Full length article

A content analysis of JUUL discussions on social media: Using Reddit to understand patterns and perceptions of JUUL use

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ABSTRACT

Background: JUUL, an electronic cigarette, is estimated to occupy 50% of the e-cigarette market and appears to be particularly common among youth. However, there is little research on perceptions of JUUL. The aim of the current study was to examine posts on Reddit specific to JUUL and youth to better understand the context and perceptions of JUUL use.

Methods: This content analysis utilized social media discussions posted between January 2015-May 2017. Public posts on Reddit, a social media platform, were gathered and coded. Posters of discussions relevant to both JUUL and youth were included for analysis.

Results: 364 posts were included for quantitative content analysis. Posts were mixed in terms of polarity with many (41.1%) including positive and negative language regarding JUUL. In terms of polarity of youth use, 60% of posts showed negative perceptions of youth use. Among posts by youth, only 37% showed negative perceptions of youth use. Posts included a variety of reasons for using JUUL with the most frequent reason being the popularity of JUUL (34.2%) followed by using it to quit smoking (23.3%) and to feel a buzz (20.2%). Age restrictions were the most common barrier to use.

Conclusions: Posters generally had a nuanced perception of JUUL and identified both positive and negative aspects. Interestingly, while primary reasons for youth use indicate the strong influence of social norms, barriers to use suggest that public health interventions such as age restrictions may curb youth use. Findings can inform prevention efforts and important factors for JUUL initiation.

1. Introduction

Despite a decline in combustible cigarette use in recent years, use of electronic cigarettes (e-cigarettes) has increased or remained relatively stable, particularly among youth and young adults (Singh, 2016; Wang et al., 2018). E-cigarettes are now the most commonly used tobacco product among youth, with a prevalence of past 30-day use at 4.3% among middle school students and 11.3% among high school students (Jamal, 2017). While a number of adult smokers report using e-cigarettes as smoking cessation aids (Polosa et al., 2011; Dawkins et al., 2015), many youth begin using e-cigarettes without having tried other tobacco products (Soneji et al., 2017; Bostean et al., 2015). Therefore, such products may increase risk among a population that may have otherwise remained naïve to tobacco use.

In 2015, JUUL, a new device by PAX, entered the market. Just two years later, JUUL was responsible for over 50% of the entire e-cigarette market (Herzog and Kanada, 2018). JUUL is a slim, rechargeable e-cigarette that utilizes easily changed pods filled with flavored e-liquid and only requires the user to puff on the device to inhale a nicotine-laced aerosol that resembles cigarette smoke. Of note, it is shaped similarly to a USB flash drive, rendering it easy to carry and conceal. Each flavor pod contains 0.7 mL of e-liquid with 5% nicotine, resulting in nicotine delivery comparable to a cigarette after only a few puffs (Brown and Xing, 2015). JUUL e-liquid uses nicotine salts which may make inhalation of the notably high nicotine concentration in the liquid and aerosol palatable to naïve populations (Goniewicz et al., 2018). There is growing concern that JUUL's ease of use, discreet appearance, and use of appealing flavors combined with its efficient nicotine

delivery may make it not only an attractive product for youth and adults to try but a product that may sustain long-term nicotine addiction.

Unfortunately, these concerns appear well-founded even with the limited data currently available. JUUL is particularly popular among youth and young adults. In a large sample of 15-24-year-olds (Willett et al., 2018), one-quarter of youth recognized JUUL, and 8% reported current use. Moreover, almost 80% of those that reported ever trying JUUL also reported past 30-day use, indicating significant uptake of JUUL.

JUUL's popularity is also reflected on social media with mentions of JUUL on Twitter increasing rapidly from October 2017 to February 2018 (Kavuluru et al., 2018). Similarly, JUUL is commonly discussed on Reddit, a publicly available social media platform where individuals can create their own posts within a variety of forum categories ranging from entertainment to politics to seeking advice. Users can also comment and vote on the posts of others, lending itself to group discussion and dissemination of information and opinions. Content can include text, images, links, and posts that can gain more or less visibility depending on their votes. A recent commentary examining posts on Reddit identified a large number of underage Reddit users discussing their use of JUUL (Kavuluru et al., 2018).

