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Critical Review

Meta-Analysis of the Association of Alcohol-Related Social Media Use with Alcohol Consumption and Alcohol-Related Problems in Adolescents and Young Adults

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Despite the pervasive use of social media by young adults, there is comparatively little known about whether, and how, engagement in social media influences this group's drinking patterns and risk of alcohol-related problems. We examined the relations between young adults' alcohol-related social media engagement (defined as the posting, liking, commenting, and viewing of alcohol-related social media content) and their drinking behavior and problems. We conducted a systematic review and meta-analysis of studies evaluating the association of alcohol consumption and alcohol-related problems with alcohol-related social media engagement. Summary baseline variables regarding the social media platform used (e.g., Facebook and Twitter), social media measures assessed (e.g., number of alcohol photographs posted), alcohol measures (e.g., Alcohol Use Disorders Identification Test and Timeline Follow back Interview), and the number of time points at which data were collected were extracted from each published study. We used the Q statistic to examine heterogeneity in the correlations between alcohol-related social media engagement and both drinking behavior and alcohol-related problems. Because there was significant heterogeneity, we used a random-effects model to evaluate the difference from zero of the weighted aggregate correlations. We used metaregression with study characteristics as moderators to test for moderators of the observed heterogeneity. Following screening, 19 articles met inclusion criteria for the meta-analysis. The primary findings indicated a statistically significant relationship and moderate effect sizes between alcohol-related social media engagement and both alcohol consumption (r = 0.36, 95% CI: 0.29 to 0.44, $p < 0.001$) and alcohol-related problems (r = 0.37, 95% CI: 0.21 to 0.51, $p < 0.001$). There was significant heterogeneity among studies. Two significant predictors of heterogeneity were (i) whether there was joint measurement of alcohol-related social media engagement and drinking behavior or these were measured on different occasions and (ii) whether measurements were taken by self-report or observation of social media engagement. We found moderate-sized effects across the 19 studies: Greater alcohol-related social media engagement was correlated with both greater self-reported drinking and alcohol-related problems. Further research to determine the causal direction of these associations could provide opportunities for social media-based interventions with young drinkers aimed at reducing alcohol consumption and alcohol-related adverse consequences.

Key Words: Alcohol, Social Media, Underage Drinking, Adolescents, Young Adults, Meta-Analysis.

MANY ADOLESCENTS AND young adults engage in excessive alcohol consumption. The National Survey on Drug Use and Health found that, in 2016, 9% of adolescents and 57% of young adults consumed alcohol in the past month (Substance Abuse and Mental Health Services Administration, 2017). Of these individuals, 4.9% of adolescents and 38.4% of young adults engaged in binge drinking, which is defined as consuming 4 drinks for women or 5 drinks for men on the same occasion on at least 1 day in the past 30 days. In addition, nearly 1% of adolescents and 10% of young adults engaged in heavy alcohol use, which is defined as binge drinking on 5 or more days in the past 30 days (National Institute on Alcohol Abuse and Alcoholism, 2017; Substance Abuse and Mental Health Services Administration, 2017). This pattern of alcohol consumption leads to adverse psychosocial and health-related

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ALCOHOLISM CLINICAL & EXPERIMENTAL RESEARCH

consequences (Popovici and French, 2013; Wechsler et al., 2000) and is associated with poor academic achievement, suicidal behavior, tobacco use, risky sexual behaviors, alcohol-related injuries, and driving while under the influence of alcohol (Miller et al., 2007; Wechsler et al., 1994).

Social media platforms are extremely well integrated into the lives of adolescents and young adults. In recent decades, the use of social networking sites (SNSs) such as Facebook, Twitter, and Instagram has increased substantially, such that 90% of individuals aged 18 to 29 in the United States maintain personal SNS accounts (Perrin, 2015). Facebook is the most widely used SNS in the world, with an average of 1.32 billion active users (Facebook, 2017). It is the third most popular website in the United States (ALEXA, 2016), with 79% of U.S. adult Internet users having a Facebook account and 76% of those accessing their account daily (Greenwood et al., 2016). SNS engagement is facilitated through information posted on one's profile, which often includes photographs and a discussion with friends of one's thoughts, actions, whereabouts, and other important personal information. The content of these posts is skewed toward positive experiences and events (e.g., parties, trips, and birth of a child), creating a happy, entertaining social networking presence (Utz, 2015). Users also contribute SNS content by "liking" and sharing content created by others (e.g., sharing a blog post or video, or expressing support for a business).

