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REVIEW

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#TurntTrending: a systematic review of substance use portrayals on social media platforms

Brienna N. Rutherford[1,2] | Carmen C. W. Lim[1,2] | Benjamin Johnson[1,2] | Brandon Cheng[1,2] | Jack Chung[1,2] | Sandy Huang[3] | Tianze Sun[1,2] | Janni Leung[1] | Daniel Stjepanović[1] | Gary C. K. Chan[1]

[1]National Centre for Youth Substance Use Research, The University of Queensland, St Lucia, Australia

[2]School of Psychology, The University of Queensland, St Lucia, Australia

[3]School of Medicine, The University of Queensland, St Lucia, Australia

Correspondence
Brienna N. Rutherford, National Centre for Youth Substance Use Research, The University of Queensland, St Lucia, QLD 4072.
Email: b.rutherford@uq.edu.au

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Abstract

Aims: There is a growing body of literature exploring the types of substance-related content and their portrayals on various social media platforms. We aimed to summarize how content related to substances is portrayed on various social media platforms.

Methods: This systematic review was pre-registered on PROSPERO (ref: CRD42021291853). A comprehensive search was conducted in the databases of PubMed, Scopus, PsycINFO and Web of Science in April 2021. Original qualitative studies published post-2004 that included thematic and sentiment analyses of social media content on tobacco, alcohol, psychostimulant, e-cigarette, cannabis, opiate, stimulant/amphetamine, inhalant and novel psychoactive substance were included. Social media platforms were defined as online web- or application-based platforms that allowed users to generate content and interact via 'liking', comment or messaging features. Only studies that included summative and/or thematic content analyses of substance-related social media content were included.

Results: A total of 73 studies, which covered 15 905 182 substance-related posts on Twitter, YouTube, Instagram, Pinterest, TikTok and Weibo, were identified. A total of 76.3% of all substance-related content was positive in its depiction of substance use, with 20.2% of content depicting use negatively. Sentiment regarding opiate use however was commonly negative (55.5%). Most studies identified themes relating to *Health, Safety and Harms* (65.0%) of substance use. Themes relating to *Promotions/Advertisements* (63.3%), *Informative* content (55.0%) and *Use* behaviours (43.3%) were also frequently identified.

Conclusions: Substance-related content that promotes engagement with substance use or actively depicts use appears to be widely available on social media. The large public presence of this content may have concerning influences on attitudes, behaviours and risk perceptions relating to substance use, particularly among the most vulnerable and heaviest users of social media—adolescents and young adults.

KEYWORDS
alcohol, cannabis, e-cigarettes, opiates, polysubstance, social media, substance use, tobacco

INTRODUCTION

Substance use and substance-related disorders continue to be a global burden on the public health, economies and social aspects of communities [1]. Internationally, alcohol and drug use are attributable to 131 million disability-adjusted life-years (DALYs) loss [1] and substance use-related disorders continue to be the leading contributor to disease burden in adolescents and young adults [2]. Early substance use initiation (<15 years) is a significant predictor for the development of substance use disorders and increased substance use in later adulthood [3] in comparison to individuals who did not engage in substance use before 15 years or at all. Investigating the factors, which may increase the likelihood to initiate substance use in adolescence, can help to reduce the global burden of substance use-related disease and improve public health. Further research is needed to determine the influence of exposure to substance-related content from an individual's peers or social network and publicly available material from other parties or influencers.

The rise of online social media

Public access to the internet and digital communication services such as email in the 1990s [4] paved the way for social media platforms, which attracted millions of users and changed the way individuals communicate and interact [5]. Defined for the purposes of this paper as online web- or application-based platforms that allow users to generate content and interact via 'liking', commenting or messaging features, online social media has continued to evolve as the needs of its users change [6]. Global social media use has grown from 1 million monthly active users in 2004 [6] to over 3.6 billion in 2020 [7], with this figure projected to increase to almost 4.41 billion by 2025 [7].

Fuelled by the proliferation of smartphones [4], social media platforms have become integral to the daily lives of adolescents and young adults [8], with research demonstrating that adolescents spend an average of 8 hours per day online [9]. These platforms have become an extension of in-person social circles [10] with the capacity to influence societal norms, attitudes and behaviours on a grand scale [11]. As online platforms continue to increase in popularity with adolescents [12], it is likely that exposure to certain high-risk publicly available content, such as content depicting substance use, may negatively influence youth.

