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Decline in the perceived risk of cigarette smoking between 2006 and 2015: Findings from a U.S. nationally representative sample*

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Abstract

Introduction—Perceived risk of smoking is associated with smoking status, interest in quitting, quit attempts, and sustained quitting. Tracking and reporting of risk perceptions is integral to inform regulation and education. However, no research describes temporal changes in perceived great risk of smoking in the U.S. using nationally representative data.

Methods—Data came from the 2006–2015 National Survey on Drug Use and Health (NSDUH). Time trends were assessed for the population overall, stratified by smoking status and by sociodemographic characteristics. Linear time trends of perceived great risk (versus other risk) were assessed using logistic regression, with survey year as the predictor.

Results—Perceived great risk of smoking declined significantly among the entire population between 2006 and 2015 (73.89% versus 72.89%). Perceived great risk also decreased among all smoking statuses: daily (51.16% versus 48.19%), non-daily (64.12% versus 58.44%, former (79.57% versus 77.12%), and non-smokers (79.32% versus 77.10%). The prevalence of perceived great risk declined between 2006 and 2015 among both males and females; the rate of decline was more rapid among females (aOR=0.98, 95% CI=0.97, 0.98 versus aOR=0.99, 95% CI=0.98, 0.99). Older age, African American and Hispanic race/ethnicity, educational attainment, and non-daily, former, and never smoking statuses were positively associated with perceived great risk of smoking.

Discussion—Perceived risk of smoking has declined over a 10-year period in the U.S. Declines in perceived risk indicate the need for innovative interventions to reinforce the harms associated with smoking. Differential rates of decline among males and females indicate the need for sex-specific interventions.

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Contributors

Author Pacek conceptualized the research question, conducted the analyses, and wrote the first draft of the manuscript. Author McClernon has critically reviewed, revised, and approved of the final manuscript.

Conflict of Interest

The authors have no conflicts of interest to declare.

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Keywords

smoking; perceived risk; NSDUH; tobacco

1. Introduction

According to health behavior models (Janz and Becker, 1984; Miller et al., 1996; Miller and Diefenbach, n.d.; Rogers, 1975; Weinstein, 2005), perceived risk is hypothesized to play a key role in predicting health behaviors. Perceived risk of smoking is associated with smoking status (Berg et al., 2015; Murphy-Hoefer et al., 2004; Weinstein, 2005), interest in quitting (Williams et al., 2011), and is predictive of quit attempts and sustained quitting (Borrelli et al., 2010; Costello et al., 2012). Concerns about smoking-related health risks are the most common motivation to quit (Cengelli et al., 2012; Costello et al., 2012; Hyland et al., 2004; Romer and Jamieson, 2001) and protect against youth smoking initiation (Arens et al., 2014). Interventions aimed at increasing smoking-related risk perceptions can modify smoking behavior (Grevenstein et al., 2015) and increase cessation (Borrelli et al., 2010).

Harm perceptions of tobacco use differ by sociodemographic characteristics including sex (Cummings et al., 2004; Patel et al., 2013), age (Bobak et al., 2010; Cummings et al., 2004; Siahpush, 2006), race/ethnicity (Cummings et al., 2004), educational attainment (Siahpush, 2006), socioeconomic status (Bobak et al., 2010; Pacek et al., 2017; Siahpush, 2006), and tobacco use characteristics (Bansal et al., 2004; Bobak et al., 2010; Patel et al., 2013), warranting the need for stratified analyses. Monitoring risk perceptions is integral to informing regulation and education using the public health standard mandated in the Family Smoking Prevention and Tobacco Control Act (FSPTCA) (United States Congress, 2009). Decreases in smoking-associated risk perceptions may portend an increase in the uptake of smoking or decrease in interest in quitting. To our knowledge, no studies describe temporal changes in smoking-related risk perceptions in the U.S. using nationally representative data.

This study has three aims: First, we will estimate the prevalence of perceived great risk of smoking among daily, non-daily, former, and never smokers. Next, we will estimate changes in the prevalence of perceived great risk of smoking among all smoking statuses from 2006–2015. Additionally, we will investigate these relations stratified by demographic characteristics.

