



Social Media Usage and Development of Psychiatric Disorders in Childhood and Adolescence: A Review

Ilaria Cataldo^{1,2}, Bruno Lepri², Michelle Jin Yee Neoh³ and Gianluca Esposito^{1,3,4*}

¹ Affiliative Behavior and Physiology Lab, Department of Psychology and Cognitive Science, University of Trento, Trento, Italy, ² Mobile and Social Computing Lab, Bruno Kessler Foundation, Trento, Italy, ³ Social and Affective Neuroscience Lab, Psychology Program, School of Social Sciences, Nanyang Technological University, Singapore, Singapore, ⁴ Lee Kong Chian School of Medicine, Nanyang Technological University, Singapore, Singapore

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*Correspondence:

Gianluca Esposito
gianluca.esposito@ntu.edu.sg;
gianluca.esposito@unitn.it

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Social media platforms, such as Facebook, Twitter, and Instagram, are now part of almost everyone's social life, especially for the newer generations. Children and teenagers grew up together with these Internet-based services, which have become an integral part of their personal and social life. However, as reported in various studies, psychological and psychiatric problems are sometimes associated with problematic usage of social media. The primary purpose of this review is to provide an overview of the cognitive, psychological, and social outcomes correlated with a problematic use of social media sites during the developmental stages, from age 10 to 19 years. With a specific focus on depression, anxiety, eating, and neurodevelopmental disorders, the review also discusses evidence related to genetic and neurobiological issues, together with the implications in clinical work and future directions under a multidisciplinary perspective. While the scientific community has made significant progress in enhancing our understanding of the impact of social media on teenagers' lives, more research integrating biological and environmental factors is required to fully elucidate the development of these disorders.

Keywords: social media, Facebook, Instagram, Twitter, depression, anxiety, adolescence, psychiatric disorders

1. SOCIAL MEDIA: AN INCREASING PHENOMENON IN HUMAN BEHAVIOR

In our global digital world, social connections are embedded within the external environment we are physically engaged in and the life that we virtually share on social media. Social media is a class of mobile and Internet-based applications that allow people to receive information and to build and share user-generated content. Through the creation of a virtual profile, it is possible to interact with real-life friends, meet new people from all over the world, connect with one's favorite celebrities, and to maintain both online and offline relationships. Since 2004, the use of social media has been increasing rapidly, with the possibility to be connected to the Internet anytime and anywhere. According to the nature of the content, the user can choose, from a wide range of applications, the platform that best suits the purpose of the communication. For example, Facebook is more focused on real-life friends and relatives and encourage interactions through services such as sharing pictures, videos, status updates, and joining groups with specific interests.

Social platforms like Twitter, which are also known as “microblogs,” are characterized by brief communication. Other applications, like Instagram or Snapchat, provide photo- and video-sharing services, together with the possibility to like, comment, and re-post preferred content. **Figure 1** shows the popularity of the leading social networks, ranked by the worldwide number of active users (source: ourworldindata.org).

Social media platforms are widely used across different age groups and cultures, but especially for children and teenagers, online communication represents “a window into the secret world of adolescent peer culture, even as it offers young people a new screen for the projection of adolescent developmental issues” (1). While social media offers tremendous potential in allowing self-expression of personality and maintaining contact with a network of friends, some studies have also highlighted the risk of negative consequences of excessive online social platforms usage (2, 3). Online social interaction, the blurring of lines between offline and virtual life (4, 5), and the concept of digital identity (6) have become topics of great interest in psychology and mental health fields (7). Researchers in the field are attempting to find a consensual definition of the concept of “problematic social media use,” as it is often confused with a description of addictive behavior related to general Internet services, which has been included in the 5th edition of the Diagnostic and Statistical Manual of mental disorders (8). In accordance with a biopsychosocial framework, problematic use of social media involves a set of alterations affecting biological functions (i.e., neurotransmitters regulation and circadian rhythm); cognitive, psychological, and affective mechanisms (i.e.,

attention, salience, mood fluctuation, and anxiety), and aspects related to the social sphere (i.e., social desirability, popularity, and conflicts), resulting in a decreased perceived quality of life. Feedback from people belonging to the virtual social community can affect individual self-esteem and, generally, well-being (9–13). A problematic use can also affect other aspects of a teenager’s daily life, such as academic performance, time management issues, procrastination, distraction (14), and sleep disturbances (15). In severe cases, aversive outcomes could arise and, if prolonged, can become highly impactful, with the further risk of developing psychiatric disorders (16). As the Internet and social media are a recent phenomenon, it is more likely that the effect of excessive or problematic usage will affect individuals during more sensitive temporal frames, such as childhood and adolescence. A survey conducted in the United States in 2018 reported that 45% of the teenagers interviewed say they are almost constantly online, without differences among sexes, ethnicities, family incomes, and parental level of education (for the full report, see Teens, Social Media & Technology 2018). Given the continuous exposure to the virtual environment, it is essential to understand the impact that online social relationships have on mental health and interpersonal functioning in developmental stages. The aim of our review, compared to other recent publications [see (17, 18)], is to provide a detailed overview of not only the effect of social media in general but also of the associations between specific platforms and psychopathology. We believe that this point is relevant, as it is important to distinguish among the different social media platforms given that each of them has specific, unique features that drive young users’ preferences.

