

Cross-sectional Association between Walking and Sunburn: A Potential Trade-off between Cancer Prevention and Risk Factors

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Abstract

Background The positive association between physical activity and sunburn is a health behavior trade-off between the health benefits of physical activity and increased risk of skin cancer.

Purpose We assessed walking, which is a common source of physical activity, and the prevalence of sunburn.

Methods This research used the 2015 National Health Interview Survey of adults ($N = 26,632$), age ≥ 18 years. We defined four exclusive categories of walking: (a) those who reported not walking; (b) only transportation (to get some place, such as work, a store, or public transit stop); (c) only leisure (such as for fun, relaxation, or exercise); and (d) both categories. We estimated the adjusted prevalence of sunburn by walking category and separately for walking duration; we stratified by gender and sun sensitivity.

Results The adjusted sunburn prevalence was not different between walking categories for women, but it was for men. Specifically, prevalence was lower for men who reported not walking, 34.1% (95% confidence interval [CI]: 32.2%–36.1%) compared to 38.8% (95% CI: 36.5%–41.2%) who walked for both purposes ($p = .003$). Walking duration was not associated with sunburn prevalence.

Conclusion We could not determine whether sunburn occurred during walking trips because the questions were not asked as such. However, the results suggest that walking, unlike leisure-time physical activity (such

as exercise, sports, or physically active hobbies), may not generally be associated with sunburn, except for the higher sunburn prevalence for men who walked for both leisure and transportation purposes.

Keywords: Sunburn • Physical activity • Walking • Leisure • Transportation

Introduction

Public health communications in the USA, such as *Step It Up! The Surgeon General's Call to Action to Promote Walking and Walkable Communities* and *The Surgeon General's Call to Action to Prevent Skin Cancer*, address walking and skin cancer as independent issues [1, 2]. Walking is a common source of physical activity accessible to most people [3, 4]. However, those with higher amounts of physical activity also have higher risk of skin cancer, specifically melanoma [5], ostensibly from the higher rates of sunburn among physically active people [6]. Little is known about the association between types of common outdoor physical activities, such as walking, and sunburn [7]. For example, those who play outdoor sports have higher risk of sunburn [8], but it is unknown whether the much more common activity of walking is associated with higher risk of sunburn. Walking for physical activity typically occurs on neighborhood streets, in parks, or on trails, although some occurs in shopping malls or on a treadmill [9].

Better understanding of walking as both a cancer prevention behavior and as a potential cancer risk factor could inform strategies aimed at jointly achieving healthful physical activity and reducing risk of skin cancer. Disaggregation of walking into categories, for leisure or as a means of transportation, is necessary to account for walking-category-specific behaviors and

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context [10]. This research examined the association between category and duration of walking and sunburn prevalence after accounting for leisure-time physical activity and sun protection behaviors.

Methods

This cross-sectional research used the nationally representative 2015 National Health Interview Survey (NHIS; $N = 33,672$). The NHIS is an annual household survey of the U.S. noninstitutional adult (age ≥ 18 years) population [11], and a description of demographics is available [6]. The outcome variable was any reported sunburns in the previous 12 months. We defined four exclusive categories of walking reported for the past 7 days: (a) those who reported not walking more than 10 min (no walking); (b) only transportation (walking to get someplace); (c) only leisure (walking for fun, relaxation, or exercise); and (d) both categories [12]. Walking duration for transportation and leisure was calculated from responses to frequency and average duration of trips. Covariates included regular sunscreen use, sun avoidance, and sun protective clothing use. Analyses also adjusted for demographics and covariates related to sunburn risk or walking: leisure-time physical activity level (inactive, insufficiently active, sufficiently active, or highly active) [13], obesity or overweight, needs walking assistance, ever had a skin exam, skin reaction after 2 weeks in the sun (very dark tan, moderate tan, mild tan, burn repeatedly or freckle, or do not go out in the sun), personal or family history of melanoma, ever had cancer, health insurance status, sunless tanning product use, indoor tanning use, smoking status, and binge drinking status [6]. This study was exempt from review by the National Cancer Institute institutional review board because we used publicly available deidentified data.