To date, only one survey study and one commentary have examined the use of JUUL. The current study utilized Reddit to examine youth-specific posts related to JUUL use and perceptions of use. Understanding exposure to tobacco-related social media is particularly important given that over half of youth and young adults report exposure to tobacco-related media (past month), which is concerning given youth's susceptibility to tobacco use (Hébert et al., 2017). Research examining media content has led to important findings such as identifying the need for evidence-based smoking cessation videos on YouTube (Backinger et al., 2011). Notably, Reddit has several forums dedicated to e-cigarettes, including JUUL, and has been utilized in previous studies of e-cigarette content on social media (Wang et al., 2015). One recent study using Reddit examined e-cigarette flavors discussions and found an increase in posts discussing flavors and that users are interested in a large variety of flavor options (Wang et al., 2015). Given the large number of users and options for individuals to request and share information, content on Reddit has the potential to influence those visiting the site even without posting. The primary aim of the current study was to examine posts on Reddit specific to JUUL and youth to better understand the context and perceptions of JUUL use.

2. Methods

2.1. Overview

Using a systematic, quantitative content analysis, coders examined all posts and comments on the popular social media site, Reddit, that specifically mentioned the e-cigarette JUUL and youth. A codebook was developed a priori to specifically examine themes in the content including poster characteristics, polarity, flavors, references to youth, popularity, reasons and barriers to use, and health-related content.

2.2. Content selection

For the current study, content was downloaded from the popular social media site, Reddit. All publicly available Reddit comments and posts between January 2015 and May 2017 were downloaded using the pushshift.io Reddit API (Baumgartner, 2018). Comments and posts were restricted to those that included the word "juul" in the text or the title, which resulted in 16,068 total posts. Posts that did not mention JUUL the e-cigarette or included "juul" as a string of miscellaneous characters (n = 3284) or irrelevant posts (i.e., posts that mentioned a hockey player with a last name containing "Juul", not the e-cigarette;

n = 1277) were excluded. Out of the remaining posts, posts were retained if they also included one of the following youth-related keywords, including stems: college, high school, kids, students, underage, teenagers, young, or youth. The final sample resulted in 364 total posts and comments.

2.3. Unit of analysis

Reddit users are able to create their own posts as well as post comments on others' submissions. Each post has a title with comments appearing under the original submission. The unit of analysis was "post", meaning each comment and original post was coded separately for the variables of interest. There were 81 posts and 283 comments included in the coding analysis.

2.4. Coder training

Six coders underwent 12 h of training, and in addition to the training, seven of the 364 posts were coded as a group for further training. Training included review and revision of the codebook, practice coding sessions, discussions over any disagreements in the practice sessions, and training on using the online platform to facilitate coding. Then, 37 posts (10% of all posts) were randomly selected from the sample to determine intercoder reliability. 41% of the 37 posts were posts and 59% were comments. Coders reliability ranged from Krippendorff's $\alpha = .68$ to 1.00, all within an acceptable range (Krippendorff, 2004). For each of the posts used for intercoder reliability, one coder was randomly selected to represent that post in the complete study results. Coders ranged in age from 22 to 33 years old and were familiar with social media websites such as Reddit.

2.5. Content categories

Content categories of poster knowledge of JUUL, poster age, polarity, flavor mentions, reasons and barriers for use, popularity of JUUL, mention of other tobacco products, JUUL initiation, JUUL as a gateway, perceptions of JUUL, addictiveness of JUUL, and health-related categories were coded. Content categories were selected based on a priori research questions and previous e-cigarette literature. Each post was assigned a category within each content area. For categories that were not mutually exclusive (e.g., reasons for use), a post could be assigned multiple categories.

Knowledge of JUUL was defined as the poster explicitly indicating current use of or familiarity with the product. *Poster age* was defined as the poster explicitly stating whether they were a minor or an adult. *Polarity* was defined as language describing JUUL as positive, negative, ambivalent, or with no positive or negative language at all. *Flavors mentioned* was coded for mentions of a JUUL or e-cigarette flavor and then further coded for *type of flavor*. *Youth specific mentions* was coded for positive, negative, or ambivalent perceptions of youth using JUUL. *Reasons for JUUL use* was coded for mentions of popularity, social/friends, buzz, taste, easily available, price, stealthy, addicted to use, quit smoking, and throat hit. *Barriers for JUUL use* was coded for mentions of price, concern about health, concern about addictiveness, age restrictions, and/or age-related barrier (e.g., getting caught by an authority figure with JUUL) or lack of availability (e.g., cannot find product in stock). *Popularity of JUUL* was defined as the post describing JUUL as popular, an epidemic, widespread, or whether the poster made an observation about the pervasiveness of JUUL or its increased popularity. *Tobacco product user* was coded for all other tobacco products that the poster specifically mentioned using. *Initiating tobacco use with JUUL* was defined as explicitly stating that JUUL was the first-tried tobacco product by the poster. *JUUL as a gateway* was defined as explicit mentions of JUUL leading to other product use and/or trying other tobacco products after trying JUUL; this category could be assigned in reference to the poster's own experience or perceptions of