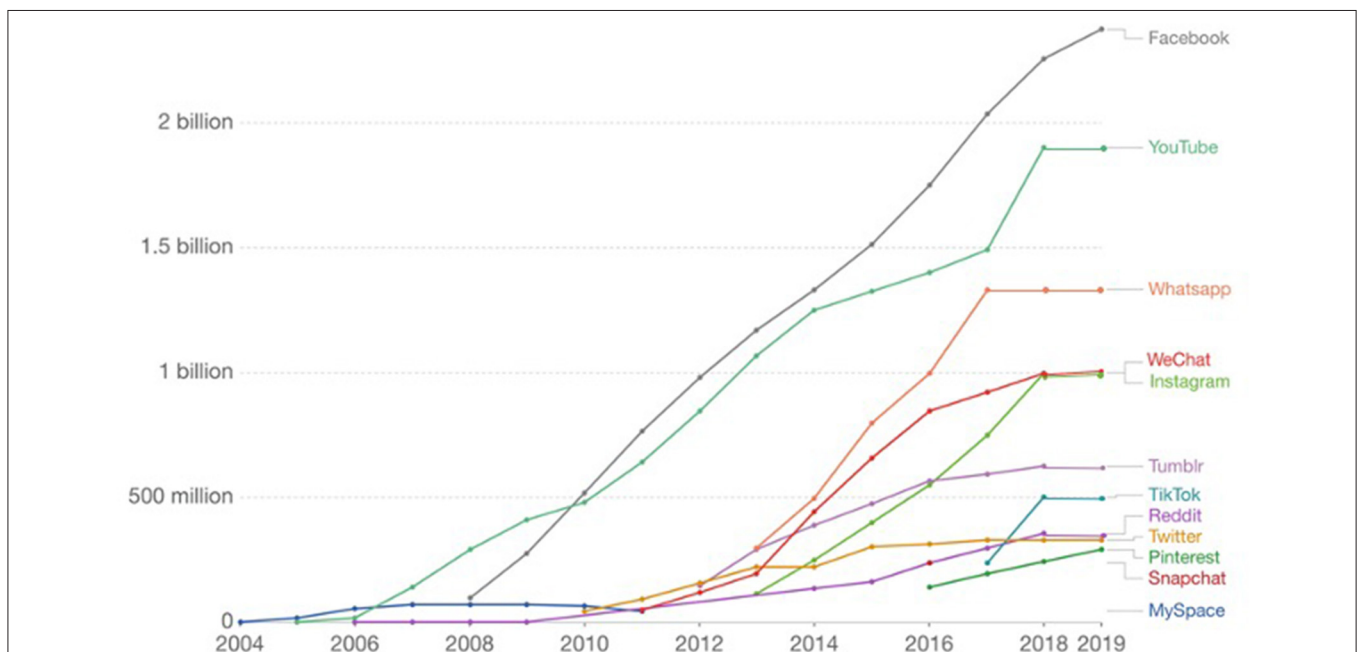


FIGURE 1 | Number of people using social media from 2004 until the end of 2019; estimates correspond to monthly active users, defined as those who logged in during the past 30 days. Source: Esteban Ortiz-Ospina (2019)—“The Rise of Social Media,” published online at ourworldindata.org and retrieved from <https://ourworldindata.org/rise-of-social-media>.

Furthermore, social media usage is often included in the broader category of Internet usage, despite the social connotation that primarily describes and defines these kinds of sites. Moreover, the included articles were discussed according to specific disorders that can develop during childhood and adolescence, not merely depression and anxiety that are the most explored disorders but also addictive behaviors toward substances and eating disorders (EDs), as both start to develop during adolescence. In fact, developmental stages are more vulnerable to environmental insults just because of the greater plasticity of the central nervous system, the multiple biological changes, and the formation of psychological mechanisms that drive social behaviors (19, 20). Due to the differences that define each platform, one of the main purposes of the present review is to provide evidence related to targeted social media services, instead of a more general discussion on social media. In fact, we retain that the multifaceted manifestation of diverse psychological issues might be expressed differently through the multiple ways of communication, such as text, video, or picture. As social behavior and the risk for psychiatric disorders is related to the activity of determined brain regions and biological features (21, 22), and since we are addressing the outcomes of problematic social media usage (PSMU) under a biopsychosocial perspective, we will also provide an overview about the neuroscientific and gene-by-environment contribution to the interplay between social media and the development of psychiatric disorders in adolescence.

2. METHODS AND RESULTS

The review adopted the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) model in conducting a systematic literature review. A search of four scientific electronic databases yielded 42 papers for qualitative evaluation. We searched PubMed Central, PubMed, PsycInfo, and Scopus databases for articles on psychiatric disorders in youths related to social media. Since this topic embraces multiple fields, such as computer science and information and communication technologies, we also browsed the Association for Computing Machinery Digital Library and the Institute of Electrical and Electronics Engineers Xplore Digital Library to find relevant research articles in the proceedings of conferences focused on the role of social media in explaining psychological issues in the developmental age. We comparatively analyzed the literature from 2006 up to the end of July 2020, combining different keywords and Boolean operators. A database was generated by combining terms and Boolean operators, such as “social media” AND “child*,” “social media use” AND “child*,” “social media” AND “disorder” AND “youth*.” To include more targeted records, we conducted a further search on the same databases using terms describing the specific issues we meant to address in this review: (“YouTube” OR “WeChat” OR “TikTok” OR “Reddit” OR “Pinterest” OR “Facebook” OR “Instagram” OR “Twitter” OR “Tumblr” OR “MySpace” OR “Whatsapp”) AND (“psychiatric disorder” OR “mental health” OR “psychological well-being”) AND (“adolescent*” OR “youth*” OR “teenager*”).

2.1. Eligibility Criteria

From a methodological perspective, studies had to fulfill the following criteria to be included: journals and proceedings of conference papers published up to the end of July 2020, published in English, and meeting the following criteria:

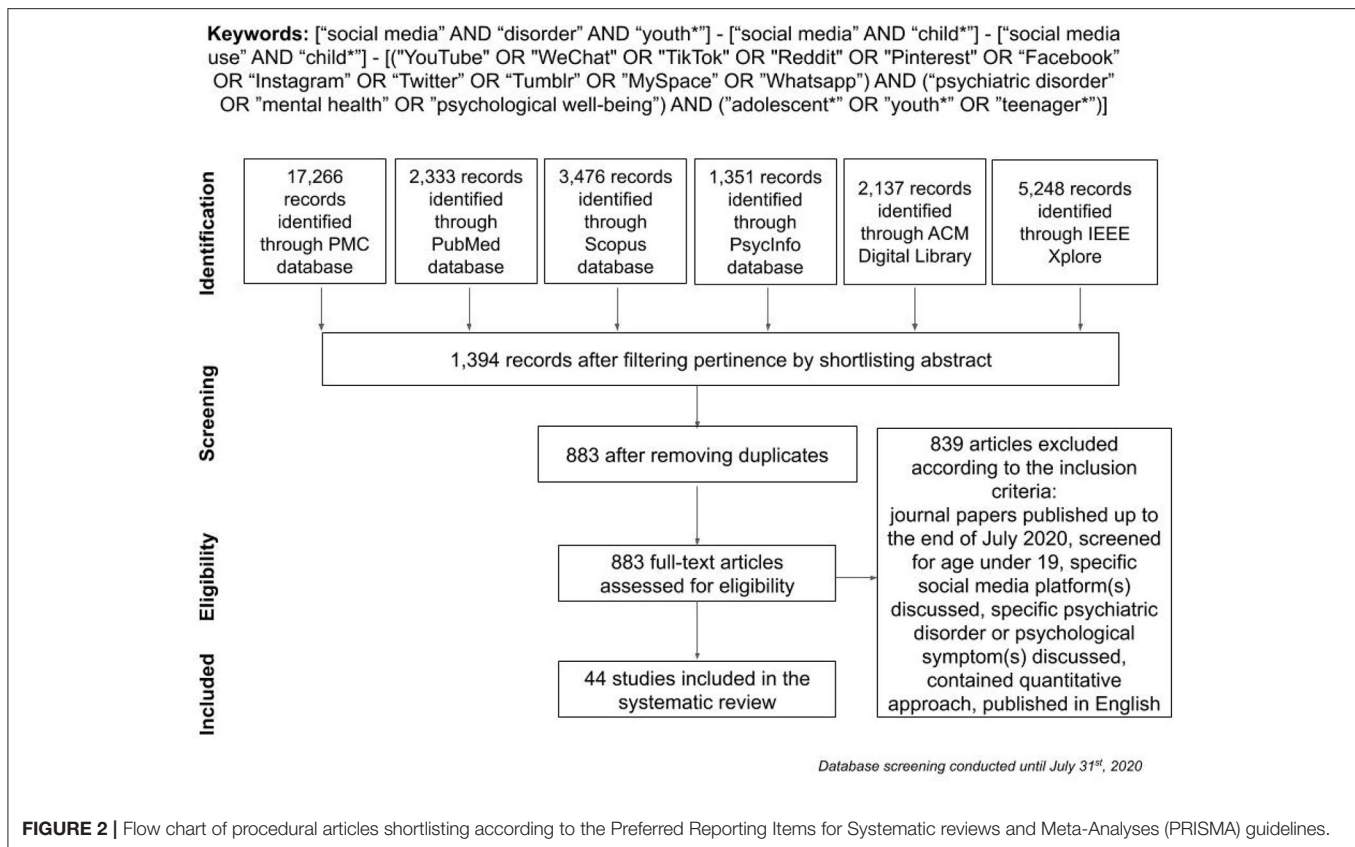
1. participants: children and adolescents until the age of 19 with a profile on at least one of the most popular social media platforms (Facebook, YouTube, WhatsApp, WeChat, Instagram, Twitter, TikTok, Tumblr, Reddit, Pinterest, Snapchat, MySpace, Q-Zone); we opted to consider the age of 19 as the upper limit of adolescence, in accordance with the definition provided by the World Health Organization <https://apps.who.int/adolescent/second-decade/section2/page1/recognizing-adolescence.html>;
2. interventions: assessment of psychiatric disorders in the developmental ages (depressive symptoms, anxiety and related issues, EDs and body dissatisfaction, neurodevelopmental disorders, substance misuse or abuse);
3. comparison: it is not applicable, as we only included studies based on the sample of social media users;
4. outcomes: we considered the levels of psychological well-being or diagnosis of psychiatric disorders as the outcome;
5. study design: we included studies containing quantitative approaches to produce empirical data and qualitative designs.

