Exploring the Relationship Between Sunscreen Use and Screen Time in American High School Students

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Abstract

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Objectives: To determine the association between reported non-school screen time (i.e. phones, televisions, gaming devices, etc…) and sunscreen usage among American high school students grades 9-12.

Materials and methods: Data from the Youth Risk Behavior Surveillance System (YRBSS), administered by the Centers for Disease Control and Prevention to high school students across the United States in 2019 were utilized. The cross-sectional analysis focused on high school students in grades 9-12 from public and private schools. Self-reported sunscreen usage and screen time were the primary outcome and exposure, respectively. Prevalence ratios (PR) for poor sunscreen usage associated with excess screen time were estimated using modified Poisson regression models, controlling for sex, age, and race/ethnicity. Effect modification by sex was assessed, considering potential differences in non-school screen time behaviors between boys and girls.

Results: In both adjusted and unadjusted models, we found that the prevalence of poor sunscreen use among students reporting excess screen time was somewhat higher compared to those not reporting having excessive screen time (PR=1.12, 95% CI: 1.08, 1.16). Adjustment for age, sex and race/ethnicity did not change this result (P=1.12, etc). When stratifying by sex to assess possible effect modification, the PR was estimated to be 1.14 (95% CI 1.05, 1.23) for males and 1.10 (CI 95% 1.02, 1.18) for females.

Conclusion: There is a weak cross-sectional association between excess non-school screen time and poor sunscreen use among American high school students grades 9-12. This association is independent of sex, age and race/ethnicity.

Introduction

Skin cancer, including melanoma and non-melanoma types (NMSC), is the most common cancer in the United States (1, 2). With an estimated one in every five Americans developing skin cancer in their lifetime, it constitutes a growing substantial public health challenge on a global scale, as evidenced by increases in incidence rates witnessed within recent decades (3, 4).

The overall incidence of basal cell carcinoma (BCC) has increased by 145% between the years 1976-1984 and 2000-2010 (30). In addition, there has also been a 263% increase in cutaneous squamous cell carcinoma (SCC) incidence within that same period (5). Research suggests that BCC and SCC impact over 3 million Americans annually (6, 7). The major risk factors for melanoma and NMSC is excess exposure to ultraviolet (UV) radiation from sunlight (8). Exposure to UV radiation accounts for the majority of melanoma cases (9-11). As a result, sunscreen use is widely recommended as a preventative strategy against skin cancer, owing to its efficacy in shielding the skin from deleterious UV radiation (12-14). A 2019 cross-sectional survey examining sun protection behaviors among U.S. adolescents revealed an inverse relationship between age and the frequency of sunscreen use ranging from 16.4% reporting never or rarely using sunscreen in the ≤6 year old category to 49.7% in the 15-18 age category. Their findings indicate that older adolescents are less likely to engage in regular sun protective behaviors (38).

While most diagnoses are among middle and older aged adults, cutaneous malignant melanoma (CMM) at any age is caused by heavy exposure to UV radiation in youth (15, 33). Research suggests that a substantial portion of lifetime UV exposure, estimated to be between 25%-50%, occurs before the age of 60, highlighting the critical role of early years in shaping long-term sun exposure effects. Moreover, studies indicate that children receive approximately three times the annual UV exposure compared to adults. Safeguarding children and adolescents against UV radiation becomes imperative in potentially reducing the risk of cutaneous melanoma stemming from early-life UV exposure (16).

On average, American children 8 to 12 years of age spend 4 to 6 hours a day watching or using screens, with teenagers spending up to an average of 9 hours (17). In 2019, adolescents aged 13 to 18 years old made up the largest portion of TV viewers (18). In addition, 57% of adolescents indicate daily TV viewing, with an average daily duration of 1 hour and 49 minutes spent in front of the TV screen (18). Since TV viewing is sedentary in nature, combined with the convenience and entertainment it offers indoors, it leads to reduced time spent outdoors. Because of reduced time spent outdoors, there may be a lower perceived risk of sunburn or skin damage from UV radiation, which can lead to less motivation to apply sunscreen as a protective measure.

