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Megan Quinn

*East Tennessee State University, quinnm@etsu.edu*

Arsham Alamian

*East Tennessee State University, alamian@etsu.edu*

Joel J. Hillhouse

*East Tennessee State University, hillhous@etsu.edu*

Colleen Scott

*East Tennessee State University*

Rob Turrisi

*The Pennsylvania State University*

*See next page for additional authors*

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## Creator(s)

Megan Quinn, Arsham Alamian, Joel J. Hillhouse, Colleen Scott, Rob Turrisi, and Katie Baker

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*East Tennessee State University, alamian@etsu.edu*

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*East Tennessee State University, hillhous@etsu.edu*

Colleen Scott

*East Tennessee State University*

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*The Pennsylvania State University*

*See next page for additional authors*

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## Prevalence and correlates of indoor tanning and sunless tanning product use among female teens in the United States

Megan Quinn<sup>a</sup>, Arsham Alamian<sup>a,\*</sup>, Joel Hillhouse<sup>b</sup>, Colleen Scott<sup>b</sup>, Rob Turrisi<sup>c,d</sup>, Katie Baker<sup>b</sup>

<sup>a</sup> Department of Biostatistics and Epidemiology, College of Public Health, East Tennessee State University, Johnson City, TN, United States

<sup>b</sup> Department of Community and Behavioral Health, College of Public Health, East Tennessee State University, Johnson City, TN, United States

<sup>c</sup> Prevention Research Center, College of Health and Human Development, The Pennsylvania State University, University Park, PA, United States

<sup>d</sup> Department of Biobehavioral Health, College of Health and Human Development, The Pennsylvania State University, University Park, PA, United States

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### ABSTRACT

**Background.** Indoor tanning (IT) before the age of 35 increases melanoma risk by 75%. Nevertheless, IT and sunless tanning product (STP) use have gained popularity among youth. However, there are limited data on the prevalence and sociodemographic correlates of both IT and STP use in a representative sample of American teens.

**Methods.** Teenage females (N = 778) aged 12–18 years were recruited as part of an on-going longitudinal study conducted between May 2011 and May 2013. Descriptive statistics explored IT and STP usage in teen females at baseline. Logistic regression was used to determine sociodemographic correlates of IT and STP use.

**Results.** Approximately 16% of female teens engaged in IT behavior and 25% engaged in using STPs. Female teens living in non-metropolitan areas were 82% more likely to indoor tan compared to those in metropolitan areas (OR = 1.82, 95% CI: 1.07–3.10). Age, geographic regions, and race increased the likelihood of IT and STP use.

**Conclusions.** Results indicate a significant proportion of teen females engage in IT and STP use. There was evidence that in teens that have never used IT before, STP use precedes IT initiation. Given the evidence for increased IT in rural populations, research focused on rural tanning bed use is needed.

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### Introduction

The popularity of tanned skin through purposeful ultraviolet (UV) exposure or the use of indoor tanning (IT) continues, particularly among teen females and young women (Lazovich et al., 2008; Choi et al., 2010; Guy et al., 2011). This trend endures despite the International Agency for Research on Cancer's reclassification of UV-emitting tanning devices as "carcinogenic to humans" (International Agency for Research on Cancer Working Group on artificial ultraviolet (UV) light and skin cancer, 2007). According to the American Cancer Society, melanoma incidence rates have steadily climbed throughout the last 30 years, with 76,100 expected new cases diagnosed in 2014 (American Cancer Society, 2014). Much of this increase may be attributed to the growth in the use of tanning beds or booths (Choi et al., 2010; Guy et al., 2011, Wehner et al., 2014). In fact, IT use before the age of 35 years old increases melanoma risk by 75% with each additional session per year adding another 1.8% risk (Boniol et al., 2012). It has been estimated that IT causes more cancers annually in Northern and Western

Europe, Australia and the US (approximately 450,000) than lung cancers from smoking (Wehner et al., 2014). Recent prevention interventions have begun exploring alternatives, such as sunless tanning products (STPs), as a way for teens to achieve their desired tanned appearance without the morbidity and mortality risks associated with IT (Hillhouse et al., 2008, Mahler et al., 2005, Pagoto et al., 2009).

