Perceptions of e-Cigarettes and Noncigarette Tobacco Products Among US Youth

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abstract

BACKGROUND: Electronic cigarettes (e-cigarettes) are now the most commonly used tobacco product among US youth. The extent to which perceptions of e-cigarettes' harm and addictiveness differ from those of other products remains unknown, as does whether these perceptions have changed over time.

METHODS: Data from the 2012 and 2014 National Youth Tobacco Survey, a repeated cross-sectional survey of grade 6 to 12 students, were used. Cross-tabulations and logistic regression models were used to describe correlates of perceptions of harm and addictiveness of e-cigarettes, cigars, and smokeless tobacco compared with cigarettes. Trends in perceptions of e-cigarettes' harm among different demographic groups were also assessed.

RESULTS: In 2014, 73.0% believed that e-cigarettes were less harmful than cigarettes, compared with 20.2% for smokeless tobacco and 25.8% for cigars. By comparison, 47.1% believed that e-cigarettes were less addictive than cigarettes, compared with only 14.0% for smokeless tobacco and 31.5% for cigars. Use of each product was associated with a perception of decreased harm and addictiveness in adjusted analyses, as was being male, being a non-Hispanic white, and residing with a household member who used that product. Between 2012 and 2014, increasing numbers of US youth thought they were able to assess the relative harm of e-cigarettes and increasingly believed that e-cigarettes are less harmful than cigarettes.

CONCLUSIONS: Most US youth view e-cigarettes as less harmful and addictive than cigarettes. Far fewer think similarly about cigars and smokeless tobacco. Increases in e-cigarettes' perceived safety mirrors rapid increases observed in their use. Perceived safety correlates with use of each tobacco product.

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WHAT'S KNOWN ON THIS SUBJECT: Noncigarette tobacco products including electronic cigarettes (e-cigarettes) are increasingly used by US youth. However, little is known about youth beliefs regarding their safety and addictiveness, how such views might be changing, and how such perceptions relate to these products' use.

WHAT THIS STUDY ADDS: Most US youth view e-cigarettes as less harmful and addictive than cigarettes. Far fewer feel similarly about cigars and smokeless tobacco. Perceived safety correlates with product use. Increases in perceived safety of e-cigarettes mirror rapid increases observed in e-cigarette use.

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Although youth cigarette smoking rates have declined over the past decade, use of electronic cigarettes (e-cigarettes) has increased.[1,2] Such trends are concerning in light of the marked uncertainty surrounding the safety of these products.[3–6] Although e-cigarettes may aid smoking cessation efforts by adults,[7] concerns have been raised about these products' safety profile, potentially misleading advertisement to youth, and potential to predispose youth to later combustible tobacco use.[3,8–15]

Because some have postulated that tobacco use is becoming renormalized,[16] attempts to characterize youth perception of these products may prove important both for understanding the observed shifts in tobacco use and for public health planning. Perception of a product's harm influences consumer behavior.[17] For example, previous research has noted that social norms and exposure to tobacco-related media influence adolescents' later tobacco use patterns, probably by influencing how individuals perceive such products.[17,18] Recent research has demonstrated associations between youth perceptions of comparative harm and tobacco product use in the cases of light and intermittent smoking patterns[19] and e-cigarettes.[20–22] Perceptions of relative safety regarding e-cigarettes may lead to unintended consequences. For example, some have suggested that perceptions of e-cigarette safety may inadvertently expose developing fetuses to nicotine, the substance primarily linked to adverse fetal effects.[23]

In light of the potential widespread implications of harm perceptions, we sought to provide an updated analysis on youth perceptions of relative harm and addictiveness of multiple noncigarette tobacco products, including a novel analysis of how such perceptions may have changed over time. By using data from the 2014 National Youth Tobacco Survey (NYTS), we provide nationally representative estimates of the perceived relative harm and addictiveness of e-cigarettes, cigars, and smokeless tobacco compared with traditional cigarettes and, in so doing, examine demographic and tobacco use correlates of those perceptions. By using comparable data from the 2012 NYTS, we examine trends in perceptions of e-cigarettes in an effort to assess whether perceptions of that product have changed concomitantly with their increasing use.

METHODS

Study Population

Data from the 2012 and 2014 NYTS were used. NYTS is designed to provide nationally representative estimates of US middle and high school students' tobacco-related knowledge, attitudes, and behaviors. It is conducted by the Centers for Disease Control and Prevention, and its methodology was approved by that institution's institutional review board. Described elsewhere,[24,25] NYTS used a stratified cluster sample of sixth- to twelfth-grade students enrolled in public, secular, or nonsecular private schools. Respondents completed a pencil-and-paper, self-administered questionnaire. Participation at the school and student level was voluntary. In 2012 and 2014, respectively, the school participation rates were 80.3% and 80.2%. The student participation rates were 91.7% and 91.4%, respectively.

Variables

Dependent Variables

Two sets of survey questions were used as dependent variables. Each set of questions was asked in turn about e-cigarettes; cigars, cigarillos, or little cigars; and chewing tobacco, snuff, dip, or snus.