Statistical Analyses

We examined the associations between walking behavior and any sunburns, controlling for covariates. We assessed variation in sunburn prevalence for walking by category and duration with logistic regression. We stratified by gender and sun sensitivity (any reported skin burn when not protected from the sun for 1 hr) following previous research [6]. We excluded respondents who were unable to walk ($n = 894$) or had missing responses to any variables ($n = 7,040$) for an analytic sample of $N = 26,632$. Among walkers, we categorized the walking duration variables into quartiles, as it was zero-inflated and right skewed. A sensitivity analysis showed that walking duration as a continuous or log-transformed variable produced similar results.

We used SAS-callable SUDAAN, version 11.0 (Research Triangle Institute) to account for the complex sampling design and weights. Significance tests used the adjusted Wald F -test and linear contrasts for differences between walking categories; $p < .05$ was the level of significance.

Results

Descriptive Statistics

A higher proportion of men reported walking for both purposes (22.1%, 95% confidence interval [CI]: 21.2%–22.2%) compared to women (19.5%, 95% CI: 18.5%–20.5%), whereas a higher proportion of women reported walking for leisure only (35.6%, 95% CI: 34.4%–36.7%) compared to men (28.7%, 95% CI: 27.5%–29.9%) (Table 1).

Sunburn and Walking Categories

Sunburn prevalence, adjusted for covariates, was not significantly associated with walking categories for women ($F[3, 14,320] = 1.15, p = .32$), but it was for men ($F[3, 12,304] = 3.25, p = .02$). Specifically, sunburn prevalence was lower for men who reported no walking (34.1%; 95% CI: 32.2%–36.1%) compared to men who walked for both purposes (38.8%; 95% CI: 36.5%–41.2%; $F[1, 12,306] = 9.24, p = .003$; Table 2). Similarly, sunburn was three percentage points higher in men who reported any walking compared to no walking ($F[1, 12,306] = 7.26, p = .008$) and there was not a significant difference for women ($F[1, 14,320] = 0.45, p = .50$).

No significant associations between sunburn and walking were found among sun-sensitive individuals ($N = 13,974$) (Fig. 1).

Walking Duration and Sunburn

Minutes of walking, in models adjusted for covariates, were not significantly associated with sunburn for women (transportation, $F[4, 14,319] = 1.34, p = .26$; leisure, $F[4, 14,319] = 1.76, p = .14$) or men (transportation, $F[4, 12,303] = 2.26, p = .06$; leisure, $F[4, 12,303] = 1.60, p = .17$). Similarly, among sun-sensitive individuals, the adjusted association between walking minutes and sunburn was not significant for women (transportation, $F[4, 7,805] = 0.67, p = .61$; leisure, $F[4, 7,805] = 1.39, p = .24$) or men (transportation, $F[4, 6,159] = 0.82, p = .51$; leisure, $F[4, 6,159] = 1.38, p = .24$).

Discussion

With one exception, the results suggest that neither walking category nor duration was generally associated

Table 1. Weighted unadjusted prevalence (% and 95% confidence intervals [CIs]) for the total population and in exclusive walking categories^a (rows sum to 100%) for U.S. adults by selected characteristics, National Health Interview Survey, 2015

