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 JOURNAL OF
 ADOLESCENT
 HEALTH

www.jahonline.org

Original article

Tobacco Magazine Advertising Impacts Longitudinal Changes in the Number of Tobacco Products Used by Young Adults

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Article history: Received April 10, 2020; Accepted October 30, 2020

 Keywords: Etiology; Longitudinal research; Marketing; Prevention; Trajectories

ABSTRACT

Purpose: The present study examined the longitudinal associations between exposure to tobacco advertisements in magazines popular among young adults and changes in the number of tobacco products used by young adults.

Methods: Participants were 4,824 students from 24 Texas colleges participating in a longitudinal study. Tobacco advertisements in 11 magazines, collected from 2015 to 2017, were objectively assessed and young adults self-reported the frequency of reading each magazine on five biannual surveys from 2015 to 2017. The objective and self-reported measures were multiplied to create a tobacco advertisement exposure score. Growth curve models were used to determine if exposure to tobacco advertisements in magazines predicted changes in the number of tobacco products used across the 2-year period, controlling for sociodemographic factors, ever tobacco use, recall of tobacco advertisements on the internet, and personality characteristics.

Results: Young adults with more exposure to tobacco advertisements reported a slower decline in the number of tobacco products they used across time.

Conclusions: Tobacco advertising in magazines contributes to the continuation of single-product and polyproduct use among young adults. Findings highlight the need for additional federal regulations limiting advertisements for all types of tobacco products in magazines, particularly those popular among young adults, the youngest legal targets of the tobacco industry.

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IMPLICATIONS AND CONTRIBUTION

Young adults exposed to more tobacco advertisements in magazines reported a slower decline in the number of tobacco products they used over time. As such, federal regulations are needed that limit the number, size, and content of magazine tobacco advertisements and their appeal to young adults.

There is substantial evidence that tobacco advertising influences tobacco initiation and progression among youth and young adults [1,2]. Tobacco advertisements impact tobacco use by increasing product awareness and visibility [3] and fostering positive attitudes and perceptions about tobacco products and

product use [4]. However, existing studies examining the impact of tobacco advertising on tobacco use are limited by a reliance on self-reported recall and/or cross-sectional data, and most are focused on adolescents. Moreover, there is no contemporary research examining the role of tobacco advertisements in magazines on young adults' tobacco use, even though magazines are among the few mass media outlets in which all tobacco products can be legally advertised and 36% of 18- to 24-year-old young adults read a print magazine in just a single week before a 2018 survey [5]. The present study extends existing research by examining the impact of exposure to objectively and subjectively

Conflicts of interest: The authors have no conflicts of interest to disclose.

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<https://doi.org/10.1016/j.jadohealth.2020.10.032>

assessed tobacco advertising in magazines popular among young adults on longitudinal changes in the number of tobacco products used by young adults.

The most recent data from the Federal Trade Commission (FTC) indicate that tobacco companies spent \$14.9 million advertising cigarettes and \$19.5 million advertising smokeless tobacco products in magazines in 2016 [6,7]. Expenditure estimates for electronic nicotine delivery systems (ENDS) are not available from the FTC, but 1 study reported that \$10.8 million was spent on ENDS advertisements in magazines in 2012, more than in any other mass media outlet including television, the Internet, radio, and newspapers [8]. The Family Smoking Prevention and Tobacco Control Act limits the advertising of cigarette and smokeless products in magazines with large youth readerships [9]. However, there are no restrictions for advertising ENDS products and cigars in magazines or for advertising tobacco products to young adults older than the minimum legal age to purchase tobacco. Although the minimum legal age to purchase tobacco products as of December 2019 is 21 years, the present study was conducted from 2015 to 2017 when the minimum legal age was 18 years. The tobacco industry's internal documents indicate that 18-year-old and older young adults have been important targets of advertisements and promotions. [10].

