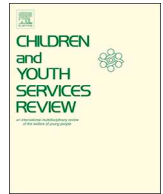




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## Social media use and deliberate self-harm among youth: A systematized narrative review



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### ABSTRACT

**Background:** Suicide is now the 2nd leading cause of death among adolescents and young adults. Social media's influence on youth suicidal risk or attenuation of risk is a novel and rapidly expanding topic of research that requires attention from a broad range of mental health services professionals. We aimed to provide an updated review of social media-related risk and protective factors to youth deliberate-self harm (DSH) to guide mental health services professionals in offering care and support to youth vulnerable to suicide.

**Methods:** Studies on which primary research was conducted that evaluated young people's use of social media platforms related to DSH were systematically searched via Scopus and identified through expert recommendation and the Association for Computing Machinery's digital library of conference materials. The search focused on the timeframe June 2014 to September 2019, to offer an update since the time the most recent systematic reviews on this topic concluded their literatures searches. Quality was reviewed using the Mixed Methods Appraisal Tool (MMAT).

**Results:** A total of 38 articles were eligible, and 24 articles rated as high quality were included in a narrative review. Of the included articles, 19 explored DSH risk and 8 explored DSH protection. Most articles reported on cross-sectional quantitative or qualitative studies. Opportunities for both risks and benefits were explored, and potential influences of social media use were considered for subgroups of youth who may be especially vulnerable to suicide.

**Conclusions:** In the relatively short period of review, the association between social media use and youth DSH was tested in population-based studies, offering preliminary evidence for suicide prevention and treatment efforts. Further research is needed to understand the contribution of social media use to youth DSH, particularly among youth most vulnerable to suicidal risk.

### 1. Introduction

Suicide is the 2nd leading cause of death for youth ages 10–34 in the U.S. (Hedegaard, Curtin, & Warner, 2018), and the reduction in this leading cause of youth mortality is a priority within the United States, as well as a global imperative (Adolescent Health, 2020; World Health Organization, 2014). Mental health services professionals, such as public health prevention scientists and social workers, are called to recognize a range of risk and protective factors that may influence this complex public health problem. While the evidence for leading risk and protective factors for suicide has been synthesized to inform prevention and intervention efforts (Cramer & Kapusta, 2017; Turecki & Brent, 2016), work to date has frequently omitted consideration of social media use as a factor that may implicate risk or protection for youth suicide. It is especially relevant to consider the influence of social media use among young people, 70% of whom use social media multiple times per day (Rideout & Robb, 2018). The goal of this review was to offer an

update on the known influences of social media use for youth suicidal risk and protection to inform and support the work of mental health services professionals. We aimed to explore associations of social media use and deliberate self-harm (DSH), which includes non-suicidal self-harm ideation and behavior as well as suicidal ideation and behavior. These components are of high importance to the discussion of adolescent suicidal risk, because each has independently been linked to heightened risk of death by suicide (Anestis, Knorr, Tull, Lavender, & Gratz, 2013; Bridge, Goldstein, & Brent, 2006; Turecki & Brent, 2016). The primary audience of this review is mental health services professionals within the United States. However, given the emergent nature of this topic of research, all available research is reviewed from across the globe.

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## 2. Context

### 2.1. Significance for the treatment and prevention of youth suicide

Gaining deeper insights into social media's helpful and harmful influences on the lives of adolescents and young adults has relevance to both the treatment and prevention of youth suicide (Lattie, Lipson, & Eisenberg, 2019; Rice et al., 2016; Robinson et al., 2016). While social media use may have little direct influence on overall well-being (Berryman, Ferguson, & Negy, 2018; Coyne, Stockdale, & Summers, 2019; Heffer, Good, Daly, MacDonell, & Willoughby, 2018; Orben and Przybylski, 2019a, 2019b; Orben, Dienlin, & Przybylski, 2019), it can have the consequence of displacing activities that have a positive impact on mental health, such as sleep, while also increasing exposure to harmful digital experiences like cyberbullying that can contribute to changes in mood and mental state (Hussain & Griffiths, 2018; Hutson, Kelly, & Militello, 2018; Viner et al., 2019). While not all youth who are exposed to harmful digital experiences are upset by them to the point of being at risk of DSH (Vallance et al., 2014), youth who are at higher risk of suicide may be especially vulnerable. Youth who are more vulnerable to suicide, such as youth who are depressed, are more likely to be exposed to harmful online content such as self-harm behavior (Dyson et al., 2016) and more likely to report negative online experiences such as internet harassment (Ybarra, Alexander, & Mitchell, 2005), cyberbullying (Hamm et al., 2015), and problematic internet use (use that impairs daily life) (Liu et al., 2017), than youth who are not depressed.

In contrast, social media offers opportunities to expand young people's social network and connect with supportive peers (Best, Manktelow, & Taylor, 2014). The ubiquitous nature of social media offers opportunities to reach a broad audience to promote positive mental health messaging, connect with prevention groups, and to increase the availability and access for mental health services through digital mental health interventions (Rice et al., 2016; Robinson et al., 2016). Recognizing the diverse influences of youth social media use, the American Association of Suicidology (AAS) (American Association of Suicidology, 2019) has recommended providers evaluate the impact of digital technology use, both positive and negative aspects, when conducting risk assessments and to use this context to guide the development of crisis intervention plans for youth at risk for suicide.

Suicide prevention scientists have also identified a need to better understand the degree and extent of social media's harmful and beneficial influences (Luxton, June, & Fairall, 2012). Public health experts have recommended research to explore subgroups who may be differentially impacted by social media use in order to inform population-based prevention strategies (Luxton et al., 2012). This recommendation is considered in light of optimism for the potential for prevention programs to engage hard-to-reach populations such as rural and minority youth. Also recognizing the potential for far-reaching benefit to marginalized and vulnerable groups, the American Academy of Social Work and Social Welfare has issued a grand challenge to "harness technology for social good," suggesting the use of emerging technologies within social work practice is essential to addressing social inequity (Berzin et al., 2016). While a growing body of professionals recognize the importance of social media to reach at-risk groups, little is known about which groups are most vulnerable to harmful influences on social media or if certain vulnerable subgroups gain resiliency from helpful and supportive aspects of their social media use (Luxton et al., 2012; Robinson et al., 2016). For example, subgroups who are more vulnerable to suicidal like LGBTQ (lesbian, gay, bisexual, transgender, and queer) youth, may on one-hand disproportionately have negative online experiences such as cybervictimization, while on another benefit from greater access to supportive interactions (Abreu & Kenny, 2018; Craig, McInroy, McCready, & Alaggia, 2015; Escobar-Viera et al., 2018). It is essential for mental health treatment providers and prevention scientists alike to be knowledgeable of research documenting social media's influence on youth who may be especially vulnerable to suicide.

### 2.2. Evidence from previous reviews

Few literature reviews have attempted to identify DSH risk and protective factors among youth within the context of social media use. The two most recent systematic reviews that evaluated social media's impact on adolescents' suicidal outcomes were led by Marchant et al. (2017) and by Dyson et al. (2016). These reviews highlighted that exposure to and expression of DSH content via social media was associated with the glorification and normalization of self-harm behavior, as well as a host of maladaptive behaviors that increased risk of future DSH. Furthermore, addictive internet use was observed among self-injuring adolescents. Social isolation was a concern, while at the same time the potential for social media to reduce isolation and contribute toward feelings of social connectedness and support were discussed as potential benefits. These benefits were thought to support a fertile ground for online help-seeking and social media-based preventive interventions, notably through moderated online groups and awareness campaigns.

These two reviews did not summarize potential impacts on subgroups known to be at increased risk for suicide to identify the potential for vulnerability to DSH among youth social media users. However, there is some evidence for vulnerability within certain subgroups, notably regarding cybervictimization and sex-based differences. Recent reviews have identified that younger adolescents, females, and sexual minority youth appear to be more vulnerable to cyberbullying victimization (Escobar-Viera et al., 2018; Hamm et al., 2015; Kowalski, Giumetti, Schroeder, & Lattanner, 2014). While cyberbullying is strongly correlated with traditional bullying (Fanti, Demetriou, & Hawa, 2012), social media can extend opportunities for bullying into a constantly present digital environment to which some youth may be especially vulnerable. Other differences in the impact of social media use appear to be present among youth of male and female sex. Recent longitudinal studies reported that female adolescents engage in higher frequencies of social media use over time than males, and persistent high frequencies of use predicted poor well-being among females (Booker, Kelly, & Sacker, 2018; Viner et al., 2019). However, when adjusting for mediating factors, the association between frequency of use and well-being was attenuated among females and not among males (Viner et al., 2019). This suggests that there may be different operative mechanisms at work impacting the mental health of males and females. The potential for social media use to differentially impact DSH risk among youth of different sexes and youth within vulnerable groups remains underexplored.