There is a growing literature examining the prevalence and correlates of the use of STPs (Brooks et al., 2006; Cokkinides et al., 2010, Mahler et al., 2005, Mahoney et al., 2012, Pagoto et al., 2010, Russo et al., 2012, Sahn et al., 2012, Sheehan and Lesher, 2005, Stryker et al., 2007). However, much of this literature is in adult populations, and there are still few studies which examine STP behaviors in a nationally representative sample of female teens. In a nationally representative sample of mixed gender American adolescents, Cokkinides et al. (2010) estimated the prevalence of STP use to be nearly 20% in female teens. In a national population of male and female adults, Stryker et al. (2007) estimated a prevalence of 10% for STP use with the behavior occurring most often in older women, living in the West, and with higher educational attainment. Using a convenience sample, Brooks et al. (2006) reported that 22% of American young men and women used STPs. Russo et al. (2012) reported that 59% of their female, college student sample reported STP use. Sahn et al. (2012) reported that 48% of their mixed community and university female samples were STP users.

\* Corresponding author at: Department of Biostatistics and Epidemiology, College of Public Health, East Tennessee State University, PO Box 70259, Johnson City, TN 37614, United States. Fax: +1 423 439 6491.

E-mail address: [alamian@etsu.edu](mailto:alamian@etsu.edu) (A. Alamian).

The IT literature is more established than STP literature (Heckman & Manne, 2012). Recent national American studies estimated the prevalence of IT at 15.6% among adolescents (Guy et al., 2011) and 18.1% among the adult population (Choi et al., 2010). Higher rates are reported in female teens, particularly non-Hispanic White female teens where 29.3% report indoor tanning, and 16.7% report frequent indoor tanning (Guy et al., 2013). IT practices have also been reported higher in the Midwest and South regions among non-Hispanic White female high school students (Guy et al., 2013). However, prevalence estimates and correlates of both IT and ST behaviors have not yet been reported together in female teens.

Studies looking at the correlates of STP use have almost entirely been conducted in young adult, mostly college aged populations (e.g., Brooks et al., 2006; Mahler et al., 2005; Mahoney et al., 2012; Russo et al., 2012; Sahn et al., 2012) with some that included non-college and slightly older participants (e.g., Brooks et al., 2006; Mahoney et al., 2012; Pagoto et al., 2010; Sahn et al., 2012; Sheehan and Leshner, 2005). Much of this literature reports a significant relationship between STP and IT use. This is not surprising given that both behaviors are motivated by a desire to be tan. Several studies have examined the question of whether STP use has impacted future intentions or past year IT, sunbathing or sun protection behavior. Unfortunately, this question has only been assessed by single item measures of unknown validity. Still, these inquiries have consistently found that the STP users report reducing or decreasing their IT use and/or intentions (Mahoney et al., 2012; Sahn et al., 2012; Sheehan and Leshner, 2005).

There are currently no studies that have reported on the co-prevalence of IT and STP use in a nationally representative teen sample, and no reports on correlates of STP use in teens. This study fills these gaps in the literature in a nationally representative sample of American teen females. Since STPs are being proposed as safe alternatives to IT (Hillhouse et al., 2008; Mahler et al., 2006; Pagoto et al., 2010) it is important to better understand both the relationship of STP use to IT use, and the correlates of STP use in IT prevention.

## Methods

### Recruitment and sample

Teenage females (N = 778) 12–18 years of age were recruited through GfK Knowledge Networks (KN). KN utilized a dual frame recruitment process that included both address-based and random-digit dialing sampling methods to provide a nationally representative sample. Parents who reported having a teen daughter were identified through the KN Panel and contacted for verification. Parental consent and teen assent were provided prior to teen enrollment in the study.

### Data collection

Baseline data were collected through the KN recruitment process as part of a larger longitudinal teen tanning project. Teens enrolled in the longitudinal tanning study completed brief surveys to assess IT and ST behaviors, intentions, attitudes, and beliefs towards tanning over a two year period (from May 2011 to May 2013). Additionally, sociodemographic characteristics including the participants' age, race (White vs. other), caregiver marital status (married vs. not married), household income (<\$50,000 vs. ≥\$50,000), and residence status (metropolitan vs. non-metropolitan) were self-reported in an online questionnaire as part of phase 1 of the longitudinal teen tanning project.

### Statistical analysis

Frequencies and percentages were used to describe the study population's characteristics. Chi-squared tests and t-tests were used to characterize indoor tanners versus non-indoor tanners, and characterize sunless tanners versus non-sunless tanners. The subgroup of

individuals who reported having used both IT and STPs in the past 6 months was also examined for age of initiation for each behavior to determine which behavior they indicate starting first. Mean age of initiation and standard errors were reported. Current IT and STP use were calculated by age and differences in use were tested with the chi-squared test. Logistic regression analyses were employed to identify sociodemographic correlates of female teens having ever used a tanning bed/booth or having ever used STPs. Interaction terms were included to test interactions between correlates. Crude and adjusted odd ratios were reported for both outcomes of interest. The final model included adjustment for all covariates. Sampling weights were used in all analyses so results would be representative of U.S. female teens aged 12–18 years. Statistical tests were 2-sided and analyses were performed using SPSS, version 20.