Social media and substance use norms

Higher levels of exposure to substance-related content have been associated with the development of positive norms and attitudes toward alcohol and drug use [13]. Adolescents who are regularly active on social media have a greater likelihood of subsequent tobacco or cannabis use initiation [14]. Additionally, recent research testing the influence exposure to different frequencies of e-cigarette related content may have on adolescent and young adult viewers found an association between higher frequency engagement and lower perceived danger of e-cigarette use [15]. Lower danger perceptions have been associated with increased substance use among adolescents [16]. High frequency viewers also had increased perceptions of substance use acceptability and greater likelihood to initiate use [15]. This research indicates that viewing substance-related content on social media platforms has the capacity to influence societal norms and acceptance of substance use behaviours.

The current study

No systematic review has synthesised the body of literature exploring the portrayals of substance-related content on social media platforms. The purpose of our work was, therefore, to clearly reflect what kinds of substance-related content are accessible and how substance-related content is depicted to viewers. This review aimed to summarise findings from qualitative studies on sentiment and thematic messages presented in substance-related content on various social media platforms and identify future directions for research, surveillance and regulation.

METHODS

Systematic review overview

This review was designed in alignment with the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines [17] and pre-registered on PROSPERO (ref: CRD42021291853).

Eligibility criteria

The inclusion criteria for studies were: (i) original studies that were peer-reviewed and included thematic and sentiment analyses of substance-related content on social media platforms; (ii) where social media platforms were defined as online web- or application-based platforms that allowed users to generate content and interact via 'liking', commenting, or messaging features; and (iii) studies that were published in English and post-2004 (coinciding with the increase in use of social media platforms and advent of social media as it currently) [6].

The exclusion criteria were: (i) commentaries, randomised controlled trials, case reports, literature reviews, conference proceedings or letters to the editor; and (ii) studies only assessing exposure to social media or its content, assessing the efficacy of automated content extraction tools, assessing social network demographics or assessing online reactions to traditional media content or proposed legislation rather than the substance itself.

Search strategy and study selection

A comprehensive search was conducted in the databases of PubMed, Scopus, PsycINFO and Web of Science in April of 2021 to identify relevant research published since 2004 (reflective of the rise in social media use). Additional relevant research was identified by checking the reference lists of included studies and from other reviews. Search strings can be found in the supporting information.

Duplicate articles were removed in EndNote before title and abstract screening in Rayyan, a web-based program for systematic review [18]. Five reviewers (B.N.R., B.C., C.C.W.L., S.H., and J.C.) independently screened titles and abstracts of studies based on eligibility criteria. Each title and abstract was screened twice, and any discrepancies were resolved through verbal discussion between researchers. Finally, the full text of articles were evaluated by two researchers (B.N.R. and B.C.) according to inclusion and exclusion criteria. Consensus was achieved through discussion between the two researchers and Cohen's κ value was used to assess the inter-reviewer reliability (initial κ score = 0.66).

Data extraction

The following study characteristics and outcomes were extracted by two researchers (B.N.R. and B.J.) from each study: author information, publication year, substance depicted, social media platform, quantity of social media content assessed, thematic and sentiment information, metadata of social media content (e.g. likes, views and comments), content type (e.g. text-, image- and video-based) and creator category (e.g. user-generated, influencer, advertisement and media content). These data were independently extracted by two reviewers. Any discrepancies were resolved through discussion until consensus was achieved.

Data synthesis

For each substance category, reported sentiment data was extracted. The sentiment data was totalled to indicate the percentage of social media content reflective of positive, negative or neutral attitudes (Supporting information Table S1 for definitions). We extracted the theme categories identified in the content analyses of included studies and totalled the number of studies, which identified those themes to indicate the proportion of content available on social media that was reflective of these themes. Sentiments and themes were analysed within each of the social media platforms individually.

Quality assessment

Risk of bias was assessed using the Mixed Methods Appraisal Tool (MMAT) [19] for qualitative studies (Supporting information Table S2). Studies were assessed by one reviewer (B.N.R., B.C., C.C.W.L., S.H. or J.C.) and checked by a second reviewer (B.N.R.), using the Qualitative Study question set. This question set required reviewers to determine whether: (i) the approach was appropriate given the research question; (ii) were the data collection methods adequate, (iii) were the findings adequately derived from data; (iv) was the interpretation sufficiently substantiated; and (v) was there coherence between each of these areas? Reviewer responses were tabulated in a Google Sheet document.