The first set of questions assessed respondents' perceptions of the relative harm of each tobacco product compared with traditional cigarettes. Subjects were asked whether they believed the product was "less harmful, equally harmful, or more harmful than cigarettes," to which they could respond with any of the above choices, "I have never heard of [these products]," or "I don't know enough about [these products]."

The second set of questions assessed respondents' perceptions of the addictiveness of tobacco products compared with traditional cigarettes. Subjects were asked whether they believed the product was "less addictive, equally addictive, or more addictive than cigarettes," to which they could respond with any of the above choices, "I have never heard of [these products]," or "I don't know enough about [these products]."

Given the variations in NYTS questioning, only questions about perceived relative harm of e-cigarettes were similarly phrased in the 2012 and 2014 NYTS. Consequently, assessments of trends are limited to e-cigarettes for these 2 years. For questions about both harm and addictiveness, we denoted subjects' confidence to provide such assessments if they were able to state a perception in lieu of reporting that they were unaware or did not know enough about the respective tobacco products. In logistic regression models, perceptions of specific products as being less harmful or addictive than cigarettes were assessed among subjects who were aware of and able to assess the analyzed products. Those who viewed products as equally or more harmful or addictive were analyzed as single comparator groups in the respective logistic models.

Independent Variables

Because norms and perceptions may differ along the lines of students'

demographic characteristics and use of and exposure to tobacco products,[26] these were included as independent variables in our analysis. Demographic variables included students' gender, age, and ethnicity.

Respondents' self-report of ever using certain tobacco products was derived from a series of questions. For cigarettes, they were asked, "Have you ever tried cigarette smoking, even one or two puffs?" For e-cigarettes, respondents were asked, "Have you ever tried an electronic cigarette or e-cigarette such as Blu, 21st Century Smoke or NJOY?" For cigars, cigarillos, or little cigars, the question read, "Have you ever tried smoking cigars, cigarillos, or little cigars, such as Black and Mild, Swisher Sweets, Dutch Masters, White Owl, or Phillies Blunts, even one or two puffs?" Finally, for smokeless tobacco, subjects were asked whether they had "ever used chewing tobacco, snuff, or dip, such as Redman, Levi Garrett, Beechnut, Skoal, Skoal Bandits, or Copenhagen, even just a small amount." The Centers for Disease Control and Prevention assessed consistency of responses to these questions in light of responses to other survey questions; inconsistent responses were excluded from the publicly available data set.

For e-cigarettes and cigars, cigarillos, or little cigars, subjects were also asked 2 questions about intended future use and potential social influence on that use. They were asked, "Do you think that you will try an electronic cigarette or e-cigarette soon?" and "If one of your best friends were to offer you an electronic cigarette or e-cigarette, would you use it?" Similarly phrased questions were asked about subjects' thoughts on cigars, cigarillos, or little cigars. To each, subjects could respond on a 4-point Likert scale, "definitely yes," "probably yes," "probably no," or "definitely no."

Because living with a user of a specific tobacco product may also influence a youth's perception and use of that product, variables assessing whether a respondent lived with a person who used the studied products was derived from the question, "Does anyone who lives with you now . . .," to which respondents could select cigars, cigarillos, or little cigars; chewing tobacco, snuff, dip, or snus; and e-cigarettes.

Statistical Methods

Because of NYTS's complex survey design, analyses were weighted to adjust for nonresponse and probability of selection and to match the sample's sociodemographic characteristics with those of middle and high school students nationwide.[24,25] Standard errors were calculated by Taylor series linearization to account for clustering of responses.[27] Using Stata 11.2 (Stata Corp, College Station, TX), we assessed cross-tabulations and constructed logistic regression models. Average marginal effects were also reported to estimate the average percentage point (pp) change in harm or addictiveness perception by altering each covariate among the study's sample.

RESULTS

Results from 22 007 students were analyzed from the 2014 NYTS. Data from an additional 24 658 respondents in the 2012 NYTS, used in our assessment of trends in perceptions about e-cigarettes, were also used. Each year's tally corresponds to ~27 million US youth.

Displayed in Table 1 are respondents' beliefs about the harm of e-cigarettes, cigars, and smokeless tobacco compared with traditional cigarettes. Whereas only 26.2% (95% confidence interval [CI], 25.1% to 28.5%) of youth felt unable to provide an opinion on the comparative safety of e-cigarettes, roughly one-third reported that they did not know enough about cigars (33.2%; 95% CI, 32.0% to 34.4%) and smokeless tobacco (32.5%; 95% CI, 31.0% to 34.0%) to comment on the relative harm of those products compared with tobacco. Of those holding opinions on the comparative harm of these products, opinions varied markedly by product (Supplemental Table 5). Although nearly 73.0% (95% CI, 71.4% to 74.6%) of such students viewed e-cigarettes as less harmful than cigarettes, only 25.8% (95% CI, 24.4% to 27.3%) and 20.2% (95% CI, 18.5% to 22.0%) viewed cigars and smokeless tobacco products, respectively, as similarly less harmful than cigarettes.

Opinions about comparative safety differed by demographic characteristics. Male students, older students, and non-Hispanic white students were consistently surer about their views on the comparative harm of tobacco products. In each case, those groups were more likely than their peers to view the alternative products studied as less harmful (Table 1).