	Unweighted <i>N</i>	Total population weighted % and 95% CI	Not walking more than 10 min % and 95% CI	Transportation only % and 95% CI	Leisure only % and 95% CI	Both purposes % and 95% CI
Total	26,632		36.0 (35.1–36.9)	11.1 (10.5–11.6)	32.2 (31.3–33.1)	20.8 (20.1–21.5)
Sex						
Women	14,324	50.4 (49.6–51.3)	35.0 (34.0–36.1)	9.9 (9.2–10.6)	35.6 (34.4–36.7)	19.5 (18.5–20.5)
Men	12,308	49.6 (48.7–50.4)	36.9 (35.7–38.2)	12.3 (11.4–13.1)	28.7 (27.5–29.9)	22.1 (21.1–22.2)
Age group						
18–24	2,508	13.2 (12.4–13.9)	35.1 (32.3–37.8)	15.6 (13.6–17.6)	25.6 (23.1–28.1)	23.8 (21.3–26.2)
25–34	4,872	18.5 (17.8–19.1)	33.1 (31.3–34.9)	11.4 (10.2–12.7)	32.7 (30.8–34.6)	22.7 (21.1–24.3)
35–44	4,414	17.3 (16.6–17.9)	34.4 (32.3–36.5)	11.0 (9.9–12.0)	32.7 (30.6–34.7)	22.0 (20.2–23.8)
45–64	9,083	34.7 (33.8–35.5)	35.3 (33.9–36.5)	10.6 (9.7–11.5)	33.8 (32.2–35.4)	20.2 (18.9–21.5)
≥65	5,755	16.4 (15.7–17.0)	43.0 (41.2–44.8)	8.0 (7.0–9.0)	32.8 (31.1–34.4)	16.3 (14.9–17.6)
Race/ethnicity						
White, non-Hispanic	16,709	65.2 (64.2–66.2)	35.0 (33.9–36.2)	9.9 (9.2–10.6)	34.5 (33.4–35.7)	20.6 (19.6–21.5)
Black, non-Hispanic	3,235	10.9 (10.3–11.6)	43.0 (40.6–45.3)	13.7 (11.9–15.5)	23.1 (21.1–25.1)	20.3 (18.2–22.4)
Hispanic	4,467	16.0 (15.2–16.7)	38.0 (36.1–39.9)	13.0 (11.6–14.4)	28.7 (26.9–30.4)	20.6 (18.8–21.9)
Other race ^b	2,221	7.9 (7.5–8.3)	29.9 (27.2–32.6)	13.2 (11.4–15.0)	32.4 (29.7–35.1)	24.4 (21.9–26.9)
At least 1 sunburn in past 12 months						
Yes	8,878	36.0 (35.0–37.0)	30.6 (29.2–31.9)	11.2 (10.3–12.2)	34.6 (33.2–36.0)	23.6 (22.2–24.9)
No	17,754	64.0 (63.0–65.0)	39.0 (37.9–40.1)	11.0 (10.3–11.6)	30.8 (29.8–31.8)	19.2 (18.4–20.1)
Skin reaction after 2 weeks in sun						
Very dark tan	3,335	12.7 (12.1–13.3)	36.1 (33.8–38.4)	12.3 (10.7–13.8)	30.8 (28.5–33.1)	20.8 (18.9–22.6)
Moderate tan	8,376	31.5 (30.7–32.2)	34.2 (32.8–35.6)	10.5 (9.6–11.5)	34.0 (32.7–35.4)	21.3 (20.0–22.5)
Mild tan	8,298	31.4 (30.6–32.3)	34.9 (33.5–36.4)	11.6 (10.6–12.6)	31.6 (30.2–32.9)	21.9 (20.7–23.1)
Burn repeatedly or freckle	4,509	17.3 (16.7–17.9)	32.9 (30.9–34.9)	10.6 (9.3–11.8)	36.0 (33.8–38.2)	20.5 (18.7–22.2)
Do not go in the sun	2,114	7.2 (6.6–7.7)	55.6 (52.4–58.8)	10.2 (8.5–11.8)	19.7 (17.3–22.1)	14.6 (12.6–16.7)
Regular sun avoidance^c						
Yes	11,154	40.9 (40.0–41.8)	39.6 (38.3–40.8)	11.3 (10.5–12.2)	30.7 (29.4–31.9)	18.4 (17.4–19.4)
No	15,478	59.1 (58.2–60.0)	33.5 (32.3–34.6)	10.9 (10.2–11.6)	33.2 (32.1–34.3)	22.4 (21.4–23.5)
Regular sun protective clothing use^d						
Yes	10,443	36.2 (35.4–37.1)	34.5 (33.2–35.7)	11.3 (10.4–12.2)	31.7 (30.4–32.9)	22.6 (21.4–23.8)
No	16,189	63.8 (62.9–64.6)	36.8 (35.7–38.0)	10.9 (10.2–11.6)	32.5 (31.3–33.6)	19.8 (18.9–20.7)