2. Methods

Data included 2006–2015 National Survey on Drug Use and Health (NSDUH) public use data files (n=559,613). NSDUH provides annual, cross-sectional estimates of extra-medical substance use in U.S. community-based individuals aged 12 (Center for Behavioral Health Statistics and Quality, 2016). Surveys were administered by computer-assisted personal interviewing (CAPI) and audio computer-assisted self-interviewing (ACASI). Respondents received \$30 for participation. Sampling weights were computed to control for unit-level and individual-level non-response, and were adjusted to ensure consistency with population estimates obtained from the U.S. Census Bureau. Further descriptions of the sampling methods and survey techniques are found elsewhere (Center for Behavioral Health Statistics

and Quality, 2016). Analyses were based on de-identified data exempt from Institutional Review Board review.

2.1 Measures – Smoking variables

Participants who smoked ≥100 cigarettes in their lifetime and ≥1 cigarette during the past month were classified as current smokers; Those who smoked 1–29 days of past month were classified as non-daily smokers and those who smoked 30 days in the past month were classified as daily smokers. Persons who smoked ≥100 cigarettes in their lifetime but 0 in the past month were classified as former smokers; individuals who never smoked part or all of a cigarette or smoked <100 cigarettes in their lifetime were classified as never smokers. Similar approaches have been utilized previously (Goodwin et al., 2018; Pacek et al., 2014).

Participants were asked: “How much do people risk harming themselves physically and in other ways when they smoke one or more packs of cigarettes per day?” Responses included “no risk,” “slight risk,” “moderate risk,” and “great risk.” Given significant differences in the prevalence of perceived no and great risk of smoking when comparing 2006 versus 2015, but not for perceived slight or moderate risk—and as in prior research (Giovacchini et al., 2017; Pacek et al., 2015)—responses were dichotomized (“perceived great risk” versus “other”).

2.2 Statistical analyses

Data were weighted to reflect the complex survey design and analyzed with STATA SE version 13.0 (StataCorp, 2013). First, we examined the prevalence of perceived great, moderate, slight, and no risk of smoking from 2006 to 2015. Next, we examined the prevalence of perceived great risk of smoking from 2006 to 2015 among each smoking status. Wald chi-square (χ^2) tests explored whether perceived great risk of smoking differed between 2006 and 2015. Linear time trends (i.e., rate of change) of perceived great risk of smoking were assessed using adjusted logistic regression models with survey year as the predictor. Adjusted logistic regression analyses assessed associations between perceived great risk of smoking with sociodemographic and smoking characteristics. To determine whether linear time trends varied by selected demographic characteristics, interactions between smoking status, survey year, and sex, race/ethnicity, age, and educational attainment were tested. The interaction term for sex was significant ($p<0.001$); we examined the prevalence of perceived great risk of smoking among each smoking status, stratified by sex.

3. Results

3.1 Perceived risk of smoking: 2006–2015

Supplemental Table 1¹ contains the distribution of perceived risk of smoking in each survey year. The perception of no risk increased and perceived great risk decreased significantly between 2006 and 2015. Though linear trends for perceived slight and moderate risks increased significantly between 2006 and 2015, when comparing the prevalence of these levels of risk perception in 2006 and 2015, the differences were not significant.

¹Supplementary material can be found by accessing the online version of this paper at <http://dx.doi.org> and by entering doi:...

3.2 Perceived great risk of smoking: 2006–2015

In 2015, perceived great risk varied by smoking status (Wald $\chi^2=5585.35$, $p<0.001$). Perceived great risk was similarly high among former and never smokers (Wald $\chi^2=1.26$, $p=0.690$), lower among non-daily smokers as compared to both former (Wald $\chi^2=2134.47$, $p<0.001$) and never smokers (Wald $\chi^2=1631.63$, $p<0.001$), and lowest among daily smokers versus other smoking statuses (non-daily: Wald $\chi^2=631.57$, $p<0.001$; former: Wald $\chi^2=5934.99$, $p<0.001$; never: Wald $\chi^2=5684.87$, $p<0.001$).

The prevalence of perceived great risk declined between 2006 and 2015 overall (Wald $\chi^2=4.10$, $p=0.045$) (Table 1). Additionally, when comparing survey years 2006 and 2015, perceived great risk declined among daily (Wald $\chi^2=5.04$, $p=0.027$), non-daily (Wald $\chi^2=8.60$, $p=0.004$), former (Wald $\chi^2=4.70$, $p=0.032$), and never smokers (Wald $\chi^2=11.11$, $p=0.001$). Linear time trends were significant for all smoking statuses; the rates of decline did not differ between smoking statuses ($F_{3,108}=0.45$, $p=0.721$).

