative	PIU: Hours per day spent on screen-related activities. Cannabis: Frequency of cannabis use in the last 12 months	Examine the association between STSBs and frequency of cannabis use.	Ordinal logistic regressions: STSB and cannabis use freq. Females (OR = 1.05, 95 % CI 1.05–1.06) Males (OR = 1.03, 95 % CI 1.02–1.04)	The study found that more time spent on STSBs was associated with more frequent cannabis use. This study's findings suggest that STSBs are a risk factor for cannabis use among youth.
Neilson and Lin (2019)	Canada	$N = 50,801$ Sex/Gender: Male = 49.0 % Female = 21.0 % Age: ≥ 12 Random sample of Canadian residents living in private dwellings.	Cross-sectional study Quantitative	PIU: Hours spent on leisure sedentary behaviors in the last three months Cannabis: Frequency of cannabis use over the past 12 months, excluding one-time use over lifetime	Examine the association between use of cannabis) and leisure-time sedentary behavior.	Logistic regression (fully adjusted model): STSB and cannabis use ("Never" = reference) Occasional (OR = 1.3, 95 % CI 1.1–1.5) Heavy (OR = 1.8, 95 % CI 1.4–2.3)	There was a significant positive association between heavy or occasional cannabis use and sedentary behavior ($\geq$ 35 h/week in leisure time) after controlling for covariates, particularly among adults aged 25–44 and people living in non-rural settings.
Baroni et al. (2019)	Italy	$N = 183$ Sex/Gender: Male = 80.9 % Women = 19.1 % Age: ≥ 18 Individuals following a rehab program for drug addictions in public centers	Quantitative	PIU: Self-assessment, questionnaire developed by authors (QUNT). Cannabis: None	Investigate the prevalence and characteristics of Internet use and abuse in a group of drug addicts from Southern Italy.	Male cannabis users (vs. females) "Social withdrawal" (2.44 $\pm$ 0.38 vs. 2.23 $\pm$ 0.39, $p < 0.01$) "Abstraction from reality" (3.12 $\pm$ 1.74 vs. 2.24 $\pm$ 0.46, $p < 0.01$)	PIU was less severe in subjects taking sedative substances, such as heroin/opioids and alcohol compared cocaine and cannabis users. QUNT scores were higher among single subjects, subjects living alone, and subjects with higher BMI. QUNT factors showed no sex-related differences.
Rücker et al. (2015)	Switzerland	$N = 3067$ Sex/Gender: Male = 0.0 % Female = 100.0 % Age: ~ 14 years old School-aged adolescents	Cross-sectional study Quantitative	PIU: IAT Cannabis: Frequency of cannabis consumption over the last 30 days	Examine whether problematic Internet use is associated with substance use and to assess whether this accounted equally for individual substances.	Logistic regression (PIU and cannabis use): Individual substance analysis (aOR = 1.94, 95 % CI 1.38–2.72) Analysis of all substances (aOR = 1.25, 95 % CI 0.83–1.89)	Found a direct link between problematic Internet use and substance use. A direct link was observed with tobacco, but alcohol, cannabis and other illegal drugs were only linked to PIU via tobacco use.

Table 1 (*continued*)

Authors, year	Country	Population/ sample	Methodology	Assessment Tools	Objectives	Estimates of interest	Conclusion
Niewiadomska et al. (2016)	Poland	*N* = 307 Sex/Gender: Male = 28.0 % Female = 72.0 % Age: ~17 years old Upper-secondary school students	Quantitative	PIU: TPUI Cannabis: MAP	Examine the relationship between the risk of Internet addiction and psychoactive substance use.	Correlation analysis: PIU and risk of marijuana abuse (r_s = 0.13, *p* = 0.03)	The risk of Internet addiction co-occurs with risk of marijuana. A significant positive correlation was observed between PIU and the frequency of using marijuana, sedatives, or hypnotics.

