ASSOCIATION BETWEEN SCREEN TIME AND DEPRESSIVE SYMPTOMS IN ADOLESCENTS: A SYSTEMATIC REVIEW OF LONGITUDINAL STUDIES

ASSOCIAÇÃO ENTRE A EXPOSIÇÃO A ECRÃS E SINTOMATOLOGIA DEPRESSIVA NOS ADOLESCENTES: REVISÃO SISTEMÁTICA DE ESTUDOS LONGITUDINAIS

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ABSTRACT

Introduction: Adolescence is a critical period for mental health, with depression representing one of the leading causes of morbidity. In parallel, exposure to screen-based technologies has increased rapidly, raising concerns about its potential impact during adolescence. Increased screen time has been associated with heightened depressive symptoms in adolescents, though the strength and nature of this relationship remain elusive. This systematic review aimed to synthesize longitudinal evidence on the association between screen time and subsequent onset or worsening of depressive symptoms in adolescents.

Methods: Following the PRISMA statement, PubMed, PsycINFO, Scopus and Web of Science were systematically searched for longitudinal studies published up to February 2025. Eligible studies included individuals aged 10–19 years, assessed screen time exposure through any device or activity and reported on depressive symptoms outcomes. Study quality was assessed using the Newcastle–Ottawa Scale. Two authors independently assessed study eligibility and quality. The study protocol was registered in PROSPERO.

Results: A total of unique 31 longitudinal studies were included. A small positive association was observed between total screen time and subsequent depressive symptoms though the direction and strength of the relationship varied across devices and activities. Internet and smartphone use were consistently associated with increased risk, whereas video game, television and video showed predominantly no association. Evidence for social media and computer use, and screen-based communication was inconsistent. Sex appeared to moderate the association, with female adolescents showing greater vulnerability. Other potential moderators and mediators were inconsistently reported. Substantial heterogeneity was observed, reflecting differences in screen time definitions, exposure and outcome assessment and analytic strategies.

Conclusion: Screen time was prospectively associated with increased depressive symptoms in adolescents. However, this effect is small and dependent on screen engagement patterns and individual characteristics. These findings support recommendations to limit prolonged recreational screen use among adolescents. Future research should adopt standardized definitions and objective measures for screen time, while considering screen content and inherent motivations, to better guide the rational use of screen-based technologies.

Keywords: Screen Time; Depression; Adolescent; Systematic Review

RESUMO

Introdução: A adolescência é um período crítico para a saúde mental, sendo a depressão uma das principais causas atuais de morbilidade. Paralelamente, a exposição a tecnologias com ecrã tem aumentado rapidamente, suscitando preocupações quanto ao seu potencial impacto durante a adolescência. A exposição excessiva a tempo de ecrã tem sido associada ao aumento de sintomas depressivos nos adolescentes, embora a força e a natureza desta relação permaneçam ainda desconhecidas. Esta revisão sistemática teve como objetivo sintetizar a evidência longitudinal sobre a associação entre o tempo de ecrã e o desenvolvimento ou agravamento de sintomas depressivos em adolescentes.

Métodos: De acordo com a declaração PRISMA, foi realizada uma pesquisa sistemática nas bases de dados *PubMed*, *PsycINFO*, *Scopus* e *Web of Science*, dirigida a estudos longitudinais publicados até fevereiro de 2025. Os estudos elegíveis incluíram indivíduos com idades entre 10–19 anos, avaliaram a exposição ao tempo de ecrã através de qualquer dispositivo ou atividade e reportaram resultados relativos a sintomas depressivos. A qualidade dos estudos foi avaliada através da escala de *Newcastle–Ottawa*. Dois autores avaliaram, de forma independente, a elegibilidade e a qualidade dos estudos. O protocolo do estudo foi registado no PROSPERO.

Resultados: Foram incluídos 31 estudos longitudinais. Verificou-se uma pequena associação positiva entre o tempo total de ecrã e sintomas depressivos subsequentes, que foi variável consoante o dispositivo utilizado e a atividade desenvolvida. A utilização da internet e do telemóvel associou-se de forma consistente a um risco aumento de sintomas depressivos, enquanto os videojogos, a televisão e os vídeos apresentaram uma associação predominantemente não significativa. A evidência relativamente à utilização das redes sociais, computador e comunicação digital foi inconsistente. O sexo foi identificado como potencial moderador da associação, sendo o sexo feminino o mais vulnerável. Foram reportados outros possíveis moderadores e mediadores embora de forma inconsistente. Verificou-se uma heterogeneidade substancial entre estudos, motivada por diferenças na definição de tempo de ecrã, avaliação da exposição e do *outcome*, e métodos de análise estatística.

Conclusão: O tempo de ecrã está prospectivamente associado ao aumento de sintomas depressivos em adolescentes, embora o seu efeito seja reduzido e dependente, tanto do padrão de utilização dos ecrãs como das características individuais. Estes achados apoiam recomendações que limitam o uso recreativo prolongado de ecrãs em adolescentes. Estudos futuros devem privilegiar definições padronizadas e medidas objetivas para o tempo de ecrã, tendo em consideração o seu conteúdo e as motivações subjacentes, de forma a orientar a utilização racional das tecnologias com ecrã.

Palavras-chave: Tempo de ecrã; Depressão; Adolescente; Revisão sistemática

KEY MESSAGES

- This systematic review found a small positive association between screen time and depressive symptoms in adolescents.
- The impact of screen time on depressive symptoms varied according to device and activity, with internet and smartphone use associated with increased risk, whereas video game, television and video exhibited predominantly no association.
- Sex appeared to moderate the association, with female adolescents showing greater vulnerability to the effects of screen time exposure.
- The findings support recommendations to limit prolonged recreational screen time and highlight the need to promote healthier digital habits among adolescents.
- Substantial heterogeneity across studies may limit the generalizability of the findings.

INTRODUCTION

Adolescence is a unique and crucial developmental stage characterized by profound physical, emotional, cognitive and social changes[1]. Environmental exposures and behavioral choices during this period play a pivotal role in shaping lifelong health trajectories, making adolescents particularly vulnerable to mental health problems[2-4].

Globally, approximately 14% of adolescents experience a mental health disorder, positioning adolescent mental health as one of the most pressing public health challenges of the 21st century[5]. Among this age group, depression stands as a leading cause of illness and disability, with prevalence rates increasing substantially over the past decade, particularly among female adolescents[5-7]. Current estimates from the 2021 Global Burden of Disease indicate that 2,4% of young people aged 10-19 years old have major depressive disorder and the World Health Organization (WHO) has projected that depression will become the primary cause of disease burden among adolescents worldwide by 2030[8, 9].

The onset of depressive symptoms during adolescence carries profound and lasting implications for overall development and well-being, including academic underachievement, impaired social functioning, substance use, self-harm and suicidal ideation[10]. Furthermore, subclinical depressive symptoms during this critical developmental period serve as significant predictors of major depressive disorder and other psychiatric conditions in adulthood[10, 11]. The etiology of depression is multifactorial, involving a complex interplay of genetic predisposition, neurobiological changes, and environmental risk factors[12-14]. Given these far-reaching consequences, identifying modifiable risk factors for adolescent depression has become a research priority.

Concurrent with the rise in adolescent depression, the digital landscape has fundamentally transformed the daily experiences and routines of young people. Screen-based technologies, including smartphones, tablets, computers, video games and televisions, have become ubiquitous in adolescent life. Comprehensive global statistics of screen time in this population remain limited. However, recent estimates indicate that adolescents spend an average of six to nine hours per day on recreational screen-based activities[15]. American adolescents' daily engagement in screen time reached five hours for individuals aged 8-12 years and eight hours for individuals aged 13-18 years in 2021[16]. Asia and Africa stand out with more than nine hours of daily screen time in adolescents, highlighting significant regional disparities worldwide[15].

While digital media offers opportunities for education and social connection, growing evidence suggests that excessive screen time is associated with adverse outcomes in adolescence, namely obesity, sleep disturbances, cardiovascular risks and psychosocial problems[17, 18]. Of particular concern is the impact on adolescent mental health, as this population demonstrates relatively limited self-regulation and increased susceptibility to environmental influences[19]. Despite guidelines from international organizations and health societies, including the WHO and the American Academy of Pediatrics (AAP), recommending no more than two hours of recreational screen time per day, over half of adolescents routinely exceed this threshold[20-23].

