

# Skin cancer and skin cancer risk behaviors among sexual and gender minority populations: A systematic review



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**Background:** Individuals of sexual and gender minorities may have different lifetime risk of skin cancer and ultraviolet radiation exposure than heterosexual persons.

**Objective:** To systematically review the prevalence of skin cancer and behaviors that increase risk of skin cancer among sexual and gender minority populations.

**Methods:** We performed a systematic literature review in PubMed/MEDLINE, Embase, Cochrane, and Web of Science, searching for articles through October 18, 2019, that investigated risk of skin cancer and behaviors among sexual and gender minority populations.

**Results:** Sexual minority men have a higher lifetime risk of any skin cancer (odds ratio range: 1.3-2.1) and indoor tanning bed use (odds ratio range: 2.8-5.9) compared with heterosexual men, whereas sexual minority women may use indoor tanning beds less frequently than heterosexual women and do not have an elevated risk of lifetime history of skin cancer. Gender-nonconforming individuals have higher lifetime prevalence of any skin cancer compared with cisgender men.

**Limitations:** Most variables rely on self-reporting in their original studies.

**Conclusions:** Sexual minority men disproportionately engage in use of indoor tanning beds, which may result in increased lifetime risk of skin cancer. Recognition of this risk is important for providing appropriate screening for patients in this population. (J Am Acad Dermatol 2020;83:511-22.)

**Key words:** gender minority; indoor tanning; LGBT health; sexual minority; skin cancer; skin cancer epidemiology.

**S**kin cancer is the most common cancer in the United States, with roughly 4.9 million people treated annually.<sup>1</sup> Exposure to ultraviolet (UV) radiation is one of the environmental risk factors most strongly associated with the development of

both melanoma and keratinocyte carcinomas, with both outdoor sun exposure<sup>2-4</sup> and indoor tanning bed use<sup>5,6</sup> conferring substantial risk.

There is increasing national focus on health disparities facing sexual and gender minority

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populations, with a recent call for further research into specific cancer risks and risk factors.<sup>7</sup> Sexual minorities include, but are not limited to, those who identify as gay, lesbian, or bisexual, whereas *gender minority* is an umbrella term that includes transgender and gender-nonconforming individuals. Transgender persons have a gender identity that is distinct from their sex assigned at birth, and gender-nonconforming individuals identify as neither male nor female or as having features of both sexes.

Sexual minority men (SMM) may be at increased risk of indoor tanning, because negative body image is linked to indoor tanning bed use,<sup>8</sup> and SMM report lower body satisfaction than heterosexual men.<sup>9</sup> Although there is increasing national attention on cancer risks among gender minority individuals,<sup>7</sup> not much is known about skin cancer risk behaviors in this population.

In this study, we aimed to review the data on the prevalence of skin cancer and skin cancer risk behaviors among sexual and gender minority populations.

## METHODS

This systematic review was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.<sup>10</sup>

### Eligibility criteria

We included all studies whose primary focus was on assessing the risk of either skin cancer or skin cancer risk behavior among sexual and gender minority communities. Case reports, letters to the editor, opinion pieces, and abstracts were excluded from our analysis, as were studies that focused on skin cancer risk among HIV-positive patients without specific consideration of sexual minority status. There were no language, date, or country restrictions for included studies.

### Information sources and search strategy

We searched the PubMed, Embase, Cochrane, and Web of Science databases through October 18, 2019, for all research articles. Search terms included both terms used to describe the lesbian, gay, bisexual, and transgender community and terms related to skin cancer and skin cancer risk

behaviors. Our study protocol was registered with PROSPERO (no. CRD42019116879).

### Study selection

Two reviewers (SS and ET) independently screened all titles and abstracts. For articles that met inclusion criteria after abstract review, full-text review was also performed. Two studies were manually added because they were published shortly after our initial search was performed. A third reviewer (AM) mediated disagreement between reviewers and approved the final list of included studies. Study quality was assessed by using a quality assessment checklist for studies assessing prevalence.<sup>11</sup>

## RESULTS

### Selection of studies

Our initial search identified 4508 articles. Of those, 4311 were excluded based on the title, and an additional 145 were excluded after review of the title and abstract. A total of 52 full-text articles were ultimately reviewed for inclusion, with 12 meeting inclusion criteria for our study. Two additional studies written by our research group that are currently in press were added, resulting in 14 total articles being included in our study sample (Fig 1).

Of the studies included, 2 included results from population-based prospective cohort studies, 7 from population-based cross-sectional studies, 4 from regional survey studies, and 1 from a focus group study (Table 1). Although we did not restrict our search to domestic studies, all studies identified were from the United States. The studies varied in age group, because 9 included exclusively adults and 5 included only adolescents and young adults.