There have been studies conducted looking at the determinants of sunscreen use among youth, but these studies have only looked at the correlation of sunscreen use between students and their parents/caregivers, gender, racial identity and attitudes (19-21). Attitudes included youth and parents'/caregivers' favorable or unfavorable evaluations, emotional feelings, and behavioral tendencies toward being tanned, sun exposure and sunscreen use despite knowledge of UV risks and low sunscreen use. As of 2024, there is no literature that has investigated the relationship between sunscreen use and non-school screen time among youth. Since sunscreen use is a preventative measure for skin cancer, it is important to understand the extent to which screen time influences sunscreen use and to inform targeted public health interventions, policy development, and preventative health strategies. As an initial step in addressing the connection between youth non-school screen time and youth sunscreen use, we investigated the association between sunscreen use and screen time among high school students using data from the Centers of Disease Control and Prevention's 2019 National Youth Risk Behavior Survey (YRBS). Our primary aim was to determine the association between sunscreen usage and reported non-school screen time (i.e. phones, televisions, gaming devices, etc…) among American children and young adults, aged 12-18.

Materials and methods

Study Design and Data Source

We included a total of 8,473 students after excluding 5,204 students for missing data on either the exposure (n=102), outcome (n=3,995), or both (n=361). This was a cross-sectional analysis of students aged 12-18 who were enrolled in either public or private high schools across the United States. Data was taken from the 2019 Youth Risk Behavior Surveillance System (YRBSS) survey, which encompassed 78 different schools throughout the United States of high school students. The anonymous survey was conducted biennially during the spring of odd-numbered years to enable the assessment of risk behaviors as they may change over time among high school students (22).

The survey was self-administered using a computer-scannable questionnaire booklet and typically required one class period, approximately 45 minutes, for completion (22).

Sampling

A nationally representative sample of students in grades 9–12 attending both public and private schools was obtained using a three-stage cluster sampling design. Our analysis did not exclude participants based on age, therefore there were participants in the sample that may be younger or older than the typical high school age range due to skipping grades or being held back. . The sampling frame included both public and non-traditional public schools (ex: charter schools, parochial institutions) across 44 U.S. states and the District of Columbia.The sampling frame datasets acquired from Market Data Retrieval, Inc., and the National Center for Education

Statistics (NCES). NCES datasets were derived from the Common Core of Data for public schools and the Private School Universe Survey for nonpublic schools.

These surveys were administered across a diverse range of educational settings, including 44 states, 28 local school districts, three territories, and two tribal governments. Schools with enrollments of 40 students or fewer across grades 9 through 12 were excluded from participation. Initially, the sampling frame consisted of 1,257 primary sampling units (PSUs), which included entire counties, groups of smaller adjacent counties, or parts of larger counties. These PSUs were categorized into 16 strata based on factors such as metropolitan statistical area status (e.g., urban or rural) and the proportions of non-Hispanic black and Hispanic students within each PSU. At the second stage, secondary sampling units (SSUs) were identified as individual physical schools offering grades 9–12 or aggregate schools formed by combining multiple geographically proximate institutions that together covered all four grades. A total of 162 SSUs were sampled from the 54 PSUs, with probability proportional to school enrollment size. Additionally, to ensure adequate representation of students in small schools, an extra 15 small SSUs were chosen from a subsample of 15 PSUs within the initial 54 PSUs. In total, these 177 SSUs corresponded to 184 physical schools.

The third and final stage of sampling involved randomly selecting one or two classrooms from each grade (9–12), either from a required subject (e.g., English or social studies) or a required period (e.g., homeroom or second period). All students in the selected classes were eligible to participate. Schools, classes, and students that declined to participate were not replaced in the sampling design.

