

Review

Indoor tanning by adolescents: prevalence, practices and policies

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Abstract

Despite known acute and chronic health effects from the use of indoor tanning, including the potential for all forms of skin cancer, the practice is popular in the United States (US) and Europe. A review of the scientific literature that examines adolescents and indoor tanning use was undertaken, summarising what is known about prevalence and practices among adolescents, characteristics associated with adolescent use, and policies that regulate adolescent access to indoor tanning facilities. The prevalence of indoor tanning is consistently found to be higher among girls than boys and to increase with age in both Europe and the US. An examination of other demographic characteristics, skin cancer risk factors, knowledge, attitudes and social factors points to higher prevalence of the behaviour among adolescents with positive attitudes towards tans and whose friends or parents also tan indoors. Adolescent access to indoor tanning is rarely regulated in the US or Europe, and where regulations exist, business compliance is low. In addition, businesses actively market their product to adolescents as they organise to limit further regulations prohibiting adolescent access. Pricing, licensure, advertising restrictions and media campaigns, in combination with adolescent-targeted interventions, are possible strategies that could be tested for their effectiveness to reduce adolescent indoor tanning use. Harm reduction policies, such as eye protection, that reduce risk for adolescents who choose to tan indoors, are also important.

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1. Introduction

Approximately 5–10% of solar ultraviolet radiation is ultraviolet B (UVB) and 90–95% is ultraviolet A (UVA), depending on the latitude [1]. Today's indoor tanning industry was launched in the late 1970's and early 1980's in the United States (US) and Europe with the introduction of modern tanning devices that emitted ultraviolet A in proportions that were either similar to or exceeded these levels of UVA from sun exposure [2–4]. Since the UVB component of ultraviolet radiation is the primary cause of sunburn, these devices provided the opportunity for tanning with less burning and gained in popularity as a result. In the US, indoor tanning is a \$5 billion industry, and the US are rising [5,6].

Both acute and chronic health effects from indoor tanning are recognised, including eye damage, photo-dermatosis, photosensitivity, and premature skin aging [7]. Whether or not the use of modern indoor tanning devices leads to skin cancer development is still under investigation. To date, laboratory studies, experiments in animals, case reports of squamous cell carcinoma and melanoma following tanning bed exposure, and increased incidence of skin cancer among psoriasis patients treated with UVA and psoralen, provide preliminary biological evidence for carcinogenesis associated with indoor tanning [8–22]. However, many case-control studies have been conducted [23], but only a few have reported positive associations between indoor tanning and non-melanoma [24] or melanoma skin cancers [23,25], perhaps because most studies did not include individuals with long-term exposure to modern, high UVA-emitting tanning

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devices sufficient for cancer development. More recently, results from a cohort study, the first to assess this relationship in a prospective manner, found that exposure to tanning devices either before or after the availability of modern tanning devices increased the risk of melanoma [26,27], thereby strengthening the likelihood that indoor tanning in use today may be a risk factor for melanoma. Despite incomplete evidence, many groups have long recommended against all forms of ultraviolet radiation, solar as well as artificial [28–31].

Avoidance of sun and use of sun protection during childhood is widely promoted and considerable research has focused on factors that encourage these actions, as well as interventions to increase adoption of these health behaviours [32,33]. Much less attention has focused on use of indoor tanning during childhood and no intervention studies in this age group have been reported. In this review, we summarise what is currently known about indoor tanning use among children, primarily adolescents, including the prevalence of the behaviour, practices, characteristics associated with use and policies pertaining to indoor tanning by children. We also provide recommendations for policy and future research.

2. Adolescent use of indoor tanning

2.1. Prevalence

A total of 13 studies (15 reports) have examined indoor tanning use among children, ages 11–19 years, and are summarised in Table 1. The European studies were conducted in Norway and Sweden [34–37]; the remainder of the studies was conducted in locations throughout the US, including two nationally representative samples [38,39]. Adolescents were identified through a paediatric clinic [40], schools [34,35,39,41–43], as offspring of adult cohort study participants [44] or through random selection of defined populations [36–38,45,46]; sample sizes ranged from 96 to over 15000. The prevalence of indoor tanning is defined variously as any use [35–37,39–42,45,46] use in the past 6 or 12 months [34,38,43,44], or frequent use in the past 12 months [35]. Given these differences in the populations studied and the definition of indoor tanning use, it is not surprising that prevalence estimates vary widely. However, according to the most recent studies, based on nationally representative samples from Europe and the US [36,39], 30% of Swedish and 24% of US adolescents, aged 13–19 years, reported any use of indoor tanning; frequent use of indoor tanning (10 or more times) was reported by 7.5% and 11.7% of adolescents, in Sweden and the US, respectively.