RESULTS

Study characteristics

Electronic searches yielded 33 215 titles, including 12 885 duplicates, which were removed. Following this, 19 999 items were excluded after screening the titles and abstracts. Ultimately, 331 full-text articles were assessed, and 73 articles were included in the systematic review (Figure 1). Consensus was then achieved through discussion. Characteristics of the included studies, and quality, can be found in Supporting information Table S2.

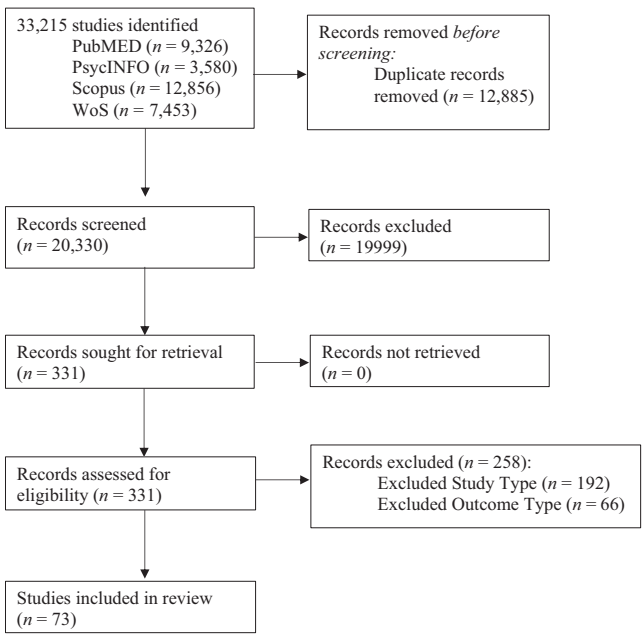

FIGURE 1 PRISMA diagram of studies selection process

A total of 15 905 182 substance-related social media posts (15 804 353 text posts, 68 023 image posts, and 32 470 video posts) were assessed across all 73 studies. Twitter data was analysed in 34 studies [20–53]; 23 studies examined YouTube [54–76]; 10 assessed Instagram content [77–85]; 4 studies used Pinterest images [85–88]; TikTok videos were analysed in 2 studies [89, 90]; and Weibo content was assessed in a single study [91]. E-cigarettes were the most common category analysed (n = 24 studies), followed by tobacco (n = 20 studies), cannabis (n = 18 studies), opiates (n = 6 studies), alcohol (n = 4 studies), psychostimulants (n = 1 study), stimulants/amphetamines (n = 1 study), inhalants (n = 1 study), novel psychoactive substances (NPS) (n = 1 study) and polysubstance use (n = 1 study).

Sample size and data coding

Sample size of included studies varied within social media platforms, with the coding method influencing the quantity of substance-related content posts coded (Supporting information Table S2). Favoured coding methods included manual coding [20–26, 29, 30, 32–34, 37–39, 42, 43, 48, 50–60, 62–91], machine learning [27, 28, 31, 35, 41, 45, 47, 49, 61] or a combination of manual and machine learning [36, 40, 44, 46]. Manual coding was the most common method, and typically involved one or more human coders categorizing data thematically and sentimentally using a codebook derived from data subsets. Disagreements between coders were resolved through discussion to reach consensus. This method of coding was typically used for smaller sample sizes across a range of text-, image- and video-based platforms, with the largest being 14 838 Instagram posts [81]. Machine learning involved the use of algorithms, refined by manual coding of data subsets, to automatically code data via computer program. Studies using this method predominantly focused on Twitter data and extracted a higher number of substance-related content posts [27, 31, 35, 41, 45, 47, 49, 61], the largest being 13 233 837 tweets [47]. There was no difference in findings from manually coded and machine learning samples.

