# Skin Cancer Knowledge, Attitudes and Sun Protection Practices in the Hispanic Population: A Cross-Sectional Survey

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## Abstract

Hispanics are more likely to be diagnosed with skin cancer at a later stage and experience worse overall survival than Whites. The objective of this cross-sectional study was to assess the skin cancer knowledge, attitudes, perceived risk, and sun protection practices among an underserved population in the Phoenix area. We recruited participants from the greater Phoenix area to undergo skin examination and complete a questionnaire. 208 participants were included. The majority were Hispanic (64.9%). Of this Hispanic group, most were from Mexico (87.9%). The Hispanic cohort had an overall mean skin cancer knowledge score of 3.68/6, the lowest of any other racial/ethnic group, but had the highest desire to learn more about skin cancer (64.6%, "strongly agree"). They were the most concerned about developing skin cancer (50.4%, "very concerned") but had relatively lower rates of sun protection practices (7.9% "always use" sunscreen, 22.0% "always use" sun-protective clothing). Limitations of this study include a small sample size, lack of validation for the skin cancer knowledge score, lack of season as a covariate in the multivariate analysis, lack of follow-up, and lack of robust skin cancer risk assessment. In conclusion, despite poorer skin cancer knowledge and sun protection practices, the Hispanic population had the highest concern for developing skin cancer and desire to learn more about skin cancer. Targeted and culturally relevant skin cancer and sun protection education for this group is needed.

## Introduction

Rising rates of melanoma and non-melanoma skin cancer have led to significant health and economic burdens in the United States (US) [1, 2]. African Americans and Hispanics are more likely to be diagnosed with melanoma at an advanced stage and have poorer overall survival than Whites [3–5]. The incidence of melanoma has been increasing in Whites and Hispanic women [5]. Despite this increasing incidence, a decrease in distant metastasis at initial diagnosis in Whites has been noted; however, there has been no decrease in distant metastasis at initial diagnosis in African Americans or Hispanics [5]. There remains a need for improved primary and secondary prevention of skin cancer in patients with skin of color.

A prior study found gaps in knowledge regarding melanoma and perceived risk of melanoma development in people with skin of color [6]. This group was also less likely to perform self-skin examinations. Similar studies have revealed decreased awareness and perceived risk of skin cancer among Hispanics relative to non-Hispanics, and decreased use of sun protection strategies in Hispanics and African Americans [7, 8]. A recent cross-sectional survey of 285 individuals found that Hispanics were less likely than Whites to know the definition of melanoma and a study of 471 mothers found decreased skin cancer and sun care knowledge in Hispanic mothers as compared to White mothers. [9, 10] Educational interventions have been shown to improve melanoma knowledge and preventative practice in people with skin of color [6]. Interventional studies in the Hispanic population, including a study

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using UV photo-aged images in adults, and a study using a "SunSmart" educational program in school children showed an increase in intention to use or self-efficacy in using sunscreen [11, 12].

The majority of dermatology educational programs are geared toward Whites, and representation of non-Whites is low in both dermatology education materials and skin cancer screening events, further compounding the issue. [13–15] A better understanding of the attitudes and beliefs about cutaneous malignancies in people with skin of color is needed to develop effective, targeted education for all patients. This study sought to assess skin cancer knowledge and attitudes, perceived skin cancer risk, and sun protection practices among an underserved, primarily Hispanic population in the greater Phoenix metropolitan area.

## Methods

Between March 2017 and August 2018, participants were recruited while participating in the American Academy of Dermatology (AAD) SpotMe skin cancer screening program in collaboration with Mayo Clinic Arizona and the University of Arizona Mobile Research Unit [15]. Twenty-three events took place throughout the greater Phoenix area. These events took place at multiple different geographic sites, including homeless shelters and community placed mobile health fairs in and around the Phoenix metropolitan area. Most events took place in the fall (34.5%) or summer (26.1%).

### Measures

Before undergoing skin examination, participants completed an optional survey covering skin type, ethnicity, demographic information, sun protection practices, 6 skin cancer knowledge questions, and desire for further education. (Supplement 1). These 6 skin cancer knowledge questions consisted of: what is melanoma? Is skin cancer related to sun exposure? Is melanoma related to sun exposure? Which of the following is a warning sign of melanoma? Can skin cancer be a deadly disease? Melanoma can be more easily cured if it is found early? A knowledge score was calculated using the mean number of correct responses to the above 6 skin cancer knowledge questions. The questionnaire was available in English and Spanish and a Spanish-speaking interpreter was available for questions. A ten-dollar remuneration was provided to participants.

Deidentified data were stored in a secure site and transferred to a password-encrypted REDCap database [16, 17]. As our population included many homeless and/or undocumented immigrant participants, date of birth and sex were not included in the analysis to further protect identity.

### Statistical Analysis

Categorical variables were summarized as count and percent. The Chi-squared test was used to test for differences in the distribution of counts between two categorical variables. A multivariable linear regression was used to estimate the impact of variables such as ethnicity on a participant's skin cancer knowledge score while adjusting for sun protection practices and behaviors, as well as skin cancer risk factors. All collected questions were considered for inclusion in the multivariate models; however, only questions which were consistent with a sun protection practice, skin cancer risk factor or knowledge, ethnicity, and socioeconomic factors were included. Specifically, the effects of the individual covariates, hours in the sun, family history of skin cancer, use of tanning equipment, ethnicity, skin color change in sun, use of sun protective clothing, and sunscreen use, on knowledge score were tested while controlling for the other listed covariates. A second multivariate analysis was run testing the effect of ethnicity on knowledge score while adjusting for the covariates of education, income, and insurance status. All hypothesis tests were two-sided with $p < 0.05$ considered statistically significant. Analyses were performed in SAS 9.4 (SAS Institute, Inc.; Cary, NC).

