



HHS Public Access

Author manuscript

Cancer Epidemiol Biomarkers Prev. Author manuscript; available in PMC 2018 February 01.

Published in final edited form as:

Cancer Epidemiol Biomarkers Prev. 2017 August ; 26(8): 1170–1174. doi:
10.1158/1055-9965.EPI-17-0095.

Tanning and teens: Is indoor exposure the tip of the iceberg?

Jennifer L. Hay¹, Kristen E. Riley¹, and Alan C. Geller²

¹Department of Psychiatry & Behavioral Sciences, Memorial Sloan Kettering Cancer Center, New York, NY USA

²Department of Social and Behavioral Sciences, Harvard T.H. Chan School of Public Health, Boston, MA USA

Abstract

Due to recent state regulations and the reduced availability of free-standing tanning salons, indoor tanning prevalence is beginning to decline. This may lead to unintended consequences – increases in outdoor intentional tanning. We advance a series of research directions to track and intervene to address all forms of intentional tanning. First, we advocate for enforcement of indoor tanning regulation and encourage collection of data on tanning salon compliance and alternative indoor tanning strategies. Second, we suggest questions about outdoor and indoor tanning should be included in national surveys. Third, we need to understand the potentially complex patterns of indoor and outdoor tanning that may exist among those who tan. Fourth, research examining changing motivations for intentional tanning is needed. Finally, indoor tanning intervention studies should include outdoor tanning as an outcome to examine the effect of interventions on these related risk behaviors. These advances will ensure the development of novel interventions to address intentional tanning through multiple routes, and to avoid any unintended negative consequence of indoor tanning regulation. The promising downward direction of indoor tanning use in the United States should now lead the public health field to sharpen its focus on outdoor tanning.

Keywords

Indoor Tanning; Outdoor Tanning; Intentional tanning; Ultraviolet radiation exposure; cancer risks

Ultraviolet (UV) radiation exposure causes skin cancers, including melanoma, the most deadly form of skin cancer (1, 2). Indoor tanning (IT) involves intentional exposure to UV for the express purpose of tanning, and is categorized as a Class I carcinogen, denoting the harmful nature of tanning and its definitive link to cancer (3). Epidemiological studies have also shown a clear link between IT and the development of melanoma (4, 5). Reducing the harms of IT is one of five goals outlined in the 2014 US Surgeon General’s “Call to Action to Prevent Skin Cancer” (2).

Corresponding Author: Jennifer L. Hay, Department of Psychiatry & Behavioral Sciences, Memorial Sloan Kettering Cancer Center 641 Lexington Avenue, 7th floor, New York, NY 10022, Phone: 646-888-0039, Fax: 646-888-2584, hayj@mskcc.org.

Conflict of Interest:
None declared.

Despite these established harms, IT use has increased precipitously over the last 20 years in teenagers and young adults, especially in females (6–9). For example, by 2009, over a third (37%) of non-Hispanic white high school females reported having tanned indoors, with half (49%) of all non-Hispanic white females who tan reporting frequent use (10 times in the past 12 months) (7, 8). These rates are now starting to decline (7). In fact, mounting indoor tanning regulation since 2012 in young users may be beginning to pay off. Guided by success in regulating underage tobacco use (10), 15 states now prohibit IT in individuals under age 18 and 28 states have instituted parental consent laws, whereby teens are able to tan only with parental consent (11). On December 22, 2015, the U.S. Food and Drug Administration (FDA) issued a proposed national rule with the following restrictions for IT beds and booths: (A) to ban use among individuals younger than 18 years; (B) to require prospective users of all ages to sign a risk acknowledgment certification; and (C) to provide user manuals to customers and tanning facility operators on request (12, 13). As of January 2017, the FDA ultimately did not advance this proposed federal regulation, thus tanning bed use will continue to be regulated at the state level. We advocate for continued efforts for state passage of underage tanning regulations.

As of 2016, IT rates have started to decline among high school students as well as adults in the United States (6, 7). There are multiple potential reasons for this. It is possible that the recent state regulations on underage IT, the media coverage regarding these regulations, as well as the classification of IT devices as carcinogenic, has actually recently led some stand-alone indoor tanning salons to close their doors (19,000 free-standing salons reduced to 9,000, thereby reducing IT availability (14). The addition of a 10% excise tax on tanning may be tipping the balance towards reduced IT, as well, and with the Affordable Care Act remaining intact, this tax remains in effect (2). Finally, the recent negative framing of IT as harmful may be leading to a concomitant erosion of positive social norms regarding IT (15).

