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REVIEW

Problematic Social Media use in Mid-Adolescents: A Systematic Review of Intrapersonal and Interpersonal Protective/Risk Factors and Psychosocial Interventions

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Abstract

Purpose of Review Problematic social media use (PSMU) is linked to negative mental health outcomes. A clear understanding of antecedents of PSMU in mid-adolescents is lacking. The present study aims to explore protective/risk factors of PSMU and strategies to prevent or reduce PSMU in mid-adolescents. A systematic search of peer-reviewed studies published from 2014 onward was conducted on four electronic databases. The review was prospectively registered on PROSPERO (CRD42024507719). Inclusion criteria encompassed longitudinal or interventional studies focusing on mid-adolescents, assessing PSMU with validated measures.

Recent Findings The included longitudinal studies investigated a variety of sociodemographic (e.g., gender), intrapersonal (e.g., depressive symptoms) and interpersonal variables (e.g., parenting practices), finding mixed results. Longitudinal studies were considered to be of good/fair quality. Although the included interventions focused on different approaches, they were all group-based, mostly delivered in schools, with a rather short duration (4 to 8 sessions). Promising results in reducing PSMU emerged for two of them, but studies were rated as being of fair/poor quality.

Summary Despite the growing interest in PSMU, the heterogeneity and the relatively small number of studies targeting mid-adolescents make it challenging to draw definitive conclusions. More knowledge is needed on protective/risk factors of PSMU and on strategies to prevent and reduce PSMU.

Keywords Problematic social media use · Systematic review · Adolescents · Longitudinal · Psychosocial intervention · Risk and protective factors

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Introduction

Problematic Social Media Use (PSMU) refers to a failure to regulate one's use of social media (SM), which is associated with adverse outcomes in everyday functioning [1, 2]. However, PSMU is a complex behaviour that is far from being fully understood, and its conceptualization is still under debate [3]. Core symptoms of PSMU have been outlined, such as difficulties in controlling one's use of SM, a tendency to think obsessively about going online, being urged to use SM, preference for online rather than face-to-face interactions, and difficulties in resisting the urge to use SM [4]. PSMU is, therefore, a maladaptive use of SM characterized by time and energy expenditure on social media to the extent that it impairs an individual's social activities, interpersonal relationships, academic or professional performance, or wellbeing [1, 2, 5].

Due to the presence of self-regulatory failures and addiction-like symptoms such as salience, withdrawal and relapse, social media addiction has also been used as a term to describe the dysregulated use of SM [6]. Recently, some scholars have discussed the potential inclusion of social-network-use disorder within the ICD-11 category of "Other Specified Disorders Due to Addictive Behaviour," although more evidence from clinical samples and studies on functional impairment is needed before a consensus can be reached [7]. However, the application of an addiction paradigm to social media use has been met with criticism. Scholars have advised caution, highlighting the risk of pathologizing common behaviours without sufficient evidence about the aetiology, onset and course of the specific behavioural addiction being studied [8, 9]. In the field of SM research, a clearer distinction has been made between "problematic" and "intense" use. Intense social media use can be seen as a normative behaviour in some contexts, reflecting social engagement and inclusion; indeed, it has been found to be associated with life satisfaction and social support [10]. In contrast, PSMU is not only concerned with the amount of time people spend on SM, but also with how that time is spent, in terms of control and preoccupation with SM [11].

Technology is constantly evolving and becoming more prominent in the lives of adolescents, who use SM to communicate, create social networks or search for information [12]. Many studies examine PSMU in relation to adolescents and young adults, both because they represent a unique population as SM users and because they are the first generation to grow up in a highly digitalized society, where the potential effects of PSMU are likely to be observed [13]. Moreover, personal identity is developed during the sensitive life stage of adolescence [14]. In particular, mid-adolescence is a pivotal period for the development of autonomy and, by the end of this stage, youth are expected to have a more established sense of themself, their choices and values [15]. During this time, intimate and peer relationships cantered on shared interests and values gain heightened importance and are integral to self-discovery and self-definition [15, 16]. At this stage, adolescents are much more sensitive to social feedback and peer pressure [17], and social media provides a unique platform for exploring one's identity. The immediate feedback they receive from their peers through SM can have a positive or negative impact on their identity development. As a result of this feedback, adolescents attempt to construct an image that meets the criteria for social acceptance [18]. This behaviour and the resulting high exposure to SM may foster greater identity development but also expose them to risks [19]. A study conducted by Wang and colleagues suggests that PMSU may increase perceptions of loneliness and lack of social support, which in turn contribute to PSMU by leading adolescents to compensate for the lack of real social interactions with virtual ones [20]. Adolescents also have limited capacity for self-regulation, which might also impact on the ability to regulate SM use [17]. Recently, one study found that mid-adolescents, compared to early and late adolescents, have heightened sensitivity to rewards [21]; therefore, they may be particularly vulnerable to the influences of SM.

Several studies highlight that PSMU may also have negative effects on adolescents' psychological well-being [13, 22, 23]. For this reason, interventions focusing on promotion of healthy ways of SM and prevention of PSMU are needed [13].

In adolescents, psychological variables, such as deficits in emotion regulation [24], substance use [25], rumination and self-esteem [20], and sociodemographic variables, such as gender [26, 27] have been found to be associated with PSMU. However, most of the studies used a cross-sectional design, making it difficult to understand whether these may be risk factors or consequences of PSMU [28]. A recent umbrella review focusing on SM use among adolescents underlined the lack of longitudinal and experimental studies, which are needed to determine the casual direction between variables [29]. In recent years, there has been a significant increase in the number of publications on PSMU, reflecting growing interest and advancements in this field. A synthesis of the evidence is, therefore, needed to better grasp the intricate dynamics of PSMU, with the ultimate goal of informing effective interventions.

In an effort to expand on the knowledge on protective and risk factors of PSMU and to inform on modifiable targets for clinical interventions, the current review aims to systematically analyse and synthesize longitudinal and interventional studies on PSMU in mid-adolescents. In particular, the review will address the following research questions:

- What are the sociodemographic and psychosocial protective/risk factors for problematic social media use in mid-adolescents?
- What psychosocial interventions for preventing or reducing problematic social media use targeting mid-adolescents have been proposed?

Materials and methods

The present study is registered at PROSPERO (CRD42024507719). The systematic review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [30] (see PRISMA checklist in Supplementary file 1).

Search and selection of studies

We conducted a systematic search of four electronic databases (i.e., PubMed, Web of Science, PsycINFO, and Scopus), filtering articles published after 1 of January 2014 and up to 1 February 2024 (search date) to ensure that the findings are relevant and generalizable to today's mid-adolescents, given the ever-changing SM landscape. Indeed, the past decade has seen the emergence of new SM platforms such as TikTok and a steadily growing research interest on this topic [31].

In the search strategy, we included words relating to social media (e.g., social media, social media, social network, Facebook, Tik Tok, Instagram), words related to the concept of problematic use (e.g., addiction, disorder, excessive, problematic,), and words regarding the targeted population (e.g., adolescent, youth) (Supplementary file 2).

To identify other potentially eligible articles, we manually searched the references of the relevant reviews found during the screening process. Furthermore, we ran an additional search on PubMed, Web of Science and PsycINFO on 22 May 2024.

Two pairs of reviewers independently screened record titles and abstracts with Rayyan. Disagreements were solved by consulting with a third independent reviewer. The full texts of all articles considered potentially eligible were independently reviewed by two reviewers. Any disagreements were resolved through discussion with the wider review team.

Inclusion and Exclusion Criteria

We included peer-reviewed articles published in English, thus excluding unpublished studies and grey literature. We included articles that either: (I) examine PSMU in mid-adolescents and its associations with sociodemographic, and psychosocial (intrapersonal or interpersonal) protective/risk factors, (ii) describe and/or test interventions aiming to prevent or reduce PSMU within this population.

The focus is on PSMU, defined as the lack of regulation of one's use of SM associated with negative outcomes in everyday functioning, other social activities, studies or jobs, interpersonal relationships, and psychological well-being [1, 2]. Considering the lack of a consensus on PSMU definition, we included articles that also focus on similar definitions of PSMU and on "addiction to social media" and "social media abuse". We did not include articles that focus exclusively on frequency of use or on other online addictions such as gambling or gaming. To be included PSMU has to be measured (either as a primary or secondary outcome) with a validated instrument (such as the Bergen Social Media Addiction Scale or the Social Media Disorder Scale). In longitudinal studies, PSMU must be considered an outcome/dependent/endogenous variable (i.e., studies that examine if one or more variables may predict or influence PSMU at a later point in time).

The present review is focused on mid-adolescence, considered as the age range of 14–18 years [32]. This age range has been used in several studies to represent the intermediate phase of adolescence [33, 34]. However, a consensus on a precise definition of this developmental stage has yet to be established, and differences in the classification of mid-adolescents can be found, such as differences in the age range (e.g., 15–19 [35] or 14–17 [16, 36]) or differences in the labelling. To ensure the inclusion of a representative sample of mid-adolescents, in addition to evaluating the age range of the participants, we also considered the mean age and the mention in the article of the focus on adolescence. This approach allowed us to exclude studies focusing on populations such as emerging adults (e.g., 18–25) or college students or on broad populations (e.g., 16–60). Inclusion and exclusion criteria according to the PICOs model are specified in Table 1.

Data Extraction and Synthesis

Two reviewers independently extracted characteristics, results and outcome measures of the selected studies using a data collection form in an Excel spreadsheet. Disagreements were discussed and, where necessary, the wider review team was involved. Data extracted included: citation details (i.e., authors, year of publication), study characteristics (e.g., aims of the study, country, sample size, sample characteristics,), variables and measurements. Moreover,

Table 1 Inclusion and exclusion criteria according to the PICOs model

REASON	INCLUDED	EXCLUDED
Population (P)	*Age*: Studies recruiting adolescents (i.e., 14–18 years old), or age ranges that fall within the range 14–18 (e.g., 15–17 years old). Studies recruiting adolescents within an age range that is close to our criteria (e.g., 12–16, 12–19) when the mean age ± 1 SD does not exceed or fall short of our predetermined age range. Studies that do not provide an age range in inclusion criteria when the sample mean age ± 1 SD does not exceed or fall short of our predetermined age range.	*Age*: Studies focusing on children/adolescents only under 14 and adolescents/young adults over 18. Information on age (inclusion criteria and mean age of the sample) is not reported. Papers not focusing on adolescents but on a broad age range (e.g., a mixture of adults and adolescents) or on college/university students, when separate results for the target population are not available. *Type of sample*: Studies focusing only on clinical samples of adolescents.
Intervention (I) or Exposure	Studies that focus on PSMU and "addiction to social media" and "social media abuse" (both in general and/or that focus on the problematic use of a specific social media platform). Articles using validated measures of PSMU. Regarding interventional studies, any psychosocial interventions aimed at preventing or reducing PSMU.	Articles that only focus on social media use (e.g., time of use) or that focus exclusively on internet use, smartphone use and gaming. Articles measuring exclusively frequency or time of social media use.
Comparison (C)	Studies may have a control group or not (if present, any control group is acceptable).	NA
Outcomes (O)	Longitudinal and cohort studies, reporting association analysis between PSMU and sociodemographic (e.g., gender, socioeconomical status) and/or psychosocial intrapersonal or interpersonal variables (e.g., well-being, self-efficacy, mental health symptoms, social isolation). Studies must include PSMU as an outcome/dependent/endogenous variable in at least one analysis. Interventional studies using a validated measure of PSMU (as primary or secondary outcome).	Longitudinal and cohort studies where PSMU is not examined or only considered an independent variable (e.g., risk factor).
Study design (S)	Studies with a longitudinal or interventional design: Longitudinal study design or cohort studies, including at least two data points. Interventional studies with all types of design (e.g., randomized controlled trials, non-randomized single-armed trials, pilot studies, feasibility studies, protocol studies)	Observational cross-sectional and qualitative studies. Reviews of all type (e.g., systematic review, narrative reviews, meta-analyses), bibliometric analyses, letters, case-studies, books/book chapters, comments, editorials, congress abstracts or symposia, poster presentations, and dissertations.

for longitudinal and cohort studies we also collected the following: methods (i.e., time points for outcome assessments, type of analysis), findings on predictors (protective/risk factors) of PSMU. For interventional studies, we collected the following: characteristics of the intervention (e.g., contents, duration, setting, mode of delivery), summary of the main results.

