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Social Media Use and Self-Injurious Thoughts and Behaviors: A Systematic Review and Meta-Analysis

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Abstract

Despite considerable public and scholarly debate about the role of social media in self-injurious thoughts and behaviors (SITBs), no comprehensive, quantitative synthesis of this literature has previously been undertaken. The current systematic review and meta-analysis examines associations between social media use and SITBs, including suicidal ideation, suicide plans, suicide attempts, and nonsuicidal self-injury (NSSI). A range of social media behaviors and experiences were identified, including cybervictimization and perpetration, exposure to and generation of SITB-related content, problematic use, sexting, social media importance, and frequency of use. A systematic search of PsycINFO, Medline, CINAHL, and the references of prior reviews yielded 61 eligible studies. Results largely suggested medium effect sizes for associations between specific social media constructs (cybervictimization, SITB-related social media use, problematic social media use) and SITBs. There was no association between frequency of social media use and SITBs; however, studies on this topic were limited. The majority of

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Statement 2: Contributors

J.N. conceptualized the study and wrote the protocol. J.N., R.T.L., and K.A.F. conducted literature searches. All authors conducted article screening. J.N., T.A.B., A.H.B., A.Y.K., H.A.M., E.C.T., and R.T.L. extracted data for meta-analysis. J.N. and R.T.L. conducted statistical analyses. All authors assisted in interpretation of findings. All authors contributed to and approved the final manuscript.

Statement 3: Conflict of Interest

The authors declare that they have no conflicts of interest

studies identified focused on cybervictimization, and results suggested positive associations with all SITBs, with the association between cybervictimization and suicidal ideation stronger for adolescents than adults. Overall, findings highlight the utility of examining specific social media behaviors and experiences, and point to the need for more research in this area.

Keywords

social media; self-injurious behaviors; suicidal ideation; suicide attempt; suicide plans; nonsuicidal self-injury

Introduction

There has been significant public and academic debate about the role of social media in mental health. This debate has been especially active in regard to the effects of social media use on self-injurious thoughts and behaviors (SITBs), including suicidal ideation, suicide attempts, and nonsuicidal self-injury (NSSI). The prevalence of social media use has increased exponentially in recent years among both youth and adults (Anderson & Jiang, 2018a; Perrin & Anderson, 2019). Alongside this large-scale societal shift has been a heightened focus on social media use in research. However, no comprehensive reviews of the associations between social media use and SITBs have been conducted, despite a rapidly expanding body of literature on this topic. Given the urgent need to synthesize existing research, this study offers a systematic and meta-analytic review of the relationships among social media use constructs and SITBs for individuals across the lifespan, and examines potential moderators of these associations. In doing so, this review provides a comprehensive overview of the current landscape of research on social media use and SITBs, and outlines directions for future research.

Social media can be broadly defined as any digital tool that allows for social interaction (Moreno & Kota, 2013). This includes social networking sites or applications (“apps”; e.g., Snapchat, Facebook, Instagram, Twitter), text messaging and messaging apps (e.g., WhatsApp), online forums and communities (e.g., Reddit, forums specifically devoted to suicide-related topics), and video sharing sites (e.g., YouTube, TikTok). In recent years, individuals’ socioemotional landscape has been reshaped by the widespread adoption of social media. Indeed, recent reports find that 97% of adolescents and 72% of adults in the U.S. report using some form of social media (Anderson & Jiang, 2018a; Perrin & Anderson, 2019), representing a dramatic increase in social media use over the past two decades (Twenge et al., 2019). Given the widespread use of social media, understanding the ways in which social media use intersects with mental health concerns is of paramount importance.

Alongside the rise in social media use, there has been a concerning increase in the prevalence of SITBs among both youth and adults (Centers for Disease Control and Prevention [CDC], 2017). The degree to which these developments are linked has been a source of debate (Orben & Przybylski, 2020; Sedgwick et al., 2019; Twenge et al., 2020). Potential associations between social media use and SITBs are of considerable public health relevance. Suicide is a leading cause of death worldwide (World Health Organization, 2019), and suicidal ideation and attempts are both prospective predictors of death by suicide

(Franklin et al., 2017; Ribeiro et al., 2016). Furthermore, NSSI is a robust predictor of suicidal behavior (Ribeiro et al., 2016). SITBs are highly prevalent among both youth and adults, representing a major public health concern (DeVille et al., 2020; Lim et al., 2019; Olfson et al., 2017).

Importantly, social media use is complex, and there are a number of potential components of social media use that may influence SITBs. Studies suggest that risk for negative mental health outcomes may be heightened as the result of negative social media behaviors, such as viewing SITB-related content, engaging in social comparison, and excessive use, as well as negative social media experiences, such as cyberbullying or social exclusion (Biernesser et al., 2020; Hamm et al., 2015; Nesi & Prinstein, 2015; Sedgwick et al., 2019). Notwithstanding these possible negative effects of social media use, there are also several potential benefits of use. For example, social media is a tool through which individuals can invite immediate social support from online and offline friends (Anderson & Jiang, 2018b; Massing-Schaffer et al., 2020; Seabrook et al., 2016), which plays a protective role for SITBs (Kleiman & Liu, 2013). The function of social media to strengthen existing relationships and connect individuals to new social networks may be particularly relevant for individuals in marginalized groups (e.g., sexual and gender minority youth, Lucero, 2017). Further, social media can provide access to mental health resources (Instagram, 2020) and it may also be used to engage individuals in treatment for mental health problems, including SITBs, or as an avenue to deliver preventive interventions for at-risk populations (Robinson et al., 2016). Below, we discuss specific domains of social media use that have been explored in relation to SITBs.

Quantity and importance of social media use

Much of the public discourse regarding social media use and SITB risk has focused on time spent using social media (i.e., “screen time”). Both the overall frequency of use and patterns of problematic use have been studied with regard to their impact on mental health. Several explanations have been offered as to why the amount of time spent on social media may be associated with mental health problems such as SITBs, including interference with in-person social interactions, disruption of sleep, and exposure to more negative experiences on social media (Twenge, 2020). However, an emerging consensus suggests that time spent using social media may not, in itself, be associated with negative outcomes (Odgers & Jensen, 2020; Orben, 2020), with a growing body of work suggesting that it may be more important to understand *how* individuals use or experience and respond to social media.

Notably, some have highlighted the important distinction between general frequency of use (i.e., “screen time”) and problematic use of social media. Problematic social media use has been alternatively referred to as “addictive” or “compulsive” social media use (Sun & Zhang, 2020), albeit with much conceptual and definitional inconsistency. Here, we use the term problematic social media use to refer to excessive time and energy devoted to social media, such that it leads to impairment and addiction-like symptoms (Lee et al., 2017; Sun & Zhang, 2020). Prior work suggests that problematic use may negatively impact a range of functional domains, such as mood, academic performance, and social relationships (Boer et al., 2020). Problematic social media use has also been linked to increases in

psychopathology symptoms over time in youth (Raudsepp, 2019), and these disruptions may, in turn, increase risk for SITBs.

Related to this concept is that of social media "importance," or investment in and concern about social media in one's life. Greater investment in social media may be associated with poorer emotional functioning (Rideout & Fox, 2018). For example, individuals who rely on social media to meet social or emotional needs, such as feeling less isolated or alone, may be more sensitive to negative experiences that occur in the context of social media. This represents one indirect pathway by which importance placed on social media in one's life could lead to negative mental health outcomes such as SITBs.

Social processes on social media

Given the inherently interpersonal nature of social media, research has also identified specific online social processes or events that may be associated with SITB risk. Cyberbullying victimization and perpetration are two such constructs that have received considerable attention. Cyberbullying victimization is robustly associated with a broad range of negative mental health outcomes, including both internalizing and externalizing problems (Kowalski et al., 2014). It may be particularly salient when considering SITBs, as abundant evidence supports the association between interpersonal stressful life events and SITBs (Liu & Miller, 2014). Experiencing bullying online may be a particularly pronounced interpersonal stressor, as individuals can be victimized publicly, perpetrators can act with some degree of anonymity, and the social media context is easily accessible at any time of day (Massing-Schaffer & Nesi, 2020). As such, prior meta-analytic reviews focused on adolescents and young adults have identified significant cross-sectional associations between cybervictimization and SITBs (John et al., 2018; Kowalski et al., 2014). Similarly, cyberbullying perpetration, or engaging in cyberbullying of others, is associated with a wide range of adverse outcomes (Marciano et al., 2020). Although this may be partially due to overlap in the experience of cybervictimization and cyberbullying perpetration for some individuals, perpetration may also serve as a unique interpersonal stressor with negative mental health implications (Camerini et al., 2020).

Sexting is another previously investigated social process that may have relevance for individuals' mental health. Although the extent to which sexting represents a maladaptive behavior or simply a normative form of digital sexual communication remains unclear, a recent meta-analysis suggest associations between sexting and anxiety, depression, delinquent behavior, and alcohol and drug use among adolescents (Mori et al., 2019). Thus, for some young people, sexting may represent a health-risk behavior with implications for SITBs.

SITB-related social media use

Social media provides a platform for individuals to share and engage with SITB-related content, such as images of self-harm or discussions about suicide methods. Posting or sharing SITB-related content, particularly self-generated content, may serve as a strategy to regulate self-harm urges or feelings of distress, or as a way to find community with shared experiences (Dyson et al., 2016). However, if and how this may be an effective tool for

managing SITB-related distress is unclear, and sharing SITB-related content may serve as an indicator of broader difficulties in regulating emotions. It is also possible that exposure to SITB-related content may "trigger" or reinforce these behaviors among individuals vulnerable to SITBs, and subsequently have a contagion effect (Nesi et al., 2021). Further, engaging with such content may increase the likelihood of seeing related content on social media in the future, given the algorithmic nature of many sites. However, the use of social media for eliciting and providing social support surrounding SITBs may offer protective benefits (Lavis & Winter, 2020), thus associations between SITB-related social media use and SITB outcomes are likely complex.

