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Review Article

Mean Nevus Counts By Sun Sensitivity Factors, Frequency of Artificial UV Tanning and Sunburns among Sorority and Fraternity-Affiliated University Students

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Abstract

Objective: To describe the geometric distribution of mean nevi among university students with high levels of tanning by various factors including gender, skin type, skin color, and number of tanning sessions.

Design: A survey and skin examination of sorority and fraternity-affiliated university students, since sorority students are thought to have high levels of intentional tanning.

Participants: 163 Undergraduate students in the Midwest who are members of sororities or fraternities at a Big-Ten University.

Interventions: None.

Main Outcome Measure(s): Mean nevus counts adjusted for clustering within Greek houses.

Results: Higher mean nevus counts were seen among females, individuals with self-reported fair complexion, and among those who had higher artificial UVR tanning rates.

Conclusions: The association of increased mean nevi with increasing artificial UVR tanning was not explained by sun sensitivity factors. Thus, skin cancer prevention efforts should be aimed at young females who frequent tanning salons.

Keywords: Artificial UVR; Nevi; Skin Type; Skin Color

Abbreviations

UVR: Ultraviolet Radiation

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Introduction

Melanocytic nevi are one of the strongest predictors of risk for cutaneous malignant melanoma. Studies consistently show that individuals with an increased number of nevi are at an increased risk of developing cutaneous melanoma [1]. Ultraviolet radiation (UVR) is the major etiologic risk factor implicated in the development of both melanoma and nevi. For melanoma, sunburns are more important than cumulative sun exposure [2]. It is less clear which aspects or forms of UVR are related to the development of nevi which typically occur early in life. Of specific interest is the relationship between artificial UVR tanning devices and nevi, as the use of artificial UVR tanning devices have increased particularly in younger females.

Artificial UVR tanning device use is common among university students allowing examination of amount and timing of use. Melanoma rates have more sharply increased in women in their 20s than women over age 40 in recent years, with rates now exceeding those in males for younger age groups. Understanding the exposures related to such increases are important. Furthermore, understanding the relationship between artificial UVR and increased nevi may help develop melanoma prevention and screening efforts for people under age 40.

The purpose of this study was to examine the distribution of nevi by body location among sorority and fraternity-affiliated university students via a cross-sectional survey and how these distributions vary by sun sensitivity and UVR exposure.

Materials and Methods

Study Population

Students from sororities and fraternities (Greek houses) with 10 or more members were asked to participate in the survey and an educational session on skin care. Subjects were provided pizza while completing the survey and a $10 re-imbursement for their time. Subjects were asked to complete a self-administered survey and have a skin examination. Only subjects who completed both the survey and the dermatological examination along with signing the informed consent document were included in the study. Among these Greek houses, 165 subjects met this requirement. This appeared to be over 80% of those attending their monthly house meeting but a specific count was not feasible as students were coming and going. Of the 165 participants, two were excluded. One participant completed a questionnaire with random answers and extreme inconsistencies based on the skip patterns; and one African-American participant was excluded because of the low baseline inherent risk of skin cancer. Thus, our final sample consisted of 163 students.

The university student population is 92% non-Hispanic white, 2.2% African Americans, 0.4% American Indians, 3.7% Asians, and 2.5% identified as Latino. Among students attending the monthly meeting at their Greek houses, only 1% was self-identified as African American and 2% as Hispanic. This may reflect minority students joining minority specific Greek houses, but we did not attempt to recruit from such Greek Houses since they had < 10 students and we were interested in UVR factors that increase the risk of melanoma which is rare in non-white populations. The survey was conducted among students in the Midwest to examine a predominantly white population (thus at higher risk of skin cancer) with little to no total body outdoor sunbathing in the winter. Thus the survey was conducted within a month following spring break and prior to temperatures increasing enough for students to start outdoor sunbathing and other activities where their skin is exposed.

At the University of Study, students typically join fraternities and sororities during the first week of their freshman year. Consequently few freshmen live in the sorority/fraternity house during this first year. Since living in a Greek house is typically more expensive, students often only live in the house during their sophomore year. Sorority and fraternity students who lived in the Greek houses were more likely to come to the house meetings. Thus, over half of our sample consisted of sophomores (53%).