While Marchant and Dyson's reviews were well-designed and offer important contributions, the rapid increase in studies within this content area and the need to consider vulnerable subgroups suggests the need for additional review. The Marchant and Dyson systematic reviews ended on June 24th, 2014 and January 26th, 2015, respectively. An initial keyword search conducted (see Appendix A) to evaluate the need for this review indicated that the literature has more than doubled in size in the subsequent 3 years. This review offers an updated account of social media-related risk and protective factors for adolescent suicide from studies published since the last systematic reviews were conducted.

## 3. Materials and methods

The method for this literature review, a systematized review, was chosen through consultation with a research librarian and based on standard approaches to reviews of health sciences literature (Grant & Booth, 2009). A systematized review uses elements of a systematic review but with a reduced scope. This review met 3 out of 4 criteria for a systematic review. The criteria that were consistent with a systematic review included: 1) a quality assessment to determine inclusion/exclusion, 2) a narrative synthesis of results, and 3) analysis that includes recommendations for best practice as well as recommendations for

future research. However, the fourth criteria for a systematic review, an exhaustive, comprehensive search of the literature, was not met. Reducing the scope of search is an approach to rapid evidence assessment that is appropriate for emergent research foci for which the literature is rapidly advancing (Grant & Booth, 2009).

### 3.1. Search strategy

Through consultation with a research librarian, the first author searched for articles published from June 25th, 2014 to May 20th, 2018. The review was subsequently updated for articles published from May 21st, 2018 to September 24th, 2019. To reduce bias associated with the reduced scope of search, Scopus was selected as a primary database and supplemented through additional sources. Scopus, which includes records from EMBASE and MEDLINE, is the largest database of peer-reviewed literature in the fields of science, technology, medicine, and social sciences (Falagas, Pitsouni, Malietzis, & Pappas, 2008). Additional literature was identified via recommendations from experts in social media and youth suicide, as well as searching the Association for Computing Machinery's digital library of conference materials to ensure the adequate inclusion of literature from computer science disciplines. Inclusion of computer science publications was deemed important, because there is an emerging literature focused on using methods typical within computer science, e.g. machine learning, to explore phenomena on social media, including suicidality. No study design restrictions were applied to the search. See **Appendix B** for a list of search terms.

### 3.2. Article selection

Two authors (C.B. and C.J.R.S.) screened titles and abstracts for eligibility. When eligibility could not be determined by the titles and abstracts alone, the authors obtained and independently evaluated full text versions of the articles. Interrater reliability analysis was performed to assess the degree to which coders consistently assigned categorical (yes/no) ratings for article eligibility based on the inclusion criteria. Interrater agreement for the abstract/title review and full-text review were  $\kappa = 0.738$  and  $0.837$ , respectively. Kappa values within this range are associated with a moderate to strong level of agreement (Landis & Koch, 1977; McHugh, 2012). Discrepancies were resolved through consensus meetings. The inclusion criteria for this review were studies that: (1) reported findings from original research; (2) were written in English; (3) had available full text articles; (4) studied adolescents or young adults ages 10–25; (5) evaluated use of social media platforms; (6) had a DSH outcome. Youth ages 10–25 were selected to capture ages of adolescence (Sawyer, Azzopardi, Wickremarathne, & Patton, 2018) as well as emergent adulthood (Arnett, 2013). Social media was conceptualized using Kaplan and Haenlein's definition, which includes social networking sites, collaborative projects (e.g. wikis), blogs, content communities (e.g. YouTube) as well as virtual gaming and virtual social worlds (Kaplan & Haenlein, 2010). Studies that did not directly focus on social media (e.g. those that involved text messaging or covered all internet use) were excluded.

### 3.3. Quality assessment

Quality assessment was performed using the Mixed Methods Appraisal Tool (MMAT), which systematizes critical evaluation of quantitative, qualitative, and mixed methods studies (Hong, Gonzalez-Reyes, & Pluye, 2018; Pluye, Robert, Cargo, Bartlett, O'Cathain, Griffiths, & Rousseau, 2011). The MMAT generates overall quality scores for qualitative, non-randomized and randomized quantitative, and mixed method studies. These overall quality scores are a combination of quality criteria designed to assess the appropriateness of sampling, measurement, rates of data completion, and a number of factors aimed to determine the potential for bias. A full list of the

quality review criteria is listed in **Appendix C**. Scores range on a scale from 100% (highest quality articles) to 0% (lowest quality articles). Articles that were rated with a score of 75% or higher (meeting at least 3 of 4 MMAT criteria) were included within the narrative synthesis. Two authors (C.B. and C.J.R.S.) independently coded eligible articles using the MMAT criteria. Interrater agreement for quality determination was  $\kappa = 0.702$ . In a previous test of the MMAT criteria, a kappa score in the range of 0.61–0.80 was classified as substantial agreement (Pace et al., 2012). Disagreements on quality ratings were discussed through consensus.

### 3.4. Data analysis

Due to the range of research questions, methods, and outcomes assessed, pooling of results was not possible. Therefore, the results of study findings thematically summarized and described in narrative form. The analysis focused on studies scoring 75% or higher on the MMAT quality criteria. Descriptive statistics were calculated using SPSS, Version 26.0 (IBM Corporation, 2017).

## 4. Results

### 4.1. Review process

A total of 627 articles were identified, 472 were screened, the full texts of 260 articles were reviewed for eligibility, and 38 articles were eligible. Of the 38 eligible articles, 24 were rated as high quality and included in the narrative review. The most common reasons for exclusion were the lack of a youth study population, no emphasis on social media, and lack of a DSH outcome. Fig. 1 provides a description of the review process.

### 4.2. Description of eligible articles

Of the 38 articles that were eligible (see Table 1), most used non-randomized quantitative methods (cross-sectional and descriptive studies) or qualitative methods. Three of the articles used a longitudinal study design. Sample sizes varied significantly with articles reporting on qualitative and case studies having the fewest participants and those amassing publicly available data from social media platforms having the largest samples.

**Age Range.** Articles focused on adolescents ( $n = 13$ ), young adults ( $n = 11$ ), or both adolescents and young adults ( $n = 14$ ). One study which estimated ages based on social media profiles did not report exact ages but had an authentication process in place to exclusively include youth users in their dataset.

**Social Media Data Collection.** Fifteen articles used data gathered directly from social media content (predominantly text-based data), eleven used surveys or questionnaires that did not report psychometric properties, seven used measures in which internal consistency reliability was reported (Cronbach's  $\alpha$  ranged between 0.69 and 0.91), two used medical records, one used data from deceased individuals' phones, one simulated a social media experience using a fMRI task, and one utilized themes from qualitative interviews.

**DSH Outcomes.** Suicidal content was assessed most frequently ( $n = 26$  articles), six of which addressed death by suicide. Non-suicidal self-injury was the focus of six of the eligible articles. Multiple domains of DSH were assessed in five articles. Additionally, one article described a novel form of DSH, "digital self-harm," which refers to anonymous online posting, sending, or otherwise sharing of hurtful content about oneself (Patchin & Hinduja, 2017).

### 4.3. Quality review

Quality was variable among the 38 eligible articles. Scores ranged from 0% (0 out of 4 criteria met) to 100% (4 out of 4 criteria met).

