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Association Between Exposure to Tobacco Content on Social Media and Tobacco Use
A Systematic Review and Meta-analysis

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Supplemental content

IMPORTANCE Exposure to tobacco-related content on social media may foster positive attitudes toward tobacco products and brands, and influence the likelihood of initiating or continuing use of tobacco, especially among adolescents and young adults.

OBJECTIVE To perform the first systematic review and meta-analysis, to our knowledge, on studies that examined the association between exposure to tobacco content on social media and lifetime tobacco use, past 30-day tobacco use, and susceptibility to use tobacco among never users.

DATA SOURCES Tobacco, social media, and marketing search terms were entered into online databases, including MEDLINE, ISI Web of Science, Scopus, and PsychINFO. Study characteristics, including research design and methods, sampling strategy, and demographics, were assessed for each study.

STUDY SELECTION Studies reporting odds ratios (ORs) for self-reported exposure to, or experimentally manipulated, tobacco content on social media and lifetime tobacco use, past 30-day tobacco, and susceptibility to use tobacco among never users. The systematic search produced 897 independent articles, of which 29 studies met inclusion criteria.

DATA EXTRACTION AND SYNTHESIS A 3-level random-effects meta-analysis was used to estimate ORs, 95% CIs, and heterogeneity (I^2) for each tobacco use outcome. Study quality and publication bias were assessed.

MAIN OUTCOMES AND MEASURES Lifetime tobacco use, past 30-day tobacco use, and susceptibility to use tobacco among never users. Tobacco use included e-cigarettes, cigarettes, and other (cigar, hookah, smokeless tobacco).

RESULTS The total sample size across the 24 included datasets was 139 624, including 100 666 adolescents (72%), 20 710 young adults (15%), and 18 248 adults (13%). Participants who were exposed to tobacco content on social media, compared with those who were not exposed, had greater odds of reporting lifetime tobacco use (OR, 2.18; 95% CI, 1.54-3.08; I^2 = 94%), past 30-day tobacco use (OR, 2.19; 95% CI, 1.79-2.67; I^2 = 84%), and susceptibility to use tobacco among never users (OR, 2.08; 95% CI, 1.65-2.63; I^2 = 73%). Subgroup analyses showed similar associations for tobacco promotions, active engagement, passive engagement, lifetime exposure to tobacco content, exposure to tobacco content on more than 2 platforms, and exposure to tobacco content among adolescents and young adults.

CONCLUSIONS AND RELEVANCE Findings suggest that a comprehensive strategy to reduce the amount of tobacco content on social media should be developed by federal regulators. Such actions may have downstream effects on adolescent and young adult exposure to protobacco content, and ultimately tobacco use behaviors.

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Exposure to tobacco-related content on social media may create brand awareness, increase product appeal, and influence susceptibility to use tobacco among adolescents and young adults.[1-4] Marketing restrictions exist to prevent tobacco companies from advertising combustible cigarettes and chewing tobacco to adolescents and young adults in retail environments and on scripted television and billboards.[5] However, companies that did not sign the Master Settlement Agreement, including e-cigarette companies, are still able to promote their products on social media platforms, which are widely used among adolescents and young adults.[6]

Research has shown that the tobacco industry uses social media platforms, such as Twitter, Facebook, Instagram, and YouTube, to promote tobacco content (ie, references to, or depictions of tobacco-related products, brands, and tobacco use).[7-11] For example, surveillance research has demonstrated that tobacco-related topics are regularly discussed on social media, including tobacco-brand-generated content featuring prevalent topics like product design, flavors, promotions, and vape trick videos.[12-14] Studies have shown that more than half of adolescent participants reported past 30-day exposure to tobacco content on social media and that levels of exposure were associated with tobacco-related attitudes and behaviors.[15,16]

Recent studies have examined the association between exposure to tobacco content on social media that comes in text, image, and audiovisual forms, and tobacco use. For example, music videos popular on YouTube that featured e-cigarette product placement and imagery were associated with lifetime and past 30-day e-cigarette use in a representative sample of young adults (ages 18-24 years) in California.[17] Other research has found that adolescents who were susceptible to tobacco use, compared with adolescents who were not exposed, were more likely to report organic tobacco-related exposure on social media, such as writing, responding, or reblogging tobacco-related posts.[16] Furthermore, engagement (eg, posting or commenting) with online tobacco marketing was associated with increased risk of tobacco use initiation among never tobacco users.[18]