3.3 Perceived great risk of smoking, stratified by sex: 2006–2015

In 2015, the prevalence of perceived great risk of smoking was higher among females than males (Wald $\chi^2=2805.21$, $p<0.001$), overall. Additionally, the prevalence of perceived great risk of smoking varied by smoking status among both males (Wald $\chi^2=5463.37$, $p<0.001$) and females (Wald $\chi^2=5379.45$, $p<0.001$). Similar to the sample overall, for both males and females, the prevalence of perceived great risk was highest and comparable among both never and former smokers, followed by non-daily, and lowest among daily smokers.

When comparing the prevalence of perceived great risk in survey years 2006 and 2015, significant differences were absent among males (Wald $\chi^2=0.12$, $p=0.726$), but present among females (Wald $\chi^2=7.24$, $p=0.008$) (Table 1). Linear time trends were significant for both males and females; the rate of decline was most rapid among females ($F_{1,110}=15.90$, $p<0.001$). Additionally, the rate of decline was more rapid for females than males among former ($F_{1,110}=5.34$, $p=0.023$) and never ($F_{1,110}=10.24$, $p=0.002$) smokers.

3.4 Characteristics associated with perceived great risk of smoking

In adjusted analyses, females were 1.54 times more likely (95% CI=1.51, 1.57) than males to perceive great risk associated with smoking. Individuals age 18–25 (aOR=1.17, 95% CI=1.13, 1.21) and 26 (aOR=1.58, 95% CI=1.52, 1.65) were more likely than persons age 12–17 to perceive great risk of smoking (Table 2). Compared to White participants, African American (aOR=1.17, 95% CI=1.12, 1.21) and Hispanic (aOR=1.34, 95% CI=1.29, 1.38) participants were more likely to perceive great risk associated with smoking, while participants of Other race/ethnicity were less likely (aOR=0.92, 95% CI=0.88, 0.96). Educational attainment (aOR=1.21, 95% CI=1.17, 1.25) was positively associated with perceived great risk of smoking. In comparison to daily smokers, non-daily (aOR=1.76, 95% CI=1.68, 1.84), former (aOR=3.47, 95% CI=3.34, 3.60), and never smokers (aOR=3.73, 95% CI=3.62, 3.85) were more likely to perceive great risk associated with smoking. Perceived great risk of smoking was less likely in years 2009–2015 versus year 2006.

4. Discussion

Findings contribute to our understanding of the perceived great risk of smoking among the U.S. general population, as well as temporal trends in and correlates thereof. In 2015, perceived great risk was highest and comparable among never and former smokers, lower among non-daily, and lowest among daily smokers. Between 2006 and 2015, perceived great risk of smoking decreased among the population as a whole, and among all smoking statuses. Though the relative percentage change in perceived great risk was greatest among non-daily smokers, the rate of decline over time did not differ between smoking status.

Though the absolute change in perceived great risk is relatively small, when considering the population of the U.S., this 1% decrease over 10 years equals approximately 3 million fewer people perceiving great risk associated with smoking. Given the negative associations between risk perceptions and smoking initiation and status (Berg et al., 2015; Murphy-Hoefer et al., 2004; Weinstein, 2005), and positive associations with cessation behaviors (e.g., interest in, attempts, and sustained quitting) (Borrelli et al., 2010; Costello et al., 2012; Williams et al., 2011), this decline in risk perceptions is concerning. Decreased risk perception is somewhat puzzling given the consistent presentation of anti-smoking messaging and continued decline in smoking (Centers for Disease Control and Prevention, 2016a, 2016b). One potential explanation includes prevention fatigue (i.e., an attitude that anti-smoking and smoking prevention messages have become tiresome). It is possible that the declining prevalence of smoking (Centers for Disease Control and Prevention, 2016a) has resulted in fewer individuals knowing someone affected by tobacco-related disease, thus decreasing the salience of smoking risks. Additionally, though most Americans recognize that smoking causes serious morbidity, many misunderstand the magnitude of the risks (Krosnick et al., 2017). Findings that the perceived great risk of smoking is declining in the U.S.—coupled with this prior work—indicate the need for innovative educational campaigns and interventions regarding the degree of harm associated with smoking.

The rate of decline in perceived great risk was more rapid among females than males overall, and among former and never smokers. Previous work highlights a number of sex differences in smoking outcomes, including the higher prevalence of smoking among males versus females (Centers for Disease Control and Prevention, 2016b). Female smokers are more likely to attempt to quit (Shiffman et al., 2008; Zhu et al., 2000), though they have more difficulty quitting than male smokers (Piper et al., 2010). This is concerning, particularly when considering that the risks of smoking-related illness are greater for females than males, partly because female smokers experience risks associated with unique health conditions (i.e., pregnancy (Centers for Disease Control and Prevention, 2017), breast cancer, and early-onset menopause (Perkins, 2001)). With reductions in risk perceptions, reduced quitting is possible, which may be particularly evident among females. Our findings have implications for interventions and public health messaging targeted toward females. Ultimately, additional research is needed to explore and elucidate reasons for these sex differences.