## Results

### Demographics

A total of 208 individuals participated in this study (Table 1). The majority (64.9%) of this group identified as Hispanic, with the next largest group being White (19.2%)." Of these Hispanic cohort, 87.9% were Mexican. A mean household income of < $25,000 was reported by more Hispanics than Whites ($p = 0.030$). Additionally, attainment of a high school degree/general equivalency diploma (GED) or less was reported by more Hispanics, than Whites ($p = 0.001$). Unemployed individuals comprised a quarter of the total population and Hispanic population, however, not significantly more than the White population ($p = 0.654$). However, Hispanics were more commonly uninsured compared to Whites and the overall cohort ($p < 0.001$). A personal history of skin cancer was reported by more Whites than the Hispanics or the total population, though not significant ($p = 0.137$). Family history of skin cancer was reported by more Whites than Hispanics ($p < 0.01$). No participants reported a personal history of melanoma. Family history of melanoma was reported by 12.5% of Whites with a family

**Table 1**  Participant demographics

| | Hispanic (N=135) | White (N=40) | American Indian/Alaska Native (N=15) | African American (n=11) | Asian (N=4) | Other (N=3) | Total (N=208) | p-value |
|---|---|---|---|---|---|---|---|---|
| Origin (If Hispanic), n (%) | | | | | | | | 1 |
| Missing | 11 | 40 | 15 | 11 | 4 | 3 | 84 | |
| Mexican | 109 (87.9%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 109 (87.9%) | |
| Central American | 14 (11.3%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 14 (11.3%) | |
| South American | 1 (0.8%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 1 (0.8%) | |
| English as Primary Language, n (%) | | | | | | | | <0.001 |
| Missing | 7 | 0 | 2 | 0 | 0 | 0 | 9 | |
| No | 97 (75.8%) | 1 (2.5%) | 2 (15.4%) | 0 (0.0%) | 1 (25.0%) | 0 (0.0%) | 101 (50.8%) | |
| Yes | 30 (23.4%) | 39 (97.5%) | 11 (84.6%) | 11 (100.0%) | 3 (75.0%) | 3 (100.0%) | 97 (48.7%) | |
| I do not wish to disclose | 1 (0.8%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 1 (0.5%) | |
| Income, n (%) | | | | | | | | 0.0301 |
| Missing | 7 | 2 | 2 | 0 | 0 | 0 | 11 | |
| Less than $25,000 | 78 (60.9%) | 16 (42.1%) | 4 (30.8%) | 6 (54.5%) | 0 (0.0%) | 2 (66.7%) | 106 (53.8%) | |
| $25,000 to $49,999 | 25 (19.5%) | 11 (28.9%) | 1 (7.7%) | 4 (36.4%) | 1 (25.0%) | 1 (33.3%) | 43 (21.8%) | |
| $50,000 to $99,999 | 8 (6.3%) | 7 (18.4%) | 3 (23.1%) | 0 (0.0%) | 2 (50.0%) | 0 (0.0%) | 20 (10.2%) | |
| More than $100,000 | 3 (2.3%) | 1 (2.6%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 4 (2.0%) | |
| I do not wish to disclose | 14 (10.9%) | 3 (7.9%) | 5 (38.5%) | 1 (9.1%) | 1 (25.0%) | 0 (0.0%) | 24 (12.2%) | |
| Education, n (%) | | | | | | | | <0.001 |
| Missing | 10 | 0 | 2 | 0 | 0 | 0 | 12 | |
| Less than high school | 35 (28.0%) | 1 (2.5%) | 4 (30.8%) | 1 (9.1%) | 0 (0.0%) | 1 (33.3%) | 42 (21.4%) | |
| High school / GED | 56 (44.8%) | 5 (12.5%) | 3 (23.1%) | 3 (27.3%) | 0 (0.0%) | 1 (33.3%) | 68 (34.7%) | |
| Some college | 20 (16.0%) | 7 (17.5%) | 1 (7.7%) | 4 (36.4%) | 0 (0.0%) | 0 (0.0%) | 32 (16.3%) | |
| 2-year college degree | 6 (4.8%) | 4 (10.0%) | 1 (7.7%) | 2 (18.2%) | 0 (0.0%) | 0 (0.0%) | 13 (6.6%) | |
| 4-year college degree | 5 (4.0%) | 17 (42.5%) | 4 (30.8%) | 1 (9.1%) | 2 (50.0%) | 1 (33.3%) | 30 (15.3%) | |
| Master's degree or higher | 3 (2.4%) | 6 (15.0%) | 0 (0.0%) | 0 (0.0%) | 2 (50.0%) | 0 (0.0%) | 11 (5.6%) | |
| Employment, n (%) | | | | | | | | 0.6541 |
| Missing | 16 | 0 | 2 | 0 | 0 | 0 | 18 | |
| Employed full-time | 39 (32.8%) | 15 (37.5%) | 3 (23.1%) | 4 (36.4%) | 3 (75.0%) | 1 (33.3%) | 65 (34.2%) | |
| Employed part-time | 15 (12.6%) | 4 (10.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 19 (10.0%) | |
| Self-employed | 8 (6.7%) | 5 (12.5%) | 1 (7.7%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 14 (7.4%) | |
| Retired | 3 (2.5%) | 2 (5.0%) | 0 (0.0%) | 1 (9.1%) | 0 (0.0%) | 0 (0.0%) | 6 (3.2%) | |
| Unemployed | 29 (24.4%) | 8 (20.0%) | 7 (53.8%) | 3 (27.3%) | 1 (25.0%) | 1 (33.3%) | 49 (25.8%) | |
| Disabled | 4 (3.4%) | 1 (2.5%) | 1 (7.7%) | 1 (9.1%) | 0 (0.0%) | 1 (33.3%) | 8 (4.2%) | |
| Other | 21 (17.6%) | 5 (12.5%) | 1 (7.7%) | 2 (18.2%) | 0 (0.0%) | 0 (0.0%) | 29 (15.3%) | |
| Insurance, n (%) | | | | | | | | <0.001 |
| Missing | 14 | 1 | 2 | 0 | 0 | 0 | 17 | |
| Private/Employer Offered Insurance | 18 (14.9%) | 15 (38.5%) | 1 (7.7%) | 3 (27.3%) | 4 (100.0%) | 1 (33.3%) | 42 (22.0%) | |

