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Title: Adolescent perspectives of bedtime social media use: a qualitative systematic review and thematic synthesis

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Summary

Adolescence is often characterised by changes in sleep patterns, with reports that the average adolescent does not get the recommended sleep time. Recent qualitative research has identified the use of electronics at bedtime and engagement with social media platforms as barriers to gaining sufficient time and quality of sleep during adolescence. A systematic review and thematic synthesis was undertaken following the three-step thematic synthesis framework. Four databases were searched, and full texts were screened based on pre-existing inclusion/exclusion criteria. Fourteen studies were included, encompassing 967 participants. Three analytical themes were developed: 1) social motivations; 2) habitual smartphone use and 3) recognition of a problem. Findings confirmed how bedtime social media use requires a new framework for recognising the importance of peer relations, where increased frequency and immediacy of communication lays the foundation for social accountability to meet communicative norms and fear of missing out. In the review, adolescents commonly express a lack of control in relation to their social media use which triggered discussion of the habitual aspects of bedtime social media use. The importance of intervention strategies which recognise the wider peer-to-peer social implications of bedtime social media use is discussed with some practical insights offered.

Keywords- social media; adolescent; sleep; qualitative; systematic review; thematic synthesis

Introduction

The average adolescent gets less sleep than recommended for their age group, which is set as eight to ten hours by the National Health Foundation [1], particularly during school days [2-4]. In addition to lack of sleep, the prevalence of insomnia disorder is estimated to be particularly common in adolescents [5], and was reported to be as high as 23.8% by one study [6]. Psychological factors can partially explain this prevalence, such as stress [7,8], anxiety and depression [9], as well as biological factors such as changes to the circadian rhythm during this developmental period [10]. Additional hormonal changes which take place during adolescence, particularly in relation to the menstrual cycle and the eveningness chronotype, can result in sex differences in insomnia prevalence, with females of all ages being more likely to suffer from insomnia than males [11,12]. Additionally, environmental factors, such as school schedules [13], social activities [14], and electronic media use [15,16] can also play a significant role in the maintenance and onset of sleep disturbances during this period. The adolescence age range can vary depending on the context and is widely affected by cultural norms. For the purposes of this present study, a wider definition of adolescent age was prioritised as the endpoint of growth is now considered to extend into the early to mid-twenties to reflect current social changes such as delayed marriage and parenthood, which increasingly due to completion of education, have resulted in changing societal perceptions of when adulthood begins [41].

Adolescents are recognised as being particularly heavy users of social media platforms with 97% of 16 to 24-year-olds reporting social networking usage, compared to only 34% of over 65s [17]. Thus, with electronic devices and social media becoming a prominent part of everyday life, particularly for young people, its use around bedtime has prompted research exploring the dynamic interplay between social media use and sleep for this population. Many studies have highlighted the strain of attending to sleep needs whilst

negotiating the social drive to maintain connected and responsive on social media in the evening. Research suggested that sleep tends to lose out [18-20]. Decreased levels of academic performance [21], depressed mood [22], and obesity [23] have been associated with poor sleep hygiene in this population. Parallels have also been drawn between sleep deprivation and habitual internet use [24], and in many cases social media use features as a common denominator in this [25].

Significant associations have been demonstrated between extent of adolescent social media use and their sleep patterns [26]. The physical explanations for the impact of social media use on sleep patterns, and smartphone use more generally, tend to be threefold. Firstly, engaging with electronic devices when one would otherwise be asleep, thus delaying bedtime [27]. Secondly, it has been shown to increase arousal before sleep, which lengthens how long it takes one to fall asleep, also known as sleep onset [28]. Lastly, whilst exposure to blue screen light is often cited [29], its impact on the circadian rhythm and alertness is modest [30]. What sets social media apart from other forms of screen use is its 24/7 interactive and social nature [15]. This has ultimately transformed the way in which adolescents in particular interact with each other, with a high level of engagement possible at any time of day, whereby one can communicate with peers without any real limits [31,32].

Quantitative research has been widely employed to explore the link between bedtime social media use and sleep quality [18,33-35]. This prioritises statistical objectivity, and has an important role to play when variables are unambiguous and clear-cut. Positivist approaches to the scientific study of sleep [33], attempt to extract numerical data using standardised measures, aiming for positivist criteria of quality such as replicability, reliability and validity. Nevertheless, qualitative research is more effective in extracting the explicit and or implicit meanings which inform the experiences held by the participant, enabling participants to speak freely, discussing their own idiographic experiences [36]. Inductively

framed qualitative research can also aid in the creation and development of theoretical frameworks [37], which is particularly important for a newly developing field such as social media use and sleep. In this case, qualitative research offers a crucial method to add the adolescent voice to conversations in research, education and policymaking. This ensures that efforts to promote healthy sleep remain up-to-date with the challenges that young people identify as affecting their sleep in today's 24/7 connected world.

The field of knowledge about the role of social media use at bedtime within an adolescent population has attracted an increase in research focus. The research topics have been varied, for instance several studies have used qualitative methods to examine adolescent perceptions of sleep behaviour, where social media use tends to have some form of involvement, such as technology use as a means of not 'missing out' on social interaction [38]. Others have placed their focus on social media use specifically, and its impact on sleep hygiene, with results including the delay of sleep in order to avoid violating social norms [39]. The body of this evidence has never been synthesised to provide a full understanding of adolescent experience of social media use at bedtime and its impact on sleep hygiene. With research of this nature having grown over the last decade, and particularly intensively over the last 2-3 years, it is timely to pool these qualitative findings systematically. Interest in adolescent social interactions has also become heightened in recent times since the beginning of government-imposed restrictions in March 2020 due to the COVID-19 pandemic. Evidence suggests that social media naturally played an important role in maintaining social interactions between peers at a time when they were physically disconnected, with more time spent connecting to friends virtually resulting in greater depression [40]. However, research during the pandemic was not the focus of this review. This current study seeks to examine "bedtime social media use", as it is described in Scott et al. [39], aligning with the New Transformation Framework of 21st century peer relations outlined in Nesi et al. [31,32]. This

framework argues that social media has changed adolescent peer relations through the frequency, timing and amplification of experiences. In addition, the qualitative nature of interactions and the changing of behaviours must be considered. This systematic review and thematic synthesis will seek to bring together this growing body of research in order to point to collective and consistent findings which can then be used to inform current and future interventions. We can also use the review to point toward policy recommendation and wider stakeholder engagement (schools, social media sites, parents). Thus, it can be useful for planning and reacting to sleep as an indicator of adolescent health, tailored towards the improvement of sleep quality in adolescents. Whilst the translation of concepts is crucial to the process, the development of analytical themes will allow this current study to do more than to simply summarise previous findings, instead it will go further and identify the meaning behind patterns, which can be best interpreted through a systematic review and thematic synthesis.