Note. PIU = Problematic Internet Use;
SDS = Severity of Dependence Scale;
CAST = Cannabis Abuse Screening Test;
IRR = incidence rate ratio;
STSB = Screen time sedentary behavior;
QUNT = "Questionario sull'Utilizzo delle Nuove Tecnologie".
BMI = Body Mass Index;
IAT = Internet Addiction Test;
TPUI = Problematic Internet Use Test;
MAP: Maudsley Addiction Profile.

videogaming, which could be considered as a specific form of Internet use. Doggett et al. (2019) examined the relationship between STSB and cannabis usage. Their study suggested that increased cannabis use was associated with more time spent engaging in STSB. Neilson and Lin (2019) also examined the relationship between leisure-time sedentary behavior and cannabis use. It was found that heavy or occasional cannabis use was significantly associated with excessive sedentary behavior (35 h per week in leisure time), which was predominantly significant among adults aged 25–44 years who did not live in rural areas (Neilson and Lin, 2019). Baroni et al. (2019) investigated the characteristics and prevalence of Internet use and problematic use among Southern Italian drug addicts and found that PIU was common among this population, however cannabis and cocaine users spent more time online (six hours per day) than abusers of alcohol and opioids. Niewiadomska et al. (2016) assessed whether a positive correlation was present between PIU and psychoactive drugs. They found that among their sample of high school students, there was a positive association between PIU and marijuana use.

Doggett et al. (2021) explored whether internalizing symptoms could be a mediator between STSB and marijuana use. They found two significant partial mediations: one between STSB and cannabis use through internalizing symptoms, and another one between internalizing symptoms and cannabis use through STSB (Doggett et al., 2021). Rücker et al. (2015) also examined whether PIU was associated with the use of different substances. They observed that when analyzing each substance individually, that participants with PIU were significatively associated to the use of each substance, but in a later model that considered all substances simultaneously, PIU was only directly linked to smoking, and alcohol, cannabis, and other illegal drugs were linked to PIU only through tobacco use (Rücker et al., 2015).

4. Discussion

The objective of this scoping review was to analyze the existing peer-reviewed literature on PIU and cannabis consumption, with the aim of summarizing the current state of knowledge on this subject and proposing future research avenues. As shown in the seven selected studies in this scoping review, a potential association was found between PIU and cannabis consumption. Nonetheless, the available literature on the subject is limited, and heterogeneity of measurement remains an obstacle to an in-depth interpretation of the studies' results as a whole. The lack of consensus within the studies could be explained by the conceptualization of PIU and cannabis consumption in each study. As the operationalization of these terms are not standardized within the

literature, many studies have defined and measured them differently. As such, despite most studies reporting a significant association between the two constructs of interest, the findings are not all directly comparable to one another due to the heterogeneity in conceptualization and measurement. For example, whether the notion of "problematic" for these behaviors should be considered beyond the *frequency* of cannabis use or *quantity* of time spent on the Internet remains an important question.

Another element to consider in the measurement of PIU is the kind of online activities being examined, and the extent to which they could overlap with another, perhaps more specific form of behavioral addiction. For instance, in Perales et al.'s (2021) work, a variety of behaviors in which individuals may engage in through the Internet (e.g., video gaming, shopping/buying, gambling, hypersexual behavior) were analyzed separately from their "excessive Internet use" construct. Their results indicated an association between problematic videogaming but not excessive Internet use with cannabis abuse and dependence. As such, it may be important for future research to be thorough and explicit about what is considered PIU in the study's methodology and when applicable, to address the nuances of more specific behaviors that may occur online (Montag et al., 2015).

Furthermore, all studies were quantitative and with a predominantly cross-sectional design, which impedes the establishment of any causal links between the constructs of interest. Longitudinal studies, as well as qualitative or mixed-method studies are necessary to broaden the current scope of understanding regarding PIU, cannabis use, and what links them as addictive behaviors, such as common, motivations or risk factors. The selected studies were conducted mainly in Europe and Canada, with most of the samples being adolescents, resulting in a limited generalizability of the findings. Consequently, studies from various regions and more age-diverse populations could help to better understand the relationship between cannabis consumption and PIU, in contexts in which cultural and social norms surrounding these behaviors may vary. Lastly, the selected studies were published between 2015 and 2021, with a majority after 2018 (*n* = 5), indicating a rather recent interest in reporting on the relationship between cannabis consumption and PIU, which is why it is important to emphasize future uniformization in measurement in benefit of a more informative and conclusive body of research.