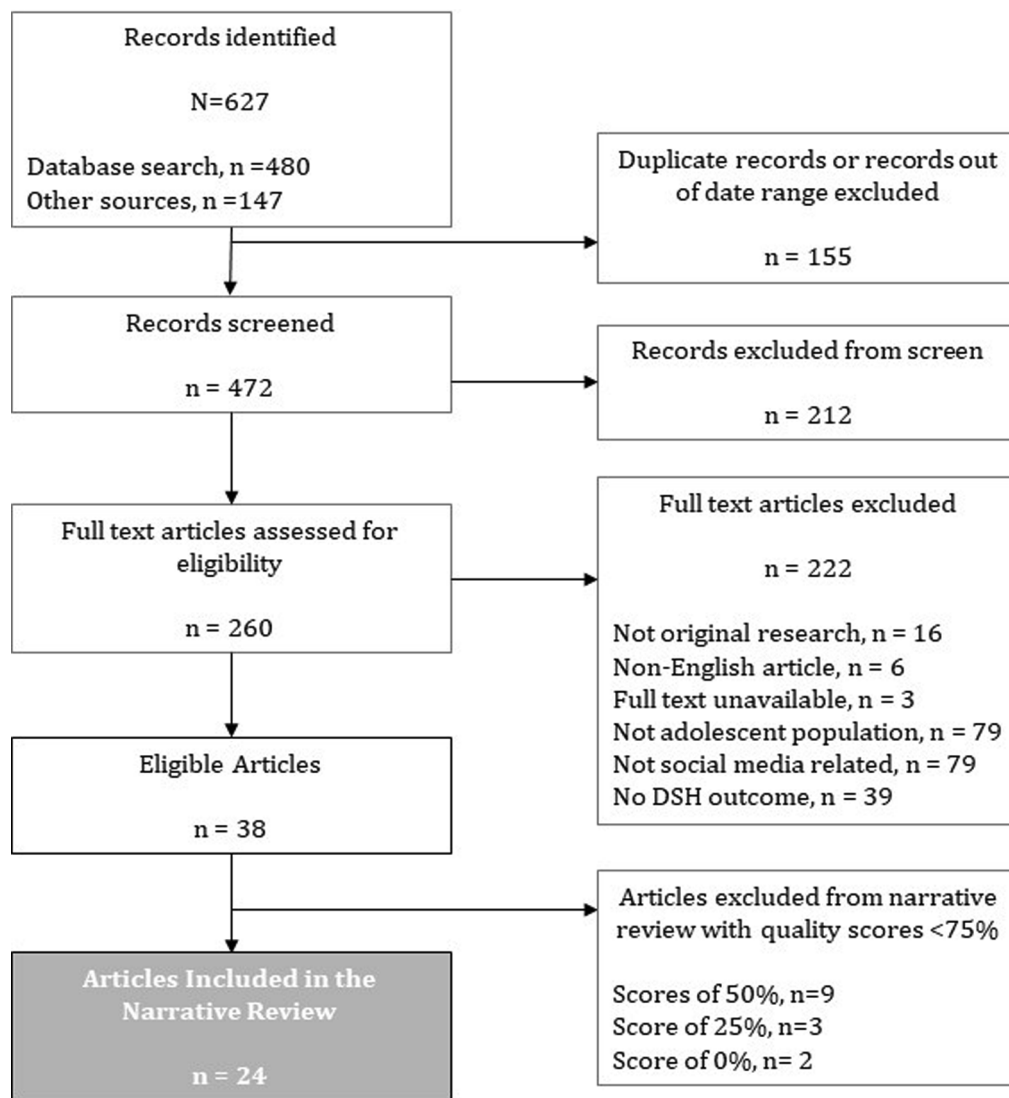


Fig. 1. Flow of Information through the Evidence Review Process.

Articles with a score of 75% or higher were defined as high quality. In total, 24 articles met the quality threshold necessary for inclusion. Articles reporting qualitative studies had the highest quality ratings (6 out of 6 studies had a score of 75% or higher) followed by quantitative studies (17 out of 28 studies had a score of 75% or higher). The lowest quality ratings were assigned to mixed methods studies (1 out of 4 studies had a score of 75% or higher). The most common reason for not meeting the quality criteria pertained to concerns with poorly define sampling strategies (29% of articles) and poor measurement quality (25% of articles) in quantitative studies and the lack of appropriate discussion of limitations (80% of articles) in mixed methods studies.

#### 4.4. Narrative synthesis of high-quality articles focusing on DSH risk factors

Nineteen of the articles defined as high quality focused on potential linkages to DSH risk and were thematically reviewed. These articles are described in Table 2. Among these nineteen articles, three primary domains emerged: (1) heavy and problematic social media use, (2) cyberbullying and online rejection, and (3) disclosure and proliferation of DSH content.

**Heavy and Problematic Use.** Four articles reported associations between heavy social media use, reported as use in either high frequency, e.g. times social media was checked, or volume, e.g. number of hours

social media was consumed, and suicidal risk. A fifth described the association with problematic use, which is broadly conceptualized as an inability to control one's use of social media leading to negative consequences in daily life (Spada, 2014). Two articles showed social media use in high volume to be commonplace (Lee, Sung, Lee, & Lee, 2017; Sampasa-Kanyinga & Lewis, 2015), and three articles found an association between heavy social media use and the suicidal risk of young people (Lee et al., 2017; Sampasa-Kanyinga & Lewis, 2015; Twenge & Campbell, 2019).

Daily use of social networking sites (e.g. Facebook, Twitter, etc.) of two hours or more was observed in 25% of high school students in Ontario and was associated with a five-fold increased odds of suicidal ideation, compared to youth who used social media for under two hours daily (adjusted odds ratio (aOR) = 5.93, CI = 2.38–14.75) while adjusting for grade, sex, subjective socioeconomic status, and parental level of education (Sampasa-Kanyinga & Lewis, 2015). Further, use of videogames and other nonacademic computer use (computer/videogame play not related to homework, e.g. on an Xbox, PlayStation, or other online device) of five hours or greater was observed in nearly 20% of U.S. high school students, and approximately a third of adolescents who were heavy videogame users reported suicidal behavior in the past year with reports being somewhat higher among females (37.8%) (Lee et al., 2017). For comparison, the Youth Risk Behavior Survey reported

**Table 1**  
Description of eligible studies (n = 38).

Lead Author; Year, Country	Study Design	Age Range <sup>a</sup>	Sample Size	Social Media Data Collection	DSH Outcome	MMAT Score
Akkin, 2017, Turkey	Quantitative	Adolescents & Young Adults	110	Social Network Use Questionnaire <sup>a</sup>	Suicidal ideation	25
Alpaskan, 2015, Turkey	Quantitative	Adolescents & Young Adults	1120	Young Internet Addiction Test $\alpha = 0.91$	Suicidal ideation & behavior	50
Aquila, 2018, Italy	Mixed Methods	Adolescents	1	Social-mobile autopsy (data collection from deceased individuals' phones) <sup>a</sup>	Suicidal death	0
Berryman, 2018, United States	Quantitative	Young Adults	467	Social Media Use Integration Scale $\alpha = 0.90$	Suicidal ideation	50
Berryman, 2018, United States	Quantitative	Young Adults	467	Social Media Use Integration Scale $\alpha = 0.90$ and a 3-item measure of vaguebooking $\alpha = 0.79$	Suicidal ideation	50
Branley, 2017, United Kingdom	Quantitative	Young Adults	412	Survey of exposure to online risk behaviors <sup>a</sup>	Non-suicidal self-harm behavior	50
Brown, 2017, Germany	Mixed Methods	Adolescents & Young Adults	6721	Photos collected from Instagram	Non-suicidal self-harm behavior	75
Cavazos-Reg, 2017, United States	Qualitative	Adolescents & Young Adults	17	Text collected from Tumblr	Deliberate self-harm	100
Chen, 2018, China	Quantitative	Adolescents	18,341	Internet victimization coded with the Relational Aggression Scale $\alpha = 0.83$	Suicidal and non-suicidal self-harm ideation	100
Colombo, 2016, United Kingdom	Quantitative	Adolescents & Young Adults	3535	Text collected from Twitter	Deliberate self-harm	100
Dillman, 2016, United States	Mixed Methods	Young Adults	357	Text collected from Twitter	Suicidal ideation	0
Duarte, 2018, United States	Quantitative	Adolescents	1031	Survey of social networking use <sup>a</sup>	Suicidal ideation	100
Gal, 2016, Israel	Qualitative	Adolescents	200	Videos collected from YouTube	Suicide prevention	100
Gritton, 2017, United States	Qualitative	Adolescents & Young Adults	32	Qualitative interviews	Deliberate self-harm	100
Hilton, 2017, United Kingdom	Quantitative	Adolescents & Young Adults	317	Text collected from Twitter	Non-suicidal self-injury ideation & behavior	75
Hobbs, 2017, United States	Quantitative	Young Adults	45,387	Social network data collected from Facebook	Suicidal death	100
Jacob, 2017, United Kingdom	Qualitative	Adolescents & Young Adults	21	Images and text collected from online communities	Non-suicidal self-harm behavior	75
Khuzwayo, 2018, South Africa	Quantitative	Adolescents & Young Adults	759	Questionnaire about bullying through Facebook or WhatsApp	Suicidal ideation & behavior	50
Kim, 2017, South Korea	Quantitative	Adolescents	2099	Questionnaire of internet activities <sup>a</sup> $\alpha = 0.69$	Suicidal ideation	100
Lee, 2017, United States	Quantitative	Adolescents	15,624	Survey of social media use and gaming <sup>a</sup>	Suicidal ideation & behavior	100
Lytle, 2018, United States	Quantitative	Young Adults	203	Survey of online social network use among LGBT youth	Suicidal ideation & behavior	50
Ma, 2016, China	Quantitative	Young Adults	6	Video broadcasts/text collected from Weibo	Suicidal behavior & death	75
Merelle, 2017, The Netherlands	Quantitative	Adolescents	21,053	Questionnaire of social media use <sup>a</sup> $\alpha = 0.82-88$	Suicidal ideation	75
Niederkrötenhaler, 2019, Australia	Quantitative	Adolescents & Young Adults	870,056	Tweets related to 13 Reasons Why	Suicidal death	100
Patchin, 2017, United States	Mixed Methods	Adolescents	5593	Questionnaire about digital self-harm <sup>a</sup>	Digital self-harm	25
Perini, 2019, Sweden	Quantitative	Adolescents	60	fMRI task with simulated social media environment	Non-suicidal self harm	75
Poonai, 2017, Canada	Quantitative	Adolescents	62,058	Medical records in aftermath of suicide announced on social media	Suicidal ideation & behavior	100
Robinson, 2018, Australia	Quantitative	Young Adults	27	Questionnaires about safe online communication about suicide	Suicidal ideation & behavior	100
Rodway, 2015, United Kingdom	Quantitative	Adolescents & Young Adults	145	Searches and posts from social networking sites	Suicidal death	75
Roussel, 2016, United States	Quantitative	Adolescents	5	Medical records during the time period of a social media-based challenge	Non-suicidal self-harm behavior	50
Sampasa-Kanyinga, 2015a, Canada	Quantitative	Adolescents & Young Adults	5126	Questionnaire of time on social media <sup>a</sup>	Suicidal ideation & behavior	100
Sampasa-Kanyinga, 2015b, Canada	Quantitative	Adolescents	753	Questionnaire of time on social media <sup>a</sup>	Suicidal ideation	100
Scourfield, 2019, United Kingdom	Quantitative	Adolescents & Young Adults	52	Death memorials posted on social media	Suicidal death	25
Seward, 2016, Australia	Quantitative	Young Adults	713	Online Relationship Initiation Scale $\alpha = 0.90$	Suicidal ideation & behavior	50
Song, 2016, South Korea	Quantitative	Young Adults	99,693	Posts collected from social networking sites	Deliberate self-harm	75
Tan, 2017, China	Quantitative	Young Adults	4222	Text collected from Weibo	Suicidal ideation	50
Twenge, 2019, USA	Quantitative	Adolescents	221,096	Hours spent on social media, collected from 3 large-scale surveys	Suicidal ideation & behavior	75
Wood, 2016, United States	Quantitative	Adolescents & Young Adults	22	Text collected from Twitter	Suicidal behavior	100

