Content analysis of Twitter chatter about indoor tanning

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Abstract

Twitter may be useful for learning about indoor tanning behavior and attitudes. The objective of this study was to analyze the content of tweets about indoor tanning to determine the extent to which tweets are posted by people who tan, and to characterize the topics of tweets. We extracted 4,691 unique tweets from Twitter using the terms “tanning bed” or “tanning salon” over 7 days in March 2016. We content analyzed a random selection of 1,000 tweets, double-coding 20% of tweets ($\kappa = 0.74$, 81% agreement). Most tweets (71%) were by tanners ($n = 699$ individuals) and included tweets expressing positive sentiment about tanning (57%), and reports of a negative tanning experience (17%), burning (15%), or sleeping in a tanning bed (9%). Four percent of tweets were by tanning salon employees. Tweets posted by people unlikely to be tanners (15%) included tweets mocking tanners (71%) and health warnings (29%). The term “tanning bed” had higher precision for identifying individuals who engage in indoor tanning than “tanning salon”; 77% versus 45% of tweets captured by these search terms were by individuals who engaged in indoor tanning, respectively. Extrapolating to the full data set of 4,691 tweets, findings suggest that an average of 468 individuals who engage in indoor tanning can be identified by their tweets per day. The majority of tweets were from tanners and included reports of especially risky habits (e.g., burning, falling asleep). Twitter provides opportunity to identify indoor tanners and examine conversations about indoor tanning.

Keywords

Indoor tanning, Twitter, Cancer prevention

Indoor tanning increases risk for melanoma [1, 2], the most common cancer in women aged 25–29 years [3, 4]. In 2014, the Surgeon General’s Call to Action to Prevent Skin Cancer emphasized the need to reduce harms from indoor tanning specifically by developing and disseminating tailored messages for high-risk populations [5]. Effective interventions to reduce indoor tanning exist [5, 6], including appearance-based approaches [7] and multicomponent community interventions [6]. However, because tanners do not typically seek help to quit tanning, they can be difficult to identify and reach with interventions. Strategies for identifying tanners and disseminating targeted messaging are greatly needed [8]. Social media platforms have been suggested for the delivery of skin cancer prevention messages [9], and a recent study that disseminated sun safety and skin cancer prevention messages via Twitter reported improved knowledge about skin cancer and attitudes toward tanning [10].

Implications

Practice: Tweets about indoor tanning include report of particularly risky behaviors such as burning and sleeping in tanning beds.

Policy: Twitter may be an effective platform through which to disseminate health messages targeted at individuals who engage in indoor tanning.

Research: Twitter provides an opportunity to identify indoor tanners and to learn about indoor tanning behavior and attitudes.

Social media platforms provide opportunities to reach people more efficiently and cost-effectively than traditional media, given the sheer volume of people who participate and that participation is free. Seventy-four percent of online U.S. adults have at least one social media account, with higher use (90%) among 18- to 29-year olds [11]. Twitter is the largest “open” online social network, with 317 million monthly active users who post content, the majority of which is publicly viewable [12]. Young adults who tan indoors have higher rates of Twitter use than young adults who do not [13], which suggests that Twitter may be a particularly useful means to learn about indoor tanning behavior and attitudes. Such data could inform public health campaigns.

A recent study of tweets using a wide range of terms, both domestic (e.g., “tanning bed”) and international (e.g., “sun bed”), to refer to indoor tanning revealed over 154,000 tweets by over 120,000 users over 2 weeks, with tweets reaching over 100 million people [14]. Very few tweets mentioned the negative consequences of tanning, including cancer (2.6%) and photoaging (0.3%), and few mentioned tanning legislation (2.6%) [14], suggesting that conversations about indoor tanning on Twitter are likely not dominated by health promotion messages. Still unknown is how much of the conversation is coming from tanners themselves and what tanners are saying about their tanning habits and beliefs on Twitter. Another study focusing specifically on tweets that reported

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a burn and/or injury in a tanning bed identified 15,178 such tweets over one year [15]. To expand on these studies, we explored whether we can identify tanners on Twitter via the content of their tweets, what proportion of tweets are posted by tanners, and what the conversations are about (e.g., positive vs. negative experiences).

The purpose of this study was to analyze the content of tweets that included the two most common lay terms for indoor tanning in the USA (“tanning bed,” “tanning salon”) to determine the extent to which tweets are posted by people who tan (i.e., are admissions of tanning), and to characterize the topics of tweets. Based on past research [15], we hypothesized that some of the content coming from tanners will be about burns and injuries but this is likely to be a small proportion. We also explored what proportion of tweets express positive or negative sentiments about indoor tanning. To the extent that tanners discuss their tanning habits on Twitter, we have opportunities to learn about tanning behavior and attitudes from a data source that may not have the same biases as self-report surveys and other traditional data collection methods [16]. To the extent that we can identify individuals engaging in high-risk behavior on Twitter, we may also have the opportunity to use Twitter to deliver public health messaging to them.