While undoubtedly this is a positive development, it is important to highlight that IT remains only one vehicle for UV exposure. Intentional outdoor tanning (OT) causes sunburns and skin cancer, including melanoma (1). Across an entire population, outdoor tanning may engage a broader and more diverse population than does IT. Outdoor tanning can be pursued cost-free during vacations, seasonally, and during recreational and sports activities. The belief that people look better with a tan, and reductions in the use of sunscreen, increase dramatically between ages 11 and 14, particularly among girls (16). Tanning may be more the norm than the exception among young people in outdoor settings; one study showed that 60% to 80% of teen beach and park users report that they intentionally tan outdoors (17, 18). Only half of teens use sunscreen, and only a third do so routinely (19–23), with 83% of teens reporting sunburn in the most recent summer (21). The highest sunburn rates are among girls who believe sunburning is “worth it” to get a good tan (21), indicating that tanning intentions discourage sun protection. In Sweden, 86% of teens aged 17–19 report that they tan outdoors (24). However, precise data on OT rates in the United States are lacking. Use of sunscreen has actually decreased in United States high school students from 2001 to 2011 (from 68% to 56%, respectively), (19, 25). Sunscreen use may be being replaced by other, more efficacious strategies, such as protective clothing use and shade-seeking (26). Yet, despite these small increases in sun protective behaviors in recent years, sunburn rates have been shown to be stable in the United States, with 50% of all adults reporting at least one

sunburn in the last twelve months (27). Given that national United States surveys only track IT, one cannot determine how OT might be changing over time, or how changes in IT regulation may be affecting OT.

Furthermore, IT and OT can co-occur. Two studies, one in the United States (28), and one in Sweden (24), show that IT and OT are strongly correlated. In Sweden for example, OT is associated with an increase in the likelihood of IT in both males (1993 OR = 6.68, $p < .001$; 1999 OR = 3.45, $p < .001$) and females (1993 OR = 4.64, $p < .001$; 1999 OR = 3.18, $p < .001$). One large study in the United States demonstrated that indoor tanning is significantly related to avoiding shade and having more sunburns, although OT per se was not measured (29). High school students who report IT have a higher incidence of recent sunburn compared to those who do not report IT (83% versus 54%, respectively, $p < .001$) (7), and this is true in adults, as well (30). Sunbathing is more common among those who indoor tan more frequently (31). Accordingly, it is possible that OT may increase among those who are potential IT users, among those who use IT sporadically, as well as those who alternate use of IT and OT. Some may use IT and OT concurrently, as well.

The overarching objective of enhanced IT regulation is to reduce skin cancer and melanoma rates via reductions in exposure to UV among young people, who may arguably be most susceptible to its carcinogenic potential. Yet the promising downward direction of IT use in the United States should not lead the public health field to overlook OT. In contrast, the promising downward direction of IT use in the United States should now lead the public health field to sharpen its focus on OT.

In fact, greater IT regulation and greater awareness of the harms of IT may shift some IT users to greater OT exposure. Reduced availability of IT for underage youth may lead them to identify increasing opportunities to tanning outdoors, especially among those who remain motivated to achieve a tanned look, or to maintain the perceived mood and relaxation benefits of tanning (32). The heightened publicity regarding the harms of IT may lead the public to perceive OT as comparatively safe (15). High school students perceive OT as preferable, as they are “healthier” and more “natural” than tans achieved indoors (33). A similar phenomenon may be operating in the tobacco context, as well. Currently, rates of e-cigarettes, which are seen as safer than cigarettes, are on the rise. Cigarette and e-cigarette use are highly correlated (34), and there is developing public health concern that adolescent smokers may be replacing one risk behavior with another (34). Combined with the strong correlation between indoor and outdoor tanning, it is likely that IT and OT are reciprocal behaviors. Below we advance a series of research recommendations that require immediate attention to this end (See Table 1 for a summary).

