Irregular use of sunscreen and associated factors in adults and older people: a population-based study in Southern Brazil

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ABSTRACT

Introduction: The southern region leads skin cancer statistics in Brazil, with multiple factors related to this predisposition. Ultraviolet radiation is the main modifiable risk factor, and regular use of sunscreens has proven effective in reducing risk. Despite this, the prevalence of irregular sunscreen use has been higher than desired. **Objective:** To evaluate the association between irregular sunscreen use and sociodemographic, behavioral, and health characteristics in adults and older individuals. **Method:** A cross-sectional population-based study conducted in 2019 with adult residents in the urban area of Criciúma, state of Santa Catarina, Brazil. The outcome variable was irregular use of sunscreens. Exposure variables included sex, age, skin color, education, income, paid work, smoking, household registration in a Primary Health Care unit, access to supplementary health insurance, preventive medical and dental visits in the last year, walking in leisure time, commuting on foot or by bicycle, sufficient physical activity, personal history of cancer of any organ and the skin. To assess the association between irregular sunscreen use and these variables, crude and adjusted analyses were performed using Poisson Regression with a significance level of 5%. **Results:** In total, 820 individuals were studied. The prevalence of irregular sunscreen use was 52.8%. Factors associated with an increased prevalence of irregular sunscreen use were: male sex (PR 1.57; 95%CI 1.39-1.77), smoking (PR 1.19; 95%CI 1.03-1.37), being 60 years or older (PR 1.62; 95%CI 1.26-2.09), and lower education (inverse linear trend: p<0.001). On the other hand, having supplementary health insurance (PR 0.84; 95%CI 0.71-0.99) and walking in leisure time (PR 0.76; 95%CI 0.64-0.90) were protective factors. **Conclusion:** This study allowed us to identify the profile of individuals at higher risk of irregular sunscreen use, representing a potential health benefit by better targeting strategies for preventing skin cancer in older populations and adults.

Keywords: Sunscreens, Skin neoplasms, Melanoma, Ultraviolet rays.

INTRODUCTION

The various wavelengths that make up solar radiation are indispensable to the life cycle of many living beings, as they participate in important photochemical and photobiological reactions[1]. However, since 1992, based on studies by the International Agency for Research on Cancer (IARC), it is known that ultraviolet radiation (UVR) is carcinogenic in humans[2], and since 2012, there has been sufficient evidence UVR causes skin cancer[3].

Non-melanoma skin cancer (NMSC) is the most common cancer worldwide[4]. In Brazil, the National Cancer Institute (INCA) estimated 177,000 new cases in 2020, with the Southern region of Brazil leading the national ranking, and the state of Santa Catarina in second place. Regarding melanoma incidence, Santa Catarina

was in the absolute lead[5]. With a lethality of up to 30% in Brazil[6], cutaneous melanoma represents the main cause of death in dermatology worldwide.

UVR is the main known environmental risk factor to develop both melanoma and non-melanoma skin cancers[7], which underscores the role of sunscreens in skin cancer prevention. The risk is higher in light-skinned individuals, such as those of European descent[7-9], a profile prevalent in the city of Criciúma, Santa Catarina (SC)[10]. Despite this, most people seem not to use sunscreens regularly. Studies in cities with demographic characteristics similar to Criciúma, like Rio Grande[11] and Pelotas[12], in the state of Rio Grande do Sul (RS), showed a prevalence of irregular sunscreen use of 39.2% and 38.2%, respectively.

Multiple factors have been related to irregular use of sunscreens, whether socioeconomic, cultural, or behavioral[12-16]. Identifying the prevalence of nonuse/irregular use of sunscreens and the variables associated with this behavior are fundamental for developing strategies aimed at reducing skin cancer rates, especially in the Criciúma area and throughout southern Brazil.

Based on the above, this study aimed to assess the association between nonuse/irregular use of sunscreens and sociodemographic, behavioral, and health characteristics of adults and older people in the municipality of Criciúma to support health managers in decision-making.

METHODS

This cross-sectional population-based study was conducted in Criciúma, a municipality with about 219,000 inhabitants in the southern region of SC, just 22km from the coast. Its average ultraviolet (UV) index is 5[17]. Criciúma was initially colonized by Italian, Portuguese, and Polish immigrants[10], i.e., Europeans with light skin. Moreover, the city is geographically positioned at 28° South Latitude, a position it shares with parts of Australia, a country with a high incidence of skin cancer[18].

This study was carried out with data from the "Health of the Population of Criciúma" survey, developed from March to December 2019, providing detailed information about the health of the citizens. Adults and older people (18 years or older) residing in the urban area of the city were included in the study. Those who were unable to respond and/or complete the interview due to physical or cognitive impairment were excluded.

The sample was obtained in two stages, based on the 2010 Demographic Census. In the first stage, all 306 census sectors of Criciúma in the urban area of the municipality and having private properties were considered, of which 77 (25%) were randomly selected. In the second stage, 618 households in the selected census sectors were chosen to participate in the survey.

All interviewers were trained to apply the research instrument, a unique, standardized, and pre-coded questionnaire with an average application time of 50 minutes. Sociodemographic, behavioral,

anthropometric, and health data were collected and later double-entered into Epi-Data software version 3.1.