2.2. Results

For the selection procedure for the included articles, please refer to **Figure 2**. In the results, we will discuss only the studies resulting from the literature research. In **Table 1**, all the articles included in the review are listed, together with the principal information. Effect size computations for each study have been performed using an effect size calculator (64) or calculated manually. When more variables were analyzed in the study, we reported the range of values for effect sizes (Cohen's *d*). Disorders will be discussed in distinguished macro-categories, divided by diagnostic class, according to the DSM-5(65). Relevant topics such as involvement/changes of neural correlates and genetic contribution will also be discussed. A total of 31,823 papers were screened by title and abstract, 1,394 were considered for further screening, and 511 duplicate papers were removed. Note that 839 papers were removed after assessment for eligibility according to the exclusion criteria, resulting in 44 papers included in the review.

2.3. Depressive Symptoms and Mood Disorders

Depression is a prevalent mood disorder, in which symptoms include persistent sadness and a loss of interest in activities that the person enjoys typically, together with the inability to carry out daily activities (65). With regard to childhood and adolescence, interpersonal models of depression in developmental ages accentuate the cyclical associations between social experiences and depressive symptoms. New schemes in the interpersonal environment, with more articulated, frequent, and unsupervised contacts, may represent a further complication as the influence of peer relationships may affect a person's identity and psychological



well-being (66). As depression and internalizing symptoms have increased among youths in the last decade (67), it is vital to question to what extent social media usage is directly linked to this and to understand how they impact each other.

2.3.1. Effects of Social Media Usage on Depressive Symptoms

Given that social media provide users with a range of possible activities, it is possible to identify specific patterns of usage. For instance, a set of actions such as browsing other users' photos or scrolling through comments or news feeds has been labeled as passive social media use. Recent research indicates that this sort of behavior and depression are linked in both directions. Passive social media usage could directly aggravate depressive symptoms, like loss of interest or blue mood, and thwart personal well-being (16, 32, 68, 69). High social media use appears to be predictive of depressive symptoms and low offline social support from both family and peers (57). It might also act indirectly through mediators such as reduced sense of belonging (70), hence increasing levels of loneliness first (43) and, subsequently, depressive mood and stress (16), which, in turn, reinforce each other (68).

2.3.2. Effects of Depressive Symptoms on Social Media Usage

Passive social media use appears to be increased by depressive symptoms, loneliness, and high levels of stress. In a longitudinal study, Kross and colleagues have demonstrated that a sense of

loneliness is a predictor for more intense usage of social media (71), as it might represent a solution to alleviate depressed mood, reinforcing PSMU (68). Specific kinds of actions on social media, related to the peculiarity of the site, were found to be associated with adverse emotional and relational outcomes at different times and vice versa. With regard to Instagram, Frison and Eggermont reported that former browsing behavior was related to a later increase in depressed mood (38). Moreover, levels of depressed mood at Time 1 were associated with increased Instagram posting at Time 2, without differences between boys and girls (38). As for Facebook, levels of depressive symptoms at the first stage can be predictive of a lower number of Facebook friends and fewer ties between friends in the second stage (52). Another study based on Facebook data highlights the relationships between internalizing symptoms and online communication in terms of received comments offering support in response to posts indicating negative or depressive emotional states, with girls receiving more backing compared to boys. Such rumination-like behavior through social media might affect negatively not only the mood of the person who posts but also of those who respond, increasing levels of internalizing symptoms and depression (72). Depressive symptoms, together with sleep problems, can represent a positive predictor for excessive involvement in Facebook-related activities (53). Similarly, emotional dependence on Facebook has been found to be negatively correlated to several aspects of adolescents' psychological well-being, such as autonomy, purpose in life, positive relationships, personal growth, self-acceptance, and ability to manage one's environment

TABLE 1 | List of the studies included in the review.