Account type

Account type was usually informed by data found in account profiles (e.g. bio, location, username, profile photos, etc.) or using external screening software [22] (e.g. Demographics Pro). One study identified 'Bots', which are software applications that run automated tasks over the internet (such as 'spam' posting on social media) [35]. Influencer accounts were also identified as sources for substance-related content in a study of Twitter data [32]. User-generated personal accounts were frequently identified in 89.0% of studies. Commercial accounts were identified in 50.7% of the studies and included advertising or promotional content, often providing viewers with direct links to purchase substances or paraphernalia. Public health or education organisations were identified as content sources in 21.9% of studies, followed closely by media accounts (such as news organisations), which were found in 20.5% of studies. Government entities were identified in 5.5% of studies and medical professionals in 2.7% of studies.

Overall sentiment of substance-related content

A total of 38 studies [21, 22, 25, 29, 30, 32, 34–37, 40–48, 50, 52, 53, 55–58, 66, 71, 72, 75, 76, 79, 82, 86, 88–90], analysed the sentiment of substance-related content (n = 14 753 551)[1] on social media. Most substance-related content depicted substance use positively (76.3%). A further 20.2% of substance-related content portrayed substance use negatively and 3.5% of content depicted substance use neutrally. Similar patterns of sentiment were identified in tobacco-, alcohol-, cannabis-, e-cigarette, and polysubstance-related content. Opiate-related content was the only substance type where sentiment was predominantly negative (55.5% of all opiate-related content depicted opiate use negatively). Specific values for each sentiment category can be found in Table 1.

Overall theme categories of substance-related content

Sixty studies [20–24, 26–30, 32–36, 38–40, 42–46, 48, 50, 52–55, 58–85, 87–91] analysed themes identified in substance-related content (n = 2 178 739) on social media. We summarised the themes into 22 overarching categories: *Health*, *Safety and Harms*, *Barriers to Treatment*, *Legislation and Legalisation*, *Use*, *Entertainment*, *Promotions/Advertisements*, *Popular Culture*, *Traditional Culture*, *Informative*, *Sensory Characteristics*, *Access to Substances*, *Polysubstance Use*, *Paraphernalia*, *Perceived Benefits*, *Associated Qualities*, *Attitudes*, *Drug Effects*, *Social Interactions*, *Special Populations*, *Other Risky Behaviours*, *Criminal/Legal Consequences* and *Other* (see Supporting information Table S1 for definitions). Most studies identified themes relating to *Health*, *Safety and Harms* (65.0%; n = 39) of substance use. Themes relating to *Promotions/Advertisements* (63.3%), *Informative* content (55.0%; n = 33) and *Use* behaviours (43.3%; n = 26) were also frequently identified. Further information on the proportion of studies that identified other theme categories can be found in Table 2.

Twitter content

Twenty-eight studies, with a total of 15 792 280 tweets, reported the results of sentiment and thematic analyses on Twitter. Of these studies, 12 assessed e-cigarette-related content [24, 26– 28, 33, 34, 36, 37, 39, 43, 48, 53], nine assessed cannabis-related content [22, 23, 38, 41, 42, 46, 47, 50, 51], five assessed opiate-related content [20, 21, 25, 40, 56], five assessed tobacco-related content [32, 35, 44, 45, 52], one assessed alcohol-related content [30], and a single study assessed polysubstance use-related content [29].

TABLE 1 Results of sentiment analyses of substance-related content on social media.

Substance	Sentiment			Total	References
	Positive, No. (%)	Negative, No. (%)	Neutral, No. (%)		
Tobacco	365 286 (59.8)	182 128 (29.8)	63 451 (10.4)	610 865	[32, 35, 44, 45, 52, 55, 56, 57, 58, 71, 75, 86]
Alcohol	3879 (91.6)	352 (8.3)	NS	4231	[30, 79]
Opiates	3114 (40.7)	4247 (55.5)	288 (3.8)	7649	[21, 25, 40, 56]
Cannabis	2 346 064 (79.5)	543 404 (18.4)	60 766 (2.1)	2 950 234	[22, 41, 42, 46, 47, 50, 76, 88, 89]
E-cigarette	52 560 (85.9%)	4805 (7.9)	3786 (6.2)	61 151	[34, 36, 37, 43, 48, 53, 66, 72, 82, 90]
Polysubstance	2648 (87.9)	365 (12.1)	NS	3013	[29]
Total	2 773 551 (76.3)	735 301 (20.2)	128 291 (3.5)	3 637 143	

NS indicates that data for this column was not stated.

TABLE 2 Theme categories identified in content analyses of substance-related content on social media.