The student sample size for the 2019 survey was 13,677, with a school response rate of 75% and a student response rate of 80% (32).

Exposure

Our primary exposure of interest is excess non-school screen time, defined as either reporting three or more hours a day of television use and/or computer use for a purpose other than school work (including gaming, social media, etc). Screen time on school days was based on the survey question for hours of watching TV, “On an average school day, how many hours do you watch TV?” with the response options being, I do not watch TV on an average school day, Less than 1 hour per day, 1 hour per day, 2 hours per day, 3 hours per day, 4 hours per day, 5 or more hours per day

For video streaming, computer games, or other non-school related computer use the question is worded, “On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work? (Count time spent playing games, watching videos, texting, or using social media on your smartphone, computer, Xbox, PlayStation, iPad, or other tablet.)” with the response options being, I do not play video or computer games or use a computer for something that is not school work, Less than 1 hour per day, 1 hour per day, 2 hours per day. 3 hours per day, 4 hours per day, 5 or more hours per day.

The primary exposure was a dichotomized variable of excess screen time or no excess screen time. Excess screen time was defined as either reporting three or more hours a day of television use and/or computer use for a purpose other than school work (including gaming, social media, etc.).

Outcome

The primary outcome of interest was poor usage of sunscreen of at least SPF 15 or higher while outside for more than an hour on a sunny day. Participants who answered “never” or “rarely” were categorized as having “poor sunscreen usage,” and participants who answered “sometimes” “most of the time” or “always” were classified as having “adequate sunscreen usage.”

Covariates

Covariates of interest included sex, age and race/ethnicity. The version of the YRBSS survey utilized in our study contained pre-categorized age groups, which we used in our analysis. These groups were categorized into bins of 12 or younger, 13, 14, 15, 16, 17 and 18 or older. We categorized sex as male or female, as those were the only two options available on the survey. Two separate questions about race were asked on the survey, one being “Are you Hispanic or Latino?” and “What is your race?” with the option to select one or more responses. We categorized race/ethnicity as American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, White, Hispanic/Latino (of any listed race), multiple races (not including Hispanic/Latino) and multiple races (including Hispanic/Latino).

Statistical Analysis

In order to account for selection and nonresponse bias, as well as the oversampling of black and Hispanic students, YRBSS includes sampling weights that capture the likelihood of an individual appearing in the sample based on sex, race/ethnicity, and grade. These sampling weights were incorporated so our estimates provide a nationally representative portrayal of students in grades 9–12 attending both U.S. public and private schools (31).

We estimated the prevalence ratio (PR) and corresponding 95% confidence intervals (CIs) of reporting poor sunscreen usage associated with screen time by fitting a modified Poisson regression model for binary outcomes with robust error estimation (23). We controlled for sex, age, and race/Hispanic ethnicity as potential confounders. All analyses were conducted in R Programming Language version 2023.12.1+402. All figures were constructed using R Programming Language and Microsoft Word version 16.84.

Effect modification

We assessed for effect measure modification by sex. A 2018 cross-sectional study examined a nationally representative sample of children aged 10 to 19 years of age and found that 80% of boys played video games while only 20% of girls did (25). Video games are typically played indoors, because they require specific equipment such as gaming consoles or computers, and a stable environment conducive to focused gameplay. Indoor settings also provide the necessary infrastructure such as electricity and a stable internet connection to support gaming activities effectively. In addition, the immersive nature of video games often encourages players to remain indoors for extended periods to fully engage with the game environment. On the other hand, social media platforms can be accessed both indoors and outdoors due to their accessibility on various devices, including smartphones, tablets, and laptops. A 2022 study by the Pew Research Center asked teens about social media use and found that more teen girls than boys reported using Tiktok, Instagram and Snapchat (26). It is possible that girls, while also using screens, are more inclined to spend time outdoors compared to boys, who tend to be indoors playing videos where it is most conducive for such activities. We assessed for effect modification by fitting the primary model (as described above) with the addition of a cross-product term representing the combination of sex and screen time terms. Comparison of the likelihoods between this latter model and the primary model permitted a test of the null hypothesis that there was no multiplicative interaction.