SNSs have evolved from personal sharing platforms to include commercial content. Substance use, particularly alcohol consumption, is frequently advertised, endorsed, and displayed on social media. As a consequence, social media has become an environment in which alcohol consumption (binge drinking in particular) is normalized and glamorized among adolescents and young adults (Griffiths and Casswell, 2010). A content analysis of 225 university undergraduate males' Facebook profiles found that 85% contained alcohol references (Egan and Moreno, 2011). In a survey of male and female college students' posting of images depicting alcohol consumption on SNSs, as many as one-third reported posting pictures of themselves drinking alcohol (Morgan et al., 2010). These depictions are often delivered in a comedic fashion and omit consideration of the negative consequences of drinking.

Moreover, alcohol-related social media engagement may influence drinking behavior. A review of the literature on the relations between social media and addictive behaviors in college students concluded that exposure to social media "breed[s] misperceptions regarding acceptance and prevalence of addictive behaviors" (Steers et al., 2016, p. 347). The authors of this review noted that positive social validation for substance use-related posts (conveyed through "likes," shares, or comments) is likely to increase the frequency and intensity of students' alcohol consumption. Consistent with this hypothesis, exposure to peers' alcohol-related content on Facebook, Instagram, and Snapchat during the first 6 weeks of school in 408 first-year college students predicted alcohol consumption 6 months later. This finding was present after controlling for drinking during the initial 6-week period (Boyle et al., 2016).

To date, reviews have considered drinking behavior in relation to risk behaviors or advertising content rather than focusing specifically on alcohol-related SNS engagement (Groth et al., 2017; Steers et al., 2016). To address this issue systematically, we conducted a meta-analysis of published literature to test the hypothesized positive association of alcohol-related social media engagement (i.e., posting, liking, commenting, and viewing alcohol-related social media content) with both alcohol consumption and alcohol-related problems among young adults.

MATERIALS AND METHODS

Identification and Screening of Articles

To identify articles, we followed a standard protocol outlined in the Preferred Reporting Items for Systematic Reviews & Meta-Analysis (PRISMA, 2015; see Fig. 1). We searched MEDLINE (via PubMed), PsycINFO, EMBASE, Scopus, and the Cochrane Library using the MeSH heading terms and selected free text for "social media," and the most commonly used platforms, "Facebook," "Twitter," "YouTube," "Snapchat," or "Instagram." The search was limited to "alcohol," English language literature, and articles or reviews published before January 2017. Article titles were compiled across the database findings, and duplicates were removed. We reviewed the bibliographies of included articles and applicable reviews for missed publications. Two authors (BLC and SJL) screened the abstracts of studies identified in the search and removed poster abstracts and those that lacked either relevant social media variables (i.e., observational and self-reported social media posting, viewing, and interacting with alcohol-related material posted by friends or advertisements) or alcohol variables or were otherwise unrelated to these topics. Studies including social media variables that were not relevant to the current project (e.g., social media content analysis, alcohol advertisement on social media, views on social media posting about alcohol consumption, and qualitative studies) were excluded. The 2 authors resolved disagreements ($n = 9$) through a discussion of the criteria for selection; a third reviewer (DER) helped to resolve persistent disagreements. Studies that assessed social media and alcohol consumption were retained for full-text analysis, and we excluded studies that used social media only as a form of recruitment, focused on a content analysis of social media sites, or measured alcohol advertising (Table S1).

We collected the following data from each study: the social media platform used (e.g., Facebook and Twitter), social media measures assessed (e.g., number of alcohol posts and density scores of alcohol images), alcohol-related measures used (e.g., Alcohol Use Disorders Identification Test [AUDIT; Saunders and Aasland, 1987], Rutgers Alcohol Problem Index [RAPI; White and Labouvie, 1989]; and Timeline Followback Interview [TLFB; Sobell and Sobell, 1992]), and the number of time points at which data were collected (see Table 1). The AUDIT assesses drinking behaviors, alcohol consumption, and consequences, whereas the RAPI is specific to adolescent and young adult problem drinking; both are considered robust and valid measures of problematic drinking. The TLFB queries the frequency and intensity of alcohol consumption only. We tested 5 study characteristics as moderators: (i) study design (whether the alcohol-related social media engagement and alcohol consumption were measured jointly at once or individually at 2 different time points), (ii) the social media platform with which