Table 1. Continued

	Unweighted <i>N</i>	Total population weighted % and 95% CI	Not walking more than 10 min % and 95% CI	Transportation only % and 95% CI	Leisure only % and 95% CI	Both purposes % and 95% CI
Regular sunscreen use (SPF15+) ^e						
Yes	8,322	32.7 (31.8–33.5)	26.2 (24.9–27.6)	10.0 (9.1–10.9)	38.6 (37.0–40.2)	25.2 (23.7–26.6)
No	18,310	67.3 (66.5–68.2)	40.7 (39.6–41.8)	11.6 (10.9–12.3)	29.0 (28.0–30.0)	18.7 (17.9–19.4)
Physical activity level ^f						
Inactive	7,932	28.1 (27.2–29.0)	63.5 (62.0–65.1)	12.5 (11.4–13.5)	15.2 (14.1–16.2)	8.9 (8.0–9.7)
Insufficiently active	5,387	20.5 (19.8–21.2)	33.7 (32.0–35.5)	11.2 (10.0–12.4)	37.4 (35.6–39.2)	17.7 (16.3–19.1)
Sufficiently active	4,355	16.8 (16.1–17.5)	22.4 (20.7–24.2)	11.8 (10.5–13.2)	41.8 (39.8–43.9)	23.9 (22.0–25.7)
Highly active	8,958	34.6 (33.7–35.6)	21.5 (20.2–22.7)	9.5 (8.7–10.3)	38.2 (36.7–39.7)	30.8 (29.3–32.3)

^aReported walking categories for at least 10 min in the past 7 days.

^bAmerican Indian, Alaskan Native, Asian, other, or multiple race

^cSun avoidance was defined as always or usually staying in the shade or responding not going into the sun for any sun protective question.

^dSun protective clothing was defined as always or usually wearing at least one: wide-brimmed hat, long sleeved shirt, or long clothing to the ankles.

^eRegular sunscreen use was defined as always or usually using sunscreen with SPF15+ (sun protection factor)

^fIndividuals were categorized into four activity levels based on the 2008 Physical Activity Guidelines for Americans: highly active (>300 min/week of light or moderate-intensity aerobic activity, 150 min of vigorous-intensity aerobic activity, or an equivalent combination per week [i.e., moderate-intensity equivalent activity]), sufficiently active (150–300 min/week of moderate-intensity equivalent activity), insufficiently active (some activity but less than 150 min/week of moderate-intensity equivalent activity), and inactive (no light to moderate or vigorous-intensity aerobic activity for at least 10 min).

Table 2. Weighted and adjusted^a prevalence (% and 95% confidence intervals [CIs]) of ≥1 sunburns in past 12 months for U.S. adults for walking categories^b and selected covariates, National Health Interview Survey, 2015