Age-related trends in social media use and SITBs

Much of the extant research on social media use and SITBs has been focused on adolescents (John et al., 2018; Sedgwick et al., 2019). Rates of suicide are increasing faster among adolescent girls than any other group (Ruch et al., 2019), mirroring age-related trends in social media use. Furthermore, the frequency and prevalence of social media use is greater among adolescents compared to adults (Anderson & Jiang, 2018a; Perrin & Anderson, 2019). Adolescence is a developmental period in which youth's peer relationships become increasingly important, time-consuming, and independent of adult supervision (e.g., Brown & Larson, 2009; Rudolph, 2014), and social media is an important context in which these relationships occur (Nesi et al., 2018). Furthermore, specific facets of social media use that may be more common among adolescents versus adults (e.g., problematic or heavy use, exposure to cybervictimization, or exposure to self-harm content) may be more strongly linked to SITBs (Biernesser et al., 2020).

Although there are many reasons to explore links between social media use and SITBs among adolescents, it is critical to examine potential associations between these factors across the lifespan. Some research has found associations between problematic social media use and perceived social isolation among older individuals (Meshi et al., 2020). Notably, however, research with older adults has focused on positive, rather than detrimental, effects of social media use (e.g., social connectedness, curbing loneliness, coping) (Bell et al., 2013; Leist, 2013). Despite patterns indicating that suicide rates are higher among adults compared to adolescents (CDC, 2017), and rates of social media use among older individuals have increased in recent years (Perrin & Anderson, 2019), few prior reviews have focused on both adolescent *and* adult populations. It is important to explore these associations across the lifespan, as well as to identify any differences in associations between these age groups.

Sex differences in social media use and SITBs

Prior research has identified sex and gender differences in social media use and SITBs. Rates of suicide are higher among males across the lifespan; however, suicide rates among males have been declining in many countries while rates among females have held or increased in recent years (Roh et al., 2018). Although rates of suicide death are higher among males, rates of suicide attempts and levels of suicidal ideation are higher for females (Cibis et al., 2012), indicating differences in risk trajectories by sex. Studies have also shown sex differences in social media use, particularly among young people. Female adolescents spend more time on social media, use it more actively (Herring & Kapidzic, 2015), and are

more likely to be victims of cyberbullying compared to boys (Beckman et al., 2013; Hamm et al., 2015). Importantly, some research has demonstrated stronger links between social media-based behaviors and poorer mental well-being (e.g., depressive symptoms, suicide risk factors) in adolescent females compared to males (Booker et al., 2018; Nesi & Prinstein, 2015; Twenge & Martin, 2020), indicating the importance of exploring sex differences in associations between social media use and SITBs. Notably, many studies have failed to distinguish between sex and gender among participants, and although preliminary work finds differences in social media use for gender minority versus cisgender individuals (Nesi et al., 2021; Selkie et al., 2020), this work remains limited.

Prior systematic reviews of social media use and SITBs

No prior reviews have systematically and quantitatively synthesized research on the full range of social media experiences in connection with the full range of SITBs, among individuals across the lifespan. However, prior reviews provide initial insight into this literature. In a scoping review of social media use and SITBs and depression in adolescents, a thematic analysis highlighted the importance of examining multiple social media use indices (e.g., quantity, quality, and social aspects of use; Vidal et al., 2020). A recent narrative review highlighted three domains of importance in the relation between social media use and self-harm in youth: excessive use, rejection or cyberbullying experiences, and disclosure or creation of self-harm content (Biernesser et al., 2020). Several systematic reviews have focused on internet or digital media use, but not specifically social media, and SITBs. These reviews have similarly highlighted positive and negative effects of digital media on SITB risk (Daine et al., 2013; Durkee et al., 2011; Marchant et al., 2017; Messina & Iwasaki, 2011; Sedgwick et al., 2019). Prior meta-analytic reviews have also identified positive associations between cyberbullying (perpetration and victimization) and SITBs (John et al., 2018; Kowalski et al., 2014; Van Geel et al., 2014)

Although prior reviews provide valuable insight into associations between social media use and SITBs, they have been limited in several important ways. First, no reviews to date have spanned the full range of social media use, behaviors, and experiences, and the full range of SITBs. Second, prior reviews have largely focused on the effects of social media use in youth; importantly, no reviews have systematically examined relations between social media use and SITBs across the lifespan. Third, no reviews have quantitatively examined potential moderators of these associations. Finally, given the shifting landscape of social media use among youth and adults, and the rapidly growing body of work on this topic, an updated review is needed.

The Current Review

To address these important gaps in the literature, a systematic and meta-analytic review of social media use and SITBs was conducted. The primary goals were: (1) to provide an overview of the current landscape of research on social media use in relation to SITBs, and (2) to comprehensively examine associations between different aspects of social media use and SITBs. Specifically, we aimed to evaluate all discrete indices of social media use that emerged from our review. These indices included: cybervictimization, cyberbullying perpetration, SITB-related use (including exposure to SITB-related content and posting

SITB-related content), frequency of use, problematic use, sexting, and social media importance. We examined associations among these social media constructs and a range of SITBs, including suicidal ideation (passive and active), suicide plans, suicide attempts, and NSSI. Potential moderators of these associations were also explored, including age, sex, sample type, measure quality, and time frame of construct assessed.

Method

All procedures for the current review were pre-registered on the International Prospective Register of Systematic Reviews (PROSPERO), registration number CRD42020182002, available at https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42020182002.

Search Strategy and eligibility criteria

A systematic search of the literature was conducted in PsycINFO, MedLine, and CINAHL on August 12, 2020 to identify relevant studies published prior to that date. Search terms for social media use included all terms used in six prior social media reviews identified in Odgers and Jensen (2020) (i.e., Baker & Algorta, 2016; Best et al., 2014; Huang, 2017; Keles et al., 2020; McCrae et al., 2017; Seabrook et al., 2016), and was supplemented by a list of the current most popular social media sites. Search terms for SITBs were also informed by a prior review (Liu et al., 2019). The following search string was used: (suicid* OR parasuicid* OR self-harm OR NSSI OR self-injur* OR self-cut* OR self-mutilat*) AND (“online forum” or twitch or “online friend” or “net generation” or “digital native” or “generation z” or “web 2.0” or “social media” or msn or “online social network*” or “social network* site” or facebook or twitter or instagram or myspace or youtube or tumblr or reddit or blog* or snapchat or tiktok or wechat or QQ or QZone or cyber* or “online friend*” or “online communit*” or “e?communit*” or blog* or “chat room” or “chatroom” or cyber* or tumblr or pinterest or reddit or bebo or “discussion forum” or “online social support” or “instant messag*” or “text messag*” or texting or texted or whatsapp or sext*). Search results were limited to English-language publications and peer-reviewed journals. This search was supplemented by reviewing references of prior relevant reviews (Dyson et al., 2016; John et al., 2018; Marchant et al., 2017; McCrae et al., 2017; Memon et al., 2018; Robinson et al., 2016; Sedgwick et al., 2019). A total of 1974 records were identified, and 1673 were unique.

Articles were then screened for eligibility independently by two authors, with discrepancies resolved through discussions with the other authors. First, the title and abstract of each article was screened. If eligibility could not be determined based on the title and abstract alone, the full text was reviewed. Study inclusion criteria were: (i) social media use was assessed separately from other constructs (e.g., excluded studies examining overall internet use or examining a combined measure of traditional bullying and cyberbullying); (ii) SITBs were analyzed distinctly from other constructs (e.g., excluded suicide risk composites); (iii) each SITB was distinguished from other aspects of self-harm (i.e., suicidal ideation, suicide attempts, suicide plans, and NSSI); (iv) social media use and SITBs were assessed

systematically; and (v) quantitative data were presented on the association between social media use and SITBs.

Note that social media was broadly defined to include digital tools designed for social interactions, including social networking sites/apps (e.g., Snapchat, Facebook, Instagram), text messaging and messaging apps (e.g., WhatsApp), online forums and communities (e.g., Reddit, forum specifically devoted to suicide), and video sharing sites (e.g., YouTube). Studies examining video games and online gaming sites were excluded, as were studies of online or messaging tools designed specifically for intervention purposes. The corresponding author of a given study was contacted when more information was needed to determine study eligibility or the presence of overlapping samples, and/or when an association between social media use and SITBs was presented in the study but did not report enough data for meta-analysis. Note, however, that if an article contained enough data for meta-analysis on any index of social media use and SITBs, authors were not contacted for further indices of social media use.

Data extraction

For each article, all data were extracted by two authors independently and reviewed for any discrepancies. Discrepancies were resolved in consultation with the senior author. The following study sample characteristics were extracted: (i) mean age of sample; (ii) age group of the sample (adolescent or adult or combined); (iii) percentage of female participants in the sample; and (iv) sample type (i.e., community, at-risk, clinical). The following study design characteristics were extracted: (i) cross-sectional versus longitudinal study; (ii) social media measure; (iv) timeframe covered by social media measure; (v) SITB measure; and (vi) timeframe covered by SITB measure. In cases of multiple studies containing overlapping samples, decisions of which studies to include were based, in descending order, on: (i) adequate data available for meta-analysis; (ii) presence of multiple samples, and thus multiple effect sizes, in a single article (e.g., male/female subgroups); (iii) for cybervictimization studies, presents cybervictimized participants in a single group or provides raw data for combining groups (i.e., combining “cybervictimization only” and “cybervictimization and traditional victimization” groups); and (iv) larger sample size[1].

