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# Differences in reported sun protection practices, skin cancer knowledge, and perceived risk for skin cancer between rural and urban high school students

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## Abstract

**Purpose—**The purpose of the current study was to evaluate differences in reported use of sun protection, tanning behaviors, skin cancer-related knowledge, and perceived risk between rural and urban high school students in a geographic area with high rates of melanoma.

**Methods—**A total of 1,570 high school students (56.8% female) from urban (6 schools) and rural (7 schools) geographic areas in Utah completed questionnaires assessing sun protection and tanning behaviors, skin cancer-related knowledge, and perceived risk for skin cancer. Analyses examined potential differences in these outcomes between rural and urban students and by gender.

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**Conflict of interest** The authors have no conflict of interest to disclose.

**Research involving human participants and/or animals** All study procedures were approved by the University of Utah Institutional Review Board and the appropriate school district authorities.

**Informed consent** Prior to data collection, consent cover letters were sent by schools to all parents, allowing them to opt their child out of participation.

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**Results—**Compared to students in urban areas, those in rural areas had lower odds of wearing sunscreen (OR 0.71; 95% CI 0.53, 0.95; $p = 0.022$), re-applying sunscreen (OR 0.61; 95% CI 0.74, 1.02; $p = 0.002$), wearing long-sleeved shirts (OR 0.63 95% CI 0.46, 0.86; $p = 0.004$), and seeking shade (OR 0.67; 95% CI 0.50, 0.88; $p = 0.005$).

**Conclusions—**Rural students reported less adequate use of sun protection than urban students. Rural male students reported lower knowledge scores compared to urban males. Future skin cancer prevention efforts targeting rural high schoolers are warranted.

### Keywords

Skin cancer; Rural health; Health education; Cancer prevention

## Introduction

Melanoma is the 6th most common cancer in the United States, and is associated with a significant morbidity and mortality burden [1–4]. Unlike most other types of cancer, the incidence of melanoma has risen over the past three decades [1]. Melanoma is increasingly affecting adolescents and young adults and is now the second most common cancer among women aged 15–29 years [5].

Geographical differences in the incidence and mortality of several cancers have been well documented and there is preliminary evidence that disparities also exist for melanoma incidence and mortality between residents of rural and urban areas [6–8]. Certain areas of the United States, particularly in the West, feature high incidence rates of melanoma and also large geographic areas that are rural. For example, Utah leads the nation in melanoma incidence and mortality and roughly 10–15% of the state's population resides in rural areas [9, 10].

Ultraviolet radiation (UVR) exposure is the primary modifiable risk factor for melanoma [11–14]. Reduction of UVR exposure through use of sun protection and avoidance of sunburns and intentional tanning early in life, a period of melanocyte development and susceptibility, is critical [15, 16]. Although not yet extensively studied in the pediatric population, use of sun protection may be particularly sub-optimal among adolescents in geographically rural areas [17, 18]. Rural adults report less frequent shade-seeking and use of sunscreen, higher mid-day sun exposure, and increased sunburn occurrence compared to urban residents [19, 20]. Low use of sun protection is associated with lower knowledge and perceived risk of skin cancer, which could be specifically targeted in skin cancer preventive interventions [21]. Examining potential rural-urban differences in use of sun protection behaviors that could prevent melanoma is essential given documented disparities in melanoma incidence and mortality between these geographic areas [7].

Prior studies have described sun protection use and intentional tanning among rural adolescents but have not directly compared rural and urban adolescents [17, 18]. Little is known about potential differences in sun protection, tanning behaviors, and other modifiable factors (e.g., knowledge, perceived risk) between rural and urban adolescents. This gap in knowledge impedes progress on developing targeted and tailored behavioral cancer

prevention-control interventions that address melanoma risk factors. In order to guide skin cancer prevention efforts targeting students residing in urban and rural areas, the current study evaluated potential differences in reported use of sun protection, tanning behaviors, sunburn occurrence, skin cancer knowledge, and perceived risk for skin cancer between urban and rural high schoolers in a geographic area with a high incidence of skin cancer [22, 23]. Additionally, the current study also examined student gender as a potential moderator of the relationship between geographic location (rural versus urban) and sun protection use and knowledge. Based on the existing literature, we hypothesized that rural students would report less frequent use of sun protection strategies, lower skin cancer-related knowledge, and lower perceived risk for skin cancer than urban students [19, 20, 24–26].