In part perhaps because of targeted efforts by tobacco companies, 18- to 24-year-old young adults have the highest prevalence of tobacco use and are more likely than their younger and older counterparts to be polytobacco users, concurrently using two or more products, such as cigarettes, cigars/little cigars/cigarillos, smokeless tobacco, and ENDS [11]. Data from the Population Assessment of Tobacco and Health Study indicate that 41% of 18- to 24-year-old young adults were current users of at least one tobacco product in 2013–2014 [11] and 21.7% were current polytobacco users [12]. Despite high prevalence of use, limited longitudinal research indicates that use of some products (e.g., ENDS, cigars) declines as young adults increase in age [13]. Similarly, there are declines in polytobacco use, suggesting that young adults may experiment with multiple tobacco/nicotine products, but eventually quit using at least some of these products as they increase in age [14]. As such, it is important to identify factors that contribute to the continued use of tobacco products and/or slow the decline in the number of tobacco products used across young adulthood. There are no studies that examine the impact of exposure to tobacco advertisements in magazines on tobacco use changes among young adults.

The purpose of the present study was to examine longitudinal associations between exposure to tobacco advertisements in print magazines popular among young adults and changes in the number of products used by young adults. We examined if (1) exposure to tobacco advertisements was associated with the number of tobacco products used by young adults; and (2) exposure to tobacco advertisements predicted changes in the number of tobacco products used by young adults across a 2-year period. In addressing both questions, we controlled for important covariates, including sociodemographic factors, ever tobacco use, recall of tobacco advertisements on the Internet, and personality characteristics. These covariates were selected because men, those reporting a sexual and gender minority identity [15], younger individuals, non-Hispanic white and African-American young adults [15], students in 2-year colleges [16], those exposed to more advertising on the internet [17], and those high in sensation seeking and impulsivity [18] are generally more likely than their counterparts to report tobacco use. We

hypothesized that (1) Young adults exposed to more tobacco advertisements in magazines would report using more tobacco products; and (2) that exposure to more tobacco advertisements would slow the decline in the number of tobacco products used across the 2-year period.

Methods

Participants

Participants were 4,824 young adults drawn from wave 2 (Spring, 2015) to wave 6 (Spring, 2017) of the Marketing and Promotions across Colleges in Texas project. The Marketing and Promotions across Colleges in Texas project is a longitudinal study that recruited a convenience sample of 5,482 students attending 1 of 24 colleges in Texas. Wave 1 data for the larger study were collected in October 2014–February 2015, and five follow-up waves were collected every 6 months thereafter. Data from wave 1 were not included in the present study because information from the wave 1 survey was used, in part, to identify the magazines that would be subsequently objectively assessed. Retention rates for waves 2 through 6 ranged from 78% (wave 5) to 81% (wave 4) of the 5,482 participants. For this study, data from young adults who participated in at least 1 study wave were included ($n = 4,824$). At wave 2, the 4,824 respondents were 18–29 years of age ($M = 20.46$; $SD = 2.35$), 64% were women; 93% attended a 4-year college versus a 2-year college; and 36.1% were non-Hispanic white, 30.9% were Hispanic/Latino, 17.6% were Asian, 8.0% were African-American/black, and 7.4% were another race/ethnicity or reported two or more races/ethnicities.

Procedure

Survey data collection procedure. All study procedures were approved by the institutional review board of the University leading the study. Participants were recruited from 1 of 12 4-year or 12 2-year Texas colleges in five counties surrounding Austin, Dallas/Fort Worth, Houston, and San Antonio. Survey data collection was Web-based, and participants were required be 18–29 years of age and full- or part-time degree- or certificate-seeking undergraduate students attending a 4-year college or a vocational/technical program at a 2-year college. Eligible students completed informed consent before completion of the first online survey. More than 13,000 students ($N = 13,714$) were eligible to participate in the study, and of these, 40% ($n = 5,482$) provided consent and completed the survey. Additional information on the study procedure has been detailed elsewhere [19].

Magazine data collection procedures. Eleven magazines (see Table 1) were continuously collected beginning 2 months before wave 2 and ending at wave 6. These magazines were selected because (1) they have high youth [20,21] and young adult [21] readerships (see Table 1); and/or (2) they were the most commonly selected print magazines (of a list of 20) read by participants on the wave 1 survey. Magazines were mailed to an Austin, Texas, address and cross-checked for number of tobacco advertisements with the same magazines collected in New Brunswick, New Jersey, where some members of the study team were located. A cross-check of the total number of tobacco advertisements across all magazines at the two locations was virtually identical ($r = .98$, $p < .001$). Thus, we used the tobacco

Table 1
Mean number of tobacco advertisements and number of issues (n) for each magazine at each study wave, 2015–2017