## Results

The majority of teens enrolled in the study were White (78.0%), lived in a metropolitan area (84.3%), lived in a household where the caregiver was married (74.0%), the caregiver had a college education (78.8%), and the annual household income was greater than or equal to \$50,000 (61.9%) (Table 1). About 16% of female teens aged 12–18 years engaged in IT and 25.1% engaged in using STPs. Further, 9.1% of female teens engaged in both IT and STP use. Of those female teens who participated in IT, 55.6% also engaged in STP use.

The teens reported initiating STP use on average at a younger age than IT (mean age of initiation for ST = 13.9 years) (SE = 0.001); IT = 14.1 years (SE = 0.002). Almost one half of teens in the sample reported initiating STP use before IT, with another 37% reporting initiating the behaviors at approximately the same time. Less than 20% reported initiating IT before STP use.

Current reported usage, defined as usage in the past 6 months of IT and STPs in teens by current age (12 through 18 years old) was also examined (Fig. 1). STP usage was greater than IT usage through the age of 16 years. IT usage was then more frequent in 17-year olds. Overall, IT usage remained low and steady with approximately 6% reporting use through age 15 years old, which then approximately doubles to 11% at age 16 years, and increases another 2.5 times between the ages of 16 and 17 years (i.e., from 11% to 27.5%,  $p < 0.001$ ). STP use increased from

**Table 1**  
Characteristics of the study participants, iStart cohort 1 May 2011.

		Study population N = 14,163,143
		N (%) <sup>a</sup>
Age (years)	12	1,409,872 (10.0)
	13	2,607,878 (18.4)
	14	1,997,346 (14.1)
	15	2,003,751 (14.1)
	16	2,026,711 (14.3)
	17	2,107,289 (14.9)
Caregiver marital status	18	2,010,295 (14.2)
	Married	10,474,218 (74.0)
Caregiver education	Not married	3,688,925 (26.0)
	College	11,166,900 (78.8)
Household income	No college	2,996,243 (21.2)
	<\$50,000	5,393,927 (38.1)
Race	≥\$50,000	8,769,216 (61.9)
	Other	3,120,616 (22.0)
Residence	White	11,042,527 (78.0)
	Metropolitan	11,934,660 (84.3)
Region	Non-metropolitan	2,228,483 (15.7)
	Northeast	2,425,694 (17.1)
	Midwest	3,038,147 (21.5)
	South	5,266,692 (37.2)
	West	3,432,610 (24.2)

<sup>a</sup> Weighted percentage expressed in terms of percentage of U.S. female teens aged 12–18 years.

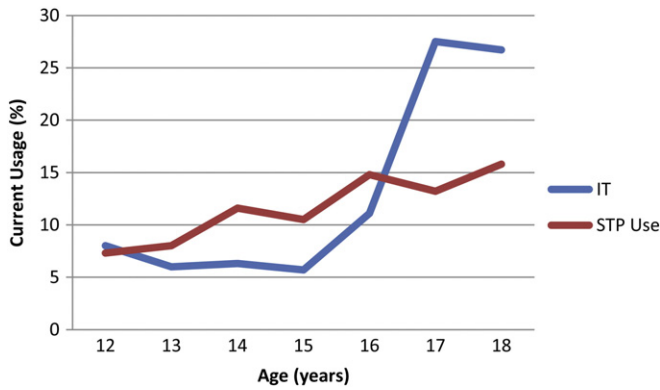


Fig. 1. Current usage of indoor tanning and sunless tanning among U.S. teen females aged 12 to 18 years, iStart cohort 1 May 2011.

age 13 to 14 years (8.0% to 11.6%), then remains steady until another slight increase between 15 years old and 16 years old ( $p < 0.001$ ).

IT behaviors occurred significantly more often in Whites (20.4%) compared to other races (1.9%), occurred more often in non-metropolitan areas (24.6%) compared to metropolitan areas (14.8%) and in the Midwest (24.1%) compared to the Northeast (18.0%), West (14.1%) and South (12.5%) (Table 2). STP use occurred significantly more often in Whites (31.1%) compared to other races (3.7%), in teens with married parents (27.8%) compared to those with non-married parents (17.4%), and in those with a household income greater than or equal to \$50,000 (28.4%) compared to those with a household income less than \$50,000 (19.6%).