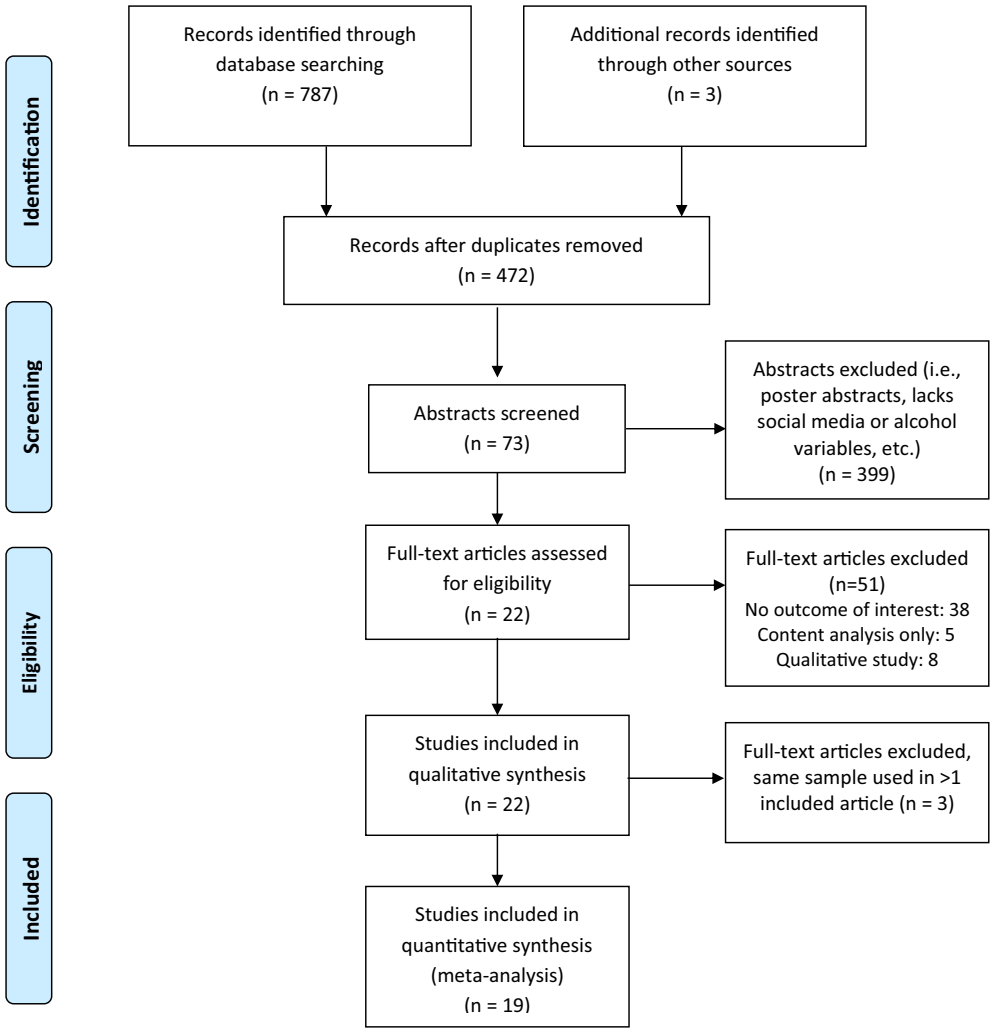

Fig. 1. Study flow diagram.

alcohol-related social media engagement was assessed (Facebook vs. other sites), (iii) the method used to measure alcohol consumption (TLFB vs. other methods), (iv) statistical analysis used (correlation, linear regression, logistic regression, and mean differences), and (v) study location (studies conducted outside of the United States vs. studies conducted in the United States). There were 2 categories of alcohol-related measures that were consistently evaluated across studies: alcohol consumption (i.e., the amount of alcohol consumed in a given time period) as reported in a single question or on the TLFB; and alcohol-related problems (e.g., regret after drinking, blacking out, and sustaining injuries while drinking), which was measured using the AUDIT (though in 1 study, the RAPI was used).

