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Reducing e-cigarette use among youth and young adults: evidence of the truth campaign's impact

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ABSTRACT

Background Mass media campaigns have been shown to be effective in reducing cigarette use. However, evidence is limited for whether campaigns can shift e-cigarette use among youth and young adults (YYA). To assess the impact of the truth anti-e-cigarette campaign, which focused on the effects of vaping on mental health, this study examines the relationship between campaign awareness and e-cigarette behaviour among YYA.

Methods Data from weekly cross-sectional surveys of YYA aged 15–24 years from September 2021 to October 2022 were used for multilevel models assessing how weekly campaign awareness is related to intentions to use e-cigarettes and current e-cigarette use (past 30 days). Weekly campaign awareness was calculated by averaging individual-level awareness for each week. Control variables included individual-level campaign awareness, sociodemographics, perceived financial situation, parental smoking, sensation seeking, and mental health.

Results Weekly campaign awareness ranged from 50% to 78%, with most weeks (77%) being within 65% and 75% of weekly campaign awareness. At weekly awareness levels between 65% and 75%, there was a significant association with lower intentions to use e-cigarettes. A dose–response relationship was observed for current use: compared with weeks with lower (<65%) awareness, weeks with awareness of 65–70% had 14% lower odds of current use, weeks with 70–75% awareness had 16% lower odds and weeks with >75% weekly awareness had 18% lower odds ($p=0.018$, $p=0.009$ and $p=0.007$, respectively).

Conclusions Findings from this analysis of weekly campaign awareness demonstrate that exposure to the truth anti-e-cigarette campaign is associated with significantly lower odds of intentions to use and current use of e-cigarette among YYA.

BACKGROUND

Decades of research have demonstrated that mass media campaigns in numerous countries are an effective tool in preventing smoking initiation and prompting cessation, particularly among youth and young adults.^{1–4} Numerous studies have provided strong evidence supporting the effectiveness of these campaigns in changing tobacco-related attitudes, intentions and behaviours to reduce cigarette use.^{5–12} Coupled with comprehensive tobacco policies, including tobacco taxes and smokefree indoor air restrictions, campaigns have been instrumental in helping to reduce cigarette use from 28.3% in 1997 to 2.3% in 2021 among youth in the USA.¹³ The declines in cigarette use have been lauded as

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Previous research has shown that mass media campaigns are effective in reducing cigarette use, but evidence is limited for whether media message can help reduce e-cigarette use among youth and young adults.

WHAT THIS STUDY ADDS

⇒ Findings indicate that awareness of the truth campaign's anti-e-cigarette message is associated with significantly lower odds of intentions to use and current use of e-cigarettes among youth and young adults.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study provides evidence that mass media campaigns remain an important component of comprehensive tobacco control programmes, particularly with respect to e-cigarettes, the most popular tobacco product among youth and young adults.

one of the most successful public health advances in the modern era.^{14 15}

As declines in cigarette use occurred, the tobacco industry introduced a set of non-combustible tobacco products including electronic nicotine delivery systems or e-cigarettes. E-cigarettes now surpass combustible cigarettes as the most popular nicotine delivery product among youth and young adults.^{13 16 17} In 2015, the prevalence of past 30-day e-cigarette use escalated to 16% among high school students, which prompted the Surgeon General to identify e-cigarette use as 'an epidemic'.¹⁸ In 2022, the prevalence of past 30-day e-cigarette use among high school students was 14%, peaking at 28% in 2019.¹⁹

Developments in e-cigarette product design have resulted in higher levels of nicotine delivery to users and increasing popularity of these high-nicotine products.^{20 21} In 2017, the production of the fourth-generation pod mod design (eg, JUUL), offered a higher yield of nicotine than previous e-cigarettes and combustible cigarettes.^{22 23} These high-nicotine devices were available in flavours and were featured in marketing that appealed to youth and young adults.²⁴ In more recent years, disposable e-cigarette devices were introduced and quickly grew to gain a significant market share among youth; disposable sales increased by 134% from early 2020 to fall 2022.²⁵ Popular disposable devices have nicotine concentrations greater than



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Figure 1 Examples of ads in truth campaign focused on mental health.