Individual studies have shown that exposure to tobacco content on social media, defined in this study as content designed and/or intended to increase tobacco use through advertising, promotions, sponsorships, or behaviors that positively portrays tobacco use, is a risk factor for tobacco use initiation and continued use, particularly among adolescents and young adults.[19] However, research to date has not summarized the pooled effect of exposure to tobacco content on social media across studies with diverse populations or explored how methodological features or study characteristics, including social media platform type, are associated with tobacco use. The current study sought to fill this gap in the literature by conducting a systematic review and meta-analysis that estimated the overall association between exposure to tobacco content on social media, and lifetime tobacco use, past 30-day tobacco use, and susceptibility to use tobacco among never users.

Key Points

Question Is there an association between exposure to tobacco content on social media and tobacco use?

Findings A systematic review and meta-analysis of 29 studies showed that participants who were exposed to tobacco content on social media, compared with those who were not exposed, had greater odds of reporting lifetime tobacco use, past 30-day tobacco use, and susceptibility to use tobacco among never users.

Meaning Findings suggest that a comprehensive strategy to reduce the amount of tobacco content on social media should be developed by federal regulators; such actions may have downstream effects on adolescent and young adult exposure to protobacco content, and ultimately tobacco use behaviors.

Methods

Search Strategy

The Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) reporting guidelines were used to structure this meta-analysis.[20] Search terms were adopted from a systematic review, in addition to a review of the literature on tobacco, social media, and marketing.[21] Tobacco-related search terms consisted of 40 key words, such as "hookah," "cigarette," "cigar," or "ecig." Social media terms consisted of 20 key words, such as "social," "media," "Twitter," or "Facebook." Marketing search terms consisted of 5 key words, including "advertising," "promotion," "marketing," "intervention," or "content." A Boolean search string was entered into PubMed, PsychINFO, ISI Web of Science, and Scopus (eTable 1 in the Supplement). Two tobacco journals, *Tobacco Control* and *Nicotine & Tobacco Research*, were also used to search for articles that may have been absent from the search engines. Peer-reviewed articles in English, including 1 article in press, and dissertations published between the years 2000 and 2021 were included in the search. Facebook, one of the oldest social media platforms, was launched in 2004, suggesting this time period would be inclusive of most relevant studies.

Inclusion and Exclusion Criteria

To be included in this analysis, a study had to have (1) measured self-reported exposure to, or experimentally manipulated, tobacco content on social media, including tobacco-related organic posts or promotional content (eg, advertising, sponsorships); (2) used a control group (ie, participants who were not exposed to or reported not being exposed to tobacco content on social media); (3) measured tobacco use, including lifetime or past 30-day tobacco use, or susceptibility to use tobacco among never users; and (4) provided raw data (eg, frequencies) to compute odds ratios (ORs) or reported ORs in the article.

A study was excluded from this analysis if it had (1) only measured exposure to tobacco content from a billboard, retail store, tobacco brand page, or retailer website; (2) used a control group that reported some degree of exposure (eg, were exposed to tobacco content at least once in their lifetime) to

tobacco content on social media; (3) only measured cannabis- or alcohol-related content on social media; (4) measured outcomes (eg, negative social consequences, addiction concern) other than tobacco use behaviors; (5) were opinion pieces or editorials; or (6) measured exposure to anti-tobacco content (eg, health campaigns). If relevant statistics were not provided in the article, the lead or corresponding author of the article was contacted. Contact with lead authors was attempted 3 times.

Study Selection

Covidence software was used for title and abstract screening and full-text review.[22] Two reviewers (S.D. and C.P.) independently coded articles in 2 phases. In the first phase, the titles and abstracts of the papers were assessed for relevance, including the presence of tobacco-related, social media-related, and marketing-related search terms. In the second phase, the full-text articles were evaluated based on the inclusion and exclusion criteria. All articles were double-coded and disagreements were discussed until a consensus was reached.

Data Extraction

Data extracted from the included articles were added to an Excel table. Extracted data consisted of study design, methodology, location, population, age, gender, social media platforms, engagement, tobacco content type, exposure time frame, and tobacco-use outcomes.