2.2. Factors associated with indoor tanning among adolescents

A variety of characteristics have been studied in relation to adolescent use of indoor tanning. Although, approximately one-half of the studies offer a comprehensive assessment of predictors of indoor tanning [35,38,39,42,44,46–48], there is little overlap between studies in the types of questions asked or consistency when similar types of information was elicited. Nevertheless, results to date can be broadly summarised according to demographic characteristics, personal skin cancer risk and sun protection practices, other health behaviour, knowledge of risks and attitudes toward indoor tanning, psychological factors, and social influences.

2.2.1. Demographic characteristics

Demographic characteristics include gender, age, race, geographical location and socioeconomic indices. Consistently, on both continents, girls are at least two to three times more likely to tan indoors than boys (Table 1), and use is more common with increasing age. Since most studies have been primarily limited to Caucasians, conclusions about race/ethnicity cannot be made (use by skin type is discussed under factors associated with skin cancer risk). Similarly, many studies have been conducted in urban settings, limiting geographical comparisons. However, in two national studies conducted in the US, higher prevalence of indoor tanning was reported in rural locales compared with suburbs or cities [38,39] and the practice was found to be more common in midwestern and southern than western or northeastern regions of the US. Four studies from the US report adolescent use of indoor tanning according to parent's education and/or income [38,39,45,48]; three of these found the least use of indoor tanning among adolescents whose parents were well educated or were in the highest income groups [38,39,48]. One study conducted in Stockholm County, Sweden found no correlation between indoor tanning use and geographical or socioeconomic factors, such as type of high school programme (academic or vocational) [47].

2.2.2. Skin cancer risk factors

Skin type, skin colour, sun sensitivity, sunbathing and use of sun protection, such as sunscreens, may affect skin cancer risk; the relationship between these factors and indoor tanning has been reported in more than half of the studies listed in Table 1. The earliest studies tended to find indoor tanning use to be more prevalent among adolescents with fair skin types that were more prone to burning [35,41,45], but more recent studies in the US have found the opposite [38,39,44] or no association [46]. Not surprisingly, adolescents who tan outside are also more likely to tan indoors, although this was the

Table 1
Summary of studies that examine adolescent use of indoor tanning

Author [Ref.]	Year of survey	Location	Population source	N	Age (years)	Prevalence of indoor tanning use ^a			Characteristics assessed in relation to indoor tanning use
						Boys	Girls	All	
Banks [40]	1989	Vienna, VA	Adolescents seen at nine paediatric clinics	96	16–19	16	33	23	Gender, age, frequency
Mermelstein [41]	1990	Chicago, IL	10 Schools participating in skin cancer intervention study	1703	9th and 10th graders	7	19	–	Gender, age, skin type
Oliphant [42]	1991	St. Paul, MN	One high school	1008	13–19	15	51	34	Gender, age, frequency, knowledge of risks, practices, symptoms
Wichstrom [34]	1992	Norway	56 Randomly-selected high schools	15,169	17.3 (mean)	35	75 ^b	–	Gender, age, frequency
Boldeman [35,47]	1993	Stockholm, Sweden	60 Randomly-selected classes	1252	14–19	32	68	57	Gender, age, knowledge of risks, smoking, frequency, skin type, symptoms, sunbathing, skin disease, perceived attractiveness, attitudes
Robinson [45]	1994	Chicago, IL	Population-based random sample	658	11–19	1	16	8	Gender, age, skin type, socioeconomic status
Brandberg [37]	1996	Sweden	Population-based random sample	2615	13, 15, 17	4	16	10	Gender, age, satisfaction with self
Demko [39]	1996	US	132 Schools in 80 communities	6903	13–19	11	37	24	Gender, age, frequency, sun sensitivity, geographical region, school location, student income, maternal education, sunbathing, substance use, diet, obesity, body image, physical activity, body piercing, psychosocial factors
Cokkinides [38]	1998	US	Population-based random sample	1192	11–18	5	16	10 ^b	Gender, age, race, parent education and income, residence, sun sensitivity, skin type, sunbathing, sun protection, health-provider advice, attitudes, parent tans
Lucci [43]	1999	Dallas, Houston Texas	Junior and senior high students	210	14–19	–	–	18 ^c	None
Boldeman [36]	1999	Stockholm, Sweden	Population-based random sample	4060	13–19	19	40	30	Gender, age, frequency, symptoms
Geller [44]	1999	US	Prospective cohort of offspring of Nurses Health Study	10,079	12–18	2	14	10 ^b	Gender, age, skin type, social factors, sun protection, attitudes
Lazovich [46] Stryker [48]	2000	Minneapolis/St. Paul, MN and Boston, MA	Random sample of households likely to have adolescents	1273	14–17	12	42	30	Gender, age, smoking, satisfaction with looks, depression, sun protection, skin cancer risks, parent and teen knowledge of risks, parent and teen attitudes, social factors, parent tans, parent education, parent concern, parental influence score.