Methods

Guidelines for reporting systematic reviews were followed according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [41]. The review protocol was registered on PROSPERO (CRD42020218800; https://www.crd.york.ac.uk/prospERO/display_record.php?RecordID=218800).

Search Strategy

Four databases (MEDLINE, Embase, PsycINFO and CINAHL) were searched from inception until 26th November 2020. A specialist librarian assisted in the search process to ensure maximised potential of the search strategy. Search terms included *sleep, deprivation, initiation, habit, sleep quality, sleep hygiene, insomnia and bedtime*. For the social media aspect, examples of search terms included *social media, social network, twitter, tweet, facebook, smartphone, and screentime*. The boolean operand of ‘or’ allowed studies including any of these terms in the title or abstract to be identified. Similarly wide-ranging terms were also used to ensure that social media was included, along with adolescent participants, and studies using qualitative methods. These terms were then adapted to fit other databases (See Supplementary File 1 for the detailed search strategy for Medline). The reference lists of the 22 identified papers were searched to capture any suitable studies which may have been missed by the original search process.

Study Eligibility

Pre-registered eligibility criteria as per our review protocol were strictly followed during the screening process, using P(IC)OS measure of eligibility criteria.

Population

Studies with at least 80% of participants within the predefined adolescent age bracket (10-24 years) were eligible for inclusion. This wide definition of adolescence was selected to promote inclusivity and recognise modern thinking with regards to adolescent growth and life

phases for the purposes of both scientific research and social policies [42]. Younger or older samples, or where adolescents encompass less than 80% of participants were excluded, as were studies whereby all participants were parents or caregivers speaking about, or on behalf of, adolescents. However, no studies were excluded based on the above criterion.

Outcomes

Studies with verbatim quotes which relate to the adolescent experience of using a smart device with social media at bedtime and its impact on sleep were included. Findings which relate only to adolescent experience of sleep or social media, rather than both, were excluded. It was acknowledged that social media has evolved over time and that pre-smartphone studies should be included if they fit all other criteria. Studies which referred to electronic use were eligible for inclusion as long as the electronic use could be attributed at least partly to social media.

Study Type

To be eligible for inclusion, studies had to be full-text, empirical and published in English in peer-reviewed journals. Conference abstracts, reviews, editorials, book chapters, dissertation theses and grey literature were not eligible for inclusion.

Study Design

Studies which included a qualitative component with verbatim quotes linking sleep and social media were eligible for inclusion. Quantitative-only studies were excluded and when studies employed mixed methods only the qualitative aspect were included.

Quality Assessment

The quality of included studies was assessed using the Joanna Briggs Institute (JBI) Checklist for Qualitative Research [43]. Each study was appraised independently by two members of the research team (MM and MG). The JBI tool is formed by 10 questions which researchers must apply to each individual study and decide if it adheres to each point,

adjudged to be yes, no or unclear. A specific definition for each point can be found in Supplementary File 2. Studies were not excluded based on their quality assessment.

Data Synthesis

As per the thematic synthesis framework [44], this review followed a three-step process. Firstly, using NVivo 12 software [45], each article was coded line-by-line in the parts of the results section. Each line was analysed in its own right without relating it to other lines, and was summarised in a few words. This is known as ‘free-coding’ as it does not follow a hierarchical structure. Secondly, descriptive themes were developed through grouping together common, conceptual issues related to the stated aims, by translating the same concepts across different studies, where terminology can sometimes differ. Lastly, analytical themes were developed by taking the descriptive themes and “going beyond” to create new interpretations. This thorough process ensures a robust analysis which synthesises data across studies in a systematic manner.

Results

A total of 585 papers were retrieved across the four databases searched. The Rayyan QCRI [46] duplicate detection function was used to remove duplicates (n=185), although further duplicates were then removed manually (n=25). Thus, 375 remaining titles and abstracts were screened blind using Rayyan, conducted by two authors (MM and MG). All disagreements (n=12) were discussed and resolved between the researchers. Following screening, 353 studies were excluded based on the inclusion and exclusion criteria resulting in 22 studies for full text review. The reference lists of these 22 studies were hand searched, with a further 4 studies identified as potentially eligible. The full text screening of the remaining 26 studies resulted in 14 studies included in the review and 12 excluded. (See Figure 1 for the PRISMA flow chart).

[Insert Figure 1 here]

Study Characteristics

The principal characteristics of each study were extracted as follows, having met all inclusion criteria: authors, year, country, aim, sample characteristics, type of data collection and analytical method employed (Table 1). It is important to highlight that all studies with the exception of one [47] were published between 2018 and 2020, demonstrating the novel, rapid attraction of research to this topic in a short period of time. The study by Thomée et al [47], discusses a different kind of social media, as methods for using social media reflects technology and discourse of the time and are susceptible to adaption and change in preferences. Specifically, terms such as ‘smartphone use’ or ‘electronic use’ are used when referring to technologies which also encompass social media in the format of “chatrooms” and therefore it was included.

In total, five studies originated from the United States [48-52], four from Sweden [47,53-55], two from the United Kingdom [39,56], and one each from Australia [38], Iran

[57] and Bhutan [58]. Three studies included participants with high reported use of electronics [47,57,58]. One study sampled from participants in employment [38], another sampled from a housing estate with low-socio economic status [52], and one study used American Indian/Alaska Native participants [51]. Two studies focused on adolescents with a type 1 diabetes diagnosis but included some relevant data unrelated to their condition [48,50]. One study interviewed the adolescent's carers [48], but their input was not utilised in this thematic synthesis.

Data collection and analytical methods

Seven studies collected data via individual interviews [47-51,55,58], and a further six used focus groups [38,39,52,53,56,57]. One study used an open-ended "free-text" questionnaire [54], allowing answers of up to six sentences. Three studies were mixed methods [49,52,58] and thus also had quantitative components which were not considered in the thematic synthesis of this review. Six studies used Thematic Analysis to govern their data analysis methods [39,48,51,56-58]. Four used Content Analysis [47,50,53,54], whilst each of the remaining four used an "inductive approach" [38], an "inductive and deductive approach" [52], a "phenomenological hermeneutic analysis" [55] and a "multi-stage analytic process" [49] respectively. Ten studies focused their research questions on sleep itself, and the barriers, facilitators and/or consequences of sleep [38,48-56] three studies focused more on the experience and consequences of overuse of technology [47,57,58], whilst one study directly examined adolescent motivations for bedtime social media use and its perceived consequences on sleep quality [39].

