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Keywords

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Teens, Tweets, and Tanning Beds: Rethinking the Use of Social Media for Skin Cancer Prevention



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The incidence of skin cancer is rising in the U.S., and melanoma, the deadliest form, is increasing disproportionately among young white women. Indoor tanning is a modifiable risk factor for all skin cancers and continues to be used at the highest rates in young white women. Adolescents and young adults report personal appearance-based reasons for using indoor tanning. Previous research has explored the influences on tanning bed use, including individual factors as well as relationships with peers, family, schools, media influences, legislation, and societal beauty norms. Adolescents and young adults also have high rates of social media usage, and research is emerging on how best to utilize these platforms for prevention. Social media has the potential to be a cost-effective way to reach large numbers of young people and target messages at characteristics of specific audiences. Recent prevention efforts have shown that comprehensive prevention campaigns that include technology and social media are promising in reducing rates of indoor tanning among young adults. This review examines the literature on psychosocial influences on indoor tanning among adolescents and young adults, and highlights ways in which technology and social media can be used for prevention efforts.

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INTRODUCTION

Technologic advances and the ubiquity of smartphones, social media, and Internet access have drastically shifted the social landscape. More than 70% of teens use social media, with Facebook (71%); Instagram (52%); Snapchat (41%); and Twitter (33%) being the most commonly used.¹ Visually oriented social media, including Instagram, Snapchat, and Pinterest, have a higher proportion of teenage female users compared with their male counterparts.² Young adults aged 18–29 years report even higher social media use on these platforms, including Facebook (82%); Instagram (55%); Pinterest (37%); and Twitter (32%).¹ On average, teens send and receive 30 text messages per day.¹ These new platforms with high engagement of young users provide a unique opportunity to reach this population with prevention efforts.

Research on the influence of social media use in health campaigns is in its early stages, but several studies suggest that social media use can be effective for promoting several different health behaviors. Nine of ten studies included in a review of public health campaigns using social media to target eating behaviors and physical

inactivity showed improvement in those aspects of health behaviors.³ For example, a study that provided a short message through social media to adolescents at high risk of sexually transmitted diseases found that those receiving the messages had fewer postings of health risk behaviors.⁴ However, the majority of studies involving social media in adolescent and young adult health have been observational and not focused on social media-based interventions.⁵

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This review focuses on skin cancer prevention, the role of indoor tanning in skin cancer prevention, and how social media may be leveraged to improve prevention efforts. First, the authors describe the scope of the problem of indoor tanning among adolescents and young adults and current efforts to reduce the rates of indoor tanning. Then, innovative ways to accelerate prevention efforts using mobile technology and social media are outlined in the context of psychosocial issues unique to adolescence and young adults. Throughout this review, the terms *adolescent* and *teenager* refer to studies with most participants who were either high school-aged or aged 11–18 years, whereas the term *young adult* refers to studies looking at either college-aged students or participants aged 18–30 years.

WHY SKIN CANCER?

Despite decades of ongoing skin cancer prevention efforts, the rates of both melanoma and non-melanoma skin cancer continue to increase in the U.S.^{6–8} and internationally,⁹ particularly among adolescents and young women. Melanoma, the deadliest form of skin cancer, is the second most frequently diagnosed cancer overall among individuals aged 15–29-years. In fact, melanoma makes up 8% of cancer diagnoses among people aged 15–19 years and is the most frequent cancer diagnosed among those aged 25–29 years at 18% of all cancers in this age group.¹⁰

Ultraviolet (UV) light exposure both from solar and artificial sources is a strong modifiable risk factor for all types of skin cancers.^{11,12} Indoor tanning specifically is associated with melanoma and non-melanoma skin cancer, and multiple studies demonstrate the strongest associations with first exposure before age 35 years, suggesting a susceptibility period in early life.^{13,14} Despite these known risks, both adolescents and young adults have high rates of several known risk factors. More than half of young adults aged 18–24 years report a sunburn in the past year. Among all surveyed adult age groups, individuals aged 18–24 years also report the lowest rate of sun protection usage, with 60% responding they used one or more types in the past year.^{15,16} Similarly among U.S. adolescents, only 13% of high school girls report wearing sunscreen regularly while in the sun and more than a third report a sunburn in the previous year.^{15,17}

A recent systematic review and meta-analysis showed that 55% of young adult university students and 19% of adolescents have used indoor tanning at some point in their lives, and 14% of young adult and 18% of adolescents have used indoor tanning the year prior.¹⁸ In the most recent 2015 National Health Interview Survey of U.S. adults, the highest rate of indoor tanning

was among non-Hispanic white women aged 18–24 years: 17.2% reported indoor tanning in the past year, whereas Hispanic young women reported a lower rate of 4.1%.¹⁹ In addition, approximately 3.6% of adult women reported using indoor tanning ten or more times per year.²⁰ The overall rate of indoor tanning decreased among U.S. young women by 4.5% between 2010 and 2013, and 7% among all U.S. high school students between 2010 and 2015.^{17,20} However, there were still approximately 10 million U.S. adults and 15% of white female U.S. high school students engaging in indoor tanning in 2013.^{17,20} Thus, prevention strategies are still needed, and more effective messaging has the potential to speed the decline of indoor tanning.