Table 1
Frequencies on post characteristics (N = 364).

Characteristics	n (%)
Poster	
Minor	40 (11.0)
Adult	75 (20.6)
Unknown	249 (68.4)
Familiarity	
Familiar	332 (91.2)
Unfamiliar/Unsure	14 (3.8)
JUUL use status	
Current user	75 (20.6)
Past user	3 (0.8)
Tried/unclear use	35 (9.6)
Other product mentions	
Other ENDS	74 (20.3)
Combustible cigarettes	79 (21.7)
Smokeless tobacco	4 (1.1)
Hookah	3 (0.8)

Fig. 1. JUUL pod specific flavor mentions (n = 39).

others' experiences. *JUUL separate from vaping* was defined as explicitly describing an opinion that JUUL is different/separate from vaping, e-cigarettes, or other electronic nicotine delivery devices (ENDS). *Addictiveness of JUUL* was defined as mentioning that JUUL was addicting/addictive, being addicted to JUUL, being an addict because of JUUL, or that others are addicted to JUUL. *JUUL to quit combustible cigarettes* was defined as mentioning using JUUL to quit or cut down on smoking combustible products. *Health-polarity of JUUL* was defined as whether the poster mentioned JUUL was positive for health (absolute), positive for health in comparison to other tobacco products, negative to health, ambivalent, or neither.

3. Results

Descriptive statistics were used on the full data set (*N* = 364) to examine a priori topics of interest. In the majority of posts, the poster did not explicitly mention their age. Among posts where the poster explicitly mentioned their age, there were 40 posts written by minors and 75 written by adults (Table 1). Almost all posters reported knowing what JUUL was (*n* = 332 were familiar with JUUL, *n* = 2 were not familiar with JUUL, and *n* = 12 were uncertain whether they knew what JUUL was).

Combustible cigarettes (*n* = 79) and other ENDS (*n* = 74) were the most frequently mentioned tobacco products. Interestingly, only 5 posts included a poster who reported current cigarette smoking, while 18 indicated current non-JUUL ENDS use. Posters indicated current JUUL use in 75 posts, and an additional 38 posts indicated unclear or past use of JUUL (ever use *n* = 8; past use *n* = 3, unclear use *n* = 27). In 18 posts, posters stated that they currently do not use JUUL and did not mention current or past use of other nicotine/tobacco products. Only two posts explicitly stated that JUUL was the first tobacco product tried by the poster. Further, only three posts expressed the viewpoint of JUUL as a gateway product that led to trying and using other nicotine/tobacco products.

Several posts (*n* = 39; see Fig. 1) mentioned specific JUUL flavors, with mango being the most frequently mentioned flavor (*n* = 18), followed by cool mint (*n* = 11) and flavors that were not specific to JUUL pods (*n* = 7). Relatedly, 9 posts specifically mentioned taste as a reason for using JUUL.

Language surrounding JUUL and its use was also examined (Table 2). 185 posts (50.8% of all posts) used positive language, negative language, or both when describing JUUL. 76 posts (41.1%) used both positive and negative terms in reference to JUUL. 66 posts (35.7%) exclusively used positive language, while 43 posts (23.3%) exclusively used negative language. Posts that discussed youth use of JUUL were also examined for polarity (*n* = 156). Of these, 95 posts (60.9%) described negative perceptions of youth using JUUL, while 31 (19.9%)
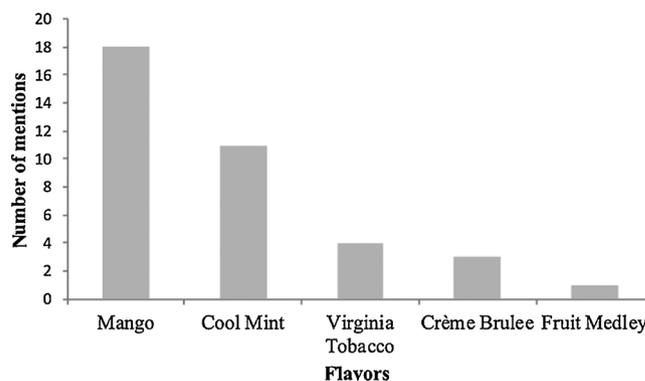
reported positive perceptions of youth use. An additional 30 posts (19.2%) used both positive and negative language to describe perceptions of youth JUUL use. 121 posts referenced youth in relation to JUUL but did not use positive or negative language.