**Table 1** (continued)

| | Hispanic (N=135) | White (N=40) | American Indian/Alaska Native (N=15) | African American (n=11) | Asian (N=4) | Other (N=3) | Total (N=208) | p-value |
|---|---|---|---|---|---|---|---|---|
| Government funded insurance | 25 (20.7%) | 9 (23.1%) | 8 (61.5%) | 7 (63.6%) | 0 (0.0%) | 2 (66.7%) | 51 (26.7%) | |
| Self-paid insurance | 10 (8.3%) | 3 (7.7%) | 0 (0.0%) | 1 (9.1%) | 0 (0.0%) | 0 (0.0%) | 14 (7.3%) | |
| Uninsured | 63 (52.1%) | 12 (30.8%) | 4 (30.8%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 79 (41.4%) | |
| I don't know | 5 (4.1%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 5 (2.6%) | |
| Personal History, n (%) | | | | | | | | |
| Skin Cancer | 2 (1.6%) | 4 (10.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 6 (3.1%) | 0.1371 |
| Melanoma | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 1 |
| Squamous Cell Carcinoma | 0 (0.0%) | 1 (2.5%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 1 (0.5%) | 0.5181 |
| Basal Cell Carcinoma | 1 (0.7%) | 4 (10.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 5 (2.4%) | 0.0321 |
| Uncertain | 1 (0.7%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 1 (0.5%) | 0.9901 |
| Family History, n (%) | | | | | | | | |
| Skin Cancer | 8 (6.5%) | 16 (42.1%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 1 (33.3%) | 25 (12.8%) | <0.001 |
| Melanoma | 0 (0.0%) | 5 (12.5%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 5 (2.4%) | 0.0011 |
| Squamous Cell Carcinoma | 1 (0.7%) | 2 (5.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 3 (1.4%) | 0.4781 |
| Basal Cell Carcinoma | 1 (0.7%) | 3 (7.5%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 4 (1.9%) | 0.1431 |
| Uncertain | 5 (3.7%) | 8 (20.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 1 (33.3%) | 14 (6.7%) | 0.0021 |

history of skin cancer, while no other race reported a family history of melanoma.

## Skin Cancer Knowledge and Attitudes

When asked about perceived personal risk of developing skin cancer, most (63.7%) Hispanics responded, "I don't know," compared to only 15% of Whites ($p < 0.001$) (Table 2). Despite lack of knowledge, Hispanics were the most concerned about developing skin cancer, with 50.4% reporting being "very concerned," vs. 35% of Whites and 42% overall ($p < 0.001$). Regarding skin cancer knowledge, Hispanics displayed the largest knowledge deficit with 58.3% responding, "I don't know" when asked what melanoma is ($p < 0.001$), 13.7% responding that skin cancer cannot be a deadly disease ($p = 0.101$), and 47.2% responding "I don't know" regarding warning signs of melanoma ($p = 0.002$). Hispanics had a significantly lower mean knowledge score of 3.68/6 (standard deviation [SD] 1.79) compared to Whites (5.68/6; SD 0.57), and the overall cohort (4.19/6; SD 1.79; $p < 0.001$). Hispanics exhibited the greatest desire to learn more about skin cancer, with 64.6% selecting "strongly agree," vs. 32.5% of Whites and 54.5% of the overall cohort ($p = 0.05$). Hispanics preferred to be educated through speaking with a health educator (37.1%) or through video (22.6%). These rates were similar to the total cohort's rates of 36.5% and 21.9%, respectively ($p = 0.114$).

## Practices and Behaviors

Whites more frequently (71.8%) reported sunscreen usage compared to Hispanics (47.3%) and the overall population (53.2%) ($p = 0.142$) (Table 3). Additionally, Hispanics were less likely to wear sun-protective clothing (67.7%), compared to Whites (74.4%), and the overall cohort (67.9%) ($p = 0.010$). Despite decreased sun protection, 28.9% of Hispanics worked in the sun vs. 17.5% of Whites and 28.8% the overall cohort ($p = 0.049$). Nearly all participants (98.5%) believed skin exams for melanoma detection were important; however, only 22.7% of Hispanics had heard of a self-skin exam, and only 8.1% had ever checked themselves for skin cancer (vs. 65% and 51.3% for Whites, and 65.9% and 18.5% for the overall cohort, respectively) ($p < 0.001$), ($p < 0.001$). Furthermore, only 9.9% of Hispanics had ever received a skin examination by a medical professional (vs. 37.5% of Whites and 15.2% of the overall cohort; $p = 0.001$). Finally, 63.5% of Hispanics either rarely or had never seen a doctor, and 62.7% had not seen a healthcare provider in the past 6 months (vs. 57.5% and 42.1% of Whites and 56.8% and 53.3%, of the overall cohort, respectively) ($p = 0.232$), ($p < 0.001$).

## Knowledge Multivariable Analysis

Despite controlling for sun protection practices and skin cancer risk factors, a significant difference in knowledge score between ethnicities was still observed ($p < 0.001$). Multivariable analysis also revealed that use of sunscreen was significantly associated with knowledge score while controlling for all other variables, including ethnicity ($p = 0.002$). No other significant associations were observed. When multivariable analysis was performed while adjusting for education, income, and insurance status, no significant difference in knowledge score between ethnicities was found ($p = 0.487$).