The temporal convergence of increasing screen time and rising depression rates among adolescents has prompted considerable scientific interest in potential causal relationship between these phenomena. Several theoretical frameworks have been proposed to explain how digital engagement might influence adolescent mental health. The displacement hypothesis suggests that time spent on screens displaces beneficial activities such as physical exercise, face-to-face social interactions, and adequate sleep, thereby increasing vulnerability to depressive symptoms[24-26]. The upward social comparison theory posits that exposure to idealized and selectively presented content of others' achievements, appearances, and lifestyle experiences on social media platforms leads adolescents to make unfavorable social comparisons, resulting in

decreased self-esteem and increased depressive symptoms[27]. Additionally, the reinforcing spirals hypothesis suggests that individuals with depressive tendencies may seek out content that reinforces their negative mood states, creating a self-perpetuating cycle of worsening symptoms[28].

Despite this theoretical background, empirical research examining the relationship between screen time and depression has yielded a complex and often inconsistent body of evidence[29]. While cross-sectional studies generally report positive associations between increased screen time and higher levels of depressive symptoms, findings from longitudinal studies, which are better positioned to establish temporal relationships and potential causal effect, have been mostly inconsistent[30, 31]. These discrepancies in the literature are usually attributed to methodological heterogeneity, namely the screen time definition, the measures of depressive symptoms and the inconsistent consideration of moderating factors such as age, sex and individual characteristics[32], which have challenged the soundness of existing guidelines on limiting screen time for children and adolescents[33]. Moreover, despite previous efforts to synthesise the body of evidence examining the effect of screen time on mental health outcomes in adolescents, these were predominantly based on cross-sectional studies[34].

Considering this outlook, this systematic review aims to synthesize longitudinal evidence on the association between baseline screen time and subsequent onset or worsening of depressive symptoms in adolescents. Specifically, examining whether this association vary according to screen device and activity, and exploring the role of potential moderators and mediators.

METHODS

This systematic review was conducted in compliance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[35]. The protocol was design and pre registered in the International Prospective Register of Systematic Reviews (PROSPERO), under the registration number CRD420251145781.

Eligibility criteria

The Population, Exposure, Comparison, Outcomes, and Study design [PECO(S)] framework was used to define eligibility criteria[36]. Studies were eligible if they fulfilled the following inclusion and exclusion criteria:

(1) Population: Adolescents, aged 10 to 19 years old, as defined by the WHO definition. Studies were included if the age criteria were met at both baseline and follow-up periods. Studies were excluded if participants had a formal clinical diagnosis of depression at baseline, addictive or problematic technology use, or other severe mental, cognitive or developmental disorder (including attention deficit hyperactivity disorder (ADHD), obsessive-compulsive disorder (OCD), borderline personality disorder), history of self-harm, suicidal ideation or suicide attempt.

(2) Exposure: Quantification of screen time, defined as time spent engaging with visual screen-based technologies, including any type of devices (televisions, computers, video games, smartphones and tablets) or activities (communication, social media, internet, gaming, videos). Screen time should be reported and quantified through self-report, parent-report, validated instruments or objective measurement. Studies were excluded if screen-based technologies were used as part of an intervention to aid functionality or improve mental health.

(3) Comparator: not required.

(4) Outcome: Quantitative assessment of depression or depressive symptoms as primary or secondary outcome measured using formal and validated instruments or scores, rating scales or questionnaires (self-reported, proxy or clinician-administered) specific for depression or from which depression scores could be isolated. Studies not defining depressive symptoms as an outcome (whether primary or secondary), not providing data regarding depression, or with insufficient or incomplete information regarding the method of assessment, were excluded.

(5) Study design: Longitudinal studies reporting original data, specifically cohort and case-control designs, were included. Cross-sectional studies, clinical trials, reviews, case reports and editorials were excluded.

Information sources and search strategy

A thorough literature search was conducted on four major electronic bibliographic databases concerning medical and social sciences, namely PubMed, PsycINFO (through EBSCO interface), Scopus, and Web of Science (WoS) Core Collection from inception to February 2025. The search strategy was developed with the support and supervision of a health sciences librarian combining three key blocks of terms regarding “screen time”, “adolescence” and “depression”, using the Boolean AND operator (Suplementary Material A). No restrictions based on the year of publication or language were applied. The electronic literature search was further supplemented by hand searching the list of references from relevant studies and previous reviews as well as additional

searches for grey literature using OpenGrey and Google Scholar. For the latter, a search by title was used, following Haddaway et al. guidance[37]. To minimize publication bias, unpublished studies, including conference abstracts and proceedings, were searched for additional eligible studies. For reports not retrievable, corresponding authors were contacted at least twice by email.

Selection process

All search results were imported into Rayyan for systematic review management. After removing duplicates, two reviewers from the research team (CPN, BDF) independently screened all records retrieved from the various sources for eligibility against the pre-defined criteria, first by title and abstract, and subsequently by full-text review. At each phase, discrepancies were resolved by consensus, by consulting a third reviewer (CA) or by referral to the wider team. To enhance transparency, the selection process and reasons for exclusion were documented and presented in the PRISMA 2020 flow diagram.

Data collection process

Data extraction was conducted using a standardized data collection form. The first study was reviewed together by two researchers (CPN, BDF) to ensure accuracy and completeness of the form. Following this, the two researchers independently extracted data from a random subset of 10% of studies and CPN extracted data from the remaining studies. Inconsistencies were resolved by re-checking reports and if no agreement was reached, a third reviewer was involved. For the studies agreed to be included, the following information was retrieved: study identification and meta-data (title, first author, publication year, country), study characteristics (aim, design, follow-up period, inclusion and exclusion criteria), participant characteristics (sample size, age at baseline, sex ratio), exposure characteristics (screen time quantification, type of device and activity, measurement method), outcome characteristics (depression measurement instruments), variables (covariates, moderators and mediators), effect estimates and main study findings. Extracted data were tabulated for descriptive synthesis.

Study quality assessment

Risk of bias were independently assessed for all included studies by two reviewers (CPN, BDF) using the Newcastle-Ottawa Scale[38]. Scores for each category (selection, comparability and exposure/outcome) were recorded, and overall study quality was classified as high (total score >6), moderate (total score 5-6) or low (total score <5). Discrepancies were resolved through consensus or referral to a third reviewer (CA). To maximize the evidence base, studies were not excluded solely based on their quality scores.

Synthesis methods

A quantitative synthesis using a random-effects meta-analysis with the restricted maximum likelihood approach was planned per protocol if sufficient homogeneity was observed among the included studies. Heterogeneity assessed through Cochran's Q test p-value, the I^2 statistic, and forest plot analysis. Owing the heterogeneity, a narrative synthesis of longitudinal studies was conducted to summarize and interpret the qualitative and quantitative data on the association between screen time and subsequent onset or worsening of depressive symptoms. To provide a structured and comprehensive overview of the available evidence, studies were summarized through tabular and thematic analysis by grouping them according to total screen time and specific type of device and activity, namely television/video, video games, smartphone, computer, internet, social media and communication.

RESULTS

Study selection

A total of 10796 records were identified through the electronic database search, comprising 2884 from PubMed, 3447 from Scopus, 2187 from Web of Science, 2278 from PsycINFO. Additional searches yielded one other potential record from grey literature and two from manual citation searching. After removing 3541 duplicates, 7258 studies were screened by title and abstract, resulting in 61 studies for full-text review. Three reports could not be obtained despite requests to the authors. The remaining 58 full text articles were assessed for eligibility, leading to the exclusion of 26 studies due to the following reasons: cross-sectional design (n = 9), population outside the age range (n = 6), no screen time assessment (n = 1), depression diagnosis at baseline (n = 4), non-validated depression measure (n = 3), off-topic association (n = 4). Overall, 31 unique longitudinal studies met the eligibility criteria and were included in the systematic review. The study selection process is presented in the PRISMA flow diagram (Figure 1).