### Skin cancer development among sexual minority populations

A cross-sectional study used 2 separate national samples to compare the risk of skin cancer development in sexual minority populations relative to their heterosexual peers.<sup>12</sup> Using data from the 2001 to 2005 California Health Interview Surveys, Mansh et al showed that SMM had a significantly increased odds of lifetime history of any skin cancer (adjusted odds ratio [aOR], 1.6; 95% confidence interval [CI], 1.2-2.1), melanoma (aOR, 1.7; 95% CI, 1.1-2.7), and non-melanoma skin cancer (NMSC) (aOR: 1.4 [1.0-2.1]). Using the 2013 National Health Interview Survey,

## CAPSULE SUMMARY

- Recent evidence shows that sexual minority populations may disproportionately engage in skin cancer risk behaviors.
- Sexual minority men have a higher prevalence of both skin cancer and indoor tanning bed use compared with heterosexual men, which likely reflects unique community pressures and appearance ideals in this community.

*Abbreviations used:*

CI:	confidence interval
NMSC:	nonmelanoma skin cancer
SMM:	sexual minority men
SMW:	sexual minority women
UV:	ultraviolet

Mansh et al<sup>12</sup> found that SMM had significantly higher odds of lifetime history of any skin cancer (aOR, 2.1; 95% CI, 1.1-4.0), although they were unable to assess specific subtypes of skin cancer in this sample. This study also found lower odds of NMSC in sexual minority women (SMW) compared with heterosexual women (aOR, 0.6; 95% CI, 0.4-0.9) but no significant difference in lifetime history of any skin cancer or melanoma based on sexual orientation among women in either sample.

Another cross-sectional study used data from the 2014 to 2018 Behavioral Risk Factor Surveillance System surveys examining lifetime skin cancer prevalence among sexual minority populations.<sup>13</sup> In this study, the authors found that gay (aOR, 1.3; 95% CI, 1.0-1.5) and bisexual (aOR, 1.5; 95% CI, 1.0-2.1) men had increased lifetime prevalence of skin cancer compared with heterosexual men and that bisexual women (aOR, 0.8; 95% CI, 0.6-1.0) had decreased lifetime prevalence of skin cancer compared with heterosexual women. There was no difference between heterosexual and gay or lesbian women with regard to lifetime skin cancer prevalence.

### **Skin cancer development among gender minority populations**

A cross-sectional study used data from the 2014 to 2018 Behavioral Risk Factor Surveillance System surveys examining lifetime skin cancer prevalence among gender minority populations.<sup>14</sup> The results showed that gender-nonconforming individuals (aOR, 2.1; 95% CI, 1.0-4.3) had significantly higher odds of lifetime skin cancer diagnosis compared with cisgender men, but no difference was found when comparing transgender men (aOR, 1.1; 95% CI, 0.6-1.9) or transgender women (aOR, 1.1; 95% CI, 0.7-1.8) with cisgender men.

### **History of indoor tanning bed use**

Three cross-sectional studies of adults evaluated the prevalence of indoor tanning bed use for SMM versus heterosexual men and identified a prevalence of 5.0% to 27.0% in SMM vs 1.6% to 9.1% in heterosexual men (OR range, 2.8-5.9) (Table II).<sup>12,15-17</sup> The only study to substratify gay men and bisexual men

found that both groups were more likely to report ever having used an indoor tanning bed compared with heterosexual men (Table II).<sup>7</sup>

A study examined indoor tanning bed use among SMM and heterosexual adolescents and found a significantly increased prevalence of tanning bed use among SMM (27.0%) compared with heterosexual adolescents (8.6%; OR, 3.9).<sup>20</sup>