Posts were coded for reasons for and barriers to JUUL use (Table 3). 193 posts described at least one reason for using JUUL. The most common reasons for using JUUL were because JUUL is popular (*n* = 66; 34.2%), JUUL can be used to help quit smoking (*n* = 45; 23.3%), and the buzz (*n* = 34; 20.2%). Using JUUL in social settings (*n* = 5; 2.6%), the price of JUUL (*n* = 4; 2.1%), and JUUL being easily available (*n* = 3; 1.6%) were the least common reasons for use. 149 posts described barriers to JUUL use. Barriers related to age (e.g., needing to be at least 21 years of age to sign for JUUL order) were the most frequent barriers to use (*n* = 52; 34.9%). Consistent with findings from reported reasons for use, the price of JUUL (*n* = 28; 18.8%) and lack of availability (*n* = 24; 16.1%) were the next most frequent barriers to use.

Notably, 30.5% of all posts (*n* = 105) mentioned the popularity of JUUL using language describing JUUL as an epidemic, widespread, or similar language. 11.6% of posts (*n* = 40) described either being addicted to JUUL or that JUUL is addictive. Eight posts reported JUUL as being separate/different from other ENDS by describing JUUL and ENDS as two unique product categories.

Perceptions of JUUL as it relates to health were assessed, including potential health benefits and negative consequences of use. Among all posts, 16.2% (*n* = 55) described JUUL as a way to reduce or quit combustible cigarette use. 15.3% (*n* = 53) of posts used health language to described possible benefits or consequences related to JUUL use. Specifically, 29 posts used positive comparative health language describing JUUL as healthy or beneficial compared to other tobacco products. Only 14 posts described negative health consequences of JUUL use, including both short-term (e.g., nausea) and long-term (e.g., cancer) consequences.

4. Discussion

The current content analysis is the first to examine use patterns and perceptions of JUUL with a focus on youth on a popular social media platform. Findings suggest a wide variety of perceptions regarding JUUL and its users. The vast majority of posters were familiar with JUUL, with numerous posts indicating either current or past use. Additionally, a portion of posts mentioned other ENDS and combustible cigarettes when discussing JUUL, with almost one-third of posts reporting either current, past, or some history of JUUL use. This finding suggests that many people discussing JUUL on Reddit may not have used JUUL themselves and may be seeking information on the product through forums on Reddit. Given that social media platforms such as Reddit can provide a wealth of both accurate and inaccurate information, it is important to understand how individuals may use social media to inform their own use of JUUL. The extent to which forums such as Reddit can influence user use and perceptions of JUUL is

Table 2

. Polarity of language about JUUL (n = 185) and youth use (n = 156).

Category	n (%) all posts	n (%) posts by youth posters	Example quotes
Positive language	66 (35.7)	9 (39.1)	"If you want a refillable vape that hits closer to a cigarette you should check out the Juul. It's very small and discrete and doesn't blow huge clouds but the flavors they sell are good (especially mango) and it hits hard."
Negative	43 (23.2)	5 (21.7)	"I don't count the Juul as that new technology… if they didn't leak and could easily use liquid other than what's supplied, I feel like many more people would use one."
Ambivalent	76 (41.1)	9 (39.1)	"Yeah I'm in high school and juul use is so widespread. I don't know anyone with a juul who isn't addicted tbh. I had to get rid of mine bc I was developing a serious addiction, but I'm still addicted just from catching qb's off other people's juuls since they're so easy to find.."
Positive towards youth	31 (19.9)	7 (36.8)	"I'm a grown man… Kids are going to smoke cigs anyway… they're just picking the better alternative…"
Negative towards youth	95 (60.9)	7 (36.8)	"Kids are dumb and Juul is easy and sexy. Enjoy your nicotine addictions, kids."
Ambivalent towards youth	30 (19.2)	5 (26.3)	"I do agree that the Juul is a lot better than smoking.. If we can smash the image around vaping/smoking to where kids don't see it as cool that would be great!… and if kids turn to vaping in large numbers, as much as it's better then smoking…"

Table 3

Reasons for use (n = 193) and barriers to use (n = 149).