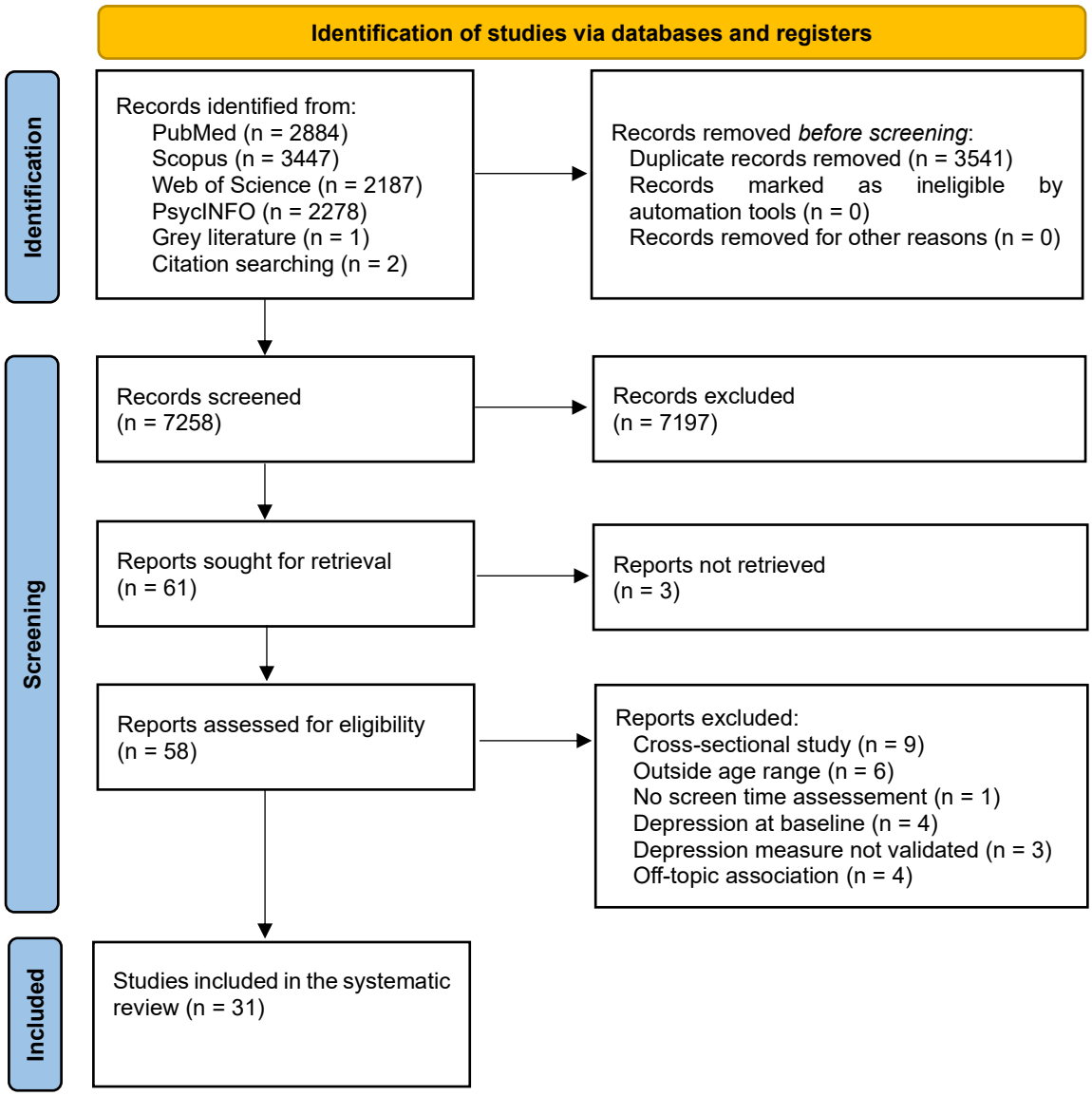

Figure 1 – PRISMA 2020 flow diagram

Table 1 – Characteristics of included studies.

Study identification (author, year, country)	**Methods** (design, follow-up)	**Population** (sample size, age at baseline, sex)	**Exposure** (screen time measurement, device/activity)	**Outcome** (depressive symptoms measurement, baseline)	**Covariates adjustment**	**Findings**	**Quality assessment** (Newcastle-Ottawa Scale)
Hume et al. (2011)[39] Australia	Cohort study 2 years follow-up	155 Mean 14.4 ± 0.6 years 60% female	Self-report Minutes/week Television	CES-DC Included at baseline	Baseline depressive symptoms	No association between television use and depressive symptoms.	Selection - 2 Comparability - 0 Outcome - 2 Total score 4
Brunborg et al. (2014)[40] Norway	Cohort study 2 years follow-up	1928 Range 13-17 years 55.5% female	Self-report Hours/day and frequency of use Gaming	Hopkins Symptom Checklist Included at baseline	Age, sex, academic achievement	No association between time spent on video games and depressive symptoms, only if addiction.	Selection - 2 Comparability - 1 Outcome - 2 Total score 5
Gunnell et al. (2016)[41] * Canada	Cohort study 7 years follow-up	1160 Mean 13.54 ± 1.12 years 60.5% female	Self-report Hours/weekend day and hours/weekday Total screen time	CDI Included at baseline	Sex, ethnicity, school location, BMI, birth year, parents' education	No association between screen time and depressive symptoms.	Selection - 2 Comparability - 1 Outcome - 2 Total score 5
Wu et al. (2016)[42] China	Cohort study 1 year follow-up	2521 Mean 18.43 ± 0.96 years 52,9% female	Self-report Hours/weekend day and hours/weekday Total screen time	CES-D Included at baseline	Sex, age, residential background, perceived family economy, BMI, sleep quality, smoking, alcohol intake, exercise after school and physical activity	Positive association between screen time and depressive symptoms.	Selection - 2 Comparability - 2 Outcome - 3 Total score 7
Houghton et al. (2018)[43] Australia	Cohort study 2 years follow-up	1749 Range 10-15 years 47% female	Screen Based Media Use Scale (SBMUS) Hours/weekend day and hours/weekday Total screen time, television, social media, internet, gaming	CDI 2 Included at baseline		Positive association of total screen time and internet use with depressive symptoms.	Selection - 3 Comparability - 1 Outcome - 3 Total score 7
Vannucci et al. (2019)[44] USA	Cohort study 6 months follow-up	1205 Mean 12.73 ± 0.69 years 51% female	Technology Use Questionnaire (TUQ) Hours/day Social media	CES-DC Included at baseline	Age, sex, ethnicity, socioeconomic status, baseline depressive symptoms	Positive association between social media use and depressive symptoms.	Selection - 3 Comparability - 1 Outcome - 2 Total score 6

Boers et al. (2019)[45] Australia	Cohort study 4 years follow-up	3826 Mean 12.7 ± 0.5 years 47% female	Self-report Hours/day Television, computer, social media, gaming	Depression subscale of the Brief Symptoms Inventory Included at baseline	Sex, socioeconomic status	Positive within-person association between time spent on social media and television, and depressive symptoms.	Selection - 2 Comparability - 1 Outcome - 3 Total score 6
Brunborg et al. (2019)[46] Norway	Cohort study 6 months follow-up	763 Mean 15.22 ± 1.44 years 54.9% female	Self-report Hours/day Social media	PHQ-9 Included at baseline	Frequency of sports practice, frequency of unsupervised leisure activities, peer relationship problems	Positive association between social media use and depressive symptoms.	Selection - 2 Comparability - 1 Outcome - 2 Total score 5
Khouja et al. (2019)[47] UK	Cohort study 2 years follow-up	1869 16 years 57% female	Self-report Hours/weekend day and hours/weekday Television, computer, communication	CIS-R Included at baseline	Sex, baseline depressive symptoms, maternal age, anxiety, depression and education, parental socioeconomic status, presence of the child's father, parental conflict, number of people living in the child's home, bullying, family TV use in early life, intelligence quotient, time spent engaging other activities, time alone	Positive association between computer use at weekend days and depressive symptoms.	Selection - 2 Comparability - 2 Outcome - 3 Total score 7
Zink et al. (2019)[48] § USA	Cohort study 1 year follow-up	2525 Mean 14.6 ± 0.40 years 56.2% female	Self-report Hours/day Television, computer, video game	RCADS Included at baseline	Sex, age, ethnicity, BMI, physical activity, baseline depressive symptoms socioeconomic status, parental education	No association of television, computer and video game use with depressive symptoms, after adjusting for covariates.	Selection - 2 Comparability - 2 Outcome - 3 Total score 7
Coyne et al. (2019)[49] † USA	Cohort study 6 years follow-up	457 Mean 13.50 years 53% female	Self-report Hours/day Social media	CES-DC Included at baseline	Sex, family structure, self-regulation, total screen time	Positive association between social media use and depressive symptoms, especially if increasing trajectory during adolescence.	Selection - 2 Comparability - 1 Outcome - 3 Total score 6
Heffer et al. (2019)[50] Canada	Cohort study 2 years follow-up	594 Mean 12.21 ± 0.931 years 50.8% female	Self-report Hours/weekend day and hours/weekday Social media	CES-DC Included at baseline	Age, born inside or outside Canada, parental education, non-screen activities, other screen activities	No association between social media use and depressive symptoms.	Selection - 2 Comparability - 2 Outcome - 3 Total score 7
Thorisdottir et al. (2020)[51] Iceland	Cohort study 2 years follow-up	2211 12 years 49.9% female	Self-report Hours/day Social media	Depression subscale of the Original Symptom Checklist Included at baseline	Sex, family structure, parental support	Positive association between social media use and depressive symptoms, especially among female adolescents.	Selection - 2 Comparability - 1 Outcome - 3 Total score 6