When changing views about e-cigarettes nationally were examined, increasing numbers of youth believe that e-cigarettes were less harmful than cigarettes (Fig 1) and appeared, moreover, to be increasingly sure of their views on the subject (Supplemental Table 6). In nearly all cases, except girls <15 years of age who had previously used an e-cigarette, respondents were significantly more likely in 2014 than in 2012 to believe that e-cigarettes were less harmful.

Adjusted analyses from logistic regression models assessing subjects who provided an opinion on the comparative harm of the studied products are shown in Table 2. When adjusted for other covariates, use of each studied product was associated with a decreased perception of that

TABLE 1 Beliefs About the Harm of e-Cigarettes, Cigars, and Smokeless Tobacco Compared With Cigarettes

	Belief About Harm of Listed Product Compared With Cigarettes[a]					
	Less Harmful	Equally Harmful	More Harmful	Unaware of Product	Don't Know Enough	*P*
Electronic cigarettes						
Overall	50.7 (1.1)	15.2 (0.4)	3.5 (0.2)	3.8 (0.2)	26.8 (0.9)	
Gender						<.001
Male	54.8 (1.2)	12.8 (0.4)	3.8 (0.3)	3.4 (0.3)	25.2 (0.9)	
Female	46.7 (1.2)	17.5 (0.6)	3.2 (0.2)	4.2 (0.3)	28.4 (1.1)	
Age						<.001
<15 y	45.0 (0.9)	13.6 (0.4)	3.8 (0.3)	5.8 (0.4)	31.8 (0.7)	
≥15 y	56.0 (1.6)	16.7 (0.6)	3.2 (0.2)	1.9 (0.2)	22.2 (1.2)	
Ethnicity						<.001
Non-Hispanic white	56.4 (1.3)	15.5 (0.6)	2.3 (0.2)	2.7 (0.2)	23.1 (1.0)	
Non-Hispanic black	42.2 (2.1)	14.1 (1.1)	5.6 (0.5)	5.9 (0.8)	32.2 (1.4)	
Hispanic	45.2 (1.2)	16.2 (0.6)	4.8 (0.4)	4.5 (0.3)	29.2 (1.0)	
Other or missing	41.5 (2.0)	12.9 (1.0)	4.6 (0.6)	5.5 (0.7)	35.6 (2.2)	
Cigars, cigarillos, or little cigars						
Overall	16.2 (0.5)	31.0 (0.5)	15.5 (0.4)	4.2 (0.2)	33.2 (0.6)	
Gender						<.001
Male	18.8 (0.7)	28.1 (0.6)	19.1 (0.6)	3.8 (0.3)	30.3 (0.8)	
Female	13.6 (0.7)	33.9 (0.7)	12.0 (0.5)	4.5 (0.2)	36.1 (0.8)	
Age						<.001
<15 y	12.3 (0.5)	25.9 (0.6)	14.9 (0.6)	6.3 (0.3)	40.7 (0.6)	
≥15 y	19.9 (0.8)	35.7 (0.7)	16.2 (0.7)	2.1 (0.2)	26.1 (0.7)	
Ethnicity						<.001
Non-Hispanic white	17.9 (0.8)	32.8 (0.6)	15.2 (0.6)	3.2 (0.3)	30.9 (0.8)	
Non-Hispanic black	17.9 (1.0)	26.3 (1.7)	15.2 (1.0)	5.3 (0.5)	35.3 (1.3)	
Hispanic	12.8 (0.7)	31.1 (0.9)	16.3 (0.6)	5.0 (0.4)	34.9 (1.0)	
Other or missing	10.8 (0.9)	26.6 (1.5)	16.5 (1.3)	6.5 (0.7)	39.6 (1.6)	
Chewing tobacco, snuff, dip, or snus						
Overall	13.0 (0.6)	32.0 (0.7)	19.4 (0.6)	3.2 (0.2)	32.5 (0.7)	
Gender						<.001
Male	15.7 (0.9)	30.2 (0.8)	20.3 (0.8)	3.1 (0.2)	30.8 (0.8)	
Female	10.3 (0.5)	33.8 (0.8)	18.4 (0.6)	3.2 (0.3)	34.3 (0.9)	
Age						<.001
<15 y	10.5 (0.6)	26.5 (0.6)	18.0 (0.7)	4.9 (0.3)	40.0 (0.8)	
≥15 y	15.3 (0.7)	37.2 (0.8)	20.5 (0.9)	1.5 (0.2)	25.4 (0.9)	
Ethnicity						<.001
Non-Hispanic white	16.1 (1.0)	35.8 (0.9)	17.6 (0.8)	1.9 (0.2)	28.6 (0.9)	
Non-Hispanic black	7.8 (0.9)	26.0 (1.2)	22.1 (1.2)	5.3 (0.6)	38.8 (1.3)	
Hispanic	9.5 (0.5)	28.2 (1.0)	22.8 (1.0)	4.3 (0.3)	35.2 (0.9)	
Other or missing	9.9 (0.8)	26.0 (1.1)	18.0 (1.3)	5.5 (0.6)	40.5 (1.9)	

[a] Weighted percentages with SEs in parentheses are displayed.

product's harm. Of all products, use of smokeless tobacco most markedly increased the likelihood of perceiving that that product was less harmful than cigarettes among the study's sample. Believing that one would soon try the product was associated with the perception that cigars were less harmful, although this association was not clearly observed in the case of e-cigarettes. Responses to questions about what one would do if offered a particular product by a friend were also informative. The extent to which a respondent agreed that he or she would definitely try a cigar if a best friend were to offer it was associated with a perception that cigars were harmful, with an even stronger association observed for e-cigarettes. On average, such students were 23.1 pp (95% CI, 18.1 to 28.1 pp) more likely to view e-cigarettes as less harmful than cigarettes compared with those who would definitely not agree to try a peer's e-cigarette.