The final multiple logistic regression model (Table 2) showed residence, region, age, and race as significantly associated with IT ( $p < 0.05$ ). Female teens living in non-metropolitan areas, including rural regions, were more likely to IT compared to female teens living in metropolitan areas (OR = 1.82, 95% CI: 1.07–3.10). Female teens from the Midwest had higher odds of indoor tanning compared to female teens in the South (OR = 1.85, 95% CI: 1.08–3.18). There was a moderate association between IT and each year of increase in age (OR = 1.35, 95% CI: 1.21–1.52). Finally, there was a strong association between race and indoor tanning. Specifically, White females aged 12–18 years had much higher odds of indoor tanning compared to other races (OR = 13.25, 95% CI: 4.16–42.24).

Age, region, and race were identified as correlates of STP use. For every one year increase in age, females were 23% more likely to engage in STP use (OR = 1.23, 95% CI: 1.12–1.35). Similar to IT behaviors, White teens were more likely to engage in STP use compared with teens of other races (OR = 10.18, 95% CI: 4.39–23.58). Female teens in the Midwest were 66% more likely to use STPs compared to those in the South (OR = 1.66, 95% CI: 1.03–2.69). Female teens in the West were more than twice more likely to use STPs compared to those in the South (OR = 2.31, 95% CI: 1.45–3.67).

## Discussion

This is the first report of the prevalence and sociodemographic correlates of both IT and STP use among a representative sample of American female teens. Results indicate that 16.3% of U.S. teen females aged 12–18 years engaged in IT behavior and 25.1% engaged in STP use in 2011. These estimates suggest slight increases in purposeful UV exposure as compared with previously reported estimates in teen and adult populations for IT behavior (Choi et al., 2010; Guy et al., 2011). These estimates also show a likely increased use of STPs compared with previously reported estimates in American adults and teens (Brooks et al., 2006; Stryker et al., 2007; Cokkinides et al., 2010). Overall, the prevalence findings suggest that teen girls continue to initiate and engage in IT behaviors to a relatively high degree, which may increase their risk of developing skin cancer.

The apparent rise in STP use among teens is of interest. Using a harm reduction approach, alternative behaviors such as STP use may help to reduce IT and subsequent negative health outcomes associated with this behavior. Mahler et al. (2006) and Pagoto et al. (2010) have conducted interventions using STPs that provide experimental confirmation of the ability for STP use to decrease intentional tanning and increase sun protection. Specifically, Pagoto's intervention (Pagoto et al., 2010) focused on behavioral economic approaches seeking to switch teen and young adult UV tanning behavior to STP use which has less risk. The current study indicates that teens generally initiate sunless tanning before starting IT. This makes sense given that STP use is generally cheaper and easier to procure for younger teens as well as likely being more acceptable to parents. However, by the end of high school it seems that most teens have transitioned to using IT rather than STPs to achieve their tanned look. STP use is a behavior that many teens have experience with and has satisfied the need to be tan at an earlier time in their lives. Therefore it may serve as an alternative

Table 2  
Correlates of indoor tanning and sunless tanning among U.S. female teens aged 12 to 18 years, iStart cohort 1 May 2011.