Analysis

For meta-analysis, we used r, Pearson's correlation coefficient following Fisher's Z transformation as the effect size. For studies reporting other measures, such as a mean difference or odds ratio, we converted the effects to correlations using the methods proposed by Borenstein and Cooper (2009). We used a random-effects model and the Q statistic to determine whether there was significant variability among study effect sizes. The I^2 statistic is reported as a measure of the proportion of variance attributed to study heterogeneity. A forest plot (Fig. 2) displays the individual studies and the weighted aggregated effect from the random-effects model. In the face of significant heterogeneity in effect sizes among the studies, we conducted a metaregression with study characteristics entered as moderators. Because the meta-analysis was limited to published articles, we also assessed publication bias using the Egger regression. All analyses were conducted in SAS v9.4 (SAS Institute Inc., Cary, NC).

RESULTS

Figure 2 shows the forest plot from the random-effects model for alcohol consumption. There was no evidence for publication bias ($t = 0.58$, $p = 0.57$; see Fig. 3). The weighted effect size was $r = 0.36$ (95% CI: 0.29 to 0.44), which was statistically significant ($p < 0.001$) and reflected a moderate effect size (Cohen, 1992) for the correlation between alcohol-related social media engagement and alcohol consumption. As evidenced by the varying size of the correlations and nonoverlapping confidence intervals, the heterogeneity between studies exceeded random variation ($\chi^2_{16} = 7{,}429$, $p < 0.001$), accounting for 93% of the variability in correlations ($I^2 = 0.93$).

Table 1. Studies Included in Meta-Analysis

References	Population	Measurement recording	Sample size	Statistic	SNSs	SNS measure (time period)	Alcohol measure (time period)	No. of time points
Fournier and Clarke (2011)	United States, college students	Observation	68	Correlation	Facebook	Total alcohol pictures/posts (last 100 tagged/posted photographs)	Self-report alcohol consumption (unspecified)	1
Glassman (2012)	United States, college students	Self-report	445	Linear regression	Facebook	Do you post photographs of you drinking? (Y/N)	Drinks per week (average weekly consumption)	1
Ridout et al. (2012)	Australia, college students	Self-report	158	Linear regression	Facebook	Alcohol identity measured by total alcohol-related pictures (all) and posts (past 6 months)	RAPI (past year), Graduate-Frequency Measure (past year), AUDIT (past year)	1
Huang et al. (2014)	United States, adolescents	Observation	1,563	Linear regression	Facebook, MySpace	Friends' alcohol postings (past 30 days)	Alcohol consumption status score (range 1 to 5) (past 30 days)	2
Hoffman et al. (2014)	United States, college students	Self-report	637	Linear regression	All Social Media	Alcohol-related Social Media Use Index (past 3 months)	Alcohol consumption (past 30 days)	1
D'Angelo et al. (2014)	United States, college students	Observation	312	Correlation	Facebook	Alcohol displays (past 3 months)	TLFB binge drinking (last 28 days)	2
van Hoof et al. (2014)	the Netherlands, college students	Observation	71	Correlation	Facebook	Density scores for photographs (last 20), updates (last 10), info (0 to 50 items listed)	TLFB quantity and frequency (past 30 days), AUDIT (past year)	1
Westgate et al. (2014)	United States, college students	Self-report	1,106	Correlation	Facebook	How often post alcohol-related content (unspecified)	RAPI (past 3 months), Daily Drinking Questionnaire (past 3 months), AUDIT (past year)	1
Miller et al. (2014)	Australia, female college students	Self-report	129	Correlation	Facebook	Percentage of posts related to alcohol; unspecified	Alcohol consumption as measured by AUDIT-C (unspecified)	1
Moss et al. (2015)[a]	United Kingdom, college students	Self-report	145	Logistic regression	Facebook	Dichotomous engagement in a drinking game (neknomination), unspecified	AUDIT (past year)	1
Jones et al. (2016)	Australia, adolescents & young adults	Self-report	283	Logistic regression	Facebook	Any Facebook likes, views and interests in alcohol vs. none, unspecified	Alcohol use frequency (past year)	1
Geusens and Beullens (2016)	Belgium, adolescents	Self-report	3,133	Correlation	Facebook, Instagram, Snapchat	Sharing alcohol references on social media (unspecified)	AUDIT alcohol consumption subscale (past year)	1
Cabrera-Nguyen et al. (2016)	United States, young adults	Self-report	587	Logistic regression	Twitter	Exposure to alcohol-related social media (past year)	Self-report heavy episodic drinking (past 30 days)	1
Boyle et al. (2016)	United States, college students	Self-report	408	Correlation	Facebook, Twitter, Instagram	Social media alcohol exposure (past year)	Drinks per week (last 30 days)	2
Marczinski et al. (2016)	United States, college students	Self-report	146	Linear regression	Facebook	Alcohol-related Facebook Activity (past 30 day Facebook use)	TLFB number of drinks (past 30 days), AUDIT (past year)	1
Moreno et al. (2016)	United States, college students	Self-report	94	Logistic regression	Facebook, Twitter	Total posts and alcohol references (past 5 months)	TLFB drinks (past month)	2
Rodriguez et al. (2016)	United States, college students	Self-report	109	Correlation	Facebook	Alcohol-related SNS posts (most recent 100 posts)	Drinks per week (unspecified)	1
Thompson and Romo (2016)	United States, college students	Self-report	364	Correlation	Facebook, Twitter, Instagram	Alcohol-related SNS use (unspecified)	Drinks per week (past 30 days), RAPI (past 3 months)	1
Hormes (2016)[a]	United States, college students	Self-report	537	Mean difference	Facebook	Average pattern of daily SNS use (variable time with each question)	AUDIT (past year)	1