In 2014, the Surgeon General's Call to Action to Prevent Skin Cancer established strategic goals for multiple sectors of society including government, businesses, schools, community organizations, and individuals to enhance UV protection from the sun and artificial UV sources, such as indoor tanning.²¹ Since 2012, the U.S. Preventive Services Task Force has recommended that people aged 10–24 years with fair skin be counseled on the reduction of UV exposure to reduce the risk of skin cancer.²² According to the 2016 Skin Cancer Prevention Progress Report, recent progress in prevention strategies for adolescents and young adults includes state-specific legislation banning minors from indoor tanning, implementation of sun safety curriculum in schools, and a proposal for a U.S. Food and Drug Administration ban on indoor tanning for anyone aged <18 years.²³

WHAT WORKS IN SKIN CANCER PREVENTION?

Several innovative initiatives aimed at increasing awareness about the risks of indoor tanning have been implemented, including appearance-based messaging, school-based interventions, and community-wide comprehensive approaches.

A meta-analysis evaluating appearance-based interventions showed a significant reduction in indoor tanning behavior.²⁴ For example, one study found that when female university students were provided booklets with appearance-focused information, rates of indoor tanning decreased compared with controls at 6-month follow-up.²⁵ Interventions using UV photography to illustrate UV damage to the face also showed significant decreases in indoor tanning usage after participants viewed their photos that highlighted UV damage to facial skin.²⁶

Multicomponent community-wide interventions have demonstrated effectiveness at reducing UV exposures, including reducing indoor tanning. An example of one

community-wide program is the SunSmart City project launched in Montclair, New Jersey, which employed a variety of strategies, including mass media campaigns, policy changes, and sun protection education in schools to address the issue of sun protection comprehensively.¹⁶ A meta-analysis of seven community-based multi-pronged approaches including at least two components (e.g., educational, mass media, policy) in at least two different settings (e.g., school, recreation areas, entire community) showed a small decrease of 4% in indoor tanning use.²⁷ One intervention that combined traditional mass media intervention with social media found a reduction in indoor tanning use by >30% and a decrease in adolescents who started indoor tanning before age 15 years.²⁸ Furthermore, a recent Danish study on an adolescent school-based intervention to reduce indoor tanning used an e-magazine that included short films, advertisements, campaign materials, fiction, and social media and focused mainly on appearance-damaging effects of indoor tanning. The study found the odds of sunbed use were 40% lower at 6 months post-intervention.²⁹ The successful SunSafe program in Australia has also estimated that 100,000 skin cancers have been prevented over 15 years.³⁰ These comprehensive approaches show promise as long-term interventions.

Legislation

Although federal restrictions are lacking in the U.S., an increasing number of states have passed legislation banning indoor tanning for minors. As of March 2017, a total of 15 states and Washington, DC, have banned indoor tanning to all individuals aged <18 years, eight states have no age restrictions, and the remaining 29 states either ban some minors or require parent consent.³¹ Because most bans have been implemented within the past decade, studies of their impact are few. One study in Utah found a significant self-reported decrease in the prevalence of indoor tanning use from 12% to 7% among eighth- to 12th-grade students after restricting use for those aged <18 years unless accompanied by a parent or with a physician's note.³² However, 1 year after a ban of all minors aged <17 years was put into law in New Jersey, the rate of indoor tanning among female students did not change, and the rate increased in male students.³³ Compliance with these bans may also be an issue. In California, which bans all minors aged <18 years from indoor tanning, only 77% of >300 salons told a caller posing as a minor that she could not use their facilities, and many salons continued to make false claims about their services.³⁴ As part of the Affordable Care Act in 2010, a 10% federal tax on the use of indoor tanning devices was implemented.³⁵ In one study evaluating the legislation, 26% of surveyed tanning salons in Illinois

reported fewer customers after the tax.³⁶ Although 78% of salons reported that they perceived customers did not seem to care about the tax and younger clients were less likely to care about the tax than older clients.³⁶ In December 2015, the U.S. Food and Drug Administration proposed landmark legislation that included a ban on indoor tanning for minors aged <18 years and requires potential users to sign a risk acknowledgment before use.³⁷

SOCIAL MEDIA AND CANCER PREVENTION

It is hard to ignore the role and influence of social media on the lives of young adults. With >90% of teens and young adults going online daily and spending an average of almost 9 hours per day on social media, prevention campaigns have an opportunity to reach a large proportion of this population, including users of indoor tanning.³⁸ Among young adult indoor tanning users specifically, >80% report occasional to regular Facebook use, and >30% report occasional to regular Twitter, Instagram, and Pinterest use. Higher rates of indoor tanning are associated with regular Instagram and Twitter use. Respondents who report least occasional use of Instagram had double the odds of reporting indoor tanning in the past year.³⁹

Social media platforms are already used by commercial entities, including the indoor tanning industry, to advertise directly to adolescents and young adults.⁴⁰ A large proportion of social media pages from salons focus on popular culture references, a strategy thought to build relationships and engage with its targeted audience.⁴⁰ Although the influence of the indoor tanning industry on young adults through social media is concerning, social media and other online platforms also give public health advocates the opportunity to target health messages directly to those at highest risk and reach a large number of people at relatively low cost. The public health community needs to work together with technology companies to develop creative ways to use social media to reach those at highest risk of cancer-causing behaviors.

Although this field is rapidly developing, some parameters to consider include:

1. content of messages, given the growing evidence that appearance-based messages may be more effective for skin cancer prevention;
2. timing, given online searches for indoor tanning are most frequent between February and May⁴¹ suggesting online campaigns may be best implemented during this time frame for maximum exposure; and
3. type of platform used.

