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Marijuana-Related Posts on Instagram

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Abstract

Instagram is a highly visual social networking site whose audience continues to grow, especially among young adults. In the present study, we examine marijuana-related content on Instagram to better understand the varied types of marijuana-related social networking occurring on this popular social media platform. We collected 417,561 Instagram posts with marijuana-related hashtags from November 29 to December 12, 2014. We assessed content of a random sample (n = 5000) of these posts with marijuana-related hashtags. Approximately 2136 (43 %) were explicit about marijuana and further analyzed. Of the 2136 marijuana-related posts, images of marijuana were common (n = 1568). Among these 1568 marijuana images, traditional forms (i.e., buds/leaves) were the most common (63 %), followed by some novel forms of marijuana, including marijuana concentrates (20 %). Among the 568 posts that displayed marijuana being ingested, 20 % showed someone dabbing marijuana concentrates. Marijuana-related advertisements were also observed among the 2136 marijuana-related posts (9 %). Our findings signal the promotion of marijuana use in its traditional plant-based form; trendy and novel modes of marijuana ingestion were also endorsed. This content along with the explicit marketing of marijuana that we observed on Instagram have potential to influence social norms surrounding marijuana use.

Keywords

Marijuana; Social media; Substance use; Cannabis; Risk behavior

Social media has been shown to enhance communication and social connection among young people (Ito et al. 2008); however, the breadth of exposure to topics that could potentially encourage and/or normalize health risk behaviors is yet unknown. This poses an important challenge to public health, as the health risk behaviors of young people can be

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Conflict of Interest One of the authors, Dr. Bierut, is listed as an inventor on Issued U.S. Patent 8, 080, 371, “Markers for Addiction,” covering the use of certain SNPs in determining the diagnosis, prognosis, and treatment of addiction. All other authors declare that they have no conflicts of interest.

Compliance with Ethical Standards

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent The Washington University Human Research Protection Office granted this study a non-human determination. Therefore, consent was not needed for this study.

influenced by peer pressure and other social forces (Allen et al. 2012; Iwamoto and Smiler 2013; Whaley et al. 2014). For instance, the development and continuation of substance use has been correlated with both explicit and implicit peer pressure as well as exposure to others who use substances (Allen et al. 2012; Eisenberg et al. 2014; Kosterman et al. 2000). This aligns with constructs of social learning theory (Bandura and McClelland 1977), whereby people, especially those young in age, are influenced by others who model a behavior (i.e., substance use). Research has shown that young people can easily view and interact with substance use content on social media (Cavazos-Rehg et al. 2015a, b; Cranwell et al. 2015; Seidenberg et al. 2012; Winpenny et al. 2013). Not only is substance use frequently discussed on social media sites, but the dialog is generally driven by normalizing and pro-use messages (Egan and Moreno 2011; Moreno et al. 2009; Morgan et al. 2010; Myslin et al. 2013). Repeated observations of pro-substance use messaging could influence the social norms of those that view the content and ultimately result in imitation of the displayed behavior (Bandura and McClelland 1977; Fujimoto and Valente 2012).

Only two known studies have examined substance use content on Instagram (alcohol and tobacco content) despite Instagram's popularity among young people (Instagram Intoxicated 2015; Richardson et al. 2014). Instagram is a mobile-based photo- and video-sharing application where users upload images and short video clips that post to their account and are shared with their followers (i.e., online friends) (Instagram 2015a). Instagram features interactive components such as hashtags (a word or phrase that is preceded by the "#" symbol and categorizes photos/images or videos based on a similar topic) as well as the ability to "follow" other users and "like" or "comment" on posts. Instagram posts are commonly selfies (pictures of oneself) and images with friends; however, the range of topics captured in Instagram photos are limitless (Hu et al. 2014). Since its launch in October 2010, Instagram has grown to be one of the most popular social networking sites with more than 300 million users (Instagram 2015b). Instagram has one of the youngest audiences with 37 % under 24 years of age (Mander 2014). In fact, in 2014, teens named Instagram the most important social network, outranking the importance of both Twitter and Facebook for the first time (MarketingCharts 2014).