Content Category	n (%)	exemplar quote
Reasons for use		
Popularity	66 (34.2)	"Phoenix here too, work with some high schoolers, every single guy juuls and like half the girls including freshman at all schools to the point where you almost have a bad stigma if you don't"
Social/Friends	5 (2.6)	"I'm currently in high school and Juuls are extremely popular… I'm in an extra curricular group after school and we use them."
Buzz	34 (20.2)	"compared to normal vaping, the JUUL delivers nicotine much faster to the bloodstream, allowing the kids to get their instant buzz"
Taste	9 (4.7)	"…as soon as i ripped my first time from my friend's juul and that delicious mango flavor graced my throat i was ready to devote my life."
Easily available	3 (1.6)	"… I'm in high school and almost everyone that has ever used any kind of vape has a JUUL. Our main shop doesn't card so it's always available…"
Price	4 (2.1)	"..Juul, so far, has been much more inexpensive.."
Stealthy/Discreet	22 (11.4)	"nowadays kids use JUULs to be more inconspicuous"
Addiction	19 (9.8)	"… honestly the addiction is MUCH less than nicotine.. I dont smoke anymore but i use a juul, and the withdrawals are so much more".
Use to quit smoking	45 (23.3)	"…And the way I quit cigs is vaping, it was a little e-cig. Search up Juul…"
Throat hit	13 (6.7)	"I like the Juul because I was a heavy smoker for probably 5 years.. the Juul gives me the throat hit and nic pleasure that you crave after being an avid smoker.."
Other	46 (23.8)	
Barriers to use		
Price	28 (18.8)	"Been meaning to replace my Juul because as a student need something more discreet I just couldn't justify the expensive pods…"
Concern about health	16 (10.7)	"One of the problems with Juul is that they do not offer lower nicotine levels… While vaping seems a lot safer than other forms of tobacco, I worry a lot about my health."
Concern about addictiveness	17 (11.4)	"Vape does smell nice, but the fact that some of them have nicotine is what I have a problem with. Those juul things are quite common at my school…I do know of a case where a good friend of mine went from vaping to cigarettes because of a nicotine addiction she developed… If you can't stop vaping in public, then you're addicted."
Age restrictions	52 (34.9)	"Ordering a Juul and made sure my account had my age saying I was 21 years old, but now I have to verify it using an ID…Willing using my Fake ID's information work?"
Lack of availability	24 (16.1)	"The one that worries me is the Juul… When we get them in store, they sell out within a week…"
Other	27 (18.1)	

Note. Percentages total more than 100 due to posts that listed multiple reasons or barriers.

unknown but has important implications for prevention. Though a minority of posts explicitly provided an age, findings suggest that perceptions of JUUL use and users likely differ between adults and youth.

Interestingly, the majority of posts that used positive or negative language to describe JUUL contained ambivalent language (i.e., used both positive and negative language). These findings suggest that perceptions of JUUL tend to be complex; a multitude of posts acknowledged benefits of JUUL as well as drawbacks or reasons individuals may not perceive JUUL favorably. Further, several posts indicate positive views regarding JUUL, the product, but negative views of youth use of JUUL (e.g., "The juul is an amazing piece of technology. It's a shame that it's popularity amongst kids is what will lead to it's eventual demise."). Among posts that specifically discussed youth use of JUUL, over half of the posts described negative perceptions of youth use. This differs from results on general polarity, where only under a quarter of the posters used exclusively negative language, suggesting that among this population the JUUL device is generally viewed favorably, but the idea of minors using JUUL is more susceptible to criticism. Notably, it

appears that youth posters were more likely to view youth use of JUUL favorably than the total sample of posters, suggesting a divide between adult and youth perceptions of youth using JUUL. Finally, a relatively small percentage of all posts discussed health benefits or consequences related to JUUL, with the majority of those describing JUUL as a less harmful alternative to other tobacco products. Results suggest posters were more likely to talk about JUUL as a way to reduce combustible cigarette use than potential short- or long-term negative health consequences (e.g., nausea or cancer).