n	Article	Age	N	Social media	Disorder/symptoms	Findings	ES
1	Szwedo et al. (23)	13/20	89	f , MS	Depressive symptoms, social anxiety	– (depr); + (s.anx)	0.40–0.60
2	Moreno et al. (24)	18–19	66	f	Alcohol use	+	0.72
3	Pumper and Moreno (25)	12–14	315	f	Alcohol use	+	0.15
4	Tiggemann and Slater (26)	13–15	1,087	f , MS	Body image concerns	+	0.26
5	D'Angelo et al. (27)	18–19	312	f	Alcohol use	+	0.20
6	Huang et al. (28)	14–15	1,563	f , MS	Alcohol and cigarette use	ns	na
7	Birnbaum et al. (29))	12–21	80	f , @, t	Psychotic-spectrum and mood disorder	na	na
8	Nesi and Prinstein (30)	12–16	619	f , @	Depressive symptoms	+	0.53
9	Bert et al. (31)	18	341	t	Pro-anorexia	na	na
10	Ehrenreich and Underwood (2016)	18	125	f	Internalizing symptoms	+	0.58
11	Frison et al. (32)	12–19	1,612	f	Depressive symptoms	ns	0.58
12	Marczinski et al. (33)	19	146	f	Alcohol use	+	0.44
13	Moreno et al. (34)	17–19	94	f , t	Alcohol use	+	0.47–0.92
14	Naeemi and Tamam (35)	13–16	401	f	Psychological well-being	–	0.67
15	Sampasa-Kanyinga and Chaput (36)	11–19	4,468	f , t , @, S , S	Body image concerns	+	0.39
16	Abar et al. (37)	19	252	f	Substance use	na	na
17	Frison and Eggermont (38)	12–19	671	@	Depressed mood	+	0.42
18	Gul et al. (39)	13–19	289	f	ADHD	+	0.69
19	Jacob et al. (40)	16–24	21	t	Self-injury	+	na
20	Nesi et al. (30)	15–16	658	f	Alcohol use	+	0.43
21	Nesi et al. (30)	13–16	816	f , @	Depressive symptoms	+	0.85
22	Pontes (41)	10–18	509	f	Depressive symptoms, anxiety	+	0.62–0.68
23	Spilkova et al. (42)	16	4,887	f , t , @, S , S	Binge drinking, marijuana use	– (drink); ns (marj)	0.88
24	van Rooij et al. (43)	12–15	3,945	t	Depressive symptoms, social anxiety	+	0.45–0.95
25	Weinstein (44)	14–18	507	@	Depressive symptoms	+	0.68
26	Brown et al. (45)	16	52	@	Self-injury, suicidal ideation	na	na
27	Muzaffar et al. (46)	12–20	102	f	Depressive symptoms, social anxiety	ns	na
28	Niu et al. (47)	12–18	764	QZ	Depressive symptoms	+	0.44
29	Settanni et al. (48)	15	283	f	ADHD symptoms	+	0.56
30	Chang et al. (49)	12–16	303	@	Body esteem	–	0.58
31	de Vries et al. (50)	12–19	440	f	Body dissatisfaction	+	0.49
32	Louragli et al. (51)	12–19	541	f	Anxiety, nomophobia	+	0.50–0.98
33	Negriff (52)	13/21	319	f	Depressive symptoms	–	0.58
34	Przepiorka and Blachnio (53)	12–17	426	f	Depressive symptoms	+	0.83
35	Raudsepp and Kais (54)	13	397	f , @, t	Depressive symptoms	+	0.72
36	Savolainen et al. (55)	15–25	4,816	f , @, t , S , S	Alcohol use	+	0.12–0.43
37	Shakir et al. (2019)	12–18	537	f , @, t , S , t	Cyberbullying	na	na
38	Steers et al. (56)	17–19	316	f	alcohol use	+	0.69
39	Vannucci and Ohannessian (57)	11–14	1205	f , @, t , S , t	Depressive symptoms, panic disorder symptoms	+	0.28–.92
40	Yurdagül et al. (58)	14–19	491	@	Depressive symptoms, anxiety, social anxiety, body dissatisfaction	+	0.28–0.50
41	Boursier et al. (59)	13–19	693	f , @, S , S	Body image concerns	+	0.36
42	Fardouly et al. (60)	10–12	528	@, S , S	Depressive symptoms, social anxiety, body satisfaction	– (depr.); ns (s.anx); – (body)	0.43–0.82
43	Stockdale and Coyne (61)	17/19	385	f , @, t	Depressive symptoms, anxiety	ns (depr.); + (anx)	0.36
44	Brown et al. (62)	16	59	@	Self-injury	na	na

Age, range of age of the participants; N, sample size; ES, effect size; +, directly proportional; –, inversely proportional; ns, non-significant; na, not applicable; **f**, Facebook; @, Instagram; **t**, Twitter; **S**, YouTube; **S**, Snapchat; **t**, Tumblr; **S**, Skype; MS, MySpace; QZ, QZone. Icons of social media platforms have been created using the fontawesome package (63).

(35). An addictive attitude toward Facebook was found to be positively correlated with depression, regardless of age (age range 10–18) and gender (41). Longitudinal research on adolescent girls

found an association between changes in PSMU and changes in depressive symptoms in both directions, with baseline levels of depressive symptoms being predictive of PSMU (54).

2.3.3. Social Comparison and Negative Affect

Social comparison is a mechanism highly involved in the development of a person's identity starting from childhood, where evaluations are more distorted especially in a positive way, throughout adolescence, when the greater development of cognitive skills permit the generation of more realistic estimates (73). Social comparison, as a consequence, can generate both a positive or a negative self-appraisal, affecting the way people, especially teenagers, perceive themselves and their quality of life. Evidence in literature suggests that PSMU and depressive symptoms might be mediated by social comparisons with others' lives as they appear on their profiles (44, 47, 66), generating a sense of inferiority and feelings of worthlessness (74–78). As a consequence, people showing downward social comparisons are more likely to seek offline feedback for reassurance (66). Social comparison is closely linked to self-esteem, which, in turn, resents of the effect of individual cognitive appraisal, acting as a moderator in the processing of comparison. As a consequence, lower levels of self-esteem can represent a risk factor when making comparisons with others' lives (47). These results appear to be more evident in girls, compared to boys, (44, 66) suggesting that intrinsic features of female identity development can represent a vulnerability for a more negative self-appraisal, especially when comparing or evaluating physical features or attractiveness (49, 54). Moreover, it is possible that online parasocial relationships may amplify distorted perceptions, due to the filtered and selective nature of the information shared, principally when evaluating profiles of users that do not belong to a close or offline network (44).

2.3.4. Controversial Results in the Association Between Depressive Symptoms and Social Media Usage

Amid the research investigating the connection between social media usage and depressive symptoms, a few studies reported no evidence linking social media sites and depression. A recent study investigated the relationships between reasons for Facebook use and psychological and mental health outcomes for a 3-year period in late adolescents, aged from 17 to 19 years. According to their results, none of the possible motivations, which were social connection, boredom, and information seeking, were correlated to depression at any stage of the experimental procedure (61). As for the short-term consequences of negative experiences on Facebook, online peer victimization is not predictive of increased depressive symptoms after 6 months (79). In addition, Fardouly and colleagues did not find differences between users and non-users of the most popular social media platforms (Youtube, Instagram, and Snapchat) among Australian preadolescents in terms of depressive symptoms. Taken together, these results suggest that low mood derived from social media usage might be explained through different factors, such as worry about how youths appear on their preferred social networks sites and their tendency to compare their own image to someone else's image (60). Finally, a longitudinal study by Szwedo and colleagues investigated the preference for Facebook and/or MySpace communication in a cohort of adolescents in relation to depressive symptoms, assessing the sample at the age of

13 (Time 1) and 20 (Time 2). Interestingly, higher depressive symptoms at Time 1 predicted a preference for communication via social media, but at Time 2, higher depressive symptoms were predictive of lesser online disclosure (23). This change in direction might be explained by the different ways, especially social withdrawal, through which depression is manifested in early adolescence and early adulthood. With regard to psychotic and non-psychotic mood disorders, social platforms such as Facebook and Twitter represent an initial avenue to seek help by diagnosed youths (29) and a potential base to examine depressive symptoms and perceived social support from online friends (80).

