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Preventing Skin Cancer Through Reduction of Indoor Tanning: Current Evidence

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Abstract

Exposure to ultraviolet radiation from indoor tanning devices (tanning beds, booths, and sun lamps) or from the sun contributes to the risk of skin cancer, including melanoma, which is the type of skin cancer responsible for most deaths. Indoor tanning is common among certain groups, especially among older adolescents and young adults, adolescent girls and young women, and non-Hispanic whites. Increased understanding of the health risks associated with indoor tanning has led to many efforts to reduce use. Most environmental and systems efforts in the U.S. (e.g., age limits or requiring parental consent/accompaniment) have occurred at the state level. At the national level, the U.S. Food and Drug Administration and the Federal Trade Commission regulate indoor tanning devices and advertising, respectively.

The current paper provides a brief review of (1) the evidence on indoor tanning as a risk factor for skin cancer; (2) factors that may influence use of indoor tanning devices at the population level; and (3) various environmental and systems options available for consideration when developing strategies to reduce indoor tanning. This information provides the context and background for the companion paper in this issue of the *American Journal of Preventive Medicine*, which summarizes highlights from an informal expert meeting convened by the CDC in August 2012 to identify opportunities to prevent skin cancer by reducing use of indoor tanning devices.

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Indoor Tanning and Cancer Risk

In 2009, the WHO classified ultraviolet (UV) radiation–emitting tanning devices as Class I carcinogens based on evidence linking indoor tanning to increased risk of skin cancer.¹ Genetic factors, exposure to UV radiation, and a history of sunburn all contribute to risk of skin cancer,^{2–7} but most skin cancers are caused by exposure to UV radiation, either from the sun or from artificial sources such as indoor tanning devices (tanning beds, booths, and sun lamps), and are therefore preventable.^{1,8–11} Indoor tanning has been proven to increase the risk of developing squamous and basal cell carcinoma and melanoma.^{1,3,12,13} There are an estimated 3.5 million cases of basal and squamous cell carcinomas in the U.S. annually, and the incidence is increasing worldwide.^{14,15}

Two recent studies provide estimates of the number of skin cancers that may be caused by indoor tanning each year; more than 170,000 cases of squamous and basal cell carcinomas of the skin may be due to indoor tanning in the U.S. annually, and more than 3400 cases of melanoma may be due to indoor tanning in Europe.^{16,17} Melanoma causes more deaths than any other skin cancer, and its incidence is increasing, particularly among non-Hispanic whites and women; increases have also been noted among all tumor thicknesses.¹⁸ Additionally, melanoma is one of the most commonly diagnosed cancers among adolescents and young adults in the U.S.^{19,20} Indoor tanning before age 35 years increases the risk of melanoma by 60%–80% or more, possibly because of longer duration of use.^{3,13,16,21}

In addition to the morbidity and mortality it causes, skin cancer poses a substantial economic burden in the U.S.^{22,23} The treatment of melanoma and nonmelanoma skin cancer costs an estimated \$1.7 billion each year. Costs due to lost productivity are estimated to be \$3.8 billion.²⁴

Systems and environmental approaches focus on broader social factors in an effort to change the context in which health behaviors occur and make healthy options the easy choice.^{25,26} Broader interventions may increase impact at the population level and maximize the return on public health investment. This manuscript provides a brief review of (1) the evidence on indoor tanning as a risk factor for skin cancer; (2) factors that may influence use of indoor tanning devices at the population level; and (3) the various environmental and systems options available for consideration when developing strategies to reduce the prevalence of indoor tanning.

Prevalence of Indoor Tanning

Two national surveys conducted by the CDC allow for the examination of self-reported use of indoor tanning devices in the U.S. The Youth Risk Behavior Survey (YRBS) provides a nationally representative sample of public and private high school students in Grades 9–12. The National Health Interview Survey (NHIS) collects data on a nationally representative sample of the U.S. civilian, non-institutionalized population through confidential interviews conducted in households. Recent data on indoor tanning device use from the YRBS and NHIS are summarized in Table 1.