A study observing the social networking about marijuana on Instagram is warranted given the issue of marijuana law reform as a current hot topic (Caulkins et al. 2015; Kamin 2015) and an increasing acceptance of marijuana use among the general public (Doherty et al. 2015). In our own related research, we found that Twitter and YouTube facilitate social networking about marijuana, especially among young adults and underage youth (Cavazos-Rehg et al. 2015b; Krauss et al. 2015). Specifically, we observed that young people tend to socially network online about their own marijuana use behaviors and/or favorable opinions regarding marijuana use (Cavazos-Rehg et al. 2015b; Cavazos-Rehg et al. 2014). In relation, videos depicting novel ways to ingest marijuana (i.e., dabbing marijuana concentrates) were observed on YouTube (Krauss et al. 2015); socially, networking about new ways to consume marijuana has potential to generate interest in its use. It is similarly possible that Instagram facilitates information exchanges about emerging trends related to marijuana because such content could easily be posted and viewed on this visually dominant platform—via pictures or videos—by those who have interest in socially networking about such behaviors.

With consumers of marijuana using social media to network about their marijuana use, it is probable that the vendors of marijuana and/or related paraphernalia will likewise utilize social media to endorse their businesses via advertisements or other promotional tactics. Yet, studies that address the marketing of marijuana on social media or otherwise are virtually nonexistent. This is in stark contrast to the extensive research across traditional media outlets (and emerging social media research) that has worked to inform the regulatory advertising standards for alcohol and tobacco industries (Anderson et al. 2009; Freeman 2012; Siegel et al. 2015; Tye et al. 1987; Wakefield et al. 2003). Customers tend to prefer advertisements that utilize pictures or videos versus text-based ads (MDG Advertising 2012), and Instagram is an ideal platform for such marketing tactics. For this reason and in consideration of the field of research that associates the substance use behaviors of young people with exposure to campaigns that market those behaviors (D'Amico et al. 2015; Duke et al. 2014; Martino et al. 2016; Soneji et al. 2014; Tucker et al. 2013), a study of marijuana advertisements on Instagram is timely and can be useful for informing policy development regarding advertising and promotion of marijuana.

In the present study, we direct our attention toward a better understanding of the images about marijuana that exist on Instagram. We study the varied forms of marijuana ingestion being posted, and we examine the marijuana-related advertisements on Instagram, as these are two topics about marijuana that have been understudied but have the potential to fuel interest in its use. We additionally investigate the characteristics of the individuals posting this content (i.e., their age, marital status, race, and popularity on Instagram) for better insight into the creators of these images.

Methods

Data Collection

Instagram data used in this study are publicly available via the Instagram public API, which allows users open access to Instagram data. The Washington University Human Research Protection Office reviewed this study and granted it a non-human determination.

Identifying the "Most Popular" Marijuana-Related Hashtags on Instagram

We collected marijuana-related media (photos/images or videos) posted on Instagram over a 2-week period (November 29–December 12, 2014). Searching for media posts related to a specific topic on Instagram involves the use of hashtags (searching by terms that are not hashtags is not possible). Instagram users can "tag" an image with hashtags when uploading to this platform. Tagging a post with a hashtag creates a link that when clicked directs users to a page that displays all other images that have been uploaded using the same hashtag. To garner the most popular marijuana-related hashtags used on Instagram, we first identified 13 Instagram users with marijuana-focused handles (e.g., @weedstagram420) who have a relatively large number of followers (i.e., more than 1000 followers). We used keywords and hashtags that were identified for a previous social media study (weed, blunt, marijuana, stoner, kush, stoned, bong, pot, cannabis, joint, ganja, pothead, sativa, indica; Cavazos-Rehg et al. 2015b) to identify these 13 Instagram users. For each of the Instagram users, a member

of the research team scanned the past 3 months of posts and took note of common hashtags used for images relating to marijuana or its use.