METHODS

We conducted a cross-sectional study of tweets about indoor tanning on Twitter. We searched Twitter for two common lay terms (“tanning bed” and “tanning salon”) that refer to “indoor tanning,” a technical public health term first appearing in the scientific literature in 1985 to refer to tanning using artificial ultraviolet light-emitting devices [17]. The search was restricted to lay terms given the focus on understanding what tanners are tweeting about and to what extent public health messages arise in searches restricted to lay terms. We captured tweets posted on seven consecutive days starting March 17, 2016 (the season in which indoor tanning is most frequent [18]) using the NCapture add-on for Chrome (QSR International, Melbourne, Australia). We then imported the captures into NVivo 10 (QSR International) and exported to SAS 9.4 (SAS Institute, Inc., Cary, NC) for data management and quantitative analysis. Daily prospective data collection 1 day past the 7-day sampling window resulted in multiple capture of some tweets but increased the likelihood of capturing all relevant tweets in the sampling window. We removed duplicate tweets, retweets, and original tweets posted outside the 7-day sampling window (March 17, 2016 to March 23, 2016). We excluded retweets since our primary interest was in who talks about indoor tanning on Twitter and topics of conversation, and thus we were interested in capturing individuals’

own words. Individuals may retweet another’s tweet for numerous reasons, and retweeting does not necessarily imply agreement with the content of the tweet or that the individual retweeting engages in a described behavior. From this sample of original tweets within the 7-day sampling window, we randomly ordered tweets within strata defined by search term (“tanning bed” vs. “tanning salon”) and posting day (weekday vs. weekend), and reviewed consecutive tweets to remove ads until we reached 1,000 non-ad tweets, retaining a sampling fraction within each strata matching the distribution of strata in all unique tweets within the sampling period. Thus, our final sample of tweets to content analyze represent a random sample of original tweets, stratified by search term and whether the tweet was posted on a weekday or weekend day. During coding, we identified and replaced additional tweets that were ads, spam, or links to pornography. We choose to content analyze 1,000 tweets as this sample size would be large enough to capture less common topics of conversation. This study does not meet the definition of human subjects research and thus did not require IRB approval.

Statistical analyses

We conducted a directed content analysis of tweets [19]. The investigative team reviewed a subset of 50 tweets stratified by search term and posting day and developed an initial codebook of tweet topics. The codebook was iteratively refined by coding four training sets of a 5% random subsample of tweets ($n = 50$ each), sampled within strata (search term $\times$ posting day). After finalizing the codebook, two coders (C.N.M. and A.P.) coded all 1,000 tweets with 20% double-coded. Based on their content, tweets were categorized as being posted by “people who appear to engage in indoor tanning,” “tanning salon employees,” “people who likely do not indoor tan,” and “people whose tweets do not indicate whether they tan or whose tweets suggest that they do not tan.” If a tweet appeared to be posted by a tanning salon employee but referred to his/her tanning behavior, we coded the tweet as being by a tanner. For replies, coders viewed the conversation thread on Twitter to aid in coding.

We examined inter-rater reliability by calculating percent agreement and kappa, and discrepantly coded tweets were discussed to reach consensus ($\kappa = 0.74$ [95% CI: 0.66–0.83], 81% agreement). During coding, we discovered a distinct subset of tweets that appeared to be posted by tanners but did not fit into the existing topics. During initial coding, these tweets were lumped with tweets that were unrelated to indoor tanning; we subsequently revisited these tweets to differentiate between tweets by tanners and those unclear if the author engages in indoor tanning. Coders reached consensus on the $n = 4$ discrepantly coded tweets (81% agreement). We summarized the proportion of tweets posted

by tanners, and calculated the number of tweets posted by unique Twitter accounts. We compared the precision of search terms (“tanning bed” vs. “tanning salon”) for identifying tweets by tanners using chi-squared tests. Using tweet location data (latitude and longitude), we categorized whether tweets were posted from the USA using PROC GINSIDE and U.S. map data sets built into SAS. Quantitative analyses were conducted using SAS 9.4 (SAS Institute, Inc.).