Data analysis

All analyses were conducted with Comprehensive Meta-Analysis Version 3.3.070 (Biostat, 2014). Odds ratios (OR) were used to calculate the pooled effect size for analyses of potential associations between social media use and SITBs, with OR = 2.0 considered a small effect size, OR = 3.0 considered medium, and OR = 4.0 considered large (Ferguson, 2009). Random-effects models were used for all analyses; in comparison to fixed-effects models, random-effects models account for sampling and study-level error. Random-effects models were used given the high heterogeneity expected across studies due to differences in

[1]One exception to these rules was the use of YRBS 2015 data for the association between cybervictimization and suicide attempt. Although Kim et al. (2018) contained multiple samples, it contained only a continuous measure of suicide attempts. In order to be consistent with all other studies of associations between cybervictimization and suicide attempt, data from Kuehn et al. (2019) was extracted instead given the presence of a dichotomous measure of suicide attempt. Note that when studies with overlapping samples examined different SITBs or different social media constructs, both studies were retained.

design, measures, and samples. Pooled effect sizes were calculated such that values greater than one reflect positive associations between a given social media construct and the presence of a given form of SITB.

Heterogeneity across studies was examined using the I^2 statistic, which represents the percentage of variance in an effect estimate that is due to heterogeneity across studies rather than sampling error. For the current meta-analysis, heterogeneity was calculated only for studies examining cybervictimization, given the small number of effect sizes for analyses of other social media constructs. Significant heterogeneity indicates the need for moderator analyses to determine potential sources of that heterogeneity. The following moderators were examined: mean age of the sample, age group (adolescents versus adults), percentage of female participants in the sample, sample type (community versus at-risk or clinical), cybervictimization measure time frame, cybervictimization measure quality (established measure versus measure created specifically for a given study), SITB measure time frame, and SITB measure quality. These moderators were examined in univariate analyses. Other design quality features were considered (i.e., self-report versus other measurement type, longitudinal versus cross-sectional studies), but the vast majority of studies identified relied on self-report measures and cross-sectional designs, and thus too few studies were available for moderator analysis for these design features.

The presence of publication bias was also assessed only for the pooled effect for associations between cybervictimization and SITBs, given the small number of effect sizes available for other constructs. Funnel plots, Duval and Tweedle's trim-and-fill analysis (Duval & Tweedie, 2000), and Egger's regression intercept (Egger et al., 1997) were used to account for publication bias.

Results

Out of the 1673 unique records identified, a total of 1043 were excluded based on the title and abstract, and the full texts of the remaining 630 articles were reviewed. Of these, 87 articles met all study eligibility criteria. Fourteen of these 87 articles were excluded due to containing samples that overlapped with other studies and provided no new relevant data. In addition, eleven of these 87 articles were excluded from analyses because the social media construct measured did not align with any other articles identified. Social media constructs examined in these excluded studies included: expressing distress online (Chan et al., 2017); language used in Instagram captions (Brown et al., 2019); specific online behaviors and motivations for using social networking sites (Jarvi et al., 2017); having "reliable acquaintances" on the Internet (Katsumata et al., 2008); anxiety about not getting email replies (Katsumata et al., 2008); hurtful experiences online (Katsumata et al., 2008); most frequently used Internet site (social media sites vs. non-interactive sites; Kim et al., 2020); primary use of smartphone (social networking services vs. studying, gaming, or entertainment; Lee et al., 2020); participation in online suicide support communities versus other suicide-related websites (Mok et al., 2016); motivations for using suicide bulletin boards (Sueki & Eichenberg, 2012); meeting partners for sex online (Turban et al., 2017); a measure of cybervictimization *or* cyberbullying perpetration (Duarte et al., 2018); and having Facebook versus not (Teo et al., 2018). Finally, one study was also excluded because

the SITB construct examined (suicide attempt versus NSSI) did not align with constructs examined in other studies (Mars et al., 2015).

Thus, a total of 61 articles were included in quantitative synthesis (see Fig. 1 and Table 1; Appendix for references). Separate estimates of overall effects size were obtained for associations between seven different types of social media use constructs and four different types of SITBs (see Table 2). In addition, for studies examining SITB-related social media use, further analyses were conducted separately examining (i) exposure to SITB-related content and (ii) generating SITB-related content. Note that some of the pooled effect sizes relied on fewer than 3 effects (specified below); such estimates may be unstable and should be interpreted with caution.

Cybervictimization.

The majority of studies identified examined cybervictimization, broadly defined as the experience of being the victim of bullying via any type of social media. A total of 45 unique effects were identified for the association between cybervictimization and suicidal ideation, 25 for suicide attempts, 10 for suicide plans, and 3 for NSSI. Medium to large pooled effect sizes were revealed for cybervictimization in relation to each SITB outcome: suicidal ideation (OR = 2.93, 95% CI 2.43, 3.54), plans (OR = 3.07, 95% CI 2.18, 4.34), attempts (OR = 3.38, 95% 2.59, 4.41), and NSSI (OR = 4.36, 95% CI 2.32, 8.20), suggesting that higher levels of cybervictimization were associated with higher odds of SITBs.

Significant heterogeneity across studies was revealed for suicidal ideation (I^2 = 98.25%, p < .001) and suicide attempts (I^2 = 97.15, p < .001), indicating that moderator analyses were appropriate. Significant heterogeneity was also revealed for NSSI (I^2 = 70.53%, p = .034) and suicide plans (I^2 = 95.44%, p < .001), but there were too few effects (k = 10 and k = 3, respectively) for moderator analyses. For suicide attempts, the following candidate moderators were examined: age as a continuous variable (i.e., mean age for each sample), percentage of female participants in each sample, sample type (clinical or at-risk versus community), time frame covered by cybervictimization measure (three months or less versus greater than three months), and time frame covered by SITB measure (one year or less versus greater than one year). Age as a categorical variable (i.e., adolescents versus adults) was not examined, as only one of the included studies featured an adult sample (see Table 3). For suicidal ideation, the same candidate moderators as for suicide attempts were examined, with two exceptions. First, age as a categorical variable (i.e., adolescents versus adults) was examined due to a sufficient number of studies containing each sample type. Second, sample type (i.e., community, at risk, or clinical) was not examined, as only one included study featured a clinical or at-risk sample (see Table 3).

In univariate moderator analyses, age (as a categorical variable), cybervictimization measure time frame, and suicidal ideation measure time frame moderated the association between cybervictimization and suicidal ideation. Specifically, the association between cybervictimization and suicidal ideation was stronger for studies with adolescent samples (OR = 3.54, 95% CI 2.98, 4.20), compared to adult samples (OR = 1.69, 95% CI 1.36, 2.11). The association was also stronger for studies in which the time frame for assessment of cybervictimization was greater than three months (OR = 3.14, 95% CI 2.63, 3.74) versus

three months or fewer (OR = 1.86, 95% CI 1.41, 2.45), and where the time frame for assessment of suicidal ideation was one year or less (OR = 3.27, 95% CI 2.75, 3.90) versus greater than one year (OR = 1.49, 95% CI 1.08, 2.06). Percentage of female participants in the sample was not a significant moderator, and age as a continuous variable was only marginally significant ($p = .06$).

For suicide attempts, moderator analyses revealed the following significant moderators: sample type and time frame for assessment of suicide attempts. Specifically, the association between cybervictimization and suicide attempts was stronger for community samples (OR = 3.63, 95% CI 2.66, 4.97) than for clinical samples (OR = 2.01, 95% CI 1.83, 2.22), and for studies where the time frame for assessment of suicide attempts was one year or less (OR = 3.89, 95% CI 2.73, 5.56) than for greater than one year (OR = 2.10, 95% CI 1.74, 2.55). Notably, however, only three studies were identified with clinical samples. Thus, these results should be interpreted with caution. Percentage of female participants in the sample was not a significant moderator, nor was age when used as a continuous variable. Time frame for assessment of cybervictimization was only marginally significant ($p = .06$). Meta-regression analysis was not conducted for suicide ideation or attempts outcomes due to multicollinearity between moderator variables, as well as instability of estimates resulting from the small numbers of effects available for each level of the moderators. For example, for the suicide attempts model, one effect size for a clinical sample combined adolescents and adults, and thus could not be included in the multivariate model, leaving only two effects with clinical samples.

The presence of publication bias was examined for associations between cybervictimization and each of suicidal ideation, suicide plans, and suicide attempts. No evidence of publication bias was revealed for the association between cybervictimization and suicidal ideation, based on Egger's regression test (p = .24), trim-and-fill analysis, and the funnel plot (Figure 2a). Similarly, for suicide plans, no evidence of publication bias was revealed in Egger's regression test ($p = 0.4$), trim-and-fill analysis, or the funnel plot (see Figure 2b). For suicide attempts, Egger's regression test yielded no evidence of publication bias ($p = .08$), nor did the funnel plot (Figure 2c). Trim-and-fill analysis indicated negligible evidence of publication bias, as the adjusted effect of cybervictimization on suicide attempts remained unchanged to the hundredth decimal point compared to the observed effect.

Cyberbullying Perpetration.

A smaller number of studies examined the effects of perpetrating cyberbullying on SITBs. Five unique effects were identified for the association between cyberbullying perpetration and suicidal ideation, one for suicide plans, three for suicide attempts, and none for NSSI. Very small effects were observed for the association between cyberbullying perpetration and suicidal ideation (OR = 1.89, 1.54, 2.32), attempts (OR = 1.65, 95% CI 1.25, 2.18), and plans (OR = 1.87, 95% CI 1.41, 2.48).

SITB-Related Social Media Use.

Studies were identified that examined any type of SITB-related social media use, including: (1) posting or talking about SITBs using social media, and (2) exposure to SITB-related

content on social media (e.g., viewing others' posts about suicide). Analyses were run with these two categories combined (i.e., SITB-related social media use), and again with each of these categories analyzed separately. For general SITB-related social media use, five unique effects were identified for each of suicidal ideation and attempts, respectively, three effects for suicide plans, and two effects for NSSI. Medium to large pooled effect sizes were revealed for associations between SITB-related social media use and each of suicidal ideation (OR = 2.79, 95% CI 1.85, 4.21), plans (OR = 3.78, 95% CI 1.90, 7.55), attempts (OR = 3.94, 95% CI 2.20, 7.07), and NSSI (OR = 2.98, 95% CI 1.46, 6.11).