Consistent with prior research (Cummings et al., 2004; Pacek et al., 2015; Thornton et al., 2013), females were more likely to perceive great risk in adjusted analyses. Though research

regarding smoking-related risk perceptions and age are mixed (Cummings et al., 2004; Siahpush, 2006), older age being positively associated with perceived great risk of smoking has been observed previously (Thornton et al., 2013). Consistent with prior work (Siahpush, 2006), greater education was positively associated with perceived great risk.

This work has several limitations. Data were collected via self-report, and are subject to recall and social desirability biases. To mitigate concerns regarding the latter, ACASI increases the likelihood of honest responding for sensitive information (Center for Behavioral Health Statistics and Quality, 2016). The cross-sectional nature of NSDUH precludes us from making inferences regarding the temporal ordering of perceived great risk and correlates thereof. We could not take into account state-level differences (e.g., tobacco control policies) that may impact the decline in perceived great risk of smoking; future work should take these characteristics into account. Additionally, we observed an uptick in perceived great risk in year 2015. It is difficult to say whether this represents a stable increase in perceptions of great risk or if it represents an anomalous, one-year, increase. Future work should explore whether this increase is sustained once additional nationally representative data is available. This work also has a number of strengths. To our knowledge, it represents the first to provide current estimates of and temporal changes in the perceived great risk of smoking among the population overall and selected subgroups in a nationally representative sample.

Perceived great risk of smoking declined significantly in the U.S., and declined more rapidly among females than males. Sex, age, race/ethnicity, educational attainment, and smoking status were associated with the perceived great risk of smoking. Findings help to characterize the public's opinions regarding smoking. The identified correlates of perceived great risk of smoking may be helpful when determining which groups should be targeted for educational and prevention interventions; this is particularly relevant given the evidence for interventions to alter smoking behavior via increased risk perceptions of smoking (Borrelli et al., 2010; Grevenstein et al., 2015). Additional research is needed to fully assess reasons for the decline in perceived great risk of smoking, and to elucidate differential rates of decline among males and females.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- Perceived risk was highest among never/former smokers and lowest in daily smokers.
- Perceived risk of smoking declined significantly between 2006 and 2015 in the U.S.
- Perceived risk of smoking declined more rapidly among females than among males.

Table 1

Prevalence of perceived great risk of cigarette smoking over time from 2006 to 2015 and linear time trends, stratified by smoking status and sex, National Survey on Drug Use and Health, 2006–2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Linear Time Trends			aOR* (95% CI)	p-value
	wt%														
Smoking status															
All smoking statuses	73.89	73.94	73.64	70.85	71.38	71.25	71.67	71.16	71.20	72.89	-1.00		-1.35	0.99 (0.98, 0.99)	<0.001
Daily smokers	51.16	50.22	49.91	47.32	48.72	47.27	48.34	48.56	46.06	48.19	-2.97		-5.69	0.98 (0.97, 0.99)	<0.001
Non-daily smokers	64.12	63.89	66.76	60.85	60.25	63.00	60.40	59.95	61.35	58.44	-5.68		-8.86	0.97 (0.96, 0.99)	<0.001
Former smokers	79.57	79.78	79.12	76.27	75.15	75.42	75.59	75.63	76.45	77.12	-2.45		-3.08	0.98 (0.97, 0.99)	<0.001
Never smokers	79.32	79.21	78.64	76.73	76.10	76.78	75.59	75.69	77.47	77.10	-2.22		-2.80	0.98 (0.97, 0.98)	<0.001
Differential time trend: year as continuous x smoking status															
All smoking statuses														F(3, 108)=0.45	0.721
Male	68.75	68.78	68.08	66.08	66.84	66.32	66.92	66.03	67.26	68.52	-0.23		-0.33	0.99 (0.98, 0.99)	0.001
Female	78.74	78.81	78.87	75.35	75.69	75.90	76.13	75.99	74.91	77.01	-1.73		-2.20	0.98 (0.97, 0.98)	<0.001
Differential time trend: year as continuous x sex															
Daily smokers														F(1, 110)=15.90	<0.001
Male	47.66	46.21	42.47	42.25	44.06	43.76	43.51	43.81	42.53	43.87	-3.79		-7.95	0.99 (0.97, 1.00)	0.021
Female	55.19	54.71	58.24	52.65	53.61	51.08	53.61	63.74	50.04	52.99	-2.20		-3.99	0.98 (0.97, 0.99)	0.001
Differential time trend: year as continuous x sex															
Non-daily smokers														F(1, 110)=0.47	0.493
Male	61.27	60.17	61.91	57.37	57.05	56.89	58.14	56.21	59.99	56.45	-4.82		-7.87	0.98 (0.97, 1.00)	0.019
Female	67.65	69.13	70.70	65.22	64.80	71.12	63.58	65.33	63.13	61.36	-6.29		-9.30	0.97 (0.95, 0.98)	0.001
Differential time trend: year as continuous x sex															
Former smokers														F(1, 110)=1.53	0.220
Male	74.67	75.46	74.04	73.39	72.05	71.32	71.69	72.54	72.69	73.64	-1.03		-1.38	0.99 (0.97, 1.00)	0.026
Female	85.53	84.89	85.33	79.74	79.37	80.47	80.54	79.17	81.02	81.51	-4.02		-4.70	0.96 (0.95, 0.98)	<0.001
Differential time trend: year as continuous x sex															
Never smokers														F(1, 110)=5.34	0.023