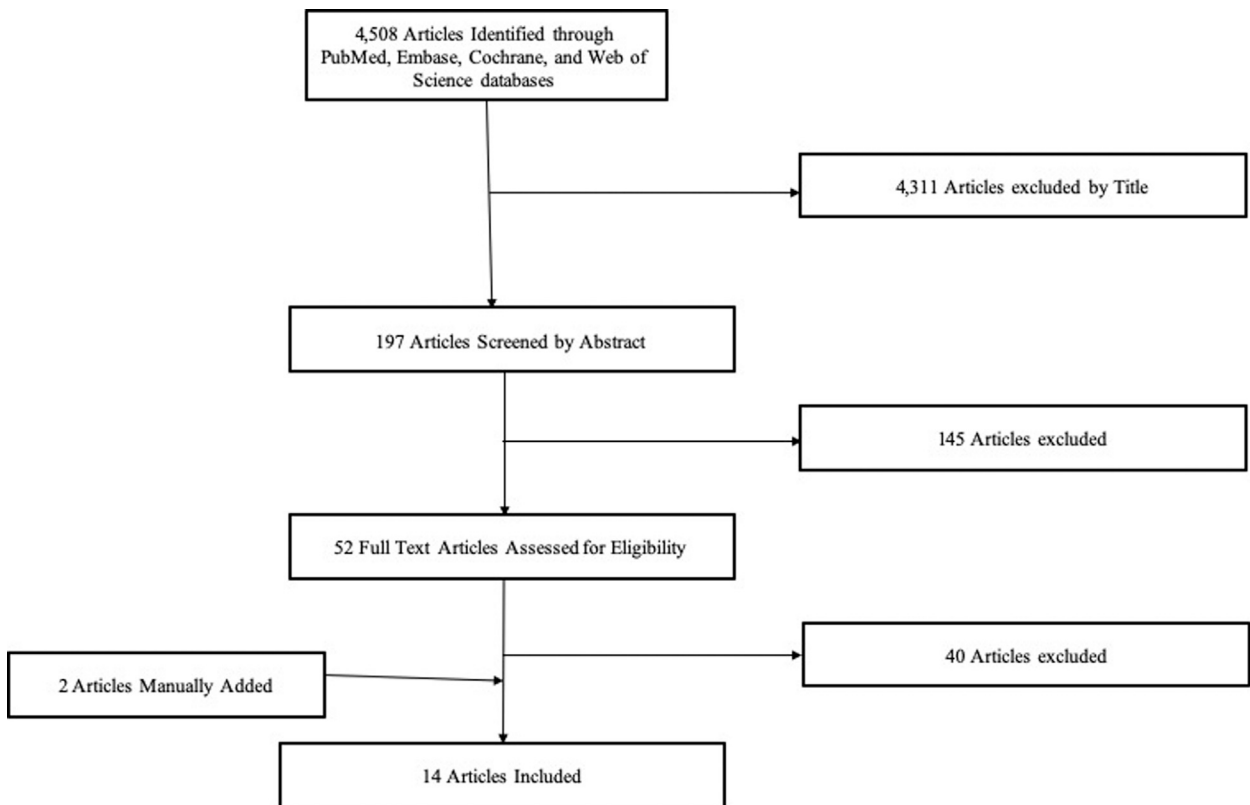
Three studies have evaluated the prevalence of indoor tanning bed use among women based on sexual minority status. One found a decreased likelihood of ever having indoor-tanned among SMW compared with their heterosexual peers (OR, 0.4-0.6) (Table II).<sup>12</sup> The other 2 studies showed no difference between SMW and heterosexual women with regard to indoor tanning bed use.<sup>16,18</sup>

One study assessed indoor tanning risk among high school-aged participants by using the 2015 Youth Behavior Risk Survey; this was the only study able to stratify the sample by race in addition to sex and sexual orientation. In this study, among black participants, both sexual minority status (OR, 4.5; 95% CI, 2.5-8.0) and male sex (OR, 2.6; 95% CI, 1.0-6.6) independently conferred increased risk of indoor tanning bed use, whereas in Hispanic participants, sexual minority status conferred increased risk of tanning bed use for both men and women (OR, 3.9; 95% CI, 1.8-8.6). Among white participants, sexual minority status was a risk factor for indoor tanning bed use among males (OR, 3.2; 95% CI, 1.3-7.7), but it decreased risk among females (OR, 0.4; 0.2-0.7).<sup>19</sup>

### **Frequent indoor tanning bed use**

Two studies assessed frequent indoor tanning bed use (defined as 10 or more uses in the past 12 months) by sexual orientation among men and found a prevalence of 3.4% to 24% among gay men, 4.5% to 8.3% among bisexual men, and 0.7% to 7.2% among heterosexual men.<sup>15,16</sup> One study found significantly increased odds of frequent indoor tanning among gay men (aOR, 4.7; 95% CI, 2.0-11.2) and bisexual men (aOR, 7.4; 95% CI, 2.1-26.4) compared with heterosexual men, but the other found increased odds only among gay men (aOR, 4.7; 95% CI, 3.0-7.4).

Of 2 studies that assessed frequent use of indoor tanning beds among SMW, 1 found no statistically significant difference between gay (aOR, 0.5; 95% CI, 0.2-1.4) or bisexual women (aOR, 0.8; 95% CI, 0.3-2.0) compared with heterosexual women,<sup>16</sup> and the other found significantly decreased odds of frequent indoor tanning among both gay (aOR, 0.4; 95% CI,



**Fig 1.** Search and selection strategy of relevant articles.

0.3-0.7) and bisexual women (aOR, 0.4; 95% CI, 0.3-0.6) compared with their heterosexual peers.<sup>15</sup>

### Outdoor sun exposure and infrequent sunscreen use

Four cross-sectional studies of adults examined outdoor UV exposure among sexual minorities compared with their heterosexual peers.<sup>15,17,18,20</sup> Although each of the 3 studies examined different variables related to sun exposure (frequent or occasional sunbathing to get a tan<sup>19</sup>; 1 or more sunburns in last 12 months<sup>17,18</sup>; sun exposed sometimes, frequently, or always last summer; and >5 sunburns last summer<sup>15</sup>), none found an increased prevalence of high-risk outdoor UV exposure among SMM or SMW compared with their heterosexual counterparts (Table II).