Study Quality

Most studies performed well in the quality assessment, however it was notable that point 6 ("Is there a statement locating the researcher culturally or theoretically?") was either unclear or not met by thirteen studies (see Table 2). This can be identified as a weakness in

the field, whereby researchers tended to overlook the integral researcher role and their own subjectivity in informing methodology and analysis but did not link this to their own specific cultural or theoretical insight. Although it did not result in the exclusion of poorer rated studies from the review as per our protocol, it is important to take into account the quality of each study, especially if one theme is reliant upon evidence from one study in particular.

[Insert Tables 1 and 2 here]

Thematic Synthesis

Following the three-step thematic synthesis [44] 72 initial codes were created, which were developed into 15 descriptive themes. Upon synthesising and translating each descriptive theme, three analytical themes were created with 12 subthemes spread across the three (Table 3). These analytical themes were: 1) Social motivations, 2) Habitual smartphone use, and 3) Recognition of a problem.

[Insert Table 3 here]

1: Social motivations

Evidence to support this theme was available in 11 of the 14 papers which documented the social motivations behind delaying sleep, by communicating with friends via social media, both in group chats and one-to-one messaging. Four subthemes emerged: fear of missing out, social accountability, not subscribing to norms and enjoyment of bedtime social media use.

1.1: Fear of missing out (FoMO)

A common explanation by adolescents for delaying their sleep was that whilst sleeping they would not be a part of ongoing conversations or other real-time virtual events. Particularly important here is the feeling of involvement as participants across studies appear to seek involvement in social interaction online, even at the cost of their sleep. Adolescents expressed concern that by going to sleep they could ‘miss out’ on important social activity.

“I go to bed the earliest of all my friends; when I wake up there’s so many messages I haven’t seen and I’ve missed out on all this stuff.” [38]

Adolescents perceived that the consequences of missing out on such activity promotes paranoia and social exclusion, in that they will not be part of real-life social activity because they had not been part of the virtual activity on social media platforms the night before.

“If you've not seen something that everybody else has seen...then they have a joke between them, it's sort of annoying because you don't know what they're talking about. You think ‘maybe they're talking about me, maybe they're talking about somebody else’. You sort of feel a bit paranoid. Yeah then it sort of leads to exclusion and you feel paranoid that you're not included in that.” [39]

The impact of FoMO on sleep was also recognised, with the concept that it was difficult to sleep whilst one’s peers were communicating with each other via social media, as instead of sleeping, one’s mind was occupied with concerns about ‘missing out’, making it very difficult to be relaxed enough to sleep.

“As soon as you give into that temptation you're on it for an hour, two hours at least and then- so yeah, I would say it always affects your sleep. And then you're always wondering ‘what's everyone else doing? Are they speaking to each other? Am I missing out? Should I be on this? Should I be up?’ And then yeah- it affects my sleep.” [39]

1.2: Social accountability

Participants across various studies highlighted the importance of a form of accountability whereby they are responsible for participating in online group conversations regardless of the time of day. Interestingly, this phenomenon seems to be perceived as an obligation, rather than a desire. Whilst much of this social accountability was mentioned in relation to FoMO, where it was considered unacceptable for anyone in a peer group to ‘miss

out', some examples suggested it was more than a mere extension of FoMO. This can be understood as where the actions taken because of FoMO are a conscious decision based on social involvement, social accountability appears to not be a choice at all, it is essential.

“The social requirement is that you...there are group chats

and if we are writing something, then you have to join and participate.” [54]

The priority of sleep is often considered secondary to social accountability for adolescents from various studies, with the consequences of not upholding responsibilities perceived as being worse than the consequences of limited sleep. Explanations for this accountability revolve around the hesitation of ending a conversation with someone in order to go to sleep in fear of coming across as being rude, and furthermore a general reluctance when it comes to rejecting someone's advances to having a one-to-one conversation on social media.

“If you send someone a picture and then they send you one back and it just goes on for ages and you just send random pictures to each other and then it keeps going on I feel like that might keep you up or- Yeah because if the conversation is going good you need to keep it going, you can't ignore them or else that's just rude. You feel rude. Very rude.” [39]

1.3: Not subscribing to norms

Some participants admitted to not being well-disciplined when it comes to upholding to their peer's social norms, such as not responding to messages quickly or replying faster to people they wanted to talk to more than others. Interesting is the use of the term 'guilty' in admissions of not subscribing to communicative norms, as this would suggest a recognition of the accountability, and that they feel they should be more disciplined in their social media activity.

“I'm guilty of this but sometimes if it's not someone special, like that I don't want to talk to, I just kind of ignore it for a bit...but if it's someone like I do want to talk to then I'm like ‘OK yeah’ so I open it straightaway.” [39]

One participant suggested that social media fatigue plays a part in not subscribing to norms, with it being natural to simply disconnect from social media after a receiving a significant amount of unread notifications. However, there was little consensus for this across all studies, so generalisability is limited.

“After a certain point I just stop reading my notifications. I just do my own thing, like watch something and I just don't care about what anyone says.” [39]

1.4: Enjoyment of bedtime social media use

Notably, it was not only the negative aspects of bedtime social media use which were common to multiple studies. Participants in various studies expressed their enjoyment for bedtime social media use, for example:

“We're just [on our phones] chatting to friends. I just enjoy that in the evening.” [56]

This suggests they do not necessarily do it to satisfy others or to become involved, part of their motivation is that being able to communicate with friends with 24-hour availability is a fun pastime for many adolescents. Thus, it is important to make a distinction between the reasons why many adolescents delay sleep by using social media at bedtime, as whilst social accountability is an important factor, this is necessarily not as forced and pressurised for all adolescents as may be suggested. Furthermore, it is also possible to consider that adolescents who feel forced into staying awake due to their social accountability, could simultaneously enjoy staying awake despite sleep costs, as is evident in the following admission:

“Because if you sit...and I've made that mistake many nights that I sit up late and chat. And then you get stuck in it...you talk to people and it's fun, and then you sit

and surf around a little bit and it takes extra time, and then it's two o'clock...and you have to get up at seven." [47]

2: Habitual smartphone use

Prominent descriptions of the habitual nature of smartphone use at bedtime featured in 12 out of 14 papers, with some verging towards the problematic aspects of it. Five nuanced subthemes were identified: strong urge to 'check' phone, automaticity of habitual use, difficulty in stopping electronic use, losing track of time and social media as a facilitator of sleep. Whilst all five themes are, naturally, very closely connected, it was felt that these five distinctions were clear-cut and deserved analysis in their own right.