Questionnaire and Skin Exam

Participants completed a self-administered questionnaire while they waited for a full-body skin examination by a dermatologist. The questionnaire included information on artificial UVR tanning, sunless tanning creams, sunburns, and sun sensitivity. The reliability for the section of the self-administered questionnaire on artificial UVR tanning for specific time-periods ranged in Kappa values from 0.7 to 0.9 [3], suggesting that these students reported their artificial UVR tanning practices consistently [4]. Moderate to high reliability scores were also seen for recalled sunburns. After asking age-specific recall of artificial tanning, we asked subjects to estimate their total lifetime artificial UVR tanning exposure. This resulted in a Kappa of 0.94 (95% CI of 0.85-1.00) for lifetime artificial UVR tanning [3].

The dermatology examination included site specific nevus counts along with categorization of Fitzpatrick skin type. We defined a nevus as a pigmented macule or papule which was not a freckle, seborrheic keratosis, birth mark, or lentigo, at least 3mm in diameter. All body sites were examined except those covered by underwear. Nevus counts were recorded by anterior and posterior, right and left, for arms and legs; head (except for scalp); and trunk included back and chest. Total body nevus counts were calculated by summing across all body sites. However, 24 students chose not to have their entire leg examined, resulting in only partial nevi counts for the lower extremities. Consequently, total body counts are missing for these 24 individuals. This project was conducted

according to the Declaration of Helsinki Principles and was approved by the Institutional Review Board for Human Subjects.

Statistical Analysis

Descriptive statistics were used to describe the characteristics of the sample. Survey sampling statistical techniques were used since we first recruited from Greek houses, then we recruited the members from those who attended a monthly meeting. All analyses were conducted within SAS version 9 [5]. Survey sampling methods including a finite population correction [5,6] were used to describe the means and ranges for the number of nevi by body location and by risk factors. Sampling weights were computed from the selection probabilities at each stage, and were based on the recruitment of Greek houses and for the participation rate within each Greek house, even though we did not attempt to recruit all Greek houses and only recruited from students attending the monthly house meeting [6]. PROC SURVEYMEANS was used to calculate mean nevi stratified by various risk factors while accounting for potential clustering by Greek house. PROC SURVEYREG was used to examine the log-nevi to calculate the geometric means. Based on the sampling weights used, SAS estimated the total membership of the Greek Houses. This estimate was similar to the number reported in student enrollment records. The Taylor expansion method was used to estimate the standard errors of the estimators for the means [5,7]. The variance estimates also accounted for the clustering of the students associated with the same Greek houses. These models were re-run without accounting for clustering using PROC MEANS and PROC REG. Minimal differences were seen. Thus, geometric mean nevus counts are reported hereafter and referred to as mean nevus counts.

T-tests based on the ratio of the parameter estimates to its corresponding standard errors within a regression model were used to test for differences in mean log-nevi by gender, tendency to burn, inability to tan, Fitzpatrick skin type, skin color, sunburns and artificial tanning frequency. Differences in frequency distributions were based on a Wald log-linear F-test.

Results

Participants ranging in age from 18-23 were recruited among sorority and fraternity-affiliated university students with 75% of participants age 19 or 20. The study population was predominantly female (72%). None of the participants reported a personal history of skin cancer, but 30% of participants reported a family history of skin cancer but the majority did not know what type of skin cancer. Participants who reported a family history were not asked if it was a first, second or third degree relative who had skin cancer. Based on the dermatological exam, most students had a Fitzpatrick skin type of II or III, with only 13% as skin type I. Self-reported skin color of the upper inner arm had 52% reporting to be fair skinned with only 3% self-reporting dark skin. We chose sorority and fraternity-affiliated university students because of their perceived high desire to tan. This perception was verified with 84% in our survey stating they felt it was important to be tanned. Ever use of artificial UVR for tanning was reported in 88% of subjects. Similarly, 80% of subjects stated that they liked to spend as much time in the sun as they can when they had the chance, suggesting a high level of sunbathing.

Table 1 reports the mean nevi by subject characteristics. Figure 1 shows the differences in geometric mean nevus counts by body location by sex. For all sites females have higher nevus counts (Table 1). Females had significantly higher mean nevus counts for total body, arms, and hands (Figure 1). These associations were not reduced by adjustment for skin type or sunbathing. However, females had a higher mean number of artificial UVR tanning sessions for each time period (p-values < 0.001, except p=0.03 for 3 months prior to spring break). No association was seen with age (range 18-23), inability to tan, eye color, or hair color and the mean nevus counts. Self-reported skin color and tendency to burn showed the largest differences between the geometric mean nevi with high mean nevi among the most sun sensitive participants (Table 1). Students with self-reported fair skin had higher total body nevus counts (Table 1) along with higher nevus counts on all body sites, compared to medium or dark skinned students (Figure 2). The significance levels did not change with adjustment of either sex or skin type.