## Methods

### Study sample

The current data were collected from a baseline assessment of a skin cancer preventive intervention for high school students in urban and rural areas of Utah. A convenience sampling method was used to contact schools to participate. The goal of the convenience sampling design was aimed at enrolling an even distribution of participants from rural and urban school districts. Participants were drawn from 4 school districts (2 rural districts, 2 urban districts). From these districts, 11 high schools located in three counties (1 urban county, 2 rural counties) participated. In terms of recruitment, 85% (11 out of 13) of schools approached agreed to participate in the current study. Six schools were located in rural areas and five were in urban areas based on Rural Urban Commuting Code classification [27]. RUCA codes utilize census tract-based population estimates and work commuting information to categorize census tracts and zip codes into four categories: urban, large rural, small rural, and isolated rural. Of the schools in rural districts, three were classified as “small rural” and three were classified as “isolated rural.” Participants from “small rural” and “isolated rural” were both categorized as “rural” for the purposes of the current analysis. Data were collected between March and May of 2017 and analysis was conducted between May and September of 2018. Prior to data collection, consent cover letters were sent by schools to all parents, allowing them to opt their child out of participation. All study procedures were approved by the University of Utah Institutional Review Board and the appropriate school district authorities.

## Measures

High school students were asked to complete a questionnaire assessing sun protection and intentional tanning, sunburn occurrence, skin cancer knowledge, their perceived risk for skin cancer, and demographic information. A modified version of the valid and reliable Sun Habits Survey was used to assess students’ reported engagement in sun protection behaviors, tanning behaviors, sunburn occurrence, and hours spent outside [28]. Students were asked how often in the past month they engaged in each of eight sun protection behaviors (wearing sunscreen, re-applying sunscreen, wearing long pants or skirts, long-sleeved shirts, wide-brimmed hats, sunglasses, seeking shade, avoiding peak UVR hours between 10 am and 4 pm) when they were outdoors for more than 15 min, on a 5-point Likert scale ranging from

"never" to "always" [28]. Students were also asked how often they engaged in intentional indoor tanning and intentional outdoor tanning using the same 5-point Likert scale [28]. In addition, students were asked how many hours they were outside on a typical weekday and weekend day (on a scale from 0 to more than 8 h) and how many times they had a red or painful sunburn that lasted a day or more (on a scale from 0 to 5 or more) in the past 12 months and past 30 days [28]. Skin cancer knowledge was assessed using 5 investigator-designed true/false items (Cronbach's alpha = 0.60). The items assessed knowledge of risk factors and prevention measures for skin cancer. Students' perception of their lifetime risk for skin cancer was assessed using a single item rated on a 5-point scale from "very unlikely" to "very likely" [29].

### Statistical analysis

Descriptive statistics were calculated to summarize participant demographic characteristics. $\chi^2$ tests were performed to compare demographic characteristics between rural and urban participants. Descriptive statistics were calculated to summarize participant responses to sun protection behaviors, tanning behaviors, sunburn occurrence, and perceived risk items. Multi-level mixed-effects ordered logistic regression was used to compare sun protection behaviors, tanning behaviors, sunburn occurrence, and perceived risk between rural and urban students due to the ordinal. Proportional odds ratios were determined by exponentiating the ordered logit coefficients to aid in the interpretation of results. Generalized linear mixed modeling (GLMM) was used to compare knowledge scores and time spent outside on week days and weekend days between rural and urban students. All models accounted for within-school clustering and GLMM models used restricted maximum likelihood estimation. Models were adjusted for potential confounding factors, including gender, grade, race/ethnicity, and family history of skin cancer. We also compared the impact of rural/urban status on sun protection behaviors, tanning behaviors, sunburn occurrence, knowledge, and perceived risk for skin cancer for male and female students. Multi-level mixed-effects ordered logistic regression was used to calculate the interaction effects for gender, rural/urban residents, and the use of sun protection (e.g., wearing sunscreen and wearing sunglasses) methods. GLMM was used to calculate the interaction effects for gender, rural/urban residence, and skin cancer-related knowledge. All statistical analyses were conducted using R [30].