For analyses of studies looking specifically at posting or talking about SITBs (e.g., talking about suicide in forums, posting about suicide on Twitter), three effects were identified for associations with suicidal ideation, two for suicide plans, three for suicide attempts, and one for NSSI. Medium to large effects were revealed for suicidal ideation (OR = 3.96, 95% CI 2.75, 5.71), plans (OR = 5.95, 95% CI 2.27, 15.55), and attempts (OR = 4.59, 95% CI 1.83, 11.53), with small effects for NSSI (OR = 2.45, 95% CI 0.49, 12.37).

Note that one study (Sueki et al., 2015) had very large effect sizes for associations between posting suicidal tweets and suicide attempts (OR = 22.83, 95% CI 6.75, 77.246) and plans (OR = 10.18, 95% CI 5.54, 18.69). These effects may be outliers, and thus analyses were re-conducted with these effects removed. Pooled effect sizes remained small to medium for associations between overall SITB-related social media use and each of suicide attempts (OR = 2.92, 95% CI 1.78, 4.78) and suicide plans (OR = 2.64, 95% CI 1.89, 3.68). For studies examining posting or talking about SITBs, pooled effects also remained small to medium for associations with suicide plans (OR = 2.96, 95% CI 2.53, 3.46) and suicide attempts (OR = 2.81, 95% CI 1.11, 7.14).

For analyses looking at exposure to SITB-related content on social media (e.g., exposure to self-harm images, learning about others' suicides via social media), three unique effects were identified for associations with suicidal ideation, two for suicide plans, three for suicide attempts, and one for NSSI. Effect sizes were small to medium for associations between exposure to SITB content and ideation (OR = 2.12, 95% OR 1.31, 3.43), plans (OR = 2.28, 95% CI 1.99, 2.61), attempts (OR = 2.93, 95% CI, 1.96, 4.39), and NSSI (OR = 3.13, 95% CI 1.41, 6.96).

Frequency of Social Media Use.

A small number of studies examined frequency of social media use, including six unique effects for associations with suicidal ideation, two for suicide plans, three for NSSI, and none for suicide attempts. Effects of social media use frequency were not significant for associations with suicidal ideation (OR = 1.45, 95% CI 0.95, 2.23), plans (OR = 1.47, 95% CI 0.33, 6.43), nor NSSI (OR = 2.03, 95% CI 0.79, 5.21), with pooled effect sizes generally in the very small to small range.

Problematic Social Media Use.

Four unique effects were identified for associations between problematic use of social media and suicidal ideation. No studies were identified examining associations between

problematic use and suicide plans, attempts, nor NSSI. Results suggest a small to medium effect for the association with suicidal ideation (OR = 2.81, 95% CI 1.72, 4.59).

Sexting.

A very small number of effects were identified for associations between sexting and SITBs: two for suicidal ideation, one for suicide attempts, two for NSSI, and none for suicide plans. The pooled effect size for the association between sexting and suicidal ideation was not significant (OR = 2.37, 95% CI 0.98, 5.73). Larger effect sizes were revealed for suicide attempts (OR = 4.24, 95% CI 3.13, 5.44) and NSSI (OR = 3.07, 95% CI 2.53, 3.74). However, the small number of effects identified requires caution in interpreting these results.

Importance of Social Media.

Two studies (three unique effects) examined the importance that individuals place on social media in their lives. Total number of effects for importance of social media and SITBs were: three for suicidal ideation, two for suicide plans, two for NSSI, none for suicide attempts. Pooled effects were not significant for the association with suicidal ideation (OR = 1.05, 95% CI 0.96, 1.15) nor suicide plans (OR = 1.02, 95% CI 0.71, 1.49). A very small effect size was revealed for associations with NSSI (OR = 1.25, 95% CI 1.06, 1.47).

Discussion

There has been considerable debate surrounding potential associations between social media use and mental health outcomes, including SITBs, with much of the emphasis on overall frequency of social media use. However, to date, no comprehensive, quantitative synthesis of the empirical literature on this topic has been available. This systematic and meta-analytic review assessed relations between various social media behaviors and experiences and SITBs (suicidal ideation, plans, attempts, and NSSI) across the lifespan. Results were generally consistent in suggesting significant, positive associations with SITBs for most of the social media constructs examined (i.e., cybervictimization, cyberbullying perpetration, SITB-related social media use, problematic use, and sexting), though effect sizes and number of studies identified varied considerably among these constructs. Notably, no significant associations were identified between frequency of social media use and suicidal ideation, plans, nor NSSI. However, only a limited number of studies were identified examining these associations. Results highlight the importance of investigating a range of specific social media behaviors and experiences in relation to SITBs, and the critical need for more research in this area.

Cybervictimization and cyberbullying

Findings support a robust association between cybervictimization and SITBs. With a total of 83 unique effects analyzed across SITB outcomes, a medium effect size was identified for cybervictimization's association with each of suicidal ideation, plans, and attempt, and NSSI. These findings are in line with prior meta-analyses focused on the association between cybervictimization and SITBs (John et al., 2018; Kowalski et al., 2014), and expand on these reviews through an up-to-date analysis of studies of both youth and adults. Results

underscore that this specific social media experience may play an important role in risk for SITBs.

The current findings also build substantively on prior meta-analyses, in that a sufficient number of studies were included in this review to conduct moderator analyses for cybervictimization effects. Notably, moderator analyses for associations between cybervictimization and suicidal ideation suggested that the effects were stronger among adolescents compared to adults. This is the first meta-analysis to empirically test and support this assertion in relation to suicidal ideation. Adolescence is characterized by heightened focus and time spent on peer relationships (e.g., Brown & Larson, 2009; Rudolph, 2014) and sensitivity to social evaluation and rejection (e.g., Somerville, 2013). Cybervictimization may, thus, represent a particularly challenging experience for adolescents, compared to adults. Indeed, interpersonal theories of suicide (Van Orden et al., 2010) highlight the critical role that social and peer factors may play in adolescents' risk for STIBs, perhaps more so than for adults (Stewart et al., 2017).

Contrary to prior work suggesting that the impact of specific social media use patterns and experiences may be stronger among females compared to males (Kelly et al., 2018; Nesi & Prinstein, 2015; Twenge & Farley, 2020), the current findings did not support a moderating effect of sex on the association between cybervictimization and suicidal ideation nor attempts. It may be the case that the mental health effects of cybervictimization do not differ for females versus males, whereas those of other social media behaviors and experiences do. Further, it may be that the strength of associations between cybervictimization and SITBs does not differ between males and females, but that females are simply more likely to experience cybervictimization (Beckman et al., 2013; Hamm et al., 2015). Alternatively, the null result for sex as a moderator may be due to analyses being conducted at the study level rather than participant level, and the latter would offer a more sensitive test of potential sex differences. Future research is needed to differentiate between these possibilities, and to investigate whether sex moderates associations between a variety of social media experiences and SITBs.

Other moderation effects should be interpreted with a degree of caution, given the small number of effects available for some moderator variables. For suicide ideation as an outcome, associations with cybervictimization were stronger across shorter SITB assessment timeframes, and across longer cybervictimization timeframes. Future studies are needed examining both short- (i.e., momentary) and long-term associations between cybervictimization and SITBs. However, it is possible that the experience of cybervictimization is better conceptualized as a short-term or even proximal predictor of SITBs. In addition, sample type was found to moderate associations between cybervictimization and suicide attempt, such that effects were stronger for community samples versus clinical or at-risk samples. Interpersonal stress, including victimization, are common among clinical and at-risk samples. Thus, it is possible that effects of cyberbullying are weaker in these samples due to lesser variability. More research is needed, with a greater variety of sample types, to clarify the nature of these effects.

Although far fewer studies have examined the association between cyberbullying *perpetration* and SITBs, findings suggest small or very small positive associations between this social media behavior and suicidal ideation, plans, and attempts. Notably, these effects were significantly smaller than those for cybervictimization, as evidenced by the fact that confidence intervals (for effects on suicidal ideation and attempts) did not overlap. These findings are consistent with those of past reviews (e.g., John et al., 2018). Of note, prior literature suggests that cyberbullying perpetration and cybervictimization often co-occur (Festl et al., 2017). Thus, it remains unclear whether this association may be an artifact of such co-occurrence.

SITB-related social media use

Both exposure to and generation of SITB-related content on social media evidenced medium to large associations with NSSI, suicidal ideation, plans, and behavior. These effects were revealed both when examining all effects pooled into a single estimate of SITB-related social media use, and when separately examining exposure to SITB-related content (e.g., viewing others' content related to SITB, learning about suicides via social media) and generation of SITB-related content (i.e., posting or talking about SITBs via social media). Effects for the generation of SITB content were medium to large, whereas effects for exposure to SITB content were small to medium. However, differences between these two effects (i.e., generation versus exposure) should be interpreted cautiously due to the relatively low number of effects identified.

These results may be interpreted in light of theories of both peer and media effects. Individuals' own engagement in SITBs, particularly among adolescents, may be influenced by the self-injurious behavior of their peers, with selection and socialization effects playing a role (Heilbron & Prinstein, 2008; Insel & Gould, 2008). Similarly, media effects theories have highlighted the possibility of SITB contagion effects via exposure to digital SITB-related content (Niederkrotenthaler & Stack, 2017). Individuals' engagement with SITB-related content on social media – that they both generate and consume – may have an important role in reinforcing offline suicide and self-injury risk. Given the likely bidirectional associations between exposure to and generation of SITB content and the experience of SITBs themselves (Arendt et al., 2019), longitudinal and experimental research designed to disentangle this association is needed. Notably, although one longitudinal study identified in this review supported a prospective relationship between SITB-content exposure and generation and SITBs (Arendt et al., 2019), too few prospective studies were identified to estimate pooled effects.