Female adolescents are higher users of visual-oriented social media² and prevention messages are more effective when they contain images,²⁴ suggesting image-based messages on Instagram and Snapchat could be an opportunity to place effective evidence-based message targeted at female adolescents.

Research is emerging on how individuals are using social media platforms in relation to health topics. Google search trends of tanning-related search terms showed seasonal trends with higher rates of searching in the U.S. annually in February–May with the peak in March.⁴¹ Over a 2-week period, >150,000 posts on Twitter, reaching >100 million users, mentioned indoor tanning, with <5% of the tweets mentioning risks.⁴²

Early studies on using technology interventions to reduce skin cancer risk show some promising results in promoting behavior change. A study of middle school students aged 11–14 years reported changes in sun protection after receiving 36 skin cancer prevention text messages over 12 weeks.⁴³ A study of adults aged 18–42 years who received 21 sun protection text messages over 12 months showed greater improvement in sun protection than the control group.⁴⁴ In an RCT of a web-based intervention where participants viewed a series of psychoeducational web pages and answer questions designed to restructure their beliefs about the ideal tan, the intervention group showed an increase in odds of abstaining from indoor tanning at the 6-week follow-up.⁴⁵ Another national RCT of a multimedia web-based intervention targeted at young adults at moderate or high risk of skin cancer showed increased sun protective behaviors.⁴⁶

TEENS, YOUNG ADULTS, AND INDOOR TANNING

Psychosocial and Environmental Factors Contributing to Indoor Tanning Behavior

Several factors influence an adolescent or young adult's tanning behavior, including those at the individual level (e.g., addiction, internalization of tan ideal, body image, psychiatric comorbidity); family level (e.g., interactions with parents, parent approval); peer level (e.g., peer use of indoor tanning, peer beauty ideals); and societal level (e.g., legislation, advertisements, beauty ideals).

Appearance is the main motivator for young adults who tan, with one study showing 90% of college students who frequently indoor tan reported the primary reason was to “look good.”⁴⁷ Those who perceive tanning makes them more attractive are more likely to use indoor tanning.⁴⁸ Weight is also a factor: Frequent indoor tanners were more likely to be concerned about their

weight, reported higher rates of dieting, and dieted to lose weight.⁴⁸

Studies have suggested that despite high levels of skin cancer risk knowledge, college students continued to tan to feel better and be more attractive.⁴⁹ Developmentally, adolescents and emerging adults show egocentrism marked by an exaggerated sense of invulnerability and sensation-seeking behavior, both of which contribute to risk-taking behaviors despite knowledge of risks.⁵⁰ Based on national survey responses, indoor tanning among high school students is associated with several other high-risk health behaviors such as attempting suicide, unhealthy weight control behaviors, binge drinking, and sexual intercourse with multiple partners.⁵¹ Similar findings were also observed among Colorado high school students with associations found between indoor tanning and alcohol use, cigarette smoking, marijuana use, and steroid abuse.⁵²

Indoor tanning can have an effect on an individual's mood and has been associated with qualities similar to other known substance use disorders. In surveys of indoor tanners for screening dependent behaviors, 30% met criteria for problematic behavior using a modified measurement used in identifying problematic behaviors related to alcohol and other substance use (CAGE or cut-annoyed-guilty-eye criteria).⁴⁷ Almost 40% of college students who use indoor tanning met DSM-IV diagnostic criteria for substance-related disorder modified for indoor tanning.^{47,53} Preliminary evidence suggests that these symptoms are driven by endogenous opioids induced by UV exposure, and physical withdrawal symptoms can be induced in frequent tanners with an opioid blockade to mimic discontinuation of indoor tanning.^{54,55} Those individuals who started tanning at a younger age were more likely to tan frequently later in life.^{47,56}

As with other health behaviors, peers and parents influence indoor tanning behavior among youth and young adults. Adolescents who report that more of their friends liked to be tan and tanned indoors are also more likely to use indoor tanning.^{48,57,58} University students who identify with the “popular” peer crowd are more likely to place importance on physical appearance and have more-favorable attitudes toward and increased use of indoor tanning than other peer groups.⁵⁹ Parents also influence adolescent health risk behaviors through modeling, health behavior attitudes, and monitoring their teen's behavior.^{57,60,61} In studies specific to indoor tanning, female caregivers are shown to have a powerful, multifaceted influence on their teenager's tanning behavior,⁶² and female parents were more likely than their teenage daughters to endorse that having a tan looks healthy and attractive.^{57,63} Youth who have primary

caregivers who used indoor tanning were much more likely to use it themselves.⁶⁴ Further, parents can act as “gatekeepers” to influence behavior: Adolescents who perceived that their parents would allow them to tan indoors are more likely to do so.⁶²

The media plays an important role in attitudes and expectations of indoor tanning.^{65–67} Frequent indoor tanning use in female adolescents is associated with the desire to look like women in movies, magazines, and TV.⁴⁸ TV and media often glamorize a tanned appearance,^{68,69} and viewing beauty-related reality TV is associated with more-positive attitudes that tan women are more attractive and increased use of indoor and outdoor tanning among college women.^{70,71}