Zink et al. (2020)[52] § USA	Cohort study 1 year follow-up	2717 Mean 14.57 ± 0.40 years 55.6% female	Self-report Hours/day Television, computer, video game	CES-D Included at baseline	Age, sex, ethnicity, BMI, socioeconomic status, baseline depressive symptoms, school physical activity, parental education	Positive and reciprocal association of computer and video game use with depressive symptoms, especially among female adolescents.	Selection - 2 Comparability - 2 Outcome - 3 Total score 7
Puukko et al. (2020)[53] Finland	Cohort study 6 years follow-up	2891 Range 13-14 years 57,3% female	Social media networking dimension of the Socio-digital Participation Inventory Frequency of use Social media	Finnish version of the Depression Scale (DEPS) Included at baseline	Sex, socioeconomic status	No association between social media use and depressive symptoms.	Selection - 3 Comparability - 1 Outcome - 3 Total score 7
Coyne et al. (2020)[54] † USA	Cohort study 8 years follow-up	487 Mean 13.82 ± 1.03 years 51.6% female	Self-report Hours/day Social media	CES-DC Included at baseline		No within-person association between social media use and depressive symptoms.	Selection - 2 Comparability - 1 Outcome - 3 Total score 6
Murray et al. (2021)[55] * Canada	Cohort study 4 years follow-up	170 Female: Mean 13.21 ± 1.06 years Male: Mean 12.67 ± 0.64 years 62% female	Leisure-Time Sedentary Activities Scale Hours/weekend day and hours/weekday Total screen time, television, computer, video game	CDI Included at baseline		Positive association between recreational screen time and depressive symptoms. Attachment style, coping style and perceived social support do not moderate this association.	Selection - 3 Comparability - 0 Outcome - 2 Total score 5
Kandola et al. (2021)[56] UK	Cohort study 3 years follow-up	11 341 11 years 51.2% female	Self-report Frequency of use Social media, internet, gaming	sMFQ Included at baseline	Sex, socioeconomic status, BMI, baseline depressive symptoms, physical activity, bullying, maternal history of depression or anxiety	Negative association between gaming frequency and depressive symptoms among male adolescents. Positive association of social media use in females and internet use in males with depressive symptoms.	Selection - 2 Comparability - 2 Outcome - 3 Total score 7
Marciano et al. (2022)[57] Switzerland	Cohort study 3 years follow-up	981 Mean 11.37 ± 0.55 years 53.9% female	Self-report Hours/weekend day and hours/weekday Internet	CES-DC Included at baseline	Sex, quality of family relations, ownership of personal internet-enabled devices, social desirability	Positive correlation between internet use and depressive symptoms, without social connections mediation.	Selection - 2 Comparability - 1 Outcome - 3 Total score 6
Jiang et al. (2022)[58] ‡ China	Cohort study 2 years follow-up	1577 Range 10-15 years 49.1% female	Self-report Frequency of use Internet	CES-D8 Included at baseline		Indirect positive association between internet use frequency and depressive symptoms, mediated by self-adjustment.	Selection - 2 Comparability - 0 Outcome - 3 Total score 5

Fitzpatrick et al. (2023)[59] Canada	Cohort study 4 years follow-up	1547 Range 13-17 years 58.0% female	Self-report Hours/week Internet	Validated 8-item depression scale (Sidani et al. 2016) Included at baseline		Positive within-person association between internet use and depressive symptoms among female adolescents.	Selection - 2 Comparability - 0 Outcome - 2 Total score 4
Mougharbel et al. (2023)[60] Canada	Cohort study 1 year follow-up	17174 Mean 15.1 ± 0.9 years 53.5% female	Self-report Hours/day Television, communication, internet, gaming	CES-D10 Included at baseline	Sex, age, ethnicity, BMI, income, previous year depressive symptoms, school clustering	Positive association between each type of screen time and depressive symptoms. Sex moderates the television association.	Selection - 2 Comparability - 2 Outcome - 3 Total score 7
Ma et al. (2023)[61] ‡ China	Cohort study 2 years follow-up	3694 Range 10-19 years 47.2% female	Self-report Hours/day Internet	CES-DC Included at baseline	Sex, age, education level, self-assessed health, academic performance, academic stress, smoke, class leader, boarding school, education expenditure, parental relationship	Positive association between internet use and depressive symptoms, especially in female adolescents, mediated by sleep duration and parent-adolescent communication.	Selection - 2 Comparability - 2 Outcome - 3 Total score 7
Hökby et al. (2023)[62] Sweden	Cohort study 1 year follow-up	4793 Range 13-15 years 49.3% female	Self-report Hours/day Total screen time	BDI-II Included at baseline	Sex, socioeconomic status	Indirect positive correlation between screen time and depressive symptoms, mediated by problem-focused coping.	Selection - 2 Comparability - 1 Outcome - 3 Total score 6
Liu et al. (2024)[63] China	Cohort study 6 months follow-up	1142 Range 10-16 years 69.9% female	Self-report Hours/day Total screen time	CDI-S Included at baseline	Sex, age, parent's education level, family annual income	Positive association between recreational screen time and depressive symptoms after the COVID-19 pandemic.	Selection - 2 Comparability - 1 Outcome - 2 Total score 5
Shen et al. (2024)[64] UK	Cohort study 3 years follow-up	364 Range 13-15 years	Self-report Hours/day Smartphone, social media, gaming	PHQ-8 Excluded at baseline		Positive association between smartphone use and depressive symptoms.	Selection - 3 Comparability - 0 Outcome - 3 Total score 6
Wang et al. (2024)[65] China	Cohort study 2 years follow-up	1480 Mean 13.6 ± 1.5 years 49.9% female	Self-report Hours/day Total screen time	CES-D Included at baseline	Age, sex, socioeconomic status, one child or not, living arrangement, parents' education level, perceived academic pressure, relationships with classmates and teachers, baseline depressive symptoms, ever smoking a cigarette, physical activity	Positive association between persistent high exposure to screen time and depressive symptoms among female adolescents.	Selection - 2 Comparability - 2 Outcome - 3 Total score 7

Liu et al. (2024)[66] China	Cohort study 3 months follow-up	588 Mean 11.57 ± 1.35 years 45.41% female	Screen Time Assessment Tool Hours/day Total screen time	CES-DR Included at baseline	Sex, annual household income, baseline depressive symptoms	Indirect positive association between screen time and depressive symptoms, mediated by self-esteem and resilience.	Selection - 3 Comparability - 1 Outcome - 2 Total score 6
Rudolf et al. (2024)[67] South Korea	Cohort study 3 years follow-up	2588 13 years 45.79% female	Self-report Hours/day Smartphone, communication	CESD-10 Included at baseline	Sex, self-reported health, relations with friends, academic performance, after-school study hours location of residence, household income, year dummies, exercise hours	Positive association between smartphone use and depressive symptoms among female adolescents. Pre-existing conditions and the timing of puberty moderate the effect. Negative association between time spent on screen-based communication and depressive symptoms.	Selection - 2 Comparability - 2 Outcome - 3 Total score 7
Zink et al. (2024)[68] †† USA	Cohort study 1 year follow-up	10828 Mean 9.9 ± 0.6 years 47.8% female	Self-report Hours/weekend day and hours/weekday Total screen time	CBCL/4 to 18 Included at baseline	Age, ethnicity, BMI, socioeconomic status, physical activity	Positive and independent association of weekend screen time and sleep duration with depressive symptoms among female adolescents.	Selection - 2 Comparability - 2 Outcome - 3 Total score 7
Nagata et al. (2024)[69] †† USA	Cohort study 2 years follow-up	9538 Mean 9.9 ± 0.6 years 48.8% female	Self-report Hours/weekend day and hours/weekday Total screen time, television, social media, communication, gaming, videos	CBCL/4 to 18 Included at baseline	Sex, ethnicity, household income, data collection period, parent education, baseline depressive symptoms, study site	Positive association of total screen time and all specific screen types studied with depressive symptoms, mainly for communication, gaming and video activities. However, the association was not statistically significant for social media use.	Selection - 2 Comparability - 1 Outcome - 3 Total score 6

* Cohort from the Research on Eating and Adolescent Lifestyle (REAL) Study
§ Cohort from the Happiness and Health (H&H) study
† Cohort from the Flourishing Families Project
‡ Cohort from the China Family Panel Survey (CFPS)
†† Cohort from the Adolescent Brain Cognitive Development (ABCD) Study

UK, the United Kingdom; USA, the United States of America; BDI, Beck Depression Inventory; CBCL, Child Behavior Checklist; CDI, Children's Depression Inventory; CDI-S, Children Depression Inventory - Short Form; CES-D, Center for Epidemiologic Studies Depression Scale; CES-DC, Center for Epidemiological Studies Depression Scale for Children; CES-DR, Center for Epidemiologic Studies Depression Scale – Revised; CIS-R, Clinical Interview Schedule; PHQ, Patient Health Questionnaire; RCADS, Revised Children's Anxiety and Depression Scale; sMFQ, short Moods and Feelings Questionnaire; BMI, Body mass index.