Study design was coded as mixed methods (ie, both quantitative and qualitative data were collected), cross-sectional, longitudinal, or experimental. Methodology was coded as quantitative (eg, digital survey, telephone survey, paper-pencil survey) or qualitative (eg, open-ended interviews). Location was coded at the country level and included state-level information for the US. Sample size was coded to reflect the number of participants from each study. Population was coded to reflect adolescents (age <18 years), young adults (age 18-25 years), or adults (age >25 years). The age range of each study was coded. Gender was coded as the percentage of female participants.

Social media platforms including Facebook, Twitter, YouTube, Pinterest, GooglePlus, Tumblr, Instagram, Snapchat, or unspecified were recorded. Engagement was coded as active engagement (ie, searching, posting, commenting, and/or liking tobacco-related content on social media) or passive engagement (ie, only viewing advertisements, promotions, or tobacco-related coupons on social media). Tobacco-content type was coded as organic tobacco use (ie, as user-generated tobacco-related posts displaying tobacco use behaviors), or promotional (ie, tobacco-related advertising, promotion, or sponsorship). Exposure to social media content was coded as lifetime or past 30 days. Exposure recall method was coded as open-ended, check box, yes/no, or scale. Tobacco use outcomes were coded as lifetime tobacco use (eg, any form of tobacco use, including e-cigarettes, cigarettes, or other tobacco use), past 30-day tobacco use, and susceptibility to use tobacco among never users. Within tobacco use outcomes, product types were defined as e-cigarettes, cigarettes, or other tobacco use (eg, hookah, smokeless tobacco, cigars).

To assess the association between design quality, sample breadth, and effect size, a rubric developed by Wellman et al[23] was used (see eTable 2 in the Supplement). The rubric presents design quality on a continuum: cross-sectional/convenience, cross-sectional/representative, longitudinal/convenience, longitudinal/representative, and experimental/convenience. Experimental designs were ranked the highest for demonstrating potential causality between exposure to tobacco content on social media and tobacco use. Sampling breadth was coded at the local, state, and national level.

Statistical Analysis

To test the hypothesis that participants who were exposed to tobacco content on social media, compared with those who were not exposed, will have greater odds of reporting lifetime tobacco use, past 30-day tobacco use, and susceptibility to use tobacco among never users, a random-effects meta-analysis was used.[24] ORs were collected from each primary study or were computed from raw data using the practical meta-analysis calculator.[25] Several studies reported multiple effect sizes, creating statistical dependency known as the unit-of-analysis error.[26] To account for statistical dependency, 3-level generic inverse-variance random-effects meta-analysis was used.[27]

Heterogeneity measures the extent to which effect sizes vary between studies. Heterogeneity of effect sizes was assessed using a restricted maximum-likelihood estimator for t^2 and I^2. Subgroup analyses, including demographic and methodological variables, were examined to assess their association with tobacco use outcomes. Subgroup variables may help explain why effect sizes differ from study to study, including differences in demographic characteristics and study design. A test for subgroup differences was performed using Q, df, and P values to detect statistical significance among categories within subgroup variables.

Publication bias (ie, the threat that excluding nonsignificant findings may impact the effect size estimates) was assessed in 3 ways. Rücker limit meta-analysis was used to measure bias owing to small-study affects.[28-30] A P-curve analysis was used to assess P-value hacking (ie, when researchers perform statistical analyses until nonsignificant results become significant).[31] P-values were 2-tailed and a P-curve analysis shows the number of effect sizes that were significant at $P = .05$, $P = .04$, $P = .03$, and so forth. A true underlying effect is present when highly significant findings ($P = .01$) are more likely than marginally significant findings ($P = .049$).[32] Fail-safe Ns were calculated using the Rosenthal method to determine the number of nonsignificant findings needed to make the effect size estimates lose significance.[33] In other words, the amount of negative findings it would take to reverse a significant P value for an effect size. Rosenthal suggested 5 times the number of included effect sizes plus 10 (5000 +10) would serve as a threshold to determine the presence of publication bias.[33] All meta-analysis procedures were performed in R (version 3.5.0; R Project)[34] using the packages meta and metafor (version 4.9-2; R Project).[35]

Results

The total sample size across the 24 included datasets was 139 624, including 100 666 adolescents (72%), 20 710 young adults (15%), and 18 248 adults (13%). **Figure 1** shows the PRISMA diagram of study inclusion with a total of 1331 articles identified using the key word search strategy. After the removal of duplicate articles, 897 articles were selected for title and abstract screening. Eighty-nine articles were eligible for full-text review from which 60 articles were removed based on the exclusion criteria. The analytic sample for this meta-analysis comprised 29 articles.