Convenience is another factor associated with indoor tanning. Indoor tanning salons are widely available in urban areas across the U.S.⁷² In a national sample, just fewer than half of 125 top colleges were found to have indoor tanning facilities available to students on campus or in off-campus student housing, and these facilities are more common at colleges located in the Midwest and Northeast in addition to colleges with high enrollment.⁷³ Campus debit cards can be used to pay for indoor tanning at 14% of all surveyed colleges.⁷⁴ In addition, 41% of young women who report indoor tanning used facilities other than a tanning salon such as a gym, apartment complex, or beauty shop.⁷⁴

The tanning industry advertises heavily on social media platforms (e.g., Facebook, Twitter) known to have high rates of adolescent and young adult users to promote discounts and frequent use.⁴⁰ Tanning salons target teenage girls with promotions and provide inaccurate information regarding risk and recommended usage.⁷⁵

Opportunities for Social Media Use in Primary Care

Because many users of indoor tanning are generally healthy, the primary care setting provides a great opportunity to counsel about skin cancer prevention. Clinicians who treat adolescents are encouraged to perform a psychosocial risk assessment at visits taught with the acronym HEEADSSS (Home environment, Education and employment, Eating, peer-related Activities, Drugs, Sexuality, Suicide/depression, and Safety from injury and violence).⁷⁶ However, skin cancer risk behaviors are not included in this assessment, and fewer than half of a national sample of pediatricians surveyed report they counseled patients about avoidance of indoor tanning.⁷⁷ Most cite insufficient time as a barrier to skin cancer risk reduction counseling.⁷⁷ In 2012, the U.S. Preventive Services Task Force reaffirmed its recommendation that there was sufficient evidence to deliver behavioral counseling in the primary care setting to

fair-skinned patients aged 10–24 years to reduce UV exposure.⁷⁸ However, based on claims data, adolescents have infrequent primary care visits, with 70% of adolescents having one or fewer preventative care visits between the ages 13 and 17 years.⁷⁹ This creates another barrier to implementation of the U.S. Preventive Services Task Force recommendations. Social media is a potential tool to keep adolescents engaged with primary caregivers in this setting of fewer in-person interactions.

The Surgeon General’s Call to Action to Prevent Skin Cancer in 2014 emphasized the need for all sectors of society coming together to form a comprehensive skin cancer prevention strategy to help curb the increasing rates of skin cancer that would include governments, businesses, healthcare systems, schools, communities, families, and individuals.²¹ Strategies that go beyond education and address practical, environmental, and behavioral barriers to the reduction of indoor tanning have the highest likelihood of success (Table 1). Considering evidence of psychosocial issues that affect indoor tanning behavior among adolescents and young adults, the authors propose several action items involving stakeholders to help achieve the Surgeon General’s goal. Investing in the reduction of indoor tanning has the potential for returns in both money saved and healthier lives. A 2017 analysis of the financial implications found that direct medical care for patients with melanoma in the U.S. totals \$343 million annually, and a total economic loss of \$127 billion over their lifetime. It was projected that the comprehensive national skin cancer prevention intervention in Australia would lead to savings of 2.3 times the money spent on a comprehensive campaign and save >20,000 life-years in one state alone over 15 years.³⁰

FUTURE DIRECTIONS

The broader use of social media in skin cancer prevention campaigns will accelerate prevention efforts. As such, the authors propose:

1. that skin cancer prevention campaigns leverage social media to reach a broader audience;
2. developing and evaluating social media messages that shift norms about ideals of beauty and appearance;
3. increased use of social media to increase support, engagement, and advocacy for policies against indoor tanning for tanning bed policy efforts, including a national ban on indoor tanning on minors and a national tax on indoor tanning;
4. partnerships with technology companies to ensure public health advocates have access to the latest tools and platforms for dissemination of health messages;

Table 1. Proposed Solutions Based on Surgeon General Call to Action to Prevent Skin Cancer²²

Partners in prevention based on Surgeon General's Call to Action²²	Proposed future directions	Examples of action items
Federal, state, tribal, local, and territorial governments	Policy changes to discourage indoor tanning use Use social media to build widespread support for tanning bed policy efforts	(1) National ban on indoor tanning on minors (2) National tax on indoor tanning (3) Restriction of false advertising by tanning industry across all advertising mediums (4) Restriction of tanning industry advertising on social media
Businesses, employers, and labor representatives	Partnerships with technology companies to ensure public health advocates have access to latest tools, data, and platforms	(1) Prevention campaigns use data on social media usage to optimize target population (2) Researchers are given access to social media platforms to inform effective campaigns
Healthcare systems, insurers, and clinicians	Integration of social media prevention messages with health systems	(1) Pediatricians and general practitioners use social media to increase engagement with adolescents and provide skin cancer prevention education (2) Physicians use mobile technology such as text reminders to reinforce health messages (3) Health systems use social media pages to disseminate prevention messages
Early learning centers, schools, colleges, and universities	Further research on effective social media interventions to reduce indoor tanning	(1) University support of researchers investigating social media and prevention (2) Schools integrate social media into health education at all levels (3) Ban use of university-sponsored debit cards for purchasing indoor tanning (4) Restrict presence of indoor tanning facilities on university campuses and in university housing
Community, nonprofit, faith-based organizations	Integrate social media into ongoing skin cancer prevention campaigns	(1) Encourage all prevention campaigns to use evidence-based messaging (2) Increase social media presence for all skin cancer prevention campaigns
Individuals, families, and peers	Use social media to shift social norms about ideals of beauty	(1) Engage with social media influencers to discourage indoor tanning and devalue tan appearance (2) Use known social media influencers to spread health information (3) Use peer-to-peer social media activity to spread health messages

5. a restriction of advertising by tanning industry on social media;
6. further research on the effectiveness of social media interventions to reduce indoor tanning; and
7. integration of social media prevention messages with health systems to ensure that patients and clinicians benefit from the latest tools in dissemination of personalized health messages.