4.1. Study limitations

This scoping review has some limitations to consider. First, it can be difficult to conduct an exhaustive search of PIU, as the terminology is

Table 2

Conceptual definitions of Problematic Internet Use and cannabis use/dependence according to the selected studies on the association between Problematic Internet Use and cannabis use/dependence (database inception – May 2023).

Author, year	Problematic Internet use	Cannabis use/dependence
Perales et al. (2021)	"In all [MultiCAGE CAD-4] subscales, items refer to subjective perception of the problem, perception by relevant others, feelings of guilt, and lack of control or abstinence symptoms." (p. 3) "According to the original validation criteria, meeting 0 criteria is interpreted as absence of risk, 1 criterion indicates detectable but low risk of problems, and meeting 2 or more criteria is interpreted as indicating a high or very high risk of suffering a clinically significant condition." (p. 5)	"Severity of cannabis dependence was measured using the Spanish version of the SDS […] A cut-off of 3 is normally used to define moderate cannabis dependence, and 7 for severe dependence" (p. 5) "The CAST is a screening tool for cannabis abuse in the general population that has also been proven valid and reliable for adolescents and young adults. […] Cut-offs of 3 and 7 are used to detect moderate and severe cannabis addiction." (p. 5–6)
Doggett et al. (2021)	"The aggregate STSB variable is measured in hours and serves as an overall indicator of sedentary time spent in front of a screen" (p. 1234)	"An ordinal variable representing cannabis use frequency consistent with previous work was created based on the student questionnaire item: "In the last 12 months, how often did you use marijuana or cannabis (a joint, pot, weed, hash)?"" (p. 1233–1234)
Doggett et al. (2019)	"For each item, the number of hours and minutes were summed, resulting in four continuous variables representing time spent engaged in discrete STSBs ["Watching/streaming TV shows or movies," "Playing video/computer games," "Surfing the internet," and "texting, messaging, emailing"]. A measure of overall STSB was created by summing the four discrete measures of STSBs […]" (p. 3)	"In the last 12 months, how often did you use marijuana or cannabis? (a joint, pot, weed, hash)?" [Options were regrouped as follows: non-user ("never" or "not in the last 12 months"); rare/sporadic user ("less than once a month"); monthly user (1–3 times a month); weekly user (1–6 times a week); daily user ("every day")] (p. 2)
Neilson and Lin (2019)	"[…] interviewers asked respondents how many hours they spent in sedentary behaviors during leisure time (not at work or at school) in a typical week over the past 3 months. Statistics Canada then derived total sedentary behavior (hr/wk. as a continuous variable) as the sum of time spent (1) using the computer, (2) playing video games, (3) watching television or videos, and (4) reading. Our outcome was total sedentary behavior as a dichotomous variable using a cutoff of 35 h/wk." (p. 853)	"We studied cannabis use in terms of the frequency of use of marijuana, cannabis, or hashish in the past 12 months, excluding one-time use over the lifetime. […] Never cannabis use represented a frequency of "never in the past year"; occasional cannabis use was "less than once a month, one to three times a month, or once a week"; and heavy cannabis use was "more than once a week or every day."" (p. 854)
Baroni et al. (2019)	"PIU or Internet addiction is a behavioral addiction that can be defined as "use of the Internet that creates psychological, social, school, and/or work difficulties in a person's life" (p. 56) "We established the answer 4 (between 4 and 6 h/d) or 5 (> 6 h/d) of item 2 'time spent	No definition stated in the text. However, the sample is composed of individuals following a rehabilitation program for drug addictions (including cannabis addiction) in public centers.

Table 2 (*continued*)

Author, year	Problematic Internet use	Cannabis use/dependence
	online' as the cut-off points to identify the presence of, respectively, possible or certain/severe PIU" (p. 57)	
Rücker et al. (2015)	"PIU is described as a disorder involving symptoms such as restlessness or irritability when not online or feeling the need to spend more time online" (p. 504) "We used the French version of the Internet Addiction Test to appraise problematic Internet use […]. Based on the Internet Addiction Test score, we divided the sample into Regular Users when the score was below 50 (n = 2707) and Problematic Users when the score was above 49 (n = 360)." (p. 505)	"'Have you consumed cannabis during the previous 30 days?' […]. Five possible answers ranging from never to 10 or more times were dichotomised into never/at least once" (p. 505)
Niewiadomska et al. (2016)	"Internet addiction is defined as "an impulse control disorder, which does not cause intoxication, and has a significant impact on the level of one's functioning in social, professional and psychological spheres."' (p. 5) "The TPUI22 by R. Poprawa, was developed on the basis of the Internet Addiction Test by K. Young, which operationalises the descriptive definition and criteria of Internet use" (p.10)	"Psychoactive substance use was described on the basis of the MAP […], a structured interview designed to investigate issues connected with substance abuse. […] This study used the questionnaire section on substance use. […] The intensity of substance use is the sum of the frequencies for individual substances." (p.10)