2.1: Strong urge to 'check' phone

Adolescents across multiple studies tended to report the same feeling of an urge or desire to 'check' their smartphones. To 'check' in this context can be defined as opening various social media applications to scroll through and ensure nothing has been missed, or to ensure there are no unread messages from peers. The constant need to check again and again can clearly be recognised as a barrier to sleep, as per adolescents' own admissions:

"...and then maybe you pick up the phone again after trying to sleep for a quarter of an hour. Then it just becomes a vicious circle." [54]

In some cases, the need to check their phone is perceived by adolescents themselves as being an addiction, whereby it is the last thing they do before the sleep and the first thing they do when they wake up. In other words, checking social media is always at the forefront of their minds to the extent it can even disrupt them during sleep.

"I'm addicted to my phone. Most of the time, the reason I wake up in the middle of the night is to look for my phone because I fell asleep with it." [52]

2.2: Automaticity of habitual use

The automatic nature of smartphone and social media use was particularly notable, as adolescents suggested they lack control over their actions and sometimes find themselves on their phones without consciously deciding to do so.

“When I go to bed, I’ll roll over and then I’ll find two minutes later I’ve picked up my phone and I’m looking at it and I’m like, ‘Wait? What am I doing? I was trying to sleep!’” [38]

There was also evidence that the habitual nature of bedtime social media use does not necessarily need to be rewarded by new posts or messages for it to continue, and thus the habit did not stop when there is nothing new to look at, there is a constant desire to check again.

“We are used to checking our cell phones every 5 minutes even if there is nothing new, but it is a habit.” [57]

2.3: Difficulty in stopping electronic use

Even when recognising the importance of sleep, adolescents expressed a difficulty in making the decision to go to sleep instead of staying up to use electronics. Many of these examples refer to watching videos on YouTube, which is considered a form of social media as anyone with an account can post on it and interact with peers, with others watching Netflix, which although it has close connections, is not explicitly a form of social media itself. Regardless, both of these platforms have in common the fact that adolescents referred to them when reporting a desire to stay awake to watch more videos rather than going to sleep. Although one can argue that this is distinguishable from the types of social media which this current study is focusing on.

“So it’s a struggle. I stay up kind of late just like watching YouTube videos when I know I could go to sleep then, but I just want to watch more.” [49]

2.4: Losing track of time

Descriptions of being so engrossed in their phones that they are unaware of the passing of time was common in adolescents across studies. Again, the previously discussed concept of ‘checking’ is relevant as contrary to the expectation of how long it should take to check a few social media platforms, awareness of time disappears and any plans to sleep are delayed simply by paying full attention to the smartphone and wider world of social media contained within it.

“Every night before going to bed, I definitely pick up my cell phone to check it and when I put it down, I see that 2 hours have passed just for checking.” [57]

2.5: Social media as a facilitator of sleep

However, data from more than one study suggests that some adolescents perceive bedtime social media use as actively facilitating their sleep onset. This goes further than to simply enjoy using smart devices before bed, rather it allows social media to be viewed as a positive contribution to sleep hygiene in some circumstances, which is contrary to a number of other subthemes arising from this thematic synthesis. Adolescents often identified bedtime social media use as a way to relax and calm down before sleeping, tuning out from the world around them. The identification of the smartphone as a distraction can, it seems, work both ways. Not only can it delay and distract from sleep, but to the contrary it can also provide a level of relaxation necessary to sleep, especially when such relaxation has not already been attained. Furthermore, it was recognised as part of a bedtime relaxation routine, where along with general bedtime chores such as brushing teeth, it was considered to be just another step in the winding down process.

“I try to...relax before bed. So I put my pajamas on, I wash my face, brush my teeth, brush my hair, and then I hop into bed and I’ll probably go on my phone between...45 minutes or between 30 and 45 minutes and just like scroll through...that’s why I go

on my phone to just relax and do whatever and not really think about what's going on this day or what I have to do tomorrow.” [50]

To a slightly different effect, simply having one's smartphone nearby during the night was deemed important, particularly in circumstances where sleep was proving difficult. Hence, in one particular example, parental restrictions on late-night electronics use was perceived to be detrimental to sleep quality as it removed the calming security of having one's smartphone nearby and available:

“My mum sometimes takes my phone out of my room, but I can't sleep if it's out of my room. Yeah, same. I have to have my phone with me, it's my alarm or else I'll panic. And yeah, my mum's like ‘you should go to the doctors’...I really hate having it [my phone] out of my room, in case I wake up in the night all panicky and I need to go on my phone or something. It really calms me, but I hate it when my phone is out of my room.” [56]

3: Recognition of a problem

Adolescents discussed their awareness of their bedtime electronic use as a problem in 7 out of 14 papers. Amongst the various studies, social media use was often discussed in tandem with video games or watching television. It is notable that the experience seems similar across these various platforms, but we felt it was important to not stray too far outside the realms of social media use as this was the basis for our rationale, thus only discussion of social media usage or slightly more vague smartphone use was given full attention.

Subthemes included: negative effects, restrictions on electronics at bedtime and distraction from other priorities.

3.1: Negative effects

There was a recognition that delaying sleep by communicating with friends on social media resulted in tiredness the following day, thus impacting upon academic performance. It is also

interesting to note the employment of the first-person plural pronoun ‘we’, suggesting that this is not an issue simply for one individual, but a collective concern for multiple classmates:

“I’m a nursing student. The teacher asks us why we are so sleepy in the morning and we say: ‘we were on night shift’. He asks where and we say: ‘on Telegram!’. It is a new phrase that we use these days.” [57]

Physical effects are also recognised, ranging from eye strain after too much screen time, to feeling sluggish, as well as a basic admittance that using electronics before bed is a primary reason for their own respective sleep issues, implying an acknowledged responsibility over one’s sleep. Whilst previous themes show a social accountability for communicating with peers, this subtheme begins to suggest that many adolescents do recognise that they can, and should, control their sleep quality.

3.2: Restrictions on electronics at bedtime

Data from several studies mentioned restrictions on electronics at bedtime, either self-imposed, or imposed by parents or carers. Using smartphone features such as Apple’s ‘do not disturb’ were discussed as a means of controlling one’s own bedtime electronic use and, in turn, sleep. Although, the success of these features were doubted as despite recognising a responsibility over one’s sleep, adolescents noted a difficulty in knowing how to tackle such barriers.