Study characteristics

The main characteristics of the primary studies are depicted in Table 1. The 31 included studies were published between 2011 and 2024, and conducted in diverse geographic regions, including North America (n = 12)[41, 44, 48-50, 52, 54, 55, 59, 60, 68, 69], Europe (n = 9)[40, 46, 47, 51, 53, 56, 57, 62, 64], Asia (n = 7)[42, 58, 61, 63, 65-67] and Australia (n = 3)[39, 43, 45]. All included studies were prospective cohort studies, with follow-up periods ranging from 3 months[66] to 8 years[54]. Sample sizes ranged from 155[39] to over 17000 participants[60]. All studies reported on both female and male adolescents, with baseline mean ages ranging from 9.9 to 18.4 years.

Screen time exposure was measured through self-report questionnaires and scales in all studies. Eight studies reported on total screen time, 21 focused on specific types of screen-based devices and activities, and two studies included both measures. Depressive symptoms were assessed using validated instruments through either adolescent self-report or parental proxy-report. All studies included depressive symptom measurements at baseline and follow-up. None of the studies included participants who had a clinical diagnosis of depression at baseline.

Synthesis of the evidence

A quantitative synthesis was not performed due to substantial heterogeneity across the included studies, particularly the wide variation in statistical models fitted, inconsistent reporting of effect sizes and diversity of exposure and outcome measures that hindered the quantitative aggregation of the data. A narrative approach was undertaken.

Total screen time

Ten studies examined the association between total screen time and subsequent depressive symptoms or change in depressive symptoms severity (Table 2). Nine studies reported a positive association in both adjusted and unadjusted models, mostly with small effect[43, 62, 63, 66, 68, 69] and three with moderate effect[42, 55, 65]. In two studies, screen time at baseline was indirectly correlated with subsequent depressive symptoms, with problem-focused coping, self-esteem and resilience moderating the effect[62, 66]. Furthermore, two studies found a significant positive association only among female adolescents[65, 68]. In contrast, Gunnell et al.[41] reported that initial total screen time did not predict changes in depressive symptoms over time.

Table 2 – The association between total screen time and depressive symptoms.

Study	Effect measures	Results
Wu et al. [42]	OR (95% CI)	Reference group: No use change and ≤2 hours/day Increased use and ≤2 hours/day: 1.13 (0.79 – 1.63) Increased use and >2 hours/day: 1.98 (1.28 – 3.05), p < 0.05 No use change + >2 hours/day: 1.02 (0.72 – 1.46)
Zink et al. [68]		Weekday: Female 0.7 (0.5 – 1.0); Male 1.1 (0.8 – 1.4) Weekend day: Female 1.6 (1.1 – 2.2), p < 0.05; Male 0.9 (0.7 – 1.2)
Houghton et al. [43]	Coefficient b (SE)	RI-CLPM: 0.128 (0.057), p 0.024
Murray et al. [55]		Hierarchical linear regression model: 0.49, p < 0.001
Nagata et al. [69]	Coefficient β (SE, 95% CI)	Mixed effects model: 0.10 (0.06 – 0.13), p < 0.001
Liu et al. [63]		RI-CLPM - Within-person cross-lagged 0 – 3 months: -0.127 (0.138), p 0.355 3 – 6 months: 0.077 (0.038), p 0.041 RI-CLPM - Between-person covariance: 0.355 (0.090), p < 0.001

Hökby et al. [62]		Structural regression/pathway analysis Direct C-path: -0.018, p 0.280 Mediated C-path: 0.001, p 0.018 Pearson correlation coefficient: r 0.12
		Structural regression analysis: -0.076 SEM: -0.029 (0.112), p 0.798 Pearson correlation coefficient: r 0.11, p < 0.05
Wang et al. [65]		Inverse probability-weighted analysis: 0.97 (0.43 – 1.50), p < 0.001 Female: 1.78 (0.95 – 2.62), p < 0.001 Male: 0.37 (−0.36 – 1.10), p 0.321
Gunnell et al. [41]		Latent Growth Model Slope Screen Time – Slope Depression: 0.018 Intercept Screen Time – Slope Depression: -0.166

OR, Odds ratio; 95% CI, 95% Confidence interval; SE, Standard error; RI-CLPM, Random intercept cross lagged panel model; SEM, Structural equation model

Television/video

Eight studies assessed the association between passive screen time, comprising the time spent watching television or videos, and subsequent depressive symptoms (Table 3). From these, five studies reported no association[39, 43, 47, 48, 52], whereas three studies revealed a small positive association in both female and male adolescents after adjusting for confounding variables[45, 60, 69], namely sex, age, ethnicity, socioeconomic status and baseline depressive symptoms. Additionally, Mougharbel et al.[60] found that sex moderates the association between baseline television time and depressive symptoms at follow-up. Only one study investigated video use separately and demonstrated a positive association with depressive symptoms at two years follow-up[69].

Table 3 – The association between television/video viewing and depressive symptoms.

Study	Effect measures	Results
Mougharbel et al.[60]	OR (95% CI)	Reference group: 0 – 29 min/day 30 – 59 min/day: Female 1.03 (0.83 – 1.28); Male 0.82 (0.66–1.03) 1 – 2 hours/day: Female 1.12 (0.94 – 1.34); Male 0.81 (0.68–0.95) 2 – 3 hours/day: Female 1.15 (0.96 – 1.38); Male 0.87 (0.73–1.03) > 3 hours/day: Female 1.30 (1.09 – 1.55), p < 0.01; Male 0.91 (0.77 – 1.08)
Khouja et al. [47]		Reference group: <1 hour/day Weekday: 1 – 2 hours/day 1.01 (0.86 – 1.17); ≥ 3 hours/day 1.14 (0.86 – 1.40), p 0.31 Weekends days: 1 – 2 hours/day 0.97 (0.78 – 1.19); ≥ 3 hours/day 1.08 (0.86 – 1.36), p 0.40
Zink et al. [48]		Dichotomized (sub)clinical thresholds > 4 hours/day: 1.09 (0.80 – 1.48), p 0.60 > 2 hours/day: 0.93 (0.75 – 1.15), p 0.49 > 3 hours/day: 1.12 (0.88 – 1.42), p 0.37 Continuous RCADS subscale based on the clinical cutoffs > 4 hours/day: 1.09 (0.78 – 1.52), p 0.61
Mougharbel et al. [60]		Mixed effects model Female: 0.030 (0.019, -0.006 – 0.068), p 0.109 Male: 0.068 (0.018, (0.032 – 0.104), p < 0.001
Nagata et al. [69]		Mixed effects model Television: 0.13 (0.01– 0.26), p 0.036 Video: 0.22 (0.13 – 0.31), p < 0.001

Zink et al. [52]		Mixed effects model: -0.01(-0.06 – 0.04), p 0.69
Boers et al. [45]		Multilevel Model Assessing Between-person: -0.22 (-0.40 – -0.05) Within-person: 0.18 (0.09 – 0.27)
Houghton et al. [43]		RI-CLPM: 0.054 (0.045), p 0.230
Hume et al. [39]	Not available	No association

OR, Odds ratio; 95% CI, 95% Confidence interval; SE, Standard error; RI-CLPM, Random intercept cross lagged panel model.

Video games

Nine studies examined the association between time spent engaging in video games using a console or other screen-based devices and subsequent depressive symptoms (Table 4). Five studies reported no association[40, 43, 45, 48, 64], while three studies reported a small positive association after adjusting for confounders[52, 60, 69], namely sex, age, ethnicity, body mass index, socioeconomic status and baseline depressive symptoms. Conversely, Kandola et al.[56] observed that time spent gaming at baseline was negatively correlated with depressive symptoms among male adolescents at three years follow-up.

Table 4 – The association between video games and depressive symptoms.