We conducted a formal narrative synthesis of the extracted data and presented the results using narrative text as well as structured tables. When describing the results, we used the same terminology as the original article (e.g., social network addiction), to maintain consistency with the source.

Risk of Bias Assessment

The National Heart, Lung, and Blood Institute's (NHLBI) Quality Assessment tool was used to assess the quality of included studies. In particular, we used Quality Assessment of Controlled Intervention Studies for interventional studies and Quality Assessment Tool for Observational Cohort and Cross-Sectional Study for cohort and longitudinal studies [37]. Two independent reviewers assessed the quality and any disagreement has been discussed, including a third rater to adjudicate.

Results

Study Selection

On 1 February 2024, we retrieved 14,537 records from the databases, and, after removing duplicates removal and title and abstract screening, we assessed 359 full-text articles of which 340 were excluded, and 19 (15 longitudinal studies and 4 interventional studies) (see Fig. 1) were included. On 22 May 2024 we ran the same search to evaluate any new eligible article published after our original search. We retrieved 315 articles, and we assessed 13 full-texts for eligibility. From this updated search we included 4 articles, yielding a total of 23 articles included in the current review (i.e., 19 longitudinal studies and 4 interventional studies).

Main Characteristics of the Included Studies

The 23 included studies were published between 2018 and 2024 (see Table 2).

Of the 19 longitudinal studies, nine where from the Netherland, three form China, two from the USA, two from Estonia, and one from Israel, Iran, and Canada. Seven studies used data from the Digital Youth project [38]. Most of the

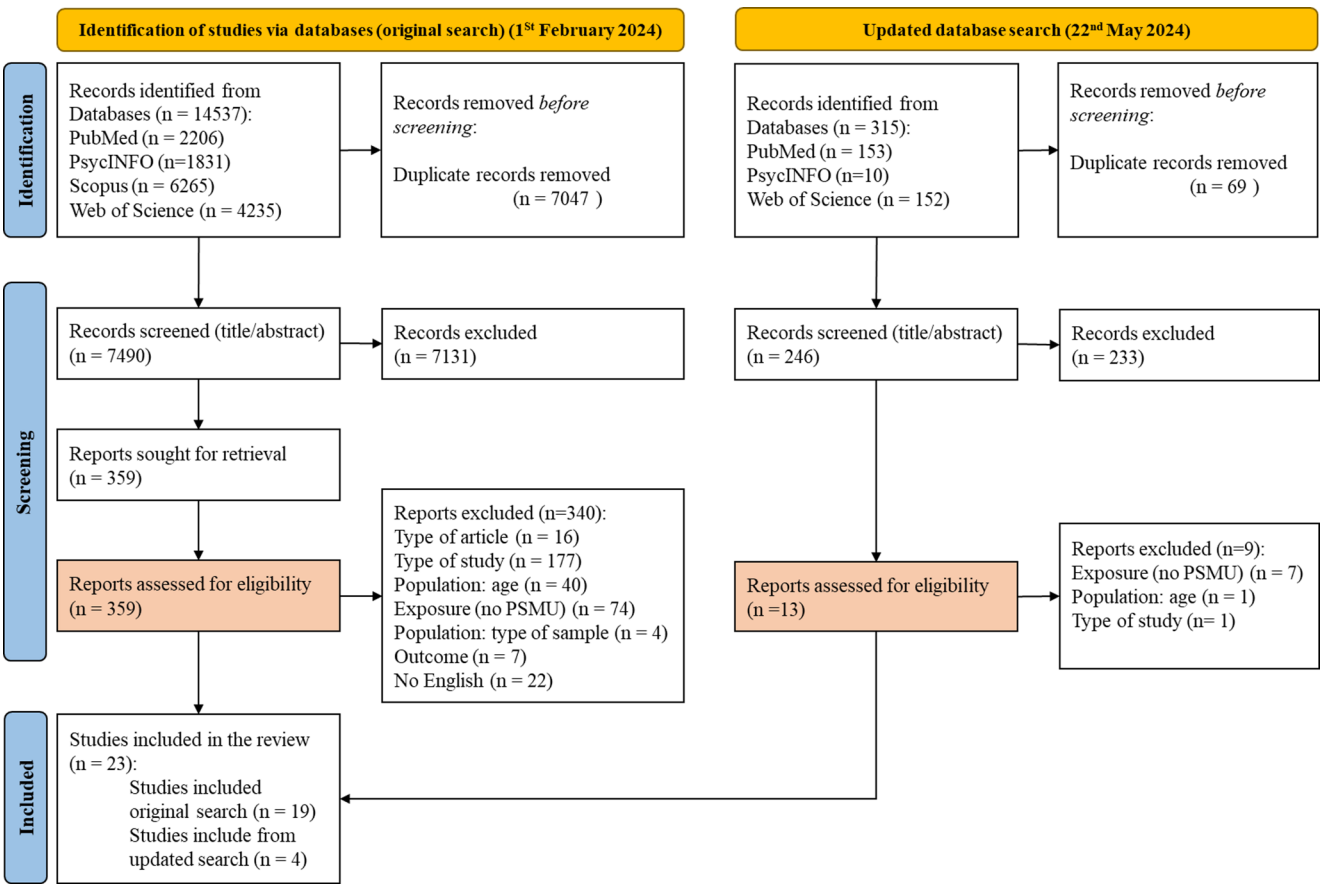

Fig. 1 - PRISMA flowchart

Table 2 Characteristic of included studies

Authors, year	Country	Research design	Time points	Aim of the study	Recruitment	Inclusion and exclusion criteria	Participants (*N*)	Age at baseline (M ± SD) *	Gender (% girls)
Boer et al., 2020	Netherlands	Longitudinal study	3	To investigate the directionality of associations between ADHD-symptoms and SMU intensity and SMU problems	Digital Youth project - School	Inclusion: Dutch secondary-school adolescents aged 11–15 years	543	12.9 ± 0.7	52%
Boer et al., 2021	Netherlands	Longitudinal study	3	To examine bidirectional associations between adolescents' SMU intensity, SMU problems and mental health.	Digital Youth project - School	N/R	2109	13.1 ± 0.8	43.1%
Boer et al., 2022	Netherlands	Longitudinal study	4	To explore how adolescents' level of PSMU evolved over time. To investigate to what extent subjective well-being, low self-control, and social competencies predicted the identified trajectories.	Digital Youth project - School.	Inclusion: students enrolled in seventh grade. Exclusion: Students who repeated a class or who participated in less than two waves	1419	12.5 ± 0.6	45.9%
Coyne et al., 2019	United States.	Longitudinal study	6	To examine differential patterns of SM time use throughout adolescence and into early adulthood, over a 6-year time period. To investigate the predictors and outcomes of patterns of time spent using SM.	Flourishing Families Project. Families were randomly selected from targeted census tracts that mirrored local school districts using a purchased national telephone survey database. A limited number of families recruited through referrals and fliers.	Inclusion: Families with adolescents between the ages of 10 and 14	457	13.5	53%
Flannery et al., 2024	USA	Longitudinal study	4	To identify developmental trajectories of neural social feedback processing that are linked to higher levels of addiction-like social media use.	Three public middle schools	N/R	103	12.8 ± 0.5	51.5%**
Geurts et al., 2024	Netherlands	Longitudinal study	3	To investigate the bidirectional within-family effects between two forms of restrictive mediation (rule-setting and reactive restrictions) and PSMU symptoms over time.	Digital Youth project - schools in urban and suburban areas, school selected based on the project initiator's personal network of contact.	N/R	1928	13.3 ± 0.9	43.3%
Geurts, et al., 2023	Netherlands	Longitudinal study	4	To identify profiles based on three Internet- specific parenting practices; To examine how the identified parenting profiles predicted (changes in) adolescents' PSMU	Digital Family project - multiple sources (schools, sport clubs, social media channels, word-of-mouth, and paper flyer distribution)	N/R	400	13.5 ± 2.2	54%

Table 2 (continued)

Authors, year	Country	Research design	Time points	Aim of the study	Recruitment	Inclusion and exclusion criteria	Participants (*N*)	Age at baseline (M±SD) *	Gender (% girls)
Gingras et al., 2023	Canada	Longitudinal study	2	To elucidate longitudinal and bidirectional associations between different types of SM use (passive, active and problematic use) and adolescents' depression and anxiety symptoms.	A community sample of families with children born in 2003–2004 who took part in a longitudinal study that started in 2005–2006.	Inclusion: Adolescents born 2003–2004	257	13.7	48.7%
Hawk et al., 2019	Netherlands	Longitudinal study	2	To examine the contributions of narcissism, ego threat (in the form of social rejection), and attention-seeking in predicting early-to middle adolescents' SM disclosures, PSMU, and problematic smartphone use	Digital Youth Project -two schools for secondary education (grades 7 and 8) in two medium-large cities in the Netherlands	Inclusion: minimum age of 12 years; possessing both an active social networking sites profile and a smartphone at both measurement points	307	12.9±0.8	52.1%
Koning et al., 2018	Netherlands	Longitudinal study	2	To better understand the bidirectional relationships between restrictive mediation and active mediation, on the one hand, and problematic use of SM and games, on the other.	Digital Youth Project - two secondary schools in two medium–large cities in the Netherlands	N/R	352	13.9±0.74	51,10%
Leijse et al., 2023	Netherlands	Longitudinal study	2	To investigate to what extent parental and peer factors influence adolescents' risky and problematic social media use and the extent to which this relation is moderated by adolescents' self-control.	Two secondary schools in the municipality of Edam-Volendam	Inclusion: Adolescents who responded at both waves. Exclusion: students who were in their exam year.	1368	14.1±1.0	51.6%
Li et al., 2018	China	Prospective cohort study	2	To estimate the longitudinal associations between online social networking addiction (OSNA) and depression, whether OSNA predicts development of depression, and reversely, whether depression predicts development of OSNA.	Nine public secondary schools from each of three regions (i.e., core, suburb, and outer suburb regions) in Guangzhou	Inclusion: All the seventh- and the eighth-grade students within the selected schools	4237	13.9±0.7	50.3%
Li et al., 2024	Netherlands	Longitudinal study	4	To examine longitudinal associations between PSMU, FoMO, and life satisfaction at a within-person level, while also exploring potential gender differences in these relationships	Digital Youth project - School	Inclusion: data from four waves of the project, from adolescents who were in 7th grade in either 2015 or 2016	1419	12.5±0.6	45.9%
Lin et al., 2021	Iran	Longitudinal study	4	To investigate temporal relationships between nomophobia, addictive use of SM, and insomnia.	40 class from 40 randomly selected high school	Inclusion: Adolescents who were 13–19 years old, spoke Persian, and owned a smartphone	1098	15.6±3.2	45.4%
Liu et al., 2023	China	Longitudinal study	2	To identify the direction of effect between online psychological need satisfaction and social networking addiction.	Junior high school in Hubei province of China	N/R	384	12.7±0.6	51.8%
Raudsepp & Kais, 2019	Estonia	Longitudinal study	3	To examine longitudinal relation between PSMU and depressive symptoms in adolescent girls.	Six public schools in Tartu city, Estonia	Inclusion: Female secondary school students (Grades 6 and 7)	397	12.6±0.7	100%