“On Apple products there's a feature ‘do not disturb’ so you set what time it comes on and what time it stops and between those hours or minutes there's no noise...no vibrations. It's important [sleep] but we don't understand how to get it always.” [56]

In situations when parents impose restrictions on late-night electronic use, there seems to be more success in tackling the issue, as adolescents are no longer in control. In some cases, this involves parents removing the smartphone from the adolescent’s room, and in other cases the internet is switched off at a particular time:

“It is good that they turn off the internet at a certain time, because then I will not have any chance to get stuck with the smartphone for too long at night.” [53]

3.3: Distraction from other priorities

Competition between the priorities of sleep and social media were not alone in the findings, with many adolescents reporting other priorities, such as homework, as being relevant to this competition. It was suggested that social media use can delay doing homework, again impacting upon academic performance, and thus in the end sleep quality is compromised as sleep must be delayed in order to finish homework, which itself had been delayed by social media use.

“When I get home after sports, I’ll eat dinner and then I’ll have my phone or my computer for a while, and it usually delays how long it’ll take for me to do my homework.” [48]

Discussion

This systematic review and thematic synthesis identified three main themes using data from 14 studies and 967 participants in order to explore adolescent experiences of bedtime social media use. The first of the three identified themes was 'social motivations', which centred around the subthemes of FoMO and social accountability, helping to explain the social aspect of bedtime social media use. The second theme, 'habitual smartphone use' focused more on the direct experience of finding it difficult to leave one's smartphone alone at bedtime, where participants described the automaticity of bedtime smartphone and social media use. The third and final theme, 'recognition of a problem', explored adolescent perspectives of the problematic nature of their bedtime social media use, with a focus on their awareness of its negative effects.

At a theoretical level, it must be noted that social media has completely transformed the way in which adolescents connect and socialise with each other. Nesi et al. [31,32] proposed a transformation framework which sought to use interdisciplinary research to argue that online peer socialising goes further than to simply mirror their offline relationships, highlighting significant differences between the two experiences. As per this framework, the widespread nature of social media has resulted in the following changes to peer-to-peer relations: 1) the increase in frequency and immediacy of experiences, 2) the increased intensity of experiences and demands, 3) reshaping the qualitative nature of interactions, allowing the potential for quantifiable responses such as likes, and building new opportunities for both 4) compensatory behaviours and 5) novel behaviours. The results of our thematic synthesis are in line with this framework. Specifically, the increase in frequency and immediacy of experiences, as well as the increased intensity of experiences and demands can be clearly seen in the theme of 'habitual smartphone use', whereby the potential for 24-hour social media engagement exists due to how instant responses from peers can be at any time of

day. Data relating to the reshaping of the qualitative nature of interactions did not directly emerge from the thematic synthesis. Although it would be a logical path for future research to follow as the concept of social media 'likes' has been closely linked to depression [59] and emotional distress [60] in adolescents, but as of yet no research exists to associate this idea with sleep. Another change to sleep behaviour due to social media is the facilitatory benefits to sleep reported by some adolescents, whereby smart devices and the social media platforms on them, can allow for relaxation before sleeping as part of a sleep hygiene routine.

It is notable, particularly with regards to FoMO, that the lines are often blurred between virtual interaction via social media and real-life social interaction. It was perceived that a sense of belonging would be lost in physical social settings, such as school, if one missed out on something important on social media. This was often discussed in terms of group chat conversations, and that by not taking part in such virtual conversations one would risk becoming distant from peers in real-world interactions. Although it is difficult to quantify when using a thematic analysis, there seems to be a good deal of overlap between these two explanations, where it is possible to experience FoMO as well as pressure from social accountability simultaneously. It was also evident that although adolescents often recognise the costs to sleep quality when they stay up late at night to use social media, any desire to sleep is often overridden by the motivations of FoMO and/or social accountability, at least until their peers begin to go to sleep. Recent studies have sought to investigate FoMO further [61,62], with one in particular having identified that it is a predictor of emotional outcomes including sensitivity to stress in association with negative reactions by peers on social media [63]. A growing body of research has found evidence for an interconnectedness between FoMO and problematic social media use [64-66]. Thus, it may be suggested that the habitual and addiction-like behaviour alluded to in the second theme, 'habitual smartphone use', may

be strongly connected to FoMO, which is particularly interesting as it draws parallels between seemingly distinct factors in the adolescent experience of bedtime social media use.

The reported desire to constantly “check” one’s phone and inability to mentally disengage from smart devices also fits into the transformation framework previously discussed, specifically in relation to the development of novel behaviours [31,32]. This assessment is fair given the highly motivating nature of social media for the teenage social brain, which prioritises peer acceptance and belonging [67]. However, research shows that this important social aspect of smart devices can lend itself to problematic behaviours [68,69]. The lack of self-control which was implied by adolescents with their habitual checking of social media can be explained biologically by the way in which we process rewards, with participants who displayed symptoms of problematic social media use having been observed to have reduced volume of the amygdala-striatal system, supporting the reward deficiency theory [70]. In the context of social media use, lower activation of reward circuits reduces the intensity of reward delivery, which in turn motivates people to continually “check” their device until their craving is satisfied [71]. In addition, delay discounting the immediate gratification of social media rewards is prioritised when making decisions, over and above larger rewards which are not immediate [72]. This could partially explain what causes problematic behaviours in this context, with delay discounting being demonstrated as a mediator between posterior insular cortex volume and problematic social media use [73].

In the final theme, where adolescents recognised the problems associated with prioritising bedtime social media use over sleep, despite identifying a problem they are unable to find the will or the appropriate methods to resolve it. Whilst findings from this theme suggest that adolescents already have an awareness of the impact of bedtime social media use and sleep deprivation on their wellbeing, education-based interventions may be

useful in encouraging adolescents to develop and maintain healthy sleep hygiene practices. However, education-based sleep interventions alone have been limited in their success to date, largely producing improvements in sleep knowledge, but not sustained improvements in sleep behaviour [74,75]. Thus, interventions should take into consideration the pivotal role social media plays in adolescent peer relations [39]. Indeed, short term abstinence from social media has recently been found to have a low effect on improving wellbeing outcomes [76,77]. Recent advancements to develop technology-based interventions such as night-time screen light and noise reduction features [78], acknowledge the important role of social media in facilitating social wellbeing and in some cases sleep itself, whilst attempting to counter its problematic and disruptive aspects [79]. Further research would be required to support more drastic intervention measures, such as limiting social media use to strictly ten minutes per day, which evidence suggest the beneficial effects on reducing loneliness and depression [80].