	Women		Men	
	Adjusted, ≥1 sunburns % (95% CI)	<i>p</i>	Adjusted, ≥1 sunburns % (95% CI)	<i>p</i>
Walking		.32		.02
Not walking more than 10 min	35.2 (33.1–37.2)		34.1 (32.2–36.1) ^c	
Transportation only	37.7 (34.5–41.0)		37.3 (34.3–40.4)	
Leisure only	35.0 (33.1–36.9)		36.0 (33.9–38.2)	
Both purposes	36.8 (34.5–39.1)		38.8 (36.5–41.2) ^c	
Age group		<.0001		<.0001
18–24	52.1 (47.7–56.4)		49.9 (45.8–54.0)	
25–34	47.6 (44.9–50.3)		46.9 (44.3–49.6)	
35–44	43.6 (41.0–46.2)		43.1 (40.2–46.1)	
45–64	30.6 (28.8–32.5)		32.2 (30.4–34.0)	
≥65	13.1 (11.0–15.5)		14.2 (12.4–16.4)	
Race/ethnicity		<.0001		<.0001
White, non-Hispanic	41.4 (39.7–43.1)		42.3 (40.5–44.2)	
Black, non-Hispanic	14.7 (12.6–17.0)		9.0 (7.1–11.3)	
Hispanic	30.5 (27.7–33.4)		29.5 (26.3–32.9)	
Other, non-Hispanic	25.5 (21.9–29.4)		26.1 (22.3–30.4)	
Physical activity level ^d		.02		.0001
Inactive	33.0 (30.7–35.3)		31.1 (28.6–33.7)	
Insufficiently active	36.3 (34.2–38.6)		37.8 (35.3–40.3)	
Sufficiently active	38.0 (35.7–40.4)		37.2 (34.8–39.7)	
Highly active	36.0 (34.1–37.9)		37.9 (35.9–40.0)	
Skin reaction after 2 weeks in sun		<.0001		<.0001
Very dark tan	30.9 (27.8–34.1)		33.9 (30.9–37.1)	
Moderate tan	35.7 (33.6–37.8)		36.1 (34.2–38.2)	
Mild tan	35.0 (33.1–37.0)		34.8 (32.8–36.9)	
Burn repeatedly or freckle	42.5 (40.3–44.8)		44.8 (41.9–47.8)	
Do not go out in the sun	20.9 (17.1–25.4)		20.5 (15.8–26.3)	
Regular sun avoidance ^e		.0003		.001
Yes	33.4 (31.7–35.1)		33.4 (31.2–35.7)	
No	37.5 (35.9–39.1)		37.3 (35.8–38.8)	
Regular sun protective clothing use ^f		.17		.47
Yes	34.6 (32.6–36.6)		36.6 (34.7–38.5)	
No	36.1 (34.8–37.5)		35.8 (34.2–37.5)	
Regular sunscreen use (SPF15+) ^g		.0001		<.0001
Yes	37.9 (36.3–39.6)		41.2 (38.8–43.7)	
No	33.7 (32.1–35.3)		34.4 (32.9–35.9)	

^aCovariates in addition to those listed: education status, marital status, foreign-born status, needs walking assistance, U.S. Census region, obesity or overweight, smoking status, binge drinking, tanning bed use, ever had a skin exam, ever had cancer, family history of melanoma, personal history of melanoma, sunless tanning product use, and health insurance status.

^bReported walking categories for at least 10 min in the past 7 days.

^cSignificant linear contrast of regression coefficients: $F(1, 12,306) = 9.24, p = .003$.

^dIndividuals were categorized into four activity levels based on the 2008 Physical Activity Guidelines for Americans: highly active (>300 min/week of light or moderate-intensity aerobic activity, 150 min of vigorous-intensity aerobic activity, or an equivalent combination per week [i.e., moderate-intensity equivalent activity]), sufficiently active (150–300 min/week of moderate-intensity equivalent activity), insufficiently active (some activity but less than 150 min/week of moderate-intensity equivalent activity), and inactive (no light to moderate or vigorous-intensity aerobic activity for at least 10 min).

^eSun avoidance was defined as always or usually staying in the shade or responding not going into the sun for any sun protective question.

^fSun protective clothing was defined as always or usually wearing at least one: wide-brimmed hat, long sleeved shirt, or long clothing to the ankles.

^gRegular sunscreen use was defined as always or usually using sunscreen with SPF15+ (sun protection factor).