CONCLUSIONS

Social media represents an underutilized and understudied opportunity for reduction of skin cancer risk factors, especially among adolescents and young adults, the most active users of social media. Public health advocates and researchers have yet to realize

the full potential of social media in cancer prevention, perhaps owing to a lack of rigorous studies testing these approaches. Research in this area will require a team science approach in which expertise in social media marketing, behavioral science, public health, health communications, and dermatology are needed. If social media interventions can be shown to shift high-risk cancer behaviors in a vulnerable group, using the example of tanning beds and skin cancer, then the implications are tremendous. Findings could be applied to tobacco cessation, obesity prevention, and beyond cancer prevention, to other health priorities where behaviors play a big role in the disease process. The authors hope to see growing collaboration between technology and social media companies and public health advocates to achieve these goals.

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REFERENCES

- Duggan M. *The Demographics of Social Media Users. Mobile Messaging and Social Media 2015*. Washington, DC: Pew Research Center, Internet, Science & Tech, 2015.
- Lenhart A. *Teens, Social Media & Technology Overview 2015*. Washington, DC: Pew Research Center; 2015.
- Maher CA, Lewis LK, Ferrar K, Marshall S, De Bourdeaudhuij I, Vandelanotte C. Are health behavior change interventions that use online social networks effective? A systematic review. *J Med Internet Res*. 2014;16(2):e40. <https://doi.org/10.2196/jmir.2952>.
- Moreno MA, Vanderstoep A, Parks MR, Zimmerman FJ, Kurth A, Christakis DA. Reducing at-risk adolescents' display of risk behavior on a social networking web site: a randomized controlled pilot intervention trial. *Arch Pediatr Adolesc Med*. 2009;163(1):35–41. <https://doi.org/10.1001/archpediatrics.2008.502>.
- Yonker LM, Zan S, Scirica CV, Jethwani K, Kinane TB. "Friending" teens: systematic review of social media in adolescent and young adult health care. *J Med Internet Res*. 2015;17(1):e4. <https://doi.org/10.2196/jmir.3692>.
- Linus E, Swetter SM, Cockburn MG, Colditz GA, Clarke CA. Increasing burden of melanoma in the United States. *J Invest Dermatol*. 2009;129(7):1666–1674. <https://doi.org/10.1038/jid.2008.423>.
- Rogers HW, Weinstock MA, Feldman SR, Coldiron BM. Incidence estimate of nonmelanoma skin cancer (keratinocyte carcinomas) in the U.S. population, 2012. *JAMA Dermatol*. 2015;151(10):1081–1086. <https://doi.org/10.1001/jamadermatol.2015.1187>.
- Purdue MP, Freeman LEB, Anderson WF, Tucker MA. Recent trends in incidence of cutaneous melanoma among U.S. Caucasian young adults. *J Invest Dermatol*. 2008;128(12):2905–2908. <https://doi.org/10.1038/jid.2008.159>.
- Lomas A, Leonardi-Bee J, Bath-Hextall F. A systematic review of worldwide incidence of nonmelanoma skin cancer. *Br J Dermatol*. 2012;166(5):1069–1080. <https://doi.org/10.1111/j.1365-2133.2012.10830.x>.
- Bleyer A, Viny A, Barr R. Cancer in 15- to 29-year-olds by primary site. *Oncologist*. 2006;11(6):590–601. <https://doi.org/10.1634/theoncologist.11-6-590>.
- Gandini S, Autier P, Boniol M. Reviews on sun exposure and artificial light and melanoma. *Prog Biophys Mol Biol*. 2011;107(3):362–366. <https://doi.org/10.1016/j.pbiomolbio.2011.09.011>.
- Kim Y, He YY. Ultraviolet radiation-induced non-melanoma skin cancer: regulation of DNA damage repair and inflammation. *Genes Dis*. 2014;1(2):188–198. <https://doi.org/10.1016/j.gendis.2014.08.005>.
- Boniol M, Autier P, Boyle P, Gandini S. Cutaneous melanoma attributable to sunbed use: systematic review and meta-analysis. *BMJ*. 2012;345:e4757. <https://doi.org/10.1136/bmj.e4757>.
- International Agency for Research on Cancer Working Group on artificial ultraviolet (UV) light and skin cancer. The association of use of sunbeds with cutaneous malignant melanoma and other skin cancers: a systematic review. *Int J Cancer*. 2007;120(5):1116–1122. <https://doi.org/10.1002/ijc.22453>.
- National Cancer Institute. Cancer trends progress report: UV exposure and sun protective practices. https://progressreport.cancer.gov/prevention/sun_protection. Published 2016. Accessed March 13, 2017.
- Centers for Disease Control and Prevention. *Skin cancer prevention progress report 2016*. Atlanta, GA: CDC, 2016.
- Kann L, McManus T, Harris WA, et al. Youth Risk Behavior Surveillance—United States, 2015. *MMWR Surveill Summ* 2016. 2016;65(No. SS-6):1–174.
- Wehner MR, Chren MM, Nameth D, et al. International prevalence of indoor tanning: a systematic review and meta-analysis. *JAMA Dermatol*. 2014;150(4):390–400. <https://doi.org/10.1001/jamadermatol.2013.6896>.
- White MC, Shoemaker ML, Park S, et al. Prevalence of modifiable cancer risk factors among U.S. adults aged 18–44 years. *Am J Prev Med*. 2017;53(3S1):S14–S20.
- Guy GP Jr, Berkowitz Z, Holman DM, Hartman AM. Recent changes in the prevalence of and factors associated with frequency of indoor tanning among U.S. adults. *JAMA Dermatol*. 2015;151(11):1256–1259. <https://doi.org/10.1001/jamadermatol.2015.1568>.
- U.S. DHHS. *The Surgeon General's Call to Action to Prevent Skin Cancer*. Washington, DC: U.S. DHHS, Office of the Surgeon General, 2014.
- U.S. Preventative Services Task Force. Final recommendation statement: skin cancer: counseling. <https://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/skin-cancer-counseling>. Published 2012. Accessed March 13, 2017.
- Centers for Disease Control and Prevention. *Skin Cancer Prevention Progress Report 2016*. Atlanta, GA: U.S. DHHS, 2016.
- Williams AL, Grogan S, Clark-Carter D, Buckley E. Appearance-based interventions to reduce ultraviolet exposure and/or increase sun protection intentions and behaviours: a systematic review and meta-analyses. *Br J Health Psychol*. 2013;18(1):182–217. <https://doi.org/10.1111/j.2044-8287.2012.02089.x>.
- Hillhouse J, Turrisi R, Stapleton J, Robinson J. A randomized controlled trial of an appearance-focused intervention to prevent skin cancer. *Cancer*. 2008;113(11):3257–3266. <https://doi.org/10.1002/cncr.23922>.
- Gibbons FX, Gerrard M, Lane DJ, Mahler HI, Kulik JA. Using UV photography to reduce use of tanning booths: a test of cognitive mediation. *Health Psychol*. 2005;24(4):358–363. <https://doi.org/10.1037/0278-6133.24.4.358>.
- Sandhu PK, Elder R, Patel M, et al. Community-wide interventions to prevent skin cancer: two Community Guide Systematic Reviews. *Am J Prev Med*. 2016;51(4):531–539. <https://doi.org/10.1016/j.amepre.2016.03.020>.
- Carter R, Marks R, Hill D. Could a national skin cancer primary prevention campaign in Australia be worthwhile?: an economic perspective. *Health Promot Int*. 1999;14(1):73–82. <https://doi.org/10.1093/heapro/14.1.73>.