AUDIT, Alcohol Use Disorders Identification Test; RAPI, Rutgers Alcohol Problem Index; SNS, social networking site; TLFB, Timeline Follow back Interview.
[a]Alcohol problems only; alcohol consumption measures query the number of standard drinks on the RAPI, AUDIT, AUDIT-C, and TLFB.

The top part of Table 2 shows the results of the metaregression, in which study type was a significant moderator ($b = -0.22$, $p = 0.02$). Studies that assessed both alcohol-related social media engagement and alcohol consumption at a single time point had a weighted correlation of $r = 0.40$, while the same statistic for studies that assessed these measures at separate time points was $r = 0.20$. Also, studies where researchers observed social media use had significantly smaller associations ($b = -0.25$, $p = 0.01$) than studies that used self-reports, with correlations of 0.15 and 0.40, respectively. In contrast, studies that used only Facebook postings as a measure of alcohol-related social media engagement did not differ from those that used other social media platforms ($b = 0.13$, $p = 0.14$), studies that used the TLFB to measure alcohol consumption did not differ from studies that used other alcohol consumption measures ($b = -0.12$, $p = 0.24$), type of analyses used did not differ, $F(2, 14) = 2.42$, $p = 0.13$, and studies conducted outside the United States did not differ from studies conducted in the United States ($b = 0.12$, $p = 0.21$). Together, timing of assessment and measurement type accounted for 49% of the between-study variability; however, there is still significant variability ($p = 0.014$).

Figure 4 shows the forest plot for alcohol-related problems. There was no evidence of publication bias ($t = -0.74$, $p = 0.49$; see Fig. 5). As with alcohol consumption, there was a moderate effect size that was statistically significant ($r = 0.37$, 95% CI: 0.21 to 0.51, $p < 0.001$) between alcohol-related social media engagement and alcohol-related problems. There was also significant heterogeneity in studies of alcohol-related problems ($\chi^2_6 = 1{,}794$, $p < 0.001$), which accounted for 94% of the variability in the correlations ($I^2 = 0.94$). The metaregression results for alcohol-related problems are shown in the bottom part of Table 2. We found no significant moderators of this heterogeneity. Because all of the studies measured alcohol-related social media engagement and alcohol-related problems at the same time point, the timing of the assessments did not account for this variability. The difference between self-report and observational measures was similar to alcohol consumption, but the smaller number of studies likely contributed to the nonsignificant result ($p = 0.24$). One study assessed alcohol-related social media engagement other than Facebook (Thompson and Romo, 2016), and it did not differ from the others ($b = -0.19$, $p = 0.36$). Likewise, type of analysis and where the study was conducted were not significant moderators.

DISCUSSION

Our systematic review and meta-analysis showed a moderate strength of relationship between exposure to alcohol-related social media content and alcohol consumption and consequences. Young adults in the United States and worldwide are very extensive users of SNSs (Pew Research Center, 2017). This age-group is also characterized by high rates of alcohol consumption and heavy drinking (Substance Abuse and Mental Health Services Administration, 2017). Thus, as might be expected, young adults frequently discuss their drinking behavior on SNSs, a phenomenon of interest in many published studies over the past 6 years. Most of the published studies of representations of drinking behavior on SNSs involve comparatively few participants. This systematic examination of 19 published studies provides a more robust measure of the relations between alcohol-related SNS engagement and both drinking behavior and alcohol-related problems.