Study	Effect measures	Results
Mougharbel et al.[60]	OR (95% CI)	Reference group: 0 – 29 min/day 30 – 59 min/day: 1.06 (0.91 – 1.22) 1 – 2 hours/day: 1.14 (1.02 – 1.28), p < 0.05 2 – 3 hours/day: 1.11 (0.98 – 1.27) > 3 hours/day: 1.29 (1.15 – 1.46) p < 0.001
Zink et al. [48]		Dichotomized (sub)clinical thresholds > 4 hours/day: 1.23 (0.96 – 1.57), p 0.10 > 2 hours/day: 1.43 (1.14 – 1.78), p 0.002 > 3 hours/day: 1.30 (1.04-1.61), p 0.02 Continuous RCADS subscale based on the clinical cutoffs > 4 hours/day: 1.21 (0.93 – 1.56), p 0.16
Shen et al. [64]		Reference group: 1st tertile 2nd tertile: 1.42 (0.79 – 2.57) 3rd tertile: 1.32 (0.63 – 2.76), p 0.37
Kandola et al. [56]	IRR (95% CI)	Reference group: Less than once a month/never Most days: Male 0.768, (0.645 – 0.913), p 0.003; Female 1.001 (0.909 – 1.120), p 0.816 At least once a week: Male 0.749 (0.624 – 0.898), p 0.002; Female 0.928 (0.833 – 1.033), p 0.171 At least once a month: Male 0.688 (0.569 – 0.833), p < 0.001; Female 0.923 (0.820 – 1.040), p 0.189
Zink et al. [52]	Coefficient β (SE, 95% CI)	Mixed effects model: 0.06 (0.01 – 0.11), p 0.01
Mougharbel et al.[60]		Mixed effects model: 0.041 (0.015, 0.011 – 0.071), p 0.007
Nagata et al. [69]		Mixed effects model: 0.20 (0.03 – 0.37), p 0.022
Houghton et al. [43]		RI-CLPM: 0.041 (0.050), p 0.416
Brunborg et al. [40]		First difference regression model: 0.00 Spearman rank order correlations coefficient: -0.08, p < 0.05
Boers et al. [45]		Multilevel Model Assessing Between-person 0.15 (-0.01 – 0.31) Within-person 0.02 (-0.07 – 0.10)

OR, Odds ratio; IRR, Incident ratio rate; 95% CI, 95% Confidence interval; SE, Standard error; RI-CLPM, Random intercept cross lagged panel model.

Computer

Four studies investigated the association between time spent using the computer and subsequent depressive symptoms in adolescence (Table 5). Two studies found no significant association after adjusting for covariates[45, 48], namely sex and socioeconomic status. Zink et al.[52] reported a positive association that was particularly robust among female adolescents, whereas Khouja et al.[47] demonstrated a small positive association only for computer use on weekend days.

Table 5 – The association between computer use and depressive symptoms.

Study	Effect measures	Results
Khouja et al. [47]	OR (95% CI)	Reference group: <1 hour/day Weekday: 1 – 2 hours/day 1.03 (0.83 – 1.27); ≥ 3 hours/day 1.06 (0.84 – 1.35), p 0.60 Weekends days: 1 – 2 hours/day 1.11 (0.92 – 1.35); ≥ 3 hours/day 1.30 (1.06 – 1.58), p 0.007
Zink et al. [48]		Dichotomized (sub)clinical thresholds > 4 hours/day: 1.23 (0.96 – 1.57), p 0.10 > 2 hours/day: 1.43 (1.14 – 1.78), p 0.002 > 3 hours/day: 1.30 (1.04-1.61), p 0.02 Continuous RCADS subscale based on the clinical cutoffs > 4 hours/day: 1.21 (0.93 – 1.56), p 0.16
Zink et al. [52]	Coefficient β (SE, 95% CI)	Mixed effects model: 0.06 (0.01 – 0.11), p 0.01
Boers et al. [45]		Multilevel Model Assessing Between-person: 0.69 (0.47 – 0.91) Within-person: 0.09 (-0.01 – 0.19)

OR, Odds ratio; 95% CI, 95% Confidence interval; SE, Standard error.

Smartphone

Two studies examined the association between smartphone use and subsequent depressive symptoms (Table 6). Shen et al.[64] reported a small positive association, whereas Rudolf et al.[67] observed a moderate positive association only among female adolescents with pre-existing depressive symptomatology but no diagnosis, and the timing of puberty moderating the effect.

Table 5 – The association between smartphone use and depressive symptoms.

Study	Effect measures	Results
Shen et al. [64]	OR (95% CI)	Reference group: 1st tertile 2nd tertile: 1.12 (0.64 – 1.97) 3rd tertile: 1.89 (1.02 – 3.49), p 0.05
Rudolf et al. [67]	Coefficient β (SE, 95% CI)	FE-IV regressions - Reference group: no use < 30 min/day: Female 0.0103 (0.0748); Male 0.120 (0.0586), p < 0.05 30 min – 1h hours/day: Female 0.0451 (0.0677); Male 0.0756 (0.0528) 1 – 2 hours/day: Female 0.0612 (0.0665); Male 0.110 (0.0515), p < 0.05 2 – 3 hours/day: Female 0.155 (0.0673), p < 0.05; Male 0.13 (0.0525), p < 0.01 3 – 4 hours/day: Female 0.260 (0.0698), p < 0.01; Male 0.138 (0.0560), p < 0.05 > 4 hours/day: Female 0.231 (0.0700), p < 0.01; Male 0.128 (0.0570), p < 0.05

		Hours per weekday: Female 0.208 (0.0404), p < 0.01; Male 0.00370 (0.0458) Heterogeneity analysis No preexisting condition: Female 0.108 (0.0585), p < 0.1; Male -0.0200 (0.0503) Pre-existing condition: Female 0.239 (0.0476), p < 0.01; Male 0.0616 (0.0663)

OR, Odds ratio; 95% CI, 95% Confidence interval; SE, Standard error; RI-CLPM, Random intercept cross lagged panel model; FE-IV, Fixed effects model and instrumental variables estimation.

Internet

Seven studies assessed the association between time spent on the internet and subsequent depressive symptoms (Table 7). All studies reported a small positive association in both adjusted and unadjusted models[43, 56-61]. Among these, Ma et al.[61]. revealed a stronger association in female adolescents and senior students, with sleep duration and parent-adolescent communication mediating the effect Fitzpatrick et al.[59], observed a positive association only among female adolescents, whereas Kandola et al.[56] demonstrated a positive association exclusively among male adolescents[56]. Jiang et al.[58] found that the frequency of internet use had no direct effect on subsequent pressive symptoms in adolescents, but can indirectly affect through self-adjustment mediation.

Table 7 – The association between internet use and depressive symptoms.

Study	Effect measures	Results
Mougharbel et al.[60]	OR (95% CI)	Reference group: 0 – 29 min/day 30 – 59 min/day: 0.90 (0.79 – 1.03) 1 – 2 hours/day: 1.00 (0.90 – 1.11) 2 – 3 hours/day: 1.03 (0.91 – 1.16) > 3 hours/day: 1.24 (1.11 – 1.38) p < 0.001
Kandola et al. [56]	IRR (95% CI)	Reference group: Less than once a month/never Most days: Male 0.864 (0.746 – 1.000), p 0.051; Female 1.100 (0.955 – 1.267), p 0.181 At least once a week: Male 0.872 (0.751 – 1.014), p 0.076; Female 0.973 (0.843 – 1.122), p 0.703 At least once a month: Male 0.969 (0.807 – 1.166), p 0.744; Female 0.944 (0.803 – 1.11), p 0.486
Fitzpatrick et al. [59]	Coefficient b (SE)	RI-CLPM – Between-person covariance Male: b 0.12 (0.05), p 0.012, β 0.39 Female: b 0.04 (0.09), p 0.144, β 0.21 RI-CLPM – Within-person regression paths 13 – 15 years old: Male 0.20 (0.28), p 0.473, β 0.06; Female 0.47 (0.19), p 0.013, β 0.12 15 – 17 years old: Male 0.13 (0.19), p 0.518, β 0.04 Female 0.35 (0.15), p 0.017, β 0.10
Houghton et al. [43]	Coefficient β (SE, 95% CI)	RI-CLPM: 0.090 (0.044), p .042
Marciano et al. [57]		RI-CLPM 2016 – 2017: 0.055 2017 – 2018: 0.070 2018 – 2019: 0.071 Bivariate correlation coefficients 2016 – 2017: r 0.153, p < 0.001 2017 – 2018: r 0.134, p < 0.001 2018 – 2019: r 0.120, p < 0.001
Jiang et al. [58]		SEM Total effect: 0.01, p < 0.001

		Indirect effect: 0.01, p < 0.001
Mougharbel et al.[60]		Mixed effects model: 0.070 (0.012, 0.045 – 0.095), p < 0.001
Ma et al. (2023)[61]		Fixed effects regression model: 0.173 (0.072), p < 0.05 Heterogeneity analysis Online learning: 0.462 (0.263), p < 0.10 Online shopping: 0.888 (0.269), p < 0.01 Online entertainment: 1.239 -(0.321), p < 0.01 Online socializing: 1.123 (0.848) Sex: -0.139 (0.079), p < 0.10

OR, Odds ratio; IRR, Incident ratio rate; 95% CI, 95% Confidence interval; SE, Standard error; RI-CLPM, Random intercept cross lagged panel model; SEM, Structural equation model.