Both reasons for and barriers to JUUL use were common across posts. Popularity of the device emerged as a common reason for use. Given that JUUL use is becoming increasingly common among youth and young adults, it is not surprising that popularity, defined here as stating JUUL is popular or widespread, was the most frequent reason for use given the importance of social normative behavior among this age group. Similarly, almost one third of all posts mentioned JUUL's popularity broadly. Given the large portion of posts that described the product's pervasiveness, it is likely that individuals are noticing this trend across geographic locations. Another common reason for use was

to help with quitting smoking. Though it appears that young people who may be tobacco naïve are trying JUUL, it is important to note that some smokers use JUUL with the intent of reducing or quitting combustible cigarette use. This reason for use highlights the difficulty of balancing regulation of such devices to limit access by youth and acknowledging their potential benefits for smokers who are able to completely switch. Obtaining a buzz was also a common reason for using JUUL; 1 in 5 posters endorsed this reason. This finding highlights the appeal of JUUL's nicotine content and delivery, which is particularly concerning for individuals trying JUUL who were previously nicotine naïve. Though a strong buzz may be beneficial for those using JUUL to help quit using combustible cigarettes, it may indicate high abuse liability for youth and nicotine naïve adults. Unsurprisingly given its seeming popularity among youth, age-related restrictions to purchasing JUUL was the most common barrier to use, suggesting this restriction is at least somewhat effective in limiting JUUL use among youth. However, it is important to note that age restrictions are inconsistently enforced, and the enactment of laws without adequate enforcement is unlikely to be effective at reducing youth use (DiFranza, 2011). Uptake of Tobacco 21 laws and increased enforcement of such restrictions may be important for preventing initiation of JUUL and other ENDS among youth. Price was another common barrier to JUUL use, suggesting that pricing strategies may be beneficial for tempering JUUL use among youth, similar to strategies used for combustible cigarettes (Huang et al., 2018). The combination of fully enforced age restrictions and increased price may be effective in curbing uptake and maintenance, especially among younger populations.

The results of this study are not without limitations. First, although Reddit is a widely used website across the world, the majority of users are young, white, and male (Barthel et al., 2016). Therefore, results may not generalize well to other populations. Further, the current study is a content analysis that utilized a subset of available posts on a single social media platform. Findings may not be consistent across other sites or necessarily representative of broader discussions of JUUL. Also, there were relatively few posts that were coded for several of the categories of interest, which impacted generalizability of conclusions. Posts included in the initial search were gathered using search terms specific to JUUL and youth (e.g., kids, young, student, etc.), which may not have captured the entire range of posts discussing JUUL use. Furthermore, some content categories could have been expanded upon, e.g., by adding a general "nicotine" mention category to assess how individuals were talking about JUUL's nicotine content. Additionally, some evidence has suggested that there are limitations to the pushshift.io database, including missing data, which could potentially bias results (Gaffney and Matias, 2018); how this missingness may have impacted findings from the current study is unknown. Finally, though coders took care to only classify posts as written by an adult, minor, current JUUL user, etc., if age or use status was explicitly stated by the poster, it was not possible with the current data to validate participant characteristics with certainty. Future research should examine these perceptions among users and non-users via questionnaire data.

Despite these limitations, this study is one of only two other studies examining the use of arguably the most popular e-cigarette on the market and the first to examine the content of Reddit posts using a systematic, quantitative content analysis examining patterns and perceptions of JUUL as well as youth use of the product. Given the recent concern about JUUL's increasing popularity and use in schools, it is particularly important to understand how both youth and adults are talking about JUUL and why individuals might initiate use as well as factors that may be barriers to use. Findings from this study can be used help to inform future research questions, including identifying features that increase the appeal and abuse liability of JUUL, public health interventions that may potentially curb youth use (e.g., Tobacco 21), and examinations of discussions on other social media sites such as Instagram, Facebook, Twitter, and SnapChat.

References

Backinger, C.L., Pilsner, A.M., Augustson, E.M., Frydl, A., Phillips, T., Rowden, J., 2011. YouTube as a source of quitting smoking information. Tob. Control 20, 119–122.

