Dermatology Practical & Conceptual

Demographics of Skin Cancer Knowledge Among Middle and High Schoolers in Texas

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Key words: melanoma, education, adolescents, knowledge, demographics

Citation: Zamil DH, Fu S, Majd Z, et al. Demographics of Skin Cancer Knowledge Among Middle and High Schoolers in Texas. *Dermatol Pract Concept*. 2023;13(1):e2023014. DOI: https://doi.org/10.5826/dpc.1301a14

Accepted: July 4, 2022; **Published:** January 2023

Funding: A grant was provided for this study by the Texas Medical Association Alliance.

Competing Interests: None.

Authorship: All authors have contributed significantly to this publication

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ABSTRACT

Introduction: Adolescents, an age group that can reduce sun exposure early, may benefit from school-based skin cancer education programs. Literature regarding the demographics of melanoma knowledge is sparse.

Objectives: This study sought to evaluate melanoma knowledge among students in Texas viewing John Wayne Cancer Foundation Block the Blaze (JWCFBTB) presentations and identify group differences with regard to sociodemographic factors.

Methods: Before JWCFBTB presentations delivered in Houston and Dallas by health professions students, a pre-presentation melanoma knowledge quiz was distributed. This survey was adapted from a 2000 study evaluating melanoma knowledge in middle and high schoolers in Houston and Dallas. Respondents were also asked to provide their gender, age, grade, race, parent education level, and whether they are first-generation American. ANOVA and Tukey tests were used to evaluate demographic group differences in scores. Logistic regression models determined predictors of answering selected true/false questions correctly.

Results: One-way ANOVA tests showed statistically significant group differences in pre-test scores for all demographic factors evaluated. Females, Whites/Caucasians, students whose parents hold graduate degrees, and older students had higher scores. Black students and non-first-generation Americans were more likely to answer selected commonly missed questions correctly.

Conclusions: Results from 2000 and 2020-2021 indicate older students from higher grade levels know more about melanoma, suggesting adolescents may benefit from earlier skin cancer education. Racial minorities and individuals of low socioeconomic status, who suffer from disparities in melanoma treatment and mortality, showed poorer melanoma knowledge. Targeting skin cancer education to disadvantaged schools may help remedy such gaps.

Introduction

Accounting for 4% of cancers in adolescents, melanoma of the skin is a common preventable cancer in the United States [1]. Adolescents can reduce sun exposure early, and thus particularly benefit from sun-protective practices [2]. This age group also tends to engage in intentional tanning and may not actively avoid UV exposure [3]. Countries such as Australia have implemented state government and non-governmental organization skin cancer awareness programs, which emphasize childhood prevention, since the 1980s [4]. A 20-year study found that one of these programs, SunSmart, likely contributed to a reduced incidence of melanoma among younger Australians [5]. Additionally, a 2015 review found skin cancer prevention initiatives to be cost-effective and even cost-saving [6]. As such, skin cancer and melanoma awareness initiatives for adolescents in the United States warrant further investigation.

Previous studies have evaluated adolescent knowledge and attitudes towards skin cancer and the efficacy of various school-based interventions. As early as 1992, a Chicago study found that high schoolers spend significant amounts of time in the sun and that a 45-minute intervention increased students' knowledge of skin cancer [7]. Another study from 2001 found that Texas teenagers under 16 indicated they would limit sun exposure following a melanoma educational quiz exercise [8]. Later research investigated different populations and methods of intervention. Disparities in skin cancer awareness and sun-safe behaviors were found among White Hispanic and White non-Hispanic students in Florida [9]. Among Utah high school students, skin cancer presentations, sunscreen efficacy demonstrations, and distribution of personalized UV damage photos at schools significantly increased sun-protective behaviors in a 1-month follow-up [3]. Finally, medical students have been described as an asset to skin cancer awareness programs for teens; they can offer cost-effective, enthusiastic, and informative melanoma education that can help identify and prevent melanoma [10].