Each of these marijuana-related hashtags was then searched on Iconosquare to gauge their frequency of use on Instagram (i.e., how often these hashtags are used by all Instagram users). Iconosquare is an online analytics and marketing suite for Instagram that connects directly to the Instagram API (http://iconosquare.com/about/) and provides a tally of times that a hashtag is used and the actual image (photos or videos) that was posted using that hashtag. This enabled us to verify that the hashtags were in fact being used to depict marijuana-related topics by examining images under that hashtag. Fifteen images under each hashtag were studied to confirm their association with marijuana. We also used Iconosquare to monitor the number of new images posted with each hashtag from October 25 to December 5, 2014 (Table 1). Using this data, we estimated the number of images tagged with each hashtag over a 2-week period in order to verify that each hashtag on our list would generate at least 2000 or more images over our 2-week data collection period. Our final list of hashtags included the following: #420, #high, #highlife, #710, #highsociety, #kush, #stoner, #cannabis, #marijuana, #shatter, #maryjane, #weedstagram420, #instaweed, #thc, #stayhigh, #blunt, #pot, #stonernation, #blunts, #wakenbake, #pothead, #smokeweedeveryday, #justblazeig, #staygreen, #bong, and #joint.

Collecting the Most Popular Marijuana-Related Hashtags from Instagram

To collect the most popular marijuana-related hashtags from Instagram, we used the Instagram API feature that allows the collection of recently tagged media. This feature does not allow the specification of a time period for data collection but rather collects a certain number of the most recent posts with the hashtag of interest and, with repeated requests to the API, continues to collect posts retrospectively. Therefore, we estimated the number of posts with the hashtags of interest that would likely be posted in a 2-week period using Iconosquare to document the number of images with each hashtag at two different time points at least 2 weeks apart. We then collected Instagram data from the API using our estimated number of posts for each hashtag.

Data collected for each Instagram post included the Instagram post identification number, the URL of the Instagram post, the caption text, the username of the profile that posted the image/video, the date the image/video was posted, the number of “likes” for the post, and the post’s hashtags. After garnering the Instagram data for each hashtag, we verified that posts for each hashtag began on November 29, 2014 and continued through December 12, 2014. Because searches may only be completed for one hashtag at a time and many Instagram posts tend to have more than one marijuana-related hashtag, we removed duplicate posts using the Instagram post identification number. This resulted in 417, 561 posts with the marijuana-related hashtags. We then randomly selected 5000 of these posts for qualitative analysis using SAS proc surveyselect (SAS version 9.4, SAS Institute, Inc., Cary, NC). See Fig. 1 for a complete methodology of post selection.

Identification of Classification Scheme

The research team reviewed approximately 200 Instagram posts in order to identify a classification scheme to code the content of all of the randomly selected posts. Classifications included whether marijuana or something related to marijuana was actually shown in the post, and whether the post was from a marijuana-related handle, as indicated by either a reference to marijuana in the username or in the Instagram profile.

If marijuana was shown in the post, then the type of marijuana was coded. The various types of marijuana that were coded included marijuana buds/leaves, joints/blunts, concentrates (shatter, wax, oil), or edibles. If marijuana-related paraphernalia was shown in the post, then the type of paraphernalia or device was coded which included bongs or other paraphernalia or vaporizers (vape pens). If a person was using marijuana in the post, then the form of marijuana being used was coded; this included whether or not the person was smoking a joint/blunt, using a bong or dabbing, or using a vaporizers (vape pen). All posts were additionally coded for the whether the post was advertising or selling a marijuana-related product (i.e., post clearly came from a business/industry that sold marijuana and/or marijuana-related products).

Coding the Data

Crowdsourcing, which uses a large on-demand collection of online workers to complete tasks, was used to classify the content of the random sample of 5000 Instagram posts. We used CrowdFlower (http://www.crowdflower.com) for our crowdsourcing services. We have used this company in prior studies to analyze the sentiment and content of Tweets about substance use with acceptable reliability (Cavazos-Rehg et al. 2015a, b). The sample of 5000 Instagram posts was uploaded into CrowdFlower's online platform, along with detailed instructions in order to teach the online workers about different types of marijuana and the classifications to be coded. In order to begin the job, workers must first achieve a score of 80 % on a quiz that included posts that were coded by the research team. Then, additional test questions coded by the research team were interspersed throughout the job to test workers as they coded the data in order to ensure that they continue to code. Workers that did not maintain a high score (80 %) were then released from the job, their prior codes were discarded, and a different worker was assigned to code those posts.