Table 2 (continued)

Authors, year	Country	Research design	Time points	Aim of the study	Recruitment	Inclusion and exclusion criteria	Participants (*N*)	Age at baseline (M±SD) *	Gender (% girls)
Raudsepp, 2019	Estonia	Longitudinal study	3	To examine complex longitudinal associations between PSMU, sleep disturbances and depressive symptoms during middle adolescence	Five schools were randomly selected from a list of all municipal schools.	Inclusion: Adolescents in the beginning of 9th grade and participation restricted to those who participated at baseline wave.	249	15.3±0.3	53.4%
Shoshani et al. 2024	Israel	Longitudinal study	3	To examine changes in substance and digital media use before and during the COVID-19 pandemic and to examine protective and risk factors leading to media and substance misuse.	Six randomly selected schools	Exclusion: Special education and ultra-orthodox religious institutions	1665	12.1±2.3	50.2%
Yang, 2024	China	Longitudinal study	2	To estimate the cumulative effects of multi-contextual risk factors on PSMU in adolescents, while also considering potential sex differences.	One junior high school situated in a city in southern China.	N/R	446	13.3±1.2	52.0%
Weaver et al., 2023	USA	Pre–post quasi-experimental design with sham activity CG	2	To examine the effectiveness of a group Mindfulness-based intervention for adolescents experiencing PSMU and FOMO.	One high school in the Southeast region of the USA	Inclusion: participants having at least one active social media account	65: 29 IG; 25 CG	11.5±0.9	41%
Favini et al., 2023	Italy	Pre–post quasi-experimental design with CG (class as usual)	2	To evaluate the effectiveness of a pilot school-based intervention to contrast online addictive behaviours while fostering adolescents' self- regulative abilities; To identify whether the design of the intervention could be effectively impact on addictive ICT behaviours in youths.	One Italian public high school	Inclusion: 14 to 16 years old (second or third year of their secondary school program); Exclusion: Not completed both the surveys	462: 248 IG; 214 CG,	15.3±0.6 IG; 15.1±0.5 CG	40% total: 38% IG; 44% CG

Table 2 (continued)

Authors, year	Country	Research design	Time points	Aim of the study	Recruitment	Inclusion and exclusion criteria	Participants (*N*)	Age at baseline (M ± SD) *	Gender (% girls)
Yıldırım, 2023	Turkey	Pre–post quasi-experimental design with no-intervention CG	2	To examine the effect of spiritually oriented narrative therapy-based group counselling on adolescents' internet addiction.	One counselling centre located in Manisa	Inclusion: Getting a high score on the Internet and social media addiction scales; being a high school student.	20: 10 IG; 10 CG	14.9 IG; 14.6 CG	55% total: 60% IG; 50% CG
Manwong, et al., 2018	Thailand	Two-arm cluster randomized trial with CG (class as usual)	3	To assess the effects of a group activity-based motivational enhancement therapy program on social media addictive (SMA) behaviours	One high school in Ubon Ratchathani province (Lower part of northeast Thailand).	Inclusion: seventh and eighth grade high school students (12–15 years of age) who used SNS; studying for more than one semester in school; having never been treated for Internet, game, or SMA, or depressive disorder; both parents and students agreed to participate; Exclusion: any diseases or physical or mental health problems	253: 127 IG; 126 CG	13.3 ± 0.6 IG; 13.3 ± 0.7 CG	52.6% total: 54.4% IG, 50,8% CG

*Inclusion criteria also considered age at other timepoints; ** 2.9% of the sample identified as non-binary, but they were excluded in gender effect analysis

IG = intervention group; CG = control group; SM = social media; SMU = Social media Use; PSMU = Problematic social media use

studies (n = 7) collected data in two time points, while six used data from three waves, five used four waves and one used six waves.

Interventional studies where from Thailand, Turkey, USA, and Italy, of which three were quasi-experimental pre-post design studies and one was a cluster randomized trial. All studies used a control group, with one study delivering sham activities (i.e., advice on how to manage SM use), and three studies having class as usual or no intervention. Only one study implemented a follow up evaluation.

Recruitment and Characteristics of Participants

Most of the studies (n=19) recruited participants in schools. One interventional study recruited participant from a counselling centre, while the remaining longitudinal articles recruited participants from the following settings: national telephone survey database, community sample, multiple sources (schools, sport clubs, social media channels, word-of-mouth, and paper flyer distribution).

Table 2 summarizes the participants' characteristics of the included studies. The reported mean ages varied, ranging from approximately 12.1 (SD=2.25) years to 15.55 (SD=3.21) years at baseline. The standard deviations (SD) (when reported) varied between 0.3 and 3.21 years, indicating some studies had a relatively narrow age range, while others (n=3) included a broader span of adolescent years with a SD larger than 2.

The gender distribution across the 23 studies included showed a relatively balanced mix of boys and girls, with the proportion of girls ranging from around 40% to 55%. One study recruited only girls.

Two studies from the USA provided data on race, one reporting that 85% of participants identified as White and one reporting a more equal distribution of white (37.9%), Hispanic/Latinx (32.0%), and black (23.3%) participants (the remaining were 4.9% multi-racial, 1.9% Asian). One study from Israel reported religious affiliation, with 95% of participants identifying as Jewish, 4% as Christian, and 1% as Muslim. Six studies from the Netherlands included information on the immigrant background of participants or their parents, with most identifying as native.

Measures to evaluate PSMU

As regards the evaluation of PSMU, longitudinal studies mainly used Social Media Disorder Scale (n = 10) [39] or the Bergen Social Media Addiction Scale (BSMAS) (n = 5) [40]. Other measures used by single studies were the Social networking addiction [41], the subscale Social networking addiction scale of the internet addiction type questionnaire [42], a 7-item questionnaire based on items from the Diagnostic Statistical Manual V (DSM-5) substance use disorder checklist [43], and a 7-item problematic social media use scale [44].

The four interventional studies used the BSMAS [40], the Social Media Use Questionnaire [45], the Social Media Addiction Scale for Adolescents [46], and Social Media Addiction Test [47].

Risk and protective factors in longitudinal studies

Risk and protective factors have been organized into three categories: socio-demographical variables, intrapersonal variables, and interpersonal variables. Questionnaires used to evaluate intrapersonal and interpersonal predictors have been reported as supplementary 3.

Socio-demographical Variables

Thirteen studies investigated gender (or sex) as a variable influencing PSMU; among them, seven reported no significant associations and six studies found girls had a heightened risk.

Seven studies investigated age with four studies reporting no significant effects, two finding higher age to be protective and one finding higher age to be a risk factor. (Table 3) Eight investigated educational level or type of education, finding mixed results.

One study found that living with both parents was a protective variable, while perceived poor financial situation was found to be a risk variable for PSMU. Other variables investigated by single studies were family intactness, parental education level, annual household income, parental ethnic background, race, immigrant status, which were found to have no significant associations with PSMU.

Intrapersonal Variables

Depressive symptoms were investigated by six studies (two found them to be a risk factor, four not significant); two studies exploring the role of symptoms of anxiety found it to be not significant (Table 4).

Social media use intensity was explored in four studies with three finding it to be a risk factor, while one failed to highlight a significant association with PSMU. Inconsistent results were also found for insomnia, which was measured in two studies.

Wellbeing (self-esteem and life satisfaction) was a protective factor in one study; life satisfaction was also measured

Table 3 Risk and protective socio-demographic predictors in longitudinal studies

Author, year	Outcome measure	Type of analysis	Variable*	Results	Risk/ protective
Boer et al., 2020	SMD Scale	RI-CLPM	*Gender*	Girls reported more SMU problems than boys (β = 0.22, p = .007).	RISK (female)
			School level (pre-vocational, intermediate, pre-university)	Pre-vocational educated adolescents reported more SMU problems than intermediate or pre-university educated adolescents (β = 0.45, p < .001).	RISK
			Parental ethnic background	No significant relationship (β = −0.03, NS).	NOT SIGNIFICANT
Boer et al., 2021	SMD Scale	RI-CLPM	*Gender*	Gender (female) β = 163**	RISK (Female)
			Type of education	Pre-vocational educational level β = 0.431***, intermediate educational level β = 0.199*	RISK
			Immigrant status	Immigrant background β = 0.073 (preliminary analyses)	Not significant
Boer et al., 2022	SMD Scale	LCGA and multivariate multinomial regression analysis.	*Gender*	Preliminary analyses: significant correlation between being female and PSMU at T2 and T3. Main analyses: Girls were more likely to be in Class 1 (i.e.: variably high PSMU, variably high SMU frequency) than boys (B = 1.174, p < .001, OR = 3.241). Boys were more likely to be in Class 3 (i.e.: persistently low PSMU, persistently low SMU frequency) than girls (B = −1.147 p < .001, OR = 0.318).	RISK (female)
			Educational level (pre-vocational, intermediate, or pre-university)	Preliminary analyses: significant correlations between pre-vocational education and PSMU at T2, T3 and T4. Main analyses: Pre-vocational educated adolescents were more likely to be in Class 1 (i.e.: variably high PSMU, variably high SMU frequency) than pre-university adolescents, respectively (B = 1.445, p = .001, OR = 4.250). Adolescents attending pre-university education had a higher probability of being in Class 3 than adolescents attending intermediate or pre-vocational education (B = −0.633, p = .028, OR = 0.532; B = −0.633, p = .031, OR = 0.531)	Pre-vocational education: RISK. Attending pre-university education: PROTECTIVE.
			Immigrant background	Preliminary analyses: not significant correlations between immigrant background and PSMU at T2, T3 and T4. Main analyses: not significant relationship	NOT SIGNIFICANT
Flannery et al., 2024	7-item questionnaire based on items from the DSM-5 substance use disorder checklist.	Moderated mediation model	*Gender*	Gender identity did not significantly differ between high and low ASMU groups (preliminary analyses: differences between groups).	NOT SIGNIFICANT
			Race/ethnicity	Race/ethnicity did not significantly differ between high and low ASMU groups (preliminary analyses: differences between groups).	NOT SIGNIFICANT
			Annual household income	Annual household income did not significantly differ between high and low ASMU groups (preliminary analyses: differences between groups).	NOT SIGNIFICANT
Geurts et al., 2023	SMD Scale	Multiple latent profile analysis; Multiple regression models	*Age*	Age and PSMU at T2 [B = −0.121 SE = 0.056 β = −0.228 p = .030]	PROTECTIVE (higher age)
			Gender	Gender and PSMU at T2 and T4 [T2: B = 0.429 SE = 0.146 β = 0.214 p = .003; T4: B = 0.485 SE = 0.222 β = 0.241 p = .029]	RISK (Female)
			Family intactness	Not significant	NOT SIGNIFICANT
			Parental education level	Not significant	NOT SIGNIFICANT