Magazine	Mean number (SD) of tobacco advertisements in magazines by wave				
	2 (spring, 2015)	3 (fall, 2015)	4 (spring, 2016)	5 (fall, 2016)	6 (spring, 2017)
^a Car and Driver	3.50 (.71), n = 2	3.00 (.00), n = 2	1.50 (2.12), n = 2	3.00 (.00), n = 2	1.00 (1.41), n = 2
^a ESPN Magazine	1.25 (1.26), n = 4	1.25 (1.26), n = 4	3.67 (.58), n = 3	2.00 (2.00), n = 3	.50 (.71), n = 2
^a Essence	1.00 (.00), n = 2	1.00 (.00), n = 2	.50 (.71), n = 2	.50 (.71), n = 2	.00 (.00), n = 2
^a Entertainment Weekly	.67 (1.03), n = 6	.67 (1.03), n = 6	.67 (.52), n = 6	.43 (.79), n = 7	.83 (.98), n = 6
^a Glamour	.50 (.71), n = 2	.00 (.00), n = 2	1.00 (.00), n = 2	1.00 (1.41), n = 2	.50 (.71), n = 2
Latina	.00 (.00), n = 2	.00 (.00), n = 2	.50 (.71), n = 2	.50 (.71), n = 2	.00 (.00), n = 2
^a People	.00 (.00), n = 9	.00 (.00), n = 9	.00 (.00), n = 10	.22 (.44), n = 9	.00 (.00), n = 9
^a Rolling Stone	2.50 (1.29), n = 4	1.75 (.50), n = 4	2.75 (.50), n = 4	2.50 (1.29), n = 4	2.33 (.58), n = 3
^a Sports Illustrated	1.12 (.83), n = 8	.22 (.44), n = 9	1.11 (1.62), n = 9	1.14 (1.21), n = 7	.40 (.55), n = 5
^a U.S. Weekly	.22 (.44), n = 9	.00 (.00), n = 9	.44 (.53), n = 9	.44 (.53), n = 9	.12 (.35), n = 8
^a Vogue	.00 (.00), n = 2	.00 (.00), n = 2	1.00 (.00), n = 2	.00 (NA), n = 1	.00 (.00), n = 2

^a Prior research identified these magazines as having high youth and young adult readerships. High youth readership was defined in 1 study as 15% of readers age 12–17 years of age or there are two million 12- to 17-year-old readers [18]. In another study, high youth readership was defined as 15% of readers age 12–20 years of age [19] and high young adult readership was defined as 15% of readers age 21–29 years of age [19]. Note: Only issues from the 2-month period before each survey wave were included in the study and issue numbers (n) vary across magazines because some are weekly and others are monthly, and some magazines have double issues in a single month.

advertisement information from magazine issues that were delivered to New Brunswick, New Jersey, for 14 magazine issues (of a total of 243) that were missing in Austin, Texas. An additional 19 issues were missing from both locations; of these, 17 were purchased from <http://www.backissues.com> and the remaining two issues could not be retrieved and were treated as missing data. Thus, we obtained a virtual census of all magazines from which we objectively assessed number of tobacco advertisements.

Measures

Outcome variable

Number of tobacco products. The number of tobacco products was assessed at each of the five study waves as a sum of four types of tobacco products (cigarettes, cigars, smokeless tobacco, and ENDS) participants used in the past 30 days. Hookah use was not included because there were no advertisements for hookah in the magazines. Each type of product was assigned a score of 0 (used on 0 days in the past 30) or 1 (used on at least 1 day in the past 30). Scores were summed to create an index ranging from 0 to 4, reflecting the number of tobacco products used in the past 30 days at each wave.

Exposure variable

Magazine tobacco advertisement exposure. A total tobacco advertisement exposure composite score at each of the five study waves was computed using an objective exposure measure of the number of tobacco advertisements in each magazine and a self-reported measure of frequency of reading each magazine at each wave.

The *objective measure* was derived by obtaining the tobacco advertisement count for each issue of the 11 magazines and then computing the mean number of tobacco advertisements per issue for a 2-month window immediately before each survey administration. This 2-month window was used to capture magazine issues that may have occurred bimonthly and to correspond with the recall measure of reading frequency. The *self-reported frequency measure* was assessed by asking participants at each wave to recall how frequently they read or flipped

through a paper copy of each of the 11 magazines in the past 30 days. Recall frequency was scored on a scale from 0 (“never”) to 5 (“almost every day”).