29. Aarestrup C, Bonnesen CT, Thygesen LC, et al. The effect of a school-based intervention on sunbed use in Danish pupils at continuation schools: a cluster-randomized controlled trial. *J Adolesc Health*. 2014;54(2):214–220. <https://doi.org/10.1016/j.jadohealth.2013.08.011>.
30. Shih ST, Carter R, Sinclair C, Mihalopoulos C, Vos T. Economic evaluation of skin cancer prevention in Australia. *Prev Med*. 2009;49(5):449–453. <https://doi.org/10.1016/j.ypmed.2009.09.008>.
31. National Conference of State Legislatures. Indoor tanning restrictions for minors: a state-by-state comparison. <http://www.ncsl.org/research/health/indoor-tanning-restrictions.aspx>. Published 2016. Accessed March 13, 2017.
32. Simmons RG, Smith K, Balough M, Friedrichs M. Decrease in self-reported tanning frequency among Utah teens following the passage of Utah Senate Bill 41: an analysis of the effects of youth-access restriction laws on tanning behaviors. *J Skin Cancer*. 2014; 2014:839601. <https://doi.org/10.1155/2014/839601>.
33. Coups EJ, Stapleton JL, Delnevo CD. Indoor tanning among New Jersey high school students before and after the enactment of youth access restrictions. *J Am Acad Dermatol*. 2016;75(2):440–442. <https://doi.org/10.1016/j.jaad.2016.03.040>.
34. Grewal SK, Haas AF, Pletcher MJ, Resneck Jr. Compliance by California tanning facilities with the nation's first statewide ban on use before the age of 18 years. *J Am Acad Dermatol*. 2013;69(6):883–889.e884. <https://doi.org/10.1016/j.jaad.2013.09.016>.
35. Indoor tanning services; excise taxes. *Fed Regist*. 2013;78:34874–34879. www.federalregister.gov/documents/2013/06/11/2013-13876/indoor-tanning-services-excise-taxes.
36. Jain N, Rademaker A, Robinson JK. Implementation of the federal excise tax on indoor tanning services in Illinois. *Arch Dermatol*. 2012;148(1):122–124. <https://doi.org/10.1001/archderm.148.1.122>.
37. Coups EJ, Geller AC, Pagoto SL. The US Food and Drug Administration's proposed rule to increase regulation of indoor tanning devices. *JAMA Dermatol*. 2016;152(5):509–510. <https://doi.org/10.1001/jamadermatol.2016.0504>.
38. Rideout V. *The Common Sense Census: Media Use by Tweens and Teens*. Ottawa, Ontario, Canada: Common Sense Media, 2015.
39. Stapleton JL, Hillhouse J, Coups EJ, Pagoto S. Social media use and indoor tanning among a national sample of young adult non-Hispanic white women: a cross-sectional study. *J Am Acad Dermatol*. 2016;75(1):218–220. <https://doi.org/10.1016/j.jaad.2016.01.043>.
40. Ricklefs CA, Asdigian NL, Kalra HL, et al. Indoor tanning promotions on social media in six U.S. cities #UVTanning #tanning. *Transl Behav Med*. 2016;6(2):260–270. <https://doi.org/10.1007/s13142-015-0378-0>.
41. Cidre Serrano W, Chren MM, Resneck JS Jr, Aji NN, Pagoto S, Linos E. Online advertising for cancer prevention: Google ads and tanning beds. *JAMA Dermatol*. 2015;152(1):101–102. <https://doi.org/10.1001/jamadermatol.2015.3998>.
42. Wehner MR, Chren MM, Shive ML, et al. Twitter: an opportunity for public health campaigns. *Lancet*. 2014;384(9938):131–132. [https://doi.org/10.1016/S0140-6736\(14\)61161-2](https://doi.org/10.1016/S0140-6736(14)61161-2).
43. Hingle MD, Snyder AL, McKenzie NE, et al. Effects of a short messaging service-based skin cancer prevention campaign in adolescents. *Am J Prev Med*. 2014;47(5):617–623. <https://doi.org/10.1016/j.amepre.2014.06.014>.
44. Youl PH, Soyer HP, Baade PD, Marshall AL, Finch L, Janda M. Can skin cancer prevention and early detection be improved via mobile phone text messaging? A randomised, attention control trial. *Prev Med*. 2015;71:50–56. <https://doi.org/10.1016/j.ypmed.2014.12.009>.
45. Stapleton JL, Manne SL, Darabos K, et al. Randomized controlled trial of a web-based indoor tanning intervention: acceptability and preliminary outcomes. *Health Psychol*. 2015;34(suppl):1278–1285. <https://doi.org/10.1037/hea0000254>.