^a Prevalence of ever use unless otherwise noted.

^b Past 12 months.

^c Past 6 months.

case only for girls in one report [39,47]. Adolescents who use sun protection on a consistent basis, namely sunscreen, are much less likely than non-users to be indoor tanners [35,38,44,46]. As for other health behaviours, prevalence of indoor tanning has been associated with tobacco or other substance use [39,46,47]. Only one study examined indoor tanning in relation to physical activity and diet [39].

2.2.3. Knowledge and attitudes

Knowledge of the potential risks posed by indoor tanning did not differ between adolescents according to indoor tanning use in two reports [42,47], while Lazovich and colleagues [46] reported less tanning with higher scores on a five-item knowledge scale. However, the studies recorded adolescents' knowledge almost 10 years apart (1991–1993) [42,47] versus 2000 [46], which could explain these differences. Positive attitudes toward having a tan, for example, belief that tans are attractive or healthy, have been associated with the use of indoor tanning by adolescents [38,44,46]. Other cognitive and psychological characteristics considered include decision-making ability [39], depression [46], perceived attractiveness [47] and satisfaction with oneself [37] or one's looks [46]. Additional measures of appearance have included opinions about one's weight, physical maturity and body mass index [39]. Since most of these associations are limited to single reports, no conclusions can be drawn.

2.2.4. Social factors

Social influences on indoor tanning use are just being recognised in US-based studies and may be more important predictors of indoor tanning use among adolescents than individual psychosocial characteristics and attitudes. The perception that one's friends like to be tanned, that one's parents allow indoor tanning, holding the view that a high proportion of friends or adults tan indoors and having parents who are not concerned about their teen tanning indoors or who themselves engage in the practice have all been strongly associated with the likelihood of indoor tanning among adolescents [38,44,46,48]. These findings held up after accounting for individual attitudes and psychosocial factors in multivariate models. In one study [48], a parental influence risk factor index was created from one modelling item (parent reports tanning indoors), two cognitive items (parent reports low knowledge of risk and positive attitudes towards having a tan) and two gatekeeping items (parent reports low concern about child's indoor tanning use, child reports that parent allows indoor tanning). Among adolescents who had none of the risk factors, the prevalence of indoor tanning was just 8.7% compared with 77.8% if all of the risk factors were present.

2.2.5. Positive and negative tanning experiences

Less attention has been paid to the reasons that adolescents tan indoors or to their indoor tanning practices. Swedish adolescents reported that they tanned indoors for relaxation and to feel good, yet they also acknowledged uncomfortable aspects of tanning indoors such as sweating and claustrophobia [47]. Lazovich and colleagues [46] considered these factors and also the costs of indoor tanning and appearance (receipt of compliments about tan, indoor tans look fake) in relation to the likelihood of continued tanning among adolescents who had tanned at least once. Those who agreed with the positive aspects of indoor tanning were more likely and those who agreed with the negative aspects were less likely to keep tanning indoors; however, only statements related to perceived benefits of tanning predicted continued tanning when all factors were considered, simultaneously. The proportion of adolescents who have experienced burns or other skin injury from indoor tanning ranged from 26% [36] to 59% [42], but such experience did not affect the frequency of use [35] nor intentions to continue to tan indoors [46]. Two studies found that approximately 40% of adolescents do not consistently wear goggles while tanning indoors [42,46].