While the literature has extensively investigated attitudes towards and knowledge of skin cancer and melanoma in adults [11–14], few studies have specifically focused on adolescents [15], and even fewer studies have examined school-based interventions addressing knowledge gaps in the US. Moreover, literature regarding adolescents of varying socioeconomic backgrounds or adolescents of racial minorities is sparse [16]. Such knowledge would help identify sociodemographic subgroups that may specifically benefit from more education. This will be essential to targeting skin cancer education programs to the grade levels, age groups, and geographic areas in which they will be most effective.

The John Wayne Cancer Foundation Block the Blaze (JWCFBTB) program, based in California, delivers skin cancer education presentations to youth in 16 states [17]. The Texas branch of the program includes presentations offered at middle and high schools by Baylor College of Medicine medical and physician assistant students. Texas has a high UV index for most of the year [18] and ranks fourth in the nation for estimated new cases of melanoma of the skin in 2020 [1]. Texas is also the second most populous state in the US [19], where people enjoy spending time outside. Thus, early melanoma education in Texas is essential for prevention.

Objectives

As part of JWCFBTB presentations, anonymous surveys are distributed. These include true/false pre-presentation melanoma knowledge quizzes and post-presentation surveys evaluating program efficacy. The objective of this study was to assess the current knowledge of high school students regarding melanoma and skin cancer and examine group sociodemographic group differences in knowledge using pre-presentation survey responses.

Methods

This was a cross-sectional survey study. The pre-presentation true/false melanoma knowledge quizzes and post-presentation surveys utilized in this study were adapted from a previously published study of melanoma knowledge among Texas teenagers [8]. Surveys also collected information on race, parent education level, age, grade, gender, and whether the student is a first-generation American. Middle and high schools in the greater Houston area and Dallas were contacted via email, and 46 virtual JWCFBTB presentations

were offered at the 12 schools that responded and scheduled presentations. Survey data was collected between October 14, 2020, and May 25, 2021. Due to the COVID-19 pandemic, JWCFBTB presentations took place virtually, and a link to the survey was sent to all middle and high school students in Texas (Houston and Dallas) watching the presentations. Anonymous responses were collected in a secure spreadsheet. Students were given the option to enter a gift card raffle upon completion of both pre-presentation and post-presentation surveys. To maintain the anonymity of survey responses, students were redirected to a separate link to enter the raffle following survey completion.

The G-power 3.1 statistical software was used for sample size estimation [20]. It was estimated that a total sample of 352 subjects will be needed to provide 80% power to detect significance with a 0.3 effect size for a two-tail analysis t-test at 0.05 α-level. A total of 305 subjects will be needed to provide 80% power to detect significance with a 0.2 effect size for an ANOVA analysis at a 0.05 α-level. A total of 308 students will be needed for a two-tail analysis using logistic regression at a 0.05 α-level, 0.10 β-level (80% power), and for a 1.5 odds ratio. We planned to recruit a minimum of 500 subjects which provides sufficient power for the proposed analysis.

Scores on the melanoma knowledge pre-test were summarized as means and standard deviation overall and stratified by race, parent education level, age, grade, gender, and whether the student is a first-generation American. ANOVA and Tukey tests were used to evaluate group differences in scores. Logistic regression models were carried out to determine predictors of answering the following true/false questions correctly, selected from the most missed questions on the survey:

1. Without sun exposure, my body will not produce vitamin D.
2. Melanoma is usually flat, not raised like a mosquito bite or a pimple.

The outcome variable in the logistic regression models was correct versus incorrect response to each of the questions. Independent variables in these models included all sociodemographic variables collected in the study (race, parent education level, age categories, grade categories, gender, and whether the student is a first-generation American). Age categories were organized as pairs between adjacent ages (12-13, 14-15, 16-17, 18+). Grade-level categories were also created in this way (5-6, 7-8, 9-10, 11-12). All statistical analyses were carried out using SAS software version 9.4 (SAS Institute, Cary, NC) at an a priori significance level of 0.05 for two-sided tests. The study was approved by the Institutional Review Board of Baylor College of Medicine.