<sup>a</sup> Adolescents = 10–17 years, Young Adults = 18–25 years, Adolescents and Young Adults = 10–25 years.

<sup>a</sup> Author developed questionnaire.

**Table 2**  
Summary and characteristics of included studies examining DSH and the potential for risk (n = 19).

Lead Author, Year, Country	Study Population, Age (n)	Aims/Objectives	Key Findings & Findings Addressing Vulnerable Subgroups (if present)	Risk Factors
Brown, 2017, Germany	Self-harming youth Instagram users, aged 12–21 (n = 6721)	To investigate photos on Instagram that directly depicted self-harm wounds	Pictures with increasing wound grades and those showing different types of wounds generated significantly higher numbers of comments in response to self-harm ( $F = 44.4$ , $p < .001$ ). The 17 Tumblr accounts selected posted a median number of 185 posts (range = 0–2954). This content was reblogged or liked a median number of 1,677,362 times (range = 0–122,186,504).	Social reinforcement to self-harm  Proliferation of DSH content
Cavazos-Reg, 2017, United States	Youth Tumblr users with popular posts pertaining to depression & DSH, aged 14–20 years (n = 17)	To gain a better understanding of the depression, self-harm, and suicidal content that is shared on Tumblr	Cybervictimization was positively correlated to self-harm and suicidal ideation (aOR = 1.228–1.914, $p < .001$ ) after adjusting for demographics, parental socioeconomic status, and family structure.	Cybervictimization
Chen, 2018, China	Chinese high school students, aged 15–17 years (n = 18,341)	To investigate the associations between cyberbullying and family victimization among adolescents as well as the health correlates of cyberbullying and family poly-victimization	<b>Vulnerable Subgroup Findings:</b> Young males were significantly more likely to experience internet victimization in the preceding year (70.3%, $p < .001$ ). Children facing adversity – parents' divorce, separation, or widow (aOR = 1.27–1.68, $p < .05$ ), below-median family income (aOR = 1.11–1.35, $p < .05$ ), mother's low level of education (aOR = 1.37–2, $p < .05$ ), and father's unemployment (aOR = 1.42, $p < .01$ ) – all had higher odds for internet victimization than non-internet victimization after adjustment for sociodemographic factors.	
Colombo, 2016, United Kingdom	Adolescent Twitter users who have posted content denoting suicidal thinking, aged 11–18 (n = 3,535)	To understand the connectivity and communication characteristics of Twitter users who post suicidal content	The reciprocity of either follower/ following relationships or mutual links between suicidal users is significantly high (up to 73%), suggesting a tightly-coupled virtual community. Suicidal content was highly propagated of suicidal content. Furthermore, bridge nodes and hub nodes within a graph of retweeted suicidal content, showed connectedness of users posting suicidal ideation with users who had not posted suicidal messages, demonstrating the potential for contagion. Suicidal ideation was more prevalent among participants who reported any past-year cyberbullying than those who were not cyberbullied ( $\chi^2 = 11.7$ , $p < .001$ ).	Proliferation of DSH content
Duarte, 2018, United States	Adolescents presenting to an urban pediatric emergency department, aged 13 to 17 years (n = 1031)	To investigate risk of negative mental health outcomes associated with cyberbullying among minority adolescents	<b>Vulnerable Subgroup Findings:</b> Lesbian, gay, or bisexual adolescents were 2.49 times more likely to be involved in cyberbullying than their heterosexual counterparts after controlling for all other sociodemographic factors and social media use. Sexual minority status was not significantly associated with suicidal ideation. Five themes were identified of posts containing self-harm content using inductive thematic analysis : (1) celebrity influence, (2) self-harm is not a joke (feeling let down by unsupportive family/friends, (3) support for and from others, (4) eating disorders and self-harm (posting of various thin body parts in relation to self-harm thoughts/acts) and (5) self-harm videos and personal stories.	History of cyber-bullying
Hilton, 2017, United Kingdom	Adolescent Twitter users, estimated, mean age of 17.54 (n = 317)	To conceptualize naturally occurring online communication surrounding self-harm behavior generated through Twitter	Images, rather than textual interactions, were the primary reason cited for using the internet for self-harm purposes. Images invoked a physical reaction and inspired behavioral enactment, corresponding to a ritualistic practice of self-harm. Engagement with online communities (particularly Tumblr)	Lack of social support; celebrity influence (in some cases negative); distorted body image
Jacob, 2017, United Kingdom	Youth with a previous history of self-harm, aged 15–24 years (n = 21)	To explore young people's understanding and use of online images of self-harm		Proliferation of DSH content; social reinforcement to self-harm

(continued on next page)

Table 2 (continued)