Table 3 (continued)

Author, year	Outcome measure	Type of analysis	Variable*	Results	Risk/ protective
Gingras et al., 2023	BSMAS	CLPM	*Sex*	Sex and BSMAS T2 = 0.00 (model 3), Sex and BSMAS T2 =. 0.01 (model 4) Preliminary not significant ($p<.10$)	NOT SIGNIFICANT
Hawk et al., 2019	SMD Scale	CLPM	*Age*	PSMU showed no links with age at either time point.	NOT SIGNIFICANT
			Gender/sex	PSMU showed no links with gender at either time point.	NOT SIGNIFICANT
Koning et al., 2018	SMD Scale	SEM (Zero-inflated cross-lagged analyses)	*Gender*	Preliminary: not significant ($r= 0.01$, p = ns)	Not significant
			Age	T1 Age and T2 PSMU ($r= 0.13$, < 0.05; preliminary correlations)	RISK (higher age)
			Level of education	Preliminary: not significant ($r=- 0.03$, p = ns)	Not significant
Leijse et al., 2023	SMD Scale	Multinomial Logistic Regression	*Age*	Preliminary analyses (correlations): age negatively related ($r=-0.055$*) with PSMU at T2. Main analyses (4th model): not significant	NOT SIGNIFICANT
			Gender	Main analysis (4th model): not significant. Preliminary analyses (correlations): gender positively related ($r=.102$**) with PSMU at T2.	NOT SIGNIFICANT
			Level of education	Preliminary analyses (correlations): educational level negatively related ($r=-0.159$**) with PSMU at T2.	Protective
Li et al., 2018	OSNA scale	Multilevel logistic regression models	*Sex*	ORu = 0.94, $p=.573$	NOT SIGNIFICANT
			Grade	ORu = 1.00, $p=.977$	NOT SIGNIFICANT
			Parents' education level	ORu range = 0.67–1.28 (p range = 0.090–0.940)	NOT SIGNIFICANT
			Perceived family financial situation	Perceived poor family financial situation was associated with higher incidence of OSNA.	RISK
			Living arrangement with parents	Living with their parents was a significant protective factor for incidence of OSNA.	PROTECTIVE
Li et al., 2024	SMD Scale	Bivariate correlations (preliminary analyses); RI-CLPM (main analyses)	*Gender*	Gender (girl) positively related to PSMU at T2 (0.06*) and T3 (0.07*) (preliminary analyses). Main analyses: although the strength and significance of the cross-lagged parameters differed slightly between boys and girls, yet these differences were not significant.	NOT SIGNIFICANT
			Educational level	Educational level negatively related to PSMU at T2 (−0.15***), at T3 (−0.11***) and at T4 (−0.10*) (preliminary correlations)	Higher educational level protective
			Age	No significant correlations between age and PSMU at T2, T3 and T4 (preliminary analyses)	Not significant
Shoshani et al., 2024	BSMAS	Mixed model growth curve analyses	*Age*	Age (−0.03) associated with reduced SM addiction symptoms.	PROTECTIVE (Higer age)
			Gender	Being males (−0.06) associated with reduced SM addiction symptoms.	RISK (Female)
			School and classroom-level indicators	School and classroom-level indicators: not significant effect (not included in the final models).	Not significant

Table 3 (continued)

Author, year	Outcome measure	Type of analysis	Variable*	Results	Risk/ protective
Yang, 2024	SMD Scale	Hierarchical regression analysis	*Sex*	the interaction between sex and the T1 cumulative risk index had a significant effect on T2 PSMU (linear term; β = 0.53, $p < .001$). As the number of risk factors increased, the mean scores of T2 PSMU in females increased significantly faster than the mean scores of T2 PSMU in males.	RISK (Female)
			Age	No significant relationships	NOT SIGNIFICANT
			SES	No significant relationships	NOT SIGNIFICANT

* Discordant results between two models; ** Discordant results between time points; we used the same terminology as the original paper (e.g., gender or sex); the risk/protective factor column summarizes the results of the main analyses (UPPER CASE). Where only preliminary analyses are reported for a variable, the text is in lower case; CLPM = Cross-lagged Panel Model; RI-CLPM = Random Intercept Cross-Lagged Panel Model; LCGA = Latent class growth analysis; GMM = Growth mixture model; BSMAS = Bergen Social Media Addiction Scale; SMD = Social Media Disorder

in two other studies, which found it to be a protective factor or a nonsignificant variable.

Two studies reported risk factors related to school, investigating variables such as academic stress, poor self-reported academic performance, and high study pressure. In contrast, another study reported no associations on subjective school achievements.

Low future orientation was a risk factor in one study, while no significant associations were found in another study.

Some psychosocial variables were investigated by individual studies and found to have a protective (i.e., gratitude, secure attachment, self-control, positive affect), risk (i.e., fear of missing out, nomophobia, negative affect, narcissism, psychological need satisfaction, externalizing problems, social media use patterns, ventral media prefrontal cortex responsivity, sensation seeking, mental health symptoms, attention deficit, impulsivity) or non-significant association (passive and active use, level of extraversion, attention deficit hyperactivity symptoms, Internet Gaming Disorder symptoms, Social Media Disclosure, Smartphone Stress, screen time, passion and perseverance for long-term goals, hope, loneliness) with PSMU.

Interpersonal Variables

Nine studies focused on interpersonal variables, investigating eighteen potential predictors (Table 5).

Risk factors identified include social rejection, attention seeking, frequency of communication (only among males), parent-adolescent conflict, and perceived social support. One study tested different models with peer pressure and peer support, finding conflicting results.

In one study, high social competencies were either a risk or a protective factor of change trajectories of PSMU.

Internet-specific parenting practices had mixed results. Tolerant and supportive internet-specific parental styles were found to be protective in one study, while internet-specific rules were not significant predictors in two studies. Two studies also tested if reactive restrictions toward Internet use predicted PSMU, one without finding significant results, and one finding it to be a protective factor but only among girls. Time spent with parents has a protective effect on PSMU, according to one study.

Eleven interpersonal variables showed no significant relationships with PSMU: quality of communication, upward social comparison, cybervictimization, face-to-face contacts with friends, poor supervision, parental phubbing, and family support.

Main Characteristics and Results of the Interventions

The included interventions focused on mindfulness [48], socio-cognitive [49] narrative approaches [50] and motivational enhancement therapy [51] Table 6 summarizes the main characteristics of the interventions and results and feasibility information (when available).

Weaver and Swank created a mindfulness-based program [48] aimed at mitigating the negative effect of social media misuse (including PSMU) through increased awareness of thoughts, feelings and actions while on SM. The intervention is manualized and delivered in group format and includes 1 session per week for 5 weeks and homework with mindfulness practice assignments between sessions. Core topics included: being in the present-moment while on SM; intentions for SM use; mindful attitude while on SM. The intervention has been implemented in schools by a counsellor receiving training in mindfulness-based interventions.

Table 4 Risk and protective intrapersonal predictors in longitudinal studies

Author, year	Outcome measure	Type of analysis	Variable	Results	Risk/ protective
Boer et al., 2020	SMD Scale	RI-CLPM	*SMU Intensity*	Not significant (T1->T2: β = 0.02, p = .758; T2->T3: β = −0.05, p = .447)	NOT SIGNIFICANT
			ADHD symptoms (attention deficits, impulsivity, hyperactivity)	Not significant NB: adolescents whose SMU problems increased also reported increased SMU problems 1 year later (i.e., SMU problems are persistent over time)	NOT SIGNIFICANT
Boer et al., 2021	SMD Scale	RI-CLPM	*SMU intensity*	Adolescents whose SMU intensity increased at T1 reported increased SMU problems in T2 (M1a: β = 0.094, p < .01; M2a: β = 0.096, p < .01). No significant relationship between T2 SMU intensity and T3 SMU problems.	RISK/NOT SIGNIFICANT**
			Depressive symptoms	Adolescents whose depressive symptoms increased (M1a: βT1, T2 = 0.062, p = ns, and βT2, T3 = 0.020, p = ns) did not show increased SMU problems one year later.	NOT SIGNIFICANT
			Life satisfaction	Adolescents whose life satisfaction decreased (M2a: βT1, T2 = −0.050, p = ns and βT2, T3 = −0.08, p = ns) did not show increased SMU problems one year later.	NOT SIGNIFICANT
			Subjective school achievements	No significant relationship between subj. school achievements and SMU problems (M1d βT1, T2 = −0.001, p = ns, and βT2, T3 = 0.004, p = ns).	NOT SIGNIFICANT
Boer et al., 2022	SMD Scale	LCGA and multivariate multinomial regression analysis.	*Subjective well-being (life satisfaction, self-esteem)*	Lower life satisfaction (B = −1.349, p < .001, OR = 0.263) was associated with a greater probability of being in Class 1 (i.e.: Variably high PSMU, variably high SMU frequency) compared to Class 4 (i.e.: Persistently low PSMU, variably high SMU frequency). The lower the level of life satisfaction, the higher the probability of being in Class 2 (i.e.: Persistently high PSMU, persistently average SMU frequency) compared to Class 4 (B = −0.793, p = .013, OR = 0.454). Higher self-esteem (B = 0.881, p = .003, OR = 2.423), was associated with a greater probability of being in Class 3 (i.e., persistently low PSMU, persistently low SMU frequency.	Lower life satisfaction: RISK. Higher self-esteem: PROTECTIVE.
			Self-control (attention deficit, impulsivity)	Higher attention deficit (B = 1.050, p = .008, OR = 2.914), and higher impulsivity (B = 1.607, p < .001, OR = 5.051), were associated with a greater probability of being in Class 1 (i.e.: Variably high PSMU, variably high SMU frequency) compared to Class 4 (i.e.: Persistently low PSMU, variably high SMU frequency). Lower impulsivity (B = −2.060, p < .001, OR = 0.130) was associated with a greater probability of being in Class 3 (i.e., persistently low PSMU, persistently low SMU frequency.	Higher attention deficit, higher impulsivity: RISK. Lower impulsivity: PROTECTIVE.
Coyne et al., 2019	Seven-item problematic social media use scale (adapted from Merlo et al., 2013).	GMM	*Social Media time Use Patterns*	Class 2 (increasers) had higher levels of social media problems (M = 3.00) than did Class 1 (Peak Users) or Class 3 (Moderate Users)	RISK
Flannery et al., 2024	7-item questionnaire based on items from the DSM-5 substance use disorder checklist.	Moderated mediation model	*vmPFC (ventral media prefrontal cortex) responsivity decrease across puberty*	Decreasing vmPFC (ventral media prefrontal cortex) responsivity across puberty was related to increased ASMU (addiction-like social media use) symptoms (β = −1.8, p = .03)	RISK
Gingras et al., 2023	BSMAS	CLPM	*Passive and active use of SM*	Main: Not significant; T1 Active use Intensity and T2 PSMU (r = 0.25, p < .01; preliminary correlations)	NOT SIGNIFICANT
			Depression	Main: Not significant; T1 Depression symptoms and T2 PSMU (r = 0.21, p < .01; preliminary correlations)	NOT SIGNIFICANT
			Anxiety	Main: Not significant; T1 Anxiety Symptoms and T2 PSMU (r = .28, p < .01; preliminary correlations)	NOT SIGNIFICANT