3. Policies pertaining to adolescent use of indoor tanning

3.1. Regulation of indoor tanning businesses

3.1.1. Overview of regulations

Few countries regulate indoor tanning businesses, and when they do, the regulations are mostly silent on use of these devices by adolescents. According to a recent review by Dellavalle and colleagues [49], a comprehensive search for such laws internationally revealed that only France has established a legal minimum age for tanning (age 18 years). While France has the most comprehensive law, other countries have either adopted or considered government controls over some other aspects of exposure to indoor tanning devices [50,51]. In the US, the national Food and Drug Administration (USFDA) and the Federal Trade Commission (USFTC) both have policies that restrict some aspects of indoor tanning practices. USFDA regulations, in effect since the mid-1980's, specify equipment performance standards and instructions to users, require protective eyewear to be available, and specify language on required warning signs (FDA, 21 CFR Ch. 1, §1040.20), while the USFTC prohibits deceptive advertising, particularly claims of health benefits from indoor tanning [52]. There are no US federal regulations addressing indoor tanning by adolescents.

3.1.2. Regulation specific to adolescent use

Dellavalle and colleagues [49] also reported that limited regions of the US and Canada restrict adolescent

access to indoor tanning. In Canada, the province of New Brunswick bans indoor tanning by those under age 18 years. In the US, 18 states have some restrictions: three states establish a minimum age, and the others require written parental permission and/or that the parent accompany the child below a certain age. A few localities in the US also regulate the legal age for indoor tanning. Not all of these laws include effective methods for enforcing these laws, such as mandating licensure and establishing enforcement mechanisms and penalties for violation.

What is more common than formal laws are recommendations for age limits on the use of indoor tanning devices, such as those adopted by Australia, Spain, Sweden and Germany [49]. A recent publication of the World Health Organisation (WHO) recommends that health ministries promote legislation restricting the use of these devices to those \geq age 18 years, or if legislation is not feasible, then consider issuing standards [50]. However, the report notes that the tanning industry has not been responsive to such voluntary standards and recommendations. The recent statement by the International Commission on Non-Ionizing Radiation Protection also recommends against indoor tanning by those under the age of 18 years [31].

3.2. *Tanning industry attitudes and practices regarding regulations*

3.2.1. *Industry compliance with regulations*

Studies of tanning business practices reveal a lack of compliance with regulations. A number of studies in the US, Canada and Poland have included visits to businesses and interviews with employees. These studies have found safety hazards, multiple violations of national regulations and guidelines, poor knowledge and inaccurate communication of risks to customers [53–60].

Violations of the state age of sale laws were equally frequent in these studies. Fleischer and colleagues [54] inspected 32 tanning businesses in North Carolina and found that 88% did not have or use parental consent forms for minors as mandated by state law. In San Diego, California, among 54 tanning businesses visited by a study confederate posing as a prospective customer, among the most common violations found were not requiring parental permission for customers under the age of 18 years [57]. In a study conducted in Massachusetts and Minnesota, 81% of the 200 businesses tested sold a session to a 15-year old without a parent's written permission, in violation of the Minnesota and Massachusetts state laws [58]. In a survey of 267 adolescents who had tanned indoors from those two states, 53% of respondents indicated they had never been asked for parental permission [61].

3.2.2. *Industry marketing to adolescents*

Tanning industry publications have identified adolescents as a valuable market, contrary to the recommendations of health and regulatory organisations. Industry publications suggest that tanning businesses place advertisements in high school newspapers and yearbooks, distribute coupons in schools and at athletic events, and sponsor events or teams [62]. Other strategies include hiring and providing free tanning to adolescents who are social leaders in their schools, and drawings for tickets to popular music performances [63,64].

3.2.3. *Industry efforts to limit regulation*

As it has grown, the indoor tanning industry has formed international associations to, among other activities, lobby against increased regulation. Some of the major indoor tanning organisations include the International Smart Tan Network and the Indoor Tanning Association (ITA). A non-profit organisation, the ITA includes representatives from all sectors of the indoor tanning industry, including other national tanning associations. ITA recently held an international summit including indoor tanning associations from Europe, Canada, Australia and Japan for "...initiating discussions on regulatory reform proposals ... in several countries with the goal of reaching consensus on how to cooperate to combat unnecessary or over-burdensome regulation" [6].

4. *Policy recommendations*

As discussed by Dellavalle and colleagues [49], there are parallels between tobacco products and indoor tanning: both are believed by most health experts to be associated with serious health risks; both are marketed as providing social advantage to the users; and both are used for the first time primarily by adolescents who may give more weight to the perceived social advantage and less to the health risks of use. Accordingly, we can look to tobacco policy for possible strategies to reduce indoor tanning by youth [65]. Policy approaches could provide the context for promoting healthy behaviours and create an environment consistent with educational messages about the risks of indoor tanning. While policies that are modelled on tobacco control are generally designed to deter or discourage use and are especially effective with youth, policies are possible also that are meant to reduce the potential harm to anyone who chooses to use indoor tanning facilities.