Both studies examining sunscreen use among sexual minority populations found that prevalence of infrequent sunscreen use (self-reported history of “infrequent or seldom use of sunscreen” or being “unlikely to wear sunblock when outside for >1 hour”) was similar between sexual minority and heterosexual populations (Table II).<sup>15,17</sup>

### Motivations for indoor tanning among SMM

Four studies assessed motivations for indoor tanning among SMM. A northern California survey of 495 SMM found that 37 (7.5%) reported current indoor tanning bed use. The majority of SMM surveyed understood that indoor tanning bed use increases risk of skin cancer, because only 10.8% disagreed that indoor tanning bed use increased skin cancer risk.<sup>21</sup> Among indoor tanners, the most common motivations included increased attractiveness (56.8%), mood elevation (32.4%), and stress relief (27.0%). Interestingly, 21 (56.8%) indoor tanners believed indoor tanning bed use before a sunny vacation would protect the skin.

A focus group study showed that SMM identified both aesthetic concerns and community pressures as reasons for wanting to initiate indoor tanning.<sup>23</sup> SMM reported that tanned skin appeared healthier and more toned, which was appealing for the participants in this group. This study also found that fears of more rapid skin aging and increased risk of skin cancer were among the primary motivators for stopping indoor tanning among SMM.

Another survey study that showed that SMM who reported darker ideal skin tones were more likely to engage in both indoor and outdoor tanning, particularly among those who had a fairer skin type.<sup>24</sup> A

**Table I.** Study characteristics and outcomes

Source	Age limitation	Study design	Population-based sample (yes/no)	Study population	Groups	Outcome(s)	Major finding(s)	Assessment of risk of bias*
Admassu et al, <sup>23</sup> 2019	≥18 y	Qualitative: focus groups	No	SMM in San Francisco, CA, who had used indoor tanning at least once	38 gay men, 7 bisexual men, 3 individuals with other sexual orientation	<ul style="list-style-type: none"> <li>• Reasons for starting and stopping indoor tanning</li> </ul>	Aesthetic concerns and community pressures were the primary motivations for indoor tanning, whereas skin aging and skin cancer risk were among the top motivations for stopping.	Moderate risk
Blashill and Safren, <sup>20</sup> 2014	16-29 y	Prospective cohort study	Yes	Male respondents of National Longitudinal Adolescent Health Study	78 SMM, 1689 heterosexual men	<ul style="list-style-type: none"> <li>• History of indoor tanning ever</li> <li>• Sunbathing history</li> <li>• Sunscreen use</li> </ul>	SMM have higher rates of indoor tanning at age 16 y (OR, 3.9).	Moderate risk
Blashill <sup>19</sup> 2017	9th-12th graders, in high school <sup>†</sup>	Cross-sectional study	Yes	9th- to 12th-grade respondents of 2015 Youth Risk Behavior Survey	354 SMM, 5013 heterosexual males, 886 SMW, 4391 heterosexual females	<ul style="list-style-type: none"> <li>• Indoor tanning bed use (by race)</li> </ul>	Both sexual minority status and male sex independently increase odds of indoor tanning.	Low risk
Blashill et al, <sup>25</sup> 2018	15-35 y	Survey study	No	Online survey of SMM in San Diego, CA	231 SMM (84% gay, 11.3% bisexual, 0.4% asexual, 0.4% heterosexual, 3.8% other)	<ul style="list-style-type: none"> <li>• Reasons/motivations for indoor tanning</li> <li>• Future intention to indoor tan</li> <li>• Perceived skin cancer risk</li> </ul>	Higher perceived skin cancer risk was associated with decreased intent to indoor tan. Social pressures and association of tanning with skin cancer risk affect regulation increased likelihood of future tanning.	Low risk
Gao et al, <sup>17</sup> 2018	≥18 y	Cross-sectional study	Yes	Male respondents of 2015 National Health Interview Survey	370 SMM; 13,328 heterosexual men	<ul style="list-style-type: none"> <li>• Indoor tanning bed use</li> <li>• Sunburns</li> <li>• Sunscreen use</li> </ul>	SMM use indoor tanning and use sunless tanning more frequently than heterosexual men.	Low risk
Klimek et al, <sup>24</sup> 2018	16-35 y	Survey study	No	SMM in San Diego, CA	198 gay men, 25 bisexual men, 1 heterosexual man, 7 individuals with other sexual orientation	<ul style="list-style-type: none"> <li>• Current and ideal skin tones</li> <li>• Tanning behavior</li> </ul>	Darker ideal skin tone was correlated with use of indoor tanning and intent to indoor tan among SMM.	Moderate risk