Other social media behaviors and experiences

Fewer studies were identified examining other social media behaviors and experiences: sexting, importance placed on social media, and problematic social media use. Given the small number of effects, results should be interpreted cautiously, and overall, point to the need for significantly more research in these areas. Findings suggest that sexting was associated with suicide attempts and NSSI, though not suicidal ideation, in line with findings from a recent meta-analysis demonstrating associations between sexting and both internalizing and externalizing symptomatology (Mori et al., 2019). However, only one

effect size was identified for suicide attempts and two for suicidal ideation and NSSI; thus, these estimates may be unstable. Mixed findings were revealed for the relation between reported importance of social media and SITBs, with a significant, albeit very small, pooled effects only for its association with NSSI. While some prior studies have found that individuals' investment in or concern about social media may be associated with internalizing symptoms (Rideout & Fox, 2018), others suggest that valuing social media as important is normative, particularly for adolescents (Rideout & Robb, 2018).

Although based on a small number of studies, our findings suggest that problematic social media use is associated with suicidal ideation, with a small to medium effect. As noted in a recent theoretical review of social media addiction (Sun & Zhang, 2020), the manner in which problematic social media use is operationalized varies widely in the literature. The field has been plagued by numerous methodological and conceptual issues in this area, including frequent conflation of "addictive" social media use with simply higher frequencies of use, as well as the failure to disentangle problematic internet use from social media use, specifically. Although our analyses excluded studies that did not distinguish between social media and general internet use, variability in definitions across the small sample of studies in this domain underscores the preliminary nature of findings. Future research that investigates problematic patterns of social media use and their association with SITBs is warranted, in order to inform intervention.

Frequency of social media use

Although significant associations were revealed between the majority of social media constructs investigated and SITBs, no evidence was found of significant associations between frequency of social media use and SITBs. Notably, although 11 total effects were identified, these effects emerged from only six studies, and examine associations with only suicidal ideation, suicide plans, and NSSI; no studies examined the association between frequency of social media use and suicide attempts. Furthermore, it should be noted that these studies examined a range of frequency measures, including continuous measures of average hours spent per day (e.g., Berryman et al., 2018) and categorical measures with different "cut-points," including 2 hours of social media use per day (Sampasa-Kanyinga & Lewis, 2015) and 30 minutes of "online chatting" per day (Tseng & Yang, 2015).

Findings of this review reveal the nascent state of the literature on the topic of frequency of social media use and SITBs. Although preliminary evidence suggests a lack of an association between frequency of social media use and SITBs, more research is needed before definitive conclusions can be drawn. Also notable is that all studies included in the current review that assessed social media use frequency relied on retrospective self-report. Research employing objective metrics of frequency of social media use (Gower & Moreno, 2018) is necessary to more rigorously examine this association, especially given a recent meta-analysis finding only moderate correlations between self-report and device-logged measurements of time spent on digital media (Parry et al., 2020). Nevertheless, preliminary findings suggest that the amount of time individuals spend on social media may be less relevant for SITB risk than the specific stressors experienced and the patterns of behavior in which they are engaged online.

Limitations and Future Directions

Although the current meta-analysis represents the most comprehensive review to date on social media and SITBs across the lifespan, it also reveals a number of limitations in the current literature. Most notably, this review highlights the paucity of research on social media factors beyond cybervictimization and their relations to SITBs. This was particularly surprising in the case of social media use frequency, given ongoing debate regarding associations between social media use time and risk for SITBs. Such limited numbers of studies in certain domains of social media use – particularly sexting and importance of social media use – render any conclusions in these areas tenuous. Further research on SITB-related social media use, frequency (especially in relation to suicide attempts, on which there was no data), problematic use, and sexting, and their relation to SITBs would increase confidence in the stability of effects reported here. In addition to revealing the limited quantity of research in this area, this review highlights the many methodological shortcomings of prior research on social media use and SITBs. These include reliance on cross-sectional methods, a preponderance of self-report studies, and lack of clarity in defining various social media constructs.

The lack of research on aspects of social media use beyond cybervictimization prevented examination of moderators of relations between other social media use constructs and SITBs. Thus, it is not yet known whether the strength of these associations differs based on age, sex, sample type, or time frame of construct assessed. Other potential moderators, for which data was not available in the current review, should also be considered in future work, such as sampling strategy and social media platform examined. Although the current study found no differences in associations between cybervictimization and either suicidal ideation or attempts based on sex, many studies did not specify whether reports of the demographic makeup of the sample were based on participants' gender or sex. Additional research is therefore needed on the relation between social media and SITBs for individuals of a range of gender identities. This is particularly true given recent evidence that gender minority individuals may be at greater risk for negative effects of SITB-related social media use (Nesi et al., 2021), but also may rely more heavily on online social support (Selkie et al., 2020).

Moreover, given the problematic nature of pooling study effects when race and ethnicity were assessed in different ways across studies, and the limited number of studies available that presented data across a range of racial and ethnic groups, race and ethnicity were not assessed as moderators in this review. It will be important for future studies to recruit diverse samples, and to clearly and consistently assess effects across racial and ethnic groups. Examination of the association between social media constructs and SITBs by developmental stage was limited to comparisons between adolescents and adults, broadly defined, with no studies of older adults or children identified. Future work should examine how social media use impacts individuals differently across development.

The methods used in the reviewed studies primarily relied on self-report measures that are inherently limited in their ability to provide objective and corroborated data. In moderator analyses, we explored the quality of measures used in studies of cybervictimization and suicide ideation and attempts. Studies that used study-specific measures (i.e., those generated for a given study) were compared with those using more standard measures (i.e.,

previously used or validated measures, including items drawn from established national surveys like the Youth Risk Behavior Surveillance System). Although no differences in effects were identified, future research is needed to examine other indicators of study and measure quality (e.g., interview versus self-report, peer or parent observation versus self-report), for which too few studies were identified in the current review. Furthermore, recent studies have included data extraction techniques for collecting and analyzing social media data (e.g., natural language processing, deep learning) directly from online platforms. In this review, studies were excluded if they assumed the presence of SITB based solely on observed social media data. Two studies were identified that included a self-report or interview measure of SITBs, in combination with an observed measure of social media use via social media data (i.e., Brown et al., 2019; Glenn et al., 2020). However, these studies were excluded because the social media constructs measured could not meaningfully be combined with those of other studies. Thus, future, multi-method work on this topic, which incorporates objective social media data, is needed.

The majority of studies identified in this review used cross-sectional assessments that limit the examination of longitudinal and dynamic processes. Additional prospective studies are needed to understand the potential causal nature of the relationship between social media use and SITBs. It may be that engaging in maladaptive social media use increases individuals' distress and feelings of isolation or burdensomeness, increasing risk for SITBs or alternatively, that individuals who engage in SITBs engage with social media in more problematic ways. The use of ecologically valid methods to assess social media use and the experience of SITBs may be one way to glean important information about these associations in real-time. In turn, such research could present promising opportunities for developing and testing digitally delivered interventions for the prevention of SITBs (Melia et al., 2020).

Finally, until the field accumulates further evidence to draw firm conclusions, research study designs should reflect a perspective that is agnostic as to whether social media use is helpful or harmful. For example, emerging evidence suggests that social media can be used as a coping strategy or to obtain social support for those in crisis (Dodemaide et al., 2019; Lavis & Winter, 2020), yet these protective factors have not been explored in detail, or in relation to SITBs. Benefits of social media use may include opportunities for enacting coping strategies, developing and maintaining friendships, improving self-esteem, exploring one's identity, increasing social support, and engaging in adaptive self-disclosure (Uhls et al., 2017). Research is needed examining whether these positive social media uses are protective against SITBs, especially in considering social media as a potential tool for prevention or intervention delivery.

Clinical Implications

Overall, results suggest that specific social media behaviors and experiences may be particularly relevant for understanding SITB risk in the context of social media use. Although preliminary, findings support assessment, education, and intervention related to social media use in SITB prevention and treatment efforts. As the results suggest a positive association between cybervictimization and SITBs, future research aimed at intervening

upon cyberbullying behaviors (for perpetrators) and coping with these effects (for cybervictims), is warranted. Since the association between cybervictimization and suicidal ideation was strongest among adolescents, efforts should be focused on providing psychoeducation and intervention strategies to youth and their parents. For adolescents experiencing cybervictimization, effective coping could entail distracting via pleasant activities, seeking social support, and disengaging from online sites/activities where cyberbullying is likely. Intervention efforts targeting in-the-moment behavior and coping may be particularly important, including via leveraging technology or apps to access skills/strategies, or developing coping plans in preparation for high-risk scenarios.

Furthermore, interventions should prioritize specific online behaviors and stressors (e.g., cybervictimization and perpetration, SITB-related content access or generation), as these were more consistently and strongly associated with SITBs than length of time spent online. Clinical efforts with youth and adults should assess the frequency and function of patients' SITB-related engagement on social media, including posting, talking about, and viewing content related to SITBs. Although future research is needed to better understand intricacies of the relation between indices of social media use and SITBs, findings highlight the importance of assessing, monitoring, and intervening in the social media use, especially for youth and their families.