4.1. *Price*

Studies have shown that young people are particularly price-sensitive with regard to tobacco products,

and it seems likely that the same would be true for indoor tanning. Excise or product-specific taxes, which average almost \$1.50 per pack of cigarettes in the US, could be added to both achieve a price increase and to generate revenue for education on indoor tanning and for enforcement of tanning business regulations [49].

4.2. *Licensure*

Requiring a license to sell both assists in and can pay for inspection activities, and can be a vehicle for establishing conditions for businesses that wish to have a license and penalties for non-compliance. For example, license requirements could include no sale to those under the age of 18 years, training for all employees, and no employees under the age of 18 years, with penalties ranging from fines for initial violations to license suspension or revocation upon repeated violations.

4.3. *Advertising restrictions*

Perceived social advantage is a powerful motivator for indoor tanning by youth, and advertising promotes that norm. Laws against youth-oriented advertising would be a start towards changing that perception.

4.4. *Media campaigns*

Tobacco control has used endorsement by fashion models, performers, and sports figures who are role models to youth to promote the no-use message broadly in an attempt to change social norms. Anti-tobacco campaigns have also used humour and social disadvantages of use to good effect. These campaigns are very expensive and require dedicated funding, which might be provided by excise taxes, but in the case of tobacco have been shown to be essential for changing youth use rates.

4.5. *Harm reduction*

These policies are those designed to reduce risk for those of any age who choose to expose themselves to UV radiation via indoor tanning. While these policies are necessary as long as indoor tanning is available to the public, it is essential that they do not imply that indoor tanning is safe at any level or under any circumstances. Both the International Commission on Non-Ionizing Radiation Protection [31] and the WHO [50] have made recommendations for harm reduction policies if artificial tanning devices are to be available. These recommendations include government policies that specify standards for tanning devices; health warnings provided to clients; training and certification for operators; a ban on unattended devices; limits on exposure time, frequency and irradiance; and provision of UV

radiation protective goggles, as well as insistence on their use by all clients.

5. **Research gaps**

Our review of prevalence and predictors of adolescent use of indoor tanning suggest that we are just beginning to understand the basis for adoption of this behaviour by adolescents. To advance our knowledge so that actions can be taken to reduce adolescent use of indoor tanning, a consistent definition of indoor tanning use is needed, and for studies that attempt to replicate findings based on single reports, the use of similar measures would be helpful. We note the lack of information on adolescent indoor tanning from most European countries. Similarly, change in this behaviour among adolescents over time, whether increasing or decreasing, is unknown in both the US and Europe, but needs to be monitored.

Studies that develop and test intervention strategies to reduce the indoor tanning by youth are almost nonexistent and clearly needed. While a number of interventions have been shown to reduce UV exposure from sun among youth, only one study, to our knowledge, has tested an intervention to reduce indoor tanning. In this study, [66], conducted among college-age students, the treatment group received a workbook describing appearance-damaging effects of indoor tanning. At two months post-intervention, the treatment group reported 50% fewer indoor tanning visits than the control group. While these are promising results, individual skill or knowledge-based interventions to reduce behavioural risk factors often have not shown positive outcomes over the long-term without an extensive community or social network component.

Similarly, research to identify effective strategies to improve business compliance with existing regulations is lacking. Recently, a small study tested an intervention to train tanning business owners and managers about compliance with all levels of regulation. This intervention showed no effect on the sale of tanning sessions to underage teens, despite general enthusiasm for the training by those who participated (Forster, J., data not shown). As has been shown in the case of tobacco merchants, without enforcement and meaningful penalties for non-compliance, the salience of such training is low for business people. Methods to promote adoption and enforcement of and compliance with regulations on indoor tanning businesses must be developed.

6. **Summary**

Use of indoor tanning is popular among adolescents, especially among girls. While regulations exist in the US

and Europe, they often do not address adolescent use, and if they do, are poorly enforced. Routine surveillance of this behaviour, expanded to all countries on the North American and European continents, will be important, particularly if skin cancer rates continue to rise. Research is also needed to confirm risk factors for adoption and maintenance of this behaviour and to identify effective interventions to prevent its adoption among adolescents. Implementation of policy recommendations described in this review may also act to reduce adolescent use of indoor tanning. Even if the debate about the relationship between use of modern indoor tanning devices and skin cancer is not resolved, such actions will prevent many of the known harmful health effects of UV radiation exposure from tanning indoors.

Conflict of Interest Statement

None declared.

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