Study Characteristics

The numbers found in eTable 3 in the Supplement from articles (Clendennen et al 2020,[6] 2020,[36] and 2021[37]; Emery et al 2014,[38] and 2019[39]; Soneji 2018,[40] 2019,[41] and 2019[42]) relied on the same data set. The total sample size across the 24 independent data sets was 139 624 participants, including 100 666 adolescents (72%), 20 710 young adults (15%), and 18 248 adults (13%). All studies were conducted after 2014 with most studies from 2017 through 2021. In terms of study design, 14 (59%) used cross-sectional methods, 7 (29%) used longitudinal methods, 2 (8%) used mixed methods, and 1 (4%) study used an experimental design. Most studies used digital surveys (n = 19; 79%). Study locations ranged from states in the US (Connecticut, Texas, California, Hawaii) to India, Australia, and Indonesia.

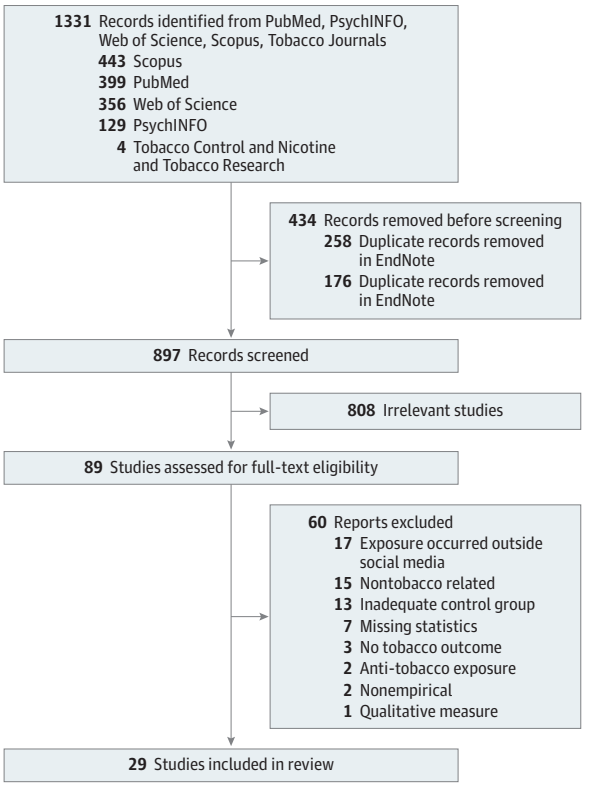
Exposure to Tobacco Content on Social Media and Lifetime Tobacco Use

Participants who were exposed to tobacco content on social media, compared with those who were not exposed, had greater odds of reporting lifetime tobacco use (OR, 2.18; 95% CI, 1.54-3.08; I^2 = 94%) (**Figure 2**).[43-58] Similar associations were found for specific products like e-cigarettes, cigarettes, and other tobacco products. Subgroup analyses showed that participants exposed to organic tobacco use content on social media, compared with those who were not exposed, had greater odds of reporting lifetime tobacco use (OR, 2.36; 95% CI, 1.53-3.62; I^2 = 76%) (eTable 4 in the Supplement). Similar associations were found for tobacco promotions, active engagement, passive engagement, lifetime exposure to tobacco content, exposure to tobacco content on more than 2 platforms, and exposure to tobacco content among young adults.

Exposure to Tobacco Content on Social Media and Past 30-Day Tobacco Use

Participants who were exposed to tobacco content on social media, compared with those who were not exposed, had greater odds of reporting past 30-day tobacco use (OR, 2.19; 95% CI, 1.79-2.67; I^2 = 84%) (eFigure 3 in the Supplement). Similar associations were found for specific products like e-cigarettes, cigarettes, and other tobacco products. Subgroup analyses showed that participants who were exposed to tobacco content on social media, compared with those who were not exposed, had greater odds of reporting past 30-day tobacco use (OR, 1.94; 95% CI, 1.72-2.19; I^2 = 73%) (eTable 5 in the Supplement). Similar associations were found for tobacco promotions, active engagement, passive engagement, lifetime exposure to tobacco content, past 30-day exposure to tobacco content, and exposure to tobacco content on more than 2 platforms.