2.4. Anxiety Disorders

Symptoms relating to anxiety often overlap with depression, especially in youths; just like depression, anxious manifestations may result from a set of internal and external circumstances. In social media, where the relational component is strong, anxiety can derive from a perception of being connected inappropriately, from negative online peer-comparison, or from reduced emotion-regulation abilities, as online interaction can be used as a surrogate for offline physical interaction (81). Targeted Facebook features, such as seeking online approval and support through the number of "likes," or only retaining the visibility of posts and pictures that received lots of positive feedback on one's profile, can promote or elicit non-adaptive behaviors (i.e., excessive social comparison and rumination) and increase anxiety-related traits, such as socially prescribed perfectionism, aggravating pre-existing symptoms in youths diagnosed with an anxiety disorder (82). Facebook can also be used by teenagers as a pastime when feeling bored: a 3-year study found that usage of Facebook in order to alleviate boredom at stage 1 (17 years old) was correlated with increased levels of anxiety at a following stage (19 years old), indicating that the anxiety might be a secondary product of the problematic use of social media developed over the two time-points (61). This could reflect the fact that a 3-year window frame can encompass different stages of a teenager's life, especially when approaching emerging adulthood. As the high school period is over, fewer amounts of structured time, coupled with less monitoring behavior by parents and teachers and greater accessibility to smartphones or other electronic devices, can result in an increase in problematic usage of social media and, as a consequence, underlying anxiety-related mechanisms (61). The type and the reiteration of a set of behaviors that Facebook users could engage in (e.g., posting a photo/comment/status update, "liking" behavior, or using the instant message) can be linked with levels of general anxiety. This might be explained by the need to keep worries related to that driving the person to frequently check a previous posting behavior (46). With regards to Instagram, which is more focused on visual contents, one study reported a direct association between Instagram usage with general anxiety in boys, while in girls this link was mediated by body image dissatisfaction, leading to different adverse outcomes in the two groups (58). This difference between genders suggests that females might be more prone to engage in social comparison, especially when it involves physical appearance. This might be because their

perception of their ideal body image as being thin is affected by their excessive exposure to attractive celebrity and peer images on Instagram. Moreover, it underlines once again the importance of considering the possible concurrent mechanisms that contribute to the development of psychological issues.

2.4.1. Online Social Anxiety

Social anxiety is described by the enduring preoccupation of being judged negatively by others during a social performance or social circumstances (65). The worry of receiving unfavorable feedback is even stronger during adolescence, when the identity of the self is developing. Online activity on social media can be very attractive, especially for young people with such fears, as it is possible to share information or content in a more controllable environment. Although this allows people with social anxiety issues to overcome, even partially, the fear of being exposed to public judgment, it can lead to the development of a problematic usage of social media platforms. With regard to Facebook, a longitudinal study by Szewo and colleagues found that at 13 years of age (Time 1), social anxiety does not explain preference for virtual communications, and at 20 years of age (Time 2), it was positively correlated with a predilection for online relations, especially for those expressing increased levels of maternal behavior undermining autonomy at Time 1 (23). Levels of social anxiety in social media young users have been shown to be positively correlated with online behavioral dimensions such as the attitude of comparing one's appearance with other people's pictures on YouTube, Instagram, and Snapchat (60). As a consequence, the approach toward social media can be conflicting: the person desires at the same time to be recognized as interesting and "liked," but would also like to avoid being judged negatively or ridiculed. The awareness of these mechanisms might intensify pre-existing symptoms of social anxiety, leading to non-adaptive patterns of behavior (82).

2.4.2. Fear of Missing Out and Nomophobia: The Urge to Be Constantly Online

The more people share their lives on their online profiles, the more they are at risk of being afraid of missing updates and feeling the urge to check their profiles for feedback (16, 83). This specific phenomenon has been labeled "fear of missing out" (FoMO), defining the pervasive anxiety experienced by a user when thinking that other people might be enjoying gratifying experiences in their physical absence, pushing him/her to be connected constantly to check upon updates about these experiences, hence fostering the addictive behavior circuit (16, 84–86). FoMO has been shown to be associated with the severity of Facebook usage through a process that is likely to be activated by users as a way to temporarily compensate or regulate negative affect and anxious manifestations (87). Specific social needs may underlie FoMO and reasons for social media usage, like the desire to be popular, or at least not unpopular in the eyes of peers and the need for social affiliation, especially during adolescence when peers acquire greater value compared to the family (88). To this purpose, online interaction can represent a constantly available means of gratification but, at the same time, an attractive risk as

it might trigger addictive behaviors and aggravate symptoms of anxiety. This combination of behavioral and cognitive patterns, in the context of social media usage, appears to be mediated by nomophobia, which is described as the fear of not being able to use the mobile phone. Evidence in literature reports a direct association among levels of anxiety, addictive behavior toward social media (41) and nomophobia, with a negative impact on academic performances (51).

2.5. Feeding, Eating Disorders, and Body Dissatisfaction

Adolescence is a temporal frame during which physical changes and identity development occur, and teenagers acquire a greater awareness of the body, both their own and those of their peers (49). Posting pictures on social media is one of the most common practices among young people, especially self-photos (commonly known as "selfies") (89). Exposing and being exposed massively to pictures of body might lead to negative outcomes, such as body image dissatisfaction, defined as "the discrepancy between identification of one's own figure (actual) and the figure chosen as the desirable self-image" (90), or alterations in nutrition habits, to the extent of the development of EDs. With regard to Instagram, body image dissatisfaction mediates the relationship between PSMU and internalizing symptoms differently in males and females, with the latter showing a stronger indirect effect (58). Evidence from a study involving Singaporean girls showed that selfie practice on Instagram (browsing and editing) and body esteem are mediated by appearance comparison operated by peers' groups with a negative association, while posting self photos and body esteem are directly correlated (49). With regard to Facebook, Tiggemann and colleagues investigated social media exposure and body image concerns in girls, finding that time spent on the online platform was strongly correlated to body surveillance and the ideal of a thin body shape (26). An analysis of a Canadian sample of teenagers highlights that more frequent and prolonged usage of social media services is associated with body dissatisfaction, with a trend to perceive oneself overweight in both boys and girls (36). Recent findings from a study by Fardouly and colleagues indicate that more frequent appearance comparisons with others on social media and considering them to be more attractive than oneself is negatively correlated with body image satisfaction and positively linked with eating-related disorders in both male and female teenagers (60). Evidence from a sample of Italian adolescents highlights the role played by appearance control beliefs and body image control in photos, as these dimensions could be configured as predictors of problematic usage of social media and negative mental health outcomes (59). Overall, the findings indicate a higher vulnerability for girls to develop a negative image of their own body. This risk can be compounded by misleading and harmful content that can be found on social media.