5%, exceeding levels seen in pod mods (eg, 3%, 5%) and mimic flavours seen in pod mods like JUUL.²⁶ In response to the rising vaping epidemic among youth and young adults, the national truth campaign has aired numerous successive message executions designed to increase knowledge about the consequences of using e-cigarettes, change in attitudes about e-cigarettes, denormalise e-cigarette use and promote e-cigarette cessation behaviours.

Recent research demonstrates that mental health problems among youth and young adults increased during COVID-19 lockdowns internationally.^{27–29} High school students who reported persistent feelings of sadness and hopelessness increased from 37% in 2019 to 44% only 2 years later in 2021.^{27–28} The pandemic caused students to transition to online learning which contributed to increased social isolation, more exposure to difficulties in abusive homes and reduced opportunities for identification of mental health symptoms by supportive educators.³⁰ Unfortunately, e-cigarette use has been associated with a variety of indicators of poor mental health among adolescents and young adults, including internalising problems, depression and perceived stress.³¹ Since researchers have observed a bidirectional relationship between nicotine and depressive symptoms,^{32–33} the role of e-cigarettes in mental health concerns remains unclear. The truth campaign launched 'It's Messing With Our Heads' in September 2021. Examples of ads can be seen in [figure 1](#) and include: a satirical introduction of a new e-cigarette product marketed as a 'Depression Stick'; a series of ads about nicotine's potential to amplify feelings of anxiety and depression; testimonials from youth and young adults which included their experiences with mental health and vaping; and emphasising the e-cigarette industry's ability to profit from the mental health implications of its products. Videos of some of the ads that were live during data collection can be found on YouTube.

Earlier research indicated that individual-level, self-reported awareness of the anti-e-cigarette truth campaign was associated with greater campaign-aligned knowledge, attitudes and beliefs by respondents.³⁴ Campaign awareness continues to present significant challenges in this new media environment. In the past when messages were predominantly delivered on television and radio, as measured by geographically bound gross ratings points or target ratings points, mass media campaign evaluations relied on these exogenous measures of campaign message delivery to assess effectiveness.^{5–10–35} Since the current media landscape consists of a complex array of channels and platforms including social media sites, video-on-demand and streaming services, no consistent exogenous measure of message delivery exists.^{36–39} In recent years, a weekly average of campaign awareness has been used to serve as a proxy for an exogenous measure of campaign exposure to examine the effectiveness of a public education

campaign.⁴⁰ This proxy measure helps to reduce the bias associated with individual-level self-report of campaign awareness. This study employs a weekly average campaign awareness measure to examine the influence of the latest phase of the truth campaign to help reduce e-cigarette use among young people.

METHODS

Study sample

Data for this study is drawn from a repeated cross-sectional survey of participants (aged 15–24 years) drawn from Dynata, a national online panel.⁴¹ The survey includes questions regarding participant demographics; e-cigarette-related attitudes, intentions and behaviours; campaign awareness; and ad perceptions. The total study sample includes 18 377 respondents who were each surveyed once between September 2021 and October 2022, which corresponds to the launch of the mental health messaging approach, titled 'It's Messing With Our Heads'. New subjects were surveyed weekly for the duration of the airing of the campaign (n=275–310 unique respondents per week). Sampling quotas and survey weights were applied to reflect national demographic benchmarks for age, sex, race and ethnicity. Advarra Institutional Review Board approved the study.