## Discussion

Our study population was unique in that the majority were Hispanic, originating from Mexico. In contrast, previous studies have mostly focused on populations in the East Coast of the USA, and likely did not comprise such a high proportion of participants identifying as Mexican. [5] As the Southwestern USA hosts a large proportion of the Hispanic-American population, and the majority of Hispanic-Americans identify as Mexican, it is important to characterize the knowledge, perceived risk, and skin health behaviors of this demographic group [18]. This is particularly important as Hispanic-Americans are projected to comprise more than a quarter of the entire US population by 2060 [19]. Previous studies have demonstrated that Hispanic-Americans with melanoma have a lower 5-year survival rate than Whites [20]. This is likely due to poorer access to healthcare and later stage of disease at time of diagnosis [5]. Additionally, prior studies have shown that outcomes and treatment of all stages of melanoma are affected by income, insurance status, and education [21]. Over half of our Hispanic population had an income of < $25,000, a quarter were unemployed with half uninsured, and three-quarters had a high school degree/GED or less education. As our population of Hispanic Americans in the southwestern USA is comprised of vulnerable individuals who are more likely to suffer from later stage of melanoma at time of diagnosis and poorer prognosis compared to the general population, this group should be a focus of educational skin cancer programs and outreach measures. Further, primary care providers should be made aware of the skin cancer risk in this population, as primary care may be the initial healthcare point of contact.

We found a significant difference in skin cancer knowledge between ethnicities while controlling for variables such as sun protection practices and skin cancer risk factors. However, when adjusting for socioeconomic factors, such as insurance status, income, and education level, no difference in knowledge score was observed between ethnicities. This implies that these socioeconomic factors, such as education level, are an important factor in skin cancer knowledge and risk perceptions, which is in line with previous studies [22, 23]. An additional striking finding was the discrepancy between skin cancer knowledge in the Hispanic population and their overall desire to learn more about skin cancer. Hispanics had the lowest skin cancer knowledge score of any group but expressed the highest concern about skin cancer. A prior study analyzing skin cancer risk perception revealed that Hispanics, along with African Americans, the elderly, and less educated individuals, were more likely to believe that they cannot lower their skin cancer risk and often express uncertainty regarding the efficacy of prevention recommendations [22]. A prior interventional study in Hispanic school children showed that educational initiatives are effective in increasing sun care self-efficacy [12]. This implies that the observed low rates of skin cancer knowledge and sun protection practices are due to a failure to properly educate this group on the dangers of skin cancer and proper prevention methods.

We found a further discordance between reported sun exposure and sun protection practices in our Hispanic cohort. Despite approximately one-third of Hispanics reportedly working in the sun (the highest of any group), only half reported using sunscreen or wearing sun-protective clothing. This is consistent with previous studies, including a study which revealed the majority of Hispanic outdoor workers rarely or never wore sunscreen [24]. Another study of 1676 Hispanic adults with sun-sensitive skin found even lower rates of sunscreen and sun-protective clothing use [24, 25]. Similar findings were noted in focus groups from multiple cities across the US found that Hispanics had a lower perceived risk of skin cancer and were less likely to use sun protection [8]. Our study found that there was a significant relationship between the use of sunscreen and knowledge score. This implies that knowledge score may have an impact on sun care practices, highlighting the importance of education initiatives that increase skin cancer knowledge.

Of note, our Hispanic population was the least likely to perform self-skin exams. This is likely due to a failure to properly educate this population, as less than a quarter had ever heard of a self-skin examination, the lowest of any of our racial/ethnic groups. These results are similar to prior reports of lower rates of self-skin examination and self-skin examination education in Hispanics [7]. Finally, the rates of medical utilization were low in the Hispanic population, as few had previously received a professional skin exam, and the majority rarely see or have never seen a doctor. While this is influenced by socioeconomic factors and the cost of accessing healthcare, improved education regarding the importance of regular medical care and skin examinations is needed.