2.5.1. Presentation of Eating Disorders on Social Media Platforms

In recent years, groups supporting anorexia nervosa in several ways (endorsement and promotion of dysfunctional eating

behavior, maintenance of the disorder, and interference with recovery) have been spreading across social media platforms. The dynamics of the Proana Movement, which promotes behaviors relating to anorexia nervosa, have been examined using Twitter, finding that adhering people and/or promoters were almost totally teenage girls (31). In the midst of the factors mediating the risk to develop body dissatisfaction or EDs, one study focused on teenagers' offline social environment, finding that a positive mother-adolescent relationship can exert a protective function against the adverse effects of social media usage on body perception (50). An alarming factor is determined by the support of pro-EDs in online networks. As popular platforms started blocking pro-ED related terms, users supporting dangerous eating habits have begun altering the hashtags, bringing forward their approval toward endangering conducts. On the other hand, it is not unusual that people rehabilitating from an ED seek support during their journey to recovery by sharing their testimony through textual posts or visual media (i.e., pictures, video, and gif). This dual nature of online communication represents a great challenge for research, as the analysis focused uniquely on hashtags may be misleading (91). Moreover, people supporting ED behaviors often alter the terms in hashtags or post them in comments in order to overcome social media censorship policy, with a possible risk to expose more fragile or sensitive people to explicit content.

2.6. Alcohol Use/Abuse and Addiction

Adolescence is the stage of life where people gain more independence and make new experiences in their social environment, where peer influence might encourage and provide opportunities to come into contact with alcohol, potentially leading to the development of an addictive behavior toward the substance. As the social environment is now composed of two realities, online and offline, it is crucial to understand the contribution of social media in fostering, maintaining, or conveying contents related to substances. Studies on drinking behavior among teenagers and social media use highlight that online platforms like Facebook might represent a helpful tool to detect problematic alcohol use (25, 33, 34, 92, 93), or advertise for healthy behavior in settings such as popular alcohol-related events and parties (24). A higher number of alcohol-related posts has been shown to be linked to greater drinking conduct and approval from friends, although heavier consumers seem to tend to post less over time compared to light drinkers (56). A longitudinal study revealed that in the Facebook profiles of individuals identified as dependent alcohol users, alcohol references increased and half of those identified referenced intoxication or problematic drinking after 1 year (25), while another longitudinal study indicated that alcohol references at a first stage can predict binge drinking later in time (27). With regard to alcohol-related attitudes, binge drinkers appear to be more prone to use social media excessively (42). Moreover, posts containing references to alcohol predict the number of weekly substance consumption (93), the risk of developing an addiction, and alcohol cravings (92). In order to predict drinking conduct, Marcziński and colleagues have developed the Alcohol-Related Facebook Activity (ARFA) questionnaire (33) based on a sample

of college students. The preference for the virtual environment as a platform to share alcohol-related experiences has been studied by Moreno and colleagues, who report that students owning a profile on both Facebook and Twitter tended to post more alcohol references on Facebook compared to Twitter (34), as they were entertaining more social connections on the former site. Online social networks often include connections with offline friends; therefore, the exposure to a friend's drinking pictures or posts can be associated with higher alcohol consumption (28, 30). Risky alcohol behavior can differ according to the country; a cross-cultural study examined the relationship between daily usage of popular social media platforms and alcohol consumption among youths in the United States, Spain, Finland, and South Korea. In the targeted countries, the different platforms were correlated with greater hazardous alcohol usage as follows: Facebook and Instagram in Spain, Finland, and South Korea, YouTube in South Korea, and Twitter in Spain (55). These results suggest that specific social media sites might play an attractive or inspiring role in risky alcohol consumption but, on the other hand, they could also turn out to contribute greatly to online-based interventions. According to a study on nicotine, alcohol, and marijuana consumption in high school, being friends on Facebook with one's own parents and not hiding contents can represent a protective factor against substance use (37). Parental inclusion on social media interactions, without undermining autonomy and privacy of youths, can depict an important element in substance use prevention targeted toward youths.

2.7. Self-Harm and Suicidal Ideation

Amid the psychological issues potentially occurring in young people, self-harm is a primary concern, with harmful behaviors lying on a continuum between non-suicidal self-injury (NSSI) and suicidal intention (40). Social media can influence self-injury tendencies negatively, through fostering conducts, contagion, or competitions (94), but they can also represent the first foothold when support is needed. A study based on the analysis of MySpace profiles indicates that teenagers utilize personal virtual space to share their suicidal ideation and behaviors directly or by reporting desperation, hopelessness, and despair (95). From the interviews with adolescents recently collected by Jacob and colleagues about self-harm behaviors, it emerges that Tumblr is the preferred platform to share self-injuring content, like pictures, in an anonymous way, with the consequent risk to normalize such harmful behaviors (40). Looking into the motives that push young people to share self-injury related content such as their own wounds on Instagram, there are mostly social purposes, like the need to belong to a group where the person can feel understood (62). Another reason might be the need to self-disclose in an environment that can guarantee anonymity. These reasons are reported to be valid both for the first NSSI post and for the general NSSI ones. Beyond self-oriented motives, another aim is to raise awareness about the topic in order to help other people (62). Although results concerning Instagram do not report any risk for acute suicidality (96), photos of self-injury practices might play a reinforcement role as they are often posted (45) and frequently concealed behind ambiguous

hashtags (97). In fact, as users often resort to the use of hashtags to track the shared contents and to find images or discussions related to specific topics, those regarding self-harming behaviors can contain non-related words (i.e., “blithe” for self-cutting pictures) or be constantly changed, in order to make them easily accessible only to a restricted community (98). Social media-related suicidal behavior is a topic of increasing interest and critical importance that has garnered the attention of newspapers and newscasts all over the world, concerning popular and unpopular people (see Channel News Asia for a recent episode). Although researchers attempted to study the extent of social media on suicidal behaviors in-depth, complexities derive from legal and privacy issues, as well as from the indirect association between the usage on web-based platforms and the suicide itself (99).