RESULTS

We identified 4,691 unique tweets posted within the 7-day sampling window in March 2016 (Fig. 1). The majority of tweets (82.9%) resulted from the “tanning bed” search term. Nineteen percent (19.1%) of tweets from each search term were posted on weekends. Forty-six percent of tweets (45.8%; $n = 2,149$) included location data; of these tweets, 82.0% ($n = 1,762$) were tweeted from the USA. Prior to coding, we excluded 192 tweets that were ads, spam, or links to pornography; and during coding we identified and replaced an additional eight such tweets, resulting in a sample of 1,000 tweets for content analysis (Fig. 1).

Tweets ($n = 1,000$) were posted by 978 unique accounts. The majority of tweets (71.2%) indicated that the user engaged in indoor tanning ($n = 699$ individuals; Table 1). A small proportion of tweets (3.8%) were posted by tanning salon employees, 15.0% were from people who do not likely tan, and in the remaining 10.0% of tweets it was unclear whether the author was a tanner. Among tweets that suggested the user is a tanner ($n = 712$) five themes emerged: (i) positive sentiment about tanning (e.g., a desire or eagerness to tan; 56.9%), (ii) report of

negative experience at the tanning salon (e.g., unsanitary conditions, negative interactions with salon staff, or unpleasant experiences with other customers; 17.4%), (iii) report of a burn or injury (14.8%), (iv) report of sleeping in a tanning bed (8.7%), and (v) other (2.3%; Table 1). Tweets by tanning salon employees ($n = 38$) were day-to-day observations in the tanning salon (Table 1). Tweets posted by people who did not appear to tan ($n = 150$) included tweets mocking tanners or the act of tanning (71.3%) and health warnings (28.7%). Whether the individual was a tanner could not be clearly distinguished in the remaining 10% of tweets ($n = 100$). While most of these tweets were unrelated to indoor tanning (91.0%), some expressed dissent for anti-tanning legislation (9.0%).

The search terms “tanning bed” and “tanning salon” differed in their precision to capture tweets likely posted by individuals engaging in indoor tanning ($P < 0.0001$; Table 2): 76.6% of tweets captured by the term “tanning bed” were by tanners compared to 45.0% of tweets by “tanning salon.”

DISCUSSION

We captured 675 unique tweets per day about tanning beds and salons ($n = 4,691$ tweets over 7 days). By examining roughly one-fifth of these tweets ($n = 1,000/4,691$), we identified 699 individuals whose tweets indicate that they engage in indoor tanning—an average of nearly 100 per day, which if extrapolated to the entire sample of tweets would be 468 individuals per day who engage in indoor tanning. This study demonstrates individuals who likely engage in indoor tanning can be identified from the content they publically post on Twitter.

Fig. 1 | Tweet sampling and construction of the analytic sample of 1,000 tweets

Table 1 | Topics of tweets about indoor tanning on Twitter, by who is tweeting (*N* = 1,000 tweets)