**Table 2** Skin cancer knowledge and perception questions

| | Hispanic (N=135) | White (N=40) | American Indian/Alaska Native (N=15) | African American (n=11) | Asian (N=4) | Other (N=3) | Total (N=208) | p-value |
|---|---|---|---|---|---|---|---|---|
| Perceived Risk of Developing Skin Cancer, n (%) | | | | | | | | <0.001 |
| Higher than average | 9 (6.7%) | 15 (37.5%) | 2 (13.3%) | 1 (9.1%) | 0 (0.0%) | 1 (33.3%) | 28 (13.5%) | |
| Average | 32 (23.7%) | 16 (40.0%) | 3 (20.0%) | 4 (36.4%) | 2 (50.0%) | 0 (0.0%) | 57 (27.4%) | |
| Lower than average | 8 (5.9%) | 3 (7.5%) | 5 (33.3%) | 3 (27.3%) | 0 (0.0%) | 0 (0.0%) | 19 (9.1%) | |
| I don't know | 86 (63.7%) | 6 (15.0%) | 5 (33.3%) | 3 (27.3%) | 2 (50.0%) | 2 (66.7%) | 104 (50.0%) | |
| Concern About Developing Skin Cancer, n (%) | | | | | | | | <0.001 |
| Missing | 2 | 0 | 0 | 1 | 0 | 0 | 3 | |
| Not concerned at all | 7 (5.3%) | 1 (2.5%) | 4 (26.7%) | 3 (30.0%) | 0 (0.0%) | 0 (0.0%) | 15 (7.3%) | |
| Slightly concerned | 15 (11.3%) | 9 (22.5%) | 5 (33.3%) | 4 (40.0%) | 2 (50.0%) | 0 (0.0%) | 35 (17.1%) | |
| Neither concerned nor not concerned | 4 (3.0%) | 4 (10.0%) | 0 (0.0%) | 1 (10.0%) | 0 (0.0%) | 1 (33.3%) | 10 (4.9%) | |
| Moderately concerned | 40 (30.1%) | 12 (30.0%) | 4 (26.7%) | 0 (0.0%) | 2 (50.0%) | 1 (33.3%) | 59 (28.8%) | |
| Very concerned | 67 (50.4%) | 14 (35.0%) | 2 (13.3%) | 2 (20.0%) | 0 (0.0%) | 1 (33.3%) | 86 (42.0%) | |
| Risk of developing skin cancer for your identified ethnicity, n (%) | | | | | | | | <0.001 |
| Missing | 2 | 0 | 1 | 0 | 0 | 0 | 3 | |
| Above average | 19 (14.3%) | 17 (42.5%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 2 (66.7%) | 38 (18.5%) | |
| Average | 32 (24.1%) | 16 (40.0%) | 1 (7.1%) | 3 (27.3%) | 2 (50.0%) | 1 (33.3%) | 55 (26.8%) | |
| Below average | 10 (7.5%) | 1 (2.5%) | 5 (35.7%) | 4 (36.4%) | 1 (25.0%) | 0 (0.0%) | 21 (10.2%) | |
| Impossible | 6 (4.5%) | 0 (0.0%) | 3 (21.4%) | 1 (9.1%) | 0 (0.0%) | 0 (0.0%) | 10 (4.9%) | |
| I don't know | 66 (49.6%) | 6 (15.0%) | 5 (35.7%) | 3 (27.3%) | 1 (25.0%) | 0 (0.0%) | 81 (39.5%) | |
| Desire to Learn More About Skin Cancer, n (%) | | | | | | | | 0.0051 |
| Missing | 5 | 0 | 1 | 0 | 0 | 0 | 6 | |
| Strongly agree | 84 (64.6%) | 13 (32.5%) | 6 (42.9%) | 4 (36.4%) | 2 (50.0%) | 1 (33.3%) | 110 (54.5%) | |
| Agree | 34 (26.2%) | 20 (50.0%) | 6 (42.9%) | 4 (36.4%) | 2 (50.0%) | 1 (33.3%) | 67 (33.2%) | |
| Neither agree nor disagree | 12 (9.2%) | 7 (17.5%) | 1 (7.1%) | 3 (27.3%) | 0 (0.0%) | 1 (33.3%) | 24 (11.9%) | |
| Disagree | 0 (0.0%) | 0 (0.0%) | 1 (7.1%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 1 (0.5%) | |
| Preferred Education Method, n (%) | | | | | | | | 0.1141 |
| Missing | 11 | 2 | 2 | 1 | 0 | 0 | 16 | |
| Video | 28 (22.6%) | 6 (15.8%) | 2 (15.4%) | 4 (40.0%) | 1 (25.0%) | 1 (33.3%) | 42 (21.9%) | |
| Text message | 14 (11.3%) | 1 (2.6%) | 3 (23.1%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 18 (9.4%) | |
| Email | 19 (15.3%) | 15 (39.5%) | 2 (15.4%) | 1 (10.0%) | 1 (25.0%) | 0 (0.0%) | 38 (19.8%) | |
| Talk to health educator | 46 (37.1%) | 14 (36.8%) | 2 (15.4%) | 4 (40.0%) | 2 (50.0%) | 2 (66.7%) | 70 (36.5%) | |
| Class | 17 (13.7%) | 2 (5.3%) | 4 (30.8%) | 1 (10.0%) | 0 (0.0%) | 0 (0.0%) | 24 (12.5%) | |
| Knowledge Score, mean (SD) | 3.68 (1.79) | 5.68 (0.57) | 4.27 (1.75) | 3.82 (1.78) | 5.75 (0.50) | 6.00 (0.00) | 4.19 (1.79) | <0.001 |
| What is melanoma? n (%) | | | | | | | | <0.001 |
| Missing | 8 | 0 | 1 | 0 | 0 | 0 | 9 | |
| A skin disease that is not cancer | 12 (9.4%) | 0 (0.0%) | 0 (0.0%) | 1 (9.1%) | 0 (0.0%) | 0 (0.0%) | 13 (6.5%) | |