A *tobacco advertisement exposure composite score* was computed for each magazine (e.g., People) for each participant by multiplying the objective exposure and self-reported frequency measures, similar to research on tobacco advertising at the point-of-sale. [22] The advertisement exposure composite score for each of the 11 magazines was then summed for each participant to create a total magazine tobacco advertisement exposure score. To ameliorate the possibility of the disproportionate effect of outliers in the positively skewed distribution, the magazine tobacco advertisement exposure score was log transformed.

Sociodemographic and ever tobacco use covariates. Five sociodemographic variables were included in all models: wave 1 age in years (centered at age 18 years); sex (0 = female, 1 = male); sexual and gender minority identity (SGM; 0 = heterosexual; 1 = SGM identity); race/ethnicity (dummy-coded Hispanic/Latino, African American/black, Asian American, and other; non-Hispanic, white served as the reference group); and wave 1 type of college attended (0 = 2-year, 1 = 4-year). Wave 1 ever/lifetime use of cigarettes, cigars, smokeless tobacco, and ENDS (0 = never used any products, not even 1 puff; 1 = ever used at least 1 product) was also included in all models.

Recall of tobacco advertisements on the internet covariate. Participants were asked to recall if they remembered seeing advertisements for cigarettes, cigars, smokeless tobacco, and ENDS on the Internet/online at each of the five study waves. Separate items were presented for the four tobacco products (each coded 0 = not recalled; 1 = recalled), which were summed to create a composite ranging from 0 to 4 at each wave.

Personality characteristic covariates. Sensation seeking and impulsivity were assessed at each of the five study waves. Sensation seeking was assessed using the four-item Brief Sensation Seeking Scale-4 [23], and impulsivity was assessed with the three-item Impulsivity subscale from the Substance Use Risk Profile Scale [24]. Items for both scales were scored on a five-point scale ranging from 1 (“strongly disagree”) to 5 (“strongly agree”) and were averaged with higher scores reflecting higher

levels of sensation seeking and impulsivity, respectively, at each wave.

Data analysis

Multilevel growth curve models were used to examine longitudinal associations between exposure to tobacco advertisements in magazines and changes in the number of tobacco products used across the 2-year period. Analyses were conducted in R with the lmer function [25] and models were multilevel to account for the nesting of study waves within participants and participants within colleges. The number of products used in the past 30 days at each of the five waves was the outcome variable for all models. The models allow for variables at each of three levels of the model (level 1 = study wave; level 2 = participant; and level 3 = college). Variables at level 1 were time-varying covariates and included exposure to tobacco advertisements in magazines, recall of tobacco advertisements on the Internet, the two personality characteristics, and study wave. Variables at level 2 were time-invariant and included the participant sociodemographic covariates of age, sex, SGM identity, race/ethnicity, and ever tobacco use. The variable at level 3 was also time-invariant and included the type of college attended (4-year vs. 2-year) covariate.

Unconditional growth models (i.e., models that only contained variables representing time) were first fit to determine the best model of change across time for the number of tobacco products used outcome variable. The study wave, beginning at wave two and centered at wave 2, was the time variable in all growth models. We fit linear, quadratic, and log-linear unconditional growth models. The three models were compared using the Akaike Information Criterion, and the log-linear model was selected as the best-fitting unconditional growth model.

Next, we fit a conditional model that included the time-varying total magazine tobacco advertisement exposure score and all covariates (sociodemographics, ever tobacco use, recall of tobacco advertisements on the Internet, personality characteristics). Two conditional models were fit. In the first model, the “main effects” model, all predictor variables, including time (i.e., study wave) and advertisement exposure, were treated as independent predictors of the outcome. This model was conducted to evaluate if exposure to tobacco advertisements was associated with the number of tobacco products used by young adults, even after controlling for all covariates. The second model, the

“interaction” model, was identical to the first with the addition of a two-way interaction between study wave and total magazine tobacco advertisement exposure. The two-way interaction model tested if exposure to tobacco advertisements in magazines predicted rate of change in number of tobacco products used by young adults across the 2-year period, after controlling for all covariates.