Fig. 1. Weighted^a and adjusted^b prevalence (% and 95% confidence intervals) ≥ 1 sunburns in past 12 months by walking category^c for sun-sensitive individuals^d, National Health Interview Survey, 2015. ^aError bars represent upper and lower bounds of 95% confidence interval. ^bCovariates: age group, race/ethnicity, education, marital status, foreign-born status, needs walking assistance, U.S. Census region, obesity or overweight, physical activity level, smoking status, binge drinking, sun avoidance, sunscreen use, sun protective clothing use, skin reaction after 2 weeks in sun, tanning bed use, ever had a skin exam, ever had cancer, family history of melanoma, personal history of melanoma, sunless tanning product use, and health insurance status. ^cReported walking categories for at least 10 min in the past 7 days. ^dSun-sensitive individuals defined as those reporting any skin burn when not protected from the sun for 1 hr.

with sunburn prevalence. The one caveat concerned men, where the difference in sunburn was nearly 5 percentage points higher between those who walked for both leisure and transportation purposes compared to men who reported not walking at least 10 min.

These results differ from prior population studies where general physical activity has been strongly associated with increased sunburn [6, 14]. Some reasons walking is different from general physical activity may be due to type of clothing (e.g., clothing worn while walking to work may cover more skin than clothing worn while jogging), time of day, or context. Also, in contrast to findings of a gender difference in general physical activity, women reported more leisure walking trips than men, but they did not report more sunburn, which is a consistent gender-related finding in prior sunburn research [6]. We found differences in sun protection between genders: more women used sunscreen and avoided the sun; however, more men wore protective clothing, similar to prior research [6].

Limitations

Our purpose was to examine the association between walking and sunburn while controlling for overall physical activity. However, our measure of physical activity may be a limitation with these data. First, it was limited to leisure-time physical activity. Second, we compared models controlling for leisure-time physical activity versus not controlling; findings in models controlled for physical activity were attenuated. This attenuation may be due to controlling for the effect of physical activity;

however, it may also be due to measurement issues. There was a potential overlap between reported walking and leisure-time activity, so inclusion of this variable could be overcontrolling for the association of interest. For example, some respondents could have reported walking activity during the walking questions and reported leisure and transportation walking as part of their leisure-time activity. It is likely that the true association may lie somewhere between the two models' estimates, and our main findings adjusting for physical activity may be conservative.

The survey questions referenced different time periods. Walking questions referred to the past 7 days, sunburn questions referred to the previous 12 months, and sun protective questions referred to an unspecified time: on a warm sunny day. The different temporal spans of these questions and the seasonality and daily fluctuations of UV risk may limit interpretability of these findings. Indoor walking is a common type of leisure-time walking among some sociodemographic groups (e.g., less than high school education; <30 or >64 years of age) [9]. This may confound some of the association between physical activity and sunburn in these groups. Lastly, the degree to which sunburn (and sun protection) occurred while walking and time of day of walking trips were unknown and limit the validity of these findings.

Conclusion

Walking, one of the most commonly reported forms of physical activity, does not appear to have a similar

association with sunburn as general physical activity. Still, sunburn may occur with outdoor walking. Public health messages that encourage walking should advise sun protection, with special attention to men, to reduce sunburn and skin cancer risk.

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Compliance with Ethical Standards

Authors' Statement of Conflict of Interest and Adherence to Ethical Standards Authors Tribby, Berrigan, and Perna declare that they have no conflict of interest.

Authors' Contributions: C.P.T., D.B., and F.M.P., conceptualized the study, developed the methodology, and edited the manuscript. C.P.T. conducted the formal analysis and original draft preparation. All authors read and approved the final version.

Ethical Approval: This study was exempt from NCI IRB, as it was an analysis of secondary data collected by the National Center for Health Statistics (NCHS) that was de-identified and made publicly available.

Informed Consent: The National Center for Health Statistics (NCHS), which is part of the Centers for Disease Control and Prevention (CDC), conducts the National Health Interview Survey in accordance with The National Health Survey Act of 1956 and all prevailing federal government regulations and policies concerning informed consent and human subjects research.

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