## Results

A total of 1,570 students completed the self-reported questionnaire. Of those, 1,547 students (98.5%) completed the survey in its entirety. Of those, 54.9% were non-Hispanic White ($n$ = 863) and 21.7% were Hispanic ($n$ = 341), 46.8% were male ($n$ = 735), and 28.3% ($n$ = 444) reported a family history of skin cancer (Table 1).[1] Thirty-one percent ($n$ = 485) of students attended rural schools and the remaining 69% ($n$ = 1,085) attended urban schools. Rural students were more likely to be White, report having a family history of skin cancer, and be in a lower grade ($p$'s < 0.05; Table 1). Socioeconomic indicators were not assessed for

[1]The entire Utah student population consists of 51% males, 49% females, 75% non-Hispanic White students, and 16% Hispanic students.

individual participants due to school district policies. Schools were located in one urban and two rural counties, which differ in median household income. The urban county has a higher median household income compared to the two rural counties (urban: $64,601, rural: $61,244 and $53,902) [31].

Use of sun protection among the entire sample of students was generally low. On average, students reported applying sunscreen "rarely" (mean = 2.06, SD = 1.11) and "never" reapplying sunscreen (mean = 1.70, SD = 1.02) when outside for more than 15 min. Students reported "rarely" avoiding peak hours when outdoors (mean = 2.09, SD = 1.07). The most common sun protection method endorsed was wearing long pants or a long skirt "sometimes" (mean = 3.49, SD = 1.22). Students on average reported "rarely" intentionally tanning outdoors (mean = 2.13, SD = 1.24) and "never" intentionally tanning indoors (mean = 1.15, SD = 0.57). Students reported experiencing an average of 2.6 (SD = 1.57) sunburns in the past year and 1.3 (SD = 0.72) in the past month. Across the entire sample, students reported their risk for getting skin cancer was, on average, "neither likely nor unlikely." Student responses to items addressing sun protection, tanning behaviors, sunburn occurrence, and perceived risk are reported in Table 2. Students scored an average of 2.7 (SD = 1.29) out of 5 on skin cancer knowledge.

## Rural versus urban differences in sun protection, tanning behaviors, and sunburn

Figure 1 depicts average levels of sun protection and tanning behaviors among rural and urban students. There were significant differences in sun protection use between students in rural and urban areas after adjusting for gender, race/ethnicity, grade, and family history of skin cancer (Table 3). Specifically, students who attended rural high schools had lower odds of wearing sunscreen (OR 0.71; 95% CI 0.53, 0.95; $p = 0.022$), re-applying sunscreen (OR 0.61; 95% CI 0.74, 1.02; $p = 0.002$), wearing long-sleeved shirts (OR 0.63 95% CI 0.46, 0.86; $p = 0.004$), and seeking shade (OR 0.67; 95% CI 0.50, 0.88; $p = 0.005$) compared to those who attended urban schools. In contrast, students in rural schools had higher odds of wearing long pants or skirts (OR 1.65; 95% CI 1.23, 2.21; $p = 0.001$), wearing hats (OR 1.56; 95% CI 1.15, 2.11; $p = 0.004$), and engaging in indoor tanning (OR 1.78; 95% CI 1.03, 3.07; $p = 0.039$) compared to students in urban schools. Students from rural schools reported spending 0.95 more hours outside on a typical weekend day compared to students from urban schools (95% CI 0.12, 1.83; $p = 0.023$). Rural students had higher odds of reporting a greater number of sunburns in the past year compared to urban students (OR 1.47, 95% CI 1.05, 2.05, $p = 0.023$). There was no significant difference in sunburn occurrence in the past month, avoidance of peak UVR hours, wearing sunglasses, or intentional outdoor tanning between students in rural and urban areas in the adjusted model. The interaction between gender and rural/urban area was a significant predictor of wearing pants, hats, and sunglasses. Specifically, males in rural areas had higher odds of wearing pants (OR 2.63; 95% CI 1.47, 4.71; $p = 0.001$) and hats (OR 2.13 95% CI 1.16, 3.91; $p = 0.014$) more than males in urban areas. Females in rural areas had lower odds of wearing sunglasses than females in urban areas (OR 0.52; 95% CI 0.30, 0.92; $p = 0.024$). There was no statistically significant interaction effect between gender and rural/urban area for wearing sunscreen, re-applying sunscreen, wearing long sleeves, seeking shade, or avoiding peak UVR hours ($p > 0.05$).