Social media

Twelve studies examined the association between time spent on social media and subsequent depressive symptoms (Table 8). Seven studies found a small positive association after controlling for confounders, namely sex, ethnicity, socioeconomic status, physical activity and baseline depressive symptoms[44-46, 49, 51, 56, 69]. Thorisdottir et al.[51] found a stronger effect among female adolescents and Kandola et al.[56] reported a significant association only among female adolescents. Conversely, five studies reported no association[43, 50, 53, 54, 64].

Table 8 – The association between social media use and depressive symptoms.

Study	Effect measures	Results
Shen et al. [64]	OR (95% CI)	Reference group: 1st tertile 2nd tertile: 0.72 (0.42 – 1.25) 3rd tertile: 0.92 (0.48 – 1.75), p 0.62
Kandola et al. [56]	IRR (95% CI)	Reference group: Less than once a month/never Most days: Male 1.071 (0.976 – 1.174), p 0.148; Female 1.130, (1.050 – 1.217), p 0.001 At least once a week: Male 1.024 (0.903 – 1.162), p 0.705; Female 0.964 (0.883 – 1.052), p 0.416 At least once a month: Male 1.012 (0.869 – 1.178), p 0.877; Female 0.966 (0.853 – 1.094), p 0.588
Brunborg et al. [46]	Coefficient b (SE, 95% CI)	First differencing model: 0.13 (0.01 – 0.24), β 0.08, p 0.038 Pairwise Spearman correlations coefficient: r 0.11, p < 0.05
Thorisdottir et al. [51]		Fixed effects model: 0.05 (0.01, 0.04 − 0.06), p < 0.001, β 0.13 (0.01) Male: -0.05 (0.01, -0.07 − -0.03), p <0.001, β -0.12 (0.02)
Puukko et al. [53]		RI-CLPM 2014 – 2019: 0.01 (0.03, 0.05 − 0.07), p 0.802, β 0.01 2016 – 2018: 0.14 (0.08, 0.03 − 0.31), p 0.097, β 0.18
Boers et al. [45]	Coefficient β (SE, 95% CI)	Multilevel Model Assessing Between-person 0.64 (0.48 – 0.81) Within-person 0.41 (0.32 – 0.51)
Nagata et al. [69]		Mixed effects model: 0.14 (-0.09 – 0.33), p 0.230
Houghton et al. [43]		RI-CLPM: 0.008 (0.051), p 0.873
Heffer et al. [50]		Autoregressive cross-lagged model Female: -0.043 (-0.159 – 0.073) Male: 0.145 (0.000 – 0.288) Pearson correlation coefficient Female: r 0.251, p < 0.001 Male: r 0.220, p < 0.001
Coyne et al. [54]		ALT-SR – Within-person cross-lagged path 13 – 14 years old: 0.01

		14 – 15 years old: 0.02 15 – 16 years old: 0.01 16 – 17 years old: -0.08, p < 0.05 17 – 18 years old: 0.00 18 – 19 years old: 0.03
Coyne et al. [49]	Mean (SE)	Peak Users: 2.36 (0.25) Increasers: 2.35 (0.21) Moderate Users: 1.59 (0.12) Overall χ^2: 6.16, p < 0.05
Vannucci et al. [44]		Low social media use: 15.15 (0.61) High instagram/ snapchat use: 15.32 (0.49) High social media use subgroup: 21.83 (1.73) Overall χ^2: 13.91, p < 0.01 Effect size: 0.08

OR, Odds ratio; IRR, Incident ratio rate; 95% CI, 95% Confidence interval; SE, Standard error; RI-CLPM, Random intercept cross lagged panel model; ALT-SR, autoregressive latent-trajectory models with structured residuals SEM, Structural equation model; BCH, modified correction method of Bolck.

Communication

Four studies investigated the association between time spent on screen-based communication and subsequent depressive symptoms in adolescence (Table 9). Two studies found a small positive association[60, 69], while Khouja et al.[47] reported no significant association after adjusting for covariates. On the other hand, Rudolf et al.[67] observed that social and active types of screen time, specifically calling and messaging friends and family, were negatively associated with depressive symptoms at three years follow-up.

Table 9 – The association between screen-based communication and depressive symptoms.

Study	Effect measures	Results
Mougharbel et al.[60]	OR (95% CI)	Reference group: 0 – 29 min/day Talking on the phone 30 – 59 min/day: 1.13 (0.99 – 1.29) 1 – 2 hours/day: 1.07 (0.96 – 1.20) 2 – 3 hours/day: 1.16 (0.99 – 1.36) > 3 hours/day: 1.33 (1.15 – 1.53) p < 0.001 Texting/messaging/emailing 30 – 59 min/day: 1.07 (0.96 – 1.20) 1 – 2 hours/day: 1.07 (0.96 – 1.18) 2 – 3 hours/day: 1.11 (0.99 – 1.25) > 3 hours/day: 1.32 (1.19 – 1.46) p < 0.001
Khouja et al. [47]		Reference group: Texting <1 hour/day Weekday: 1 – 2 hours/day 1.05 (0.91 – 1.22); ≥ 3 hours/day 1.00 (0.82 – 1.23), p 0.89 Weekends days: 1 – 2 hours/day 1.04 (0.89 – 1.21); ≥ 3 hours/day 1.02 (0.85 – 1.24), p 0.75
Mougharbel et al.[60]	Coefficient β (SE, 95% CI)	Mixed effects model Talking on the phone: 0.084 (0.017, 0.050 – 0.118), p 0.000 Texting/messaging/emailing: 0.100 (0.013, 0.071 – 0.124), p 0.000
Nagata et al. [69]		Mixed effects model Texting: 0.26 (0.09 – 0.44), p 0.005 Video chat: 0.35 (0.19 – 0.51), p < 0.001
Rudolf et al. [67]		FE-IV regressions Smartphone social use: Female -0.209 (0.0454), p < 0.01; Male -0.179 (0.0419), p < 0.01

OR, Odds ratio; IRR, Incident ratio rate; 95% CI, 95% Confidence interval; SE, Standard error; RI-CLPM, Random intercept cross lagged panel model.

Study quality assessment results

According to the Newcastle-Ottawa Scale, 13 studies were of high quality, 16 studies were of moderate quality, and two studies were of low quality (Table 1). The quality assessment results of the included studies are displayed in Suplementary Material B. Recurrent problems among studies were the lack of objective measurement of screen time exposure, the presence of the outcome of interest at baseline and the limited adjustment for confounding variables other than sex and baseline depressive symptoms.

DISCUSSION

The current systematic review of 31 longitudinal studies provides a comprehensive synthesis of evidence on the association between screen time and subsequent onset or worsening of depressive symptoms in adolescents irrespective of the gender. The findings demonstrate a small positive association between total screen time and depressive symptoms. However, this relationship varied across different types of screen devices and activities. Internet and smartphone use were most consistently associated with subsequent depressive symptoms, whereas evidence for non-addictive video game use and passive screen time, such as television and video viewing, was predominantly non-significant. Social media, computer and communication use showed inconsistent evidence of association. Furthermore, the strength of these relationships appeared to be moderated by sex, suggesting greater vulnerability of female adolescents to the effects of screen time exposure.

Consistent with previous systematic reviews and meta-analyses, our findings confirm that total screen time is prospectively associated with increased depressive symptoms in adolescents[31, 34, 70]. Although statistically significant, the strength of this association was generally small, with some studies suggesting that this relationship may be indirect and influenced by psychological and individual factors. Across studies from which comparable effect sizes could be derived, correlations were around r = 0.10. Recent meta-analyses on this issue, assessing both cross-sectional and longitudinal studies, reported pooled odds ratio ranging from 1.10 to 1.28, although with high heterogeneity[30, 31, 70, 71]. Despite the small magnitude of association, its importance at the population level should not be disregarded given the widespread exposure to screen time among adolescents. The interplay between screen time and depression appears to be complex and mediated by multiple mechanisms. Subgroup analysis performed in previous meta-analysis have identified differences in the association determined by screen device and activity, sex, age, geographic region and baseline depression status[30, 31, 70]. Importantly, evidence from Liu et al. and Gao et al.[30, 70] demonstrate a curvilinear dose-response association between screen time and depression risk, whereby screen use of less than two hours per day was not associated with increased risk of depressive symptoms, or even showed protective effect, while exposure exceeding two hours per day was significantly associated with increased risk[30, 70]. These findings support current health recommendations to limit recreational screen time in adolescents.