Variations were also noted by demographic characteristics. Compared with their female peers, male students on average viewed cigars (3.5 pp; 95% CI, 1.2 to 5.9 pp), smokeless tobacco (4.0 pp; 95% CI, 2.1 to 5.9 pp), and e-cigarettes (7.6 pp; 95% CI, 5.7 to 9.5 pp) as less harmful than cigarettes. After we accounted for other factors, age did not alter respondents' perceptions. Compared with non-Hispanic white students, those of other ethnicities consistently viewed noncigarette tobacco products as more harmful than cigarettes. Regarding e-cigarettes, for example, non-Hispanic white students were, respectively, 4.9 pp (95% CI, 1.0 to 8.6), 9.5 pp (95% CI, 6.9 to 12.0), and

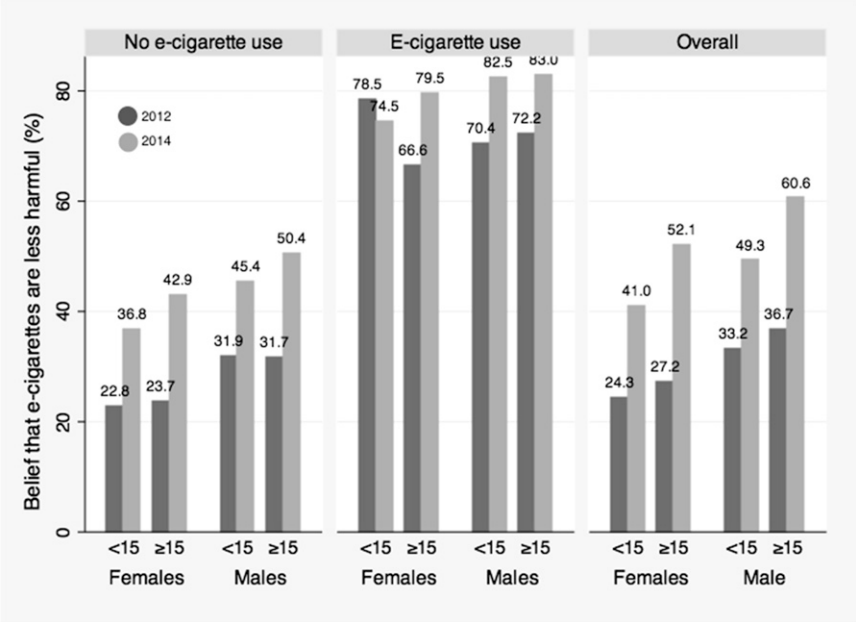

FIGURE 1

Trends in beliefs about e-cigarettes, 2012–2014. Displayed are percentages by age, gender, and e-cigarette use status for US youth who believe that e-cigarettes are less harmful than cigarettes. All results vary significantly over time. Dark gray bars, 2012; light gray bars, 2014.

3.9 pp (95% CI, 0.8 to 7.0) more likely to view e-cigarettes as less harmful than did non-Hispanic black students, Hispanic students, and those of other ethnicities. Living with a household member who used an noncigarette tobacco product also consistently reduced a student's perception that that product was harmful.

Results regarding students' perceptions of the addictiveness of e-cigarettes, cigars, and smokeless tobacco compared with cigarettes were largely similar to those regarding those products' harms, although greater numbers of respondents felt unable to assess these products' addictiveness (Table 3). Roughly two-fifths felt unable to assess cigars or smokeless tobacco. Greater numbers of subjects felt able to assess the addictiveness of e-cigarettes, with less than one-third feeling unready to do so. Of those holding opinions (Supplemental Table 7), more than half thought cigars were as addictive as cigarettes, and roughly one-third believed that cigars were less addictive than cigarettes. For smokeless tobacco, however, 63.2% of respondents believed it to be similarly addictive to cigarettes; nearly one-quarter believed it to be more addictive, and only 14.0% viewed it as less addictive than cigarettes. By contrast, e-cigarettes were widely perceived as less addictive than cigarettes; 47.1% of respondents thought e-cigarettes were less addictive, compared with 44.8% who viewed e-cigarettes as equally addictive to cigarettes. Only 8.1% viewed e-cigarettes as more addictive than traditional cigarettes. Patterns in beliefs about addictiveness largely mirrored those espoused regarding harm, discussed above.

Results from assessing views of the comparative addictiveness of e-cigarettes, cigars, and smokeless tobacco among those who held views were globally similar to perceptions of harm for cigars and smokeless tobacco (Table 4). For e-cigarettes, some minor differences were noted. In contrast to perceptions of e-cigarette harm, in which non-Hispanic black students were on average more likely than their non-Hispanic white peers to perceive e-cigarettes as less harmful, black students were more likely than white students to perceive e-cigarettes as less addictive than cigarettes (6.8 pp; 95% CI, 3.2 to 10.5 pp).