Lead Author, Year, Country	Study Population, Age (n)	Aims/Objectives	Key Findings & Findings Addressing Vulnerable Subgroups (if present)	Risk Factors
Kim, 2017, South Korea	Students nested within 125 schools, taking part in the Korean Youth Panel Survey, aged 12–15 years (n = 2099)	To examine the extent to which online media activities are associated with the psychological well-being of adolescents	often led to an exacerbation of self-harm due to normalization of self-harm, increased exposure to self-harm content, and access to new techniques. When controlling for demographic variables, there was a strong and negative relationship between frequency of use of online activities and self-reported mental health and suicidal ideation (OR = 1.36, 95% CI: 1.10–1.67, p < .01). Additionally, cyberbullying and academic stress were associated with an increased odds for suicidality (OR = 1.77, 95% CI: 1.22–2.59, p < .05 or OR = 2.26, 95% CI: 1.12–4.54, p < .05 respectively). Those spending 5 or more hours per day using video games or other nonacademic computer games (20% of the overall sample) had the highest prevalence of suicidal behavior (32.4%)	Frequency of online activities, cyberbullying, & academic stress
Lee, 2017, United States	Participants of the 2015 Youth Risk Behavior Survey, 9th – 12th graders (n = 15,624)	To determine differences by sex in the association between video gaming or other non-academic computer use with depressive symptoms, suicidal behavior, and being bullied among US adolescents	<b>Vulnerable Subgroup Findings:</b> The prevalence of suicidal behavior among female adolescents was 22.5% when no hours were spent with video games (14.9% in males) and rose to 37.8% at 5 or more hours of video game use (compared to 25.1% among males). Problematic video-gaming and problematic social media use were both associated with suicidal thoughts, (OR = 2.28, 95% CI [1.96–2.65], p < .001) and (OR = 1.79, 95% CI [1.59–2.01], p < .01) respectively During the timeframe in which social media communication about 13 Reasons for Why peaked, excess suicides among 10–19 year olds of both sexes increased by 14.6% (95% CI, 4.0%–25.3%).	Volume of videogame use Problematic video-game and social media use
Merelle, 2017, The Netherlands	Early adolescents in The Netherlands, mean age of 14 years (n = 21,053)	To understand health-related problems and demographic factors associated with problematic video-gaming and social media use	<b>Vulnerable Subgroup Findings:</b> Gender specific models, indicated 27.9 (95% CI, 2.3–53.5) excess suicide among males (14.2% increase; 95% CI, 1.2%–27.3%) and 16 (95% CI, 3.5–28.4) excess suicides among females (27.1% increase; 95% CI, 6.0%– 48.2%).	Contagion
Niederkrötenhaler, 2019, Austria	Twitter users ages 10–19, compared to users who were 20–29 & 30–39 years old (n = 870,056)	To describe the associations between exposures to 13 Reasons Why on social media and suicidal outcomes	<b>Vulnerable Subgroup Findings:</b> Girls who self-harmed felt rejected significantly more than healthy control youth (U = 172, p = 0.009, r = 0.37) and were more sensitive to being rejected than healthy control youth (F(0.47) = 11.5, p = 0.001). Brain regions contributing to a multi-voxel pattern analysis of the self-injuring group include the dorsomedial prefrontal cortex and subgenual anterior cingulate cortex, regions implicated in mood control. There was a significant increase in the monthly ED visit rate for the composite outcome (p = 0.02) and death or ICU admission (p = 0.006) from April 2002 to December 2013. There was no significant change in the ED visit rate for the composite outcome before and after the announcement of Amanda Todd's death, (119.8 before versus 219.2 after, p = 0.5).	Sensitivity to rejection
Perini, 2019, Sweden	Female adolescent patients with non-suicidal self-injury (n = 30) and age-matched controls (n = 30)	To investigate whether subjective interpretations of social interaction in a simulated online environment might be biased among self-injuring youth	Internet use related to suicide (i.e., internet searches for suicide methods, suicidal ideas posted on social media, or online bullying) was recorded in 30 (23%) deaths. In total, 12	No significant risk identified
Poonai, 2017, Canada	Adolescents reporting to an emergency department in Ontario for suicidal ideation or intentional self-harm, aged 11–17 years (n = 62,058)	To investigate whether emergency department visits for suicide-related diagnoses increased following Amanda Todd's YouTube video death announcement	Internet use related to suicide (i.e., internet searches for suicide methods, suicidal ideas posted on social media, or online bullying) was recorded in 30 (23%) deaths. In total, 12	Proliferation of DSH content
Rodway, 2015, United Kingdom	Adolescents who died by suicide between Jan 1, 2014 - Apr 30, 2015 and were residents of or died in England, aged 10–19 (n = 145)	To describe antecedents to suicidal death from including coroner inquest hearings, child death investigations, criminal justice reports, and the English National Health Service		

(continued on next page)

**Table 2 (continued)**

Lead Author, Year, Country	Study Population, Age (n)	Aims/Objectives	Key Findings & Findings Addressing Vulnerable Subgroups (if present)	Risk Factors
Sampasa-Kanyinga, 2015a, Canada	Youth who completed the mental health portion of the Ontario Student Drug Use and Health Survey in 2013, aged 11–21 years (n = 5,126)	To examine the impact of SNS use and psychological distress, suicidal ideation, and suicide attempts, and to test the mediating role of cybervictimization	people posted suicidal ideas on social media prior to their death (9% of the sample). After adjustment for sociodemographic factors, heavy use of SNSs was associated with suicidal ideation (aOR = 3.44, CI = 1.54–7.66) and attempts (aOR = 5.10, CI = 1.45–17.88). Cyberbullying victimization was found to fully mediate the relationships between the use of SNSs with suicide attempts; whereas, it partially mediated the link between use of SNSs and ideation.	Heavy use of SNSs; Cyberbullying victimization
Sampasa-Kanyinga, 2015b, Canada	High school students who completed the 2013 Ontario Student Drug Use & Health Survey, 7th – 12th graders (n = 753 students)	To investigate the association between time spent on SNSs and unmet need for mental health support, poor self-rated mental health, and reports of psychological distress and suicidal ideation	Daily SNS use of more than 2 h was also independently associated with suicidal ideation (5.93 [2.38–14.75]).	Heavy use of SNSs
Song, 2016, South Korea	Suicide-related documents from social media websites in South Korea between Jan 1, 2011 - Dec 31, 2012, aged 19 years or under (n = 99,693)	To investigate online search activity of suicide-related words in South Korean adolescents through data mining of social media website	The link between grade pressure and suicide risk showed the largest path coefficient ( $\beta = 0.357, p < .001$ ) in structural models and a significant random effect ( $p < .01$ ) in multilevel models with depression as a partial moderator. The multilevel models indicated that about 27% of the variance in the daily suicide-related word search activity is explained by month-to-month variations. A lower employment rate, higher rental prices index, and higher rates of bullying were associated with an increased suicide-related word search activity.	Grade pressure; macro-economic factors such as the employment rate and rental price indexes
Twenge, 2019, USA	Adolescents from 3 datasets: 15-year olds in the UK (n = 120,115), 9th – 12th graders in the US (n = 52,115), and 8th – 12th graders in the US (n = 41,866)	To examine the association between time using digital media and psychological well-being	Across three datasets, electronic device use that was light (< 1 h of daily use) vs. heavy (5 + hours of daily use) was associated with a doubling of those who had suicidal thoughts ( $R^2 = 2.56\%, d = -0.32$ ) made a suicide plan ( $R^2 = 2.25\%, d = -0.30$ ), or who had attempted suicide ( $R^2 = 2.25\%, d = -0.29$ ) after controlling for sociodemographic factors. The machine learning classifier correctly identified 70% of users who attempted suicide. The authors estimate that if used in clinical practice between one third and one half of the users flagged for further screening would attempt suicide.	Suicidal ideation and behavior
Wood, 2016, United States	Twitter users who have publicly disclosed suicide attempts, mean age of 22, (n = 125)	To identify signals from language of social media users who have previously attempted suicide		Detection of DSH risk



the rate of past-year suicide attempt among U.S. high school students was 7.4% in 2017 among all youth and 9.3% among females (Behavior, 2007). Across three large-scale datasets in the United States and the United Kingdom, Twenge and team found an association between heavy use of electronic devices (5+ hours per day) and suicidal thoughts ( $R^2 = 2.56\%$ ,  $d = -0.32$ ), plans ( $R^2 = 2.25\%$ ,  $d = -0.30$ ) and attempts ( $R^2 = 2.25\%$ ,  $d = -0.29$ ) after controlling for socio-demographic factors (Twenge & Campbell, 2019). Greater frequency of online activities (chatting, participating in social media communities, or boards) was also strongly and negatively associated with suicidal ideation in a nationally-represented longitudinal survey of Korean youth, particularly among victims of cyberbullying or youth who experienced academic stress (Kim, 2017).

In regard to problematic use, Merelle and team (M erelle et al., 2017) studied the impact of addictive social media and video game use in a cross-sectional study of over 20,000 early adolescents in The Netherlands. They defined addictive use as “loss of control, pre-occupation, withdrawal symptoms, coping, social problems, and problems fulfilling responsibilities in school.” (M erelle et al., 2017) They found an association between suicidal ideation and both problematic video-gaming and problematic non-videogame social media use (OR = 2.28, 95% CI (1.96–2.65),  $p < .01$  and OR = 1.79, 95% CI (1.59–2.01),  $p < .01$ , respectively) (M erelle et al., 2017).

**Cyberbullying and Rejection.** Five articles reviewed the impact of cyberbullying on the suicidal risk of young people. Two of these articles reported cyberbullying victimization as a mediating factor in the relationship between heavy use of social media and suicidal ideation and behavior (Lee et al., 2017; Sampasa-Kanyinga & Hamilton, 2015). Three additional articles evaluated the independent association between history of cyberbullying/cybervictimization and DSH in population-based and clinical samples. Within a large-scale, cross-sectional study of Chinese high school students, Chen and team (Chen et al., 2018) showed cybervictimization was correlated with both non-suicidal and suicidal self-harm ideation (aOR = 1.228–1.914,  $p < .001$ ,  $n = 18,341$ ) while adjusting for demographics, parental socioeconomic status, and family structure. Using a longitudinal dataset of 2,000 Korean adolescents, Kim and colleagues (Kim, 2017) found that more youth who were cyberbullied, compared to those with no history of cyberbullying, reported suicidal thinking (OR = 1.77, 95% CI: 1.22–2.59,  $p < .05$ ). Another article explored the role of cyberbullying among adolescents who presented to an urban northeastern U.S. pediatric emergency department, showing a higher prevalence of suicidal ideation among adolescents who reported cyberbullying within the past year, compared to those who had not (Duarte, Pittman, Thorsen, Cunningham, & Ranney, 2018). Vulnerability to cyberbullying experiences was observed among certain subgroups. Specifically, lesbian, gay, and bisexual adolescents in the U.S. were more likely to be involved in cyberbullying than their heterosexual counterparts (Duarte et al., 2018). Further, boys and youth facing familial adversity had higher rates of internet victimization within one cross-sectional study in China (Chen et al., 2018).