Tweet category	N (% of tweets by that actor)	Illustrative examples^a
People who appear to engage in indoor tanning (<i>n</i> = 712 tweets by 699 accounts)		
Positive sentiment about tanning	405 (56.9%)	<ul style="list-style-type: none"> • moms finally let me go to the tanning salon #blessed • SO EXCITED BC I FINALLY GET TO LAY IN A TANNING BED TOMORROW YAY • The tanning bed is the best part of my day
Negative experience from tanning	124 (17.2%)	<ul style="list-style-type: none"> • I wore a belly button ring in the tanning bed not thinking about it and have a circle on my stomach • I don't think there's anything worse than a cold tanning bed • I hate when I smell like the tanning bed
Burn or tanning-related injury	105 (14.8%)	<ul style="list-style-type: none"> • The tanning bed burned me today. I think I'm going to die • I am a lobster from the tanning bed and crying bc I can't move • Note to self 15 min is way too long in the tanning bed today. I'm burned
Sleeping in tanning bed	62 (8.7%)	<ul style="list-style-type: none"> • Tanning bed naps are awesome • Shout out to LB for waking me up in the tanning bed before I burned to death • I'm always falling asleep in the tanning bed
Other tweets by people who appear to engage in indoor tanning	16 (2.3%)	<ul style="list-style-type: none"> • It's crazy how many guys are in the waiting room at the tanning salon. • I just watched The Perfect Guy and now I'm scared to go to the tanning salon alone
Tanning salon employees (<i>n</i> = 38 tweets by 37 accounts)^b		
Tanning salon employee observations	38 (100%)	<ul style="list-style-type: none"> • for someone who works at a tanning salon I sure am ghost white • beyond thrilled to be working at a tanning salon again. I missed it • Anyone want a job at my tanning salon? We need help ASAP
People who likely do not indoor tan (<i>n</i> = 150 tweets by 149 accounts)		
Negative sentiment about tanning or people who tan	107 (71.3%)	<ul style="list-style-type: none"> • You ladies who love laying out and hitting the tanning salon are gonna look like a baseball glove by age 40 • you know what's not smart #Drumpf? For a man your age to go to the tanning salon or even spray tan. Looks ridiculous! • Did the tanning bed get a little too hot for you? #YoureFried • When the freaks of Jackson county get their tax return and splurge at the nail and tanning salon
Health warnings	43 (28.7%)	<ul style="list-style-type: none"> • Protecting U.S. Minors from Tanning Bed Exposure https://t.co/elJH7tEnLL • On FDA's tanning bed ban: An ounce of prevention beats a pound of cure https://t.co/a3ioPavoSb • I can't enjoy the warmth of a tanning bed because it's like I'm inviting skin cancer into my life
People whose tweets do not indicate whether they tan (<i>n</i> = 100 tweets by 98 accounts)^c		
Argues against messages that tanning is unhealthy or anti-tanning legislature	9 (9.0%)	<ul style="list-style-type: none"> • it's so annoying. They all say "the tanning bed is so bad for you. You'll get cancer and die." • Taking away your rights one right at a time. More idiotic regulations. https://t.co/FT03L4xDqK
Unrelated to indoor tanning, tweets by people who do not indoor tan, or unclear whether speaker is a tanner	91 (91.0%)	<ul style="list-style-type: none"> • https://t.co/kMbnOpFyhF Conan Visits A Spray Tanning Salon & Gets A Weave - CONAN on TBS • this is so depressing... the darkest shade is a tanning salon white girl https://t.co/JmnHGkE5Xp • Yes my tan is natural. No I don't use tanning beds.

^aWhile all tweets included in the analysis were posted publicly, to protect the privacy of the individuals who posted these tweets, we paraphrased the wording of tweets in a way that prevents the content to be searchable without changing meaning.

^bIncludes one tweet by an individual who also posted a tweet indicating that he/she engages in indoor tanning.

^cIncludes six tweets by four individuals whose other tweets provided information about whether they likely tan (one tanner, one tanning salon employee, and two individuals unlikely to engage in indoor tanning).

The majority of tweets examined (71%) were by tanners. Tweets by tanners were largely positive in sentiment (57%), expressing eagerness to tan, how much they enjoy tanning, and how good it feels. However, 29% were negative in sentiment, including

reports of burns or other negative experiences while tanning. Tweets also included reports of especially risky habits like burning and falling asleep in the tanning bed. That individuals who use tanning beds can be easily identified on Twitter suggests

Table 2 | Precision of search terms for capturing tweets by individuals who engage in indoor tanning, *N* (%)

	Search term	
	“Tanning bed” (<i>N</i> = 829 tweets)	“Tanning salon” (<i>N</i> = 171 tweets)
Individual appears to engage in indoor tanning	635 (76.6%)	77 (45.0%)
Tanning salon employee	6 (0.7%)	32 (18.7%)
Individual likely does not engage in indoor tanning	125 (15.1%)	25 (14.6%)
Unclear if individual engages in indoor tanning	63 (7.6%)	37 (21.6%)

opportunities for social media campaigns. A major challenge is how to reach such individuals with health messaging given they may not be receptive to anti-tanning messages [8]. Public health messaging might be best delivered by individuals, companies, and/or organizations that are viewed by tanners as credible and influential. Tanners tweeting about burns, injuries, and negative experiences at a tanning salon might be particularly receptive to health messages to the extent that negative consequences increase ambivalence toward tanning. Also, exposing tanners to other tanners complaints about negative experiences may have the potential to shift perceived social norms regarding the downsides of tanning [20, 21].

The 15% of tweets posted by people we assumed were not tanners were largely negative about tanning, either mocking tanners or the tanned look, or emphasizing health risks. The presence of both positive and negative tweets suggests the possibility of two competing social norms about tanning. Future research should explore the characteristics of individuals who have strong negative attitudes about tanning, how these attitudes have formed, and whether individuals with competing views about tanning engage with one another about tanning on social media. Social norms have a powerful influence on the initiation and continuation of tanning [22], thus it could be instructive to learn how the negative social norms have emerged as they may lend clues into counter-messaging approaches.