**Table 2** (continued)

| | Hispanic (N=135) | White (N=40) | American Indian/Alaska Native (N=15) | African American (n=11) | Asian (N=4) | Other (N=3) | Total (N=208) | p-value |
|---|---|---|---|---|---|---|---|---|
| A non-skin cancer | 3 (2.4%) | 0 (0.0%) | 1 (7.1%) | 1 (9.1%) | 0 (0.0%) | 0 (0.0%) | 5 (2.5%) | 0.1731 |
| A type of skin cancer | 38 (29.9%) | 37 (92.5%) | 9 (64.3%) | 6 (54.5%) | 4 (100.0%) | 3 (100.0%) | 97 (48.7%) | |
| Other | 0 (0.0%) | 0 (0.0%) | 1 (7.1%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 1 (0.5%) | |
| I don't know | 74 (58.3%) | 3 (7.5%) | 3 (21.4%) | 3 (27.3%) | 0 (0.0%) | 0 (0.0%) | 83 (41.7%) | |
| **Is skin cancer related to sun exposure? n (%)** | | | | | | | | |
| Missing | 7 | 1 | 1 | 1 | 0 | 0 | 10 | |
| No | 19 (14.8%) | 0 (0.0%) | 2 (14.3%) | 1 (10.0%) | 0 (0.0%) | 0 (0.0%) | 22 (11.1%) | |
| Yes | 109 (85.2%) | 39 (100.0%) | 12 (85.7%) | 9 (90.0%) | 4 (100.0%) | 3 (100.0%) | 176 (88.9%) | 0.1021 |
| **Is melanoma related to sun exposure? n (%)** | | | | | | | | |
| Missing | 25 | 1 | 1 | 3 | 0 | 0 | 30 | |
| a. No | 24 (21.8%) | 2 (5.1%) | 3 (21.4%) | 3 (37.5%) | 0 (0.0%) | 0 (0.0%) | 32 (18.0%) | |
| b. Yes | 86 (78.2%) | 37 (94.9%) | 11 (78.6%) | 5 (62.5%) | 4 (100.0%) | 3 (100.0%) | 146 (82.0%) | 0.0021 |
| **Which of the following is a warning of sign of melanoma? n (%)** | | | | | | | | |
| Missing | 8 | 0 | 1 | 0 | 0 | 0 | 9 | |
| A red bump | 6 (4.7%) | 1 (2.5%) | 0 (0.0%) | 1 (9.1%) | 0 (0.0%) | 0 (0.0%) | 8 (4.0%) | |
| Hair Loss | 3 (2.4%) | 0 (0.0%) | 0 (0.0%) | 1 (9.1%) | 0 (0.0%) | 0 (0.0%) | 4 (2.0%) | |
| Red Skin | 8 (6.3%) | 0 (0.0%) | 2 (14.3%) | 1 (9.1%) | 0 (0.0%) | 0 (0.0%) | 11 (5.5%) | |
| A mole that is changing in size shape or color | 50 (39.4%) | 36 (90.0%) | 8 (57.1%) | 5 (45.5%) | 3 (75.0%) | 3 (100.0%) | 105 (52.8%) | |
| I don't know | 60 (47.2%) | 3 (7.5%) | 4 (28.6%) | 3 (27.3%) | 1 (25.0%) | 0 (0.0%) | 71 (35.7%) | 0.1011 |
| **Can skin cancer be a deadly disease? n (%)** | | | | | | | | |
| Missing | 11 | 0 | 1 | 0 | 0 | 0 | 12 | |
| No | 17 (13.7%) | 0 (0.0%) | 0 (0.0%) | 1 (9.1%) | 0 (0.0%) | 0 (0.0%) | 18 (9.2%) | |
| Yes | 107 (86.3%) | 40 (100.0%) | 14 (100.0%) | 10 (90.9%) | 4 (100.0%) | 3 (100.0%) | 178 (90.8%) | 0.3361 |
| **Melanoma can be more easily cured if it is found early? n (%)** | | | | | | | | |
| Missing | 20 | 0 | 2 | 3 | 0 | 0 | 25 | |
| No | 8 (7.0%) | 2 (5.0%) | 3 (23.1%) | 1 (12.5%) | 0 (0.0%) | 0 (0.0%) | 14 (7.7%) | |
| Yes | 107 (93.0%) | 38 (95.0%) | 10 (76.9%) | 7 (87.5%) | 4 (100.0%) | 3 (100.0%) | 169 (92.3%) | |