Perini and team investigated vulnerability to social rejection among adolescent females who engaged in self-injury (Perini et al., 2019). Using a fMRI task that simulated a social media environment and classification through multi-voxel pattern analysis, they identified a negative bias toward rejection among a sample of females who engaged in self-injury. Further, females who self-injured were significantly more likely to feel socially rejected than females in a healthy control group after adjusting for medications and psychiatric disorders ( $F(0,47) = 11.5$ ,  $p = 0.001$ ).

**Communication of Deliberate Self-Harm Content on Social Media.** The frequent disclosure and rapid proliferation of DSH content was a predominant theme in the literature, addressed in nine of the articles reviewed. Two articles led by Cavazos-Rehg (Cavazos-Rehg et al., 2017) and Colombo (Colombo, Burnap, Hodorog, & Scourfield, 2016) highlight the extent to which self-harm and suicidal content is spread

online. Colombo and team (Colombo et al., 2016) compared the online social networks of suicidal Twitter users compared to suicidal cases of youth ages 11–18 who were identified through traditional forms of media. They found that mutual linkages, i.e. reciprocity within follower and following relationships, between suicidal users was especially high. Up to 73% of suicidal users demonstrated mutual linkages compared to 42% among users within the general population. They also evaluated the average shortest path of retweets, which provides an estimate of information spread within a social network with short paths indicating high information sharing performance. The average shortest path of retweets of suicidal content among their sample of 3535 youth were similar to networks of over 3 million nodes, suggesting a high level of propagation of suicidal content. They indicate these findings suggest tighter linkages exists within networks of suicidal users, making the potential for contagion higher. Cavazos-Rehg et al. (2017) further demonstrated the propagation of suicidal content online by following 17 Tumblr accounts that had highly popular posts pertaining to depression and DSH. They found that the posts generated from these accounts were re-blogged or liked a median number of 1.6 million times. Offering additional context for the dissemination of DSH-related content on social media, Niederkrotenthaler et al. (2019) reported excess suicides among 10–19 year olds above expected population suicide trends (14.6% increase; 95% CI, 4.0–25.3%) in the time period following the release of 13 Reasons Why (a popular TV show that aired a suicide death scene).

Several authors (Brown et al., 2017; Hilton, 2017; Jacob, Evans, & Scourfield, 2017; Song, Song, Seo, & Jin, 2016) aimed to understand the context of DSH communication on social media through textual analysis. One approach was data mining of content from a South Korean social networking site (Song et al., 2016). Through this approach, expressions of stress over maintaining grades had the strongest association to DSH communications, partially mediated by expression of depressed mood. Another approach was an inductive thematic analysis of Twitter messages, which revealed themes of celebrity influence on self-harm behavior, receipt of peer support (or lack thereof), expression of distorted body image, and personal stories of self-harm (Hilton, 2017).

Other authors spoke of the potential for images, rather than textual references, to influence suicidal risk. In an article by Jacob and team, adolescents indicated that seeing others’ images of self-harm on the internet was a primary reason for their own engagement in self-harm (Jacob et al., 2017). Youth explained that photos and videos invoked a physical reaction and inspired ritualistic practices of self-harm (Jacob et al., 2017). Further, in a study of self-harm images a positive relationship was observed between reinforcement and wound grade, where images showing greater wound severity elicited the most responses (Brown et al., 2017).

Finally, Rodway et al. (2016) and Poonai et al. (2017) each led papers that investigated severe forms of DSH online content. Rodway et al. (2016) conducted a consecutive case series study that investigated the presence of DSH disclosure on social media as an antecedent to suicidal death. This study showed that internet use related to suicide (including searches of suicidal methods, posting suicidal ideas on social media, and online bullying) was recorded in 23% of deaths among adolescents in their sample. Poonai et al. (2017) investigated the impact of a high-profile suicide death announcement made on social media to subsequent suicide-related diagnoses within emergency rooms; however, in this case no significant relationship was observed.

**Identification of DSH Risk.** One paper showed the potential for social media data to be used for the identification of DSH risk. Wood, Shiffman, Leary, and Coppersmith (2016) discussed the novel use of machine learning to classify social media users who have attempted suicide. They estimated their classifier correctly identified 70% of users who attempted suicide and recommend use of this approach within clinical settings to flag patients at risk of a future suicide attempt.

**Table 3**  
Summary and characteristics of included studies that examined DSH and the potential for protection (n = 8).

Lead Author, Year, Country	Study Population, Age (n)	Aims/Objectives	Key Findings and Findings Addressing Vulnerable Subgroups (if present)	Opportunities for Protection
Brown, 2017, Germany	Self-harming youth Instagram users, aged 12–21 (n = 6721)	To investigate the characteristics and response to Instagram photos depicting self-harm wounds	While few comments were hostile, most comments in response to self-harm content were either neutral (i.e. discussion-based n = 3,291 out of 6,568 comments) or empathetic in nature (n = 1,562) and some offered help (n = 462).	Peer support following disclosure of DSH
Cavazos-Rehg, 2017, United States	Tumblr users with popular depression & DSH posts, aged 14–20 (n = 17)	To better understand the expression of the depression, self-harm, and suicidal content on Tumblr	Of the 249 of posts that involved interaction from another Tumblr user, 117 (47%) provided emotional support and 52 offered/sought advice; although 32 messages (25%) provided potentially harmful advice.	Emotional support following disclosure of DSH
Gal, 2016, Israel	YouTube videos stemming from the “It Gets Better Campaign” targeting LGBTQ teens (n = 200)	To conceptualize the body of videos released in response to the “It Gets Better Campaign”	The content of the campaign involved expressing experiences of distress experienced by LGBTQ youth and sharing solution-focused language, frequently featuring emotional support. Participation structures rarely included representatives from marginalized populations.	Emotional support offered through a prevention campaign
Gritton, 2017, United States	American Indian and Alaskan Native (AI/AN) youth, aged 14–22 years (n = 32)	To understand AI/AN adolescents’ perspectives on concerning social media posts, including those expressing suicidal intent	Vulnerable Subgroup Findings: AI/AN youth conceptualized themselves as having a primary role and responsibility to respond to online suicidal crises expressed by their peers. While youth endorsed being frequently distressed by these responsibilities (see risk factor section), they support AI/AN-specific technological interventions, e.g. “We R Native.”	Acceptable social media-based prevention resources for AI/AN youth
Hilton, 2017, United Kingdom	Adolescent Twitter users, estimated, mean age of 17.54 (n = 317)	To conceptualize naturally occurring communication about self-harm behavior on Twitter	Among the themes identified, the potential for celebrity influence to offer support for self-harming youth was identified.	Social support offered through celebrity influence
Hobbs, 2017, United States	Cases of young adult suicide deaths with a Facebook profile, aged 18–24 years (n = 15,129) and living controls with a Facebook profile, aged 18–24 years (n = 30,258)	To examine social networks on Facebook in which a friend died by suicide in comparison to networks in which no death occurred	Overall, friendship interactions increased sharply after the death of a friend and slowly faded over time (log months from death slope = -0.026, CI = -0.032 to -0.020). Among close friends of the deceased, there were 4.5% (95% CI 3.4–5.7%) more interactions in close friend networks nine months after losing a mutual friend than the control group, and these interactions were less likely to fade over time. An estimate of 99% of social interactions lost due to a death of a friend were recovered within bereaved users’ networks (simulated 95% CI 77% to 126%).	Social connectedness; recovery of social interactions following loss of a friend to suicide
Ma, 2016, China	Chinese young adults who have live-broadcasted suicidal incidents on Weibo, aged 18 to 25 years (n = 6)	To examine the behaviors of both suicide broadcasters and their audience	Case studies of emergent adults who live broadcasted suicidal behavior on Weibo showed most audience members attempted to prevent suicides through active engagement and contact with suicide prevention services, while few audience members engaged in cyberbullying, inciting suicidal behaviors to occur.	Willingness of audience members of live suicide broadcasts to offer assistance
Robinson, 2018, Australia	Youth advocates, ages 18–25 (n = 27)	To develop stakeholder-informed guidelines for safely communicating about suicide online	A total of 173 items from 2 rounds of surveys were collected toward the development of final guidelines for safe communication about suicide on social media, informed by panels of youth & professional stakeholders.	Safe discussion of suicide on social media

#### 4.5. Narrative synthesis of high-quality articles focusing on DSH protective factors

Eight high-quality articles focused on the protective potential of social media for youth at risk of DSH and were thematically reviewed. These articles are described in Table 3. These articles highlighted the potential of social media to offer social support and connectedness through online communication and prevention efforts.