Barthel, M., Stocking, G., Holcomb, J., Mitchell, A., 2016. Reddit News Users More Likely to be Male, Young, and Digital in Their News Preferences. Pew Research Center, Washington, D.C.

Baumgartner, J.M., 2018. pushshift.io. http://files.pushshift.io/reddit/.

Bostean, G., Trinidad, D.R., McCarthy, W.J., 2015. E-cigarette use among never-smoking California students. Am. J. Public Health 105, 2423–2425.

Brown, A., Xing, C., 2015. Nicotine Salt Formulations for Aerosol Devices and Methods Thereof. Juul Labs, San Fransisco.

Dawkins, L., Kimber, C., Puwanesarasa, Y., Soar, K., 2015. First-versus second-generation electronic cigarettes: predictors of choice and effects on urge to smoke and withdrawal symptoms. Addiction 110, 669–677.

DiFranza, J.R., 2011. Which interventions against the sale of tobacco to minors can be expected to reduce smoking? Tob. Control 21, 436–442.

Gaffney, D., Matias, J.N., 2018. Caveat emptor, computational social science: large-scale missing data in a widely-published Reddit corpus. PLoS One 13, e02000162.

Goniewicz, M.L., Boykan, R., Messina, C.R., Eliscu, A., Tolentino, J., 2018. High exposure to nicotine among adolescents who use Juul and other vape pod systems ('pods'). Tob. Control Epub ahead of print.

Hébert, E.T., Case, K.R., Kelder, S.H., Delk, J., Perry, C.L., Harrell, M.B., 2017. Exposure and engagement with tobacco-and E-cigarette–related social media. J. Adolesc. Health 61, 371–377.

Herzog, B., Kanada, P., 2018. Nielsen Tobacco 'all channel' Data 1/27/2018: Wells Fargo Equity Research Reports. Wells Fargo, San Francisco.

Huang, J., Gwarnicki, C., Xu, X., Caraballo, R.S., Wada, R., Chaloupka, F.J., 2018. A comprehensive examination of own-and cross-price elasticities of tobacco and nicotine replacement products in the US. Prev. Med. 117, 107–114.

Jamal, A., 2017. Tobacco use among middle and high school students – United States, 2011–2015. MMWR Morb. Mortal. Wkly. Rep. 66, 597–603.

Kavuluru, R., Han, S., Hahn, E.J., 2018. On the popularity of the USB flash drive-shaped electronic cigarette Juul. Tob. Control Epub ahead of print.

Krippendorff, K., 2004. Reliability in content analysis. Hum. Commun. Res. 30, 411–433.

Polosa, R., Caponnetto, P., Morjaria, J.B., Papale, G., Campagna, D., Russo, C., 2011. Effect of an electronic nicotine delivery device (e-Cigarette) on smoking reduction and cessation: a prospective 6-month pilot study. BMC Public Health 11, 786.

Singh, T., 2016. Tobacco use among middle and high school students– United States, 2011-2015. MMWR Morb. Mortal. Wkly. Rep. 65, 361–367.

Soneji, S., Barrington-Trimis, J.L., Wills, T.A., Leventhal, A.M., Unger, J.B., Gibson, L.A., Yang, J., Primack, B.A., Andrews, J.A., Miech, R.A., Spindle, T.R., 2017. Association between initial use of e-cigarettes and subsequent cigarette smoking among adolescents and young adults: a systematic review and meta-analysis. JAMA Pediatr. 171, 788–797.

Wang, T.W., Gentzke, A., Sharapova, S., Cullen, K.A., Ambrose, B.K., Jamal, A., 2018. Tobacco product use among middle and high school students—united States, 2011–2017. MMWR Morb. Mortal. Wkly. Rep. 67, 629.

Wang, L., Zhan, Y., Li, Q., Zeng, D.D., Leischow, S.J., Okamoto, J., 2015. An examination of electronic cigarette content on social media: Analysis of e-cigarette flavor content on reddit. Int. J. Environ. Res. Public Health 12, 14916–14935.

Willett, J.G., Bennett, M., Hair, E.C., Xiao, H., Greenberg, M.S., Harvey, E., Cantrell, J., Vallone, D., 2018. Recognition, use and perceptions of JUUL among youth and young adults. Tob. Control Epub ahead of print.