Theme categories	Studies, No. (%)	References
Health, safety and harms	39 (65.0)	[21, 24, 26–28, 30, 32–36, 38, 40, 44, 46, 48, 50, 52, 53, 55, 58–61, 67, 70, 72–75, 79–81, 83–85, 87, 88,90]
Promotions/ advertisements	38 (63.3)	[23, 24, 26–28, 30, 32, 35, 36, 42–44, 48, 50, 53, 55, 58, 60, 62, 64, 65, 67, 68, 72, 73, 75–85, 89, 91]
Informative	33 (55.0)	[20, 23, 26, 27, 36, 38, 39, 42, 45, 48, 54, 55, 60, 61, 63–69, 71–73, 75, 76, 79, 82, 83, 85, 87–89]
Use	26 (43.3)	[21, 23, 28–30, 32, 35, 36, 39, 40, 42–44, 46, 48, 50, 53, 54, 61, 63, 66, 77–79, 83, 85]
Entertainment	21 (35.0)	[22, 26, 36, 45, 55, 58, 59, 61, 62, 70, 72, 73, 75, 78, 80–82, 84, 85, 89, 90]
Polysubstance use	19 (31.7)	[23, 26, 28–30, 32, 35, 36, 45, 46, 48, 50, 61, 66, 70, 71, 78, 79, 85]
Popular culture	15 (25.0)	[29, 30, 32, 46, 50, 55, 58, 61, 68, 71, 75, 81, 84, 85, 91]
Sensory characteristics	15 (25.0)	[24, 26, 28, 35, 36, 43, 44, 48, 61, 69, 71, 74, 81, 84, 85]
Attitudes	13 (21.7)	[26, 27, 30, 46, 50, 63–66, 85, 88–90]
Social interactions	13 (21.7)	[26, 28–30, 32, 35, 45, 46, 50, 74, 80, 82, 84]
Legislation and legalisation	13 (21.7)	[20, 26, 27, 36, 38, 43, 44, 48, 50, 53, 54, 84, 88]
Drug effects	10 (16.7)	[23, 26, 28, 30, 33, 42, 43, 67, 74, 81]
Perceived benefits	9 (15.0)	[22, 29, 46, 50, 52, 69, 71, 87, 88]
Access to substances	8 (13.3)	[24, 26, 27, 35, 42, 46, 53, 71]
Paraphernalia	7 (11.7)	[22, 32, 52, 58, 74, 77, 79]
Special populations	6 (10.0)	[26, 51, 80, 83, 84, 91]
Other	5 (8.3)	[45, 58, 59, 79, 91]
Other risky behaviours	3 (5.0)	[22, 38, 70]
Associated qualities	3 (5.0)	[30, 50, 70]
Barriers to treatment	2 (3.3)	[20, 40]
Traditional culture	1 (1.7)	[91]
Criminal/legal consequences	1 (1.7)	[50]

Sentiment

Twenty-Three studies [21, 22, 25, 29, 30, 32, 34–37, 40–48, 50, 52, 53, 56] reported sentiment analyses of substance-related content on Twitter. Overall, substance-use sentiment on Twitter was positive, with 76.0% of all analysed content depicting substance use positively. Similar trends were identified for alcohol (91.7%), polysubstance (87.9%), cannabis (79.5%), e-cigarettes (61.1%) and tobacco (59.7%) specific content. Sentiments toward opiate use were predominantly negative (55.5%) however, with only 40.7% depicting use positively. Ultimately, negative sentiment was expressed in 20.4% of the Twitter substance-related content assessed (Supporting information Table S3).

Themes

Twenty-Five [20, 21, 23, 24, 26–30, 32–36, 38–40, 42–45, 48, 50, 52, 53] Twitter studies contained thematic analyses of substance-related social media content. Across all substance types, themes relating to *Health, Safety and Harms* were most prominent (84.0%). Themes relating to *Use* (72.0%) and *Promotion/Advertisement* (60.0%) were also frequently identified. *Health, Safety and Harms* was also identified as the most frequent theme category in studies assessing e-cigarette- (100.0%), opiate- (66.7%), alcohol- (100.0%) and tobacco-related (80.0%) content. Themes relating to *Use* in polysubstance use- and cannabis-related (83.3%) content were most common (Supporting information Table S4).