Continued

Table I. Cont'd

Source	Age limitation	Study design	Population-based sample (yes/no)	Study population	Groups	Outcome(s)	Major finding(s)	Assessment of risk of bias*
Mansh et al, <sup>12</sup> 2015	≥18 y	Cross-sectional study	Yes	2001-2005 and 2009 California Health Interview Survey and 2013 National Health Interview Survey respondents	3083 SMM; 78,487 heterosexual men; 3029 SMW; 107,976 heterosexual women	<ul style="list-style-type: none"> <li>Indoor tanning bed use in past 12 months</li> <li>History of physician-diagnosed skin cancer</li> </ul>	SMM have increased odds of history of skin cancer and indoor tanning bed use compared with heterosexual men. SMW have lower odds of indoor tanning than heterosexual women.	Low risk
Morrison et al, <sup>21</sup> 2019	≥18 y	Survey study	No	Venue- and time-based sample of respondents to 2017 National HIV Behavioral Surveillance Survey	495 MSM in San Francisco, San Mateo, and Marin counties of California	<ul style="list-style-type: none"> <li>Indoor tanning bed use in past 12 months</li> </ul>	There was a 7.5% prevalence of indoor tanning bed use among MSM. Binge drinking in past 30 days was higher among indoor tanners. Reasons for tanning included improved attractiveness, mood elevation, and stress relief.	Moderate risk
Nogg et al, <sup>22</sup> 2019	15-35 y	Survey study	No	SMM in San Diego, CA	290 SMM in San Diego, CA	<ul style="list-style-type: none"> <li>Indoor tanning dependence</li> <li>Past indoor tanning behaviors</li> <li>Intent to indoor tan</li> <li>Sunscreen use</li> </ul>	Tanning dependence in SMM is associated with greater future intent to indoor tan.	Moderate risk
Rosario et al, <sup>15</sup> 2016	9-25 y	Prospective cohort study	Yes	Growing Up Today Study (1999-2010) respondents	101 gay men, 24 bisexual men, 245 mostly heterosexual men, 3427 heterosexual men, 80 lesbian women, 136 bisexual women, 961 mostly heterosexual women, 4984 heterosexual women	<ul style="list-style-type: none"> <li>Indoor tanning booth use</li> <li>Sunburn</li> <li>Infrequent sunscreen use</li> </ul>	Gay men were more likely to frequently indoor tan than heterosexual men. Lesbian women used indoor tanning booths less frequently than heterosexual women.	Low risk

Singer et al, <sup>13</sup> 2020	≥18 y	Cross-sectional study	Yes	2014-2018 Behavioral Risk Factor Surveillance System Survey respondents	7823 gay men; 5277 bisexual men; 364,833 heterosexual men; 5609 lesbian or gay women; 9767 bisexual women; 484,341 heterosexual women	<ul style="list-style-type: none"> <li>• Lifetime skin cancer diagnosis</li> </ul>	Both gay and bisexual men carry an increased lifetime prevalence of skin cancer compared with heterosexual men. Bisexual women have lower lifetime prevalence of skin cancer compared with heterosexual women.	Low risk
Singer et al, <sup>14</sup> 2020	≥18 y	Cross-sectional study	Yes	2014-2018 Behavioral Risk Factor Surveillance System Survey respondents	1240 transgender men; 1718 transgender women; 791 gender-nonconforming individuals; 382,216 cisgender men; 511,231 cisgender women	<ul style="list-style-type: none"> <li>• Lifetime skin cancer diagnosis</li> </ul>	Gender-nonconforming individuals carry increased lifetime prevalence of skin cancer diagnosis compared to cisgender men.	Low risk
Yeung and Chen, <sup>16</sup> 2016	≥18 y	Cross-sectional study	Yes	2013 National Health Interview Survey respondents	320 gay men; 78 bisexual men; 14,495 heterosexual men; 251 lesbian women; 155 bisexual women; 18,051 heterosexual women	<ul style="list-style-type: none"> <li>• Indoor tanning bed use</li> </ul>	Gay and bisexual men were more likely to have ever indoor tanned or to frequently indoor tan.	Low risk
Yeung et al, <sup>18</sup> 2019	≥18 y	Cross-sectional study	Yes	Female respondents of 2015 National Health Interview Survey	464 SMW; 17,340 heterosexual women	<ul style="list-style-type: none"> <li>• Indoor tanning device use in past 12 months</li> <li>• ≥1 sunburns in past 12 months</li> <li>• Skin cancer screening examination in past 12 months</li> <li>• Frequent sun-protective behaviors</li> </ul>	No difference was found between SMW and heterosexual women with regard to sunburn, indoor tanning device use, skin cancer screening, and sun-protective behaviors.	Low risk

MSM, Men who have sex with men; OR, odds ratio; SMM, sexual minority men; SMW, sexual minority women.

\*Assessment was performed by using a quality assessment checklist for studies assessing prevalence.<sup>11</sup>

†No specific ages were given, but all participants were enrolled in high school at the time of data collection.