46. Heckman CJ, Darlow SD, Ritterband LM, Handorf EA, Manne SL. Efficacy of an intervention to alter skin cancer risk behaviors in young adults. *Am J Prev Med*. 2016;51(1):1–11. <https://doi.org/10.1016/j.amepre.2015.11.008>.
47. Harrington CR, Beswick TC, Leitenberger J, Minhajuddin A, Jacobe HT, Adinoff B. Addictive-like behaviours to ultraviolet light among frequent indoor tanners. *Clin Exp Dermatol*. 2011;36(1):33–38. <https://doi.org/10.1111/j.1365-2230.2010.03882.x>.
48. O'Riordan DL, Field AE, Geller AC, et al. Frequent tanning bed use, weight concerns, and other health risk behaviors in adolescent females (United States). *Cancer Causes Control*. 2006;17(5):679–686. <https://doi.org/10.1007/s10552-005-0453-9>.
49. Dennis LK, Lowe JB, Snetselaar LG. Tanning behavior among young frequent tanners is related to attitudes and not lack of knowledge about the dangers. *Health Educ J*. 2009;68(3):232–243. <https://doi.org/10.1177/0017896909345195>.
50. Greene K, Krcmar M, Walters LH, Rubin DL, Jerold, Hale L. Targeting adolescent risk-taking behaviors: the contributions of egocentrism and sensation-seeking. *J Adolesc*. 2000;23(4):439–461. <https://doi.org/10.1006/jado.2000.0330>.
51. 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):501–511. <https://doi.org/10.1001/jamadermatol.2013.7124>.
52. Sendelweck MA, Bell E, Anderson AM, et al. Associations between indoor tanning and substance use among Colorado high school students. *JAMA Dermatol*. 2016;152(5):575–577. <https://doi.org/10.1001/jamadermatol.2015.5663>.
53. Mosher CE, Danoff-Burg S. Indoor tanning, mental health, and substance use among college students: the significance of gender. *J Health Psychol*. 2010;15(6):819–827. <https://doi.org/10.1177/1359105309357091>.
54. Kaur M, Liguori A, Lang W, Rapp SR, Fleischer AB Jr, Feldman SR. Induction of withdrawal-like symptoms in a small randomized, controlled trial of opioid blockade in frequent tanners. *J Am Acad Dermatol*. 2006;54(4):709–711. <https://doi.org/10.1016/j.jaad.2005.11.1059>.
55. Feldman SR, Liguori A, Kucenic M, et al. Ultraviolet exposure is a reinforcing stimulus in frequent indoor tanners. *J Am Acad Dermatol*. 2004;51(1):45–51. <https://doi.org/10.1016/j.jaad.2004.01.053>.
56. Zeller S, Lazovich D, Forster J, Widome R. Do adolescent indoor tanners exhibit dependency? *J Am Acad Dermatol*. 2006;54(4):589–596. <https://doi.org/10.1016/j.jaad.2005.12.038>.
57. Hoerster KD, Mayer JA, Woodruff SI, Malcarne V, Roesch SC, Clapp E. The influence of parents and peers on adolescent indoor tanning behavior: findings from a multi-city sample. *J Am Acad Dermatol*. 2007;57(6):990–997. <https://doi.org/10.1016/j.jaad.2007.06.007>.
58. Geller AC, Colditz G, Oliveria S, et al. Use of sunscreen, sunburning rates, and tanning bed use among more than 10 000 U.S. children and adolescents. *Pediatrics*. 2002;109(6):1009–1014. <https://doi.org/10.1542/peds.109.6.1009>.
59. Stapleton J, Turrise R, Hillhouse J. Peer crowd identification and indoor artificial UV tanning behavioral tendencies. *J Health Psychol*. 2008;13(7):940–945. <https://doi.org/10.1177/1359105308095068>.
60. Farkas AJ, Distefan JM, Choi WS, Gilpin EA, Pierce JP. Does parental smoking cessation discourage adolescent smoking? *Prev Med*. 1999;28(3):213–218. <https://doi.org/10.1006/pmed.1998.0451>.
61. Lau RR, Quadrel MJ, Hartman KA. Development and change of young adults' preventive health beliefs and behavior: influence from parents and peers. *J Health Soc Behav*. 1990;31(3):240–259. <https://doi.org/10.2307/2136890>.
62. Stryker JE, Lazovich D, Forster JL, Emmons KM, Sorensen G, Demierre MF. Maternal/female caregiver influences on adolescent indoor tanning. *J Adolesc Health*. 2004;35(6):528.e521–528.e529. <https://doi.org/10.1016/j.jadohealth.2004.02.014>.