A growing number of publications have examined the correlation between alcohol-related SNS engagement and both drinking and alcohol-related problems, but this does not speak to the direction of the association. In our analysis, we identified 19 reports that met our criteria for inclusion in a meta-analysis. This represented a total of more than 9,000

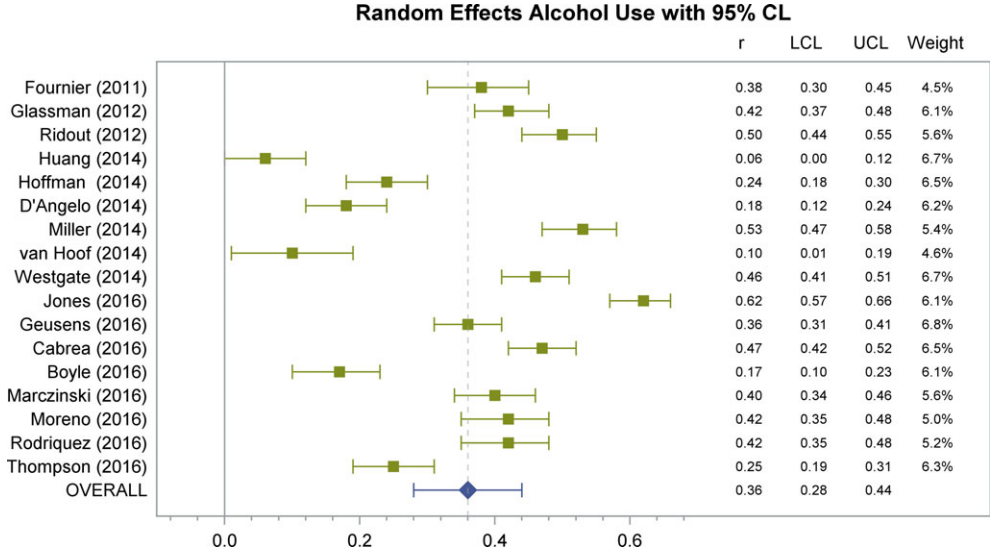

Fig. 2. Forest plot for alcohol consumption.

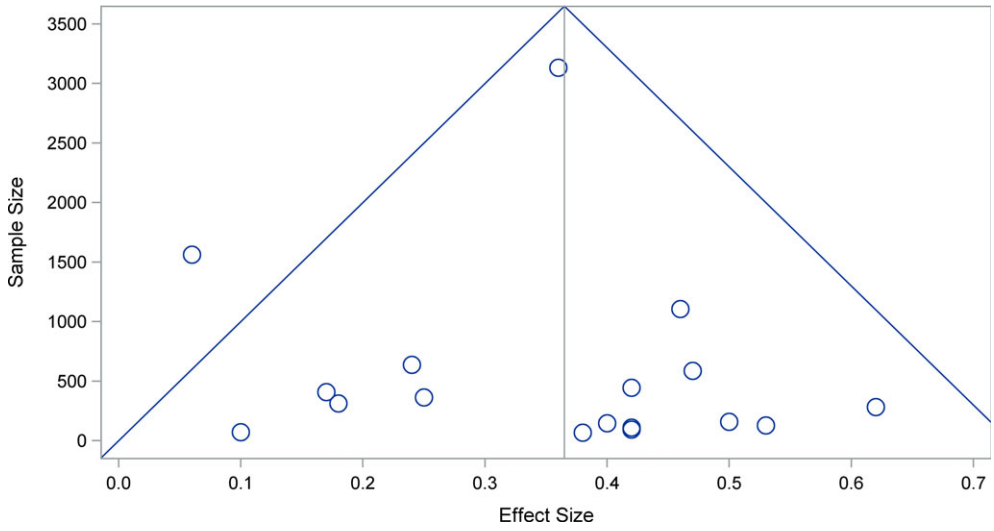

Fig. 3. Alcohol consumption funnel plot.