**Table II.** Prevalence and odds ratios of skin cancer risk behaviors by sexual orientation and sex\*

Article	Data source	Variable	Male sex, % (OR or aOR [95% CI])				Female sex, % (OR or aOR [95% CI])			
			Gay	Bisexual	Sexual minority	Heterosexual	Gay	Bisexual	Sexual minority	Heterosexual
Lifetime development of any skin cancer										
Mansh et al, <sup>12</sup> 2015	2009 California Health Interview Survey (N = 36,814)	Lifetime diagnosis of any skin cancer	—	—	4.3 (1.6 [1.2-2.1])	2.7 (1.0 [ref])	—	—	2.3 (0.8 [0.6-1.2])	2.6 (1.0 [ref])
	2015 National Health Interview Survey (N = 13,698)	Lifetime diagnosis of any skin cancer	—	—	6.7 (2.1 [1.1-4.0])	3.2 (1.0 [ref])	—	—	1.6 (0.5 [0.1-2.0])	3.1 (1.0 [ref])
Singer et al, <sup>13</sup> 2020	2014-2018 Behavioral Risk Factor Surveillance System Survey (N = 877,650)	Lifetime diagnosis of any skin cancer	8.2 (1.3 [1.0-1.5])	8.5 (1.5 [1.0-2.0])	—	6.8 (1.0 [ref])	6.1 (1.0 [0.8-1.3])	4.6 (0.8 [0.6-1.0])	—	6.7 (1.0 [ref])
Any indoor tanning bed use <sup>†</sup>										
Blashill and Safren, <sup>20</sup> 2014	National Longitudinal Adolescent Health study, age 16 y (N = 1767)	Any indoor tanning bed use (ever)	—	—	27.0 (3.9 [1.6-9.8])	8.6 (1.0 [ref])	—	—	—	—
Gao et al, <sup>17</sup> 2018	2015 National Health Interview Survey (N = 13,698)	Any indoor tanning bed use (ever) <sup>‡</sup>	—	—	22.1 (3.1 [2.1-4.6])	9.1 (1.0 [ref])	—	—	—	—
Gao et al, <sup>17</sup> 2018	2015 National Health Interview Survey (N = 13,698)	Any indoor tanning bed use (last 12 months) <sup>‡</sup>	—	—	6.6 (5.9 [3.5-9.8])	1.5 (1.0 [ref])	—	—	—	—
Mansh et al, <sup>12</sup> 2015	2009 California Health Interview Survey (N = 36,814)	Any indoor tanning bed use in past 12 months <sup>§</sup>	—	—	7.4 (5.8 [2.9-11.6])	1.5 (1.0 [ref])	—	—	2.6 (0.4 [0.2-0.9])	5 (1.0 [ref])
		Any indoor tanning bed use in past 12 months, ages 18-34 y <sup>§</sup>	—	—	11.1 (5.9 [2.1-17.0])	2.3 (1.0 [ref])	—	—	4.8 (0.5 [0.2-1.4])	7.5 (1.0 [ref])
	2013 National Health Interview Survey (N = 33,350)	Any indoor tanning bed use in past 12 months <sup>  </sup>	—	—	5.1 (3.2 [1.8-5.6])	1.6 (1.0 [ref])	—	—	4.2 (0.5 [0.3-0.8])	6.5 (1.0 [ref])
		Any indoor tanning bed use in past 12 months ages 18-34 y <sup>  </sup>	—	—	10.6 (3.6 [1.5-8.4])	2.6 (1.0 [ref])	—	—	7.6 (0.4 [0.2-0.7])	12.2 (1.0 [ref])
Yeung and Chen, <sup>16</sup> 2016	2013 National Health Interview Survey (N = 34,557)	Any indoor tanning bed use in past 12 months <sup>  </sup>	5.0 (2.8 [1.4-5.6])	7.1 (4.6 [1.6-13.2])	—	1.7 (1.0 [ref])	4.1 (0.5 [0.3-1.2])	6.1 (0.6 [0.3-1.3])	—	6.6 (1.0 [ref])
Yeung et al, <sup>18</sup> 2019	2015 National Health Interview Survey (N = 18,601)	Any indoor tanning device use in past 12 months <sup>#</sup>	—	—	—	—	—	—	6.6 (0.9 [0.5-1.5])	5.2 (1.0 [ref])