63. Hay JL, Geller AC, Schoenhammer M, et al. Tanning and beauty: mother and teenage daughters in discussion. *J Health Psychol.* 2016;21(7):1261–1270. <https://doi.org/10.1177/1359105314551621>.
64. Cokkinides VE, Weinstock MA, O'Connell MC, Thun MJ. Use of indoor tanning sunlamps by U.S. youth, ages 11–18 years, and by their parent or guardian caregivers: prevalence and correlates. *Pediatrics.* 2002;109(6):1124–1130. <https://doi.org/10.1542/peds.109.6.1124>.
65. Mahler HIM, Beckerley SE, Vogel MT. Effects of media images on attitudes toward tanning. *Basic Appl Soc Psych.* 2010;32(2):118–127. <https://doi.org/10.1080/01973531003738296>.
66. Cafri G, Thompson JK, Roehrig M, van den Berg P, Jacobsen PB, Stark S. An investigation of appearance motives for tanning: the development and evaluation of the Physical Appearance Reasons For Tanning Scale (PARTS) and its relation to sunbathing and indoor tanning intentions. *Body Image.* 2006;3(3):199–209. <https://doi.org/10.1016/j.bodyim.2006.05.002>.
67. Myrick JG, Noar SM, Kelley D, Zeitany AE. The relationships between female adolescents' media use, indoor tanning outcome expectations, and behavioral intentions. *Health Educ Behav.* 2017;44(3):403–410. <https://doi.org/10.1177/1090198116667251>.
68. Poorsattar SP, Hornung RL. Television turning more teens toward tanning? *J Am Acad Dermatol.* 2008;58(1):171–172. <https://doi.org/10.1016/j.jaad.2007.10.015>.
69. Champman S, Marks R, King M. Trends in tans and skin protection in Australian fashion magazines 1982 through 1991. *Am J Public Health.* 1992;82(12):1677–1680.
70. Fogel J, Krausz F. Watching reality television beauty shows is associated with tanning lamp use and outdoor tanning among college students. *J Am Acad Dermatol.* 2013;68(5):784–789. <https://doi.org/10.1016/j.jaad.2012.09.055>.
71. Cho H, Choi J. Television, gender norms, and tanning attitudes and intentions of young men and women. *Commun Stud.* 2011;62(5):508–530. <https://doi.org/10.1080/10510974.2011.577500>.
72. Hoerster KD, Garrow RL, Mayer JA, et al. Density of indoor tanning facilities in 116 large U.S. cities. *Am J Prev Med.* 2009;36(3):243–246. <https://doi.org/10.1016/j.amepre.2008.10.020>.
73. Pagoto SL, Lemon SC, Oleski JL, et al. Availability of tanning beds on U.S. college campuses. *JAMA Dermatol.* 2015;151(1):59–63. <https://doi.org/10.1001/jamadermatol.2014.3590>.
74. Hillhouse J, Stapleton JL, Florence LC, Pagoto S. Prevalence and correlates of indoor tanning in nonsalon locations among a national sample of young women. *JAMA Dermatol.* 2015;151(10):1134–1136. <https://doi.org/10.1001/jamadermatol.2015.1323>.
75. U.S. House of Representatives Committee on Energy and Commerce. False and misleading health information provided to teens by the indoor tanning industry investigative report. 2012.
76. Klein DF, Goldenring J, Adelman W. HEEADSSS 3.0: the psychosocial interview for adolescents updated for a new century fueled by media. *Contemp Pediatr.* 2014. <http://contemporarypediatrics.modernmedicine.com/contemporary-pediatrics/content/tags/adolescent-medicine/heedsss-30-psychosocial-interview-adolesce>.
77. Balk SJ, O'Connor KG, Saraiya M. Counseling parents and children on sun protection: a national survey of pediatricians. *Pediatrics.* 2004;114(4):1056–1064. <https://doi.org/10.1542/peds.2004-1305>.
78. U.S. Preventive Services Task Force. Final recommendation statement: skin cancer: counseling. *Recommendations for Primary Care Practics.* 2012. <https://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/skin-cancer-counseling>. Accessed September 28, 2016.
79. Nordin JD, Solberg LI, Parker ED. Adolescent primary care visit patterns. *Ann Fam Med.* 2010;8(6):511–516. <https://doi.org/10.1370/afm.1188>.