2.8. Cyberbullying

Suicidal ideation can also derive from the non-adaptive usage of online communication by others, as in the case of cyberbullying. Cyberbullying can be defined as the intentional use of information and communication technologies such as electronic mail, smartphone, short message services, and social media platforms, carried out repeatedly by a group or an individual, to support deliberate, repeated, and hostile behaviors against a victim who cannot easily defend him- or herself (100, 101). Cyberbullying constitutes a possible worrisome phenomenon, given its devastating, occasionally even fatal, consequences on a person's life. Recent statistics point out that cyberbullying is prevalent on platforms based on visual content, such as Instagram (42%), Facebook (37%), and Snapchat (31%) (see the article by Petrov C. on statistics about cyberbullying, February 28, 2019). As the contents are shared and spread quickly online, the victim can experience, besides a lack of control, a series of highly negative psychological consequences, such as social anxiety (102), depression, and suicidal ideation and attempt, especially when bullying behavior perpetuates across time (103, 104). An investigation on social media usage and youths' mental health revealed that cyberbullying appears to mediate this relation occurring in a set of negative outcomes, such as sleep problems and anxiety, more than the frequency of exposure to social media itself, with girls being more exposed to these effects (10). However, social media started adding certain features including the ability to report inappropriate content, comments, and to block users in order to stem violent and inappropriate behaviors.

2.8.1. Safety Measures Adopted by Social Media Sites

Initially, the different platforms did not take responsibility for single users' online behaviors. However, the growing prevalence of cyberbullying in recent years has gained increased relevance, resulting in the implementation of several measures aimed at both children and parents. For instance, in 2013, Facebook launched a safety section on its site, providing information on policies, tools to increase profile protection, and relevant resources and contacts to access in the case of cyber abuse (see Facebook Safety page). Likewise, in 2015, Twitter activated a safety center for parents and teens with guidelines for a more

secure navigation and utilization of the site. Furthermore, they founded the Twitter Trust and Safety Council that works in partnership with several institutions and organizations in order to direct users to the appropriate service in case of abuse (see Twitter Safety Partner). With regard to Instagram, which has been owned by Facebook since 2012, the platform presents the community guidelines and another section where parents can find more information about the accessibility and visibility of their children by other users. Moreover, an online form is available for reporting self-injury material, hate comments, abusive or inappropriate content, and profiles belonging to teens younger than 13 years old, which is the requirement to own a profile (see Instagram Privacy and Safety Center page). The same subscription criteria are applied to YouTube, although videos posted by other users are accessible even without owning a profile. Because of this, it is possible for parents to set restrictions in order to avoid potentially dangerous or improper material. In addition, together with the site policies, informative material about harmful behaviors such as self-injury, suicide, harassment, and cyberbullying is provided (see YouTube Community Guidelines). So far, statistics about the efficacy of these safety measures have not been available. Generally, targeted services for prevention have been made known on the most popular online platforms by providing users with links to websites, hotlines, and information about how to detect warning signs of suicide. Web communities focused on suicide prevention have been founded, giving their members the opportunity to share their own direct or indirect experience in an anonymous way and to support each other, without the constraints of physical boundaries (99).

2.9. Neurodevelopmental Disorders

Neurodevelopmental disorders are characterized by altered functioning of the neurological system and brain, affecting cognitive functions and social behavior. Although social media interfere with offline interaction by reducing the investment of time and resources in them while offering a more immediate alternative to satisfy social needs, they can also simplify the engagement in social contacts. This feature might be suitable, for instance, for youths with autism spectrum disorders, as they can have difficulties in decoding complex social information (105, 106). As adolescence is a crucial developmental stage where interactions with peers occur both online and offline, it is of pivotal relevance to understand the impact of social media platforms on teenagers with neurodevelopmental disorders. With regard to ASD, evidence shows a positive association between Facebook usage and friendship quality, moderated by anxiety levels, suggesting that online platforms might act as a means to improve friendship quality (105). For this purpose, Gwynette and colleagues explored Facebook's therapeutic potential as a tool to improve social skills in adolescents with ASD. Their web-based intervention, according to the authors, could have the potential to facilitate interventions, leading to higher engagement with peers through the virtual environment (106). In the context of neurodevelopmental disorders, Asperger syndrome is characterized by significant difficulties in social interaction and non-verbal communication; as a consequence,

they could be more vulnerable to cyberbullying victimization on online applications. Findings in the literature suggest that, although adolescents with Asperger syndrome use social media less than their peers, the percentage and frequency of cyberbullying are similar (107). Another neurodevelopmental condition is attention-deficit/hyperactivity disorder (ADHD), which is defined by persistent inattention, hyperactivity, and sometimes impulsivity. These features, combined with online-based platforms, might lead to addictive social media behaviors, with further consequences on mental health, productivity, and academic scores (48). Studies analyzing the correlation between ADHD traits and social media found that a large number of adolescents with ADHD own more than one Facebook account, showed greater overuse compared to their counterparts (39), and ADHD symptoms are positively associated with Facebook addictive use (48). Furthermore, teenagers with more marked ADHD traits were more likely to develop problematic usage of Internet-based services and less likely to remit from problematic Internet usage (108).

3. GENE-BY-ENVIRONMENT CONTRIBUTION TO UNDERSTAND BEHAVIOR ON SOCIAL MEDIA

The hypothesis that genetic features influence behavior and social interactions has been corroborated in several studies [for a review, see (109)], and so is the notion that human behavior and psychological traits are modulated by the interaction between genetic variation and environmental factors (21). Due to the intrinsic interactional nature of social media platforms, it is important to deepen the exploration of concurrent factors that could explain underlying mechanisms related to online interaction adopting integrated methodologies widely used for offline social behavior, that is, the gene-by-environment interaction framework. Few studies report results about genetic contribution in Internet-related usage. Two studies on Turkish twins on communication and social media reported that genetic and environmental effects were equally influential on problematic Internet usage especially in male twin-pairs (110). Another twin study highlighted the impact of genetics on mobile phone use (111). These results have been corroborated by a more recent investigation by York, who focused specifically on social media use (e.g., contact friends and contact family) even after controlling for demographic factors (112). A recent study by Deryakulu and Ursavaş examines the extent to which nomophobia can be explained by genetic and environmental factors, revealing that the dimensions which were more explained by genes were “losing connectedness” and “giving up convenience,” while environmental factors were more related to the fear of “not being able to communicate” and “not being able to access” (113). Familiar context represents a factor of great interest in shaping social behavior, especially at the developmental stage, and perception of parental warmth or intrusiveness can influence social media usage in adolescents. With regard to the genetic contribution within the frame of

recalled parental bonding, a recent exploration found that people who are genetically more sensitive to environmental factors, represented by oxytocin receptor polymorphisms, with a history of perceived high maternal overprotection tend to show a higher social desirability index on Instagram (114). This index, which describes the ratio between the number of following and followed profiles, could be used for future studies to unveil some tendencies underlying user behavior on Instagram.