Results

The JWCFBTB presentations were offered to 1279 students in Texas, of which 1154 completed the pre-presentation survey, providing a response rate of approximately 90.3%. The overall average score on the pre-presentation melanoma knowledge test was 64.6%, with a standard deviation of 0.121, a median of 65.6%, and a range of 24.13% to 96.6%. One-way ANOVA tests showed statistically significant group differences in melanoma knowledge pre-test scores for all demographic factors evaluated, including gender ($F_{2,1151}$ = 21.74; P<.001), race ($F_{5,1148}$ = 6.10; P<.001), parent educational level ($F_{5,1148}$ = 3.92; P= .002), age ($F_{4,1149}$ = 7.70; P<.001), and grade level ($F_{3,1150}$ = 10.82; P<.001).

For gender (male, female, or other), the Tukey post-hoc test showed higher test scores among females compared to males (η^2=0.050; 95% CI, 0.032-0.068; Tukey Honestly Significant Difference (HSD), P<0.05). Individuals of multiracial or biracial background scored higher than individuals of Black/African American race (η^2=0.059; 95% CI, 0.007-0.112; Tukey HSD, P<0.05) and other (Native American/Alaskan Native, ethnicity not listed, prefer not to answer) race (η^2=0.064; 95% CI, 0.002-0.126; Tukey HSD, P<0.05). Whites/Caucasians also had higher pre-test scores than Hispanics/Latinos (η^2=0.031; 95% CI, 0.003-0.059; Tukey HSD, P<0.05), Blacks/African Americans (η^2=0.052; 95% CI, 0.017-0.087; Tukey HSD, P<0.05), and individuals of other race (η^2=0.057; 95% CI, 0.009-0.104; Tukey HSD, P<0.05). With regards to parent education level, significant differences were only found between two categories: students who answered graduate degree (Master's, MD, PhD, etc.) had higher scores than those selecting prefer not to answer (η^2=0.055; 95% CI, 0.008-0.102; Tukey HSD, P<0.05). Students aged 12-13 scored lower than students aged 14-15 (η^2=0.043; 95% CI, 0.015-0.071; Tukey HSD, P<0.05) and 16-17 (η^2=0.060; 95% CI, 0.028-0.091; Tukey HSD, P<0.05). Students in grades 9-10 tended to outperform students in grades 5-6 (η^2=0.052; 95% CI, 0.018-0.087; Tukey HSD, P<0.05) and 7-8 (η^2=0.039; 95% CI, 0.014-0.065; Tukey HSD, P<0.05). Students in grades 11-12 also scored higher than students in grades 5-6 (η^2=0.060; 95% CI, 0.023-0.098; Tukey HSD, P<0.05) and 7-8 (η^2=0.047; 95% CI, 0.017-0.077; Tukey HSD, P<0.05).

Table 1 summarizes the logistic regression results for selecting the correct versus incorrect answer for the True/False statement "Without sun exposure, my body will not produce vitamin D." Black/African American students were at a greater odd of answering this question correctly than White/Caucasian students (aOR=1.56; 95% CI, 1.03-2.37; P-value=0.007). Additionally, eleventh and twelve graders were at significantly greater odds of answering this question correctly than fifth or sixth graders (aOR=3.41; 95% CI, 1.24-9.37; P-value= 0.04).

Table 1. Multivariable logistic regression for selecting the correct versus incorrect answer for the True/False statement "Without sun exposure, my body will not produce vitamin D."

Variable	aOR[a] (95% CI[b])	P-Value
Age		
12-13 vs Under 12	0.89 (0.35-2.28)	0.82
14-15 vs Under 12	0.72 (0.24-2.16)	0.43
16-17 vs Under 12	0.68 (0.20-2.28)	0.35
18+ vs Under 12	0.98 (0.23-4.14)	0.70
Gender		
Male vs Female	0.92 (0.70-1.20)	0.45
Other vs Female	0.49 (0.13-1.87)	0.33
Race		
Asian or Pacific Islander vs White or Caucasian	1.20 (0.85-1.72)	0.15
Black or African American vs White or Caucasian	1.56 (1.03-2.37)	0.007*
Hispanic or Latino vs White or Caucasian	1.00 (0.70-1.44)	1.00
Multiracial or Biracial vs White or Caucasian	0.86 (0.48-1.54)	0.53
Other vs White or Caucasian	0.62 (0.33-1.16)	0.06
First-generation American		
Yes vs No	0.83 (0.64-1.07)	0.15
Grade		
11-12 vs 5-6	3.41 (1.24-9.37)	0.04*
7-8 vs 5-6	2.09 (1.03-4.27)	0.76
9-10 vs 5-6	2.19 (0.93-5.14)	0.58
Highest parent education level		
Bachelor's degree vs Low education	0.91 (0.56-1.48)	0.56
Graduate degree (Master's, MD, PhD, etc.) vs Low education[c]	0.93 (0.59-1.48)	0.66
Prefer not to answer vs Low education[c]	0.89 (0.46-1.73)	0.68
High education[e] vs Low education[c]	1.04 (0.62-1.73)	0.72
Intermediate[d] education vs Low education[c]	1.14 (0.70-1.87)	0.31