Note. SDS = Severity of Dependence Scale;
CAST = Cannabis Abuse Screening Test;
STSB = screen time sedentary behavior;
PIU = Problematic Internet use;
TPUI22 = Problematic Internet Use Test;
MAP = Maudsley Addiction Profile.

not homogeneous. To counter this, we collaborated with an academic health librarian at the University of Sherbrooke, where several tests were conducted before the official and final extraction of data to develop an extensive search strategy. Second, only peer-reviewed articles published in scientific journals were included in this review, excluding grey literature, which limited our ability to identify potential research and advance our understanding. Third, the study selection criteria restricted this review to English and French, which prevented studies in other languages from being considered. As such, studies in other languages and the inclusion of grey literature could provide further insights into this subject.

5. Conclusion

The purpose of this scoping review was to identify and summarize the literature regarding cannabis and PIU. The majority of selected studies have shown a positive association, such that increased cannabis use or dependance is linked to increased PIU, or vice versa. Nevertheless, this conclusion should be approached cautiously due to the small number of studies, the various conceptualizations of cannabis use and PIU, and methodological limitations, indicating the need for further research with a clear and unified definition of the constructs.

CRediT authorship contribution statement

Kellie-Anne Bélisle: Writing – review & editing, Writing – original

Data availability

Data will be made available on request.

References

Arksey, H., O'Malley, L., 2005. Scoping studies: towards a methodological framework. Int. J. Soc. Res. Methodol. 8 (1), 19–32. https://doi.org/10.1080/1364557032000119616.

Baroni, S., Marazziti, D., Mucci, F., Diadema, E., Dell'Osso, L., 2019. Problematic internet use in drug addicts under treatment in public rehab centers. World Journal of Psychiatry 9 (3), 55–64. https://doi.org/10.5498/wjp.v9.i3.55.

Connor, J.P., Stjepanović, D., Le Foll, B., Hoch, E., Budney, A.J., Hall, W.D., 2021. Cannabis use and cannabis use disorder. Nat. Rev. Dis. Prim. 7 (1), 16. https://doi.org/10.1038/s41572-021-00247-4.

Doggett, A., Qian, W., Godin, K., De Groh, M., Leatherdale, S.T., 2019. Examining the association between exposure to various screen time sedentary behaviours and cannabis use among youth in the COMPASS study. SSM - Population Health 9, 100487. https://doi.org/10.1016/j.ssmph.2019.100487.

Doggett, A., Gohari, M.R., Godin, K.M., Ferro, M.A., Patte, K.A., Leatherdale, S.T., 2021. Cannabis use, screen time, and internalizing symptoms among Canadian youth: testing mediation pathways. Subst. Use Misuse 56 (8), 1232–1240. https://doi.org/10.1080/10826084.2021.1922455.

Ekelund, U., Steene-Johannessen, J., Brown, W.J., Fagerland, M.W., Owen, N., Powell, K.E., Bauman, A., Lee, I.-M., 2016. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. Lancet 388 (10051), 1302–1310. https://doi.org/10.1016/S0140-6736(16)30370-1.

Fernández-Aliseda, S., Belzunegui-Eraso, A., Pastor-Gosálbez, I., Valls-Fonayet, F., 2020. Compulsive internet and prevalence substance use among Spanish adolescents. Int. J. Environ. Res. Public Health 17 (23), 8747. https://doi.org/10.3390/ijerph17238747.

Kim, B.-S., Chang, S.M., Park, J.E., Seong, S.J., Won, S.H., Cho, M.J., 2016. Prevalence, correlates, psychiatric comorbidities, and suicidality in a community population with problematic internet use. Psychiatry Res. 244, 249–256. https://doi.org/10.1016/j.psychres.2016.07.009.