Figure 1. PRISMA Diagram of Study Inclusion



Exposure to Tobacco Content on Social Media and Susceptibility to Use Tobacco Among Never Users

Figure 3[59-63] shows that participants who were exposed to tobacco content on social media, compared with those who were not exposed, had greater odds of reporting susceptibility to use tobacco among never users (OR, 2.05; 95% CI, 1.61-2.60; I^2 = 100%). Subgroup analyses showed that participants who were exposed to tobacco content on social media, compared with those who were not exposed, had greater odds of reporting organic tobacco use content on social media (OR, 2.18; 95% CI, 1.56-3.06; I^2 = 63%) (eTable 6 in the Supplement). Similar associations were found for tobacco promotions, active engagement, passive engagement, lifetime exposure to tobacco content, past 30-day exposure to tobacco content, and exposure to tobacco content on more than 2 platforms, and adolescents.

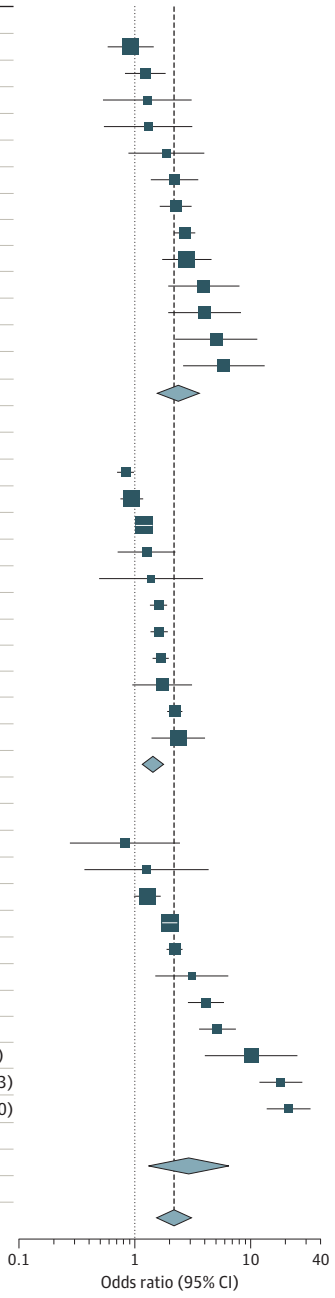
Design Quality, Sampling Breadth, and Publication Bias

Studies with cross-sectional/convenience designs had larger effect sizes than cross-sectional/representative, and longitudinal and experimental designs. Sampling breadth was unrelated to effect size (see eTable 2 in the Supplement).

The Rücker limit meta-analysis method showed that bias adjusted (OR, 1.95; 95% CI, 1.69-2.25; z = 9.29) and bias unad-

Figure 2. Forest Plot of 3-Level Meta-analysis for Exposure to Tobacco Content on Social Media and Lifetime Tobacco Use, Including e-Cigarettes, Cigarettes, and Other Tobacco Use