Surprisingly, very few health messages were observed (4.3% of tweets). Possibly, health care professionals and public health messaging for skin cancer prevention use different terminology than tanners to refer to tanning bed use or focus mostly on other behaviors (e.g., sunscreen use). In the scientific literature, “indoor tanning” [23] and “artificial UV radiation” [24] are technical terms used to refer to tanning bed use. Future research should explore the content and penetration of public health messaging into tanners’ online social network feeds. Health professionals focusing on cancer prevention may have distinct social networks from tanners. An important goal is to determine how to bridge any gaps between these two possibly disconnected communities on social media. An avenue to explore is the dissemination of health messages about indoor tanning by celebrities with a personal interest in skin cancer prevention efforts [25], or by physicians, as

they are seen as credible sources of information on Twitter [26].

Our findings also inform future studies that aim to identify tanners on Twitter. We used two search terms—“tanning bed” and “tanning salon”—to capture relevant tweets. While “tanning bed” had a high rate of precision in identifying tweets by indoor tanners (77%) than “tanning salon” (45%), “tanning salon” was more effective at capturing tweets posted by tanning salon employees, suggesting that this search term may be more useful for identifying this population. While tanning salon employees accounted for a small portion (4%) of the tweets overall, nearly one in five tweets captured with “tanning salon” were salon employees, suggesting that these individuals have a presence on Twitter and may be a novel target for interventions regarding legislation compliance.

This study has limitations. First, data collection was limited to two very common lay terms used in the USA to refer to indoor tanning. Our purpose was not to assess the entire volume of tanning tweets but rather content analyze a sample and identify the level of precision of two common lay terms in identifying tanners on Twitter. We do not know if other terms used to refer to indoor tanning would produce similar findings. Future research could expand search terms to include more general terms (e.g., “tanning”), international terms (e.g., “sunbed”) [27], and slang terms (e.g., “fake and bake”) [28]. While including more general search terms would likely identify additional indoor tanners, such terms would likely have less precision, thus increasing the burden of reviewing and excluding irrelevant tweets. Second, less than half of tweets (45.8%) included location information, similar to previous research of English-language tweets (43.4%) [29], and users who enable location services on their Twitter account likely differ from those who do not elect to provide these data [29]. However, researchers could use available location data to examine geographic variation in conversations about indoor tanning or to identify tanners from specific geographic regions in order to recruit them into skin cancer prevention research studies. Third, we excluded advertisements from the analytic sample of tweets. Tanning salons use social media presence to maintain relationships with customers and to encourage more frequent tanning [30], and such content could provide insights into pro-tanning messages that indoor tanners are

exposed to. Fourth, our tweet data were extracted in March, a month during the season in which indoor tanning rates are highest [18], and the volume of tweets vary across the year. Many colleges and universities in the USA have spring break in March, which may influence indoor tanning behavior relative to other times of the year. Nineteen percent of tweets were posted on Saturday or Sunday, lower than the 29% expected if tweets were evenly distributed across the 7-day period. Future studies should examine temporal trends in the conversations to identify weekly and seasonal patterns among conversations about indoor tanning on Twitter, including the volume and content of conversations. Finally, we manually coded 1,000 tweets out of the nearly 5,000 unique tweets captured during the 7-day sampling period. We randomly selected tweets for analysis, so it would seem likely that proportions of tweets by tanners and themes observed are representative of all tweets captured over the sampling period. However, it is possible that we missed rare yet interesting topics of conversation on Twitter about indoor tanning. Machine learning techniques may be useful for reducing the burden of classifying tweet content in future studies. Manual classification of tweet content is often a first step toward automated machine learning approaches that produce more comprehensive classification models [31], and the current study may inform such approaches in future research.

People discuss unhealthy habits on Twitter which provides an opportunity to efficiently and inexpensively gain an understanding of their motivations and behavior relative to traditional survey- and qualitative-based methodologies [31]. Identifying high-risk individuals on social media is a necessary step in the development of targeted social media-delivered campaigns. Our study revealed that people who indoor tan are easily identifiable on Twitter and in large numbers. Social media provides a unique opportunity to reach tanners with public health messaging [9].

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Compliance With Ethical Standards

Conflict of Interest: The authors report no conflicts of interest to disclose.

Authors' Contributions: M.E.W. designed the study, collected the data, analyzed the data, interpreted the results, and drafted the manuscript. K.B. provided input on the design of the study and analysis of data, interpreted the results, and revised the manuscript for important intellectual content. A.P. and C.N.M. analyzed the data, interpreted the results, and revised the manuscript for important intellectual content. S.L.P. designed the study, analyzed the data, interpreted the results, and drafted the manuscript. All authors approved the final version to be published and agree to be accountable for all aspects of the work.

Ethical Approval: This study does not meet the definition of human subjects research and thus did not require IRB approval.

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