Measures

Independent Variables

Campaign exposure was calculated as the weekly average awareness of any airing truth media messages, all of which centred around the theme of mental health among youth and young adults. Self-reported campaign awareness was measured among each respondent by showing five collages of images from recently aired ads and asking the question, 'How often would you say you have seen the ads/videos online or on TV recently?' Response options ranged from 'Never' to 'Very Often' on a 5-point scale. The five separate collages presented each series of ads that were running simultaneously that week. The order in which collages were presented to respondents was randomised to minimise bias. Respondents were assigned a value of '1' if they responded 'Sometimes', 'Often', or 'Very often', and assigned '0' if they responded 'Never' or 'Rarely'.

To construct the primary independent variable for the analysis, individual self-reported campaign awareness was averaged across respondents for each week. Weekly average awareness was categorised into four levels of exposure determined by prior research and based on CDC guidance (0=less than 65% aware; 1=65 to less than 70% aware; 2=70 to less than 75% aware; 3=75% or more aware).⁴² There was an approximately normal distribution of the number of weeks in each category: there were 7 weeks with <65% awareness, 26 weeks with >65–70% awareness, 21 weeks with >70–75% awareness and 7 weeks with >75% awareness. Each respondent was assigned the average level of awareness for their corresponding week.

Dependent variables

Intentions to use. To measure behavioural intentions to use e-cigarettes, all respondents were asked, 'Do you think you will use e-cigarettes, e-cigars, e-hookahs, personal vaporizers, vape pens or hookah pens (even 1 or 2 puffs) in the next year?' Response options included: 0=definitely not; 1=probably not; 2=probably yes; and 3=definitely yes, which were then dichotomised for analysis (0=definitely not; 1=probably not, probably yes or definitely yes).

Current use. Survey respondents who had used e-cigarettes at least once during the past 30 days were classified as a current

e-cigarette user (coded as 1), and those who had not used an e-cigarette on any of the last 30 days were classified as non-users (coded as 0).

Covariates

Several control variables were added to models to account for potential confounding between weekly variation in factors known to predict e-cigarette use intentions and behaviour and average campaign awareness. Control variables included individual-level campaign awareness (yes; no), age (15–17; 18–20; 21–24), gender (male; female), race/ethnicity (white, non-Hispanic; black and/or African-American, non-Hispanic; Hispanic; other, non-Hispanic), perceived financial situation (live comfortably; meet needs with a little left over; just meet basic expenses; do not meet basic expenses),⁴³ dichotomised parental tobacco use (neither parent uses tobacco; one or both parent uses/used tobacco) and sensation seeking scale.⁴⁴ Mental health status was also used as a control variable by averaging the responses to how often ‘you have trouble sleeping’, ‘you are unhappy, sad or depressed’ and ‘you have trouble concentrating or paying attention;’ response options were 1=never, 2=rarely, 3=sometimes, 4=often. Awareness of other national anti-e-cigarette campaigns were not included in the models as covariates because there is collinearity between the awareness of other campaigns and the truth campaign.

Statistical analysis

Multilevel model analyses were conducted in M-Plus V.8.2.⁴⁵ Generalised random coefficient multilevel models assessed the relationship between week-level average campaign awareness and an individual’s current e-cigarette use. Generalised random coefficient multilevel models were used to account for the hierarchical structure of the data, with approximately 300 participants clustered within each of the 61 weeks. This adjusts for the likelihood that respondents who answered the survey in a particular week were more similar to one another than respondents who answered in different weeks. The multilevel models estimate the error variances, which provide more accurate and robust parameter estimates.^{46–47} These models are also able to simultaneously estimate individual-level and week-level effects and provide an estimate of the association between week-level campaign exposure and individual-level current use of e-cigarettes. Due to significant associations found between covariates and the outcomes of interest, subgroup analyses for age, gender and race/ethnicity were also conducted.

We estimated the models in a series of steps, starting with an unconditional effects model to assess between-cluster and within-cluster variation in the outcome and ending with a final model that includes predictors at the individual level, as well as a predictor of weekly campaign awareness, and a random intercept.