[a]aOR = adjusted odds ratio
[b]CI = confidence interval
[c]Low education includes the following categories: No schooling, some elementary school, completed elementary school, some middle school, some high school, some trade/vocational school, completed trade/vocational school
[d]Intermediate education includes the following categories: Completed high school, associate degree
[e]High education includes the following categories: Some college, some graduate school
*Indicates statistical significance (significance level $P < 0.05$)

Table 2 summarizes the logistic regression results for selecting the correct versus incorrect answer for the True/False statement "Melanoma is usually flat, not raised like a mosquito bite or a pimple." Students who were first-generation Americans were less likely to select the correct answer, as compared to students who were not first-generation Americans (aOR=0.71; 95% CI, 0.55-0.92; P-value= 0.009).

Discussion

A web-based education resource in Switzerland gathered data on melanoma knowledge in association with disease development over 10 years, and found that education programs can statistically prevent melanoma, reduce mortality, and increase early diagnosis [21]. While this highlighted the importance of melanoma education, a PubMed search of "melanoma education" showed that there are only 23 results since 1983, as of August 2021, underscoring the lack of melanoma awareness education programs and research analyzing its efficacy. In this study, we implemented a melanoma education program designed by the John Wayne Cancer Foundation in middle and high schools, with presentations delivered by health professions student volunteers.

This study uses surveys adapted from a school-based melanoma education study that took place in Houston and Dallas in 2000, which found that students aged 16 and older scored 11 percentage points higher, on average, than those between 12-15 years on the melanoma pre-test [8]. The present study found

Table 2. Multivariable logistic regression for selecting the correct versus incorrect answer for the True/False statement "Melanoma is usually flat, not raised like a mosquito bite or a pimple."

Variable	aOR[a] (95% CI[b])	P-Value
Age		
12-13 vs Under 12	2.10 (0.90-4.92)	0.12
14-15 vs Under 12	1.46 (0.53-4.05)	0.99
16-17 vs Under 12	1.26 (0.41-3.89)	0.50
18+ vs Under 12	1.72 (0.43-6.80)	0.67
Gender		
Male vs Female	1.07 (0.82-1.39)	0.62
Other vs Female	1.56 (0.49-5.00)	0.49
Race		
Asian or Pacific Islander vs White or Caucasian	0.97 (0.69-1.37)	0.89
Black or African American vs White or Caucasian	0.90 (0.59-1.37)	0.58
Hispanic or Latino vs White or Caucasian	1.08 (0.75-1.54)	0.54
Multiracial or Biracial vs White or Caucasian	1.04 (0.59-1.81)	0.83
Other vs White or Caucasian	0.95 (0.54-1.67)	0.86
First-generation American		
Yes vs No	0.71 (0.55-0.92)	0.009*
Grade		
11-12 vs 5-6	1.06 (0.41-2.80)	0.57
7-8 vs 5-6	0.80 (0.42-1.56)	0.41
9-10 vs 5-6	0.84 (0.38-1.88)	0.58
Highest parent education level		
Bachelor's degree vs Low education[c]	0.62 (0.38-0.99)	0.17
Graduate degree (Master's, MD, PhD, etc.) vs Low education[c]	0.82 (0.52-1.28)	0.38
Prefer not to answer vs Low education[c]	0.54 (0.28-1.03)	0.16
High education[e] vs Low education[c]	0.80 (0.48-1.31)	0.61
Intermediate education[d] vs Low education[c]	0.75 (0.46-1.22)	0.91