*Social Support and Connectedness through Online Communication.* Five articles discussed social connectedness and the provision of social support through the social media communication of youth engaging in DSH. Three articles investigated peer interactions with youth who posted DSH content on social media (Brown et al., 2017; Cavazos-Rehg et al., 2017; Ma, Zhang, Harris, Chen, & Xu, 2016). While a portion of interactions in response to DSH disclosure were either hostile or offered harmful advice, each of these studies showed the presence of empathetic responses. As examples of this, nearly half of posts responding to Tumblr users posting DSH content were coded as demonstrating emotionally supportive content (Cavazos-Rehg et al., 2017), and the majority of responses to live broadcasts of suicide attempts involved audience members acting to prevent suicide through contact with prevention services (Ma et al., 2016). Additionally, the impact of supportive communication by celebrities to their followers was shown in a paper by Hilton (2017) which investigated Twitter communications surrounding self-harm behavior. Celebrities' online influence was described as a source of support with teens finding celebrities' stories of overcoming struggles with self-harm behavior to be inspiring. However, negative influences of celebrity comments were also observed, some of which involved the encouragement of self-harm behavior.

Robinson et al. (2018) engaged in a Delphi study that leveraged a systematic review and questionnaires with Australian youth advocates and experts to identify priorities for safe and supportive communication about suicide on social media. This youth-engaged process yielded evidence-informed guidelines for online communication about suicide meant to inform young people and their key supports, e.g. parents, teachers, and health professionals.

Hobbs and Burke (2017) provide an example of the impact of a youth's death by suicide on the online connectedness of surviving friends on social networking sites. They found that friendship interactions increased sharply after the death of a friend and that friendships were less likely to fade over time than a comparison group that did not have a friend who died by suicide.

*Social Support Provided through Prevention Efforts.* Two articles demonstrate the provision of social support through prevention efforts. Gal, Shifman, and Kampf (2016) offered an example through analysis of YouTube videos made in response to the "It Gets Better" campaign, which they described as an online video-based campaign that was created in response to suicide among gay teens suffering from homophobic bullying (Gal et al., 2016). They highlight ways in which this campaign offers support to combat the heightened risk of suicide within LGBTQ youth through social media-based memes; however, the authors critique the inadequate inclusion of LGBTQ individuals from marginalized groups, such as non-Caucasian, non-Christian, non-disabled, non-American youth. Gritton et al. (2017) provides the perspective of American Indian and Alaskan Native (AI/AN) youth engaging in prevention efforts. Youth noted feeling responsible for responding to DSH content disclosed on social media by peers within their network. This responsibility left a heavy burden, described as a "cycle of viewer distress" characterized by stress and worry following perceived failures in response to peers' concerning posts on social media. They recommended AI/AN-specific media-based resources such as "We R Native," (WeRNative, 2020) to address DSH prevention through social media.

## 5. Discussion

This review, an update to two previous systematic reviews (Dyson et al., 2016; Marchant et al., 2017), explored the relationship between social media use and DSH among youth over a period in which the literature on this topic has more than doubled in size (June 25th, 2014 – September 24th, 2019). The volume of new studies published, demands a more recently updated examination of DSH risk and protective factors associated with young people's use of social media. While one other recent review offers an update focused on DSH (Memon, Sharma, Mohite, & Jain, 2018), this is the most recently updated review and the only paper that has incorporated a rigorous quality review, which is important for reducing bias. A total of 38 articles were eligible. Twenty-four articles were rated as high quality and thematically reviewed. Over twice as many articles summarized in this review demonstrate the potential for DSH risk ( $n = 19$ ) than those demonstrating the potential for protection ( $n = 8$ ). Further investigation is required to understand social media's influence on youth suicidal risk, particularly regarding protective factors that were evaluated in far fewer articles than risk factors. Although additional research is needed, findings from this review can aid mental health services professionals in weighing the current strength of evidence of potential harmful and helpful aspects of youth social media use, information that is critical for considering evidence-based approaches to treatment and prevention.

### 5.1. Risk and protective factors

This review highlighted four possible risk factors of DSH associated with young people's use of social media: heavy use, problematic use, experiences of cybervictimization, and exposure to DSH content within online spaces. Additionally, the review highlighted two possible protective factors of DSH among youth: social support and social connectedness.

While the findings from this review reflect a possible association between heavy social media use and suicidal risk, readers should take care in considering the weight of this evidence. Study of the influence of social media use on youth is a new and rapidly emerging area of research, in which rigorous longitudinal studies have not been conducted to understand the magnitude and direction of association with suicidal outcomes. Several high-impact papers showed significantly less evidence for a linkage between heavy social media use and related outcomes, such as well-being (Berryman et al., 2018; Coyne et al., 2019; Heffer et al., 2018; Orben and Przybylski, 2019a, 2019b; Orben et al., 2019). For example, Orben and Przybylski found that while the association between frequency of digital media use and adolescent well-being was negative, it explained only 0.4% of the variation in well-being (Orben & Przybylski, 2019a). Additionally, readers should be cautious in considering connections between videogame use and suicidal risk. This review summarizes the results from a small number of correlational studies on this topic, which limits the capacity to draw clear conclusions. This is consistent with the American Psychiatric Association's stance that there is insufficient evidence for addiction to internet gaming to be considered a disorder within the DSM-5 (Internet gaming, 2020). Additional research utilizing a longitudinal design to evaluate the influence of a broad range of potential mediators is necessary to offer greater context to the contribution of frequency or amount of social media use to DSH risk.

The potential for a risk relationship between problematic social media use and youth DSH identified through this review is consistent with the findings from a recent meta-analysis. Cheng et al. (2018) assessed the relationship between internet addiction and suicidal behavior across twenty-three observational studies. When controlling for demographic variables and depression, they found a negative association between suicidality and internet addiction, and youth reported higher rates of suicidality than adults (Cheng et al., 2018). Further, Hokby and team found a strong negative correlation between

problematic internet use and DSH through a longitudinal examination of internet use among over 1500 European adolescents (Hokby et al., 2016). They showed that features of problematic internet use (specifically negative mood experienced from internet withdrawal), as well as sleep loss due to internet use, had a negative prospective relationship with mental health over time (Hokby et al., 2016). Ongoing study is necessary to explore the association between problematic social media use and DSH through further prospective studies that assess potential mediators, especially in regard to sleep loss due to its association to acute suicidal risk (Goldstein, Bridge, & Brent, 2008).

This review presented studies that showed a negative impact of social media-based cyberbullying on youth DSH risk. A risk relationship is supported by recent reviews and meta-analyses, which have shown relationships between suicidal ideation and attempt among youth and cyberbullying victimization, perpetration, or both (John et al., 2018; Kowalski et al., 2014). These relationships may be linked to in-person experiences of bullying, given the strong association between online and traditional bullying (Fanti et al., 2012). Of note, this review included only a limited number of articles focused on adolescent mental health and cyberbullying experiences, due to the specific focus on cyberbullying that occurred on social media (rather than other forms of digital media) and suicidal outcomes. Other reviews, such as those led by Kowalski et al. (2014) and John et al. (2018) have addressed the influence of cyberbullying on suicidality across digital media platforms.

Multiple articles within this review addressed potential risks associated with adolescents' exposure to online self-harm content and the proliferation of DSH content on social media. Online exposure to DSH content via social media is an ongoing theme from Dyson's and Marchant's previous systematic review (Dyson et al., 2016; Marchant et al., 2017). Furthermore, findings pertaining to the rapid propagation of DSH content are consistent with another review that discussed the potential for contagion across media platforms (Ortiz & Khin, 2018). Of note, these articles focus less on the potential for benefit from online disclosure of DSH. Dyson's previous review highlighted studies in which youth found benefit from online disclosures of DSH, such as the ability to authentically communicate within a group of supportive peers in moderated online support communities (Dyson et al., 2016).

Potential protective factors identified within this review include the provision of social support, especially emotional support, as well as enhanced peer connectedness (Brown et al., 2017; Cavazos-Rehg et al., 2017; Gal et al., 2016; Gritton et al., 2017; Hilton, 2017; Hobbs & Burke, 2017; Ma et al., 2016). The benefit of these protective factors has also been shown in previous reviews (Best et al., 2014; Dyson et al., 2016; Marchant et al., 2017), which have also highlighted the positive influence of protected online environments for the mental health of young people. Similar to previous reviews, high quality papers also revealed some unintended consequences to online disclosures of DSH that are communicated with the intention to provide or receive support, such as hurtful or unhelpful comments in response to DSH disclosures (Brown et al., 2017; Ma et al., 2016). The guidelines produced by Robinson and team's #chatsafe project offer needed guidance for safe social media communication about DSH (Robinson et al., 2018).