Beyond the amount of time spent on screen-based technologies, the association between screen time and depressive symptoms in adolescents also appears to be influenced by the type of device, purpose of use, and nature of the content[30, 34, 72]. In our systematic review, specific screen devices and activities produced different outcomes over time, which is concurrent with previous evidence. However, the direction of effect for the different screen modalities varied across studies[70, 72]. The most consensual finding was the divergent impact of active screen time (gaming, learning, engaging in social interactions, creating content) compared to passive screen time (watching television or videos, scrolling through social media) on depressive symptoms. Notably, passive television viewing consistently showed minimal impact on mental health compared to interactive and interpersonal forms of screen engagement, suggesting that differences in the user experience and social effects may underlie this pattern[34, 70, 72]. Such variation in the relationship between screen time and depressive symptoms according to the type of device and activity suggests that screen time itself is unlikely to causally increase depression. Rather, these findings underscore the need for future longitudinal research to move beyond simple measures of total screen time and incorporate qualitative aspects of screen use, especially as digital behaviors and technologies continue to evolve rapidly.

Regarding video games, most studies reported no significant association with depressive symptoms, and one study even identified a potential protective effect among male adolescents.

This may reflect the increasingly social nature of contemporary gaming, which frequently involves engagement with online communities or collaborative in-person play[73]. From this perspective, video games can facilitate meaningful social connections, promote teamwork and problem-solving skills, as well as provide positive feelings and a sense of achievement and belonging, thereby generating potential social and emotional benefits that may counterbalance negative mental health effects[28, 45, 73]. In contrast, all studies evaluating the prospective impact of smartphone and internet use reported an increased risk of depressive symptoms in adolescents. For smartphone use, small to moderate associations were observed, with stronger effects among female adolescents and those with pre-existing depressive symptomatology or early pubertal timing. In fact, smartphones are now ubiquitous in adolescent daily life and, while they can facilitate social interactions through messaging or calling, their passive functions, such as social media scrolling, video viewing and casual browsing, may provide an easily accessible means of escaping real-world experiences, potentially reinforcing negative mood[67, 74, 75]. However, the current evidence remains elusive, as only two studies specifically examining smartphone use were included in this systematic review[64, 67]. Similarly, internet use was consistently associated with small increases in depressive symptoms, with sex, age, sleep, self-adjustment and parent–adolescent communication patterns emerging as potential mediators. Several mechanisms may explain this association, including displacement of face-to-face interactions, sleep disruption from screen light and bedtime use, and exposure to negative online content[57, 61]. Female adolescents appear to be particularly vulnerable to internet effects, possibly due to greater engagement with appearance-focused media content that promotes unhealthy social comparisons[56, 59]. Additionally, evidence suggests bidirectional effects, whereby adolescents with depressive symptoms may turn to online environments as a coping mechanism, creating a self-reinforcing maladaptive cycle that may worsen mental health problems over time[57]. These findings underscore the need for in-depth exploration of the specific patterns of smartphone and internet use to clarify their potential contribution to depression in adolescents.

The impact of other types of screen-based devices and activities, namely computer, social media and communication use, on depressive symptoms remains unclear, as the available evidence has produced inconsistent and sometimes contradictory findings. Studies assessing computer use reported null or small positive associations, with stronger effects among female adolescents and on weekend days. This discrepant findings may be explained by different purposes of computer use, since educational and productive activities, typically conducted on weekdays, have been associated with improved self-efficacy and lower internalizing symptoms, whereas recreational use, including gaming and passive activities, frequently prolonged on weekends, may displace healthier experiences and contribute to the development of depressive symptoms over time[19, 45]. Regarding social media, although findings were inconsistent, female adolescents appear to be a particularly vulnerable group. Excessive social media use has been linked to loneliness, low self-esteem, and increased risk of depression, partly explained by mechanisms such as negative social comparison, exposure to objectifying or harmful content and fear of missing out (FoMO)[19, 76-79]. Conversely, active and socially supportive use of social media can foster connectedness and strengthen peer relationships, potentially buffering against emotional distress[78, 79]. However, studies examining the association between active screen-based communication and depressive symptoms did not clearly demonstrate these underlying benefits, reporting contradictory findings. This may be explained by the displacement hypothesis, since digital communication, such as calling and messaging, while convenient, may not adequately substitute for the depth and emotional quality of face-to-face interactions[60, 69].

The complexity of the association between screen time and subsequent onset or worsening of depressive symptoms among adolescents has prompted investigation into potential moderators and mediators, as well as into the putative mechanisms underlying this relationship. Several potential moderators have been identified through the body of evidence to influence the strength and direction of this association, with sex emerging as the most consistent moderator[31, 70-72].

Accordingly, our systematic review found some sex differences, with few studies reporting greater vulnerability among female adolescents to the negative effects of screen exposure, although one study showed the opposite[56]. Moreover, the moderating effect of sex varied depending on specific screen devices and activities. This susceptibility may reflect both biological differences and divergent patterns of screen use, as female adolescents are more likely to engage with appearance-focused content that promotes upward social comparisons and increases exposure to cyberbullying, potentially lowering self-esteem and exacerbating depressive symptoms[70]. Other moderating factors reported by included studies were problem-focused coping, self-esteem, pre-existing depressive symptoms and timing of puberty. Additionally, sleep duration, parent-adolescent communication patterns and self-adjustment were identified as other potential mediators. However, given that each variable was examined in only a single study, the limited evidence precludes definitive conclusions. Further longitudinal research is needed to replicate these findings and clarify the mechanisms through which these individual, psychosocial, and contextual factors influence the relationship between screen time and depressive symptoms in adolescents. Previous meta-analyses also found differences in geographic region and adolescents age in subgroup analysis, with studies conducted in Asia and those focusing on late adolescence (ages 15 – 19 years) reporting significantly higher risk of depressive symptoms following increased screen time[30, 31, 70]. Nevertheless, due to the heterogeneity of the included studies and the limited number of studies available for direct comparisons, such conclusions cannot be drawn from the present review.

Although this systematic review generated important findings, several limitations should be acknowledged when interpreting the results of this systematic review. First, substantial heterogeneity was observed across included studies, attributable to differences in screen time definition, exposure and outcome assessment, follow-up periods, analytic strategies, cultural and socioeconomic contexts and study quality, which have limited the comparability of findings and precluded the quantitative synthesis of the data. Screen time definitions and assessment instruments were inconsistent, with some studies focusing solely on total screen time while others distinguished between different types of devices and activities. The analytical approaches varied considerably across studies, with some employing statistical models that may have introduced bias through covariate omission or overadjustment, and only few studies utilizing advanced methods capable of examining bidirectional relationships between screen time and depressive symptoms. Second, the predominant reliance on self-report measures of both screen time exposure and depressive symptoms while providing a practical method for data collection, are prone to potential recall and measurement bias that should be acknowledged. Although all outcome measures are validated tools, differences in their sensitivity and scoring methods must be considered. Future research would benefit from incorporating objective measures such as device usage data and ecological momentary assessment (EMA) to enhance measurement precision. Third, the limited number of longitudinal studies examining specific devices such as smartphones and computer restricts the strength of conclusions regarding these increasingly prevalent technologies and hinders further analysis to uncover sources of heterogeneity. Fourth, the geographic distribution of included studies was skewed toward high-income countries, with limited representation from the global south. This geographical concentration may limit the scope of application of the present findings, potentially limiting the generalizability to diverse populations, particularly in developing countries. Finally, the procedural quality of the studies varied widely, with inadequate reporting of attrition and participation biases, raising concerns about selective retention.

CONCLUSION

This systematic review indicates that screen time may act as a predictive factor for depressive symptoms in adolescents, though the prospective association was small and varied across screen devices and activities. Internet and smartphone use were consistently associated with subsequent onset or worsening of depressive symptoms, whereas video game and passive screen time (television and video viewing) showed predominantly non-significant associations. Evidence regarding social media, computer, and communication use was inconsistent. However, given the limited number of longitudinal studies and substantial heterogeneity in methods and populations, findings should be interpreted with caution.

The association between screen exposure and adolescent depression is complex and multifactorial. Beyond the quantity and quality of screen engagement, individual characteristics and contextual factors also play an important role in this relationship. Sex emerged as the most consistent moderator, with evidence indicating greater vulnerability among female adolescents. Other potential moderators and mediators were reported inconsistently and require further investigation.

Overall, the findings support recommendations to limit prolonged recreational screen time and highlight the importance of parental guidance and supervision. Additionally, targeted interventions are needed to foster healthier digital habits among adolescents, aiming at improving psychosocial well-being and prevent depression in this vulnerable population. Future research endeavours should employ standardized and objective measures of screen time, account for screen content and motivations, and adopt advanced longitudinal methods to clarify mechanisms underlying this association. This will enable the development of more nuanced and evidence-based guidelines for adolescent screen use that consider both the complexity and heterogeneity of digital engagement patterns.

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