Each post was coded by at least three CrowdFlower workers. For each classification for each post, the single "top" result is used; meaning the response with the highest confidence score is used. Confidence score describes the level of agreement between multiple contributors, is weighted by the contributors' trust scores, and indicates "confidence" in the validity of the result (http://success.crowdflower.com/customer/portal/articles/1295977-how-to-calculate-a-confidence-score).

The procedures outlined above are typical for CrowdFlower jobs in order to ensure accuracy in the tasks. To ensure that reliability was high, a member of the research team coded a sample of 200 posts that were not used as test items, and responses were compared to CrowdFlower's final top response. Agreement was good for all classifications (median percent agreement 98 %, range 91 to 100 %; median kappa 0.92, range 0.68 to 1.00).

Coding Marijuana-Related advertisements on Instagram

After the Instagram posts were coded according to the above classifications by crowdsourced workers, two members of the research team further analyzed all posts that were coded as advertising/selling a marijuana-related product. We classified the type of product being advertised, including a form of marijuana, type of device for using marijuana, marijuana-related accessories (such as clothes and jewelry), or whether the ad only advertised a shop/dispensary (with no specific item featured). We also classified whether the advertisement included certain promotional tactics, including contests or giveaways, or discounted prices via coupons or sales. Each research team member coded the advertisements independently, and any discrepancies were resolved.

Demographics of Instagram Accounts

In order to predict the demographic characteristics of the Instagram accounts posting marijuana-related content, we used the services of Demographics Pro (http://www.demographicspro.com/). Demographics Pro uses a series of algorithms to infer the likely demographics of social media accounts. Inferred characteristics include gender, marital status, race, and age and are based on multiple data signals from online social networks, consumption of information, and language used on the social media site. Iterative evaluation testing for the methodology is performed on large training sets of established samples of Instagram users with verified demographics. These services have been used in our previous Twitter-based research and are described in more detail elsewhere (Cavazos-Rehg et al. 2014; Cavazos-Rehg et al. 2015b). In addition to the inferred demographic characteristics of the Instagram accounts posting marijuana-related content, for comparison purposes, Demographics Pro also provides a median average value for each characteristic-based analysis of all followers from a large number of Instagram accounts. We descriptively compared characteristics of the Instagram accounts that posted marijuana to the median average of Instagram accounts.

Results

Over the 2-week time period, we collected 417,561 posts with marijuana-related hashtags. Among the 5000 randomly sampled posts from this total, 2136 (43 %) were explicitly about marijuana. A total of 1706 (34 %) of the posts did not show or reference anything related to marijuana in the image or caption, but used one of the hashtags of interest, and were excluded from further analysis. For 23 % of the posts, the link to the post did not work (n = 1052, 21 %) or the caption/image was not in English (n = 106, 2 %); as a result, these posts were also excluded from further analysis.

The 2136 posts that were images about marijuana or something related to marijuana were included for further analysis, and all statistics reported in the remainder of the results pertain to these 2136 posts. The 2136 marijuana-related posts had a median number of 28 likes (inter-quarter range 15–51), and 46 % (n = 983/2136) were from a handle that had a reference to marijuana in the handle name or in the Instagram profile.