Table 2. Metaregression Results

Moderator	Coefficient	*p*-Value
Alcohol consumption		
Timing of assessments (cross-sectional)[a]	−0.220	0.021
Measurement (self-report) observation	−0.250	0.011
Facebook (not Facebook)	0.133	0.144
Timeline Follow back Interview (TLFB) (not TLFB)	−0.125	0.238
Analysis (correlation)		
Logistic regression	0.243	0.125
Linear regression	0.007	
Foreign (United States)	0.124	0.211
Alcohol-related problems		
Measurement (self-report) observation	−0.256	0.243
Facebook (not Facebook)	−0.191	0.364
Analysis (correlation)		
Logistic regression	−0.170	0.503
Linear regression	0.088	
Mean difference	−0.260	
United States (non-United States)	−0.098	0.543

[a]Comparison group in parentheses.

SNS users for whom data were available. Using random-effects modeling to account for significant heterogeneity in correlations, we found a moderate overall effect, with greater alcohol-related social media engagement correlated with greater self-reported drinking and alcohol-related problems. The inclusion of study design and measurement type as moderator variables accounted for a substantial portion of the heterogeneity in the observed correlations involving alcohol consumption. Studies that assessed variables at different points in time or observed social media use showed correlations that were about half the size of the correlations seen in studies in which the key variables were measured at the same point in time or used self-reports. Despite a similarly high level of heterogeneity among studies of the correlation between alcohol-related social media engagement and alcohol-related problems, we found no significant moderators of this variability, possibly because there is greater consistency in the measurement of drinking than for alcohol-related problems, which by their nature are more varied. Or also, it could be the reduced power as fewer studies measured alcohol-related problems compared to alcohol consumption.

Consumers of alcohol may be more exposed to alcohol-related content on social media by posting it themselves, having drinkers in their online social networks post such content, or as a result of targeting by alcohol industry marketing. Indeed, heavy drinkers' real-life social networks are more likely to include drinking friends who influence the index individual's drinking behavior (Neighbors et al., 2008), and social media may expand the opportunity for drinking behavior to spread through social networks, providing additional opportunities for exposure (McCreanor et al., 2013). Among light drinkers, drinking may be glamorized on social media to portray a life of excessive fun or glamor (Tucker et al., 2013) and may be more likely than other posts to be shared through the social networks of young adults. Additionally, those who drink are likely to be targeted by alcohol marketing efforts. Although it is not possible to market directly to individuals who exhibit a specific behavior, the most popular social media tools use individuals' social media data to offer marketers strategies to target those who are most likely to use their products (e.g., Ramo et al., 2014).

Exposure to alcohol content may also increase the likelihood that youth will initiate alcohol consumption. Alcohol marketing is not limited to individuals who drink. One U.K.-based study showed that 89% of male and 91% of female adolescents and young adults were exposed to alcohol marketing in an average month on the 3 most common social media sites (Winpenny et al., 2013). Further, many social media channels, such as YouTube, are accessible to all ages with no limitations on subscribers to alcohol brand channels (Barry et al., 2014). Social media marketing is often delivered using strategies that are highly attractive to young audiences

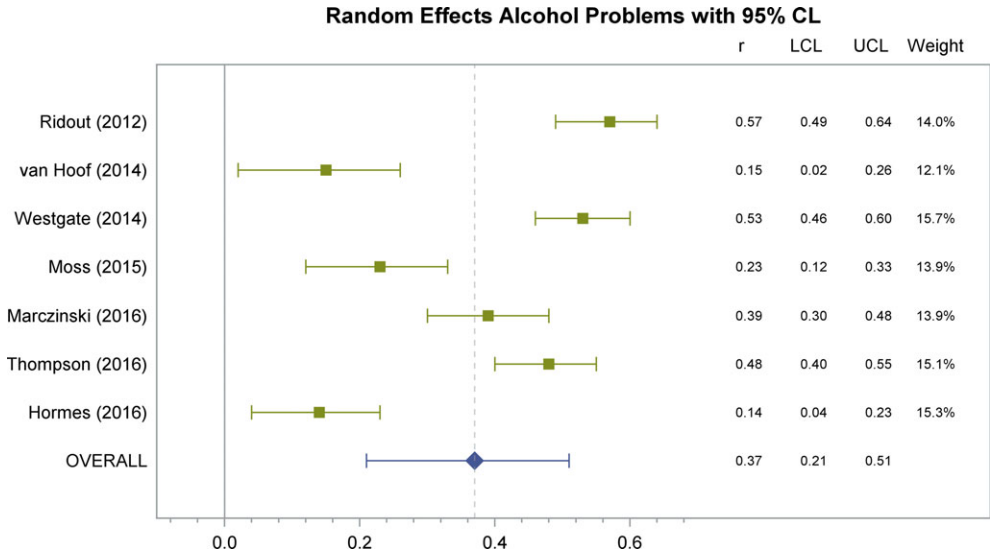

Fig. 4. Forest plot of correlations between social media alcohol exposure and alcohol-related problems.