Higher nevus counts were also seen among those engaging in artificial UVR tanning. The strongest associations with artificial UVR tanning were seen for higher use during high school and after age 18 (Table 2), however the associations with increased nevi were also strong for other time periods except for use between New Years and spring break (the 3 months prior to measurement of nevi). Since females had much higher mean nevi than males, as did students using artificial UVR tanning, we explored artificial UVR tanning further by restricting analyses to females. Figure 3 shows nevus counts among females stratified by lifetime number of artificial UVR tanning sessions. Females with higher artificial UVR exposure (21+ sessions) had higher nevus counts than other females. The significance of 21+ artificial tanning sessions did not change with adjustment of skin type. Adjustment for sunbathing along with skin type had minimal effects on artificial UVR tanning with a few p-values reducing from p<0.01 to p<0.05 (left arm, both arms, right leg and both legs) and to p<0.10 for the trunk. Since this population was specifically selected for their high intentional tanning, our results should be interpreted within the context of a young population with extremely high artificial UVR exposure and sunbathing. When the 30% of students reporting a family history of skin cancer were removed, similar trends were seen with increases in artificial tanning.

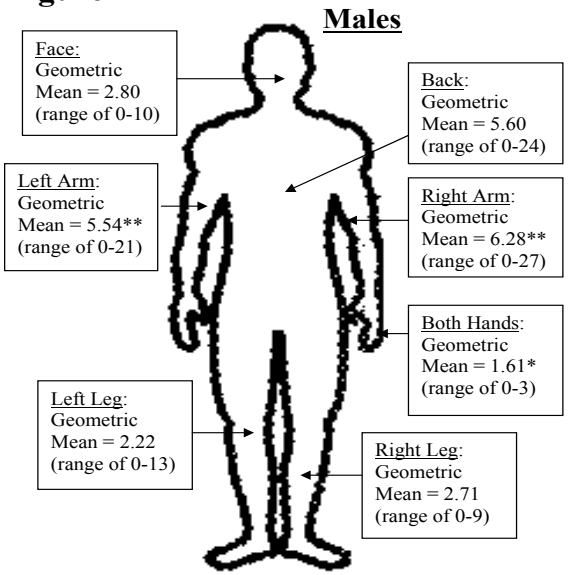
Table 1. Mean number of nevi related to host factors and sun sensitivity measures among sorority and fraternity students.

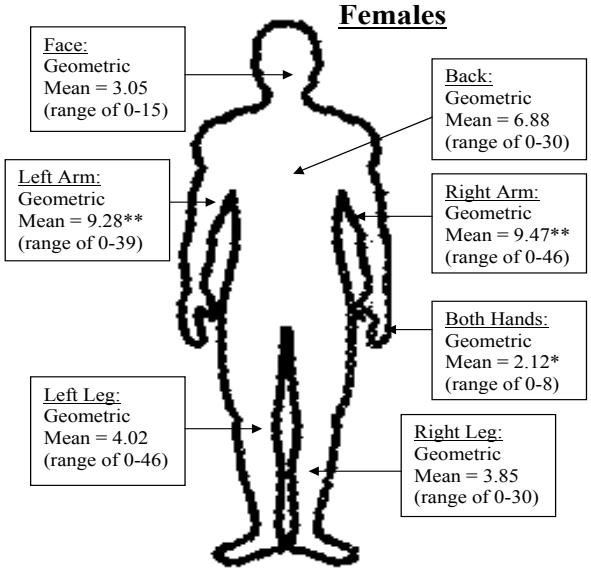
Host factors and Sun Sensitivity Measures	categories	N	Mean nevi	Log mean nevi	Geometric mean*	p-value
Overall		133	50.56	3.74	42.10	
Sex	Male	35	34.82	3.41	30.12	0.0129
	Female	98	56.24	3.86	47.28	
Age	18	11	32.53	3.30	27.18	0.8529
	19	52	51.58	3.78	43.76	
	20	45	53.23	3.80	44.62	
	21	13	55.94	3.77	43.43	
	22	7	53.62	3.84	46.50	
	23	2	16.00	2.77	15.97	
Tendency to sunburn	Severe/Pain/Moderate	22	64.52	4.05	57.30	0.0135
	Mild Sunburn	28	48.02	3.67	39.25	
	Sunburn then tan	36	56.22	3.86	47.41	
	No Sunburn	47	41.13	3.54	34.31	
Inability to tan	Deeply tanned	47	44.83	3.63	37.83	0.4135
	Moderately tanned	67	55.93	3.84	46.72	
	Mild or no tan	19	45.46	3.60	36.76	
Skin color	Fair	69	58.61	3.92	50.23	0.0081
	Medium/dark	64	41.72	3.54	34.42	
Fitzpatrick skin-type**	I	14	62.31	3.98	53.62	0.1139
	II	74	47.91	3.71	40.70	
	III	41	52.92	3.75	42.50	
	VI	4	23.75	2.94	18.97	
Eye color	Blue	47	51.30	3.76	43.12	0.7936
	Green	20	50.02	3.76	43.13	
	Hazel	27	43.53	3.59	36.33	
	Brown	38	54.25	3.78	43.61	
Hair color	Blond	23	52.00	3.81	44.96	0.3227
	Red/Blond	2	51.78	3.80	44.74	
	Red/Auburn	4	48.01	3.72	41.14	
	Light brown	50	50.33	3.74	42.04	
	Dark brown	49	51.12	3.72	41.21	
	Black	4	25.48	3.19	24.38	