### Rural versus urban differences in skin cancer knowledge and perceived risk

After adjusting for race, grade, gender, and family history of skin cancer, rural students scored 0.37 points lower on the skin cancer prevention knowledge subscale than urban students (95% CI − 0.55, − 0.18; $p = 0.001$) (Table 3). The interaction between gender and rural/urban location was a significant predictor of skin cancer prevention knowledge scores such that males in rural areas scored on average 0.49 points lower than males in urban areas (95% CI − 0.78, − 0.19; $p = 0.001$). There was no significant difference in knowledge scores between females in urban areas compared to females in rural areas (95% CI − 0.40, 0.06; $p = 0.163$). Students from rural schools also had higher odds of reporting a higher perceived risk for melanoma (OR 1.42; 95% CI 1.03, 1.96; $p = 0.033$) compared to urban students (Table 3).

## Discussion

The current study is among the first to compare modifiable skin cancer prevention and risk factors between rural and urban adolescents. Our findings highlight that geographical differences exist in reported use of sun protection and skin cancer prevention knowledge among high school students. Building on studies that have examined sun protection behaviors among rural students alone [17, 18], we found that rural students reported spending more time outdoors, but were less likely to implement skin cancer preventive behaviors such as wearing sunscreen, re-applying sunscreen, wearing long-sleeved shirts, and seeking shade when compared to urban students. However, it is notable that mean levels of sun protection were generally low across students in both rural and urban areas. Our findings are consistent with prior findings with adults living in rural and urban areas [19, 20], whereby individuals living in rural areas report less frequent use of sun protection compared to their urban counterparts.

In addition to low use of sun protection, rural students demonstrated significantly lower skin cancer prevention knowledge compared to urban students. These findings underscore the need for skin cancer prevention efforts that are targeted towards rural adolescents. Adolescents spend a large proportion of their time in school, and thus, the school setting offers an ideal venue in which to provide skin cancer prevention programming to students [32]. In line with the U.S. Surgeon General’s recommendation to bolster skin cancer prevention efforts in schools and community settings, the development and implementation of skin cancer curriculum and programs in rural districts may help to increase use of sun protection among rural students and decrease disparities in melanoma incidence and mortality among rural populations [33].

Based on our findings, skin cancer prevention programs for youth may want to account for observed gender differences in skin cancer prevention knowledge and sun protection use. For example, rural males reported wearing long pants and wide-brimmed hats more frequently than urban males, but had significantly lower skin cancer prevention knowledge scores. Rural males may be wearing long pants and hats due to outdoor work responsibilities or social norms for fashion in their areas, but are still unaware of the risks that contribute to and prevention of skin cancer. Because of this, rural males may benefit from targeted skin

cancer prevention education within their schools which could be tailored to outdoor lifestyles that are common in rural areas (e.g., farming, ranching).

The current study has several strengths and limitations worth noting. To our knowledge, this is one of the first studies to directly compare rural and urban adolescents on their reported use of sun protection, tanning behaviors, and skin cancer prevention knowledge and perceived risk for skin cancer. The sample comprised primarily of Non-Hispanic White students which reflects the population of Utah and those most at risk for skin cancer, but may limit generalizability to other areas [31]. Additionally, there was variability in sociodemographic factors (e.g., household income levels) between the geographic areas included in the current study, which was not statistically accounted for because we were unable to collect such information directly from students due to school district policies. Use of sun protection was based on self-report which could be subject to reporting biases; however, self-reported sun protection behavior use has been shown to be valid among adolescent populations [34, 35]. Another limitation of this study was the use of a dichotomized definition for rural/urban status. Future work could explore potential differences in outcomes between small and isolated rural adolescents and urban adolescents. In addition, future studies could include rural and urban students in different regions of the US.

## Conclusion

The findings from this study indicate significant differences between rural and urban adolescents' behaviors and knowledge related to skin cancer prevention that could contribute to the health disparities in skin cancer incidence and mortality observed in rural areas. The geographical and gender differences in skin cancer preventive behaviors and skin cancer prevention knowledge should be considered when developing skin cancer prevention programs and school curriculum for adolescents.