Recommendation 1: Better-enforced indoor tanning regulations and collection of data

New indoor tanning regulations infrequently include language on enforcement. Studies have shown that not all tanning salons are complying with regulations, and not all states are adequately enforcing these regulations (13). Research must monitor industry perceptions of enforcement but seek to conduct interviews of underage consumers who attempt to indoor

tan, both in tanning salons as well as contexts much more difficult to regulate, including gyms and spas. Definitions of “tanning facilities” vary by state, but are often defined as “any place where a tanning device is used for a fee, membership, or any other compensation”, including gyms, spas, or apartment buildings that provide access to tanning equipment, whether or not a fee is charged (35). Additionally, consideration of under-19-years-old tanning regulations should be considered (36). Laws to limit minors’ access to tanning parlors should be considered in the same way as laws that limit youth access to tobacco (37, 38). Every state prohibits the purchase of tobacco products by those younger than 18 years old and some prohibit sales to those under 19 years old (37). Under 19 years old laws have the benefit of keeping all exposure out of high schools, where 18 year olds could potentially increase indoor tanning behavior in their young peers. Tanning and tobacco are carcinogenic and both are preventable exposures, therefore, governments should act to protect young people from these known carcinogens (36). We must continue to advocate for better and better-regulated legislation around the restriction of IT.

Recommendation 2: Inclusion of outdoor tanning questions in National surveys

Second, United States national survey efforts such as the Youth Risk Behavior Survey (YRBS), have, remarkably, not collected data on intentional OT, making it difficult to track the problem of intentional OT. While some large national studies measure sun protection such as shade seeking, using sunscreen, wearing long sleeves, etc., on the state level (YRBS (39), or on the national level (40), no large studies regularly measure intentional OT. We recommend that a more careful tracking of both forms of intentional tanning associated with UV exposure – both IT and OT – be conducted on nationally representative samples of teenagers and young adults, and specifically for the inclusion of OT in the YRBS, National Longitudinal Study of Adolescent to Adult Health, and the National Longitudinal Survey of Youth 1979 (41). Such items may include seeking outdoor exposure or avoiding sun protection strategies in order to achieve a tan. In a systematic review of intentional tanning among adolescents in the United States (42), almost all studies (12 of 14) presented data on adolescent IT but not OT; one study presented data on both indoor tanning and sunbathing among adolescent males (43), and one study reported data on whether participants “try to get a tan” (44). Inclusion of OT in national surveys and other population-based studies will allow us to track whether reductions in IT, which will hopefully continue, are resulting in increases in OT as a consequence. These new questions could be piloted first in a few states. However, in the absence of targeted campaigns to counter the positive perception of appearing tan, it is unlikely that it will result in a reduction of OT. Campaigns in Australia have led to a reduced perception of the value of tanned skin that ultimately resulted in reduced OT (45, 46). Given this successful example, a United States public health effort to directly combat social norms about the beauty of tanned skin, emphasizing the attractiveness of all natural skin tones, would hold promise in reducing all forms of intentional tanning, as well as sunburning, in the United States.

Recommendation 3: Understanding complex patterns of indoor & outdoor tanning

Third, we need to understand the potentially complex patterns of use of IT and OT, including conjoint use. Studies have shown that people may alternate sources of tanning by climate and season of the year – tanning outdoors in the summer and indoors in the winter (31), indicating that those who prefer a tan may be utilizing all means possible to tan year round. Use of indoor tanning may serve as “preparation” for sunny holidays (47). Studies also indicate that sunburns are very frequent in the United States (48); OT may be an important motive that leads to getting sunburned. We advocate for research examining how broad, diverse groups of young people might make discrete choices about IT versus OT, based on availability, social norms, culture, perceived risk, or other relevant factors. These advances would be helpful in developing novel interventions to address intentional tanning broadly, rather than keeping the spotlight on only the best understood of these behaviors—namely IT. It will be important to document, in descriptive and longitudinal research, how these patterns and individual trajectories may shift over time as IT decreases, and whether there are upturns in sunburn rates and even rates of new skin cancers that may be associated with increased OT, as well. Incidental tanning, tans achieved without specific tanning goals, may have similar or distinct motivations and prevalence compared to intentional tanning. Importantly, as IT decreases, trajectories for OT – both intentional and unintentional – are currently completely unknown and require further study.