Table 4 (continued)

Author, year	Outcome measure	Type of analysis	Variable	Results	Risk/ protective
			Level of extraversion	Main: Not significant; No significant correlation (r = 0.12 NS; preliminary correlations)	NOT SIGNIFICANT
Hawk et al., 2019	SMD Scale	CLPM	*Narcissism*	Direct relationship: not significative. We observed a positive indirect effect from T1 Narcissism to T2 Problematic Use, via T2 Attention-Seeking (β = 0.034, p = .045; 95% CI [0.001, 0.068]). We also observed an indirect effect from the T1 Narcissism × Rejection interaction to T2 Problematic Use, via T2 Attention-Seeking (β = 0.035, p = .046; 95% CI [0.001, 0.069]).	RISK
			Social Media Disclosure	Not significant; T1 Social Media Disclosure with T2 PSMU (r = 0.191, p < .001, preliminary correlations)	NOT SIGNIFICANT
			Smartphone Stress	Not significant; T1 Smartphone Stress with T2 PSMU (r = .372, p < .001, preliminary correlations)	NOT SIGNIFICANT
Koning et al., 2018	SMD Scale	SEM (Zero-inflated cross-lagged analyses)	*Internet Gaming Disorder (IGD) symptoms*	Main: not significant ("Only significant paths are presented); T1 IGD Symptoms and T2 PSMU (r = 0.26, p < .001; preliminary correlations)	NOT SIGNIFICANT
Leijse et al., 2023	SMD Scale	Multinomial Logistic Regression	*Self-control*	Preliminary analyses (correlations): T1 adolescents' self-control (−0.297**) was negatively related with T2 PSMU. Main analyses: 3rd model = strong effect of self-control (T1) on risky social media use (OR = 0.524, p = < 0.001) as well as on problematic social media use (OR = 0.347, p = < .001) (i.e.: higher levels of self-control decreased the risk of becoming a risky and problematic social media user).	PROTECTIVE
Lin et al., 2021	BSMAS	Linear mixed-effects regression analyses with three-level random intercepts	*Insomnia Severity*	Insomnia severity was weakly to moderately correlated to Addictive use of social media (r = 0.239 to 0.437; preliminary correlations).	Risk
			Nomophobia	Nomophobia was moderately correlated with the addictive use of social media (r = 0.416 to 0.614; correlations).	Risk
Liu et al., 2023	Social networking addiction scale	CLPM	*Online basic psychological need satisfaction (perceived autonomy, perceived competency, perceived relatedness)*	Significant correlations between T1 PNS (0.26***), T1 autonomy (0.26***), competence (0.26***), relatedness (0.22***) and T2 (preliminary correlations). Main: As for the cross-lagged path: T1 online psychological need satisfaction (e = 0.13, p < .05, R2 = 0.02, 95% CI [0.04, 0.22]), T1 need for autonomy (e = 0.14, p < .05, R2 = 0.02, 95% CI [0.05, 0.24]), T1 need for competence (e = 0.13, p < .05, R2 = 0.02, 95% CI [0.04, 0.22]) and T1 need for relatedness online (e = 0.11, p < .05, R2 = 0.01, 95% CI [0.02, 0.20]) positively predicted social networking addiction at Time 2.	RISK
Li et al., 2018	OSNA scale	Multilevel logistic regression models	*Depression*	Among 3,657 adolescents who were free of OSNA at baseline, univariate results demonstrated a significant positive association between baseline depression and higher incidence of OSNA (univariate OR: 2.02, 95% CI: 1.58–2.58)	RISK
			Academic performance	Self-reported poor academic performance was associated with higher incidence of OSNA.	RISK
			Perceived study pressure	Perceived heavy study pressure was associated with higher incidence of OSNA	RISK
Li et al., 2024	SMD Scale	Bivariate correlations (preliminary analyses); RI-CLPM (main analyses)	*Fear of Missing Out (FoMO)*	Preliminary analyses: significant positive relationships between FoMO (coefficients from 0.18** to 0.32***) and subsequent PSMU. Main results (RI-CLPM): unidirectional association from FoMO at T3 to PSMU at T4 (b = 0.29, SE = 0.13, p = .026, β = 0.15).	RISK

Table 4 (continued)

Author, year	Outcome measure	Type of analysis	Variable	Results	Risk/ protective
			Life satisfaction	Preliminary analyses: significant negative associations between life satisfaction (coefficients from-0.15** to −0.22***) and subsequent PSMU. Main results (RI-CLPM): No significant effect of life satisfaction on subsequent PSMU.	NOT SIGNIFICANT
			Social Media use intensity (SMUI)	Preliminary analyses: significant positive relationships between social media use intensity (coefficients from 0.17*** to 0.28***) and subsequent PSMU	Risk
Raudsepp, 2019	BSMAS	Parallel latent growth model	*Depressive symptoms*	Main: Not significant; Preliminary correlations on the entire sample: T1 Depressive symptoms and T2 PSMU ($r = 0.28$, $p < .01$); T1 Depressive symptoms and T3 PSMU ($r = 0.24$, $p < .01$); T2 Depressive symptoms and T3 PSMU ($r = 0.25$, $p < .01$)	NOT SIGNIFICANT
			Insomnia Severity	Main: Not significant; Preliminary correlations on the entire sample: T1 Sleep Disturbances and T2 PSMU ($r = 0.24$, $p < .01$); T1 Sleep Disturbances and T3 PSMU ($r = 0.22$, $p < .01$); T2 Sleep Disturbances and T3 PSMU ($r = 0.31$, $p < .01$)	NOT SIGNIFICANT
Raudsepp & Kais, 2019	BSMAS	Latent growth models	*Depressive symptoms*	The path from initial depressive symptoms to the change in PSMU was significant ($\beta = 0.23$, $p < .05$), indicating that participants who started with higher depressive symptoms tended to have steeper increases in PSMU. T1 Depressive Symptoms and T2 PSMU ($r = 0.25$, $p < .01$); T2 Depressive Symptoms and T3 PSMU ($r = 0.22$, $p < .01$); T2 Depressive Symptoms and T3 PSMU ($r = 0.17$, $p < .05$) (correlations)	RISK
Shoshani et al., 2024	BSMAS	Mixed model growth curve analyses	*Screen time*	Not significant relationship (0.02)	NOT SIGNIFICANT
			Gratitude	Gratitude (−0.03) associated with reduced SM addiction symptoms.	PROTECTIVE
			Future orientation	Not significant relationship (0.01)	NOT SIGNIFICANT
			Grit (passion and perseverance for long-term goals)	Not significant relationship (−0.02)	NOT SIGNIFICANT
			Hope	Not significant relationship (0.003)	NOT SIGNIFICANT
			Life satisfaction	Life satisfaction (−0.01) associated with reduced SM addiction symptoms.	PROTECTIVE
			Positive affect	Positive emotions (−0.01) associated with reduced SM addiction symptoms.	PROTECTIVE
			Negative affect	Negative emotions (0.04) associated with higher SM addiction symptoms.	RISK
			Sensation seeking	Sensation seeking (0.005) associated with higher SM addiction symptoms.	RISK
			Mental health symptoms	Mental health symptoms (0.02) associated with higher SM addiction symptoms.	RISK
			Secure attachment	Secure attachment (−0.011) associated with reduced SM addiction symptoms.	PROTECTIVE
Yang, 2024	SMD Scale	Hierarchical regression analysis	*Academic stress*	Before controlling other risk factors, all potential risk factors at T1 significantly affected T2 PSMU. After controlling other risk factors, T1 academic stress ($\beta = 2.46$, $p < .001$), still significantly affected T2 PSMU.	RISK
			Low future orientation	Before controlling other risk factors, all potential risk factors at T1 significantly affected T2 PSMU. After controlling other risk factors, T1 low future orientation ($\beta = 2.38$, $p < .001$) still significantly affected T2 PSMU.	RISK

Table 4 (continued)

Author, year	Outcome measure	Type of analysis	Variable	Results	Risk/ protective
			Depression	Before controlling other risk factors, depression at T1 significantly affected T2 PSMU. After controlling other risk factors, not significant.	NOT SIGNIFICANT
			Anxiety	Before controlling other risk factors, anxiety at T1 significantly affected T2 PSMU. After controlling other risk factors, not significant.	NOT SIGNIFICANT
			Loneliness	Before controlling other risk factors, loneliness at T1 significantly affected T2 PSMU. After controlling other risk factors, not significant.	NOT SIGNIFICANT
			Externalizing problems	Before controlling other risk factors, all potential risk factors at T1 significantly affected T2 PSMU. After controlling other risk factors, T1 externalizing problems ($\beta = 2.75$, $p < .001$) still significantly affected T2 PSMU.	RISK
			SMU intensity	Before controlling other risk factors, all potential risk factors at T1 significantly affected T2 PSMU. After controlling other risk factors, T1 SMU intensity ($\beta = 5.75$, $p < .001$) still significantly affected T2 PSMU.	RISK

* Discordant results between two models; ** Discordant results between time points; we used the same terminology as the original paper (e.g., gender or sex); the risk/protective factor column summarizes the results of the main analyses (UPPER CASE). Where only preliminary analyses are reported for a variable, the text is in lower case; CLPM = Cross-lagged Panel Model; RI-CLPM = Random Intercept Cross-Lagged Panel Model; LCGA = Latent class growth analysis; GMM = Growth mixture model; BSMAS = Bergen Social Media Addiction Scale; SMD = Social Media Disorder

Manwong and collaborators (2018) developed and evaluated a group activity-based motivational enhancement therapy program (GA-MET) on social media addictive (SMA) behaviours [51]. The program has been developed through a review of the literature, the evaluation of the content and construct validities by experts in motivational enhancement therapy (MET) via motivational interviewing (MI) [52]) and, preliminary evaluation of the appropriateness through the preliminary implementation in a school. GA-MET includes three phases: education and feedback, commitment and strengthening, follow-up. Each activity has been performed in each classroom for 45–50 min/week (for a total of 8 weeks) in groups of 8–10 students via a facilitator with experience consulting or educating adolescents and trained in MI/MET and GA-MET programs. In two studies, the reduction of PSMU is one of the aims of a broader intervention that also focuses on internet addictive behaviours among adolescents.