### 5.2. Vulnerable subgroups

Research focusing on subgroups who may be more vulnerable to either positive or negative online experiences was limited and requires significant further exploration. This review did, however, highlight the importance of considering sex, sexual minority status, and familial adversity, as well as experiences of mental health challenges within prevention and intervention programming, particularly regarding vulnerability to cyberbullying and rejection experiences (Chen et al., 2018; Duarte et al., 2018; Perini et al., 2019). While this review highlights one article indicating boys in China reported higher rates of internet victimization than girls (Chen et al., 2018), within the U.S. girls are more consistently reported to have higher rates of cybervictimization than

boys, whereas boys are more commonly reported to engage in cyberbullying than girls (Hamm et al., 2015; Patchin, 2019). Additional reviews highlight the importance of targeting LGBT youth (Abreu & Kenny, 2018), as well as younger children and girls (Hamm et al., 2015).

While the research predominantly explored risk among vulnerable groups, there were also indications of protection. Specifically, a widely disseminated prevention campaign targeting LGBTQ youth was described as well as a social media program aimed to prevent DSH among AI/AN youth that was described as acceptable and culturally appropriate (Gal et al., 2016; Gritton et al., 2017). These reports speak to the capacity to reach and offer support via social media-based interventions to two groups that experience higher rates of suicidal behavior and death (Khan et al., 2018; Miranda-Mendizabal et al., 2017).

### 5.3. Implications for treatment and prevention

The risk and protective factors identified within this review may offer important targets for mental health services professionals engaged in suicide prevention and treatment, which is consistent with AAS' recommendations to consider youth's vulnerability to both the harmful and helpful influences of social media use (American Association of Suicidology, 2019). In regard to potentially harmful influences, the findings within this review and other mounting evidence suggests approaches that aim to reduce the negative influences of cybervictimization, social media use that impairs teens daily lives and sleep, and exposure to self-harm and suicidal content may be of high importance. Additionally, mental health services professionals could be available to problem-solve potential pitfalls to disclosures of DSH on social media, while also recognizing the potential benefit of youth sharing their voice and experiences with online peers, particularly within moderated online support groups. Public health-based prevention approaches are also important to reduce risk associated with DSH communication among vulnerable populations, including prevention interventions that address risk communication on social media platforms.

The positive influences that were identified, namely emotional support and access to beneficial social connections, may serve as important targets for prevention and treatment. Mental health services professionals should consider access to emotionally supportive online friends and moderated online communities as potentially beneficial contributions to safety plans for suicidal youth. The presence of such social resources may be especially beneficial to groups vulnerable to suicide such as LGBTQ youth, who seek out online communities where they may feel a sense of belongingness, acceptance, and an ability to express themselves freely (Craig et al., 2015; Jacob et al., 2017).

Mental health services professionals aiming to understand the potential for DSH risk or protection within a youth's digital environment should consider methods of assessment. Self-report assessments of social media use and experiences are common. However, studies have shown that self-report measures of digital technology are inaccurate when compared against objective measures, such as those derived directly from an online platform (Araujo, Wonneberger, Neijens, & de Vreese, 2017; Scharkow, 2016; Sewall, Bear, Merranko, & Rosen, 2020). The use of machine learning algorithms that detect DSH risk from social media content, such as the approach reported by Wood and team or others reported in a recent systematic review (Burke, Ammerman, & Jacobucci, 2019; Wood et al., 2016), show promise for aiding mental health service professionals in this regard. However, use of such technology with a patient population requires consideration toward potential ethical challenges, such as risks to privacy and confidentiality (Van Royen, Poels, & Vandebosch, 2016). Social media data collection practices should be adherent to applicable laws and codes of ethics. For example, the National Association of Social Work has offered important standards for social work practice in the digital age (National Association of Social Workers, 2017). These standards suggest the creation of a policy that clearly delineates practices for engaging with

technology in the provision of services and recommends gaining informed consent to access online information except in cases of emergency.

#### 5.4. Strengths and limitations

The body of literature was limited in two critical areas. First, the use of longitudinal study designs was limited, and no studies utilized a randomized control trial (RCT) design. While the inclusion of articles with population-based samples is promising, longitudinal and RCT studies are necessary to investigate causal mechanisms. Second, nearly half of the included studies used questionnaires to guide data collection, few of which were validated. Further, self-reports of social media may be less accurate than objective measures of social media data (Araujo et al., 2017; Scharkow, 2016; Sewall et al., 2020). Crucially, the inaccuracy in self-reports of social media usage could be due to systematic bias, where those with the highest amounts of use and greatest psychosocial impairment are more likely to inaccurately report their usage, potentially leading to inflated correlations and false positive findings (Kobayashi, 2012; Sewall et al., 2020).

Limitations exist based upon the scope of the review. First, previously identified high-quality articles within the Marchant and Dyson systematic reviews (Dyson et al., 2016; Marchant et al., 2017) were not included within this review. Readers may consult the prior reviews to consider the full extent of the literature to date evaluating social media's influence on DSH risk and protection. Secondly, this review, as well as the previous systematic reviews by Marchant and Dyson, focus only on studies evaluating DSH. Articles evaluating other outcomes known to be associated with youth DSH, such as depression, anxiety, and sleep disturbance, were not included. The findings of this review had significant overlap with recent systematic reviews that evaluated the influence of social media use on adolescent depression and anxiety (Keles, McCrae, & Grealish, 2019; Seabrook, Kern, & Rickard, 2016). In particular, common risk factors were observed that included use in high volume, problematic internet use, and cybervictimization, and common protective factors were observed in social support and connectedness. However, these sources identified additional risk factors that were not discussed in this review, including experiences of negative upward social comparison within online spaces and social media-related sleep disturbance (Hokby et al., 2016; Seabrook et al., 2016). As such, future reviews are needed that address a broad range of outcomes associated with suicidal risk to gain a more fine-grained idea of the pathways by which social media influences adolescent DSH. Third, this review is also limited by the database search exclusively focusing on Scopus. Thus, articles that were not indexed within Scopus or were not identified by expert review may have been missed.

Though only one database was searched, the use of Scopus is estimated to offer wide scoping coverage of the literature. Scopus was selected because it offers comprehensive overview in fields most pertinent to this review (public health, social sciences, medicine, and technology) and offers peer-reviewed literature from a variety of sources, including scientific journals, books, dissertations, and conference proceedings (Falagas et al., 2008). Subsequently, bias was also minimized through supplementation of resources from conferences focused on the computer sciences and literature suggested by expert review.

This review also presents important strengths. Within a landscape in which the publications on this topic are rapidly increasing, there is a need for a focused review to advance the literature for researchers, clinicians, and prevention experts to act nimbly to new scientific findings. This review is unique, because it not only addresses the current state of the literature on this topic, but also links the extant literature to clinical recommendations from AAS and considerations for how these findings could be applied to suicide prevention. Further, it bridges the gap between the need for rapid release of findings with the need for rigor by using systematic search methods and quality review. Thus, this review was necessary, and additional reviews aimed to update the

literature should be done frequently.

#### 5.5. Future directions

Future research is needed to broaden insights into the direction and causal nature of the associations between social media use and DSH. Studies assessing the impact of social media use within the proximal time period to suicidal death may be especially critical, given the potential to predict imminent suicidal risk. With few articles in this review using validated measures of social media use, there is a clear need for valid and reliable measures, as well as use of objective measures of social media use. Future research should also focus on protective aspects of use, given that the recent research has disproportionately focused on risk relationships. Finally, the impact of social media use on vulnerable groups is poorly understood. Study of social media's impact and opportunities for prevention and treatment within groups known to be at heightened risk of suicide are vitally important next steps.

## 6. Conclusion

The study of social media's impact on youth suicide is rapidly evolving to meet the breakneck speed of technological innovation. In this relatively short period of review (2015–2019), the correlation between use of social media and youth DSH was tested in population-based studies. Further, the vast amount of data present on social media platforms was used to explore the proliferation of suicidal content. Additionally, new opportunities for the detection of suicidal risk to impact the prevention of youth suicide were identified. These findings were synthesized to suggest implications for mental health service professionals engaged in adolescent suicide prevention and treatment. Despite progress, large blind spots remain in the understanding of social media's impact on youth suicidal risk, including understanding how social media impacts the most vulnerable adolescents. Researchers and mental health services professionals engaged in treatment and prevention efforts must band together to explore and attenuate suicidal risk associated with harmful influences of social media use while exploiting benefits of protective online environments for the health and safety of young people.

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### CRediT authorship contribution statement

**Candice Biernesser:** Conceptualization, Methodology, Formal analysis, Data curation, Investigation, Writing - original draft, Writing - review & editing. **Craig J.R. Sewall:** Formal analysis, Data curation, Writing - review & editing. **David Brent:** Supervision, Writing - review & editing. **Todd Bear:** Supervision, Writing - review & editing. **Christina Mair:** Supervision, Writing - review & editing. **Jeanette Trauth:** Supervision, Writing - review & editing.

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### Appendix A. Supplementary material

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.childyouth.2020.105054>.

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