Instagram Account Demographics

Inferred demographics of our sample of 1968 unique Instagram users who shared the 2136 posts about marijuana estimate that the users were predominantly male (59 %), which is higher than the Instagram median average (38 % male). The majority of Instagram users in both our sample and Instagram median average were single (68 % in our sample, 67 % single among the Instagram median average). More Instagram users in our sample were inferred to be African American (40 %) and less Caucasian (48 %) when compared to the Instagram median average (12 % African American, 77 % Caucasian). The inferred proportion that was Hispanic was similar for our sample of users (12 %) and Instagram median average (11 %). One out of five (22 %) individuals in our sample were inferred to be 19 years of age or younger, and 54 % were 20–24 years old, compared to the Instagram median average of 34 % who were 19 years of age or younger and 37 % who were 20–24 years old. The accounts in our sample were also relatively "popular," with 39 % having more than 1000 followers, which is nearly twice the Instagram average (18 %).

Images of Marijuana on Instagram

A total of 1568 of the 2136 marijuana-related posts were images of marijuana in its varied forms (marijuana ingestion was not observed in these posts) or images of marijuana paraphernalia. Among these 1568 posts, a type of marijuana was shown in 69 % (n = 1086/1568) of the posts (Fig. 2). More than half of these posts pictured marijuana buds or leaves (64 %, n = 690/1086). Marijuana concentrates (shatter, wax, or oil) were shown in 20 % of these posts (n = 221/1086), followed by joints or blunts at 14 % (n = 148/1086), and edibles at 3 % (n = 30/1086). Marijuana paraphernalia was displayed in 19 % of the posts that did not show a person using marijuana (n = 299/1568). The majority (93 %, n = 277/299) of these posts about marijuana paraphernalia pictured bongs, rigs (rig, a glass piece similar to a bong that is used to smoke marijuana extracts), or other glass devices used when smoking marijuana; just over 7 % (n = 22/299) specifically featured a vape pen.

Images of Marijuana Ingestion on Instagram

A total of 568 of the 2136 marijuana-related posts portrayed a person using marijuana within the image (Fig. 3). The most common images pictured people smoking joints or blunts (n = 283/568, 50 %). Images of individuals smoking marijuana with a bong or a rig (n = 263/568, 46 %) were also relatively common. Among these posts, 43 % (n = 113/263) showed someone dabbing marijuana concentrates while fewer posts (29 %, n = 76/263) were of a person ingesting marijuana in its traditional plant-based form using a bong or pipe. Of this type of images, 19 %, n = 49/263 of the links were inactive at the time of coding, and we were unable to distinguish the form of marijuana in 9 % of posts (n = 23/263). A person was vaping marijuana concentrates in 4 % (n = 20/568) of the posts, and edibles were being consumed in only one (<1 %) post.

Marijuana-Related Advertisements on Instagram

Among all marijuana-related posts (i.e., irrespective of whether or not there was a person using marijuana in the image; n = 2136), 9 % (n = 187/2136) were advertisements for a marijuana-related product (Fig. 4). Nearly half of these advertisements were marketing a

device/tool to ingest marijuana (43 %, *n* = 80/187), and of the devices/tools being advertised, dabbing-related devices and/or other tools to ingest marijuana concentrates (i.e., containers, dabber sticks, nails, rigs, and domes) were observed most frequently (56 %, *n* = 45/80), followed by advertisements that marketed devices/tools used for traditional plant-based marijuana use (i.e., bongs, pipes, grinders, and rolling papers) (26 %, *n* = 21/80) and vape pens (13 %, *n* = 10/80).

We additionally observed that marijuana shops/dispensaries (without featuring a specific item) were being marketed in 13 % (*n* = 25/187) of the advertisements while marijuana-related accessories (i.e., clothes, jewelry, and candles) were being marketed in 12 % (*n*=22/187) of the advertisements. Various forms of marijuana were being marketed in 10 % (*n*= 18/187) of the advertisements. Of the various forms of marijuana being advertised, we observed traditional plant-based marijuana (i.e., joints/blunts, buds, seeds; 44 %, *n*=8/18), marijuana edibles (39 %, *n*=7/18), and marijuana concentrates (28 %, *n*=5/18). Non-working links at the time of coding advertisements were 20 % (*n*=38/187) of the posts, and non-discernible images were 6 % (*n*=11/187) of the posts.