Frequent indoor tanning bed use (10 or more uses in 12 months)											
Rosario et al, <sup>15</sup> 2016	Growing Up Today Study (1999-2010) (N = 8752)	Frequent indoor tanning bed use in past 12 months (10 or more uses)**	24 (4.7 [3.0-7.4])	8.3 (1.3 [0.4-4.9])	—	7.2 (1.0 [ref])	22.5 (0.4 [0.3-0.7])	21.3 (0.4 [0.3-0.6])	—	41.6 (1.0 [ref])	
Yeung and Chen, <sup>16</sup> 2016	2013 National Health Interview Survey (N = 34,557)	Frequent indoor tanning bed use in past 12 months (10 or more uses) <sup>†</sup>	3.4 (4.7 [2.0-11.2])	4.5 (7.4 [2.1-26.4])	—	0.7 (1.0 [ref])	2.1 (0.5 [0.2-1.4])	4.5 (0.8 [0.3-2.0])	—	3.7 (1.0 [ref])	
Outdoor sun exposure											
Blashill et al, <sup>20</sup> 2014	National Longitudinal Adolescent Health study, age 16 y (N = 1767)	Frequent or occasional sunbathing to get a tan, age 16 y	—	—	22.3 (1.7 [0.7-4.3])	14.5 (1.0 [ref])	—	—	—	—	
Gao et al, <sup>17</sup> 2018	2015 National Health Interview Survey (N = 13,698)	Sunburn in last 12 months (at least 1) <sup>‡</sup>	—	—	36.1 (1.0 [0.7-1.3])	35.1 (1.0 [ref])	—	—	—	—	
Rosario et al, <sup>15</sup> 2016	Growing Up Today Study (1999-2010) (N = 8752)	Sun exposed sometimes, frequently, or always last summer**	90.9 (0.9 [0.7-1.3])	91.3 (1.0 [0.5-2.0])	—	87.4 (1.0 [ref])	85.7 (1.0 [0.7-1.4])	76.5 (0.8 [0.6-1.0])	—	83.7 (1.0 [ref])	
		Frequent sunburns (5 or more times last summer)**	17.8 (0.8 [0.5-1.3])	16.7 (0.6 [0.2-1.4])	—	22.1 (1.0 [ref])	25.0 (1.1 [0.7-1.9])	23.5 (1.1 [0.7-1.7])	—	25.3 (1.0 [ref])	
Yeung et al, <sup>18</sup> 2019	2015 National Health Interview Survey (N = 18,601)	Sunburn (1 or more) in past 12 months	—	—	—	—	—	—	43.3 (1.08 [0.8-1.5])	33.2 (1.0 [ref])	
Infrequent sunscreen use											
Blashill et al, <sup>20</sup> 2014	National Longitudinal Adolescent Health study, age 16 y (N = 1767)	Unlikely to wear sunblock when outside for >1 hour, age 16 y	—	—	70.5 (0.9 [0.4-2.0])	73.5 (1.0 [ref])	—	—	—	—	
		Unlikely to wear sunblock when outside for >1 hour, age 29 y	—	—	75.9 (1.0 [0.4-3.0])	75.2 (1.0 [ref])	—	—	—	—	
Rosario et al, <sup>15</sup> 2016	Growing Up Today Study (1999-2010) (N = 8752)	Infrequent or seldom use of sunscreen**	20.8 (1.3 [0.9-1.7])	8.3 (1.0 [0.8-1.3])	—	17.6 (1.0 [ref])	15.0 (1.1 [0.8-1.5])	9.6 (1.2 [0.6-2.3])	—	7.4 (1.0 [ref])	

ref, Reference.

\*Blashill et al<sup>19</sup> (2017) reported on skin cancer risk among sexual minorities; however, they provided results only stratified by race, so the data could not be incorporated into this table.

<sup>†</sup>Prevalence and odds ratios are unadjusted.

<sup>‡</sup>Age-adjusted prevalence rates standardized against the age distribution of adult men in the general population; odds ratios adjusted for age, race, region, educational level, body mass index, sun sensitivity, personal history of skin cancer, and family history of skin cancer.

<sup>§</sup>Age-adjusted prevalence rates standardized against the age distribution of adult men in the general population; odds ratios adjusted for age, race/ethnicity, body mass index, annual household income, health care use, smoking history, and current alcohol consumption.

<sup>||</sup>Age-adjusted prevalence rates standardized against the age distribution of adult men in the general population; odds ratios adjusted for age, race/ethnicity, region, body mass index, annual household income, health care use, smoking history, current alcohol consumption, and immunosuppression.

<sup>¶</sup>Unadjusted prevalence rate; odds ratio adjusted for age group, race/ethnicity, educational level, income level, health insurance status, geographic region, and personal history of any skin cancer.

<sup>#</sup>Unadjusted prevalence rate; odds ratio adjusted for age group, race/ethnicity, income level, smoking status, heavy alcohol use, and body mass index.