Conclusions

Despite recent concerns over the role of social media on SITBs, no comprehensive meta-analytic review has previously examined associations between social media use and SITBs across the lifespan. The current systematic review and meta-analysis suggests robust associations of SITBs with cybervictimization. Furthermore, albeit drawing on a fewer number of unique effects, findings suggest associations of SITBs with cyberbullying perpetration, generation and exposure to SITB-related social media content, problematic use, and sexting. Notably, no evidence emerged for associations between frequency of social media use and SITBs. Overall, findings suggest the importance of examining specific social media behaviors and experience in relation to SITBs, and highlight the need for significantly more research in this critical area.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Associations between social media use and SITBs were reviewed and meta-analyzed
- Social media constructs included SITB-related use, frequency, problematic use
- SITBs examined were suicidal ideation, attempts, plans, and NSSI
- Findings support robust associations between cybervictimization and SITBs
- No evidence emerged for association between frequency of social media use and SITBs

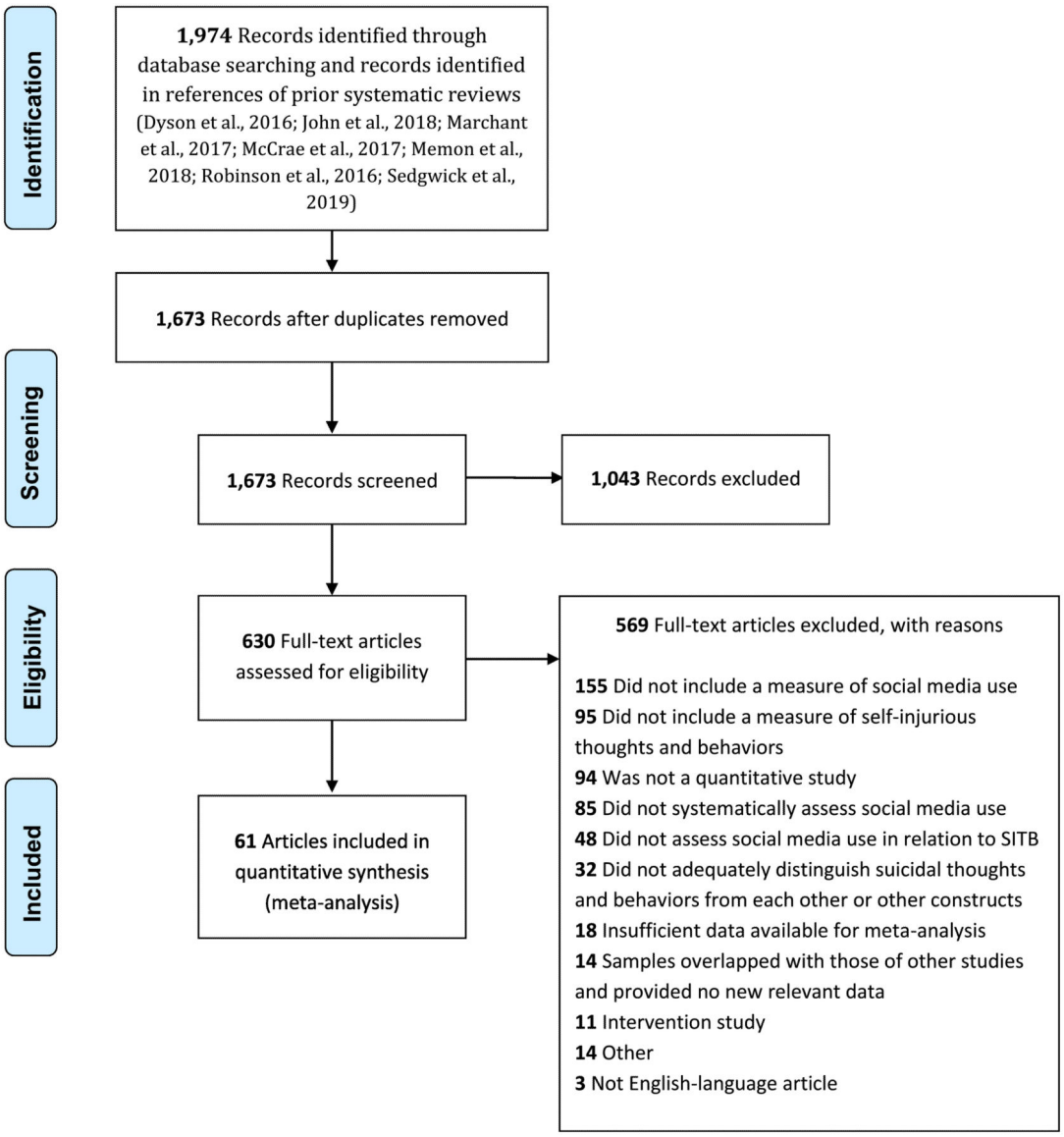
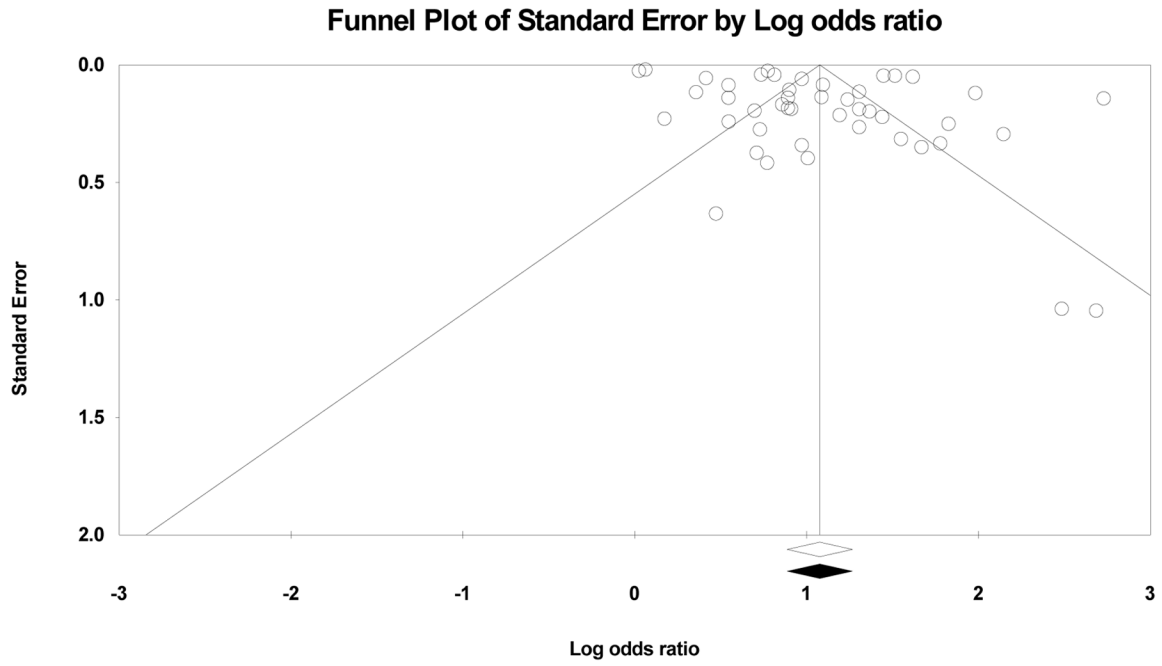
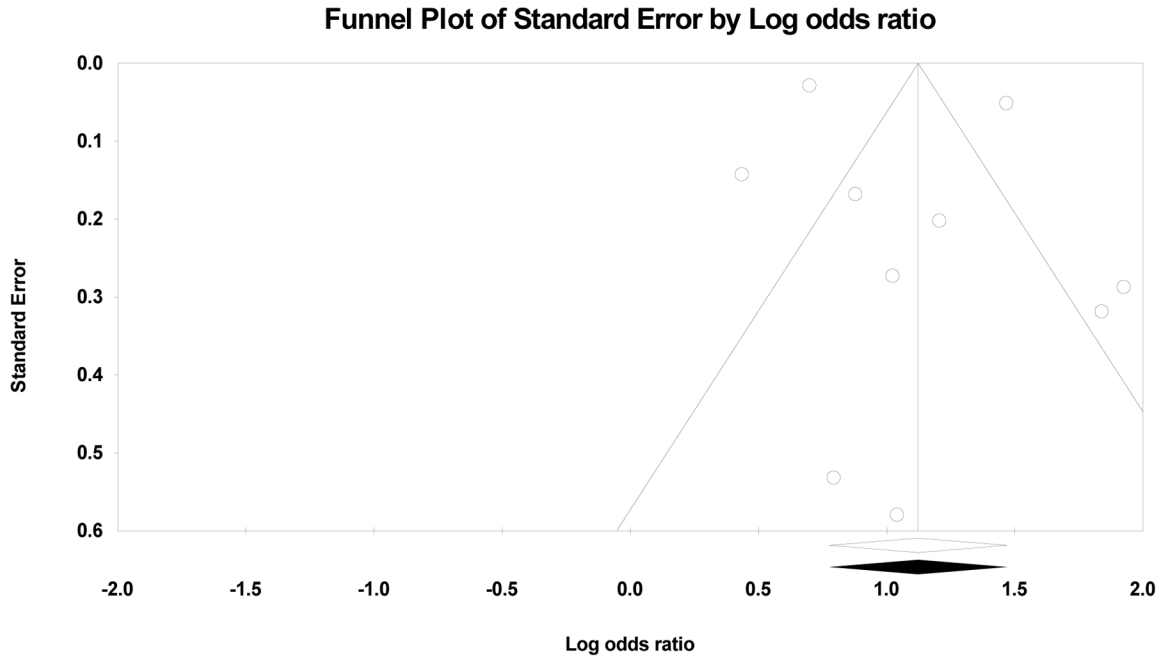


Figure 1.
PRISMA flow chart of literature search





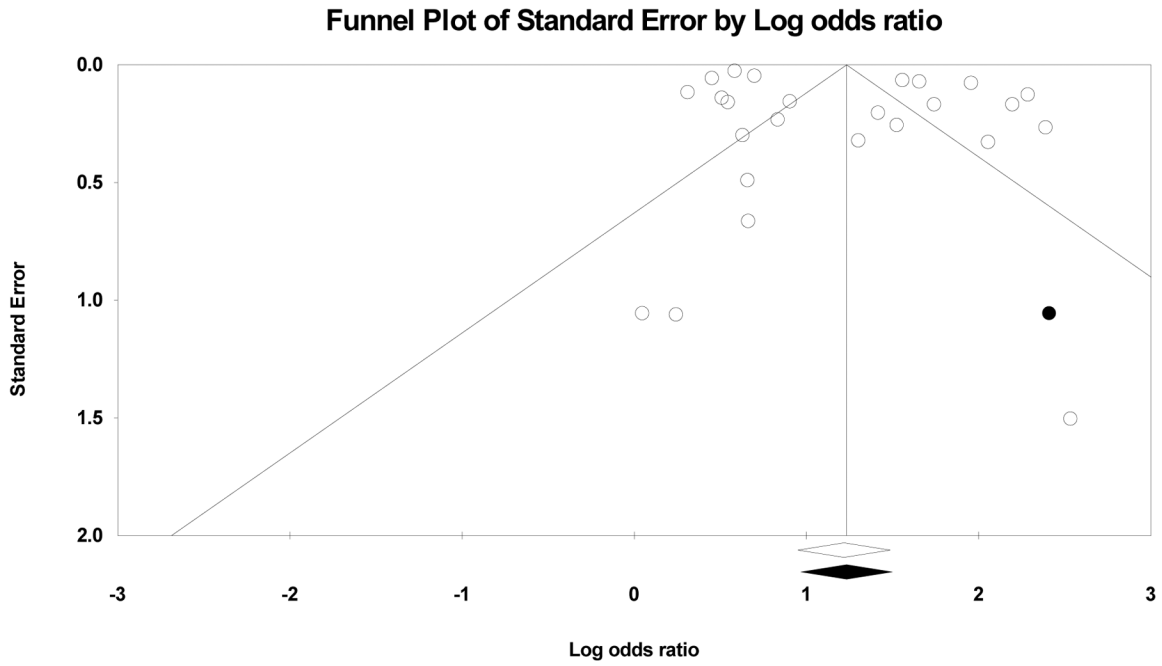


Figure 2.