Results

The distribution of the covariates of interest stratified by sunscreen use can be found in Table 1. Among those who had poor sunscreen use, there was a higher percentage of females compared to males (54.5% vs. 45.5%). The age distributions among individuals with adequate sunscreen use and those with poor sunscreen use were similar (Table 1). Among adequate sunscreen users, the largest age group was 16-year-olds (28.0%), followed by 15-year-olds (26.7%) and 17-year-olds (21.6%). Among poor sunscreen users, the largest age groups were 16-year-olds (26.3%), followed by 15-year-olds (23.6%) and 17-year-olds (24.9%).

Among all racial groups, Black/African American students reported the highest prevalence of poor sunscreen use, with 84% indicating inadequate use of sunscreen (Figure 1). In contrast, white students reported the lowest prevalence of poor sunscreen use at 53%.

The prevalence of poor sunscreen use was slightly higher among students reporting excess screen time compared to students reporting no excess screen time (Table 2).

In the unadjusted model, the prevalence of poor sunscreen use among individuals who were classified as having excessive screen time is 12.0% greater (prevalence ratio (PR): 1.12, 95% CI: 1.08, 1.16) than the prevalence of poor sunscreen use among individuals who were not classified as having excessive screen time (Table 3). This result did not change following adjustment for age, sex, race/ethnicity, or in combination.

When stratifying by sex to assess possible effect modification, the prevalence ratio was estimated to be 1.14 (95% CI 1.05, 1.23) for males and 1.10 (CI 95% 1.02, 1.18) for females. We also compared a model that included an interaction term between excess screen time and sex along with a reduced model without an interaction term, and we found no evidence of effect modification from student sex on the association between excess screen time and poor sunscreen use (Likelihood Ratio Test, p-value: 0.63).

Discussion

To the best of our knowledge, this is the first study to investigate the relationship between sunscreen use and screen time among youth. Our findings suggest that excessive screen time among adolescents is weakly associated with poor sunscreen use (Table 2). Those classified as having excessive non-school screen time demonstrated a 12.0% higher prevalence of poor sunscreen use than those who were classified as having no excess screen time (PR: 1.12, 95% CI: 1.08, 1.16). This association persisted even after adjusting for potential confounders, including age, sex, race/ethnicity, or a combination of these factors (Table 3). The consistency of our results across adjusted models suggest that the relationship between excessive screen time and poor sunscreen use is robust and not meaningfully influenced by these demographic characteristics of U.S. high school students.

We found a weak association between excess computer use and poor sunscreen use. Among those with adequate sunscreen use, 41.6% reported excess computer use, whereas 49.5% of those with poor sunscreen use reported excess computer use. This suggests that adolescents who spend excessive time on computers are less likely to use sunscreen adequately. This finding is concerning given the increasing amount of time adolescents spend on computers for non-educational "excess" screen time purposes.

Our findings also suggest that sunscreen use practices are relatively similar across all age groups, with minor variations. However, younger adolescents (≤13 years) are less represented in both categories due to a relatively small sample size. The consistency among age groups indicates that age might not be a significant factor in sunscreen application behaviors, possibly reflecting widespread public health messaging and educational efforts about sun safety across different age demographics.

Racial and ethnic disparities in sunscreen use were also evident in our study. 84% of Black/African American students reported poor sunscreen use, while white students had the lowest prevalence of poor sunscreen use (53%). This finding aligns with the existing literature on racial differences in perceived risk of sun exposure. A study of high school students found that among different ethnic and racial backgrounds, Black/African American students had the least knowledge regarding sun protection measures (34). Similarly, other studies regarding sunscreen usage found that Black/African American individuals are more likely to have inaccurate risk perceptions and less knowledge about skin cancer than other racial groups, leading to poor health protective behaviors (35-37). Though further research is necessary, this suggests that future interventions aimed at improving sunscreen use should focus on Black/African American high school students. These findings highlight the need for tailored public health interventions that address the unique barriers and misconceptions about sunscreen use within different racial and ethnic communities.