DISCUSSION

In this study, we examined adolescents' assessments of harm and addictiveness of multiple noncigarette tobacco products compared with cigarettes. With each product examined, a majority felt sufficiently informed to make such assessments, and, in the case of e-cigarettes, an even greater number of US youth felt able to do so. Among those who stated an opinion, and in contrast to views on cigars and smokeless tobacco, nearly 3 out of 4 youths believed that e-cigarettes were less harmful than cigarettes, and nearly half believed that e-cigarettes were less addictive than cigarettes. Strikingly, from 2012 to 2014, US youth have become more confident that e-cigarettes are a safer and less addictive alternative to cigarettes. Such perceptions may underlie the recent rise in popularity of e-cigarettes among US youth.

Our results should be interpreted in light of existing data. Certain noncigarette tobacco products are increasingly used, with e-cigarettes now the most common regularly used tobacco product by US youth.[28] Their rise in popularity, alongside the rise in perceived safety documented here, has occurred despite ongoing controversies about these products' safety.[4–6,16] Although what has engendered changing views on these products remains undetermined and is probably multifactorial, previous research on cigarettes suggests that social and physical environments play a key role in establishing tobacco-related norms.[17] The ease of access to and increasing ubiquity of such products has probably been influential,[10] as

TABLE 2 Logistic Regression Models Assessing Belief That e-Cigarettes, Cigars, and Smokeless Tobacco Are Less Harmful Than Cigarettes

Variable	Electronic Cigarettes			Cigars, Cigarillos, or Little Cigars			Chewing Tobacco, Snuff, Dip, or Snus		
	OR (95% CI)[a]	Average Marginal Effect: Product Is Less Harmful[b]		OR (95% CI)[a]	Average Marginal Effect: Product Is Less Harmful[b]		OR (95% CI)[a]	Average Marginal Effect: Product Is Less Harmful[b]	
		Probability, % (95% CI)	*P*		Probability, % (95% CI)	*P*		Probability, % (95% CI)	*P*
Use of cigarettes									
No	Reference	—	—	Reference	—	—	Reference	—	—
Yes	0.72 (0.63 to 0.82)	−5.9 (−8.2 to −3.6)	<.001	0.52 (0.43 to 0.64)	−11.4 (−14.7 to −8.1)	<.001	0.66 (0.57 to 0.78)	−6.1 (−8.5 to −3.8)	<.001
Use of listed product									
No	Reference	—	—	Reference	—	—	Reference	—	—
Yes	1.51 (1.24 to 1.85)	7.4 (3.5 to 10.9)	<.001	1.55 (1.26 to 1.91)	7.7 (4.1 to 11.2)	<.001	4.09 (3.42 to 4.90)	21.0 (18.4 to 23.5)	<.001
Belief that will use listed product soon									
Definitely yes	0.91 (0.58 to 1.44)	−1.7 (−10.3 to 6.8)	.688	1.71 (1.23 to 2.39)	10.3 (3.5 to 17.0)	.003	—	—	—
Probably yes	1.48 (1.15 to 1.91)	6.8 (2.7 to 11.0)	.001	1.45 (1.13 to 1.86)	6.9 (2.2 to 11.6)	.004	—	—	—
Probably no	1.45 (1.26 to 1.67)	6.5 (4.0 to 8.9)	<.001	1.21 (1.03 to 1.42)	3.4 (0.5 to 6.2)	.021	—	—	—
Definitely no	Reference	—	—	Reference	—	—	—	—	—
Would use listed product if offered									
Definitely yes	4.36 (2.83 to 6.73)	23.1 (18.1 to 28.1)	<.001	2.32 (1.65 to 3.25)	16.0 (8.8 to 23.1)	<.001	—	—	—
Probably yes	2.79 (2.23 to 3.48)	18.0 (14.6 to 21.5)	<.001	2.26 (1.81 to 2.81)	15.4 (11.0 to 19.8)	<.001	—	—	—
Probably no	1.99 (1.68 to 2.37)	13.1 (9.9 to 16.3)	<.001	1.89 (1.56 to 2.30)	11.6 (7.9 to 15.4)	<.001	—	—	—
Definitely no	Reference	—	—	Reference	—	—	—	—	—
Gender									
Female	Reference	—	—	Reference	—	—	Reference	—	—
Male	1.53 (1.37 to 1.70)	7.6 (5.7 to 9.5)	<.001	1.22 (1.06 to 1.41)	3.5 (1.2 to 5.9)	.003	1.31 (1.15 to 1.49)	4.0 (2.1 to 5.9)	<.001
Age									
<15 y	Reference	—	—	Reference	—	—	Reference	—	—
≥15 y	0.92 (0.82 to 1.02)	−1.5 (−3.4 to 0.3)	.11	1.04 (0.90 to 1.21)	0.7 (−1.9 to 3.3)	.59	1.02 (0.86 to 1.21)	0.3 (−2.2 to 2.8)	.83
Ethnicity									
White	Reference	—	—	Reference	—	—	Reference	—	—
Black	0.76 (0.62 to 0.94)	−4.8 (−8.6 to −1.0)	.014	1.15 (0.97 to 1.35)	2.5 (−0.5 to 5.6)	.11	0.72 (0.53 to 0.96)	−4.8 (−8.8 to −0.8)	.018
Hispanic	0.60 (0.52 to 0.68)	−9.5 (−12.0 to −6.9)	<.001	0.71 (0.61 to 0.82)	−5.8 (−8.2 to −3.4)	<.001	0.74 (0.60 to 0.92)	−4.3 (−7.4 to −1.2)	.007
Other or missing	0.80 (0.67 to 0.95)	−3.9 (−7.0 to −0.8)	.013	0.66 (0.51 to 0.86)	−6.8 (−10.7 to −3.0)	.001	0.82 (0.67 to 1.01)	−2.9 (−5.8 to 0.0)	.050
Household member uses listed product									
No	Reference	—	—	Reference	—	—	Reference	—	—
Yes	1.84 (1.60 to 2.11)	10.8 (8.5 to 13.1)	<.001	1.70 (1.43 to 2.02)	9.3 (6.3 to 12.3)	<.001	1.79 (1.47 to 2.18)	8.7 (5.9 to 11.4)	<.001