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## References

1. Melanoma of the Skin—SEER Stat Fact Sheets (2017). https://seer.cancer.gov/statfacts/html/melan.html. Accessed 16 Oct 2018

2. Ekwueme DU, Guy GP Jr, Li C, Rim SH, Parelkar P, Chen SC (2011) The health burden and economic costs of cutaneous melanoma mortality by race/ethnicity-United States, 2000 to 2006. J Am Acad Dermatol 65(5 Suppl 1):S133–S143 [PubMed: 22018062]
3. Guy GP, Ekwueme DU (2011) Years of potential life lost and indirect costs of melanoma and non-melanoma skin cancer: a systematic review of the literature. Pharmacoeconomics 29(10):863–874 [PubMed: 21846158]
4. Guy GP, Machlin SR, Ekwueme DU, Yabroff KR (2014) Prevalence and costs of skin cancer treatment in the US, 2002–2006 and 2007–2011. Am J Prev Med 48(2):183–187 [PubMed: 25442229]
5. NAACCR Fast Stats: an interactive quick tool for quick access to key NAACCR cancer statistics, https://www.naaccr.org/. Accessed 16 Oct 2018
6. Coory M, Smithers M, Aitken J, Baade P, Ring I (2006) Urban-rural differences in survival from cutaneous melanoma in Queensland. Aust N Z J Public Health 30(1):71–74 [PubMed: 16509022]
7. Zahnd WE, James AS, Jenkins WD et al. (2018) Rural-urban differences in cancer incidence and trends in the United States. Cancer Epidemiol Biomark Prev 27:1265–1274
8. Henley SJ, Anderson RN, Thomas CC, Massetti GM, Peaker B, Richardson LC (2017) Invasive cancer incidence, 2004–2013, and deaths, 2006–2015, in nonmetropolitan and metropolitan counties —United States. MMWR Surveill Summ 66(14):1–13
9. Mounessa JS, Caravaglio J, Dellavalle RP (2017) Comparison of regional and state differences in melanoma rates in the united states: 2003 vs 2013. JAMA Dermatol 153(3):345–347 [PubMed: 28030665]
10. 2010 Census Urban and Rural Classification and Urban Area Criteria (2012). https://www.census.gov/geo/reference/ua/urban-rural-2010.html, 2017.
11. Armstrong BK, Kricker A (1993) How much melanoma is caused by sun exposure? Melanoma Res 3(6):395–401 [PubMed: 8161879]
12. Balk SJ (2011) Ultraviolet radiation: a hazard to children and adolescents. Am Acad Pediatr 127(3):e791–e817
13. Green AC, Wallingford SC, McBride P (2011) Childhood exposure to ultraviolet radiation and harmful skin effects: epidemiological evidence. Prog Biophys Mol Biol 107(3):349–355 [PubMed: 21907230]
14. Wu S, Han J, Laden F, Qureshi AA (2014) Long-term ultraviolet flux, other potential risk factors, and skin cancer risk: a cohort study. Cancer Epidemiol Biomark Prev 23(6): 1080–1089
15. Godar DE, Wengraitis SP, Shreffler J, Sliney DH (2001) UV doses of Americans. J Photochem Photobiol 73(6):621–629
16. Whiteman DC, Whiteman CA, Green AC (2001) Childhood sun exposure as a risk factor for melanoma: a systematic review of epidemiologic studies. Cancer Causes Control 12(1):69–82 [PubMed: 11227927]
17. Olson AL, Gaffney CA, Starr P, Dietrich AJ (2008) The impact of an appearance-based educational intervention on adolescent intention to use sunscreen. Health Educ Res 23(5):763–769 [PubMed: 18039727]
18. Demko CA, Borawski EA, Debanne SM, Cooper KD, Stange KC (2003) Use of indoor tanning facilities by white adolescents in the united states. Arch Pediatr Adolesc Med 157(9):854–860 [PubMed: 12963589]
19. Duncan MJ, Kerry Mummery W, Kift RL (2008) Geographical location and sunburn in Queensland adults. Aust J Rural Health 16(3):181–182 [PubMed: 18471190]
20. Kalia S, Kwong YKK, Haiducu ML, Lui H (2013) Comparison of sun protection behaviour among urban and rural health regions in Canada J Eur Acad Dermatol Venereol 27(11):1452–1454 [PubMed: 23290000]
21. Mermelstein RJ, Riesenberg LA (1992) Changing knowledge and attitudes about skin cancer risk factors in adolescents. Health Psychol 11(6):371–376 [PubMed: 1286656]
22. Skin Cancer Rates by State (2017). https://www.cdc.gov/cancer/skin/statistics/state.htm. Accessed 16 Oct 2018
23. Sweeney C, Herget KA, Otto VY, McFadden S, Millar MM. Cancer in Utah: an overview of incidence and mortality 2004–2013. Utah Cancer Registry. 2016.