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Linear Time Trends		aOR* (95% CI)	p-value
	wt%										Absolute change	Relative change		
Male	74.32	74.16	74.13	70.99	72.31	71.46	72.33	70.22	72.04	73.38	-0.94	-1.26	0.99 (0.98, 0.99)	<0.001
Female	83.28	83.23	82.23	80.05	80.18	79.83	80.27	79.98	78.63	80.74	-2.54	-3.05	0.97 (0.97, 0.98)	<0.001
Differential time trend: year as continuous x sex														
Differential time trend: year as continuous x cigarette smoking (in 4 categories) among males														
Differential time trend: year as continuous x cigarette smoking (in 4 categories) among females														
													F(1, 110)=10.24	0.002
													F(3, 108)=0.13	0.940
													F(3, 108)=0.83	0.478

Note: Bold text indicates statistically significant findings

* Adjusted for age, race, and education

Table 2

Logistic regression analyses depicting associations between participant characteristics and perceived great risk of cigarette smoking, NSDUH 2006–2015

Characteristic	OR (95% CI)	aOR* (95% CI)
Sex		
Male	1.0	1.0
Female	1.59 (1.57, 1.63)	1.54 (1.51, 1.57)
Age		
12–17	1.0	1.0
18–25	1.03 (1.01, 1.05)	1.17 (1.13, 1.21)
26+	1.39 (1.37, 1.42)	1.58 (1.52, 1.65)
Race/ethnicity		
White	1.0	1.0
African American	1.18 (1.14, 1.22)	1.17 (1.12, 1.21)
Hispanic	1.35 (1.31, 1.40)	1.34 (1.29, 1.38)
Other	1.00 (0.96, 1.05)	0.92 (0.88, 0.96)
Educational attainment		
<High school/GED	1.0	1.0
High school/GED	1.33 (1.30, 1.36)	1.21 (1.17, 1.25)
Smoking status		
Daily smokers	1.0	1.0
Non-daily smokers	1.71 (1.64, 1.78)	1.76 (1.68, 1.84)
Former smokers	3.53 (3.41, 3.67)	3.47 (3.34, 3.60)
Never smokers	3.56 (3.46, 3.66)	3.73 (3.62, 3.85)
Survey year		
2006	1.0	1.0
2007	1.00 (0.95, 1.06)	0.99 (0.93, 1.05)
2008	0.99 (0.93, 1.05)	0.96 (0.91, 1.02)
2009	0.86 (0.82, 0.90)	0.82 (0.78, 0.87)
2010	0.88 (0.83, 0.93)	0.84 (0.79, 0.89)
2011	0.88 (0.83, 0.92)	0.82 (0.78, 0.86)
2012	0.89 (0.86, 0.93)	0.84 (0.80, 0.88)
2013	0.87 (0.83, 0.92)	0.81 (0.76, 0.85)
2014	0.87 (0.83, 0.92)	0.80 (0.76, 0.85)
2015	0.95 (0.90, 0.99)	0.86 (0.82, 0.91)

Note: Bold text indicates statistically significant findings

* Adjusted for sex, age, race/ethnicity, education, smoking status, and survey year