[a]aOR = adjusted odds ratio
[b]CI = confidence interval
[c]Low education includes the following categories: No schooling, some elementary school, completed elementary school, some middle school, some high school, some trade/vocational school, completed trade/vocational school
[d]Intermediate education includes the following categories: Completed high school, associate degree
[e]High education includes the following categories: Some college, some graduate school
*Indicates statistical significance (significance level $P < 0.05$)

a similar trend: students aged 12 to 13 tended to score lower than students who were between 14 and 17 years old. Grade level followed the same pattern as high school students (9^{th}-12^{th} grade) scored better than middle school students (5^{th}-8^{th} grade). On one of the most missed true/false questions, "Without sun exposure, my body will not produce vitamin D," eleventh and twelfth graders were nearly three and a half times more likely than fifth and sixth graders to answer this question correctly. This trend of increasing performance with age, found in Houston and Dallas both in 2000 and 2020-2021, suggests melanoma education programs should target younger students [8]. As sun exposure is cumulative [22], it is essential to expose students to information regarding skin cancer early and to bridge the knowledge gap between younger and older students.

Although melanoma of the skin is more prevalent among non-Hispanic Whites, survival has been poorer among ethnic minorities since the 1990s, and gaps are worsening over time. Across all minorities, the disparity is growing in patients with localized disease. In patients with distant or regional disease, the disparity is increasing among Hispanic patients [23]. Our study showed White/Caucasian students tended to score higher than minorities such as Hispanics/Latinos and Blacks/African Americans on the melanoma knowledge pre-test. Similar findings were reported from a survey of Boston adults, in which White race positively correlated with melanoma knowledge. Additionally, immigrants and Hispanics could less often define melanoma [24]. These results are corroborated by the present study, in which

first-generation Americans were less likely to answer the true/false statement "Melanoma is usually flat, not raised like a mosquito bite or a pimple" correctly. One unique finding in the present study was that Black/African American students were more likely to answer the true/false statement "Without sun exposure, my body will not produce vitamin D" correctly, as compared to White students.

Research has shown greater melanoma mortality rates among individuals of low socioeconomic status due to a lack of access to care and early detection [25,26]. However, group differences in scores between students stratified by parental education level were not as pronounced as other demographic factors. Nonetheless, remediation of generally poorer melanoma outcomes and general knowledge among disadvantaged populations and minorities may benefit from school-based education programs to increase awareness of melanoma and sun-protective behaviors.

With regards to gender, females outperformed males on the melanoma knowledge pre-test. As women are at a lower odds of developing skin cancer than men in the US, males may especially benefit from skin cancer education in schools [27]. Although this study did not feature a large sample size of gender minorities, literature has shown a disproportionate skin cancer burden among gender and sexual minorities, as well as unique risk factors for skin cancer in these populations [28,29].

Conclusions

Overall, on a melanoma education knowledge test given to middle and high schoolers before a skin cancer awareness presentation, this study found lower scores among racial minorities and students of younger ages and lower grade levels. Students who were Black, older, or who were not first-generation Americans were more likely to select the correct answer on a subset of the most missed questions on the test. Limitations of this study include self-reported data by the students and general cross-sectional design limitations, as well as a sample limited to schools where Baylor College of Medicine students were able to offer presentations. Future directions include analyzing the results of the post-presentation surveys from the same educational program to determine program efficacy.

Acknowledgements

We would like to thank Dr. Anthony Lucci, Lauren Fraga, Mayra De La Cruz, Yasmin Khalfe and the John Wayne Cancer Foundation for their guidance and support in conducting this study. We would also like to acknowledge Kristiana Nasto, Amna Bashir, Rujman Khan, Sahifah Ansari, Rachel Stroh, Nicole Walters, Ebubechi Adindu, Ruth Mizu, Milbrey Parke, Louisa Liu, Tiffaney Tran, Hanqing Shang, Joanne Jacob, Rohit Gupta, Tejas Joshi, and Xiaoman Yu for their role in data collection. Funding for the inaugural chapter of John Wayne Cancer Foundation's Block the Blaze program at Baylor College of Medicine was provided by the Texas Medical Association Alliance.

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