RESULTS

The sample characteristics are described in table 1. Nearly one-third (29%) of the sample were aged 15–17 years, nearly one-third (30%) were aged 18–20 years and the plurality (41%) were aged 21–24 years. About a half of the sample (49%) were white and non-Hispanic and evenly split by gender (51% male, 49% female). The majority of respondents reported their perceived financial situation as either just meeting basic expenses (31%) or that they meet their needs (35%). Over half of respondents have parents who have never used tobacco products (54%). On average, respondents reported being above neutral for sensation

Table 1 Sample characteristics (N=18 377)

	Weighted mean	SE	Range
Weekly % aggregated truth ad awareness	69.05	0.0004	49.7–77.7
	Frequency	Unweighted %	Weighted %
Individual level truth ad awareness			
No	5688	30.95	30.95
Yes	12 689	69.05	69.05
E-cigarette use			
Current e-cigarette use (past 30 days)			
No	13 508	73.50	73.54
Yes	4869	26.50	26.46
Demographics			
Age (years)			
15–17	5330	29.00	29.28
18–20	5577	30.35	29.94
21–24	7470	40.65	40.78
Gender			
Female	9100	49.52	48.81
Male	9277	50.48	51.19
Race/ethnicity			
White, non-Hispanic	9082	49.42	49.46
Black, non-Hispanic	2714	14.77	14.91
Hispanic	4401	23.95	23.75
Other, non-Hispanic	2180	11.86	11.88
Perceived financial situation			
Live comfortably	4483	24.39	24.46
Meet needs	6395	34.80	34.82
Just meet basic expenses	5708	31.06	30.99
Do not meet basic expenses	1791	9.75	9.73
Parent smoking			
No	9954	54.17	54.15
Yes	8423	45.83	45.85
	Weighted mean	SE	Range
Sensation seeking (mean)	3.24	0.006	1.00–5.00
Mental health (mean)	2.73	0.006	1.00–4.00

seeking and having poor mental health nearly ‘sometimes’ in the past 6 months (mean 3.24, SE: 0.006; mean 2.73, SE: 0.006, respectively). A quarter of the sample reported use of e-cigarettes in the past 30 days (26%) and still more (58%) reported intention to use e-cigarettes in the next year.

At the individual level, a majority of the sample (69%) reported awareness of truth ads. The weekly awareness estimates ranged from 50% to 78% with variation occurring throughout the study period rather than progressively increasing over time. Out of the 61 weeks in the analysis, a small proportion of weeks (11%) had less than 65% of weekly campaign awareness and an equal amount (11%) had more than 75% of weekly awareness. Nearly half of the weeks (43%) averaged between 65% and 69% for campaign awareness, followed by weeks averaging between 70% and 74% for campaign awareness (34%).

A negative association was observed between weekly average campaign awareness and intentions to use e-cigarettes, as well as a dose–response relationship with past 30-day e-cigarette use (table 2). Respondents in weeks with higher campaign awareness had significantly lower odds of e-cigarette use compared

Table 2 Intention to use and past 30-day e-cigarette use among youth and young adults and weekly aggregated truth ad awareness