Among these, Favini and collaborators proposed a school-based intervention, which includes among its objectives the reduction of problematic social network sites use [49]. The intervention is based on a socio-cognitive approach and referred to the Positive Youth Development Theory including psychological strategies such as self-monitoring, perspective-taking, and decision-making. The intervention included four interactive educational encounters of 1 h each, during school hours, addressing: increasing awareness of internet-related addictions; contrasting excessive smartphone and SM use; promoting positive internet-related behaviours, and empowering self-regulation and self-efficacy.

In the study by Yıldırım (2023) a narrative therapy integrated with spirituality was implemented in a group-format with the aim of to reducing internet and SM addiction [50]. The intervention, targeting students with high levels of internet and SM addictions, was implemented weekly for 8 weeks in a counselling centre. The focus was on identifying values, determining life goals in line with values, positioning adolescents outside the problem, evaluating the effects of internet addiction, discovering alternative stories, rewriting the situation, consolidating alternative stories, affirming and supporting values through role models.

As regards effectiveness results of these interventions, "Mindfulness Connections" resulted in lower scores of PSMU compared to the control group at post-intervention. A similar result emerged for mindfulness attention, while both the intervention and control groups had lower scores of fear of missing out (FOMO) and life satisfaction. In Favini and collaborators [49], compared to the control group, participants in the experimental one reported a greater decrease in social network sites (SNS) addiction and problematic smartphone use (SMA). SNS and SMA significantly decreased as a function of the intervention, with a further contribution of self-regulatory self-efficacy on the change in SNS ($\beta c = -0.33$; $p < .01$).

The spirituality-Integrated Narrative Group Therapy showed an intra-group reduction in the SM addiction levels

Table 5 Risk and protective interpersonal predictors in longitudinal studies

Author, year	Outcome measure	Type of analysis	Variable	results	risk/ protective
Boer et al., 2021	SMD Scale	RI-CLPM	Upward social comparison	Social comparison (M1b: βT1, T2 = 0.044, p = ns and βT2, T3 = 0.015, p = ns), was NOT a significant predictor of SMU problems in the next year.	NOT SIGNIFICANT
			Cybervictimization	Cybervictimization (M1c: βT1, T2 = 0.036, p = ns and βT2, T3 = 0.009, p = ns) was NOT a significant predictor of SMU problems in the next year.	NOT SIGNIFICANT
			Face to face contacts with friends	Face-to-face contact (M1e: βT1, T2 = −0.003, p = ns 0.001 and βT2, T3 = −0.003, p = ns) was NOT a significant predictor of SMU problems in the next year.	NOT SIGNIFICANT
Boer et al., 2022	SMD Scale	LCGA and multivariate multinomial regression analysis.	Social competencies (perceived friendship competence)	The lower the level of social competencies, the higher the probability of being in Class 2 (i.e.: Persistently high PSMU, persistently average SMU frequency) compared to Class 4 (B = −2.634, p <.001, OR = 0.073). Poorer social competencies (B = −1.606, p <.001, OR = 0.202) were associated with a greater probability of being in Class 3 (i.e., persistently low PSMU, persistently low SMU frequency).	RISK or PROTECTIVE depending on PMSU level and type of SM use
Geurts et al., 2023	SMD Scale	Multiple latent profile analysis; Multiple regression models	Internet-Specific Parental styles (Responsiveness, autonomy-granting, Internet-specific rule-setting, restrictions, co-use)	Limiting and supportive parental style lower PSMU at T2 [B = 0.506 SE = 0.213 β = 0.185 p =.017] and at T4 [B = 0.641 SE = 0.267 β = 0.234 p =.016] than "Limiting and less supportive". Tolerant and supportive lower PSMU at T3 [B = −0.895 SE = 0.329 β=−0.414 p =.006] and at T4 [T4 B = −0.897 SE = 0.307 β=−0.415 p =.004] than "limiting and less supportive". Tolerant and supportive lower PSMU at T3 [B = −0.595 SE = 0.266 β=−0.271 p =.025] and at T4 [B = −0.713 SE = 0.278 β= −0.325 p =.010] than "limiting and supportive".	PROTECTIVE (Tolerant and supportive parental styles)
Geurts et al., 2024	SMD Scale	Multiple Indicator RI-CLPM	Internet-specific rule-setting	Main: Not significant effects; T1 rule-setting with T2 PSMU (r = −0.07, p <.05; preliminary correlations)	NOT SIGNIFICANT
			Reactive restrictions toward Internet use	Main: Not significant; T1 reactive restrictions with T2 PSMU (r = 0.11, p <.01); reactive restrictions T1 and T2 with PSMU T3 (r = 0.20, p <.001; r = 0.17, p <.001 respectively) (preliminary correlations)	NOT SIGNIFICANT
Hawk et al., 2019	SMD Scale	CLPM	Social Rejection	We also observed an indirect effect from the T1 Narcissism × Rejection interaction to T2 Problematic Use, via T2 Attention-Seeking (β = 0.035, p =.046; 95% CI [0.001, 0.069]).	RISK
			Attention Seeking	We observed a positive indirect effect from T1 Narcissism to T2 Problematic Use, via T2 Attention-Seeking (β = 0.034, p =.045; 95% CI [0.001, 0.068]). We also observed an indirect effect from the T1 Narcissism × Rejection interaction to T2 Problematic Use, via T2 Attention-Seeking (β = 0.035, p =.046; 95% CI [0.001, 0.069]). T1 Attention Seeking with T2 PSMU (r = 0.156, p <.01, preliminary correlations).	RISK
Koning et al., 2018	SMD Scale	SEM (Zero-inflated cross-lagged analyses)	*Reactive restrictions*	Main: Among girls, more restrictive parental rules at T1 predicted fewer SMD symptoms at T2 (β = −0.23, p =.078). T1 Reactive Restrictions and T2 PSMU (r = 0.18, p <.01; preliminary correlations on the entire sample).	PROTECTIVE (but only among FEMALES)
			Internet-specific rules	Main: Not significant; T1 Reactive Internet Specific Rules and T2 PSMU (r = −0.16, p <.01; preliminary correlations on the entire sample).	NOT SIGNIFICANT
			Frequency of communication	Main: Among boys, a higher frequency of communication about Internet use at T1 significantly predicted more SMD symptoms (β = 0.21, p =.079) at T2. Preliminary analysis: T1 frequency of communication and T2 PSMU not significant (r = −0.01, p = ns).	RISK (but only among MALES).
			Quality of communication	Main: Not significant; T1 Quality of Communication and T2 PSMU (r = −0.21, p <.001; preliminary correlations on the entire sample).	NOT SIGNIFICANT

Table 5 (continued)

Author, year	Outcome measure	Type of analysis	Variable	results	risk/ protective
Leijse et al., 2023	SMD Scale	Multinomial Logistic Regression	Family support	Preliminary analyses (correlations): T1 family support (r = −0.131**) negatively related to T2 PSMU. Main analyses: 4th model: not significant.	NOT SIGNIFICANT
			Time spent with parents	Preliminary analyses (correlations): not significant. Main analyses: 4th model: including both parental and peer factors at T1, the odds of being a risky user at T2 (compared to being a normative user) was significantly increased by time spent with the parents (p =.021)	PROTECTIVE
			Peer support	Preliminary analyses (correlations): no significant relationship Main analyses: 2nd model: a significant negative effect was found for peer support T1 (OR = 0.889, p =.043) on the odds of being a risky user at T2. 4th model: including both parental and peer factors at T1, the odds of being a risky user at T2 (compared to being a normative user) was not significantly increased by peer support	PROTECTIVE/NOT SIGNIFICANT*
			Peer pressure	Main analyses: 2nd model: a positive effect was found for peer pressure T1 (OR = 1.273, p =.021) on the odds of being a risky user at T2. 4th model: including both parental and peer factors at T1, the odds of being a risky user at T2 (compared to being a normative user) was not significantly increased by peer pressure	RISK/NOT SIGNIFICANT*
Shoshani et al., 2024	BSMAS	Mixed model growth curve analyses	Perceived social support	Perceived social support associated with higher SM addiction (0.03)	RISK
Yang, 2024	SMD Scale	Hierarchical regression analysis	Poor supervision	Before controlling other risk factors, poor supervision at T1 significantly affected T2 PSMU. After controlling other risk factors, not significant.	NOT SIGNIFICANT
			Parent-adolescent conflict	Before controlling other risk factors, all potential risk factors at T1 significantly affected T2 PSMU, and T1 parent-adolescent conflict (β = 9.19, p <.001) was the strongest risk factor. After controlling for all other risk factors T1 parent-adolescent conflict (β = 3.97, p <.001) significantly affected T2 PSMU	RISK
			Parental phubbing	Before controlling other risk factors, parental phubbing at T1 significantly affected T2 PSMU. After controlling other risk factors, not significant.	NOT SIGNIFICANT
			Cyberbullying victimization	Before controlling other risk factors, cyberbullying victimization at T1 significantly affected T2 PSMU. After controlling other risk factors, not significant.	NOT SIGNIFICANT

* Discordant results between two models; ** Discordant results between time points; we used the same terminology as the original paper (e.g., gender or sex); the risk/protective factor column summarizes the results of the main analyses (UPPER CASE). Where only preliminary analyses are reported for a variable, the text is in lower case; CLPM = Cross-lagged Panel Model; RI-CLPM = Random Intercept Cross-Lagged Panel Model; LCGA = Latent class growth analysis; BSMAS = Bergen Social Media Addiction Scale; SMD = Social Media Disorder

compared to the control group, however at the post intervention no differences emerged between-group [50]. Similar results emerged for internet addiction.

The GA-MET intervention [51] did not have a significant effect on SMA behaviours both at the post and follow-up assessment, and considering different subgroups of baseline SMA behaviours. In contrast, there is a significant decrease in the average duration of SM usage during weekdays, weekends, emotional behaviours, and depression.

None of the studies explicitly evaluated intervention feasibility. All participants in the study of Yıldırım [50] completed the study, while the attrition rate was 16.9% in the pre to post-test assessment for the study of Weaver and Swank [48] and 22% for the study of Favini and collaborators [49] 3.2% at post-test and 3.6% at the follow-up for the study of Manwong and collaborators [51].

Quality of the Included Studies

Longitudinal studies were mostly considered to be of good or fair quality, with the main limitations being a lack of information on sample size justification and blinding of outcome assessors. Studies usually did not report the participation rate of eligible people (see Table 7).