4. SOCIAL MEDIA USAGE AND NEURAL MECHANISMS

Evidence deriving from the neuroscientific field reveals a link between online social behaviors and regulation of neural mechanisms. A functional magnetic resonance imaging (fMRI) study conducted by Meshi and colleagues reports that social media engagement is linked to activity in the ventral striatum (vSTR) and adjoining structures of the nucleus accumbens (115). More precisely, the authors found an association between levels of activation of these areas and in response to social feedback identified that were relevant to participants' social reputation (a surrogate for “likes” on Facebook). Another study describes greater recruitment of the vSTR in relation to more popular shared pictures compared to less socially endorsed ones (116). As for structural evidence on gray matter volume and social media habits, the striatal region was found to be linked to daily smartphone checking (117) and heavy social media usage (118). Recent evidence also suggests the involvement of the right lateral orbitofrontal cortex, linking a decreased volume in that area with an excessive usage of social media sites (119). With regard to impulse control, reduced gray matter volume in the anterior cingulate cortex was found in people with high tendencies in developing an addictive attitude toward instant messaging services (120) and “multitasking” users, suggesting that social media usage is highly involved in the control of inhibitory mechanisms (121). Another relevant study by Moissala and colleagues on media multitasking showed increased activity in the right side of the prefrontal cortex while participants were subjected to a cognitive task; this result was explained by the authors as a reflection of mental struggle in recruiting resources in executive control (122). With regard to social cognition in adolescence, fMRI studies found that online rejection by peers or other users elicits an increased activity in the medial prefrontal cortex, which is strongly associated with offline rejection (20), and elicits neural responses in the dorsal anterior cingulate cortex, the subgenual anterior cingulate cortex, and the anterior insula, which are areas generally linked to “social pain” (20, 123) and depression (124). The immediate and long-term effects of frequent and prolonged social media usage on neural structures and activity have yet to be elucidated.

5. CONCLUSION

In just one decade, individuals' lives and their social behavior have been tremendously changed by the phenomenon of social

media. Emerging technologies and platforms provide users with a wide range of activities, leisure, and the possibility to interact with friends, families, or strangers. Although different patterns of usage are moderated by a set of individual features concerning genetic, environment, temperament, and personal needs, it is undeniable that online social media have become an integrated part of people's daily lives. This leads to the necessity, in research fields linked to human behavior, to understand if, how, and to what extent these platforms are modifying our brain mechanisms, interactions, and the concept of well-being. During developmental stages, such as adolescence and early adulthood, several changes occur not only with regard to neural functions but also in social patterns, as young people have increasing opportunity to test themselves as individuals in more autonomous social interactions. As for social media, the most popular platforms require users to be at least 13 years old to own a profile and have access to the services. Although this limit is easily bypassed, it is difficult to have a clear overview of the sociodemographic information of young users and of different patterns of usage or effects of social media in early adolescence (10–14), middle adolescence (15–17), and young adulthood (18–21), as the early adolescence population should not be able to access and be engaged in virtual interactions on such platforms. This issue rebounds in a lack of studies considering this distinction, representing a further challenge to future research. Lots of efforts have been invested in creating new tools for assessing people's attitudes toward social media usage, such as the creation and validation of new scales (84, 125–129) and to interpret results within a fitting theoretical frame. Social media provide unprecedented opportunities to trace online activity and to keep track of interaction dynamics at different stages. This allows researchers to overcome issues related to self-report questionnaires and to benefit from leveraging real-time data over time more easily. Specifically, the increasing utilization of hashtags might help in detecting and monitoring targeted topics or risky behaviors, despite the risk of misappropriate use of words (for instance, sometimes people refer to "anxiety" or "depression" when perceiving alterations in preoccupation or mood but with these not being of clinical interest or diagnosed. For sure, the use of hashtags is a powerful tool to build communities and support people's journey to recover, to witness, to join a cause, or to increase awareness around a specific topic related to mental health. As the number of social media applications increases, with each having its own specific features, there is a need to separate problematic behaviors or effects according to the platforms. In fact, since the advent of social networks sites, multiple platforms have succeeded one another, gaining immediate popularity. Some of them are not used anymore, such as Google+, or had a drastic loss of users, like MySpace. Lately, a new social network site named TikTok, formerly known as Musical.ly, has risen especially among the youth, changing to some extent the way social media are used. From the simple sharing of text, music, or pictures, social media has rapidly evolved, becoming more dynamic and providing the possibility to get immediate and abundant feedback, to join wide online

communities based on common interests, and to involve users' talents or attitudes with so-called "challenges." Although TikTok had gained terrific popularity in the course of the last year, no studies regarding the potential outcomes deriving from a problematic usage are available. As social media sites are quickly developing, research appears to struggle in keeping pace with not only the new online functionalities but also with ways of interactions among users that, in turn, might alter parameters in longitudinal studies, like the amount of time spent online. This is partially due to the fact that effects can be explored in terms of both a short and long term, each with different consequences. Moreover, the social media platforms resent of the users' preferences and mass tendencies, and what is new and trendy today might swiftly lose people's interest (130). Since keeping track of how communication technologies evolve across the years can be a precious resource on developmental trajectories, it becomes of great importance for researchers to build and rely on constantly updated evidence. The creation and rise of new technologies has resulted in new behaviors and, consequently, new names for these behaviors. Neologisms like "nomophobia," "selfie," "phubbing," "FoMO," and "vaguebooking" have appeared for some years, defining specific behaviors or state of minds, that need further analysis, as they represent new, unexplored facets of human behavior. Research in psychological fields would also benefit from the exploration of specific types of interaction, such as the creation of multiple accounts, the fruition of live streaming video services, and behaviors like untagging people from posts or pictures or unfollowing/unfriending people in order to better understand the effects of mechanisms related to virtual social inclusion or exclusion. Although social media allows for greater ease of recruitment and testing of a greater number of participants in more efficient ways—sometimes comparable to laboratory testing sessions (131)—a lack of knowledge still persists regarding the involvement of specific brain regions or genetic susceptibility in developing a certain social media-related disorder. In addition, only a few studies adopted a longitudinal design, while most of the evidence is still based on a cross-sectional methodology that does not fully allow researchers to study in detail the direction of the association between social media usage and psychological well-being. Furthermore, the mental health community should commit to find a solution in considering social media-related issues as being separate from other forms of problematic online behaviors or usage. As there is no separated diagnosis, social media concerns are often included or subsumed within the Internet addiction frame, leading to an incorrect framing of the problem, especially with regard to the social connotation that primarily describes and defines these kinds of services. New evidence in these fields would be of great support for practitioners in a twofold way: on the one hand, information shared on social media sites and patterns of usage of new technologies could be implemented in clinical work for both a more complete assessment, and, on the other hand, it would be possible to profile more user-based interventions merging both online and offline strategies.

AUTHOR CONTRIBUTIONS

IC, GE, and BL conceived the paper. IC performed the search, interpreted the literature, and wrote the paper. GE, MN, and BL reviewed and edited the paper. GE submitted the paper. All the authors reviewed the final version of the paper before submission.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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