24. Hall HI, May DS, Lew RA, Koh HK, Nadel M (1997) Sun protection behaviors of the US white population. Prev Med 26(4):401–407 [PubMed: 9245656]
25. Koh HK, Bak SM, Geller AC et al. (1997) Sunbathing habits and sunscreen use among white adults: results of a national survey. Am J Public Health 87(7):1214–1217 [PubMed: 9240117]
26. Robinson JK,Rademaker AW, Sylvester JA, Cook B (1997) Summer sun exposure: knowledge, attitudes, and behaviors of Midwest adolescents. Prev Med 26(3):364–372 [PubMed: 9144761]
27. Rural Urban Commuting Area Codes (2017). https://depts.washington.edu/uwruca/. Accessed 16 Oct 2018
28. Glanz K, Yaroch AL, Dancel M et al. (2008) Measures of sun exposure and sun protection practices for behavioral and epidemiologic research. Arch Dermatol 144(2):217–222 [PubMed: 18283179]
29. Aspinwall LG, Taber JM, Kohlmann W, Leaf SL, Leachman SA (2014) Perceived risk following melanoma genetic testing: a 2-year prospective study distinguishing subjective estimates from recall. J Genet Couns 23(3):421–437 [PubMed: 24322567]
30. R: A language and environment for statistical computing [computer program] (2014). Vienna, Austria: R foundation for statistical computing
31. U.S. Census Bureau QuickFacts: Utah (2018). https://www.census.gov/quickfacts/UT. Accessed 16 Oct 2018
32. Guy GP Jr, Holman DM, Watson M (2016) The important role of schools in the prevention of skin cancer. JAMA Dermatol 152(10):1083–1084 [PubMed: 27580085]
33. US Department of Health, and Human Services (2014) The surgeon general's call to action to prevent skin cancer. Department of Health and Human Services, Washington, DC
34. Glanz K, McCarty F, Nehl EJ et al. (2009) Validity of self-reported sunscreen use by parents, children, and lifeguards. Am J Prev Med 36(1):63–69 [PubMed: 18945582]
35. Lower T, Girgis A, Sanson-Fisher R (1998) How valid is adolescents' self-report as a way of assessing sun protection practices? Am J Prev Med 27(3):385–390

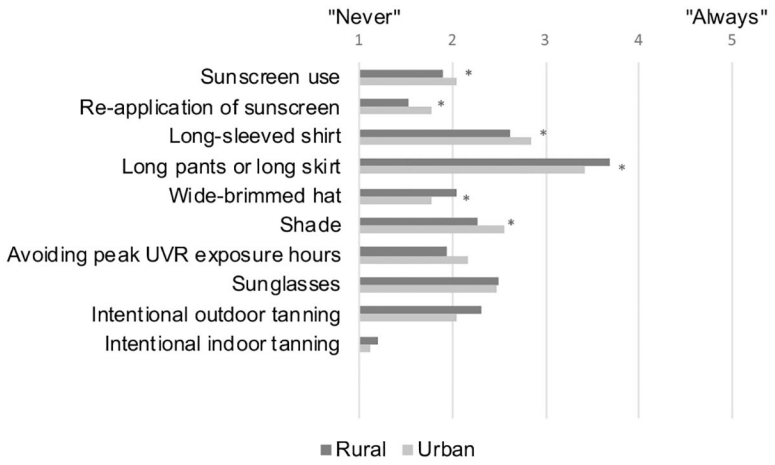


**Fig. 1.**

Students reported sun protection and tanning behaviors. Figure contains the sun protection practices and tanning behaviors among high school students. Rural students are denoted by a dark gray bar and urban students are denoted with a light gray bar. The * indicates a statistically significant difference between rural and urban students when adjusted for gender, race, grade, and family history of skin cancer