Recommendation 4: More research is needed on examining changing motivations for indoor and outdoor tanning

Fourth, with recent reductions in IT, we need to understand if important predictors of IT are decreasing as well, including beliefs that tanned skin is more attractive, among other motivations for tanning. In fact, the social norms around IT and OT may differ, and may change over time. Examination of factors related to availability of OT – including geographical differences, beach access, and frequency of winter sun vacations may help explain rates and preferences for OT. Indeed, if these motivations are also on the decrease, it may be more plausible that we can rely on reductions in IT to actually reduce skin cancer rates, including melanoma. If motivations for tanning remain high, then other approaches to addressing intentional tanning will need to be sought. Public health messaging around the health benefits of vitamin D may also be encouraging higher levels of intentional tanning – both indoor and outdoor – and reduced sun protection, compounding public beliefs around the health benefits of being out in the sun. In fact most individuals receive sufficient vitamin D from diet, supplements, as well as incidental sun exposure, and those at higher skin cancer risk (based on lighter skin phenotype) are particularly efficient at converting low levels of UVB to vitamin D. This is because vitamin D synthesis and production require very little sun exposure, with most individuals easily getting enough vitamin D using adequate sun protection. Those unable to make vitamin D effectively from sun include darkly pigmented individuals and the elderly (49, 50).

Recommendation 5: Indoor tanning intervention studies should include outdoor tanning as a secondary outcome

Finally, intervention studies addressing IT specifically should include changes in OT as at least a secondary outcome of intervention. This will allow us to develop a robust knowledge base concerning any iatrogenic increase in OT in those who may be encouraged to reduce or eliminate their tan seeking through tanning salons, as well as intervention components that may be most successful in leading to cessation of all types of intentional tanning, rather than only IT, specifically.

Concluding Remarks

In summary, we join others (51, 52) in calling for heightened focus on skin cancer prevention research given increasing rates of melanoma in the United States (1), especially among young people (1, 9). More specifically, we advocate for research to understand the behavioral and attitudinal impact of IT regulation, and recent reductions in IT in the United States. While we hope to see reductions in IT continue over time, especially in adolescent girls and young women who have traditionally been the heaviest users of IT, we should be able to document how this might be affecting other tanning strategies that may be adopted, as well as the beliefs and contexts that may promote or inhibit OT. Ideally, the ability to examine the role of all types of tanning on disease outcomes will also become possible. Given the timing of increased barriers to IT, now is the ideal time to enhance our efforts to understand, and ultimately address, all forms of intentional tanning, and to broaden our focus beyond those who engage in IT, to those who may be willing or receptive to OT, across the general population.

Acknowledgments

Thank you to the administrative support of Ms. Jillisia James.

Funding:

This work was supported by the National Cancer Institute's Research Grants (R01 CA181241) and (R01 CA197351), and Support/Core Grant (P30 CA008748). Dr. Riley was supported by a training grant (T32 CA009461).

References

1. CDC. Skin Cancer Statistics [Data Brief]. 2016. [updated June 21, 2016]. Available from: <https://www.cdc.gov/cancer/skin/statistics/index.htm>
2. USDHHS. US Surgeon General's Call to Action to Prevent Skin Cancer. 2014
3. Autier P. Carcinogenic to Humans: Why the International Agency for Research on Cancer Added Indoor Ultraviolet (UV) Tanning to Group I. The Melanoma Letter, A Publication of the Skin Cancer Foundation. 2010; 28(2):1–5.
4. Colantonio S, Bracken MB, Beecker J. The association of indoor tanning and melanoma in adults: systematic review and meta-analysis. *Journal of the American Academy of Dermatology*. 2014; 70(5):847–57.e1–18. Epub 2014/03/19. DOI: 10.1016/j.jaad.2013.11.050 [PubMed: 24629998]
5. Rigel, DS., editor. Seminars in cutaneous medicine and surgery. Frontline Medical Communications; 2010. Epidemiology of melanoma.