There was a notable absence of consideration for cultural and sociodemographic factors in the studies included in this review. Only Hedin et al. [53] which took urban and rural differences into consideration, and Palimaru et al. [51], which highlighted the cultural differences of American Indian/Alaska Native adolescents, acknowledged the well-established evidence that adolescent sleep patterns vary significantly based on nationality and sociodemographic differences [81]. The quality appraisal identified that researchers of most included studies failed to place themselves culturally or theoretically, showing limited reflexivity. This was evident in their lack of attention to cultural matters, despite included studies coming from a total of 6 different countries, including Bhutan and Iran, whose experience of social media could differ to that of western countries, as motivations for social media use are known to vary cross-culturally [82,83].

However, arguably the biggest challenge faced by this review was to discern differences in terminology and gauge exactly what could be considered as social media use, and what could not. This highlights another concern in that the majority of included studies too often utilised vague terminology, discussing ‘smartphone use’ and ‘electronic media use’, when it became clear in many instances that participants were not talking about their smart device in general, but rather they were referring to the social media networks they use to communicate with peers. In doing so, studies sometimes missed the opportunity to contribute to the growing evidence for the role of sleep in the transformation framework, as there is a distinction be made between social media use, and the vague smartphone/electronic use which some studies referred to in their evaluations, thus to some extent neglecting the potential to focus on the social interactions which are often at the forefront of technology use at night. This is particularly relevant to the habitual smartphone use theme, which was named as such to contrast problematic and addictive behaviour with biological underpinnings from the social aspects of the first theme. Despite using the vague term of smartphone use, it was felt that this accurately portrayed a phenomenon of which social media platforms are a pivotal part. To combat the terminological problem, this synthesis used the context in which adolescents were speaking, as well as any references to social media sites or functions, to separate other electronic device features such as YouTube or Netflix, from social networking applications which include Facebook, WhatsApp and Instagram, among others. Of the included studies, only Scott et al. [39] explicitly used social media use as a key term in their analysis. This fact alone signifies the importance of the translation of concepts in Thomas & Harden’s thematic synthesis process [44], as valuable evidence could easily have been missed through terminological differences, which has caused the transformation framework to be underutilised when explaining the role of social media use as a barrier to adolescent sleep.

Strengths and Limitations

The authors recognise the potential for preconceived notions to have influenced the scope of this review and synthesis. From the outset, an immediate focus was specifically placed on social media use, setting aside other technological influences on sleep, such as television or Netflix. However, the unique social and interactive aspects of social media use, as well as its ubiquitous use amongst adolescents, mean that it merited a dedicated review. Furthermore, the search strategy was formulated in collaboration with a specialist librarian, which helped to lower the risk of bias during this part of the process. It is possible that preconceived assumptions that social media always influences sleep negatively could result in a failure to show the true picture of bedtime social media use. However, the effects of such biases were limited by the discussion of findings in relation to the transformation framework which recognises the changes in peer-to-peer relations since the advent of social media, rather than simply viewing the effects as positive and negative.

With 14 included studies and a total of 967 participants, this review synthesised a large amount of qualitative data, all published within the last decade, and is the first of its kind to do so in the field of sleep and social media use. The thematic synthesis allowed for the translation of concepts, with often subtle differences between various concepts which had been utilised by previous studies. However, it must be recognised that the search strategy could have missed out potentially included studies on the basis that 1) papers which focus on social media use, but do include a small and potentially important mention of sleep, and vice versa, and 2) papers where the social media use is described completely differently and search terms did not cover it, although efforts were made to mitigate these issues during the comprehensive search process. Another limitation is that age discrepancies within adolescence were not taken into account, despite there being significant differences in priorities and lifestyles between those at the youngest and oldest stages of the adolescent age

range applied in this study. The age discrepancies in this context present a potentially promising avenue for future research.

Implications

This current study calibrates existing scientific knowledge of adolescent experience of bedtime social media use by identifying the ways in which the transformation framework can be applied to the various dimensions of the experience in relation to sleep hygiene practices. The available data supports a shift in focus away from technological devices themselves and towards the social interactions which they facilitate. It confirms the contradictory nature of bedtime social media use where it can have benefits to overall wellbeing as well as drawbacks, as evident in the perceived experience of adolescents themselves. It contributes to a change in thinking by bringing together the important role social media plays in a world of 24-hour availability to connect with peers, along with the strong social motivations which can contribute to the delay of sleep onset, two factors which had seldom been emphasised together in previous studies, particularly in the context of the changing social framework. In practice, findings suggest that sleep hygiene educational interventions alone may lack substantial rationale as adolescents are often already aware of the sleep problems which arise from bedtime social media use, and limits imposed on social media use may remove its facilitatory benefits to sleep. This highlights the need for interventions to strike a balance between acknowledging the fundamental role played by social media in peer relations, both online and offline, and the need for high quality sleep during adolescence. It is the view of this study that technology-based interventions are best placed to take this balance into account as they allow for a compromise between two essential principles in adolescent development.

Practice points

1. Fear of missing out plays a substantial role in adolescents' delaying bedtime and sleep due to their perceptions of the 24/7 nature of social media.
2. Adolescents feel that they are responsible for ensuring they participate in social media communication, and that this must be adhered to even when recognising the delay of sleep onset.
3. There is an automaticity to bedtime social media use, where adolescents feel an urge to 'check' their smartphone.
4. Interventions to improve sleep in adolescents should take into account the new role that social media play in the real-world social interactions, rather than focus solely on sleep.

Research agenda

1. Future research should focus less on the technological devices themselves, and more on the social interaction which they facilitate.
2. More studies should address the differences in experience of bedtime social media use in terms of age discrepancies, from the youngest social media users to those in their late teens and early twenties.