**Table 1**

Participant demographic characteristics and comparison between rural and urban students in Utah

| | **Total sample (N = 1570)** ***n* (%)**[a] | **Rural (*n* = 485)** ***n* (%)** | **Urban (n = 1085)** ***n* (%)** | ***p*** |
|---|---|---|---|---|
| Age (mean, std) | 15.7 (0.98) | 15.7 (0.96) | 15.6 (1.00) | 0.19 |
| Gender | | | | 0.15 |
| Male | 735 (46.8) | 214 (44.9) | 512 (47.5) | |
| Female | 727 (46.3) | 217 (45.5) | 503 (46.8) | |
| Other | 7 (0.45) | 2 (0.4) | 5 (0.5) | |
| Grade | | | | **0.007** |
| 9th | 392 (24.9) | 142 (29.8) | 245 (22.8) | |
| 10th | 783 (49.8) | 215 (45.1) | 559 (51.9) | |
| 11th | 182 (11.6) | 47 (9.9) | 135 (12.6) | |
| 12th | 140 (8.9) | 42 (8.8) | 95 (8.8) | |
| Race | | | | **< 0.001** |
| Non-Hispanic White | 863 (54.9) | 295 (61.8) | 562 (52.2) | |
| Hispanic | 341 (21.7) | 64 (13.4) | 271 (25.2) | |
| African-American | 47 (2.9) | 6 (1.3) | 40 (3.7) | |
| American Indian | 28 (1.8) | 10 (2.1) | 17 (1.6) | |
| Asian-American | 43 (2.7) | 6 (1.3) | 36 (3.4) | |
| Other | 53 (3.4) | 18 (4.4) | 45 (4.2) | |
| Family history of skin cancer | | | | **0.001** |
| Yes | 444 (28.3) | 150 (33.6) | 287 (26.7) | |
| No | 463 (29.5) | 107 (22.4) | 351 (32.6) | |
| Not sure | 585 (4.9) | 187 (39.2) | 393 (36.5) | |

Due to missing data, some percentages do not add up to 100%

[a] *n*% reported unless otherwise specified

Boldface indicates statistical significance ($p < 0.05$)

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**Table 2**

Participant responses to sun protection, intentional tanning, and perceived risk items

| | Never *n* (%) | Rarely *n* (%) | Sometimes *n* (%) | Often *n* (%) | | Always *n* (%) |
|---|---|---|---|---|---|---|
| Sun protection behaviors and tanning behaviors | | | | | | |
| Sunscreen use | 674 (42.9) | 398 (25.4) | 320 (20.4) | 113 (7.20) | | 46 (2.93) |
| Re-application of sunscreen | 919 (58.5) | 333 (21.2) | 178 (11.3) | 76 (4.84) | | 42 (2.68) |
| Long-sleeved shirt | 270 (17.2) | 318 (20.3) | 535 (34.1) | 345 (21.9) | | 81 (5.16) |
| Long pants or long skirt | 157 (10.0) | 157 (10.0) | 332 (21.2) | 566 (36.1) | | 330 (21.0) |
| Wide-brimmed hat | 823 (52.4) | 330 (21.0) | 221 (14.1) | 122 (7.77) | | 45 (2.87) |
| Shade | 366 (23.3) | 400 (25.5) | 520 (33.1) | 209 (13.3) | | 47 (2.99) |
| Avoiding peak UVR exposure hours | 573 (36.5) | 466 (29.7) | 348 (22.2) | 112 (7.13) | | 45 (2.87) |
| Sunglasses | 460 (29.3) | 337 (21.7) | 393 (25.0) | 267 (17.0) | | 90 (5.73) |
| Outdoor tanning | 680 (43.3) | 314 (20.0) | 283 (18.0) | 190 (12.1) | | 74 (4.71) |
| Indoor tanning | 1,432 (91.2) | 54 (3.44) | 39 (2.48) | 16 (1.02) | | 12 (0.76) |
| | **0** | **1** | **2** | **3** | **4** | **5 +** |
| Sunburn occurrence, *n* (%) | | | | | | |
| Sunburns in the past year | 482 (31.4) | 369 (24.0) | 294 (19.2) | 173 (11.3) | 82 (5.34) | 135 (8.79) |
| Sunburns in the past month | 1,227 (81.6) | 200 (13.3) | 36 (2.40) | 25 (1.66) | 6 (0.40) | 9 (0.60) |
| | **Very unlikely** | **Somewhat unlikely** | **Neither likely norunlikely** | **Somewhat likely** | | **Very likely** |
| Perceived risk, *n* (%) | | | | | | |
| Perceived risk | 222 (14.1) | 293 (18.7) | 365 (23.3) | 527 (33.6) | | 121 (7.71) |