Kuss, D.J., Lopez-Fernandez, O., 2016. Internet addiction and problematic internet use: a systematic review of clinical research. World Journal of Psychiatry 6 (1), 143–176. https://doi.org/10.5498/wjp.v6.i1.143.

Lanthier-Labonté, S., Dufour, M., Milot, D.-M., Loslier, J., 2020. Is problematic internet use associated with alcohol and cannabis use among youth? A systematic review. Addict. Behav. 106, 106331. https://doi.org/10.1016/j.addbeh.2020.106331.

Levac, D., Colquhoun, H., O'Brien, K.K., 2010. Scoping studies: advancing the methodology. Implement. Sci. 5 (1), 69. https://doi.org/10.1186/1748-5908-5-69.

Lopez-Fernandez, O., Kuss, D.J., 2020. Preventing harmful internet use-related addiction problems in Europe: a literature review and policy options. Int. J. Environ. Res. Public Health 17 (11). https://doi.org/10.3390/ijerph17113797. Article 11.

Marsden, J., Gossop, M., Stewart, D., Best, D., Farrell, M., Lehmann, P., Edwards, C., Strang, J., 1998. The Maudsley addiction profile (MAP): a brief instrument for assessing treatment outcome. Addiction 93 (12), 1857–1867. https://doi.org/10.1046/j.1360-0443.1998.9312185711.x.

Montag, C., Bey, K., Sha, P., Li, M., Chen, Y., Liu, W., Zhu, Y., Li, C., Markett, S., Keiper, J., Reuter, M., 2015. Is it meaningful to distinguish between generalized and specific internet addiction? Evidence from a cross-cultural study from G ermany, S weden, T aiwan and C hina. Asia Pac. Psychiatry 7 (1), 20–26. https://doi.org/10.1111/appy.12122.

Neilson, H.K., Lin, Z., 2019. Is Cannabis use associated with sedentary behavior during leisure time? A study in Canada, 2011–2012. Subst. Use Misuse 54 (5), 852–862. https://doi.org/10.1080/10826084.2018.1547910.

Niewiadomska, I., Chwaszcz, J., Wiechetek, M., Czarnecka, P., Palacz-Chrisidis, A., 2016. The risk of internet addiction and psychoactive substance use. Psychoprevention Studies 2, 5–14.

Perales, J.C., Maldonado, A., López-Quirantes, E.M., López-Torrecillas, F., 2021. Association patterns of cannabis abuse and dependence with risk of problematic non-substance-related dysregulated and addictive behaviors. PLoS One 16 (8), e0255872. https://doi.org/10.1371/journal.pone.0255872.

Petry, N.M. (Ed.), 2016. Behavioral Addictions: DSM-5® and beyond. Oxford University Press.

Rücker, J., Akre, C., Berchtold, A., Suris, J., 2015. Problematic internet use is associated with substance use in young adolescents. Acta Paediatr. 104 (5), 504–507. https://doi.org/10.1111/apa.12971.

Sinclair, H., Lochner, C., Stein, D.J., 2016. Behavioural addiction: a useful construct? Curr. Behav. Neurosci. Rep. 3 (1), 43–48. https://doi.org/10.1007/s40473-016-0067-4.

Tricco, A.C., Lillie, E., Zarin, W., O'Brien, K.K., Colquhoun, H., Levac, D., Moher, D., Peters, M.D.J., Horsley, T., Weeks, L., Hempel, S., Akl, E.A., Chang, C., McGowan, J., Stewart, L., Hartling, L., Aldcroft, A., Wilson, M.G., Garritty, C., Straus, S.E., 2018. PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. Ann. Intern. Med. 169 (7), 467–473. https://doi.org/10.7326/M18-0850.

United Nations Office on Drugs and Crime, 2023. World drug report 2023. United Nations. https://www.unodc.org/res/WDR-2023/WDR23_Exsum_fin_DP.pdf.

Weinstein, A., Lejoyeux, M., 2010. Internet addiction or excessive internet use. Am. J. Drug Alcohol Abuse 36 (5), 277–283. https://doi.org/10.3109/00952990.2010.491880.

World Health Organization, 2016. The health and social effects of nonmedical cannabis use. World Health Organization. 19-30. https://iris.who.int/handle/10665/251056.