* Geometric mean =exp of log mean

** Fitzpatrick skin type determined by a dermatologist: Skin type I: fair complexion, burn easily and strongly and never tan; Skin type II: fair complexion, burn easily, and tan minimally but with difficulty; Skin type III: medium complexion burn moderately, and tan moderately and uniformly; Skin type IV: medium/dark complexion, burn minimally, and tan easily and moderately.

Figure 1



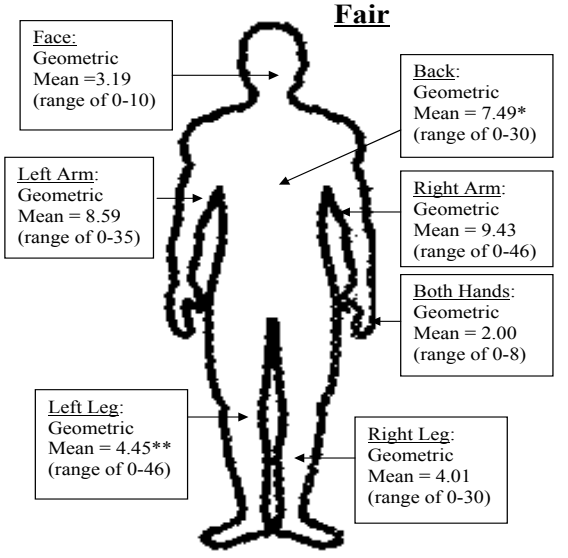


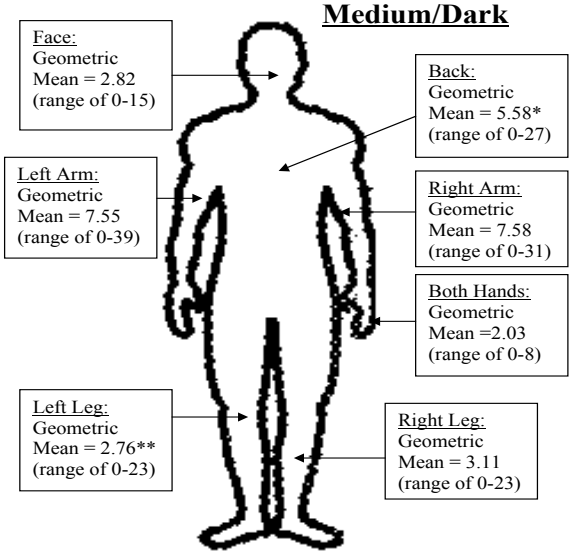
	Geometric Mean	range
Both Arms	11.38**	0-47
Raised	1.90	0-5
Non-raised	10.77**	0-45
Both Legs	3.42	0-20
Total Body	**30.12***	**5-79**

	Geometric Mean	range
Both Arms	18.36**	3-81
Raised	1.92	0-6
Non-raised	18.11**	3-78
Both Legs	6.77	0-76
Total Body	**47.28***	**7-167**

Figure 1. Mean nevus counts for body locations by sex among sorority and fraternity students. Nevus counts significantly different between males and females: * p<0.05, ** p< 0.01.