Funnel plots for effect sizes in the meta-analyses. Vertical line indicates the weighted mean effect. Open circles indicate observed effects for actual studies, and closed circles indicate imputed effects for studies believed to be missing due to publication bias. The clear diamond reflects the unadjusted weighted mean effect size, and the black diamond reflects the weighted mean effect size after adjusting for publication bias. There is no indication of a publication bias for the associations between cybervictimization and suicidal ideation (2a) cybervictimization and suicide plans (2b) or cybervictimization and suicide attempts (2c).

Table 1.

Study characteristics

Study Author(s) (year)	N	% Female	Mean Age	Sample Type	Age Category	Country	Design Type	Social Media Use			Self-Injurious Thoughts and Behaviors		
								Predictor(s)	Measure(s)	Time Frame	Outcome(s)	Measure(s)	Time Frame
Alhajji et al. (2019)[1]	1546 5	–	–	community	T	US	CS	cybervictimization	2015 YRBS	lifetime	SI, SP	2015 YRBS	1Y
Arat (2015)	1056 3	48.6	13.5	community	T	US	CS	cybervictimization	2013 YRBS	1Y	SI	2013 YRBS	1Y
Arendt et al. (2019)	594	82.3	24.2	community	A	US	L6	SITB-related use	SSM	lifetime	SI, SP	SSM	lifetime
Baiden et al. (2019a)[2]	1365 9	51.8	–	community	T	US	CS	cybervictimization	2017 YRBS	1Y	SI	2017 YRBS	1Y
Baiden et al. (2019b)[2]	1454 7	50.5	–	community	T	US	CS	cybervictimization	2017 YRBS	1Y	SA	2017 YRBS	1Y
Berryman et al. (2018)	467	71.7	19.7	community	A	US	CS	importance, frequency	SMUIS SSM	–	SI	BSI	1W
Bonanno & Hymel (2013)	399	57.1	14.2	community	T	Canada	CS	cybervictimization cyberbullying	SSM	1Y	SI	SIQJR	1M
Cenat et al. (2015)	8194	56.3	15.4	community	TA	Canada	CS	cybervictimization	SSM	1Y	SI	SSM	lifetime
Cenat et al. (2019)	4626	80.1	20.1	community	TA	Canada	CS	cybervictimization	SSM	1Y	SI, SA	SSM	6M
Chang et al. (2019)	3522	43.8	15.3	community	T	China	CS	cybervictimization	YSS 2016	1Y	SI	YSS 2016	1Y
Cheng et al. (2015)	989	38.3	24.2	community	A	China	CS	SITB-related use frequency	SSM	–	SI	SPS	–
Corcoran & Andover (2020)	155	–	–	at-risk	A	US	CS	SITB-related use	SSM	lifetime	NSSI	ISAS	lifetime
Dunlop et al. (2011)	719	51	–	community	TA	US	[L]	SITB-related use	SSM	–	SI	SSM	1Y
Duong & Bradshaw (2014)	951	69.5	–	community	T	US	CS	cybervictimization	YRBS 2009	1Y	SA	YRBS 2009	1Y
Elgar et al. (2014)	1883 4	50.7	15	community	T	US	CS	cybervictimization	SSM	1Y	SI, SA	SSM	1M
Frankel et al. (2018)	6021	49.3	–	community	T	US	CS	sexting	YRBS 2015	1M	SA, NSSI	YRBS 2015	1Y
Fredrick et al. (2018)	403	50.5	–	community	T	US	CS	cybervictimization	CBVS	2–3M	SI	SIQJR	1M
Gracia-Leiva et al. (2020)	1195	100	18.8	community	TA	Spain	CS	cybervictimization	SDAQ	1Y	SI, SA	Spanis h SRS	lifetime

Study Author(s) (year)	N	% Female	Mean Age	Sample Type	Age Category	Country	Design Type	Social Media Use		Self-Injurious Thoughts and Behaviors			
								Predictor(s)	Measure(s)	Time Frame	Outcome(s)	Measure(s)	Time Frame
Han et al. (2018)	3675	51.8	–	community	T	China	CS	cybervictimization	SSOCS	1Y	SI, SA	YRBS	1Y
Hay et al. (2010)	411	50.9	15.0	community	T	US	CS	cybervictimization	SSM	1Y	SI, NSSI	SSM	–
Iranzo et al. (2019)	1062	48.5	14.5	community	T	Spain	CS	cybervictimization	CYBVIC	1Y	SI	SIS	1W
Jasso-Medrano et al. (2018a)[3]	374	58.6	20.0	community	A	Mexico	CS	frequency problematic use	SSM	–	SI	PANSI	2W
Jasso-Medrano et al. (2018b)[3]	303	59.1	19.7	community	A	Mexico	CS	sexting cybervictimization	CBQ-V SQ	–	SI	PANSI	2W
Khine et al. (2020)	412	32.8	–	community	A	Myan mar	CS	cybervictimization	SSM	1Y	SI	SSM	1Y
Khuzwayo et al. (2018)	1659	50.7	–	community	T	South Africa	CS	cybervictimization	YRBS	–	SA, SP	YRBS	1Y
Kim et al. (2019)[4]	4940	56.7	15.0	community	T	Canada	CS	cybervictimization	2013 OSDUHS	1Y	SI	2013 OSDUHS	1Y
Kodish et al. (2016)	5429	56.5	16.8	at-risk	TA	US	CS	cybervictimization	BHS	lifetime	SA	BHS	lifetime
Kowalski et al. (2018)	230	48.5	19.3	community + at-risk	TA	US	CS	cybervictimization	SSM	lifetime	SI	SSM	–
Kowalski et al. (2020)	392	52.0	25.8	community	A	US	CS	cybervictimization	SSM	lifetime	SI	BYDI	–
Kuehn et al. (2019)[1]	10404	33.8	–	community	T	US	CS	cybervictimization	2015 YRBS	1Y	SA	2015 YRBS	1Y
Liu et al. (2020)	569	86.3	21.9	at-risk	A	China	CS	SITB-related use	SSM	1Y	SI, SA	Adult SIQ	lifetime
Lucas-Molina et al. (2018)	1664	53	16.l	community	TA	Spain	CS	cybervictimization	CBQ	2M	SI	PSS	1Y
Martinez-Monteagudo et al. (2020)	1282	53.7	–	community	A	Spain	CS	cybervictimization	ECIP Q	2M	SI	SS	lifetime
Mérelle et al. (2017)	21053	50.6	14.4	community	T	Neth erlands	CS	problematic use	CIUS	–	SI	SSM	1Y
Mitchell et al. (2017)	687	–	–	community	TA	US	CS	cybervictimization	SSM	1Y	SI	TSC	1M
Mitchell et al. (2018)	348	56.6	20.1	community	A	US	CS	cybervictimization	RBQ M	–	SI	PNSII	2W
Nesi et al. (2019)	433	61.7	14.6	clinical	T	US	CS	cybervictimization SITB-related use	SSM	2W	SA	SITBISR	lifetime
Nguyen et al. (2020)	648	47.7	11	community	T	Viet man	CS	cybervictimization	SSM	30D	SI, SP, SA	YRBS	1Y

Study Author(s) (year)	N	% Female	Mean Age	Sample Type	Age Category	Country	Design Type	Social Media Use		Self-Injurious Thoughts and Behaviors			
								Predictor(s)	Measure(s)	Time Frame	Outcome(s)	Measure(s)	Time Frame
Peng et al. (2019)	2271	51.2	13.6	community	T	China	CS	cybervictimization	SSM	6M	SA, SI	SSM	–
Quintana-Orts et al. (2020)	1821	52.4	14.5	community	T	Spain	CS	cybervictimization	ECIP Q	2M	SI	FSII	1Y
Reed et al. (2015)	15425	50.4	16.1	community	T	US	CS	cybervictimization	2011 YRBS	1Y	SI, SP, SA	2011 YRBS	1Y
Reed et al. (2019)	138	100	17	community	T	US	CS	cybervictimization	SSM	lifetime	SI	SSM	1Y
Romero et al. (2013)	650	100	–	community	T	US	CS	cybervictimization cyberbullying	2009 AZYRBS	1Y	SI, SP, SA	2009 AZYRBS	–
Sampasa-Kanyinga & Lewis (2015)[4]	753	48.5	15.0	community	T	Canada	CS	frequency	2013 OSDUHS	–	SI	2013 OSDUHS	1Y
Sampasa-Kanyiga et al. (2014)	2999	55.3	14.3	community	T	Canada	CS	cybervictimization	2011 EOYRBS	1Y	SI, SP, SA	2011 EOYRBS	1Y
Sampasa-Kanyiga et al. (2018)[4]	5478	47.8	15.2	community	T	Canada	CS	cybervictimization	2013 OSDUHS	1Y	SA	2013 OSDUHS	1Y
Schenk et al. (2012)[5]	138	72.5	–	community	A	US	CS	cybervictimization	IEQ	–	SI, SP, SA	SBQ-R	–
Schenk et al. (2013)[5]	155	57.0	19.8	community	A	US	CS	cyberbullying	IEQ	–	SI	SBQ-R	–
Schneider et al. (2012)	16746	51.0	–	community	T	US	CS	cybervictimization	MAHS	1Y	SI, SA	MAHS	1Y
Sueki et al. (2015)	1000	61.3	24.9	community	A	Japan	CS	SITB-related use	SSM	–	SI, SP, SA	SSM	lifetime
Swedo et al. (2020)	9733	50.3	–	community	T	US	CS	SITB-related use	SSM	–	SP, SA	SBQ-R	9–10M
Tseng & Yang (2015)	391	54.7	–	community	T	China	CS	importance frequency	SSM	–	SI, SP, NSSI	SITBI	1Y
Turban et al. (2020)	283	30.4	35.1	community	A	US	[L]	sexting	SSM	lifetime	SI	PRIM E-MD	lifetime
Turner et al. (2013)	1874	51.0	13.8	community	T	US	CS	cybervictimization	SSM	<6M	SI or plan	SSM	1Y
Vente et al. (2020)	179	67.0	18.6	community	TA	US	CS	frequency sexting	SSM	–	NSSI	SSM	–
Walburg et al. (2016)	246	59.3	16.5	community	T	France	CS	problematic use	SSM	–	SI	CES-D	1W
Wang et al. (2019)	1759	53.3	–	community	TA	Taiwan	CS	cybervictimization	SSM	2M	SI	SSM	1M