Study	Effect size	Odds ratio (95% CI)	Relative weight, %
Lifetime e-cigarette use			
Donaldson et al,[54] 2022	2	0.92 (0.58-1.45)	5.4
Camenga et al,[49] 2018	3	1.23 (0.82-1.84)	2.4
Camenga et al,[49] 2018	4	1.28 (0.53-3.09)	1.4
Camenga et al,[49] 2018	2	1.30 (0.54-3.13)	1.4
Hébert et al,[16] 2017	10	1.87 (0.88-3.98)	1.6
Camenga et al,[49] 2018	1	2.20 (1.37-3.53)	2.2
Hébert et al,[16] 2017	4	2.25 (1.64-3.09)	2.6
Choi,[52] 2016	6	2.69 (2.18-3.32)	2.5
Majmundar et al,[59] 2021	2	2.81 (1.72-4.59)	5.3
Sawdey et al,[64] 2017	1	3.94 (1.94-8.00)	3.1
Sawdey et al,[64] 2017	2	4.00 (1.94-8.25)	3.1
Amin et al,[47] 2020	1	5.04 (2.23-11.41)	3.0
Amin et al,[47] 2020	3	5.87 (2.61-13.21)	3.0
Random-effects model		2.38 (1.57-3.61)	36.9
Heterogeneity: I^2 = 73%; τ^2 = 0.2750; P <.001			
Lifetime cigarette use			
Septiono et al,[65] 2021	3	0.83 (0.70-0.98)	2.0
Dunlop et al,[55] 2016	2	0.94 (0.75-1.18)	5.8
Coreas et al,[53] 2021	1	1.20 (1.01-1.42)	5.9
Hébert et al,[16] 2017	3	1.26 (0.71-2.24)	2.0
Hébert et al,[16] 2017	9	1.38 (0.49-3.88)	1.1
Septiono et al,[65] 2021	5	1.60 (1.35-1.90)	2.0
Septiono et al,[65] 2021	1	1.62 (1.36-1.92)	2.0
Septiono et al,[65] 2021	4	1.67 (1.42-1.96)	2.0
Majmundar et al,[58] 2019	1	1.72 (0.95-3.12)	3.2
Choi,[52] 2016	2	2.21 (1.90-2.57)	2.6
Bauhoff et al,[48] 2017	1	2.37 (1.39-4.04)	5.2
Random-effects model		1.44 (1.16-1.78)	33.7
Heterogeneity: I^2 = 90%; τ^2 = 0.0970; P <.001			
Lifetime other tobacco use			
Majmundar et al,[58] 2019	3	0.82 (0.27-2.45)	1.7
Majmundar et al,[58] 2019	4	1.26 (0.37-4.33)	1.5
Soneji et al,[40,41,42] 2018 and 2019	1	1.28 (0.98-1.67)	5.7
Cavazos-Rehg et al,[50] 2014	1	2.00 (1.72-2.33)	5.9
Choi,[52] 2016	4	2.20 (1.88-2.58)	2.5
Roby et al,[63] 2020	5	3.10 (1.50-6.41)	1.2
Roby et al,[63] 2020	1	4.11 (2.87-5.88)	1.7
Roby et al,[63] 2020	3	5.17 (3.59-7.45)	1.7
Soneji et al,[66] 2019	1	10.09 (4.02-25.34)	4.2
Roby et al,[63] 2020	2	18.23 (11.90-27.93)	1.6
Roby et al,[63] 2020	4	21.27 (13.75-32.90)	1.6
Random-effects model		2.92 (1.31-6.49)	29.4
Heterogeneity: I^2 = 96%; τ^2 = 1.0875; P <.001			
Random-effects model		2.18 (1.54-3.08)	100
Heterogeneity: I^2 = 94%; τ^2 = 0.5228; P <.001			

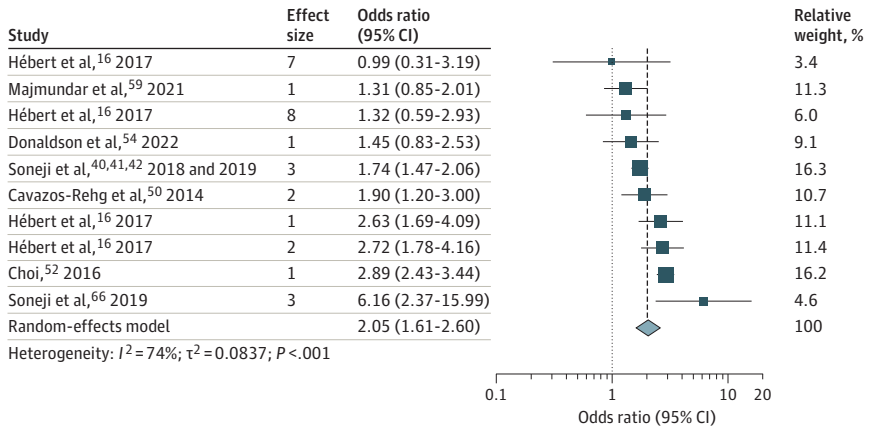


justed (OR, 2.08; 95% CI, 1.86-2.31; z = 13.35) random-effects models were similar. In other words, it is unlikely that the findings were spurious and influenced by publication bias. Evidential value was present (right-skewness test, P = .001) in the P-curve analysis, suggesting the presence of a true nonzero effect. In other words, the effect sizes estimated were likely not caused by selective reporting. The Rosenthal fail-safe N showed that 68 867 null effects would be needed to render the overall effect size nonsignificant, which greatly exceed the 595-effect size benchmark. In other words, the exclusion of nonsignificant findings likely did not impact effect size estimates.

