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ORIGINAL PAPER

Prevalence of Indoor Tanning Among U.S. High School Students from 2009 to 2017

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Abstract
Indoor tanning exposes users to high levels of ultraviolet radiation, increasing skin cancer risk. The risk is greatest for those who begin indoor tanning at a young age. The objective of this study was to assess changes in indoor tanning prevalence over time among U.S. high school students, by sex, age, and race/ethnicity. We used cross-sectional data from the 2009, 2011, 2013, 2015, and 2017 national Youth Risk Behavior Survey to examine changes in indoor tanning prevalence from 2009 to 2017 and from 2015 to 2017. From 2009 to 2017 indoor tanning declined overall (15.6 to 5.6%; $p < 0.001$), across all age groups, and among white (37.4 to 10.1%; $p < 0.001$) and Hispanic (10.5 to 3.0%; $p < 0.001$) female students, and white (7.0 to 2.8%; $p < 0.001$) and Hispanic (5.8 to 3.4%; $p < 0.001$) male students. From 2015 to 2017, indoor tanning declined overall (7.3 to 5.6%; $p = 0.04$) and among white (15.2 to 10.1%; $p = 0.03$) and Hispanic (5.8 to 3.0%; $p = 0.02$) female students, and 16-year-old students (7.2 to 4.7%; $p = 0.03$). Indoor tanning has continued to decrease, particularly among white and Hispanic female students, dropping well below the Healthy People 2020 target for adolescents. However, continued efforts are needed to further reduce and sustain reductions in adolescent indoor tanning and address remaining research gaps.

Keywords Indoor tanning · Skin cancer · Prevention · Adolescent health

Introduction

Indoor tanning devices expose users to high levels of ultraviolet radiation (UV), and the World Health Organization has classified these devices as Group 1, "carcinogenic to humans" [1]. Studies have demonstrated a dose–response relationship between number of indoor tanning sessions and risk of melanoma [2, 3], basal cell carcinoma [4], and squamous cell carcinoma [4]. The risk is greater for those who start indoor tanning at a young age [2, 4]. The target for Healthy People 2020 objective C-20.3 is to "reduce the proportion of adolescents in grades 9 through 12 who report using artificial sources of ultraviolet light for tanning" to ≤ 14% [5].

Previous publications have documented a decline in indoor tanning among U.S. high school students. A paper by Guy et al. described a more than 50% decrease in overall indoor tanning prevalence among U.S. high school students from 2009 to 2015 [6]. Additional analyses stratified by sex, age, and race/ethnicity showed statistically significant decreases across all demographic subgroups except non-Hispanic black students, among whom no change in the prevalence of indoor tanning was observed [6]. More recently, Kann et al. showed a further decline in the prevalence of indoor tanning among U.S. high school students overall from 2015 (7.3%) to 2017 (5.6%) but did not examine changes over time by demographic subgroups [7]. The current study is a follow-up to these two papers to examine whether indoor tanning prevalence declined from 2015 to 2017 specifically among demographic subgroups (by sex, race/ethnicity, sex within each racial/ethnic group, and age) of U.S. high school students. We also examined linear trends in indoor tanning prevalence from 2009 to 2017 among demographic subgroups to give context to the more recent years of data.

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Methods

The national Youth Risk Behavior Survey (YRBS) is a biennial, self-administered survey of nationally representative samples of U.S. high school students (grades 9–12) attending public and private schools. Student participation is anonymous and voluntary, and local procedures are followed to obtain parental permission. The Centers for Disease Control and Prevention's (CDC) Institutional Review Board approved the protocol for the national YRBS. Data are collected during the spring semester (January to June) in each survey cycle. Additional details about the national YRBS methodology and sampling strategies have been described elsewhere [7]. During 2009–2017 school response rates ranged from 69 to 81%, student response rates ranged from 81 to 88%, overall response rates (the product of the school and student response rates for each year) ranged from 60 to 71%, and sample sizes ranged from 13,358 to 16,410. Values were not imputed for missing responses to survey items.