—, not included in multivariate regression models.

[a] Odds ratios (ORs) displayed represent estimates from the weighted logistic model in which all listed covariates are included, with 95% CIs calculated by Taylor series linearization to account for the complex survey design. ORs presented are for respondents perceiving the listed product as less harmful than cigarettes among respondents who provided an assessment.

[b] Average marginal effects estimate the average pp change by altering listed covariates among the study population, estimating the likelihood that a respondent perceived the product to be less harmful than conventional cigarettes.

TABLE 3 Beliefs About the Addictiveness of e-Cigarettes, Cigars, and Smokeless Tobacco Compared With Cigarettes

	Belief About Addictiveness of Listed Product Compared With Cigarettes					*P*
	Less Addictive	Equally Addictive	More Addictive	Unaware of Product	Don't Know Enough	
Electronic cigarettes						
Overall	31.2 (0.8)	29.7 (0.5)	5.4 (0.2)	3.6 (0.2)	30.2 (1.0)	
Gender						<.001
Male	34.8 (1.0)	27.7 (0.6)	5.9 (0.3)	3.2 (0.3)	28.4 (0.9)	
Female	27.6 (0.8)	31.7 (0.8)	4.8 (0.3)	3.9 (0.3)	32.1 (1.2)	
Age						<.001
<15 y	25.1 (0.8)	26.8 (0.5)	6.0 (0.3)	5.3 (0.4)	36.9 (1.1)	
≥15 y	36.8 (1.0)	32.4 (0.7)	4.7 (0.4)	2.0 (0.2)	24.1 (1.1)	
Ethnicity						<.001
Non-Hispanic white	33.2 (1.1)	33.2 (0.6)	4.0 (0.3)	2.3 (0.2)	27.4 (1.2)	
Non-Hispanic black	30.3 (1.4)	22.3 (1.4)	6.4 (0.4)	6.0 (0.8)	35.0 (1.2)	
Hispanic	29.6 (0.8)	26.7 (0.9)	8.0 (0.5)	4.4 (0.4)	31.2 (1.0)	
Other or missing	23.8 (1.4)	26.3 (1.6)	6.6 (0.8)	5.3 (0.8)	38.0 (2.0)	
Cigars, cigarillos, or little cigars						
Overall	18.0 (0.7)	32.9 (0.6)	6.3 (0.3)	3.9 (0.2)	38.9 (0.7)	
Gender						<.001
Male	20.2 (0.8)	32.3 (0.8)	7.1 (0.4)	3.4 (0.3)	37.0 (0.9)	
Female	15.9 (0.8)	33.6 (0.7)	5.4 (0.4)	4.3 (0.3)	40.8 (0.8)	
Age						<.001
<15 y	12.3 (0.4)	28.0 (0.6)	6.9 (0.4)	5.9 (0.3)	46.9 (0.7)	
≥15 y	23.5 (0.9)	37.6 (0.8)	5.6 (0.4)	2.0 (0.2)	31.3 (0.7)	
Ethnicity						<.001
Non-Hispanic white	20.2 (1.0)	35.7 (0.9)	4.6 (0.3)	3.3 (0.3)	36.2 (1.0)	
Non-Hispanic black	17.5 (1.0)	27.2 (1.7)	10.1 (0.7)	3.9 (0.5)	41.3 (1.5)	
Hispanic	14.8 (0.9)	31.8 (1.0)	7.7 (0.6)	4.7 (0.4)	41.0 (1.0)	
Other or missing	12.9 (0.8)	26.9 (1.4)	6.9 (0.6)	6.5 (0.7)	46.8 (1.7)	
Chewing tobacco, snuff, dip, or snus						
Overall	8.6 (0.3)	38.7 (0.9)	14.0 (0.4)	3.2 (0.2)	35.5 (0.8)	
Gender						<.001
Male	10.6 (0.4)	37.2 (1.0)	14.9 (0.6)	2.9 (0.3)	34.4 (1.0)	
Female	6.6 (0.3)	40.3 (1.0)	12.9 (0.5)	3.5 (0.3)	36.7 (0.9)	
Age						<.001
<15 y	7.6 (0.4)	30.2 (0.8)	13.6 (0.5)	5.0 (0.3)	43.6 (0.8)	
≥15 y	9.5 (0.3)	46.9 (0.9)	14.3 (0.7)	1.5 (0.1)	27.9 (0.9)	
Ethnicity						<.001
Non-Hispanic white	9.6 (0.4)	44.5 (1.1)	12.0 (0.5)	2.1 (0.2)	31.8 (1.0)	
Non-Hispanic black	6.6 (0.7)	29.7 (1.6)	17.9 (1.1))	4.8 (0.6)	41.0 (1.2)	
Hispanic	7.4 (0.5)	33.6 (1.0)	16.8 (0.7)	4.3 (0.3)	37.9 (0.9)	
Other or missing	8.1 (0.7)	29.2 (1.5)	13.1 (0.9)	5.5 (0.7)	44.1 (2.1)	