	Intention to use OR (95% CI)	Past 30-day e-cigarette use OR (95% CI)
<65% aggregated weekly awareness	REF	REF
65–<70% aggregated weekly awareness	0.86 (0.77 to 0.97)*	0.86 (0.77 to 0.98)*
70–<75% aggregated weekly awareness	0.85 (0.75 to 0.96)*	0.84 (0.74 to 0.96)**
75%+ aggregated weekly awareness	0.90 (0.79 to 1.02)	0.82 (0.71 to 0.95)**
Individual awareness	1.55 (1.44 to 1.67)***	1.40 (1.30 to 1.51)***
Sex		
Female	0.97 (0.92 to 1.04)	1.07 (0.999 to 1.14)
Male	REF	REF
Age (years)		
15–17	REF	REF
18–20	1.63 (1.53 to 1.74)***	1.87 (1.72 to 2.04)***
21–24	2.23 (2.07 to 2.40)***	2.46 (2.24 to 2.71)***
Race/ethnicity		
Non-Hispanic white	REF	REF
Non-Hispanic black	0.92 (0.83 to 1.02)	0.61 (0.55 to 0.68)***
Hispanic	1.11 (1.03 to 1.19)**	0.75 (0.70 to 0.80)***
Non-Hispanic other	0.82 (0.74 to 0.91)***	0.67 (0.60 to 0.75)***
Financial status		
Do not meet basic expenses	1.46 (1.32 to 1.62)***	1.60 (1.40 to 1.82)***
Just meet basic expenses	1.65 (1.51 to 1.81)***	1.53 (1.38 to 1.70)***
Meets needs	1.34 (1.24 to 1.44)***	1.32 (1.21 to 1.44)***
Beyond meets needs	REF	REF
Parents smoked	1.71 (1.59 to 1.83)***	1.74 (1.60 to 1.89)***
Sensation seeking	1.61 (1.54 to 1.69)***	1.63 (1.55 to 1.71)***
Mental health	1.30 (1.24 to 1.35)***	1.17 (1.12 to 1.23)***

p<0.05, **p<0.01, *p<0.001.

with weeks with less than 65% campaign awareness (65–70% awareness OR: 0.86, 95% CI: 0.77 to 0.98; 70–75% awareness OR: 0.84, 95% CI: 0.74 to 0.96; >75% awareness OR: 0.82; 95% CI: 0.71 to 0.95). Compared with those surveyed in weeks with less than 65% awareness, respondents surveyed in weeks with higher campaign awareness had significantly lower odds of expressing intentions to use e-cigarettes in weeks with 65–70% awareness (OR: 0.86, 95% CI: 0.77 to 0.97) and 70–75% awareness (OR: 0.85, 95% CI: 0.75 to 0.96), and approaching significance in weeks with greater than 75% awareness (OR: 0.90, 95% CI: 0.79 to 1.02). When the analysis of current e-cigarette use was stratified by demographic subgroups, similar significant effects were found for sex and age group (15–17, 18–20, 21–24) (online supplemental table 1). While the results were not significant for some racial/ethnic and socioeconomic subgroups (likely due to small sample size), the direction of the relationship between population-level campaign awareness and current e-cigarette use remained the same as the overall model (online supplemental table 1).

DISCUSSION

Findings indicate that higher weekly awareness of the truth anti-e-cigarette campaign is associated with significantly lower odds

of intentions to use e-cigarettes as well as current e-cigarette use among youth and young adults. A dose–response relationship was seen between weekly awareness and e-cigarette use, but not with intentions to use, most likely due to there being a small number of weeks with >75% awareness. To our knowledge, this is the first study to find an association between exposure to a national anti-e-cigarette mass media campaign and lower e-cigarette use among its intended audience.

Results also indicate that higher individual-level campaign awareness was associated with significantly greater odds of current e-cigarette use. This is not surprising and is commonly observed in cross-sectional analyses of health-related media messages since individuals who are engaging in the targeted behaviour are generally more attentive to these messages.^{7 48} This process, also known as selective attention, has been found to increase an audience member's attention to content and thus, improves recall.^{7 48} However, the causal direction between individual-level exposure and behaviour cannot be inferred. This finding highlights the critical need for exogenous measures of campaign exposure across the widely varied digital media that do not solely rely on respondent recall.

Decades ago, the CDC recommended that public health mass media campaigns airing over television and radio attain population-level exposure of at least 75% to detect campaign effects.⁴³ Today, the truth campaign primarily uses digital media to target its audience of youth and young adults. Findings indicate that this campaign successfully targeted behaviour at a lower level of exposure, which may reflect the unique nature of digital message delivery. Future research on the relationship between campaign exposure and awareness is sorely needed, particularly across digital platforms. More specifically, further research is needed to examine how best to assess exposure to content given the complex media landscape.