Variable	Indoor tanners (N = 124)				Sunless tanners (N = 190)			
	Mean	SD	Crude OR	Adjusted OR <sup>a</sup>	Mean	SD	Crude OR	Adjusted OR <sup>a</sup>
Age (years)	15.99	1.95	1.37 (1.23–1.52)	1.35 (1.21–1.52)	15.65	1.92	1.24 (1.14–1.35)	1.23 (1.12–1.35)
Variable	Yes %	No %	Crude OR	Adjusted OR <sup>a</sup>	Yes %	No %	Crude OR	Adjusted OR <sup>a</sup>
Marital status (caregiver)								
Not Married	17.0	83.0	1.07 (0.70–1.65)	1.59 (0.95–2.67)	17.4	82.6	0.55 (0.36–0.83)	0.90 (0.56–1.45)
Married	16.1	83.9	1.00 <sup>b</sup>	1.00 <sup>b</sup>	27.8	72.2	1.00 <sup>b</sup>	1.00 <sup>b</sup>
Education (caregiver)								
College	16.3	83.7	1.00 (0.62–1.60)	0.92 (0.54–1.56)	26.9	73.1	1.67 (1.08–2.60)	1.35 (0.83–2.20)
No College	16.3	83.7	1.00 <sup>b</sup>	1.00 <sup>b</sup>	18.1	81.9	1.00 <sup>b</sup>	1.00 <sup>b</sup>
Household income								
< \$50,000	15.6	84.4	0.92 (0.62–1.37)	0.99 (0.62–1.58)	19.6	80.4	0.62 (0.43–0.88)	0.82 (0.55–1.24)
≥ \$50,000	16.8	83.2	1.00 <sup>b</sup>	1.00 <sup>b</sup>	28.4	71.6	1.00 <sup>b</sup>	1.00 <sup>b</sup>
Race								
White	20.4	79.6	13.37 (4.32–41.4)	13.25 (4.16–42.24)	31.1	68.9	11.79 (5.18–26.85)	10.18 (4.39–23.58)
Other	1.9	98.1	1.00 <sup>b</sup>	1.00 <sup>b</sup>	3.7	96.3	1.00 <sup>b</sup>	1.00 <sup>b</sup>
Residence								
Non-metropolitan	24.6	75.4	1.88 (1.18–3.01)	1.82 (1.07–3.10)	24.7	75.3	0.98 (0.62–1.54)	1.04 (0.63–1.72)
Metropolitan	14.8	85.2	1.00 <sup>b</sup>	1.00 <sup>b</sup>	25.1	74.9	1.00 <sup>b</sup>	1.00 <sup>b</sup>
Region								
Northeast	18.0	82.0	1.54 (0.87–2.71)	1.16 (0.63–2.13)	20.6	79.4	1.21 (0.72–2.05)	0.93 (0.53–1.61)
Midwest	24.1	75.9	2.21 (1.34–3.66)	1.85 (1.08–3.18)	30.9	69.1	2.09 (1.33–3.28)	1.66 (1.03–2.69)
West	14.1	85.9	1.15 (0.67–1.97)	1.18 (0.66–2.10)	17.6	82.4	2.45 (1.59–3.78)	2.31 (1.45–3.67)
South	12.5	87.5	1.00 <sup>b</sup>	1.00 <sup>b</sup>	34.4	65.6	1.00 <sup>b</sup>	1.00 <sup>b</sup>

<sup>a</sup> Adjusted odds ratio from a multivariate logistic regression model with adjustment for all covariates.

<sup>b</sup> Indicates reference category.

for teens trying to wean themselves off of UV tanning and the associated health risks. This potential has been generally confirmed in other studies looking at the effects of STP use on IT use and future intentions (Mahler et al., 2006; Mahoney et al., 2012; Pagoto et al., 2010; Sahn et al., 2012; Sheehan and Leshner, 2005). Further study of the trajectory of sunless and indoor tanning initiation and maintenance is needed.

While previous studies identified age and race to be associated with IT and STP use (Heckman et al., 2008), this study also indicates that residential status may play a significant role in IT behaviors with non-metropolitan teens almost twice as likely to IT as their urban counterparts. Demko et al. (2003) reported similar results with individuals attending rural high school being 80% more likely to IT than those attending urban high schools. Nevertheless, it was surprising to find higher rates of IT in rural teens given that they would be expected to have access to fewer IT salons. It is possible that rural areas have greater numbers of non-commercial tanning beds (e.g., beds in homes and non-tanning salon businesses) which compensate for the lack of commercial salons. Olson et al. (2012) recently explored the relationship of rural access and IT, noting that teens in low-income and rural communities are particularly vulnerable to engaging in IT practices. Since most IT research and prevention interventions have focused on urban and suburban populations (Turrisi et al., 2012), there is a need for increased research in rural populations of teens and young adults.

### Limitations

The use of a cross-sectional design precludes making causal claims; however, it does provide an indication of current prevalence and sociodemographic correlates of IT and STP use for U.S. teen girls. Further, this study has possible selection and response biases. On the other hand, rigorous identification and selection methodology for participants through the KN Panel minimizes selection bias. There is also the potential for social desirability and recall bias with self-reported data. However, previous studies in skin cancer prevention using a variety of objective measures have not indicated a tendency for social desirability to affect responses (Girgis et al., 1993; Hillhouse et al., 2012; Milne et al., 1999; O'Riordan et al., 2006; Oh et al., 2004). Despite these limitations, this study had several strengths including its use of a nationally representative sample of U.S. teen females, and the ability to study both IT and ST behaviors in an at-risk youth population.

In conclusion, the prevalence of IT among teen girls remains high across the United States. While this study supports current literature regarding the influence of age and race on IT and ST behaviors among teen girls, it additionally suggests that region and residence are also significant factors. Teen girls living in non-metropolitan and rural areas are much more likely to engage in IT than teens living in metropolitan areas. More research on IT in rural populations is needed. The study of STP use as an alternative harm reduction approach to reducing tanning in teens is also desirable.

### Conflict of interest statement

The authors declare that there are no conflicts of interest.

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