6. Guy GP Jr, Berkowitz Z, Holman DM, Hartman AM. Recent Changes in the Prevalence of and Factors Associated With Frequency of Indoor Tanning Among US Adults. *JAMA Dermatol.* 2015; 151(11):1256–9. Epub 2015/07/02. DOI: 10.1001/jamadermatol.2015.1568 [PubMed: 26131768]
7. Guy GP Jr, Berkowitz Z, Everett Jones S, Watson M, Richardson LC. Prevalence of Indoor Tanning and Association With Sunburn Among Youth in the United States. *JAMA Dermatol.* 2017; Epub 2017/03/04. doi: 10.1001/jamadermatol.2016.6273
8. Guy GP Jr, Berkowitz Z, Tai E, Holman DM, Everett Jones S, Richardson LC. Indoor tanning among high school students in the United States, 2009 and 2011. *JAMA Dermatol.* 2014; 150(5): 501–11. Epub 2014/03/01. DOI: 10.1001/jamadermatol.2013.7124 [PubMed: 24577222]
9. Guy GP, Watson M, Richardson LC, Lushniak BD. Reducing Indoor Tanning—An Opportunity for Melanoma Prevention. *JAMA dermatology.* 2016; 152(3):257–9. [PubMed: 26817798]
10. Demierre MF. Time for the national legislation of indoor tanning to protect minors. *Archives of dermatology.* 2003; 139(4):520–4. [PubMed: 12707101]
11. National Conference of State Legislatures. Indoor Tanning Restrictions for Minors | A State-By-State Comparison 2016. [updated 03/31/2016]. Available from: <http://www.ncsl.org/research/health/indoor-tanning-restrictions.aspx>
12. Coups EJ, Stapleton JL, Davis CM, Delnevo CD. Frequent indoor tanning among New Jersey high school students. *Journal of the American Academy of Dermatology.* 2015; 72(5):914. [PubMed: 25890463]
13. Bulger AL, Mayer JE, Gershenwald JE, Guild SR, Gottlieb MA, Geller AC. Enforcement provisions of indoor tanning bans for minors: an analysis of the first 6 US states. *American journal of public health.* 2015; 105(8):e10–e2.
14. Kennedy, K. Tanning industry blames 10,000 salon closings on ‘Obamacare’. Associated Press; 2016. Available from: <http://bigstory.ap.org/article/10be2df1ad4e4eed85b6b007bee6f84c/tanning-industry-blames-10000-salon-closings-obamacare>
15. García-Romero MT, Geller AC, Kawachi I. Using behavioral economics to promote healthy behavior toward sun exposure in adolescents and young adults. *Preventive medicine.* 2015; 81:184–8. [PubMed: 26361753]
16. Dusza SW, Halpern AC, Satagopan JM, Oliveria SA, Weinstock MA, Scope A, et al. Prospective study of sunburn and sun behavior patterns during adolescence. *Pediatrics.* 2012; 129(2):309–17. [PubMed: 22271688]
17. Hedges T, Scriven A. Young park users’ attitudes and behaviour to sun protection. *Global health promotion.* 2010; 17(4):24–31. Epub 2011/04/23. [PubMed: 21510096]
18. Robinson JK, Kim J, Rosenbaum S, Ortiz S. Indoor tanning knowledge, attitudes, and behavior among young adults from 1988–2007. *Arch Dermatol.* 2008; 144(4):484–8. DOI: 10.1001/archderm.144.4.484 [PubMed: 18427042]
19. Basch CH, Basch CE, Rajan S, Ruggles KV. Use of Sunscreen and Indoor Tanning Devices Among a Nationally Representative Sample of High School Students, 2001–2011. *Preventing Chronic Disease.* 2014; 11:E144.doi: 10.5888/pcd11.140191 [PubMed: 25144679]
20. Cokkinides VE, Johnston-Davis K, Weinstock M, O’Connell MC, Kalsbeek W, Thun MJ, et al. Sun exposure and sun-protection behaviors and attitudes among U.S. youth, 11 to 18 years of age. *Prev Med.* 2001; 33(3):141–51. DOI: 10.1006/pmed.2001.0877 [PubMed: 11522153]
21. Geller AC, Colditz G, Oliveria S, Emmons K, Jorgensen C, Aweh GN, et al. Use of sunscreen, sunburning rates, and tanning bed use among more than 10 000 US children and adolescents. *Pediatrics.* 2002; 109(6):1009–14. Epub 2002/06/04. [PubMed: 12042536]
22. Basch CH, Basch CE, Rajan S, Ruggles KV. Peer Reviewed: Use of Sunscreen and Indoor Tanning Devices Among a Nationally Representative Sample of High School Students, 2001–2011. *Preventing chronic disease.* 2014:11.
23. Saraiya M, Hall HI, Uhler RJ. Sunburn prevalence among adults in the United States, 1999. *American journal of preventive medicine.* 2002; 23(2):91–7. Epub 2002/07/18. [PubMed: 12121796]
24. Boldeman C, Bränström R, Dal H, Kristjansson S, Rodvall Y, Jansson B, et al. Tanning habits and sunburn in a Swedish population age 13–50 years. *European Journal of Cancer.* 2001; 37(18): 2441–8. [PubMed: 11720841]