Attrition analyses. Logistic regression analyses were conducted to determine if participants included in the present study ($n = 4,824$) varied from those in the larger cohort who were missing data and not included ($n = 658$) on the sociodemographic covariates. Although those included in the present study were younger (odds ratio = .95, confidence interval = $-.08, .01$), Asian American versus non-Hispanic, white (odds ratio = 1.64, confidence interval = 1.25, 2.13), and 4-year versus 2-year students (odds ratio = 1.57, confidence interval = 1.21, 2.07), the effect sizes were small, and there were no differences on any other sociodemographic covariates.

Results

Table 1 contains the average number of tobacco advertisements in the 11 magazines at each study wave. Table 2 presents the average number of advertisements by tobacco product as well as participant descriptive statistics. The total number of advertisements in magazines appeared to decrease across the 2-year period from wave 2 to wave 6. Of note, there were no cigarette advertisements at wave 6; in contrast, approximately half of all tobacco advertisements at wave 2 were for cigarettes. Smokeless tobacco advertisements appeared to be relatively constant across wave as were ENDS advertisements, with the exception of wave 3 when there were none. There were virtually no cigar advertisements at any study wave. The number of magazines participants reported reading at each wave also appeared to decrease from wave 2 to wave 6.

Main Effects Model (see Table 3). There was a significant negative effect for survey wave ($t[18,529] = -7.24, p < .001$) indicating that the number of tobacco products used in the past 30 days decreased across the five waves. There was also a significant positive effect for magazine exposure ($t[19,721] = 6.63, p < .001$) indicating that young adults exposed to a higher level of tobacco advertisements in magazines used more tobacco products across the five waves. These results were present even

Table 2

Mean and standard deviation for tobacco product advertisements and participant characteristics ($N = 4,824$) by study wave, 2015–2017

	Wave (year)				
	2 (spring, 2015)	3 (fall, 2015)	4 (spring, 2016)	5 (fall, 2016)	6 (spring, 2017)
Advertisement characteristics					
Number of magazines	50	51	51	48	43
Mean tobacco advertisements	.98 (1.12)	.72 (.97)	1.19 (1.09)	1.07 (1.00)	.52 (.70)
Mean cigarette advertisements	.45 (.48)	.33 (.41)	.66 (.47)	.46 (.25)	.00 (.00)
Mean cigar advertisements	.00 (.00)	.05 (.15)	.00 (.00)	.00 (.00)	.00 (.00)
Mean smokeless advertisements	.39 (.61)	.34 (.56)	.35 (.64)	.35 (.56)	.37 (.60)
Mean ENDS advertisements	.14 (.30)	.00 (.00)	.19 (.25)	.25 (.30)	.15 (.20)
Participant characteristics: Outcome and exposure variables					
Mean tobacco products used	.41 (.76)	.38 (.73)	.36 (.71)	.33 (.67)	.33 (.67)
Mean magazines read	.58 (1.16)	.58 (1.20)	.44 (1.06)	.38 (.98)	.30 (.87)
Mean magazine ad exposure	.51 (1.66)	.36 (1.36)	.63 (2.39)	.44 (1.68)	.19 (.90)

Only issues from the 2-month period immediately before each survey wave were included in the present study.

ENDS = electronic nicotine delivery system.

Table 3

Multilevel growth curve model examining the longitudinal associations between tobacco advertisement exposure in magazines and changes in number of tobacco products used, adjusting for sociodemographics, ever tobacco use, recall of tobacco advertisements on the internet/online, and personality characteristics, 2015–2017 (N = 4,824)