Consistent with the body of evidence on the effectiveness of anti-smoking mass media campaigns,^{8–10 12} findings indicate that mass media campaigns can be effective in reducing the likelihood of e-cigarette use among youth and young adults, particularly by messaging about themes that are relevant to this audience. The truth 'It's Messing With Our Heads' campaign focused on the increasingly salient issue of mental health concerns among young people. While the emerging mental health crisis among young people is not causally attributable to the rapid rise in e-cigarette use during the past decade, the availability and appeal of high-nicotine delivery devices can serve to exacerbate these conditions among a vulnerable population.

Limitations

The observed effect was found concurrently during the same week in which the weekly average awareness measure was calculated. Unfortunately, the study period did not allow for modelling a lagged effect (eg, of 6–8 weeks) between campaign exposure and past 30-day use.⁴⁰ While the current results suggest there may be an immediate impact of the campaign, the cumulative effect of an ongoing campaign remains of interest. Future research can be strengthened by examining a longer time period with a lagged estimate between the weekly measure of campaign exposure and the outcomes of interest. Next, the current analysis did not control for current cigarette use. Since nearly one-third of current smokers in the study sample also used e-cigarettes, cigarette use was highly collinear with the primary behavioural outcome of past 30-day e-cigarette use, and thus, was not included. Finally, the models did not include an interaction term for individual-level ad awareness and poor

mental health status. Consistent with the literature, a poorer mental health score was associated with e-cigarette use among respondents in this study. Future research may consider whether audience members' mental health status mediates the relationship between their awareness of ads that use a mental health message frame and e-cigarette use.

CONCLUSIONS

The results of this study provide evidence that mass media campaigns remain an important component of comprehensive tobacco control programmes that target nicotine use behaviours among young people. The truth messaging approach evaluated in this study focused on the mental health implications of e-cigarette use. A population-level measure of campaign exposure was associated with lower likelihood of intentions to use and current e-cigarette use among young people.

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Supplementary Table 1. Past 30-day e-cigarette use by demographic subgroup

Aggregated weekly awareness (between-level)	Male	Female	Age 15-17	Age 18-20	Age 21-24	Don't meet basic expenses	Just meets basic expenses	Meets needs	Beyond meets needs	Non-Hispanic White	Non-Hispanic Black	Hispanic	Non-Hispanic Other
Less than 65%	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF	REF
65%, less than 70%	0.90 (0.74, 1.10)	0.83 (0.72, 0.95) **	0.82 (0.61, 1.12)	0.76 (0.64, 0.91) **	0.98 (0.85, 1.12)	1.09 (0.87, 1.38)	0.92 (0.71, 1.19)	0.79 (0.64, 0.97) *	0.80 (0.61, 1.04)	0.85 (0.74, 0.97) *	0.94 (0.72, 1.21)	0.98 (0.80, 1.21)	0.61 (0.45, 0.83) **
70%, less than 75%	0.83 (0.67, 1.04)	0.85 (0.74, 0.98) *	0.77 (0.56, 1.05)	0.73 (0.61, 0.88) **	0.97 (0.85, 1.11)	0.76 (0.59, 0.99) *	0.90 (0.70, 1.17)	0.82 (0.66, 1.01)	0.80 (0.60, 1.08)	0.83 (0.71, 0.97) *	0.80 (0.60, 1.08)	0.91 (0.73, 1.12)	0.78 (0.57, 1.07)
75% or greater	0.87 (0.69, 1.08)	0.77 (0.63, 0.94) **	0.83 (0.61, 1.13)	0.73 (0.57, 0.92) **	0.89 (0.73, 1.09)	0.94 (0.63, 1.42)	0.78 (0.58, 1.05)	0.74 (0.58, 0.95) *	0.95 (0.72, 1.24)	0.79 (0.68, 0.91) **	0.88 (0.64, 1.21)	0.95 (0.77, 1.16)	0.62 (0.41, 0.94) *

*p<0.05, **p<0.01, ***p<0.001