**Table 3** Sun protection practices questions

| | Hispanic (N=135) | White (N=40) | American Indian/Alaska Native (N=15) | African American (n=11) | Asian (N=4) | Other (N=3) | Total (N=208) | p-value |
|---|---|---|---|---|---|---|---|---|
| Sunscreen Use, n (%) | | | | | | | | 0.1421 |
| Missing | 8 | 1 | 0 | 0 | 0 | 0 | 9 | |
| Always | 10 (7.9%) | 4 (10.3%) | 2 (13.3%) | 1 (9.1%) | 0 (0.0%) | 1 (33.3%) | 18 (9.0%) | |
| Sometimes | 50 (39.4%) | 24 (61.5%) | 5 (33.3%) | 4 (36.4%) | 3 (75.0%) | 2 (66.7%) | 88 (44.2%) | |
| Rarely | 31 (24.4%) | 9 (23.1%) | 3 (20.0%) | 1 (9.1%) | 1 (25.0%) | 0 (0.0%) | 45 (22.6%) | |
| Never | 36 (28.3%) | 2 (5.1%) | 5 (33.3%) | 5 (45.5%) | 0 (0.0%) | 0 (0.0%) | 48 (24.1%) | |
| Sun-Protective Clothing Use, n (%) | | | | | | | | 0.0101 |
| Missing | 8 | 1 | 0 | 0 | 0 | 0 | 9 | |
| Always | 28 (22.0%) | 0 (0.0%) | 2 (13.3%) | 3 (27.3%) | 0 (0.0%) | 1 (33.3%) | 34 (17.1%) | |
| Sometimes | 58 (45.7%) | 29 (74.4%) | 4 (26.7%) | 4 (36.4%) | 4 (100.0%) | 2 (66.7%) | 101 (50.8%) | |
| Rarely | 25 (19.7%) | 6 (15.4%) | 7 (46.7%) | 1 (9.1%) | 0 (0.0%) | 0 (0.0%) | 39 (19.6%) | |
| Never | 16 (12.6%) | 4 (10.3%) | 2 (13.3%) | 3 (27.3%) | 0 (0.0%) | 0 (0.0%) | 25 (12.6%) | |
| Employment in the Sun, n (%) | 39 (28.9%) | 7 (17.5%) | 9 (60.0%) | 2 (18.2%) | 2 (50.0%) | 1 (33.3%) | 60 (28.8%) | 0.0491 |
| Belief that Skin Examination for Melanoma Important, n (%) | 127 (98.4%) | 40 (100.0%) | 14 (93.3%) | 11 (100.0%) | 4 (100.0%) | 3 (100.0%) | 199 (98.5%) | 0.6041 |
| Heard of Self-Skin Exam, n (%) | 30 (22.7%) | 26 (65.0%) | 4 (26.7%) | 5 (45.5%) | 3 (75.0%) | 2 (66.7%) | 70 (34.1%) | <0.001 |
| Performed Self-Skin Exam, n (%) | 10 (8.1%) | 20 (51.3%) | 2 (13.3%) | 1 (10.0%) | 2 (50.0%) | 1 (33.3%) | 36 (18.5%) | <0.001 |
| Medical Professional Skin-Exam, n (%) | 13 (9.9%) | 15 (37.5%) | 1 (6.7%) | 1 (9.1%) | 1 (25.0%) | 0 (0.0%) | 31 (15.2%) | 0.0011 |
| Frequency of Healthcare Provider Visits in the Past 6 Months, n (%) | | | | | | | | <0.001 |
| Missing | 9 | 2 | 2 | 0 | 0 | 0 | 13 | |
| None | 79 (62.7%) | 16 (42.1%) | 5 (38.5%) | 1 (9.1%) | 1 (25.0%) | 2 (66.7%) | 104 (53.3%) | |
| 1–2 times | 32 (25.4%) | 19 (50.0%) | 3 (23.1%) | 7 (63.6%) | 3 (75.0%) | 0 (0.0%) | 64 (32.8%) | |
| 3–5 times | 11 (8.7%) | 3 (7.9%) | 3 (23.1%) | 3 (27.3%) | 0 (0.0%) | 0 (0.0%) | 20 (10.3%) | |
| More than 5 times | 4 (3.2%) | 0 (0.0%) | 2 (15.4%) | 0 (0.0%) | 0 (0.0%) | 1 (33.3%) | 7 (3.6%) | |
| What happens to your skin when you are in the sun for a long period of time? n (%) | | | | | | | | 0.1831 |
| Missing | 16 | 0 | 2 | 3 | 1 | 0 | 22 | |
| Always burn, painful burn 24 h later | 11 (9.2%) | 7 (17.5%) | 0 (0.0%) | 0 (0.0%) | 1 (33.3%) | 0 (0.0%) | 19 (10.2%) | |
| Easily burn, painful burn 24 h later | 13 (10.9%) | 9 (22.5%) | 0 (0.0%) | 1 (12.5%) | 0 (0.0%) | 1 (33.3%) | 24 (12.9%) | |
| Mild burning, skin irritation, tenderness or itching in sun-exposed skin | 24 (20.2%) | 13 (32.5%) | 3 (23.1%) | 1 (12.5%) | 1 (33.3%) | 1 (33.3%) | 43 (23.1%) | |
| Minimal skin irritation, tenderness, or itching in sun-exposed skin | 10 (8.4%) | 4 (10.0%) | 2 (15.4%) | 2 (25.0%) | 1 (33.3%) | 0 (0.0%) | 19 (10.2%) | |
| Occasional skin irritation tenderness, or itching in sun-exposed skin | 29 (24.4%) | 5 (12.5%) | 4 (30.8%) | 2 (25.0%) | 0 (0.0%) | 1 (33.3%) | 41 (22.0%) | |
| No skin irritation, tenderness, or itching in sun-exposed skin | 32 (26.9%) | 2 (5.0%) | 4 (30.8%) | 2 (25.0%) | 0 (0.0%) | 0 (0.0%) | 40 (21.5%) | |
| What happens to the color of your skin when you are in the sun for a long period of time? n (%) | | | | | | | | <0.001 |
| Missing | 19 | 1 | 3 | 3 | 1 | 0 | 27 | |