Table 6 Characteristics, contents, and results of the interventions

Authors	Aims	Approach	Intervention contents	Setting, duration and delivery	PMSU results	Other variables result	Retention rate
Weaver et al., 2023	To regulate SM use through increased awareness of thoughts, feelings, and actions while on SM.	**Mindfulness-based group intervention.**	"The Mindful Connections intervention." Session 1: group rules, SM habits, overview of mindfulness. Session 2: attention in the context of SM (being in the present moment while on SM), mindful exercises. Session 3: intention for SM use. Session 4: mindful attitude while on SM. Session 5: reviewing mindfulness exercises, additional resources.	*School*: 5 sessions of 50 min during school hours. *Homework*: mindfulness assignments between the sessions. *Duration*: 5 weeks. *Delivered by*: a doctoral student in counsellor education with a master's degree in clinical mental health counselling	The intervention group had lower scores of PSMU after the intervention compared to the control group ($F(2, 52)=6.018$, $p<.05$).	The intervention group had higher scores of mindful attention after the intervention compared to the control group ($F(2, 52)=4.65$, $p<.05$). No statistically significant difference in FOMO) ($p=.828$, and life satisfaction ($p=.191$).	11 drop out
Favini et al., 2023	To prevent online addictive behaviours such as excessive and/or problematic smartphone and SN use. To promote the adoption of positive strategies and behaviours in relation to ICT use.	**Socio-cognitive interactive educational group intervention** (preventive-promotive approach)	Session 1: baseline assessment, project presentation, awareness of smartphone and SN problematic use. Session 2: knowledge about behavioural addictions, vulnerability/protective factors, interactive educational online games to communicate information about online addictive behaviours, and extrinsic reward. Session 3: promoting positive and beneficial use of media and ICTs, practical experience of perspective-taking and decision-making. Session 4: discussion of self-monitoring, emphasizing self-efficacy skills, baseline results were shared.	*School*: 4 sessions of 1 h each, conceived as educational and practical experiences, during school hours. *Homework*: from session 3 to 4 self-monitoring activity for online positive and negative behaviours. *Duration*: 5 weeks. *Delivered by*: NA	SN problematic use: a small significant decrease across time in the intervention group, compared to the control group (Cohen's $d=-0.51$ [95% confidence interval, CI: −0.69; −0.32]); trends in the intervention group significantly decreased as a function of the intervention ($\beta=-0.34$; $p<.05$).	Problematic smartphone use: a small significant decrease across time in the intervention group, compared to the control group (Cohen's $d=-2.95$ [95% CI = −3.22; −2.69]); trends in the intervention group significantly decreased as a function of the intervention ($\beta=-0.13$; $p<.01$).	Missing data: 22% of pre-intervention
Yıldırım, 2023	To consolidate alternative stories using spiritual techniques.	**Spiritually-oriented, narrative-based group counselling**	(i) to place participants outside of the problem. (ii) to enable them to discover alternative stories in their lives. (iii) to make them realize their values. (iv) to reduce their dependence on the Internet and to rewrite their situation.	*Counselling centre*: 8 sessions of 90 min each. *Duration*: 8 weeks. *Delivered by*: NC	SM addiction in the experimental group decreased after intervention ($z=-0.2.505$, $p<.05$). No significant difference between the two groups ($U=46.00$ $z=-0.305$, $p>.05$).	Internet addiction of the experimental group decreased after intervention ($z=-0.2.812$, $p<.05$). No significant difference between the two groups on ($U=29.00$ $z=-1.599$, $p>.05$).	NA

Table 6 (continued)

Authors	Aims	Approach	Intervention contents	Setting, duration and delivery	PMSU results	Other variables result	Retention rate
Manwong et al., 2018	To enhance motivation to change social media addictive (SMA) behaviours. To reduce total time spent on SM and suppress the addictive SMA behaviour.	**Group activity-based motivational enhancement therapy (GA-MET).**	Phase I (health education and feedback; from pre-contemplation and contemplation to preparation stage): ice breaking; SM; SMA behaviour; self-assessment of SMA levels; individually information on SMA status; sharing of participants experiences; group learning session. Phase II (commitment and strengthening; for participants motivated to move on to the preparation and action stages): sharing the optional choice of reducing SM use behaviour; difference in the present behaviours and the goal of behaviour change; small group was assigned to determine whether individuals were addicted to SM or not and to share their perception of the future SMA effects; selection of role play situations; role play, followed by reflection; goal of changing; goal reminder. Phase III: assess the change of SMA behaviour; review goals; overcome obstacles; check commitment; and improve motivation; focusing on progression.	*School*: 8 sessions of 45/50 minutes each, during school hours. *Duration*: 8 weeks + follow up at 12 weeks. *Delivered by*: a clinical psychologist, or a behaviourist with experience consulting or educating adolescents about health in a school environment - trained in MI/MET and the GA-MET programs.	SMA behaviour scores not significant - (GA-MET program may be more suitable for prevention rather than treatment of SMA behaviours.	The GA-MET significantly decreased the average duration of SM usage during weekdays and weekends (hours/day) (adjusted mean difference: –1.27, 95% CI: −2.18,–0.37 and −1.25, 95% CI: −2.22, −0.29, respectively), emotional behaviour (–0.69, 95% CI: −1.18, −0.19), and depression (–4.03, 95% CI: −6.07, −1.99) compared to the control group.	96.8% retention rate at week 8; 96.4% at the follow-up (0.4% resigned). The total dropout rate was 3.6%. (8 drop out +1 drop at follow up).

Regarding interventional studies (Table 8), three were rated as poor quality and one as fair quality. All the studies lacked allocation concealment and blinding to group allocation. Analyses were not conducted on an intention-to-treat approach.

Discussion

This systematic review sought to investigate the sociodemographic and psychosocial risk and protective factors influencing problematic social media use in mid-adolescents and to explore the psychosocial interventions designed to prevent or mitigate its impact in this age group.

The nineteen longitudinal studies included in the review allowed us to explore how socio-demographic and psychosocial factors at both intrapersonal and interpersonal levels influence PSMU. However, due to the heterogeneity and the relatively small number of studies, it is challenging to draw definitive conclusions.

Gender was the socio-demographic variable most frequently investigated in the reviewed studies, being associated with inconsistent results. Six studies (out of twelve) reported that girls have a higher risk of developing PSMU, which might be due to gendered patterns of vulnerability to social comparison [53]; however, the current review found no significant associations, which is consistent with recent meta-analyses of the general population that support the idea that boys and girls are at similar risk of PSMU [2, 54]. It is worth noting that the included studies relied on a binary approach to gender, with nonbinary participants excluded from analysis in one case [43]. This framework oversimplifies gender, misrepresents individuals who do not identify strictly as boys or girls, and neglects the interplay between biological and social factors, as well as the difference between self-labelling (identity) and roles and behaviours (presentation) [55]. To address these limitations, research should adopt inclusive approach to gender [56], such as the use of open-ended or multidimensional assessments [57]. This is particularly relevant for adolescents today, as

Table 7 Quality assessment of longitudinal studies

	1	2	3	4	5	.	2	6	4	10	11	12	13	14	Overall N1
Gingras et al., 2023	O	O	NR	O	NR	O	O	O	O	O	O	NR	O	O	Good
Boer et al., 2020	O	O	O	O	NR	O	O	O	O	O	O	NR	O	O	Good
Koning et al., 2018	O	O	NR	O	NR	O	O	O	O	O	O	NR	N	O	Fair
Geurts et al., 2024	O	O	N	O	NR	O	O	O	O	O	O	NR	N	O	Fair
Raudsepp, 2024	O	O	NR	O	NR	O	O	O	O	O	O	NR	N	O	Fair
Coyne et al., 2019	O	O	NR	O	NR	O	O	O	O	O	O	NR	N	O	Fair
Raudsepp & Kais, 2019	O	O	NR	O	NR	O	O	O	O	O	O	NR	O	O	Good
Lin et al., 2021	O	O	NR	O	NR	O	O	O	O	O	O	NR	N	O	Fair
Hawk et al., 2019	O	O	NR	O	NR	O	O	O	O	O	O	NR	N	O	Fair
Liu et al., 2023	O	O	NR	O	NR	O	O	O	O	O	O	NR	O	O	Good
Li et al., 2018	O	O	O	O	N	O	O	O	O	O	O	NR	O	O	Good
Geurts et al., 2023	O	O	NR	O	N	O	O	O	O	N	O	NR	O	O	Fair
Boer et al., 2021	O	O	O	O	N	O	O	O	O	O	O	NR	N	O	Good
Li et al., 2024	O	O	NR	O	N	O	O	O	O	O	O	NR	N	O	Fair
Boer et al., 2022	O	O	NR	O	N	O	O	O	O	O	O	NR	O	O	Fair
Yang, 2024	O	O	O	O	N	O	O	O	O	N	O	NR	O	O	Fair
Leijse et al., 2023	O	O	NR	O	N	O	O	O	O	O	O	NR	O	NR	Fair
Flannery et al., 2024	O	O	NR	O	N	O	O	O	O	O	N	NR	O	NR	Fair
Shoshani et al., 2024	O	O	NR	O	N	O	O	O	O	O	O	NR	O	O	Good

1:Research question; 2: Study population; 3: Participation rate; 4= Groups recruited from the same population and uniform eligibility criteria; 5: Sample size justification; 6: Exposure assessed prior to outcome measurement; 7: Sufficient timeframe; 8: Different levels of the exposure of interest; 9: Exposure measures and assessment; 10: Repeated exposure assessment; 11 Outcome measures; 12: Blinding of outcome assessors; 13: Follow-up rate; 14: Statistical analyses

Table 8 Quality assessment of interventional studies

	1	2	3	4	5	.	2	6	4	10	11	12	13	14	Overall N1
Weaver et al., 2023	N	NR	N	N	N	O	O	NR	NR	NR	O	NR	O	N	Poor
Favini et al., 2023	N	NR	N	N	NR	O	N	NR	NR	NR	O	NR	O	N	Poor
Yıldırım, 2023	N	NR	N	N	NR	O	O	O	NR	N	O	N	O	N	Poor
Manwong et al., 2018	O	O	NR	N	NR	O	O	O	O	O	O	O	O	N	Fair

1: randomized; 2: Adequate randomization; 3: Allocation concealment; 4: Blinding to group assignment; 5: assessor blinded; 6: Similarity of groups at baseline; 7: Overall drop-out rate; 8: Differential drop-out rate; 9: Adherence; 10: Avoid other interventions; 11: Outcome measures assessment; 12: Power calculation; 13: Prespecified outcomes; 14: Intention-to-treat analysis

discourses around gender diversity are on the rise and adolescents are increasingly challenging binary conceptualizations [57, 58].

Another sociodemographic variable often studied is age, whom in the literature is generally regarded as a protective factor against PSMU [54], as older adolescents may develop greater self-regulation skills [59]. However, in the current review, the majority of studies (four out of seven) reported no significant effects of age, which could be attributed to the narrower age range examined compared to broader age distributions in other research. Interestingly thought, two recent meta-analysis found no differences on PSMU levels between adolescents and adults [2, 60]. Contrarily, the other three studies included in our review found a significant relation between age and PSMU. Interestingly, while two studies aligned with the general view of higher age being protective, one study found higher age to be a risk factor, suggesting that the influence of age on PSMU may vary depending on specific contextual or developmental factors.