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Figure 1

Search Process, PRISMA Flow Diagram [40]

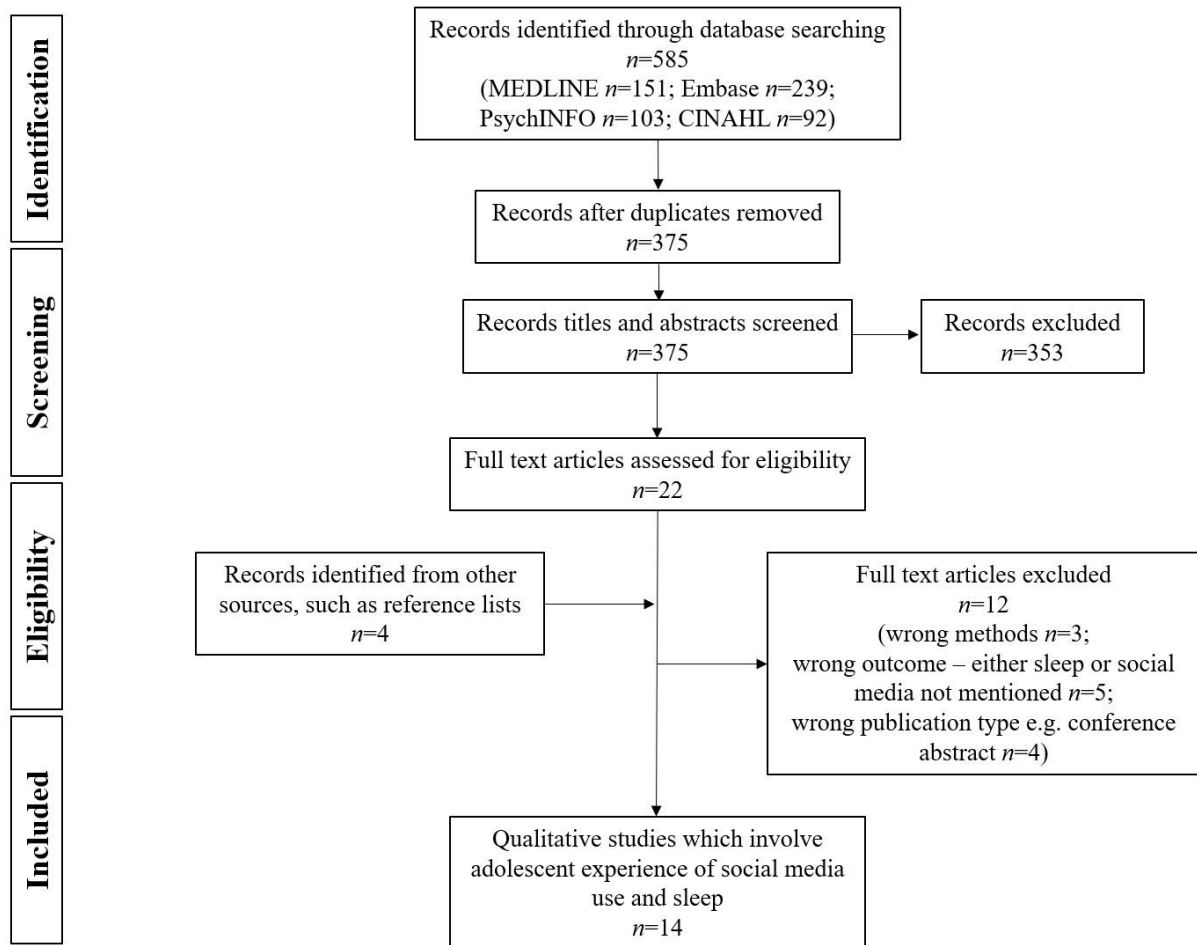


Table 1*Principal Characteristics of Included Studies*

Study (year)	Country	Aim	Sample (Qualitative components only)	Data Collection	Analytical Method
Amiri & Dowran (2020) [56]	Iran	To explore how adolescents use smartphones, how they are depended upon, and the consequences of dependence	$n=22$ (9 females, 13 males, $M=20.95$ years, $SD=1.36$ years), smartphone owners who overused their phones according to self-report	3 focus groups (between 7 and 8 participants per group)	Thematic analysis
Bergner et al. (2018) [47]	United States	To identify perceptions of barriers, facilitators and consequences of sleep quality in adolescents	$n=25$ (13 females, 12 males, $M=15.6$ years, $SD=1.48$ years), adolescents with a T1D diagnosis of at	50 individual semi-structured interviews	Thematic analysis

		with type 1 diabetes, and their caregivers	least one year, and their caregivers - a further 25		
Gaarde et al. (2020) [48]	United States	To explore the multiple levels of perceived influence on sleep patterns of urban adolescents	$n=142$ (83 females, 58 males, 1 other, $M=15.6$ years, $SD=1.33$ years), ninth to twelfth grade students from three Californian high schools	Mixed methods; 142 individual semi-structured interviews with a post-intervention survey	Multi-stage analytic process
Godsell & White (2019) [55]	United Kingdom	To explore adolescent perceptions of sleep and influences on sleep patterns and quality	$n=33$ (16 females, 17 males, age 13-14 years, mean age and standard deviation provided not), from	4 focus groups (between 7 and 9 participants per group)	Thematic analysis

			two English secondary schools		
Griggs et al. (2020) [49]	United States	To explore the perceived facilitators and barriers of sufficient sleep in young adults with type 1 diabetes	$n=30$ (20 females, 10 males, $M=22.1$ years, $SD=3.1$ years), recruited from the New Haven Health System and had a T1D diagnosis of at least 6 months	30 individual semi-structured telephone interviews	Content analysis
Hedin et al. (2020) [52]	Sweden	To investigate adolescent perceptions of barriers and facilitators of high sleep quality	$n=45$ (28 females, 17 males, $M=16.13$ years, $SD=0.5$ years), from seven upper secondary schools in	7 focus groups (number of participants per group was not disclosed)	Content analysis

			Sweden - both rural and urban areas		
Jakobsson et al. (2020a) [53]	Sweden	To identify the reasons for sleeping difficulties as perceived by adolescents	<i>n</i> =475 (275 females, 200 males, age 15-16 years, mean age and standard deviation not provided), from all 13 secondary schools in a Swedish city, with self-reported sleeping difficulties	Questionnaire with open-ended questions, and answers of up to six sentences	Content analysis, both qualitative and quantitative
Jakobsson et al. (2020b) [54]	Sweden	To highlight the meanings of adolescents' experiences of sleeping difficulties	<i>n</i> =16 (6 females, 10 males, age 14-15 years, mean age and standard deviation not provided), from two	16 individual narrative interviews	Phenomenological hermeneutic analysis