**Table 3** (continued)

| | Hispanic (N=135) | White (N=40) | American Indian/Alaska Native (N=15) | African American (n=11) | Asian (N=4) | Other (N=3) | Total (N=208) | p-value |
|---|---|---|---|---|---|---|---|---|
| Never develops a tan or gets darker in sun-exposed skin | 16 (13.8%) | 1 (2.6%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 17 (9.4%) | |
| Develops a light tan or becomes slightly darker in sun-exposed skin | 42 (36.2%) | 12 (30.8%) | 1 (8.3%) | 0 (0.0%) | 1 (33.3%) | 1 (33.3%) | 57 (31.5%) | |
| Develops a medium tan or skin becomes moderately darker in sun-exposed skin | 16 (13.8%) | 21 (53.8%) | 3 (25.0%) | 1 (12.5%) | 1 (33.3%) | 2 (66.7%) | 44 (24.3%) | |
| Develops a deep tan or skin becomes darker in sun-exposed skin | 11 (9.5%) | 4 (10.3%) | 4 (33.3%) | 4 (50.0%) | 0 (0.0%) | 0 (0.0%) | 23 (12.7%) | |
| Develops darker skin in sun-exposed skin | 17 (14.7%) | 1 (2.6%) | 2 (16.7%) | 1 (12.5%) | 1 (33.3%) | 0 (0.0%) | 22 (12.2%) | |
| No noticeable change in sun-exposed skin | 14 (12.1%) | 0 (0.0%) | 2 (16.7%) | 2 (25.0%) | 0 (0.0%) | 0 (0.0%) | 18 (9.9%) | <0.001 |
| On average, how many hours per day do you spend in the sun? n (%) | | | | | | | | |
| Missing | 9 | 0 | 0 | 0 | 0 | 0 | 9 | |
| Less 1 h | 40 (31.7%) | 19 (47.5%) | 1 (6.7%) | 0 (0.0%) | 1 (25.0%) | 0 (0.0%) | 61 (30.7%) | |
| 1–2 h | 40 (31.7%) | 7 (17.5%) | 3 (20.0%) | 4 (36.4%) | 1 (25.0%) | 1 (33.3%) | 56 (28.1%) | |
| 2–3 h | 18 (14.3%) | 10 (25.0%) | 2 (13.3%) | 2 (18.2%) | 2 (50.0%) | 0 (0.0%) | 34 (17.1%) | |
| 3–4 h | 10 (7.9%) | 3 (7.5%) | 1 (6.7%) | 0 (0.0%) | 0 (0.0%) | 2 (66.7%) | 16 (8.0%) | |
| Greater than 4 h | 18 (14.3%) | 1 (2.5%) | 8 (53.3%) | 5 (45.5%) | 0 (0.0%) | 0 (0.0%) | 32 (16.1%) | 0.5131 |
| Do you seek shade when possible? n (%) | | | | | | | | |
| Missing | 8 | 2 | 0 | 0 | 0 | 0 | 10 | |
| Always | 78 (61.4%) | 17 (44.7%) | 8 (53.3%) | 6 (54.5%) | 4 (100.00%) | 2 (66.7%) | 115 (58.1%) | |
| Sometimes | 35 (27.6%) | 19 (50.0%) | 6 (40.0%) | 5 (45.5%) | 0 (0.0%) | 1 (33.3%) | 66 (33.3%) | |
| Rarely | 8 (6.3%) | 2 (5.3%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 10 (5.1%) | |
| Never | 6 (4.7%) | 0 (0.0%) | 1 (6.7%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 7 (3.5%) | 0.5211 |
| Approximately how many times over your lifetime have you used indoor tanning equipment? n (%) | | | | | | | | |
| Missing | 10 | 1 | 0 | 0 | 0 | 0 | 11 | |
| 0 | 90 (72.0%) | 22 (56.4%) | 14 (93.3%) | 11 (100.0%) | 4 (100.0%) | 3 (100.0%) | 144 (73.1%) | |
| 1–4 | 17 (13.6%) | 6 (15.4%) | 1 (6.7%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 24 (12.2%) | |
| 5–10 | 10 (8.0%) | 2 (5.1%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 12 (6.1%) | |
| 11–20 | 3 (2.4%) | 4 (10.3%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 7 (3.6%) | |
| 21–30 | 2 (1.6%) | 1 (2.6%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 3 (1.5%) | |
| 30+ | 3 (2.4%) | 4 (10.3%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 7 (3.6%) | 0.2321 |
| How frequently do you see the doctor? n (%) | | | | | | | | |
| Missing | 9 | 0 | 2 | 0 | 0 | 0 | 11 | |
| Very often | 5 (4.0%) | 1 (2.5%) | 1 (7.7%) | 2 (18.2%) | 0 (0.0%) | 0 (0.0%) | 9 (4.6%) | |
| Often | 14 (11.1%) | 3 (7.5%) | 3 (23.1%) | 2 (18.2%) | 0 (0.0%) | 1 (33.3%) | 23 (11.7%) | |
| Regularly | 27 (21.4%) | 13 (32.5%) | 3 (23.1%) | 5 (45.5%) | 3 (75.0%) | 1 (33.3%) | 52 (26.4%) | |
| Rarely | 66 (52.4%) | 16 (40.0%) | 5 (38.5%) | 1 (9.1%) | 1 (25.0%) | 1 (33.3%) | 90 (45.7%) | |
| Never | 14 (11.1%) | 7 (17.5%) | 1 (7.7%) | 1 (9.1%) | 0 (0.0%) | 0 (0.0%) | 23 (11.7%) | |

Our results indicate a need for increased targeted education for the Hispanic population regarding both skin cancer education and sun protection practices. Studies have found that targeted education interventions are successful in increasing the sun protection behaviors and rates of self-skin examination in African Americans [26]. Multiple studies have demonstrated a relationship between acculturation in the Hispanic population and decreased sun-protective behaviors; however, a related review article did not show any significant patterns in the sun protection beliefs of US Hispanics [25, 27, 28]. Overall, these studies highlight the necessity of tailoring outreach initiatives to be culturally relevant. Regarding skin cancer knowledge, a study analyzing multiple knowledge-based interventions found that educational interventions successfully increase knowledge, awareness, and sun protection practices in skin of color populations [29]. In areas where healthcare resources are scarce, future interventions may be best formatted as video education or education through online platforms, as nearly a quarter of our Hispanic population preferred video education methods. Prior video-based education intervention targeting the Hispanic population significantly increased melanoma risk factor and prevention knowledge [30].

Some of the previous studies that have examined the relationship between ethnicity and skin cancer knowledge have taken place in the clinical setting, among patients that were already seeking dermatologic care [6, 9, 26]. Our screening events occurred in the community setting. As more than half of our total cohort reported rarely or never seeing a doctor, this subgroup is likely a more accurate reflection of the community. Future initiatives studying the relationship between ethnicity, sun protection practices, and skin cancer knowledge should consider a similar outreach-type setting as employed by this and a few previous studies [7, 8, 24, 30].

There is a paucity of data regarding skin cancer in Hispanics, and further studies are necessary to identify the risk factors, sun protection behaviors, and genetic predisposition of this fast-growing group [31]. In combination with high rates of willingness to learn and high perceived personal risk of skin cancer, our data highlight the opportunity to educate this population about skin cancer and the importance of sun protection practices.

## Limitations

A larger sample size would likely make this study more generalizable. Second, the skin cancer knowledge score which was used has not been validated, and season was not factored into the multivariate analysis. Next, a more complex, multilevel model, such as using a random intercept for each community-based event, was not performed.

Given that these data were cross-sectional, causation could not be determined. Additionally, this study lacked a robust skin cancer risk assessment section. Therefore, it is not possible to relate the observed knowledge score and sun protection practices with skin cancer risk. Finally, in order to protect vulnerable participant identity, age, sex, and other more detailed demographic information was not included in our study.

## Conclusion

A large gap between knowledge and sun protection practices exists in our Hispanic population in the Southwestern USA. Additionally, this group has low rates of self-skin examinations and healthcare utilization. Nonetheless, our Hispanic population displayed the highest concern for and desire to learn more about skin cancer. Additional research is needed to explore the relationship between risk factors, sun protection practices, and genetic predisposition among Hispanics. Future public education that is tailored to this population and is culturally relevant is needed to close this knowledge and practice gap in order to reduce outcome disparities.

## Declarations

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