The marketing tactics utilized to promote marijuana on Instagram were images that advertised discounted prices via coupons or sales of a marijuana product (24 %, *n* = 45/187). In addition, advertisements that marketed contests and free giveaways of marijuana products were observed in 5 % (*n* = 9/187) of the posts. Advertisements that did not specify any aforementioned tactics were 52 % (*n* = 98/187) of the posts.

Discussion

In the present study, over the course of 2-weeks' time, we garnered slightly over 400,000 photos that utilized marijuana-related hashtags on Instagram, and based on our follow-up content analysis of a random sample of these posts, we approximate that nearly half of these posts are explicitly about marijuana. A key finding of our study is that the marijuana-related posts examined in this sample tended to be pro-use in nature. Individuals can create an Instagram account starting at age 13, and because Instagram does not censor explicit content and/or restrict under-age viewing, these marijuana-related posts can be seen when searched for by an underage viewer.

While most marijuana-related posts in this study contained images of marijuana in its traditional form (i.e., buds/leaves), we found that images of marijuana in non-traditional forms (i.e., marijuana concentrates and marijuana-infused edibles) were also relatively popular posts. It is concerning that Instagram users are socially networking about marijuana concentrates because the few known studies about its use suggest numerous acute side effects, such as rapid heartbeat, blackouts, paranoia, and hallucinations (John 2015; Stogner and Miller 2015). Risk for dependence might also be heightened with use of marijuana concentrates (Loflin and Earleywine 2014). Likewise, consumption of marijuana-infused edibles is also a relatively prevalent behavior among users of marijuana (about 30 % of marijuana using teens consumed edibles in the past year), and emerging research about their high potential for overconsumption similarly suggests reason for worry (Berger 2014; Hancock-Allen et al. 2015; MacCoun and Mello 2015). Given our findings regarding the

promotion of marijuana use on Instagram, it appears important for public health professionals to work toward balancing this content with information for young people about the known risks about marijuana use, especially given the current research suggesting associated risks with ingesting marijuana in non-traditional forms (Stogner and Miller 2015).

Additionally, we observed that marijuana-related advertisements were present on Instagram and included tactics that would appeal to potential customers including discounts/sales, contests, and free giveaways of marijuana-related products. While the marketing of marijuana on Instagram was relatively low, our findings are nonetheless important for drawing attention to the explicit marketing of marijuana on Instagram occurring either by the vendors themselves or individuals who are socially networking this content to their online "friends" who may want to know about such deals and discounts. State marijuana laws continue to evolve, and marijuana-related businesses are emerging with the increased legalization of recreational and medicinal marijuana across the USA; yet, restrictions on how marijuana-related products should be marketed and promoted to the public are still in the early stages of development. The small number of marijuana advertisements suggests that the practice of advertising through this social media platform has not yet become widely utilized by vendors. Thus, there is time for policy stakeholders who are working to refine and/or develop legislation targeting the advertisement of marijuana to include spaces like Instagram in their proposed regulations.

Another important finding of our study is the insight we gleaned into the Instagram users who posted about marijuana in our study. Many of the individuals posting this content were inferred to be young adults or teens, which is not surprising considering Instagram's user base (37 % between 16 and 24 years old) and the prevalence of marijuana use among this population (7.4 % of 12–17-year olds; 19.6 % of 18–24-year olds) (Center for Behavioral Health Statistics and Quality 2015a, b; Mander 2014). Additionally, African American adults have seen a marked increase in marijuana use over the past decade (4.7 to 12.7 %) (National Institutes of Health 2015), a trend that has also been observed in teens (Lanza et al. 2015). Our results show that marijuana-related content was commonly shared by those of an African American background and who are relatively popular and active on Instagram; these findings also correspond with our Twitter study about individuals who tweet about marijuana (Cavazos-Rehg et al. 2015b). In terms of implications of our findings, there is a growing body of work on how to utilize social media as a tool for health-related research dissemination (Allen et al. 2013; Finch et al. 2013; Harris et al. 2013; Keller et al. 2014). In this regard, it may be useful for individuals designing prevention messages about marijuana on social media to consider the typology of individuals who are socially networking about marijuana-related content. Maximizing this information to more effectively craft prevention messages about marijuana may better equip the creators of such messages to target and engage an intended audience.