			Swedish secondary schools, with sleeping difficulties for at least 2 years		
Palimaru et al. (2020) [50]	United States	To understand facilitators, barriers and cultural aspects of sleep in American Indian/Alaska Native youths	<i>n</i> =26 (12 females, 14 males, <i>M</i> =14.3 years, <i>SD</i> =1.1 years), recruited from urban California, with parents reporting their participating adolescent as American Indian/Alaska Native	26 individual in-depth interviews	Thematic analysis
Paterson et al. (2019) [38]	Australia	To identify what changes adolescents and young	<i>n</i> =57 (32 females, 25 males, <i>M</i> =21.12 years,	6 focus groups (between 3 and	Inductive approach

		adults are willing to make	$SD=2.77$ years),	15 participants	
		to improve sleep, and to	participants had to be	per group)	
		identify the barriers and	in employment		
		facilitators of these			
		modifying factors			
Quante et al. (2019) [51]	United States	To examine mediating mechanisms and strategies which adolescents use to improve sleep quality	$n=27$ (12 females, 15 males, $M=15.7$ years, $SD=1.4$), from the same housing site in Boston which had low socio-economic status and was ethnically diverse	Mixed methods; survey followed by 3 focus groups (between 8 and 10 participants per group)	Inductive and deductive approaches
Scott et al. (2019b) [39]	United Kingdom	To examine adolescent motivations for bedtime social media use and	$n=24$ (12 females, 12 males, $M=14.3$ years, standard deviation not	4 focus groups	Thematic analysis

		perceived impact on sleep quality	provided), from a Scottish secondary school		
Tenzin et al. (2019) [57]	Bhutan	To understand the prevalence and perceived psychological co-morbidities of internet addiction in adolescents	<i>n</i> =13 (age 11-19 years, no mean age or standard deviation provided), selected for interview based on an Internet Addiction Test Score of >49 in the quantitative component	Mixed methods; self-administered questionnaire followed by 13 individual in-depth interviews	Thematic analysis
Thoméé et al. (2010) [46]	Sweden	To explore explanations for associations between ICT-use and mental health outcomes	<i>n</i> =32, 16 females, 16 males, age 21-28 years, no mean age or standard deviation	32 individual semi-structured interviews	Content analysis

provided), had

reported high ICT

exposure prior to

reporting mental

health symptoms

Table 2

Summary of how each study performed in the JBI Checklist for Qualitative Research [43]

Author(s)	Congruency Philosophical and research methods	Congruency in research methodology and question	Congruent methods research methodology	Congruency in research methodology and representation and	Congruency in research methodology and interpretation	Cultural statement of researchers	influence of the researcher on the research	Participants well represented	Evidence of ethical approval	Appropriate conclusions
Amiri & Dowran (2020) [57]	No	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	No	Yes
Bergner et al. (2018) [48]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Gaarde et al. (2018) [49]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Unclear	Yes
Godsell & White (2019) [56]	Unclear	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes

Griggs et al. (2020) [50]	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Hedin et al. (2020) [53]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Jakobsson et al. (2020a) [54]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Jakobsson et al. (2020b) [55]	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Palimaru et al. (2020) [51]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Paterson et al. (2019) [38]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes

Quante et al. (2019) [52]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Scott et al. (2019b) [39]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Tenzin et al. (2019) [58]	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes
Thomé et al. (2010) [47]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes

Table 3*Thematic analysis themes and subthemes from included studies*

Themes	Subthemes	Relevant papers
1: Social motivations	1.1: Fear of missing out	Bergner et al. (2018) [47]; Godsell & White (2019) [55]; Griggs et al. (2020) [49]; Hedin et al (2020) [52]; Jakobsson et al. (2020a) [53];
	1.2: Social accountability	Jakobsson et al. (2020b) [54]; Palimaru et al. (2020) [50]; Paterson et al. (2019) [38]; Scott et al. (2019b) [39]; Tenzin et al. (2019) [57]; Thomée et al. (2010) [46]
	1.3: Not subscribing to norms	
	1.4: Enjoyment of bedtime social media use	
2: Habitual smartphone use	2.1: Strong urge to 'check' phone	Amiri & Dowran (2020) [56]; Bergner et al. (2018) [47]; Gaarde et al. (2018) [48]; Godsell & White (2019) [55]; Griggs et al. (2020) [49];
	2.2: Automaticity of habitual use	Jakobsson et al. (2020a) [53]; Palimaru et al. (2020) [50]; Paterson et al. (2019) [38]; Quante et al. (2019) [51]; Scott et al. (2019b) [39];
	2.3: Difficulty in stopping electronic use	
	2.4: Losing track of time	Tenzin et al. (2019) [57]; Thomée et al. (2010) [46]
	2.5: Social media as a facilitator of sleep	
3: Recognition of a problem	3.1: Negative effects	Amiri & Dowran (2020) [56]; Bergner et al. (2018) [47]; Gaarde et al. (2018) [48]; Godsell & White (2019) [55]; Hedin et al (2020) [52];
	3.2: Restrictions on electronics at bedtime	Jakobsson et al. (2020a) [53]; Palimaru et al. (2020) [50]
	3.3: Distraction from other priorities	

Supplementary File 1

Database Search Keyword Terms and Subject Headings Used in MEDLINE

Sleep	Social Media	Adolescent	Qualitative Design
Sleep Deprivation/ or “Sleep Initiation and Maintenance Disorders”/ or Sleep/ or Sleep Hygiene or sleep* adj5 (depriv* or initiat* or habit* or quality or hygiene) or insomnia* or bedtime* or sleep*	Social Media/ or social network* or social medi* or twitter* or tweet* or facebook or weibo or instagram or tiktok or snapchat or smartphone* or screentime*	Adolescent/ or young adult/ or student/ or adolescen* or young adult* or young people* or teen* or student* or college* or undergrad*	Qualitative research/ or qualitative* or focus group* or interview* or experience* or perspective* or motivat* or driver* or perception* or perceive* or believ*

Supplementary File 2

The Joanna Briggs Institute Critical Appraisal tools for use in JBI Systematic Reviews:

Checklist for Qualitative Research

1. Is there congruity between the stated philosophical perspective and the research methodology?
2. Is there congruity between the research methodology and the research question or objectives?
3. Is there congruity between the research methodology and the methods used to collect data?
4. Is there congruity between the research methodology and the representation and analysis of data?
5. Is there congruity between the research methodology and the interpretation of results?
6. Is there a statement locating the researcher culturally or theoretically?
7. Is the influence of the researcher on the research, and vice-versa, addressed?
8. Are participants, and their voices, adequately represented?
9. Is the research ethical according to current criteria or, for recent studies, and is there evidence of ethical approval by an appropriate body?
10. Do the conclusions drawn in the research report flow from the analysis, or interpretation, of the data?