Study Author(s) (year)	N	% Female	Mean Age	Sample Type	Age Category	Country	Design Type	Social Media Use			Self-Injurious Thoughts and Behaviors		
								Predictor(s)	Measure(s)	Time Frame	Outcome(s)	Measure(s)	Time Frame
Wiguna et al. (2018)	28 60	54.7	–	community	T	Indonesia	CS	cybervictimization cyberbullying	SSM	6M	SI, SA	SSM	–
Wright et al. (2020)	12 1	37.0	14.1	at-risk	T	US	L[6]	cybervictimization	SSM	<9M	SI, NSSI	SHI	lifetime
Zaborskis et al. (2019)	16 28	47.7	15.6	community	T	Lithuania	CS	cybervictimization	HBSC 2013	<6M	SI, SP, SA	HBSC 2013	1Y
Zhu et al. (2016)	90	80.0	14.6	clinical	T	US	CS	SITB-related use	SSM	–	NSSI	SSM	lifetime

Note: Social media predictors examined included: cybervictimization, cyberbullying perpetration, problematic social media use, self-injurious thoughts and behavior (SITB)-related social media use, sexting, frequency of social media use, and importance of social media; AZYRBS = Arizona Youth Risk Behavior Surveillance System; BHS = Behavioral Health Screening; BSI = Brief Symptoms Inventory; BYDI = Beck Youth Depression Inventory; CBQ = The Cyberbullying Questionnaire; CBQ-V = Cyberbullying Victimization Questionnaire; CBVS = Cyberbullying and Victimization Survey; CES-D = Center for Epidemiological Studies Depression Scale; CIUS = Compulsive Internet Use Scale; CYBVIC = Adolescent Victimization through Mobile Phone and Internet Scale; EOYRBS = Eastern Ontario Youth Risk Behaviour Survey; ECIPQ = European Cyberbullying Intervention Project Questionnaire; FSII = Frequency of Suicidal Ideation Inventory; IEQ = Internet Experiences Questionnaire; HBSC = Health Behavior in School-aged Children Survey; MAHS = Metrowest Adolescent Health Survey; OSDUHS = Ontario Student Drug Use and Mental Health Survey; PRIME-MD = Primary Care Evaluation of Mental Disorders Patient Questionnaire;

PSS = Paykel Suicide Scale; PANSI = Positive and Negative Suicidal Ideation Inventory; RBQM = Retrospective Bullying Questionnaire Modified; SBQ-R = Suicidal Behaviors Questionnaire-Revised; SDAQ = Cyber Dating Abuse Questionnaire; SHI = Self-Harm Inventory; SIS = Suicide Ideation Scale; SME = Media Experiences; SMUIS = Social Media Use Integration Scale; SPS= Suicide Probability Scale; SQ = Sexting Questionnaire; SRS = Suicide Risk Scale; SS = Suicidality Scale; SSM= study-specific measure; SSOCS = School Survey on Crime and Safety; TSC = Trauma Symptom Checklist; YRBS = Youth Risk Behavior Surveillance System; YSS = Youth Sexuality Survey

Other abbreviations: T = Teenager, A = Adult, TA = combined Teen and Adult sample; W = Week; M = Month; Y = Year; D = day; SI = suicidal ideation, SP = suicide plan(s), SI = suicide attempt(s), NSSI = nonsuicidal self-injury; CS = Cross-Sectional; L = Longitudinal; [L] = Study employed a longitudinal design but only cross-sectional data on the association between social media use and SITB were available for analysis

*1–5*Studies with identical superscripts were drawn from same or overlapping samples but presented unique data included in this review.

*6*Both longitudinal and cross-sectional data were available, but cross-sectional data were included in final analyses for consistency with other studies and as there were too few cases with longitudinal data for meta-analysis.

Table 2.

Associations between social media use variables and self-injurious thoughts and behaviors.

			Effect Size Analyses		
	k	**N**	**OR**	**95% CI**	***p***
Cybervictimization					
Suicidal Ideation	45	135,424	2.93	2.43 – 3.54	<.001
Suicide Plans	10	40,760	3.07	2.18 – 4.34	<.001
Suicide Attempts	25	106,417	3.38	2.59 – 4.41	<.001
NSSI	3	532	4.36	2.32 – 8.20	<.001
Cyberbullying Perpetration					
Suicidal Ideation	5	2,444	1.89	1.54 – 2.32	<.001
Suicide Plans	1	650	1.87	1.41 – 2.48	<.001
Suicide Attempts	3	1,890	1.65	1.25 – 2.18	<.001
SITB-Related Social Media Use					
Suicidal Ideation	5	3,871	2.79	1.85 – 4.21	<.001
Suicide Plans	3	10,980	3.78	1.90 – 7.55	<.001
Suicide Attempts	5	11,735	3.94	2.20 – 7.07	<.001
NSSI	2	245	2.98	1.46 – 6.11	.003
Frequency of Social Media Use					
Suicidal Ideation	6	2,974	1.45	0.95 – 2.23	.089
Suicide Plans	2	391	1.47	0.33 – 6.43	.612
NSSI	3	570	2.03	0.79 – 5.21	.143
Problematic Social Media Use					
Suicidal Ideation	4	21,391	2.81	1.72 – 4.59	<.001
Sexting					
Suicidal Ideation	2	586	2.37	0.98 – 5.73	.057
Suicide Attempts	1	11,707	4.24	3.13 – 5.44	<.001
NSSI	2	6,103	3.07	2.53 – 3.74	<.001
Importance of Social Media					
Suicidal Ideation	3	858	1.05	0.96 – 1.15	.291
Suicide Plans	2	391	1.02	0.71 – 1.49	.902
NSSI	2	391	1.25	1.06 – 1.47	.007

Note: *k* = number of unique effects; CI = confidence interval; NSSI = non-suicidal self-injury;

SITB = self-injurious thoughts and behaviors.

Note that only outcomes for which at least one effect was identified are listed for each social media predictor. Effect size estimates where $k < 3$ should be considered unstable and interpreted with a degree of caution.

Table 3.

Moderator analyses for associations between cybervictimization and suicidal ideation and suicide attempts

		Univariate Moderator Analyses				
	k	***b***	**SE**	**OR**	**95% CI**	***p***
Suicidal Ideation						
Age (Categorical)	37					<.001
Adolescent	29			3.54	2.98 – 4.20	<.001
Adult	8			1.69	1.36 – 2.11	<.001
Age (Continuous)	28	−0.05	0.02			.061
Percentage Female	41	<0.01	<0.01			.840
Sample Type	--	--	--	--	--	--
Cybervictimization Measure Time Frame	38					<.001
≤ 3 Months	7			1.86	1.41 – 2.45	<.001
> 3 Months	31			3.14	2.63 – 3.74	<.001
Suicidal Ideation Measure Time Frame	35					<.001
≤ 1 Year	31			3.27	2.75 – 3.90	<.001
> 1 Year	4			1.49	1.08 – 2.06	.016
Cybervictimization Measure Quality	45					.784
Study-Specific Measure	19			3.04	2.23 – 4.13	<.001
Established Measure	26			2.87	2.25 – 3.68	<.001
Suicidal Ideation Measure Quality	45					.717
Study-specific Measure	13			3.12	2.12 – 4.60	<.001
Established Measure	32			2.88	2.30 – 3.60	<.001
Suicide Attempts						
Age (Categorical)	--					--
Adolescent	--			--	--	--
Adult	--			--	--	--
Age (Continuous)	13	−0.08	0.09			.413
Percentage Female	23	<0.01	−0.01			.629
Sample Type	25					.001
Community	22			3.63	2.66 – 4.97	<.001
At-Risk or Clinical	3			2.01	1.83 – 2.22	<.001
Cybervictimization Measure Time Frame	20					.062
≤ 3 Months	3			1.86	1.14 – 3.04	.013
> 3 Months	17			3.23	2.37 – 4.41	<.001
Suicide Attempt Measure Time Frame	20					.003
≤ 1 Year	16			3.89	2.73 – 5.56	<.001
> 1 Year	4			2.10	1.74 – 2.55	<.001
Cybervictimization Measure Quality	25					.179
Study-Specific Measure	9			2.38	1.26 – 4.50	<.001
Established Measure	16			3.88	2.82 – 5.34	<.001
Suicide Attempt Measure Quality	25					.505

		Univariate Moderator Analyses				
	k	***b***	**SE**	**OR**	**95% CI**	***p***
Study-specific Measure	6			2.68	1.21 – 5.94	<.001
Established Measure	19			3.58	2.65 – 4.83	<.001