\*\*Unadjusted prevalence rate; odds ratio adjusted for age and race/ethnicity.

study examined biopsychosocial correlates of indoor tanning among SMM and found that perceived susceptibility to skin cancer was associated with decreased intent to indoor tan and that increased sociocultural pressures to tan were linked to higher intent to indoor tan.<sup>25</sup> Finally, another study showed that SMM with higher levels of tanning dependence were more likely to engage in skin cancer risk behaviors, including indoor tanning, outdoor tanning, and less sunscreen use.<sup>24</sup>

## DISCUSSION

The results of this systematic review show that there are differences in the prevalence of skin cancer and behaviors that increase risk of skin cancer among sexual and gender minorities, particularly among SMM. SMM have increased risk of skin cancer prevalence and disproportionately engage in use of indoor tanning beds. The single study that provided data on photoprotective behaviors of women suggests that although SMW may have a slightly increased risk of sunburns, SMW use tanning beds less frequently than heterosexual women and do not have an elevated risk of lifetime history of skin cancer.

The increased odds of skin cancer development among SMM likely reflects increased indoor UV exposure in this population. In our review, we found that SMM had between 3.0- and 6.0-fold increased odds of reporting a history of ever using an indoor tanning bed, and SMM also reported a higher prevalence of frequent indoor tanning bed use (>10 uses in past 12 months). Indoor UV exposure is strongly linked to both melanoma and keratinocyte carcinoma development,<sup>5,6,26</sup> so this behavior is a possible explanation for the increased lifetime prevalence of skin cancer that has been shown in SMM. However, SMW use health care less than their heterosexual peers, which could result in fewer skin cancer diagnoses.<sup>27</sup>

Prior studies have shown that individuals who use indoor tanning beds are more likely to participate in outdoor tanning behaviors,<sup>25</sup> but we found that there were no significant differences in history of sunbathing, sunburns, or infrequent sunscreen use by sexual orientation among men or women. This indicates that differences in sun-protective behavior are likely not a contributing factor in the increased prevalence of skin cancer among SMM, although further studies are required to determine if the prevalence of intentional outdoor tanning is influenced by sexual minority status.

Smoking increases the risk of NMSC,<sup>28</sup> and tobacco use is more prevalent among sexual minorities,<sup>29,30</sup> but the models of skin cancer risk included

in our study found an increased risk of skin cancer among SMM even when controlling for smoking status. Immunosuppression and HIV infection also increase the risk of both melanoma and NMSC,<sup>31,32</sup> and SMM in the United States are disproportionately affected by HIV.<sup>33</sup> One study found increased risk of skin cancer among SMM after controlling for immunosuppression, and 2 studies have shown that skin cancer risk is higher among HIV-positive SMM compared with other HIV-positive individuals.<sup>32,34</sup>

Motivations for indoor tanning in the general population include relaxation, increased attractiveness, mood regulation, and peer influence,<sup>35,36</sup> and our study shows that the motivations among SMM appear to be similar. The increased risk of tanning bed use in this population may indicate differential perceptions regarding ideal skin tone between sexual minority and heterosexual men, which is also evidenced by increased use of self-applied sunless tanning products or spray tans among SMM.<sup>17</sup>

Our review has important implications for future work to reduce disparities in skin cancer development and indoor tanning bed use for sexual minorities. First, providers and the larger medical community should be aware of the increased use of indoor tanning beds among SMM, and tailor medical history-taking and counseling accordingly. Providers should also consider engaging in conversations around healthier alternatives to indoor UV exposure for achieving a tan, such as sunless tanning, because this has proven effective in decreasing indoor tanning bed use among women.<sup>37</sup> Community outreach regarding the potential health risks of indoor tanning could prove beneficial, particularly if they focus on areas noted by SMM to be motivators to stop indoor tanning, such as skin cancer risk and accelerated skin ageing. Finally, only 1 included study examined lifetime skin cancer prevalence among transgender and gender-nonconforming populations, and no studies have yet examined skin cancer risk behaviors in this population. Further research is necessary to ultimately characterize risk patterns affecting this population.

This systematic review must be considered in the context of its limitations. First, we were unable to perform a meta-analysis because many of the included studies reported ORs that were adjusted by using different covariates. All of the included data are from cross-sectional studies, and therefore definitive conclusions regarding temporality cannot be established. Additionally, the studies included relied on self-reported history of skin cancer, indoor tanning bed use, and outdoor sun exposure that was not validated. The reliability and validity of self-reported

diagnoses is controversial, with some studies showing that self-reported skin cancer rates are lower than actual prevalence.<sup>38,39</sup> Additionally, only 1 study accounted for HIV/immunosuppression status, so the link between immunosuppression status and skin cancer development in sexual minority populations is unclear. Finally, the studies in our review that assessed motivations for indoor tanning among SMM were all qualitative, so future quantitative studies are needed to validate these results in a generalizable manner.

## CONCLUSION

SMM have a higher prevalence of both skin cancer and indoor tanning bed use compared with heterosexual men, which is likely due to unique community pressures and appearance ideals that face this community. A combination of outreach, education, and public health initiatives targeted at reducing indoor tanning bed use among SMM may reduce the elevated risk of skin cancer currently seen in this population.

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