YouTube content

Twelve studies, with a total of 30 781 videos, reported the results of sentiment and thematic analyses on YouTube. Of these studies, nine assessed tobacco-related content [55–59, 71, 74, 75], six assessed e-cigarette-related content [61, 62, 66, 67, 72, 73], five assessed cannabis-related content [63–65, 68, 76], two assessed alcohol-related content [54, 70], one assessed NPS-related content [60], and a final study assessed opiate-, stimulant-, psychostimulant- and inhalant-related content [65].

Sentiment

ine studies [55–58, 66, 71, 72, 75, 76] reported sentiment analyses of substance-related content on YouTube. Overall, substance-use sentiment on YouTube was positive, with 76.7% of all analysed content depicting substance use positively. Similar trends were identified for tobacco (71.9%), cannabis (98.6%) and e-cigarette (66.7%) specific content. Negative sentiment was expressed in only 7.9% of the YouTube substance-related content assessed (Supporting information Table S5).

Themes

Twenty-One [54, 55, 58–76] YouTube studies contained thematic analyses of substance-related social media content. Themes relating to *Informative* content were most common (76.2%) across all substance types, followed by themes relating to *Health, Safety and Harms* (61.9%) and *Promotion/Advertisement* (61.9%). *Health, Safety and Harms* was also identified as the most frequent theme category in studies assessing e-cigarette (83.3%) and tobacco-related (71.4%) content (Supporting information Table S6).

Instagram content

Nine studies, with a total of 64 697 images, reported the results of sentiment and thematic analyses on Instagram. Of these studies, five assessed e-cigarette-related content [81–85], three assessed tobacco-related content [77, 78, 80], and a final study assessed alcohol-related content [79].

Sentiment

Two studies [79, 82] reported sentiment analyses of substance-related content on Instagram. Substance-use sentiment on Instagram was predominantly positive, with 96.4% of all analysed content depicting overall substance use positively. Similar trends were identified for alcohol (91.7%) and e-cigarette (96.4%) specific content. Negative sentiment was expressed in only 3.6% of the Instagram substance-related content assessed (Supporting information Table S7).

Themes

All nine Instagram studies [77–85] contained thematic analyses of substance-related social media content. Overall, themes relating to *Promotion/Advertisement* (100.0%) were most common across substance types. *Use* (66.7%) and *Entertainment* (66.7%) *Promotion/Advertisement* related themes were also the most often identified theme category for e-cigarette- (100.0%), alcohol- (100.0%) and tobacco-related (100.0%) content (Supporting information Table S8).

Pinterest, TikTok and Weibo content

Four studies assessed Pinterest content (n = 3326 images), two studies analysed TikTok content (n = 1689 videos), and a final study assessed content on Weibo (n = 12 073 text posts). These studies focused on content depicting cannabis [87–89], tobacco [86, 91] and e-cigarette [85, 90] content.

Sentiment

Two studies [86, 88] reported sentiment analyses of substance-related content on Pinterest and two reported sentiment analyses on TikTok [89, 90]. Overall, substance-use sentiment on Pinterest (95.7%) and TikTok (58.4%) was positive, with similar trends identified for tobacco (98.9% on Pinterest), cannabis (91.6% on Pinterest; 54.1% on TikTok) and e-cigarette (62.9%) specific content. Negative sentiment was expressed in only 3.8% (Pinterest) and 8.6% (TikTok) of substance-related content assessed (Supporting information Table S9 and S10).

Themes

Three Pinterest studies [85, 87, 88] contained thematic analyses of substance-related social media content. *Health, Safety and Harms* (100.0%) and *Informative*-related (100.0%) themes were present in all

studies. Themes relating to *Attitudes* (66.7%) and *Perceived Benefits* (66.7%) were also prevalent across all substance types on Pinterest (Supporting information Table S11). Both TikTok studies [89, 90] contained thematic analyses of substance-related social media content. *Entertainment* (100.0%), *Attitudes* (100.0) and *Special Populations* (100.0%) themes were the most frequently cited themes in substance-related TikTok videos (Supporting information Table S12). Six, non-mutually exclusive themes were identified in the thematic analysis of Weibo content [91]. These themes were condensed into the categories of *Traditional Culture*, *Popular Culture*, *Promotion/Advertisement*, *Special Populations* and *Other*.