25. Jones SE, Saraiya M, Miyamoto J, Berkowitz Z. Trends in sunscreen use among US high school students: 1999–2009. *Journal of Adolescent Health*. 2012; 50(3):304–7. [PubMed: 22325137]
26. Geller AC, Cantor M, Miller DR, Kenausis K, Rosseel K, Rutsch L, et al. The Environmental Protection Agency's National SunWise School Program: sun protection education in US schools (1999–2000). *Journal of the American Academy of Dermatology*. 2002; 46(5):683–9. Epub 2002/05/11. [PubMed: 12004307]
27. CDC. Sunburn and Sun Protective Behaviors Among Adults Aged 18–29 Years –United States, 2000–2010. *Morbidity and Mortality Weekly Report*. 2012; 61(18):317–33. [PubMed: 22572977]
28. Demko CA, Borawski EA, Debanne SM, Cooper KD, Stange KC. Use of indoor tanning facilities by white adolescents in the United States. *Archives of pediatrics & adolescent medicine*. 2003; 157(9):854–60. Epub 2003/09/10. DOI: 10.1001/archpedi.157.9.854 [PubMed: 12963589]
29. Heckman CJ, Coups EJ, Manne SL. Prevalence and correlates of indoor tanning among US adults. *Journal of the American Academy of Dermatology*. 2008; 58(5):769–80. Epub 2008/03/11. DOI: 10.1016/j.jaad.2008.01.020 [PubMed: 18328594]
30. Fischer AH, Wang TS, Yenokyan G, Kang S, Chien AL. Association of Indoor Tanning Frequency With Risky Sun Protection Practices and Skin Cancer Screening. *JAMA Dermatol*. 2016; Epub 2016/10/13. doi: 10.1001/jamadermatol.2016.3754
31. Heckman CJ, Egleston BL, Wilson DB, Ingersoll KS. A preliminary investigation of the predictors of tanning dependence. *American journal of health behavior*. 2008; 32(5):451–64. Epub 2008/02/05. DOI: 10.5555/ajhb.2008.32.5.451 [PubMed: 18241130]
32. Cafri G, Thompson JK, Jacobsen PB, Hillhouse J. Investigating the role of appearance-based factors in predicting sunbathing and tanning salon use. *Journal of Behavioral Medicine*. 2009; 32(6):532–44. DOI: 10.1007/s10865-009-9224-5 [PubMed: 19653089]
33. Hay JL, Geller AC, Schoenhammer M, Gordon M, Bishop M, Shuk E, et al. Tanning and beauty: Mother and teenage daughters in discussion. *Journal of health psychology*. 2016; 21(7):1261–70. Epub 2014/10/17. DOI: 10.1177/1359105314551621 [PubMed: 25318997]
34. Barnett TE, Soule EK, Forrest JR, Porter L, Tomar SL. Adolescent electronic cigarette use: associations with conventional cigarette and hookah smoking. *American journal of preventive medicine*. 2015; 49(2):199–206. [PubMed: 25840880]
35. Pennsylvania Department of Health. Frequently Asked Questions Regarding the Pennsylvania Indoor Tanning Regulation Act, Act 41 of 2014. Pennsylvania Department of Health; 2014. p. 1-5.07-16-2014 ed
36. Balk SJ, Fisher DE, Geller AC. Teens and indoor tanning: a cancer prevention opportunity for pediatricians. *Pediatrics*. 2013; 131(4):772–85. Epub 2013/03/20. DOI: 10.1542/peds.2012-2404 [PubMed: 23509165]
37. Dellavalle RP, Parker ER, Cersonsky N, Hester EJ, Hemme B, Burkhardt DL, et al. Youth access laws: in the dark at the tanning parlor? *Archives of dermatology*. 2003; 139(4):443–8. [PubMed: 12707090]
38. Balk SJ, Geller AC. Teenagers and artificial tanning. *Pediatrics*. 2008; 121(5):1040–2. Epub 2008/05/03. DOI: 10.1542/peds.2007-2256 [PubMed: 18450907]
39. Gershenwald JE, Halpern AC, Sondak VK. Melanoma Prevention–Avoiding Indoor Tanning and Minimizing Overexposure to the Sun. *Jama*. 2016; 316(18):1913–4. Epub 2016/11/09. DOI: 10.1001/jama.2016.16430 [PubMed: 27824997]
40. The National Longitudinal Study of Adolescent to Adult Health. Add Health Survey 1994–2008 [cited 2017]. Available from: <http://www.cpc.unc.edu/projects/addhealth>
41. National Longitudinal Survey. National Longitudinal Survey of Youth 1979 [cited 2017]. Available from: <https://www.nlsinfo.org/content/cohorts/nlsy79>
42. Holman DM, Watson M. Correlates of intentional tanning among adolescents in the United States: a systematic review of the literature. *The Journal of adolescent health: official publication of the Society for Adolescent Medicine*. 2013; 52(5 Suppl):S52–9. Epub 2013/04/26. DOI: 10.1016/j.jadohealth.2012.09.021 [PubMed: 23601612]
43. Yoo JJ. Peer Influence on Adolescent Boys' Appearance Management Behaviors. *Adolescence*. 2009; 44(176):1017. [PubMed: 20432614]