According to the 2011 national YRBS, 13.3% of U.S. high school students used an indoor tanning device in the previous year.²⁷ The prevalence of use of indoor tanning devices was higher among female (20.9%) than male (6.2%) students. Racial/ethnic differences were also observed, with higher use among non-Hispanic white female students (29.3%) compared to non-Hispanic black female students (3.3%) and Hispanic female students (9.6%). The prevalence of indoor tanning for female students increased by grade, with 11.7%, 15.7%, 26.5%, and 31.8% of students in Grade 9, 10, 11, and 12, respectively, reporting use.²⁷ Data from the 2009 YRBS show that frequent use of indoor tanning devices is common, with approximately half of indoor tanners reporting 10 or more sessions per year.²⁸

Results from the 2010 NHIS indicate that 5.6% of adults aged 18 years reported using an indoor tanning device in the past year.²⁹ The prevalence of indoor tanning was higher among women (8.9%) than men (2.2%) and higher among younger compared to older adults, with the highest use among adults aged 18–21 years (12.3%); 22–25 years (12.3%); and 26–29 years (9.3%). Similar to the data for U.S. high school students, racial/ethnic differences were observed, with a higher prevalence among non-Hispanic whites (8.1%) compared to non-Hispanic blacks (0.3%) and Hispanics (1.6%). Indoor tanning device use was highest among non-Hispanic white women aged 18–21 years (31.8%) and 22–25 years (29.6%). Frequent use of indoor tanning devices is also common among adults. Among white adults who reported indoor tanning, 57.7% of women and 40.0% of men reported indoor tanning 10 times in the previous 12 months.²⁹

Correlates of Indoor Tanning

Indoor tanning behavior is likely influenced by individual factors, interpersonal or social factors, and broad contextual factors, among others. In addition to age and gender differences, adolescents with a more positive attitude toward tanning or tanned skin are more likely to use indoor tanning devices.^{30–39} Perceived social norms regarding tanning and tanned skin (e.g., reporting that one's friends are tan or use indoor tanning devices) are also associated with indoor tanning among adolescents.^{30,32,35,36,38} Indoor tanning is associated with other risky behaviors as well, such as alcohol, tobacco, and recreational drug use; poor sun protection behaviors; and unhealthy eating behaviors (such as dieting frequently to lose weight or using laxatives and vomiting to control weight).^{32,34,38,39}

One large study³⁹ found adolescents who had a college-educated mother were less likely to tan, and female adolescents who participated in physical activity were less likely to tan than peers who did not. Parental permission to tan and parental tanning bed use are consistently identified in the literature as strong predictors of indoor tanning among teenagers.^{30,33,36,38,40} A study³⁶ of 6125 adolescents found that living within 2 miles of a tanning facility was associated with more tanning. Few studies have assessed the association between state indoor tanning laws restricting youth access and the indoor tanning behavior of adolescents, and those that have did not find an association.^{33,36}

Among adults, indoor tanning is most common among younger adults aged 18–25 years, and it decreases steadily with age.²⁹ Young adult indoor tanners are more likely to be female,

Caucasian, and have unhealthy behaviors, such as frequent alcohol use, binge drinking, smoking, recreational drug use, a poor diet, and nonregular sunscreen use.^{41–43} Indoor tanning is also associated with self-esteem, and indoor tanners are more likely to be appearance-oriented and to view tanned skin as attractive.^{41,44,45} One study⁴¹ found that women were more likely to report indoor tanning if they had comparatively higher education or income, or if they lived in the Midwest and South. Among young men, indoor tanning has also been associated with anxiety and obsessive–compulsive symptoms, as well as appearance-focused behaviors such as steroid use without a doctor’s prescription.^{42,46}

State and Local Regulations in the U.S

The regulation of indoor tanning devices in the U.S. is primarily controlled at the state level. Thus, the strength and enforcement of indoor tanning restrictions varies considerably throughout the U.S., as does compliance with existing controls. In October 2011, California passed the most-stringent youth access law in the country, prohibiting indoor tanning for all minors aged <18 years, which took effect on January 1, 2012.⁴⁷ In 2012, Vermont passed a similar ban that went into effect on July 1.⁴⁷ As of October 2012, a total of 18 states have proposed legislation to enact bans on indoor tanning for individuals aged <18 years.⁴⁷

Currently, 36 states have some restrictions on minors’ access to indoor tanning, including bans on indoor tanning for minors under a certain age (most commonly 14 or 16 years) and requiring parental accompaniment or permission.^{47,48} Some states also have harm-reduction requirements in place for all tanners, such as requiring use of eye protection or limiting exposure time (e.g., no more than 20 minutes).⁴⁹ In 36 states, tanning salons must be licensed or registered; in 44 states, they must provide information on the risks of tanning; and in 21 states, they must have tanners sign a warning statement before tanning.⁵⁰

Various additional regulations have been introduced by individual states. For example, Massachusetts recently proposed a law to improve compliance with existing regulations and better inform tanners of the risks of indoor tanning by requiring tanning facility employees to be aged 18 years (at the time of the writing, this law had not been voted on).⁵¹ A bill was introduced in Minnesota in March 2011 to ban advertising that describes indoor tanning as risk-free, stating: “A tanning facility shall not advertise or distribute promotional materials that claim that using a tanning device is safe or free from risk or that the use of a tanning device will result in medical or health benefits.”⁵² Similar provisions have been included in legislation introduced in Idaho.

In addition to state laws, restrictions on indoor tanning also exist at the local level. The cities of Chicago and Springfield, in Illinois, along with Howard County, Maryland, have banned indoor tanning among minors.^{47,53} Tanning salons frequently sponsor sports, cheerleading, and dance teams,⁵⁴ providing potential points of intervention at the school or organizational level. Restrictions of this nature typically occur at the local level and may not be documented in the literature; their effectiveness is currently unknown.

Federal Environmental and Systems Efforts in the U.S

At the federal level, the U.S. Food and Drug Administration (FDA) regulates use of medical devices in the U.S. The FDA currently classifies indoor tanning devices as Class I medical devices—the same classification as bandages, tongue depressors, and other devices that pose minimal dangers to consumers.^{55,56} The American Academy of Dermatology, the Skin Cancer Foundation, the American Academy of Pediatrics, and other experts on the relationship between skin cancer and indoor tanning have urged the FDA to reconsider the classification.^{57–60} In light of the WHO’s designation of tanning devices as known carcinogens, a Class I designation may no longer be appropriate.

Identification of indoor tanning devices as Class II or III would allow for greater regulation, as devices with these classifications are subject to additional controls beyond those for Class I devices, such as special labeling requirements, performance standards, and surveillance of products that are currently on the market.^{55,56} Class III medical devices are also subject to a pre-market approval process. Some tanning salons and representatives of the tanning industry point to the current state of regulation as evidence that indoor tanning device use is safe, claiming that if tanning devices were dangerous then the government would regulate them more strictly.^{60,61} Changing the classification of tanning devices could impact the general public’s perceptions about the safety of indoor tanning device use.

The FDA held an advisory panel meeting in March 2010 to seek advice on regulatory issues related to tanning devices.⁶⁰ The agency’s website states that the agency is considering revising some requirements for tanning beds.⁶² The panel recommended the reclassification of tanning beds, patient disclosures, and health education for fair-skinned tanners and others at heightened risk.⁶⁰ A majority of panelists also agreed that minors aged <18 years should not be allowed to use indoor tanning devices.⁶⁰ Although they did not agree on whether they should be reclassified as Class II or Class III, all experts on the panel agreed that Class I was insufficient.⁶⁰

In February 2012, five members of the U.S. House of Representatives Energy and Commerce Committee released an investigative report on tanning industry practices, titled “False and Misleading Health Information Provided to Teens by the Indoor Tanning Industry: Investigative Report.”^{61,63} The investigation found that 74% of tanning salons failed to follow FDA recommendations on tanning frequency.⁶³ Additionally, the investigation found that only 7% of salons reported any harmful health effects of tanning when asked by potential customers, and 78% of salons reported health benefits. Many salons targeted young women through advertisements promoting “prom,” “homecoming,” and “back-to-school” deals, and salons frequently cited FDA approval as evidence that tanning was safe.⁶³ After the release of the report, congressional committee members sent a letter to the FDA urging the reclassification of tanning devices.

The Federal Trade Commission (FTC) is responsible for investigating false, misleading, and deceptive advertising claims about tanning devices. The FTC released a consumer alert stating that UV radiation from tanning devices damages the skin and poses serious health risks including cancer, and that tanning is not necessary to get the health benefits of vitamin

D.⁶⁴ In January 2010, the FTC charged the Indoor Tanning Association (ITA) with making false health and safety claims about indoor tanning.⁶⁵ The ITA reached a settlement with the FTC, which bars the ITA from making deceptive claims in the future and requires certain ITA advertisements to include health disclosures.

Section 10907 of the Affordable Care Act created a 10% excise tax on indoor tanning services, which became effective on June 30, 2010.⁶⁶ The tax is only applicable to UV tanning services, excluding tanning devices sold directly to consumers; facilities that offer tanning as an additional service to members without a separate fee, and sunless tanning products (such as spray tans) are not subject to the tax.⁶⁶ A 2012 study⁶⁷ found that the tax was being passed on to clients as intended; 26% of salons reported fewer customers after implementation of the tax, and 78% of salons reported that the tax did not seem to affect consumer behavior.

International Environmental and Systems Efforts

Outside the U.S., other national governments have taken a variety of approaches to indoor tanning device control. Some countries have passed comprehensive laws to completely eliminate indoor tanning device use; others have sought to regulate tanning devices and reduce harm associated with their use. In November of 2009, based on the WHO's designation of tanning beds as a Class I carcinogen, Brazil became the first country to ban indoor tanning for cosmetic purposes.⁶⁸ In February of 2012, New South Wales—a state in Australia and home to more than 5 million people—passed a complete ban on indoor tanning, effective December 31, 2014.⁶⁸

Additionally, France, Spain, Portugal, Germany, Austria, Belgium, the United Kingdom, Australia, Iceland, Italy, Finland, and Norway have outlawed tanning for individuals aged <18 years.⁶⁸ Other approaches implemented by national governments include banning unsupervised tanning (e.g., personal tanning devices available without trained adult supervision, such as devices located in gyms or apartment common areas, or coin-operated devices); requiring eye protection; restricting tanning for people at heightened risk of skin cancer (e.g., individuals with Fitzpatrick Skin Type 1); limiting the UV intensity emitted from devices; requiring informational and warning notices; conducting health education; requiring informed consent; and requiring training of tanning salon staff.⁶⁹

Compliance and Enforcement

Poor industry compliance to existing laws and regulations is a barrier to successful environmental and systems efforts. Studies^{70–73} in Australia and the U.S. have shown that the tanning industry rarely complies with either voluntary industry codes or mandated governmental laws and regulations. One study⁷⁴ found that FDA-recommended tanning exposure times are exceeded by 95% of indoor tanners, calling into question general compliance with the FDA guidelines.

A 2011 study⁷⁵ in New York City found that more than one third of tanning facilities were violating federal law by failing to post warning signs on the dangers of tanning. A study⁷⁴ of tanning bed operators in North Carolina—a state that has “thorough regulations for operator

training and certification”—found poor compliance among tanning facility operators.” A study⁷⁶ of tanning locations in Minnesota and Massachusetts found that underage buyers were able to access tanning services in 81% of locations surveyed. A study⁷⁷ in Wisconsin, where indoor tanning is banned for those aged <16 years, found that 30% of facilities queried by telephone would allow a researcher posing as a child aged 15 years to tan. Compliance may vary by state, perhaps because of enforcement, or by method surveyed (in person versus telephone). A study⁷⁸ of 54 tanning salons in San Diego found zero facilities that were in compliance with all relevant regulations and recommendations. The authors recommended instituting training requirements for tanning bed operators to increase compliance.⁷⁸

A few studies have examined enforcement of indoor tanning laws and regulations in the U.S., and the evidence suggests that these controls are often not adequately enforced. For example, a 2008 study⁷⁹ examining the enforcement of licensing requirements for U.S. tanning salons in 28 cities found that routine annual inspections of tanning facilities were not conducted in 64% of the cities, and approximately half the cities gave citations to tanning facilities that violated the minor access laws. In addition, approximately 32% of the cities did not inspect indoor tanning facilities for compliance with state laws, and another 32% conducted inspections less than annually.⁷⁹ Lack of enforcement creates a potential barrier to successful implementation of control and may limit the impact such efforts could have on indoor tanning device use.

Lack of a comprehensive approach may also be a barrier to successful environment and systems efforts. Without reinforcement by other legislative or regulatory pieces, certain restrictions may be easily circumvented. For example, without adequate controls to ensure that minors do not tan indoors on their own, age bans on tanning are more easily circumvented. A survey of British youth in 2010 (prior to restrictions banning indoor tanning use for all minors) found that approximately one quarter of children aged 11–17 years had used an indoor tanning device at home, and 25% had used an unsupervised tanning device in tanning salons or gyms.⁸⁰ In order to avoid allowing minors to access unsupervised tanning facilities, the WHO recommends banning such facilities as a complement to restricting minors’ use of tanning beds.⁶⁹

Evidence of Impact

Most environmental and systems approaches have not been sufficiently evaluated to determine the effects they have on tanning behaviors. The lack of evidence is likely due, in part, to challenges in surveillance and monitoring of indoor tanning device use; wide variation in stringency, compliance, and enforcement of controls; and relatively recent adoption of restrictive laws and regulations. Although some studies have found age restrictions to be ineffective,⁷⁷ others have found that age restrictions can change behavior over time. For example, a study⁸¹ of youth access regulations found that such regulations were associated with decreased youth access to indoor tanning. High compliance levels in states with long-standing youth access regulations (Illinois and Wisconsin) demonstrate the potential for decreasing indoor tanning through legislative efforts.⁸¹

There is limited evidence regarding the effects of other environmental and system-level options on indoor tanning device use, and some studies that have attempted to examine the relationship between the presence of local laws and indoor tanning device use have failed to find an association.³⁶ Some have suggested that regulation of the indoor tanning industry would be a more effective approach than voluntary industry standards or education.⁵⁷ To have the greatest impact on behavior, environmental and systems efforts will still require adequate compliance, monitoring, and enforcement. In addition, the social norms regarding tanning, the desire to have tanned skin, and the misconceptions about the health risks associated with indoor tanning require that environmental and systems approaches be complemented with comprehensive approaches at the local, state, and national levels to maximize public health impact.