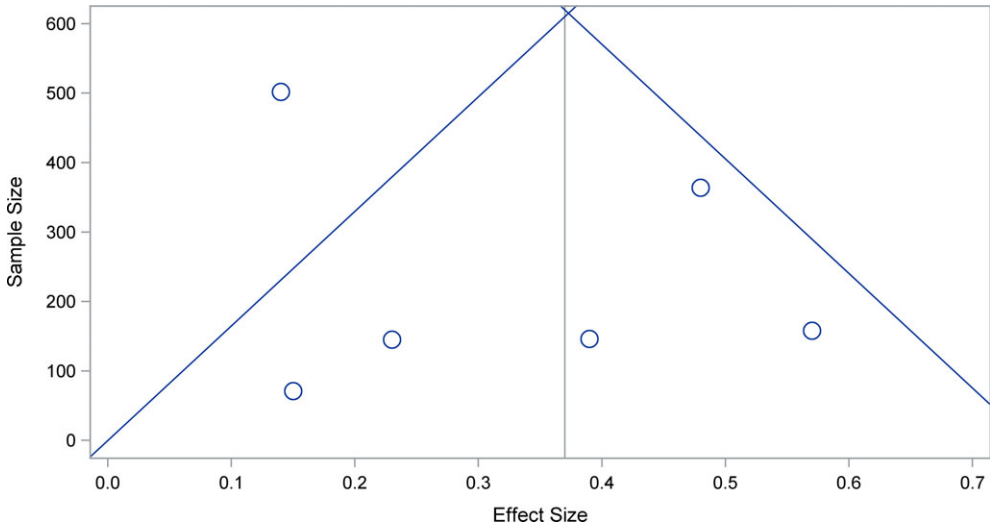

Fig. 5. Alcohol problems funnel plot.

(e.g., games; Nicholls, 2012). Longitudinal studies are needed to determine whether social media exposure contributes to young people's vulnerability to drinking by influencing their cognitions (e.g., by enhancing intentions to drink) or more directly affecting their drinking behavior (e.g., through social modeling).

The meta-analysis was limited by the different ways that social media influence and alcohol consumption were measured among studies. This may help to explain the large degree of heterogeneity of effect sizes and limits the direct comparison among studies. Unfortunately, this potential source of heterogeneity could not be captured in the metaregression because of the wide variation in methods used to measure these 2 variables. Another limitation is the different measures of effect that were used among studies. Assumptions need to be made about the underlying distribution of values when converting different effect sizes to a common measure (e.g., in converting odds ratios to correlation coefficients), and we cannot know with certainty whether the assumptions were met. A further limitation of this meta-analysis is that the 19 studies that were included were mostly of young adults or college students, and thus, the findings may not generalize to other populations. Finally, because our findings are correlational, we cannot draw conclusions regarding the direction of the effects between the measured variables. Thus, further research is needed to understand the nature of these correlations. Future studies that use experimental or quasi-experimental designs to understand whether alcohol-related SNS engagement predisposes to heavy drinking or, alternatively, that heavy drinking young adults are

more likely to use SNSs, are needed to advance this research effort. This is an important question because ascertaining the nature of the relations between these behaviors could permit social media-based interventions aimed at reducing heavy drinking and alcohol-related problems in the many adolescents and young adults who use SNSs.

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DISCLOSURE

Dr. Kranzler has been a consultant, advisory group member, or continuing medical education lecturer for Alkermes, Indivior, and Lundbeck. He is also a member of the American Society of Clinical Psychopharmacology's Alcohol Clinical Trials Initiative (ACTIVE), which in the last 3 years was supported by AbbVie, Alkermes, Amygdala Neurosciences, Arbor, Ethypharm, Indivior, Lilly, Lundbeck, Otsuka, and Pfizer. The remaining authors have no conflicts of interest.

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SUPPORTING INFORMATION

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

Table S1. Exclusion criteria of full-text articles for meta-analysis.