Discussion

This study provided the first systematic review and meta-analysis, to our knowledge, summarizing the association between exposure to tobacco content on social media and

Figure 3. Forest Plot of 3-Level Meta-analysis for Exposure to Tobacco Content on Social Media and Susceptibility to Use Tobacco Among Never Users



tobacco use outcomes as aggregated from 29 peer-reviewed articles. This study showed that exposure to tobacco content on social media was associated with increases in lifetime tobacco use, past 30-day tobacco use, and susceptibility to use tobacco among never users, respectively. Subgroup analyses demonstrated that exposure to organic tobacco content and tobacco promotions, active engagement with tobacco content, exposure to tobacco content on more than 2 platforms, and being an adolescent or young adult were associated with tobacco use behaviors.

The present study found that adolescents who were exposed to tobacco content on social media, compared with adolescents who were not exposed, had greater odds of reporting susceptibility to use tobacco.[64] This finding is comparable with a previous meta-analysis[23] that showed that adolescents exposed to protobacco marketing and media in films were more likely to initiate tobacco use. Public health practitioners may consider these findings when designing interventions aimed at countering the influence of protobacco content on social media. Interventions that educate adolescents on tobacco industry marketing manipulation on social media may help deter tobacco use among this group.

Most adolescents (71%) use more than 1 social media platform and nearly one-quarter of adolescents are online "almost constantly."[65] Participants who were exposed to tobacco content on more than 2 social media platforms, compared with those not exposed, had greater odds of reporting lifetime e-cigarette use, lifetime other tobacco use, past 30-day tobacco use, past 30-day other tobacco use, and susceptibility to use tobacco among never users. These findings offer support for the passage of the Kids Internet and Design Safety Act,[66] which proposes to "stop online practices such as manipulative marketing, amplification of harmful content, and damaging design features, which threaten young people online." Exposure to, and engagement with, tobacco content on multiple social media platforms may exacerbate these vulnerabilities. Findings from this study warrant urgent attention to address youth exposure to tobacco-related discussions on social media.

Federal regulators should use this meta-analysis as motivation to enact legislation that curbs tobacco-related content on social media platforms. While the US Food and Drug Administration and the Federal Trade Commission have previously issued warning letters to specific companies that have been found in violation of tobacco marketing regulations on social media, tobacco industry marketing on social media is still largely unregulated.[59] Social media platforms may want to ensure adequate safeguards are in place to protect adolescents from tobacco content. Social media platforms could add warning labels to a post if a tobacco-related term was present.

Limitations

Most of the studies examined in this meta-analysis relied on self-reported survey instruments, which increased the likelihood of self-report bias. Only 1 study from our data used an experimental design, preventing us from understanding the temporal precedence between exposure to tobacco content on social media and tobacco use. There was an association between design quality and effect size, suggesting that studies that used cross-sectional designs may have inflated the association between exposure to tobacco content on social media and tobacco use. Subgroup analyses for susceptibility to use tobacco among never users should be interpreted with caution owing to the small number of included effect sizes. Five studies that met inclusion criteria were not included in the final analysis owing to incomplete data and nonresponses from the corresponding authors.

Conclusions

Exposure to tobacco content on social media may encourage tobacco use initiation and normalize tobacco use behaviors among regular social media users, like adolescents and young adults. Prevention education programs that denormalize tobacco use may be needed to counter the influence of the protobacco environment on social media. Future research would benefit from implementing experimental designs to assess

causality between exposure to tobacco content on social media and tobacco use. Additionally, future research should explore how different social media platforms influence tobacco use. Findings from this meta-analysis could be useful for policy makers motivated to curb tobacco-related content on social media. Comprehensive regulations could reduce exposure to tobacco content online and ultimately reduce tobacco-related behaviors among adolescents and young adults.

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Concept and design: Donaldson, Allem.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Donaldson, Allem.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: Donaldson.
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Administrative, technical, or material support: Dormanesh, Perez, Allem.
Supervision: Allem.

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