DISCUSSION

This systematic review examined how substance-related content is portrayed on popular social media platforms, including Twitter, YouTube, Instagram, Pinterest, TikTok and Weibo. Sentiment analyses identified that overall, 76% of the substance-related content were depicted positively. Themes identified in the studies were condensed into 22 overarching theme categories, of which themes relating to *Health*, *Safety and Harms*, *Promotion/Advertisement* and *Informative* content were most common. The included studies identified eight account types that were associated with the dissemination of substance-related content: user-generated, commercial, public health organisations, professional organisations, government entities, influencers, Bots and medical professionals, which are further discussed below.

Account type

User-generated

Studies included in this review identified that user-generated content was most likely to be responsible for the dissemination of substance-related content on social media [21–23, 25, 26, 28–31, 33–37, 39–52, 54–56, 58–82, 84, 85, 87–90]. Personal accounts typically expressed positive sentiments toward substance use and shared content relating to *Informative* or *Entertaining* themes. These themes included discussions of personal use experiences, product reviews, do-it-yourself (DIY) or modification tips, tricks, memes and jokes about substance use. User-generated content, particularly content that is designed to entertain and inform, is more likely to influence viewers' substance use attitudes and behaviours [92]. This is likely attributable to increased perceptions of source credibility and authenticity in comparison to commercial information sources [93, 94].

Commercial

Commercial accounts were also a prominent source of pro-substance use messaging, predominantly through advertising and marketing campaigns [24, 26–28, 31, 39, 43–45, 48, 53, 55–58, 62, 64, 67, 71–73, 75, 77, 78, 80–86, 88, 90, 91]. These accounts were primarily for e-cigarette or tobacco companies, and shared content relating to *Promotion/Advertisement* or *Access to Substances* themes. Content offering product giveaways and promoting retailer links may increase the reach of content promoting the use of e-cigarettes and tobacco products [83] and therefore, increase the likelihood of substance use initiation. Existing literature has suggested that the lack of regulation on social media platforms may also increase the dissemination of pro-tobacco and e-cigarette messaging [57].

Public health and educational organisations

Activity from public health and educational organisation account types represented less than 21.9% of samples [21, 34, 38, 43, 45, 48, 49, 54–56, 65, 72, 75]. These accounts primarily shared content that was thematically *Informative* or related to *Health*, *Safety and Harms* associated with substance use. Although the presence of content from these account types may provide viewers with a more informed perspective of the potential risks of substance use, its reach is still limited compared to the content from commercial and user-generated accounts. More action from public health and educational agencies to communicate the potential risks associated with substance use via social media is required to balance the pro-substance use sentiments shared by commercial and user-generated accounts on these platforms.

Themes

Health, safety, and harms

Themes identified as part of the *Health*, *Safety*, *and Harms* category included discussions of substance use safety/side effects, use of opiates for treatment and pain management, cessation, public health messaging, addiction and health consequences/risks. Public health and educational organisations were the predominant account type responsible for the disseminating content coded under these themes. The availability of information discussing the potential health effects of substance use is likely to influence individuals' risk perceptions regarding substance use [95]. Content relating to *Health*, *Safety*, *and Harms* was identified across all social media platforms, indicating that public health and educational messaging regarding the potential health impacts of substance use is becoming more broadly accessible online.

Promotion/advertisement

Promotion/Advertisement themes were typically observed in content created by commercial accounts featuring licit substances. Although the substances depicted are classified as legal, this does not mean that there are no risks associated with regular use. Given the large presence of youth on social media [12] and the popularity of YouTube,

Instagram, TikTok and Facebook among this population [96, 97], promotional content may encourage youth to experiment with or initiate substance use behaviours without appropriately recognising associated risks of use. It is imperative that substance-related promotions are monitored and standardised regulations regarding marketing substances on social media platforms are implemented.

Informative

Themes categorised as *Informative* included tutorial style content such as DIYs, vape modification and recipes, as well as dosage recommendations, use guidelines and discussions of personal use experiences. User-generated accounts were responsible for disseminating most of the *Informative* content on social media. Research has shown that exposure to social media content that informs on shared interests (such as substance use) has significant influence on personal and societal risk perceptions, as well as behavioural intentions [98]. Accordingly, it is likely that viewing user-generated content that provides information on substance use behaviours may result in increased intention to use depicted substances and lower personal risk perceptions regarding substance use.