Figure 2





	Geometric Mean	range
Both Arms	17.65	1-81
Raised	2.20**	0-6
Non-raised	16.91	1-78
Both Legs	6.61	0-76
Total Body	**50.23****	**14-165**

	Geometric Mean	range
Both Arms	14.67	0-61
Raised	1.57**	0-5
Non-raised	13.93	0-54
Both Legs	4.88	0-46
Total Body	**34.42****	**5-167**

Figure 2. Mean nevus counts for body locations by self-reported skin color among sorority and fraternity students. Nevus counts significantly different between self-reported "fair" and "medium or dark" skin: * p<0.05, ** p< 0.01.

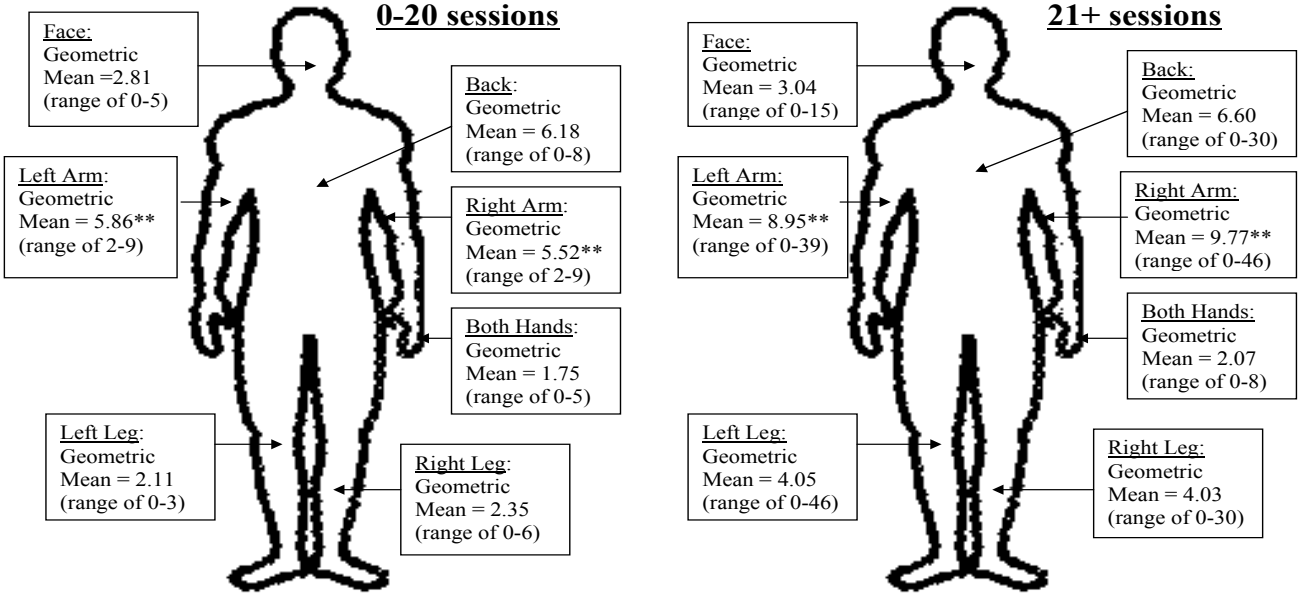
Table 2. Mean number of nevi related to use of sunlamp, tanning lamp or sunbed in order to get a tan among sorority and fraternity students.