Percentages are calculated based on the number of participants who answered that question

**Table 3**

Comparison of sun protection behaviors, tanning behaviors, sunburn occurrence, knowledge, and perceived risk between rural and urban students in Utah

| Outcome[a] | Geographic area | Unadjusted odds ratio (95% CI) | *p* | Adjusted odds ratio[b] (95% CI) | *p* |
|---|---|---|---|---|---|
| Sunscreen use | Rural Urban | 0.89 (0.63, 1.24) | 0.501 | 0.71 (0.53, 0.95) | **0.022** |
| Re-application of sunscreen | Rural Urban | 0.63 (0.46, 0.87) | **0.005** | 0.61 (0.74, 1.02) | **0.002** |
| Long-sleeved shirt | Rural Urban | 0.66 (0.51, 0.85) | **0.001** | 0.63 (0.46, 0.86) | **0.004** |
| Long pants or long skirt | Rural Urban | 1.58 (1.29, 1.93) | **0.0001** | 1.65 (1.23, 2.21) | **0.001** |
| Wide-brimmed hat | Rural Urban | 1.71 (1.33, 2.06) | **0.0003** | 1.56 (1.15, 2.11) | **0.004** |
| Shade | Rural Urban | 0.62 (0.79, 0.49) | **0.0001** | 0.67 (0.50, 0.88) | **0.005** |
| Avoiding peak UVR exposure hours | Rural Urban | 0.67 (0.51, 0.87) | **0.003** | 0.77 (0.53, 1.13) | 0.186 |
| Sunglasses | Rural Urban | 1.23 (0.85, 1.79) | 0.267 | 0.93 (0.71, 1.24) | 0.660 |
| Outdoor tanning | Rural Urban | 1.69 (1.12, 2.55) | **0.012** | 1.33 (0.87, 2.02) | 0.179 |
| Indoor tanning | Rural Urban | 1.81 (1.24, 2.64) | **0.002** | 1.78 (1.03, 3.07) | **0.039** |
| Sunburns in past year | Rural Urban | 2.01 (1.34, 3.01) | **0.001** | 1.47 (1.05, 2.05) | 0.023 |
| Sunburns in past month | Rural Urban | 1.16 (0.48, 2.78) | 0.738 | 0.96 (0.48, 1.94) | 0.914 |
| Perceived risk | Rural Urban | 1.72 (1.24, 2.37) | **0.001** | 1.42 (1.03, 1.96) | **0.033** |
| **Outcome[c]** | **Geographic Area** | **Unadjusted model Mean difference (95% CI)** | ***p*** | **Adjusted model[b] Mean difference (95% CI)** | ***p*** |
| Skin cancer knowledge | Rural Urban | − 0.09 (− 0.39, 0.21) | 0.523 | − 0.37 (− 0.55, − 0.18) | **0.0001** |
| Weekday hours spent outside | Rural Urban | 0.38 (− 0.32, 1.10) | 0.293 | 0.37 (− 0.34, 1.12) | 0.343 |
| Weekend hours spent outside | Rural Urban | 1.26 (0.37, 2.18) | **0.007** | 0.95 (0.12, 1.83) | **0.023** |

*CI* confidence intervals differences are for rural versus urban, with urban as the reference category

[a]Results of multi-level mixed-effects ordered logistic regression for ordinal outcome variables

[b]Adjusted for gender, race/ethnicity, grade, and family history of skin cancer

[c]Results of generalized linear mixed model for continuous outcome variables

Boldface indicates statistical significance