We also found that among those who had poor sunscreen use, there was a higher percentage of females compared to males (54.5% vs. 45.5%). We hypothesized that the association between excess non-school screen time and poor sunscreen use might vary by sex due to differing patterns of (electronic) screen use between boys and girls. The PRs were essentially the same for males and females, showing no evidence of effect measure modification.

Limitations

It is important to consider certain limitations of our study. The 2019 YRBSS survey, conducted biennially in the spring, may overlook potential seasonal variations in sunscreen usage. In addition, the survey excluded questions regarding other forms of sun protection such as hats, long sleeves, staying in the shade, etc. These factors can influence whether someone wears sunscreen because individuals who use alternative sun protection methods may have a lower perceived risk of sun exposure and may choose to rely less on sunscreen for protection.

Another limitation was the inability to control for additional potential confounders such as socioeconomic status, parental education level, parental supervision, parental sunscreen use, outdoor activity levels, physical activity, health literacy, history of sunburn, peer influence, media exposure, and geographical factors. While our study provides valuable insights into the association between excessive screen time and poor sunscreen use among adolescents, it also highlights several areas where further research is necessary. Future research should aim to better understand the underlying mechanisms driving the observed associations so as to develop more effective interventions. In addition, conducting longitudinal studies could allow for the assessment of changes in screen time and sunscreen use over time, providing a temporal perspective on how the latter is influenced by the former. This approach can help identify critical periods for intervention and in understanding the long-term effects of excessive screen time on sun protection behaviors.

Appendix

Tables and Figures

Table 1: Demographic characteristics of U.S. high school students, stratified by adequacy of sunscreen use, YRBSS, 2019

	Sunscreen Use	
	Adequate (n= 3129)	**Poor (n= 5344)**
Sex		
Male	1,929 (61.6%)	2,432 (45.5%)
Female	1,200 (38.4%)	2,912 (54.5%)
Age (years)		
≤12	6 (0.2%)	5 (0.1%)
13	2 (0.1%)	3 (0.1%)
14	356 (11.4%)	600 (11.2%)
15	837 (26.7%)	1,262 (23.6%)
16	877 (28.0%)	1,407 (26.3%)
17	677 (21.6%)	1,330 (24.9%)
≥18	374 (12.0%)	737 (13.8%)
Race		
American Indian/Alaska Native	22 (0.7%)	51 (1.0%)
Asian	168 (5.4%)	255 (4.8%)
Black/African American	162 (5.2%)	837 (15.7%)
Native Hawaiian/Pacific Islander	8 (0.3%)	23 (0.4%)
White	2004 (64.1%)	2278 (42.6%)
Hispanic/Latino	198 (6.3%)	537 (10.1%)
Multiple Races (Hispanic/Latino)	450 (14.4%)	1102 (20.6%)
Multiple Races (not Hispanic/Latino)	117 (3.7%)	261 (4.9%)
Excess computer use	1303 (41.6%)	2645 (49.5%)
Excess TV use	308 (9.8%)	523 (9.8%)

Table 2: Distribution of U.S. high school students by non-school screen time and sunscreen use, YRBSS, 2019

	Non-School Screen Time	
Sunscreen Use	**No excess n= 4,126**	**Excess n= 4,347**
Adequate[1]	1,675 (40.6%)	1,454 (33.4%)
Poor[2]	2,451 (59.4)	2,893 (66.5%)
Total	4,126	4,347