Conclusion

This paper provides a brief review of (1) the state of the evidence on indoor tanning device use; (2) factors that may influence indoor tanning device use; and (3) the various environmental and systems options that have been used as strategies to reduce indoor tanning device use. Many options to reduce risk of skin cancer through environmental and systems approaches at the international, national, state, and local levels have been identified, including:

- FDA reclassification of tanning devices;
- tax on tanning services;
- age bans for minors;
- banning unsupervised tanning;
- bans on advertising to minors, including team sponsorships;
- harm reduction approaches, including limiting tanning time and requiring protective eyewear;
- requiring tanning salon operators to have age and training requirements;
- licensing requirements;
- strengthening informed consent mechanisms; and
- national bans on indoor tanning devices.

Many of these approaches still need to be evaluated to determine their impact on indoor tanning device use. The feasibility of the various options also needs to be examined, particularly given the barriers to compliance and enforcement mentioned above. A comprehensive approach may have greater impact than a single effort; however, such an approach has not been evaluated. Additional efforts such as social marketing campaigns and educational programs would complement environmental and systems efforts and create a more comprehensive approach to reducing UV exposure from indoor tanning, sunbathing, and unintentional exposure when outdoors.

This review primarily focuses on environmental and systems efforts. Promising research examining individual-level interventions and psychosocial factors related to indoor tanning and sun protection is not covered here.^{82,83} This brief overview of skin cancer prevention through reduction of indoor tanning has been covered more comprehensively elsewhere, including in a recent book publication.^{84,85}

This summary provides the background information and context for an informal expert meeting convened by the CDC in August 2012 to identify strategies to reduce indoor tanning device use in the U.S. The companion paper⁸⁶ in this issue of the *American Journal of Preventive Medicine* provides highlights from the discussions during that meeting, with a focus on key research gaps and future opportunities for research and programmatic efforts to address these gaps.

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Table 1High school student and adult use of indoor tanning devices,^a U.S. 2010 and 2011

	Female % (95% CI)	Male % (95% CI)
ADOLESCENTS^b		
Race/ethnicity		
White ^c	29.3 (25.1, 33.9)	6.2 (4.4, 8.8)
Black ^c	3.3 (2.0, 5.3)	4.5 (2.8, 7.1)
Hispanic	9.6 (7.1, 12.8)	5.7 (4.2, 7.7)
Grade		
9	11.7 (9.1, 15.1)	4.5 (3.4, 6.0)
10	15.7 (11.7, 20.7)	4.9 (3.4, 7.0)
11	26.5 (21.4, 32.2)	6.8 (4.4, 10.2)
12	31.8 (26.7, 37.4)	8.5 (6.0, 11.9)
ADULTS^d		
Race/ethnicity		
White ^c	12.9 (11.9, 13.9)	3.3 (2.8, 3.8)
Black ^c	0.4 ^e (0.2, 0.9)	0.1 ^e (0.0, 0.2)
Hispanic	2.9 (2.2, 3.9)	0.4 (0.2, 0.7)
Age (years)		
18–29	18.9 (16.9, 21.1)	3.9 (3.0, 4.9)
18–21	21.2 (17.1, 25.8)	4.1 (2.7, 6.3)
22–25	20.4 (17.1, 24.2)	3.9 (2.5, 6.1)
26–29	15.2 (12.6, 18.3)	3.6 (2.4, 5.2)
30–39	9.2 (7.9, 10.7)	2.5 (1.8, 3.3)
40–49	9.2 (7.8, 10.8)	2.6 (1.9, 3.6)
50–64	4.3 (3.5, 5.4)	1.4 (1.0, 2.0)
65+	1.1 (0.7, 1.7)	0.4 (0.2, 0.7)

^aUse is defined as at least once in the previous 12 months.^bFrom the Youth Risk Behavior Survey 2011 (www.cdc.gov/mmwr/pdf/ss/ss6104.pdf)²⁷^cNon-Hispanic^dFrom the National Health Interview Survey 2010 and published in CDC 2012²⁹^eEstimates based on <30 observations or with a relative SE >0.30 are considered unreliable by the standards of the National Center for Health Statistics.