Tanning bed Use	categories	N	Mean nevi	Log mean nevi	Geometric mean*	p-value
Overall		133	50.56	3.74	42.10	
How many times would you estimate that you have ever used sunlamps, tanning lamps or sunbeds?						
Ever used	No	17	35.94	3.42	30.55	0.0883
	Yes	116	52.20	3.77	43.46	
… before high school	None	102	49.23	3.70	40.41	0.0176
	1-5 times	17	54.81	3.88	48.33	
	6-10 times	6	52.69	3.70	40.51	
	11-15 times	3	36.75	3.59	36.16	
	16-20 times	2	59.63	4.08	58.95	
	>20 times	3	76.67	4.22	67.94	
… during high school	None	25	35.43	3.42	30.45	0.0070
	1-5 times	10	34.80	3.43	31.01	
	6-10 times	14	39.40	3.43	30.95	
	11-15 times	16	63.21	3.99	53.96	
	16-20 times	15	54.66	3.94	51.17	
	>20 times	53	57.91	3.88	48.44	
… after age 18	None	22	36.36	3.46	31.77	0.0025
	1-5 times	12	37.38	3.44	31.29	
	6-10 times	14	49.62	3.66	38.72	
	11-15 times	15	46.58	3.76	42.76	
	16-20 times	11	60.43	3.80	44.84	
	>20 times	56	57.93	3.90	49.22	
… during this past year	None	26	40.10	3.53	34.21	0.0126
	1-5 times	16	42.85	3.57	35.49	
	6-10 times	20	41.92	3.56	35.02	
	11-15 times	21	57.07	3.87	47.74	
	16-20 times	14	56.60	3.84	46.74	
	>20 times	35	55.65	3.89	48.79	
… between New Years and Spring Break	None	32	44.23	3.59	36.09	0.0931
	1-5 times	29	46.99	3.69	39.85	
	6-10 times	30	44.88	3.66	38.88	
	11-15 times	16	65.63	3.99	54.26	
	16-20 times	15	55.84	3.91	50.03	
	>20 times	9	51.71	3.72	41.39	
… in your lifetime	None	17	35.94	3.42	30.55	0.0137
	1--20 times	17	31.53	3.34	28.29	
	21-50 times	45	54.46	3.84	46.60	
	>50 times	54	57.25	3.86	47.31	

Table 3. Mean number of nevi related to sunburns among sorority and fraternity students.

Mean number of nevi	categories	N	Mean nevi	Log mean nevi	Geometric mean*	p-value
	Overall	133	50.56	3.74	42.10	
How many sunburns did you have so severe that they produced blisters or pain lasting 2 or more days?						
… before high school	None	61	43.05	3.62	37.19	0.0545
	1-2	45	54.00	3.81	45.03	
	3+	17	60.61	3.88	48.54	
… during high school	None	54	45.98	3.66	38.74	0.0339
	1-2	54	56.61	3.84	46.70	
	3+	18	54.70	3.83	46.12	
… after age 18	None	83	50.62	3.75	42.54	0.7773
	1-2	36	55.89	3.80	44.69	
	3+	8	39.65	3.54	34.55	
… during the past year	None	97	52.78	3.79	44.24	0.2005
	1-2	34	45.74	3.62	37.27	
	3+	1	31.00	3.43	31.00	
… during spring break	None	111	51.67	3.76	43.07	0.5870
	1-2	20	47.94	3.67	39.28	
	3+	1	31.00	3.43	31.00	

Figure 3



	Geometric Mean	range
Both Arms	11.53**	4-18
Raised	1.91	0-2
Non-raised	10.93**	4-16
Both Legs	3.29*	0-9
Total Body	**29.22***	**9-45**

	Geometric Mean	range
Both Arms	17.97**	3-81
Raised	1.92	0-6
Non-raised	17.53**	3-78
Both Legs	6.83*	1-76
Total Body	**46.98***	**7-167**

Figure 3. Mean nevus counts for body locations by number of lifetime artificial UV tanning sessions among sorority and fraternity students. Nevus counts significantly different between +21 and 20-0 lifetime tanning sessions: * p<0.05, ** p< 0.01.

Table 3 reports the mean nevi by sunburn history. An increased mean number of mean nevi is seen with increased number of sunburns during childhood and adolescence (Table 3). The lack of association seen since age 18, during the past year and during spring break may reflect lack of time for any potential development of new nevi in these 18-23 year old students.

Discussion

Prior studies focusing on teenagers report higher nevus counts among males than females [8-11], paralleling higher rates of melanoma seen in U.S. males [12]. The literature on the distribution of nevi in children and adolescents had also suggested males have more nevi on the trunk and face while females have more on the upper and lower limbs of the body [11,13-15]. However, it appears this has been changing in the last decade or two for adolescents. Our data show higher mean nevus counts among females for all body sites. These findings parallel recent trends in melanoma that show higher rates among females than males under age 40 [16,17]. It has been suggested that this distribution in both nevi and melanomas reflects artificial UVR patterns [11,18-20]. We found higher nevus counts among those with higher artificial URV exposure. Since females in our study had higher artificial UVR exposure than males, artificial UVR may account for the higher mean nevi at all body sites seen among females (compared to males).