Weighted percentages with SEs in parentheses are displayed.

have youth-oriented flavors,[29] targeted advertisements,[15] and implicit, if not explicit, attempts to destigmatize tobacco use.[16]

We believe that our results complement others' analyses of tobacco use patterns. The influential roles of tobacco-related media[18] and targeted cigarette advertising[30,31] on adolescents' tobacco use patterns have been previously noted. Likewise, perceptions of a lack of tobacco addictiveness have correlated with adolescent tobacco use.[32] Unchecked by the public health community,[10] e-cigarette advertisement has ballooned in recent years[15]; moreover, manufacturers routinely make health claims unsupported by existing evidence.[33] At the same time, perceptions of relative safety have blossomed. As a consequence, many adolescents who might otherwise have avoided tobacco products now use alternative products such as e-cigarettes, develop nicotine addictions, and later may move on to cigarette use.[11–13]

Results from the comparative cross-sectional analysis also substantiate the notion that perception correlates highly with use. Across all noncigarette tobacco products assessed, having used, intending to use, or feeling susceptible to using the studied products was associated with a belief that they were safer and less addictive than cigarettes. Conversely, cigarette use was associated with beliefs that noncigarette products were more harmful, underscoring how adolescents perceive whichever product they use as less harmful. Corroborating existing research on adolescent tobacco perceptions,[19,21,34] findings reported here extend

TABLE 4 Logistic Regression Models Assessing Belief that e-Cigarettes, Cigars, and Smokeless Tobacco Are Less Addictive Than Cigarettes

Variable	Electronic Cigarettes			Cigars, Cigarillos, or Little Cigars			Chewing Tobacco, Snuff, Dip, or Snus		
	OR (95% CI)[a]	Average Marginal Effect: Product Is Less Addictive[b]		OR (95% CI)[a]	Average Marginal Effect: Product Is Less Addictive[b]		OR (95% CI)[a]	Average Marginal Effect: Product Is Less Addictive[b]	
		Probability, % (95% CI)	*P*		Probability, % (95% CI)	*P*		Probability, % (95% CI)	*P*
Use of cigarettes									
No	Reference	—	—	Reference	—	—	—	—	—
Yes	0.90 (0.76 to 1.06)	−2.5 (−6.2 to 1.2)	.187	0.66 (0.56 to 0.78)	−8.3 (−11.6 to −5.0)	<.001	0.87 (0.74 to 1.01)	−1.7 (−3.4 to 0.0)	.056
Use of listed product									
No	Reference	—	—	Reference	—	—	—	—	—
Yes	1.62 (1.39 to 1.89)	11.0 (7.6 to 14.4)		1.58 (1.32 to 1.90)	9.2 (5.7 to 12.7)	<.001	2.43 (1.94 to 3.04)	10.3 (7.8 to 12.7)	<.001
Belief that will use listed product soon									
Definitely yes	1.38 (1.08 to 1.75)	7.5 (1.9 to 13.2)	.009	1.56 (1.12 to 2.17)	9.4 (2.2 to 16.6)	.011	—	—	—
Probably yes	1.31 (1.08 to 1.59)	6.3 (1.7 to 10.9)	.007	1.53 (1.12 to 2.10)	8.9 (2.0 to 15.9)	.011	—	—	—
Probably no	1.40 (1.22 to 1.60)	7.9 (4.7 to 11.0)	<.001	1.25 (1.00 to 1.56)	4.5 (0.0 to 9.1)	.051	—	—	—
Definitely no	Reference	—	—	Reference	—	—	—	—	—
Would use listed product if offered									
Definitely yes	2.02 (1.55 to 2.63)	16.7 (10.5 to 23.0)	<.001	2.02 (1.50 to 2.72)	15.0 (8.3 to 21.7)	<.001	—	—	—
Probably yes	1.77 (1.45 to 2.16)	13.7 (9.0 to 18.4)	<.001	1.80 (1.40 to 2.31)	12.4 (7.0 to 17.7)	<.001	—	—	—
Probably no	1.40 (1.20 to 1.63)	8.0 (4.3 to 11.7)	<.001	1.68 (1.35 to 2.08)	10.7 (6.3 to 15.2)	<.001	—	—	—
Definitely no	Reference	—	—	Reference	—	—	—	—	—
Gender									
Female	Reference	—	—	Reference	—	—	—	—	—
Male	1.43 (1.30 to 1.57)	8.2 (6.1 to 10.3)	<.001	1.12 (1.00 to 1.26)	2.3 (0.1 to 4.5)	.037	1.43 (1.23 to 1.64)	4.1 (2.6 to 5.7)	<.001
Age									
<15 y	Reference	—	—	Reference	—	—	Reference	—	—
≥15 y	1.09 (0.98 to 1.21)	1.9 (−0.4 to 4.3)	.11	1.24 (1.09 to 1.41)	4.3 (1.7 to 6.9)	.001	0.82 (0.72 to 0.93)	−2.4 (−3.8 to −0.9)	.001
Ethnicity									
White	Reference	—	—	Reference	—	—	Reference	—	—
Black	1.35 (1.15 to 1.58)	6.8 (3.2 to 10.5)	<.001	0.94 (0.79 to 1.12)	−1.3 (−4.8 to 2.2)	.476	0.99 (0.78 to 1.27)	0.0 (−2.9 to 2.7)	.96
Hispanic	0.89 (0.80 to 0.99)	−2.7 (−5.0 to −0.3)	.025	0.73 (0.61 to 0.87)	−6.2 (−9.5 to −2.8)	<.001	0.96 (0.78 to 1.17)	−0.4 (−2.7 to 1.8)	.68
Other or missing	0.86 (0.72 to 1.03)	−3.5 (−7.4 to 0.5)	.085	0.77 (0.61 to 0.97)	−5.1 (−9.5 to −0.8)	.022	1.18 (0.94 to 1.47)	2.0 (−0.8 to 4.8)	.16
Household member uses listed product									
No	Reference	—	—	Reference	—	—	Reference	—	—
Yes	1.23 (1.10 to 1.45)	5.3 (2.1 to 8.4)	.001	1.36 (1.14 to 1.61)	6.1 (2.7 to 9.4)	<.001	1.28 (1.02 to 1.61)	2.9 (0.3 to 5.5)	.030