There are limitations to our study that merit emphasis. It was outside the scope of this study to measure the impact that marijuana-related images have on viewers. Measuring changes in individual beliefs regarding marijuana use as well as actual changes in use behavior would be an important next step in understanding the influence of these images on viewers, and we

encourage research to study this line of inquiry. In addition, we collected posts during a 2-week period in late November of 2014. This provides only a brief snapshot of the types of marijuana-related posts on Instagram during one point in time. Collecting data for a longer period of time and/or during randomly sampled time periods throughout the year could have produced a more comprehensive study of marijuana-related images. Also, photos on Instagram may be tagged with a certain hashtag in order to socially network (i.e., target and engage) with a community of individuals who follow/seek out that hashtag because they may be engaged in that lifestyle and/or have interest in the associated behavior; thus, images within the post may not be explicitly related to the hashtag. We believe this explains why a portion of the random sample was unrelated to marijuana but contained one of the marijuana-related hashtags. Additionally, our sample size was limited in that roughly a quarter of posts in the random sample contained non-functioning links. After completion of the coding, we discovered that Instagram removed a large number of marijuana-related accounts at the end of 2014, which likely reduced the number of marijuana-related posts that we were able to report in this study. In addition, we could not accurately estimate overall prevalence of Instagram posts that are about marijuana because the Instagram API does not provide access to the full “firehose” of posts and has rate limits on data requests, limiting our ability to garner 100 % of posts with marijuana-related hashtags from 100 % of all Instagram posts. Finally, Instagram does not provide a count of how many people viewed the marijuana-related images, and thus, the reach of these posts cannot be estimated. Nevertheless, we believe our sample includes images tagged with the most commonly used marijuana-related hashtags on Instagram and provides a snapshot of the marijuana-related content on this platform.

In the present study, we discovered that marijuana content is prevalent, and most of the posts normalize and promote marijuana use in its traditional plant-based form and via novel modes of ingestion including edibles and the use of marijuana concentrates. We additionally found that marijuana advertisements are explicit and strategic with numerous tactics being utilized including discounts/sales, contests, and free giveaways of marijuana-related products. Instagram is a highly visual social networking site whose audience only continues to grow, especially among young adults. Therefore, our findings are important for signaling the relatively commonplace promotion of marijuana use in its varied forms as well as the explicit and numerous advertising strategies of marijuana that can be readily viewed on this platform.

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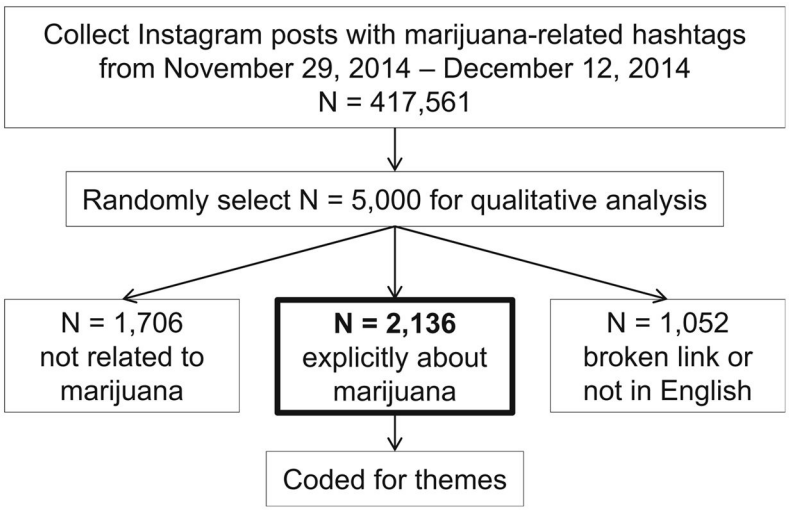


Fig. 1.
Complete methodology of selection of Instagram posts

	n (%, 95% CI)	Example images
Traditional marijuana forms		
Buds/leaves	690 (64%, 61-67%)	
Joints/blunts	148 (14%, 12-16%)	
Novel marijuana forms		
Concentrates (shatter, wax, oil)	221 (20%, 18-22%)	
Edibles	30 (3%, 2-4%)	

Fig. 2.