Sentiment

The pattern of positive sentiment was evident across all platforms and substance types, excluding opiate use, which was predominantly depicted negatively. Accounts with vested interests in the promotion of substance use (e.g. commercial, influencer and Bot accounts), had high levels of positive sentiment. Content from user-generated accounts was also typically positive in its sentiments toward substance use. As previously stated, viewers are more likely to be persuaded by peers and view their messages as more credible than other online sources [92–94]. Therefore, if content from user-generated accounts is perceived to be pro-substance use, it is likely that viewers may adopt pro-substance use attitudes and behaviours. Negative sentiments were more common in content produced by medical professionals or media accounts. Public health and educational organisations and government entities were predominantly neutral in their sentiments toward substance use, most likely because of the desire not to villainise substance use, but to educate the public about possible associated risks [99].

Future directions

Future research should aim to monitor sentiment and thematic depictions of substance-related content on social media platforms, as well as monitoring the commercialisation and promotion of both illicit and licit substances online. Promotional material was identified in nearly all included studies. Because social media is dominated by youth, it may be of interest to explore whether these marketing campaigns are directly targeting youth non-users. Existing literature has begun to demonstrate that exposure to substance-related content on social media can influence risk perceptions, norms, attitudes and behaviours toward substance use [15]. Further research should investigate whether intrapersonal factors of viewers and content format may moderate the relationship between exposure and influence on psychosocial factors associated with substance use.

Limitations

The search strategy for the current review included several key terms and variations for a range of substances, and emerging terms (such as 'slang' terms or terms for newly developed NPS) may have been missed. In addition, the reviewed material is indicative of a bias toward certain platforms (such as Twitter) and licit substances (such as e-cigarettes, and tobacco). In comparison to other social media platform data, Twitter data is relatively easy for researchers to access using its academic research application portal [100]. Licit substances are also more likely to be discussed openly on social media platforms because of the unlikely risk of criminal or legal consequences from posting content relating to these substances. Commercial and user-generated accounts would be less likely to post as publicly or prolifically about use or acquisition of illicit substances. A further limitation of the current body of literature is many of the included studies did not collect metadata information (e.g. views, likes, comments, shares or comments). Content with high metadata values is more likely to be seen and shared among social media users, and therefore, may have a higher influence regardless of whether it is promoting or discouraging substance use. Last, it is important to note that without access to the raw samples of each study, it is impossible to determine whether there is any overlap in study samples, which may lessen the prevalence of substance-related content availability.

Conclusions

Substance-related content that promotes engagement with substance use or actively depicts use continues to be widely available on social media. The large public presence of this content may have negative influences on attitudes, behaviours and risk perceptions relating to substance use, particularly among adolescents and young adults who are the primary users of social media. Social media platforms should consider introducing regulations regarding the marketing of substances online that enhance current practices. Although many platforms take an official zero tolerance policy to content that promotes or attempts to distribute drugs, tobacco and alcohol [100], promotional content continues to proliferate on social media [101]. Current regulatory efforts, such as the removal of explicit hashtags (e.g. '#cannabis') have been found to have a slow-burning impact on the availability of content at best [102] and more stringent measures are required.

AVAILABILITY OF DATA

All data extracted and included studies used in the review are publicly available.

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DECLARATION OF INTERESTS

The authors have no competing interests to declare.

AUTHOR CONTRIBUTIONS

Carmen Lim: Conceptualization; data curation; investigation; methodology. **Benjamin Johnson:** Formal analysis; investigation. **Brandon Cheng:** Data curation; investigation; methodology. **Jack Chung:** Data curation; investigation. **Sandy Huang:** Data curation; formal analysis. **Janni Leung:** Supervision. **Daniel Stjepanović:** Methodology; project administration; supervision. **Gary Chan:** Conceptualization; project administration; supervision.

ORCID

Brienna N. Rutherford https://orcid.org/0000-0002-6034-6527
Carmen C. W. Lim https://orcid.org/0000-0003-1595-6307
Benjamin Johnson https://orcid.org/0000-0003-2831-0150
Jack Chung https://orcid.org/0000-0003-3142-3316
Tianze Sun https://orcid.org/0000-0002-3939-9499
Janni Leung https://orcid.org/0000-0001-5816-2959
Daniel Stjepanović https://orcid.org/0000-0003-4307-423X
Gary C. K. Chan https://orcid.org/0000-0002-7569-1948

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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