Previous studies focusing on very young children, ages 1-6 [21] and ages 2-7 [22], did not find any significant differences between the number and density of melanocytic nevi between sexes. The lack of gender difference at these young ages [21,22] suggests that gender differences in nevus counts in older populations may be related to environmental exposures, such as UVR, in addition to host susceptibility. The relationship between melanocytic nevi and environmental UVR exposure has been shown in other studies [13,23-25]. Lower nevus counts in those with lower environmental exposure, whether intentional through protective behaviors, or unintentional by location of residence, supports the role of UVR exposure in the development of new nevi.

Nevertheless, the relationship between artificial UVR exposure and nevi in young subjects has been infrequently examined. We chose sorority and fraternity-affiliated university students because of their perceived high desire to tan. This perception was verified in our survey with 86% stating they felt it was important to be tanned and 82% sunbathing (liked to spend as much time in the sun as they can) when they had the chance. However, a large proportion of tanning among the females is apparently also through artificial UVR exposure. The proportion of our population ever using artificial UVR (58% in males; 99% in females) was higher than other studies among the general college age population which reported rates from 33% to 61% for ever use of artificial UVR tanning devices [26,27]. This is amplified by the similarly high proportion using artificial UVR tanning devices in the past year. Stratified mean nevus counts by levels of artificial UVR tanning showed that the high artificial UVR exposure accounts for most of the higher rates of nevi in our females, than have been seen in prior studies of young people. This supports that nevi are related to artificial UVR exposure.

Based on our survey responses, it appears that little to no clothing is worn during artificial UVR tanning sessions. This would expose a larger body surface area to UVR than would otherwise be exposed in the sun. Such a differential in body site exposure could result in a different nevus development pattern between natural UVR exposure and artificial UVR exposure. This may have further implications with a differential risk of cutaneous melanoma by body surface area among those with high exposure to artificial UV light.

Current literature supports both constitutional and environmental factors in determining number and type of melanocytic nevi. The higher nevus counts in females and fair-skinned individuals found in this study supports both the effects of host susceptibility and tanning behavior as factors influencing the number of nevi. If our data in females are an early reflection of cultural changes in artificial UVR use, then the traditionally higher rates of nevi and melanoma seen in males may change to higher rates in females. Further studies are needed to better understand the potential effect of artificial UVR on nevus and melanoma development and to quantify how artificial UVR use varies by age group or birth cohorts.

Our analyses by Fitzpatrick skin type and self-reported skin color showed that for each body site with a significant difference, the mean number of nevi were higher among fair-skinned individuals. This is consistent with prior studies showing associations with skin color and nevi [8,21,22,28] and also with risk of melanoma [29]. Thus, fair skinned individuals who feel tanning is important are a prime high risk group to target for skin cancer prevention efforts. The stronger association with self-reported skin color rather than Fitzpatrick skin type may reflect difficulty of an observer classifying unexposed skin color in a group where for most subjects all of their skin had been exposed to repeated artificial UVR. Further studies of Fitzpatrick skin type classifications among different populations, including those who frequently tan via artificial UVR, are needed.

The continued increased mean nevi by increased artificial UVR exposure seen when we excluded those students reporting a family history of skin cancer could reflect several issues. First of all, skin cancer is very common with skin cancers cases accounting for nearly half of all cancers [30]. The commonality particularly of nonmelanoma skin cancers may be reflected in the reporting of family history rather than a strong genetic component among all students with a family history. Secondly skin cancers typically are related to sun sensitivity and UVR exposure patterns, both of which can be

correlated among family members. Learned UVR patterns would not be related to genetics. Additionally, many students were unsure what type of skin cancer a family member had. Clinicians often find patients confused about their family history of skin cancer. The frequency and distribution of nevi need to be examined by risk factors, including gender, UVR exposure patterns, and family history, in other populations. More in depth examination of the relationship between artificial UVR tanning and nevi is needed. Prospective, longitudinal studies are necessary to confirm this relationship and determine causality.

Conclusions

The increased number of nevi in our population, which places importance on tanning, suggests that use of artificial UVR tanning devices contributes to a greater number of nevi. This is supported by the increased mean nevus counts among females with >20 lifetime artificial UVR tanning sessions compared to those with 0-20 lifetime tanning sessions. The higher nevus count in females here appears to be related to their higher use of artificial UVR tanning. Prevention efforts addressing tanning attitudes and behaviors should be directed to higher risk groups such as young, fair-skinned females, since this population appears to be at great risk of developing nevi with high rates of artificial UVR tanning.

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