Beginning in 2009, the questionnaire asked participants "how many times" they used "an indoor tanning device" Responses were dichotomized: 0 versus 1 + times. Data were analyzed by sex (female, male), age (≤ 14, 15, 16, 17, ≥ 18 years), and race/ethnicity (non-Hispanic black ["black"], non-Hispanic white ["white"], and Hispanic students [who might be of any race]). We also examined the data within each racial/ethnic group by sex. The numbers of students from other racial/ethnic groups were too small for meaningful analysis. Data were weighted to provide national estimates, and the statistical software used accounted for the complex sample design (SUDAAN version 11.0.1, Research Triangle Institute, Research Triangle Park, North Carolina). We weighted each record to adjust for nonresponse and the oversampling of black and Hispanic students. We used logistic regression analyses to examine linear time effects for 2009–2017, controlling for sex, race/ethnicity, and age, depending upon which subgroup was being analyzed. Prevalence estimates from 2015 to 2017 were compared using *t* tests. Findings were considered statistically significant when $p < 0.05$.

Results

In 2017, 5.6% of high school students had used an indoor tanning device during the 12 months prior to the survey, a significant decline since 2009, when the overall prevalence was 15.6% ($p < 0.001$; Table 1). Indoor tanning prevalence also decreased significantly from 2009 to 2017 across all of the demographic groups we examined except black students of either sex. The prevalence declined from 37.4 to 10.1% ($p < 0.001$) among white female students, from 10.5 to 3.0% ($p < 0.001$) among Hispanic female students, from 7.0 to 2.8% ($p < 0.001$) among white male students, and from 5.8 to 3.4% ($p < 0.001$) among Hispanic male students. Similarly, there were significant declines in indoor tanning from 2009 to 2017 across all of the age groups we examined ($p < 0.001$).

A comparison of the most recent 2 years of data indicated a decline in indoor tanning device use among high school students nationwide, from 7.3% in 2015 to 5.6% in 2017 ($p = 0.04$). During this time, indoor tanning declined from 15.2 to 10.1% ($p = 0.03$) among white female students, from 5.8 to 3.0% ($p = 0.02$) among Hispanic female students, and from 7.2 to 4.7% ($p = 0.03$) among 16-year-old students. Indoor tanning prevalence did not change significantly from 2015 to 2017 among white male, Hispanic male, or black students, or students who were older or younger than 16 years.

Discussion

In 2017, 5.6%, or an estimated 900,000, U.S. high school students used an indoor tanning device, a 64% reduction from the estimated 2.5 million in 2009 and a 23% reduction from the estimated 1.2 million in 2015. Furthermore, indoor tanning prevalence has dropped well below the Healthy People 2020 target of a prevalence at or below 14% [5], for all of the demographic subgroups we examined.

Since 2015, the prevalence of indoor tanning has continued to decrease substantially among white and Hispanic female students, among whom use of indoor tanning devices has historically been highest. However, decreases in indoor tanning during 2015–2017 were not observed among white and Hispanic male students, and there was no significant change since 2009 or 2015 among black students.

Public Health Implications

Although the decline in indoor tanning is a public health success, some young people continue to use indoor tanning devices. The declines—especially among female and 16-year-old high school students—may be attributable, in part, to new legislation to restrict minors' access to indoor tanning in some states [8]. Uptake of similar legislation in other states may further reduce indoor tanning prevalence. However, additional efforts may be needed to influence the behaviors of heavy tanners and those not affected by state access laws, improve compliance with existing legislation, and address pro-tanning social norms.

Research gaps remain, including a lack of information on how to address tanning among black and male adolescents [9, 10]. Efforts to reduce indoor tanning have

Table 1 Percentage[a] of high school students who used an indoor tanning device[b]—Youth Risk Behavior Survey, 2009–2017