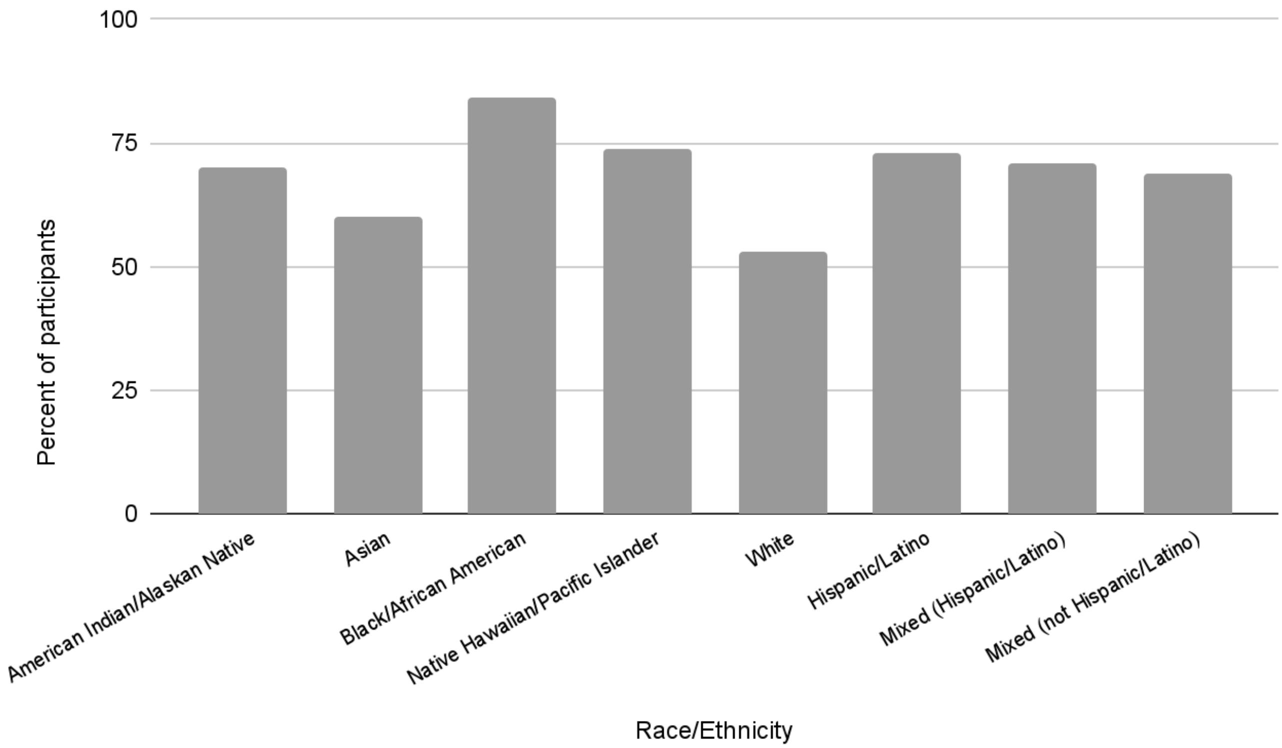
[1]Adequate sunscreen use = participants who answered “sometimes” “most of the time” or “always” were classified as having “adequate sunscreen use”

[2]Poor sunscreen use = participants who answered “never” or “rarely” were categorized as having “poor sunscreen use”

Table 3: Prevalence ratios for the association of excess non-school screen time with poor sunscreen usage among U.S. high school students, by model covariates, YRBSS, 2019

Model Covariates	Prevalence Ratio (95% CI)
None	1.12 (1.08, 1.16)
Sex	1.12 (1.06, 1.18)
Age	1.12 (1.06, 1.18)
Sex and age	1.12 (1.08, 1.15)
Sex, age, race/ethnicity	1.10 (1.06, 1.13)

Figure 1: Prevalence of poor sunscreen use among U.S. high school students, by race and Hispanic ethnicity, YRBSS, 2019



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