Parameter	Main effects model					Interaction model				
	Coefficient	SE	df	t	p	Coefficient	SE	df	t	p
Intercept	.05	.04	118	1.25	.213	.06	.04	118	1.39	.168
Study wave (log)	-.05	.01	18,529	-7.24	<.001	-.05	.01	19,037	-7.73	<.001
Magazine tobacco ad exposure (log)	.06	.01	19,721	6.63	<.001	.03	.01	17,864	1.90	.058
Participant age	.00	.00	4,562	.14	.891	.00	.00	4,554	.18	.861
Male sex	.20	.02	4,712	12.18	<.001	.20	.02	4,710	12.18	<.001
Sexual and gender minority identity	.15	.02	4,647	7.76	<.001	.15	.02	4,645	7.76	<.001
Race/ethnicity (reference = non-Hispanic, white)										
Hispanic/Latino	-.06	.02	4,037	-2.95	.003	-.06	.02	4,034	-2.97	.003
African American/black	-.07	.03	3,142	-2.35	.019	-.07	.03	3,138	-2.35	.019
Asian	-.03	.02	4,592	-1.43	.152	-.03	.02	4,591	-1.45	.148
Other race/ethnicity	.01	.03	4,647	.36	.722	.01	.03	4,645	.35	.727
4-year institution	-.01	.04	33	-.14	.889	-.01	.04	33	-.15	.882
Wave 1 ever/lifetime tobacco use	.48	.02	4,739	28.57	<.001	.48	.02	4,737	28.57	<.001
Internet/online tobacco ad recall	.00	.00	19,875	.74	.461	.00	.00	19,877	.71	.478
Sensation seeking	.02	.01	20,676	4.24	<.001	.02	.01	20,673	4.26	<.001
Impulsivity	.03	.01	20,781	4.74	<.001	.02	.01	20,779	4.72	<.001
Study wave (log) x tobacco advertisement exposure (log)						.03	.01	17,177	2.74	.006

after controlling for all covariates. Significant covariates indicated that men, those reporting SGM identity, ever tobacco use, and higher sensation seeking and impulsivity, used more tobacco products than their peers, and Hispanic and African American participants used fewer products than non-Hispanic white participants across all five waves.

Interaction Model (see Table 3). As was the case for the main effects model, there was a significant negative effect for survey wave ($t[19,037] = -7.73, p < .001$) in the interaction model. In contrast, the main effect of magazine exposure was no longer significant ($t[17,864] = 1.90, p = .058$) in the presence of the two-way interaction. However, the two-way wave x tobacco magazine advertisement exposure interaction was significant ($t[17,177] = 2.74, p = .006$), even after controlling for significant covariates of male sex, SGM identity, ever tobacco use, sensation seeking, impulsivity, and Hispanic and African American race/ethnicity. As shown in Figure 1, examination of the two-way interaction indicated that participants with higher levels of exposure to tobacco advertisements in magazines exhibited a slower decline in the number of products used across time.

Discussion

Millions of dollars are spent each year on advertisements for tobacco products in magazines, [6–8] many of which have large numbers of young readers. [20] Yet, there is no contemporary research examining the longitudinal associations between exposure to tobacco advertisements in magazines and changes in young adult's use of multiple types of tobacco products. Study findings fill a gap in the literature by showing that exposure to tobacco advertisements in magazines popular among young adults is associated with changes in the number of products used. Young adults exposed to more tobacco advertisements reported a slower decline in the number of products they used over a 2-year period from 2015 to 2017. These findings are particularly noteworthy given that magazine advertisements were objectively assessed and that the impact of exposure was present even after controlling for well-known risk factors for tobacco use, such as prior tobacco use and sensation seeking.

Findings from the present study are consistent with research indicating that tobacco advertisements increase risk for tobacco initiation and continuation [1,2]. Findings are also consistent with research showing that exposure to cigarette advertisements in magazines is positively associated with adolescents' cigarette smoking [26]. Our findings extend existing research by highlighting the role of advertisements for cigarettes as well as cigars/cigarillos/little cigars, smokeless tobacco, and ENDS on longitudinal changes in young adults' total tobacco use. Although there was an overall decline in the number of products used by young adults, those exposed to more advertisements showed less of a