Example Instagram posts containing a type of marijuana (*N* = 1086/1568, 69 %, 95 % CI 67–71 %)

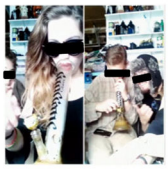
Method of ingestion	n (%, 95% CI)	Example posts
Joints or blunts	**283 (50%, 46-54%)**	 
Bong or rig	**263 (46%, 42-50%)**	
Marijuana concentrates (dabbing using rig)	113 (43%, 37-49%)	 
Plant-based marijuana (traditional bongs/pipes)	76 (29%, 23-35%)	 
Vape pen (marijuana concentrates)	**20 (4%, 2-6%)**	 

Fig. 3.

Instagram posts portraying a person using marijuana (*N* = 568/2136, 27 % 95 % CI 25–29 %)

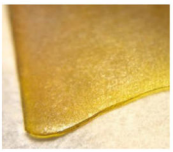
Item type	n (%, 95% CI)	Example posts
Devices or tools	**80 (43%, 36-50%)**	
Dabbing/marijuana concentrates (nails, rigs, domes, etc.)	45 (56%, 45-67%)	 *"…dope new products. Come by and grab them here or visit them at 710stop.com and get yours before they run out!"*
Traditional plant-based marijuana (bongs, pipes, grinders, etc.)	21 (26%, 16-36%)	 *"Today starts our 25 Days of Christmas deals…Today Only: $10 OFF all hand pipes!"*
Vape pens	10 (13%, 5-21%)	
Shop or dispensary	**25 (13%, 8-18%)**	 
Accessories (clothes, jewelry, etc.)	**22 (12%, 7-17%)**	*DAILY DEAL: 1x Rasta Crop Top + 1x BHO Leggings + 1x DAB Beanie + 1x Weed Socks + 1x Weed Sunglasses $35.95 only!*
Marijuana	**18 (10%, 6-15%)**	 *"…amazingly terpy "Pineapple Express" shatter just pulled up along with 6 other delicious flavors for our patients here at @greentreeswellness!!"*
Traditional plant-based	8 (44%, 21-67%)	
Edibles	7 (39%, 16-62%)	
Concentrates	5 (28%, 7-49%)	

Fig. 4.

Marijuana-related advertisements on Instagram (N = 187/2136, 9 % 95 % CI 8–10 %)

Table 1

New posts tagged with marijuana-related hashtags during the monitoring period of October 25, 2014 through December 5, 2014

Hashatag[a]	Number of new posts
#420	540,552
#high	270,756
#highlife	251,353
#710	228,903
#highsociety	207,650
#kush	182,397
#stoner	181,795
#cannabis	177,407
#marijuana	150,357
#shatter	122,064
#maryjane	90,450
#weedstagram420	61,436
#instaweed	54,937
#thc	54,823
#stayhigh	49,292
#blunt	43,965
#pot	39,563
#stonernation	38,430
#blunts	28,670
#wakenbake	28,135
#pothead	27,169
#smokeweedeveryday	26,331
#justblazeig	21,199
#staygreen	11,533
#bong	9753
#joint	7200

[a]The following hashtags did not meet the inclusion criteria: #allweedeverything, #baked, #bud, #budshots, #dabs, #dank, #dooby, #dope, #edibles, #ganja, #goodkush, #haze, #herb, #herblife, #highasfuck, #instastoned, #iwillmarrymary, #legalizeit, #medicalmarijuana, #mymedicine, #onlysmokethefinest, #potheadworld, #puffpuffpass, #reefer, #sober, #stayblazed, #staylifted, #stoned, #stonerpics, #stonerpicsdaily, #thcfuel, #vapedank, #vapelife, #wakeandbake, #w420, #weed, #weed420, #weedporn, and #weedstagram