Variables related to family composition and financial situation have only been examined in a few studies, with mixed results, probably also due to different categorization

methods. Four studies investigated the effect of minority status (ethnicity or immigrant background), founding it to be not related to PSMU. However, three of those studies [10, 61, 62] were based on data from the Digital Youth project [38], and individuals with minority status were underrepresented in the sample. The other study investigating ethnicity had a more balanced sample, but its results were limited by the smaller number of participants [43]. Minority status needs to be further examined, focusing not only on examining the group membership itself but also on how distal and proximal group-specific stressors are experienced and "get under the skin", causing minority stress [63–66].

Regarding intrapersonal variables, depression was the most frequently investigated variable and was found to be a risk factor in two out of six studies. Notably, our scope was to investigate the directional relationship from depression to PSMU, however, existing reviews highlights that depression and PSMU are often associated across various population groups, suggesting the potential for an inverse relationship to be more significant [17, 67]. Interestingly, findings suggest a possible protective role of life satisfaction underlying the importance of focusing on variables related to positive health and well-being [68].

In the included longitudinal studies, fear of missing out (FoMO) was notably underrepresented, with only one study examining its influence on PSMU. This lack of finding represents a critical gap given that FoMO is considered a key component in models of PSMU [3, 69, 70]. Regarding school-related variables, while no consistent results were found for perceived school performance, the way adolescents perceive school workload seems to act as a risk factor, potentially reflecting the role of academic stress in driving maladaptive coping behaviours. Other variables pertaining to psychological traits (e.g., narcissism, sensation seeking, self-control), psychological symptoms (ADHD symptoms), social media use patterns and neurobiological aspects (ventral media prefrontal cortex responsivity) were only investigated by a single study, making it challenging to draw conclusions.

Regarding interpersonal studies, different variables have been examined, and it is difficult to summarize the results due to the heterogeneity of investigated variables. Findings, though limited, suggest that time spent with family might act as protective buffers, whereas social rejection, parent-adolescent conflict, and attention-seeking behaviours heightened risk. A tolerant and supportive style might be more effective in preventing PSMU, while reactive restrictions might be a valid strategy for girls. Internet specific-parenting styles, which include strategies like monitoring, setting limits, or actively guiding online behaviour, were investigated by five studies, yielded mixed results. Contrary to expectations, social support was found to be a risk rather than a protective factor for PSMU in one study conducted during the COVID-19 pandemic [71]. It can be hypothesized that limitation of in-person interactions may have impacted the way social support was perceived (e.g., more reliance on online exchanges), which in turn affected the use of SM as a way of coping with the stressful period.

Peer and family relationships are likely to have a relevant impact on PSMU considering the relevance both groups have in shaping mid-adolescents' behaviours and coping strategies [72, 73], however, further research is needed on this population. For example, parental phubbing was only investigated by one study, despite its potential impact on adolescents' smartphone use [72, 74]. The lack of focus on family also mirrors the lack of parent involvement in the interventional studies included in the review.

Regarding interventions only four interventions targeting middle adolescents' PSMU were found in our systematic search. Considering the field of interventions dedicated to PSMU is rapidly evolving, we run an additional search on September 2025 (see Supplementary file 4) to collect other potentially relevant studies that could provide further evidence on intervention. The search yielded only an additional study (see Supplementary file 4 for details around characteristics of the study and intervention), confirming the paucity of intervention in this field. Thus, in this section, we will discuss all five of these interventions.

In two of the interventions, PSMU was targeted as part of a broader intervention focusing on online behaviours. Our systematic review only meant to include interventions specifically targeting PSMU, however, during our search, we found some studies that included SM as one of the topics of intervention, without including a measure of PSMU. This reflects a common tendency to regard PSMU as one facet of the broader category of online or smartphone-related problematic behaviours, which might risk overlooking the specific dynamic of each (e.g., gambling, gaming) limiting the precision and relevance of interventions tailored to PSMU.

All the five interventions were similar in the use of a group setting, a structured format and their rather short duration, ranging from 4 sessions to 8 sessions. However, there was considerable variation in the theoretical approach and strategies used, ranging, for example, from mindfulness-based, socio-cognitive, narrative therapy to motivation to change.

Two interventions showed promising results in reducing PSMU [48, 49], specifically the interventions using psychological strategies that fall within or are close to the Cognitive-Behavioural approach (e.g., mindfulness strategies, self-monitoring, self-efficacy skills). However, the limited quality and scarcity of studies does not allow to draw definitive conclusion regarding the effectiveness of the various approaches. This underscores the necessity for further research within this specific population, especially on

Cognitive-Behavioural Therapy (CBT)-based approaches. In fact, these approaches have demonstrated effectiveness in improving other addiction-like behaviours [75], including internet gaming addiction [76]. Moreover, CBT showed encouraging results in social media use interventions for improving mental health in adults [77]. Moreover, recent guidelines have recommended CBT strategies to treat social media and internet use disorders adults and adolescents, though some further evidence are needed especially for the latter group [78–80].

While all the interventions had a degree of focus on increasing awareness on SM, only a single intervention focused specifically on formally promoting mindfulness strategies [48]. Moreover, also a notable gap in longitudinal research on this variable emerged, although meta-analytic findings in broader populations show the negative association between mindfulness and PSMU [81] and, similarly, cross-sectional evidence indicates that greater dispositional mindfulness is both directly and indirectly associated with lower PSMU in mid-adolescents [82]. Indeed, mindfulness might act as a protective variable, as it is tied awareness and self-regulation thus reducing the frequency of distraction and the compulsive use of SM as a coping strategy in the face of stressors [82–84]. Active observation and awareness have also been recommended in a review on school-based prevention program for adolescent internet addiction [85].

Other intervention approaches that warrant further investigation in mid-adolescents are positive psychology, that showed encouraging results in problematic internet use [86]. Moreover, when considering additional variables associated to problematic social media use, a recent review suggests that enhancing media literacy among children and adolescents through school-based interventions may play a role in reducing body dissatisfaction [87].

Regarding the delivery, all the interventions were implemented in schools, apart from the Spirituality-Integrated narrative Therapy [50]. This finding is in line with the growing interest in school-based interventions in various fields of socio-emotional competences and psychological wellbeing in adolescence. Indeed, schools represent unique environment for learning and flourishing and a potential catalyst for mental wellbeing promotion; moreover, they offer a means of reaching a broader number of adolescents who experience mental health problems [15, 88, 89]. The literature in this field highlights that applying a "whole school approach" is an important characteristic of effective mental health promotion [15, 90, 91]. However, none of the three school-based interventions mentioned this approach, and none considered involving parents and teachers in the intervention.

As an additional consideration, all four originally included interventions were delivered in person while the study added through our secondary search was delivered via teleconferencing. However, no study explored smartphone-delivered interventions, while this type of digital solution can be found in the literature to reduce smartphone distraction or PSMU for undergraduate [92] or college and university students [84, 93]. Leveraging digital platforms for delivery, and especially smartphones, is an opportunity to engage mid-adolescents within the very medium where PSMU occurs. Indeed, SM and smartphones are not only a source of harm but also a tool for positive engagement that can foster peer support, self-expression, and access to education and information.

Finally, in addition to the scarcity of adequately powered randomized controlled trials, the absence of feasibility and sustainability assessments in the interventional studies was also notable. This restricts the scope for insight into the long-term applicability of the tested interventions, particularly in view of the absence of any description of the reasons for dropout. A way of improving adolescents' satisfaction and acceptability of, and adherence to interventions is to engage them in the development of the interventions. Their involvement as "expert in their experiences" can offer invaluable insights into their needs and preferences, ensuring that interventions are both relevant and practical, while also building a sense of partnership and shared responsibility over health promotion [94–96].

Limitations of Included Studies and Future Research

In addition to the specific shortcomings of the included longitudinal and interventional studies, which have been previously discussed, there are also general limitations.

It must be noted that the reviewed studies predominantly employed measures rooted in the addiction framework to assess PSMU, originally developed from an atheoretical perspective [3] either based on the Diagnostic and Statistical Manual of Mental Disorders (e.g., for substance use or Internet Gaming Disorder) or Griffiths' (2005) six-component model [97]. The use of these instruments has more than one limitation. For example, their unifactorial approach and short structures, hold advantages in their practicality but restrict the ability to analyse individual components separately [98]. Moreover, the high heterogeneity in conceptualizations, assessment criteria and cut-off points limit the generalizability of current research, also considering the lack of measurement invariance in cross-cultural comparisons [3, 98].

Alternative models to investigate PSMU must be rigorously tested, and consensus on the core defining

characteristics of PSMU need to be established. Specifically, adopting a multifactorial model would enable to capture the complexity of PSMU, to clarify which component distinguish between healthy high engagement versus pathological/dysfunctional use, and account for the evolving nature of SM platforms.

The majority of longitudinal and interventional studies primarily focused on negative measures such as depression, while positive variables such as gratitude, hope and life satisfaction were under-represented. Incorporating such variables into future research could help up move beyond a narrow focus on symptoms to encompass the identification and nurturing of strengths and resources.

A general limitation across the studies is the lack of attention to diversity and inclusion in sampling, with respect to factors such as migrant background, sexual orientation, gender, disability, and developmental disorders. These groups are frequently underrepresented or unacknowledged, which results in lack of understanding about how PSMU may uniquely impact them.

Future research should ensure more inclusive sampling that reflects the diversity of adolescents, possibly finding ways to include out-of-school adolescents and individuals from marginalized backgrounds. Additionally, interventions, even those targeting whole-school populations, should consider the specific needs of these groups and ensure that programs are truly inclusive and effective for all adolescents.

Limitations of our Current Review

This review has several limitations. First, despite an extensive and highly structured search of the published literature, we may have missed relevant papers, and we did not include the grey literature in our search. Second, we used strict criteria on age and PSMU measurement, thereby reducing the number of eligible studies and limiting the generalizability of results. This approach may, however, be considered a strength, as it ensured a sharper focus. We specifically targeted PSMU, rather than related but distinct variables such as frequency of SM use. Furthermore, considering that adolescence is a life stage with diverse developmental challenges and complexities, we choose to focus on a specific developmental stage (mid-adolescents) to characterize its specific vulnerabilities/resources opportunities for fostering healthy growth. Third, the heterogeneity in conceptualizations and measures of PSMU across the included studies posed challenges for direct comparisons and synthesis. Finally, the limited number of studies restricts our ability to draw robust conclusions about causality and the effectiveness of interventions for mitigating PSMU.

Conclusions

Despite the growing interest in PSMU, more robust evidence on the protective and risk factors associated with problematic social media use in mid-adolescents are needed. This knowledge is essential to design psychosocial interventions, tailored to mid-adolescence; a pivotal life stage where individuals learn to adopt healthy lifestyle behaviours and turn them into lasting habits. Effective psychosocial strategies during this period can help mitigate PSMU while fostering long-term psychological well-being.

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Data Availability Data extracted from the reviewed studies and used to synthesis results are available from the corresponding author, upon reasonable request.

Declarations

Human and animal rights and informed consent No animal or human subjects by the authors were used in this study.

Summary Despite the growing interest in PSMU, the heterogeneity and the relatively small number of studies targeting mid-adolescents make it challenging to draw definitive conclusions. More knowledge is needed on protective/risk factors of PSMU and on strategies to prevent and reduce PSMU.

Competing interests The authors declare no competing interests.

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