—, not included in multivariate regression models.

[a] Average marginal effects estimate the average pp change by altering listed covariates among the study population, estimating the likelihood that a respondent perceived the product to be less harmful than conventional cigarettes.

[b] Odds ratios (ORs) displayed represent estimates from the weighted logistic model in which all listed covariates are included, with 95% CIs calculated by Taylor series linearization to account for the complex survey design. ORs presented are for respondents perceiving the listed product as less addictive than cigarettes among respondents who provided an assessment.

to multiple tobacco products an association between perceived safety and use.

Analyses of specific populations also corroborate these and previous findings. Those who lived with a household member who used these tobacco products were more likely to contend that products were less harmful and addictive, findings previously observed.[19,21,34] Differences by ethnicity and gender also reflect this finding, with adjusted analyses finding that non-Hispanic white and male students, groups with the highest rates of e-cigarette use,[28] were more likely to view e-cigarettes, as well as smokeless tobacco products, as less harmful than cigarettes. Nonetheless, in all subgroups of e-cigarette–naive respondents and in most subgroups of e-cigarette users assessed, perception of relative safety has increased over the past few years, seemingly indicating a global change in youth attitudes toward these products.

Despite the robustness of the results presented, our study's findings should be interpreted in light of potential limitations. Because NYTS uses a repeated cross-sectional survey design, we were unable to make inferences about causality or fully differentiate between possible underlying period, age, or cohort effects. Nor were we able to investigate individual-level changes in perception and e-cigarette use over time. Data rely on self-report, and residual confounding might remain to bias results in an unknown direction. Moreover, survey questions assessing risk were not comparable across all tobacco products and years analyzed, limiting our ability to discern how views on other noncigarette products have changed over time. Nor, given the questionnaire format, were we able to discern explicitly whether views had changed on e-cigarettes, cigarettes, or both; our analysis relies on respondents' comparative assessments between those products. Furthermore, potential influential socioeconomic factors such as household income were not available in the data sets analyzed.

Nonetheless, we believe this study has significant strengths. By using a large, nationally representative sample of US youth, we depicted associations between the perceived relative harm and addictiveness of multiple noncigarette tobacco products and their use. Moreover, we demonstrated that youth views on e-cigarettes have changed, a finding that coincides with a marked increase in their use nationwide. US youth appear more confident that e-cigarettes are less harmful than cigarettes, raising concern that, absent regulation and public health efforts to combat changing social mores, e-cigarette use may continue to increase.

CONCLUSIONS

We examined views of the comparative harm of multiple noncigarette tobacco products including e-cigarettes in a nationally representative sample of US youth. Compared with their views on cigars and smokeless tobacco products, adolescents nationwide are more confident in their views on e-cigarettes and see e-cigarettes as less harmful than cigarettes. We document that beliefs about the comparative safety of e-cigarettes have increased markedly over the past few years, coinciding with increased use of these products.

ABBREVIATIONS

CI: confidence interval
e-cigarette: electronic cigarette
NYTS: National Youth Tobacco Survey
PP: percentage point

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