	2009, % (95% CI) N = 16,410[c]	2011, % (95% CI) N = 15,425[c]	2013, % (95% CI) N = 13,538[c]	2015, % (95% CI) N = 15,624[c]	2017, % (95% CI) N = 14,765[c]	2015 vs. 2017[d]	2009–2017 linear trend[e]
Total	15.6 (13.8–17.6)	13.3 (11.2–15.7)	12.8 (10.6–15.4)	7.3 (6.0–8.8)	5.6 (4.7–6.6)	**.04**	**< .001**
Sex							
Female	25.4 (22.5–28.6)	20.9 (17.6–24.7)	20.2 (16.2–25.0)	10.6 (8.4–13.3)	7.5 (5.9–9.5)	**.04**	**< .001**
Male	6.7 (5.6–8.0)	6.2 (4.9–7.8)	5.3 (4.4–6.3)	4.0 (3.3–5.0)	3.5 (2.9–4.3)	.35	**< .001**
Race/ethnicity × sex							
NH White	21.1 (18.3–24.1)	17.4 (14.6–20.5)	18.3 (15.6–21.4)	9.4 (7.6–11.6)	6.6 (5.3–8.2)	**.03**	**< .001**
Female	37.4 (33.6–41.3)	29.3 (25.2–33.8)	30.7 (25.8–36.0)	15.2 (11.8–19.4)	10.1 (7.6–13.3)	**.03**	**< .001**
Male	7.0 (5.7–8.6)	6.2 (4.4–8.8)	6.1 (5.0–7.5)	3.7 (2.7–5.1)	2.8 (2.0–3.9)	.24	**< .001**
NH Black	4.5 (3.2–6.4)	3.9 (2.6–5.6)	2.8 (2.2–3.7)	3.7 (2.5–5.4)	5.5 (4.1–7.2)	.10	.53
Female	2.7 (1.8–4.1)	3.3 (2.0–5.2)	2.5 (1.6–3.8)	2.1 (1.2–3.7)	3.8 (2.5–5.7)	.10	.54
Male	6.1 (4.2–8.9)	4.5 (2.8–7.0)	3.2 (2.1–4.6)	5.3 (3.1–9.0)	7.0 (4.8–10.1)	.39	.66
Hispanic	8.2 (6.9–9.6)	7.6 (6.1–9.5)	6.2 (4.4–8.6)	4.7 (3.5–6.3)	3.2 (2.7–3.9)	.06	**< .001**
Female	10.5 (8.8–12.5)	9.6 (7.2–12.7)	7.9 (5.2–11.7)	5.8 (3.9–8.4)	3.0 (2.3–4.0)	**.02**	**< .001**
Male	5.8 (4.4–7.6)	5.7 (4.3–7.7)	4.4 (2.9–6.8)	3.7 (2.8–5.0)	3.4 (2.7–4.4)	.66	**< .001**
Age (years)							
≤ 14	9.7 (7.7–12.1)	8.1 (6.2–10.4)	7.3 (5.5–9.6)	3.1 (2.0–4.7)	4.2 (2.8–6.1)	.30	**< .001**
15	12.0 (10.2–14.1)	8.7 (7.0–10.8)	8.8 (6.4–12.1)	4.4 (3.4–5.8)	4.0 (3.0–5.3)	.61	**< .001**
16	14.9 (12.8–17.3)	13.6 (11.1–16.6)	12.8 (10.3–15.9)	7.2 (5.6–9.3)	4.7 (3.7–6.1)	**.03**	**< .001**
17	19.1 (16.8–21.6)	17.3 (14.0–21.1)	15.2 (12.9–17.8)	9.1 (6.9–11.9)	6.6 (5.1–8.4)	.09	**< .001**
≥ 18	22.0 (19.1–25.3)	18.7 (15.8–22.0)	19.0 (15.5–22.9)	12.1 (9.9–14.9)	9.4 (7.5–11.8)	.10	**< .001**

Bold values indicate statistical significance ($p < 0.05$)

CI confidence interval, *NH* non-Hispanic.

[a]Unadjusted, nationally representative prevalence estimates, shown by year

[b]Such as a sunlamp, sunbed, or tanning booth, not counting getting a spray-on tan, one or more times during the 12 months before the survey

[c]Unweighted sample sizes

[d]Prevalence estimates from 2015 to 2017 were compared using *t* tests

[e]Logistic regression (controlling for sex, age, and race/ethnicity, as applicable) was used to examine linear trends in indoor tanning during 2009–2017

rarely targeted these demographic groups, and their use of indoor tanning has historically been low compared to that of other groups [6]. However, our findings suggest the potential for public health benefit in identifying effective interventions for black and male adolescents. Findings from a previous examination of the 2015 YRBS data [11] suggest that interventions targeting sexual minority male students may be warranted. More information is also needed to understand how age restrictions influence indoor tanning behaviors once adolescents reach an age at which they are no longer subject to the restriction. Additionally, there is a need for information on how declines in indoor tanning are related to sun exposure, especially given the high prevalence of sunburn [7]. Efforts to monitor sun exposure could provide insights into adolescents' total UV exposure. In conclusion, although indoor tanning has decreased substantially among high school students since 2009, continued efforts are needed to further reduce and sustain reductions in adolescent indoor tanning and address remaining research gaps.

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Compliance with Ethical Standards

Ethical Approval The Centers for Disease Control and Prevention's Institutional Review Board approved the protocol for the national Youth Risk Behavior Survey. Survey procedures were designed to protect students' privacy by allowing for anonymous and voluntary participation. Before survey administration, local parental permission procedures were followed [7].

Conflict of interest The authors declare that they have no conflict of interest.

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