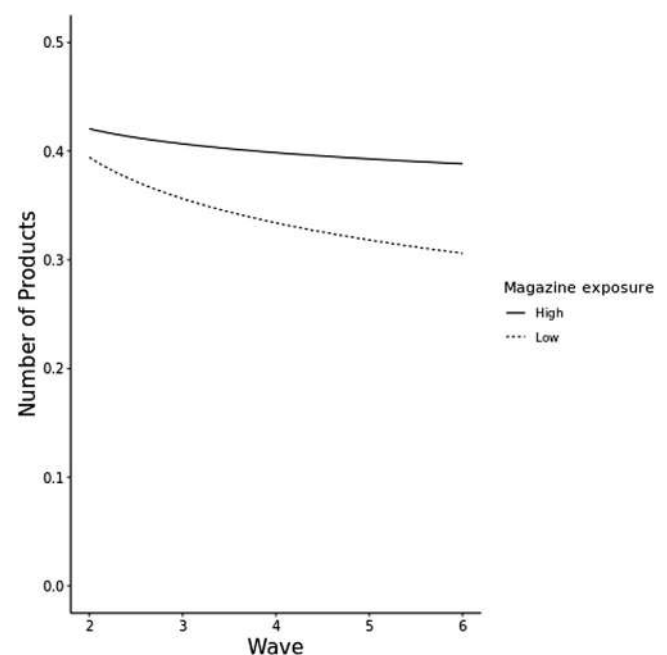


Figure 1. Results from the interaction model examining the number of tobacco products used from 2015 to 2017 at low and high levels of exposure to tobacco advertisements in magazines, adjusting for all study covariates (N = 4,824).

decline than their peers over the 2-year period and thus continued to use more tobacco products. This study did not examine the mechanisms explaining how or why exposure impacted use; however, exposure to marketing messages may shape attitudes and perceptions regarding tobacco products [4]. Young adults exposed to more tobacco advertisements, either across different magazines or the same magazines repeatedly across time, may be particularly likely to internalize the messages and in turn, be more likely to continue to use one or more tobacco products [27].

Exposure to tobacco advertisements in magazines impacted number of products used, even though the number of advertisements in magazines and participants' self-reported frequency of reading magazines declined across the 2-year period from 2015 to 2017. The decline is in contrast to research showing an increase in number of advertisements for tobacco products in magazines from 2010 to 2014 [28], but consistent with FTC estimates showing that expenditures for cigarette and smokeless tobacco magazine advertisements, the only products for which the FTC currently reports data declined from 2015 to 2017 [6,7]. Magazine advertisement declines may be due in part to increased expenditures on social media, particularly for ENDS products [29]. Regarding the decline in self-reported frequency of magazine readership, it is possible that as young adults increased in age and transitioned from young adulthood to adulthood, they had less leisure time [30] to read magazines. Continuing to track changes in exposure to tobacco advertisements in magazines and via other media will be necessary to fully understand the impact of those advertisements on young adults' tobacco use [3].

The present study has a number of strengths including the longitudinal design, the inclusion of key covariates in study models, and the objective assessment of magazine advertisements. However, there are some limitations. First, participants were recruited from 24 colleges in Texas, and although college students represented 40% of the young adult population in 2017 [31], findings cannot be generalized to all young adults. Second, although we recruited students from 2- and 4-year colleges, only a minority were from 2-year colleges. Two-year college students report higher rates of tobacco use than their 4-year peers [32]; as such, future studies should examine how exposure to tobacco advertisements in magazines impacts their tobacco use. Finally, we examined longitudinal changes in the number of products used over a 2-year period; however, assessments were based on past 30-day use of each product. Thus, we could not determine if, when, and who became regular users of these products. Subsequent research that follows up young adults across this pivotal developmental period and as they transition into adulthood, will be fundamental to understanding who continues to use tobacco products and what products they use.

Findings have important prevention, intervention, and policy implications. First, although there was an overall decline over the 2-year period in the number of products young adults used, some continued to be single-product or polyproduct users underscoring the need for prevention and intervention efforts targeting this population. Given contemporary research that young adults are now even more likely than adolescents to initiate tobacco use [33–35] prevention programs are especially necessary. Second, findings showing that exposure to magazine advertisements impacted longitudinal changes in number of tobacco products used indicate a need for additional federal regulations that limit tobacco advertisements in magazines and their appeal

to young adults. The Food and Drug Administration (FDA) has the authority to regulate tobacco advertisements. The Food and Drug Administration could, for example, impose limitations on the number, size, and content (e.g., message type, images, color, and health warning label) of advertisements in magazines, particularly those popular among young adults, the youngest legal targets of the tobacco industry and the population with the highest prevalence of tobacco use.

Funding Sources

This work was supported by the National Institutes of Health [1 P50 CA180906], from the National Cancer Institute (NCI) and the FDA Center for Tobacco Products (CTP). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health (NIH) or the Food and Drug Administration (FDA). Neither NIH nor FDA had any role in the study design, data collection, analysis, or writing of this article.

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