44. Rouhani P, Parmet Y, Bessell AG, Peay T, Weiss A, Kirsner RS. Knowledge, attitudes, and behaviors of elementary school students regarding sun exposure and skin cancer. *Pediatric dermatology*. 2009; 26(5):529–35. [PubMed: 19840306]
45. Makin JK, Dobbinson SJ. Changes in solarium numbers in Australia following negative media and legislation. *Australian and New Zealand journal of public health*. 2009; 33(5):491–4. Epub 2009/10/09. DOI: 10.1111/j.1753-6405.2009.00436.x [PubMed: 19811490]
46. Volkov A, Dobbinson S, Wakefield M, Slevin T. Seven-year trends in sun protection and sunburn among Australian adolescents and adults. *Australian and New Zealand journal of public health*. 2013; 37(1):63–9. Epub 2013/02/06. DOI: 10.1111/1753-6405.12012 [PubMed: 23379808]
47. Dissel M, Rotterdam S, Altmeyer P, Gambichler T. Indoor tanning in North Rhine-Westphalia Germany: a self-reported survey. *Photodermatology, photoimmunology & photomedicine*. 2009; 25(2):94–100. Epub 2009/03/19. DOI: 10.1111/j.1600-0781.2009.00417.x
48. Buller DB, Cokkinides V, Hall HI, Hartman AM, Saraiya M, Miller E, et al. Prevalence of sunburn, sun protection, and indoor tanning behaviors among Americans: review from national surveys and case studies of 3 states. *Journal of the American Academy of Dermatology*. 2011; 65(5):S114.e1–S.e11. [PubMed: 22018060]
49. Ross, C. Taylor, CL. Yaktine, AL., Del Valle, HB., editors. Institute of Medicine. Dietary Reference Intakes for Calcium and Vitamin D. Washington D.C.: National Academics Press (US); 2011.
50. Sinclair C. Vitamin D—an emerging issue in skin cancer control. Implications for public health practice based on the Australian experience. Recent results in cancer research *Fortschritte der Krebsforschung Progres dans les recherches sur le cancer*. 2007; 174:197–204. Epub 2007/02/17. [PubMed: 17302197]
51. Tripp MK, Gershenwald JE, Davies MA, Garcia J, Gritz ER, Hawk ET, et al. Assessment of Compliance With Texas Legislation Banning Indoor UV Tanning by Minors. *JAMA dermatology*. 2016
52. Lazovich D, Choi K, Vogel RI. Time to get serious about skin cancer prevention. *Cancer Epidemiology Biomarkers & Prevention*. 2012; 21(11):1893–901.

Table 1

Summary of recommendations.

Recommendation	Rationale
1. Better-enforced indoor tanning regulations and collection of data.	New indoor tanning regulations infrequently include content on enforcement, and enforcement is rarely measured.
2. Inclusion of outdoor tanning questions in National surveys.	Data on prevalence and frequency of intentional tanning outdoors is generally not available.
3. Understanding complex patterns of indoor and outdoor tanning.	Little is known about how indoor and outdoor tanning may function concurrently or in alternation.
4. More research is needed on examining changing motivations for indoor and outdoor tanning.	Behavioral research to understand the common and unique motivations for indoor and outdoor tanning, respectively, will improve public health messaging in reducing intentional tanning.
5. Indoor tanning intervention studies should include outdoor tanning as a secondary outcome.	Indoor tanning intervention studies should routinely consider outdoor tanning to increase our holistic understanding of intentional tanning through multiple routes.

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript