



# UV Tanning in the United States: A Multi Factorial Addiction?

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## Abstract

Despite widespread knowledge that tanning increases the risk of skin cancer, UV tanning remains a prevalent behavior in the United States, especially among young females. Skin cancer is the most common form of cancer in the United States, and UV tanning is the most preventable cause of skin cancer. This review studied current literature regarding UV tanning in an attempt to better understand the addictive nature of UV tanning and to drive future research and interventions to reduce the morbidity and mortality caused by skin cancer. Studies involving associated addictive behaviors, biochemical pathways, social factors, and individual factors that may play a role in the continued prevalence of UV tanning were reviewed. Based on our findings, the reasons for continued tanning appear to be multi factorial, as associations have been found between increased tanning and maternal tanning bed use, young age at tanning initiation, tobacco and alcohol use, a desire to fit in with peers, social media use, and increased dopamine efflux. We propose that opportunities for future interventions exist, including parental-based messages, social media anti-tanning campaigns, and counseling by primary care physicians and dermatologists.

## Keywords

UV tanning, Indoor tanning, Skin cancer, Addiction, Adolescents

## Introduction

With rising rates of both melanoma and non-melanoma skin cancers, it is important to understand patient risk factors such as sun exposure and tanning bed use in order to reduce morbidity and mortality. Skin cancer is more common than any other form of cancer in the United States, including lung cancer, and UV exposure is the most preventable cause [1]. The primary risk factor for the development of lung cancer in the United States is smoking [2], which has prompted many researchers and physicians alike to study the addictive nature of tobacco use. With skin cancer being even more prevalent than lung cancer, perhaps we should also be taking a closer look at the addictive nature of UV tanning and at ways to prevent this addiction from starting. To better understand the addictive nature of UV tanning and emphasize its importance in the development of skin cancer, a review of current literature was conducted. In our review of current literature, articles published between 1993 and 2017 were reviewed; only two of these articles were published before 2002 [3,4]. PubMed was the database primarily used, although other websites (including the Centers for Disease Control and Prevention and the U.S. Preventive Services Task Force) were also

utilized. Of the articles reviewed, many studied adolescents and college students, with some studies further focusing on females only; six studied preadolescents/adolescents (with two focusing specifically on females), four studied U.S. adults (without limiting study participants to students), and five studied adult females. Ten studies focused on students. Although no location criteria were specified, almost all studies were conducted in the United States. Study findings were organized by the associated behaviors, biochemical factors, social factors, individual factors, and effects of behavioral intervention related to UV tanning. The goal of this study was to explore the multi factorial nature of tanning prevalence in the United States in order to guide future research and interventions.

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**Received:** February 15, 2017; **Accepted:** June 12, 2017; **Published online:** June 14, 2017

**Citation:** Stefanko NS, Dellavalle RP (2017) UV Tanning in the United States: A Multi Factorial Addiction?. Arch Addict Rehabil 1(1):51-55

## UV tanning in the United States

It is estimated that almost 10 million Americans use indoor tanning devices, the majority (7.8 million) of whom are female [5]. In 2010, 31.8% of white women between the ages of 18 and 21 and 29.6% of white women between the ages 22 and 25 admitted to using tanning devices [6]. In 2013, 20.2% of female high school students engaged in indoor tanning, while 10.3% were found to be frequent indoor tanners, defined as using an indoor tanning device at least 10 times during 12 months [7]. These statistics are staggering, as they not only demonstrate how commonplace indoor tanning is, but also because those who use tanning beds before the age of 35 have a 75% higher chance of developing melanoma than those who do not [8]. In the United States in 2013 alone, 71,943 people were diagnosed with melanoma of the skin (cutaneous melanoma), and 9,394 people died from cutaneous melanoma [9]. The International Agency for Research on Cancer classifies UV exposure from indoor tanning and from the sun as a human carcinogen [10], and twelve states, in addition to the District of Columbia, currently prohibit people under the age of 18 from utilizing tanning beds [11].

As with cigarette smoking, in today's society, it is generally known that tanning bed use promotes the development of cancer; despite this, people continue to use tanning beds. In a study of college students who used tanning lamps, over 90% admitted to being aware of the adverse effects of tanning, including increased risk for skin cancer and premature aging [12]. In fact, people who use tanning beds are more aware of the long-term adverse effects of tanning beds than are non-users [3], which beg the question: why do people continue to use tanning beds?

## UV tanning and addictive behaviors

Several studies have shown an association between UV tanning and addictive symptoms. In a study conducted in Galveston, Texas, the majority of beachgoers - 53% - met criteria for substance-related disorder using a modified version of the American Psychiatric Association Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) criteria [13]. As a follow-up to this study, a questionnaire was created for indoor tanners that also modified the DSM-IV-TR criteria to make them more applicable to tanning [14]. 41% of subjects studied were found to meet criteria for "tanning addictive disorder", with 87% of respondents stating that they continued to tan "despite knowing that it is bad for your skin (can cause wrinkles, premature ageing, and sun spots) [14]". A staggering 34% of respondents reported that they either had a personal or a family history of skin cancer [14].

In a study of university students in the northeastern United States, 39.3% of those who reported indoor tanning met criteria for indoor tanning addiction based on modified DSM-IV-TR criteria, and 30.6% met modified CAGE criteria [15]. CAGE is a widely used assessment instrument for the identification of alcoholics consisting of four questions relating to attempts to Cut down, Annoyance with criticism from others, feeling bad or Guilty, and experiencing Eye openers [16]. The results of this study reinforce the aforementioned addictive nature of UV tanning and show its relevance among university students.

Several studies have shown an association between UV tanning and addictive behaviors. Use of tanning beds among adolescents has been shown to be more common in those who use marijuana and alcohol and in those who smoke, suggesting a possible susceptibility to addictive disorders. Among adolescent females between the ages of 12 and 18, frequent tanning bed use was found to be associated with weight concerns and health risk behaviors [17]. Such health risk behaviors included smoking, using recreational drugs, binge drinking (defined as four or more drinks on an occasion in the past year), and vomiting or using laxatives to control weight [17]. A study of non-Hispanic white adolescents between the ages of 13 and 19 found that those who reported no substance use were over 3 times less likely to engage in indoor tanning than those who reported using 2-3 substances [18].

Using a cross-sectional survey and psychiatric interview, a study of female university students between the ages of 18 and 25 found that indoor tanners were more likely to endorse symptoms of generalized anxiety disorder, use of tobacco in the previous 30 days, and alcohol use disorder symptoms [19]. In another study of undergraduates, those who met modified CAGE and DSM-IV-TR criteria for indoor tanning addiction reported higher use of marijuana and alcohol and reported more symptoms of anxiety [15]. However, the use of tobacco and stimulants such as cocaine and amphetamines did not vary based on status of tanning addiction, in contrast to other study findings [15]. Associations have also been found between those women aged 18-29 years who participated in indoor tanning more than twelve times in the previous year and those who used psycho-tropic medications, especially anti-depressants [20].

## UV tanning and biochemical pathways

Studies have been conducted to analyze the relationship between UV tanning addiction and biochemical pathways, including dopamine signaling and release of beta-endorphins ( $\beta$ -endorphins). Dopamine is a central component of the brain reward system, and many drugs

of abuse artificially increase dopamine transmission, leading to addiction [21]. In a double-blind crossover trial, striatal dopamine efflux was found to increase briefly following exposure to UV radiation in those participants who were classified as being addicted to tanning, and efflux did not increase in those who were classified as infrequent tanners [22]. Addicted users were those who met criteria for tanning dependence (“inability to cut down or stop tanning”) and had used a tanning bed at least twice weekly over the past year [22]. Thus, a biologic basis for UV tanning addiction may exist, as an increase in signaling to the brain reward system is seen with frequent tanners.

Another study found that repeated UV exposure produced an “opioid receptor-mediated addiction” [23] that was related to increased levels of circulating  $\beta$ -endorphin, an abundant endogenous opioid in the human body [23,24]. In response to UV exposure, keratinocytes in the epidermis induce upregulation of Proopiomelanocortin (POMC), which is cleaved post-transcriptionally into such peptides as alpha-Melanocyte Stimulating Hormone ( $\alpha$ -MSH) and  $\beta$ -endorphin [23,24]. Thus, UV exposure leads to elevated plasma levels of  $\beta$ -endorphin [23]. While  $\alpha$ -MSH induces the synthesis of the pigment melanin, which confers photo-protection from UV radiation during tanning,  $\beta$ -endorphin produces analgesia/antinociception [23,25,26]. The opioid system - including  $\beta$ -endorphin - plays a key role in well-being and mood, and opioids can cause not only pain relief but also addiction and euphoria [27,28].

Two small studies also showed that naltrexone, an opiate antagonist, can cause withdrawal symptoms in frequent tanners, further suggesting that opioids such as  $\beta$ -endorphin may play a role in the reinforcing nature of exposure to UV radiation [29,30]. Frequent tanners described experiencing nausea, vomiting and feeling “disoriented” and “unable to concentrate” shortly after naltrexone administration, with resolution of symptoms the next morning [29,30]. Naltrexone administration also caused a reduction in ultraviolet preference in frequent tanners [29,30].

### **UV tanning and social factors**

Weight and dieting appear to play a role in tanning dependence. A study of students and university community volunteers found not only a link between current smoking and higher odds of tanning dependence, but also that those who were underweight or normal weight were more likely to be tanning dependent than those who were obese [31]. In addition, a study of non-Hispanic white adolescent teenagers found that those who diet are more likely to use indoor tanning, regardless of body mass index [18].

Studies have found associations between tanning bed use and adolescent females’ perceptions that their friends find it important that they be thin, indicating that peer influences may play a role in tanning behavior [17]. In a survey of undergraduate college students, the top reason given for UV tanning was “to look better”, with the second reason being “to relax” [32]. These findings imply that adolescents and college students participate in tanning in part due to social factors.

In a study of adolescent females in the southeastern United States, use of interpersonal media (including texting, talking on the phone, and social media) had a positive correlation with “positive outcome expectations” of indoor tanning such as appearance benefits, mood enhancement, health improvement, and social approval [33]. Interestingly, a significant negative correlation was found between magazine use and viewing indoor tanning as a threat to one’s health [33]. Overall, increased levels of media use were associated with positive outcome expectations (including mood enhancement) of indoor tanning; however, while interpersonal and social media use had a mostly significant positive association, consumption of news and entertainment had less clear associations [33].

### **UV tanning and individual factors**

In a study of females aged 18 to 30 years, those who were accompanied by their mother during their first tanning experience were 4.64 times more likely to be heavy tanners [34]. Those who reported tanning with their mother during their initial tanning experience also began tanning at a much younger age (14.5 vs. 16.5 years old) [34]. This is in line with studies that show that parental modeling and behaviors serve as precursors to adolescent behaviors, including substance abuse and vulnerability to peer pressure [4].

Yet another study found that an association exists between difficulty in quitting indoor tanning and the age at which adolescents begin indoor tanning, with younger age associated with increased difficulty quitting [35]. Increased frequency of indoor tanning bed use was also associated with increased difficulty quitting [35]. Further, the study found that adolescent girls are not only much more likely to participate in indoor tanning, but that they are also much more likely to report difficulty quitting than adolescent boys [35]. Interestingly, negative consequences (experiencing adverse effects such as red/painful skin, itching, and medication reactions) were also found to have a positive association with difficulty quitting, suggesting some level of dependence with the behavior [35].

### **UV tanning and behavioral intervention**

Behavioral intervention has been shown to be effective in reducing indoor tanning behavior. A study of female undergraduates in the northeastern and southeastern United States found that of those individuals who had a low-level baseline knowledge about the adverse effects of tanning, those who received a booklet providing information about UV-induced health damage and changes in appearance reported tanning half as often as those who did not receive the intervention [36]. This group represented 34% of the study sample, indicating that there is a subgroup of Americans who may not be receiving adequate information about increased rates of skin cancer and skin aging resulting from UV tanning [36]. Another study of female undergraduates at a large northeastern university used a Peer-Delivered Motivational Interview (PMI), a “one-on-one, 30-minute counseling session to provide cognitive-behavioral skills information” to spur desire to reduce harmful behaviors [37]. Those participants who attended a session with a PMI-trained peer counselor engaged in fewer indoor tanning sessions during a 3-month post-intervention period [37]. Additionally, the U.S. Preventive Services Task Force (USPSTF) recommends that all adolescents, children, and young adults between the ages of 10 and 24-years-old with fair skin receive counseling regarding minimization of UV radiation exposure [38]. Thus, there exists an opportunity to make primary care physicians and dermatologists more aware of this recommendation and encourage them to counsel all patients 10-24 years old about the adverse effects of UV tanning.

## Discussion

Based on extensive research regarding the risks associated with UV tanning and its prevailing use among Americans, in particular young females, it would seem as though the issue of continued tanning is not based solely on lack of education regarding potential health risks. In fact, studies have shown that many people who use tanning beds are aware of the risks associated with UV radiation [3,12]. This review demonstrates that the reasons for UV tanning are multi factorial, as associations have been found between maternal tanning bed use, tobacco and alcohol use, and a desire to fit in with peers. Social media, texting, psychotropic medication use, and release of  $\beta$ -endorphin are additional factors related to tanning bed use.

As demonstrated by this review, there exists an opportunity to target at-risk youth to prevent them from starting a routine use of tanning beds that could lead to addiction later in life. As those adolescent females who tan with their mothers for the first time are more likely to begin tanning at a younger age, which in turn places them at increased risk of tanning addiction, future par-

ent-based interventions may prove effective in reducing rates of adolescent tanning bed use [34]. In addition, because recent studies have shown that positive outcome expectations from indoor tanning are associated with social media use, we believe that researchers and advocates alike could use this to their advantage [33]. Social media could be used as a platform for future anti-tanning campaigns, targeting at-risk adolescent populations in an attempt to decrease the rising rates of skin cancer and its associated morbidity and mortality. Based on study results and U.S. Preventive Services Task Force (USPSTF) recommendations, an opportunity also exists to encourage primary care providers and dermatologists to counsel all patients 10-24 years old about the adverse effects of UV tanning [38]. Additionally, an opportunity exists for schools to actively teach at-risk youth about the dangers of UV tanning, including an increased risk for skin cancer. This could be done not only as part of health classes but also as part of anti-drug campaigns. By associating UV tanning with other high-risk behaviors such as smoking and drinking alcohol, perhaps children and adolescents will become more aware of the addictive nature of UV tanning.

One of the top reasons given by college students for tanning is “to look better”, [32] indicating that social factors play a large role in the continued use of tanning beds by young Americans. So long as America’s youth feel that they will be more attractive when they tan, tanning may continue to be a prevalent behavior. An opportunity exists to change the standards of beauty in America by marketing companies; if adolescents saw more advertisements about the beauty of fair, untanned skin, would this become a more desirable appearance?

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