The dependent variable studied was "irregular use of sunscreens", identified through the question "Do you usually use sunscreen or sunblock?", with the response options: "No", "Yes, only in the summer" and "Yes, throughout the year". Irregular use of sunscreens was defined by the responses "No" and "Yes, only in the summer," while the response "Yes, throughout the year" was considered regular use.

The independent variables were: sex (male, female); age (collected in complete years and categorized into 18-29, 30-59, and 60 or older); skin color (white, brown, black); education (collected in complete years and categorized into 0-4, 5-8, 9-11, and 12 or more); monthly income (categorized into <500, 500-1,000, 1,001-2,000, 2,001-4,000, and > 4,000 reais); paid work (yes, no); smoking (yes, no); household registered at a Primary Health Care Unit (PHCU) as Basic Health Unit (UBS) or Family Health Strategy (ESF) (yes, no); access to supplementary health insurance (yes, no); preventive medical consultation in the last 12 months (yes, no); preventive dental consultation in the last 12 months (yes, no); practice of walking in leisure time (yes, no); commuting on foot (yes, no); commuting by bicycle (yes, no); sufficient physical activity (≥150 minutes per week) (yes, no); personal history of cancer of any organ (yes, no) and personal history of skin cancer (yes, no).

Descriptive analyses of all studied variables were performed, presenting absolute (n) and relative (%) frequencies. Crude and adjusted analyses of the as-sociation between irregular use of sunscreen and the independent variables were performed using Poisson Regression with robust variance and a significance level of 5%. The results were presented as prevalence ratios (PR) and their respective 95% confidence intervals. The p-value presented corresponds to the Wald test for heterogeneity or linear trend.

For the adjusted analysis, a hierarchical analysis model was constructed, considering as potential confounding factors the independent variables that showed a p-value <0.20. At the first level (most distal), demographic variables (sex, age, skin color) were included; at level 2, sociodemographic factors (education, paid work, monthly income) were included; level 3 was composed of variables related to health care (supplementary health plan, household registered at primary health care units); at level 4, variables related to health care and early diagnosis (preventive medical consultation, preventive dental consultation) were included. Finally, at level 5 (most proximal), behavioral factors and other health-related factors (smoking, sufficient physical activity, walking in leisure time, commuting on foot, commuting by bicycle, personal history of skin cancer, personal history of other types of cancer) were inserted.

IBM SPSS software version 22.0 was used for data analysis.

The Research Ethics Committee of the University of the Extreme South of Santa Catarina approved the study in December 2018 (CAAE: 04033118.4.0000.0119). All participants provided consent to participate through the Informed Consent Form.

RESULTS

In total, 820 individuals aged 18 and over were studied (86.1% response rate). The characteristics of the studied sample are shown in Table 1. Most respondents were female (63.8%), aged 60 years or older (45.0%), with white skin color (82.5%), up to 8 years of study (53.6%), monthly income between 1,001 and 2,000 reais, and without paid employment (64%). A large portion of the individuals reported their household was registered at a UBS (94.6%) and did not have supplementary health insurance (72.0%). Regarding preventive consultations, more than half of the respondents reported not having had a medical (58.8%) or dental (58.2%) consultation in the last year. As for physical activity variables, a third of the respondents walked in their free time (30.0%), and 25.1% engaged in sufficient physical activity. When asked about their mode of transportation, 64.2% reported walking, while 5.4% used a bicycle. Additionally, 1.5% of the respondents reported having had skin cancer, while 5.5%, cancer of other organs.

Table 1. Characteristics of the Sample of Adults and Older People - Criciúma, SC, Brazil, 2019 (n=820)

Variable	n	%
Sex		
Male	297	36.2
Female	523	63.8
Age (years)		
18-29	101	12.3
30-59	350	42.7
60 or more	369	45.0
Skin Color*		
White	660	82.5
Black	49	6.1
Brown	91	11.4
Education (years)		
0-4	219	26.7
5-8	220	26.9
9-11	266	32.5
12 or more	114	13.9
Monthly Income (in reais)*		
<500	151	19.0
500-1,000	166	20.9
1,001-2,000	248	31.2
2,001-4,000	164	20.6
>4,000	66	8.3
Paid Employment		
No	523	64.0
Yes	294	36.0

Smoking

No	702	85.6
Yes	118	14.4

Registration in PHCU

No	42	5.4
Yes	741	94.6

Health Insurance

No	590	72.0
Yes	229	28.0

Preventive Medical Consultation

No	468	58.8
Yes	328	41.2

Preventive Dental Consultation

No	458	58.2
Yes	329	41.8

Walking in Leisure Time

No	572	70.0
Yes	245	30.0

Walking for Commuting

No	289	35.8
Yes	518	64.2

Bicycle for Commuting

No	773	94.6
Yes	44	5.4

Sufficient Physical Activity

No	611	74.9
Yes	205	25.1

History of Skin Cancer

No	808	98.5
Yes	12	1.5

History of Cancer of Other Organs

No	775	94.5
Yes	45	5.5

Irregular Use of Sunscreen

Yes	433	52.8
No	387	47.2

PHCU: Primary Health Care Unit.
Variable with the highest data loss: registration in PHCU (n=37; 4.5%).
* Indigenous and yellow (Asian) were excluded (n=20).
** Minimum wage in 2019: R$998.00.

The prevalence of irregular sunscreen use was 52.8%. Table 2 presents the association between the independent variables and the outcome variable. In the crude analysis, irregular sunscreen use was higher among men, individuals aged 60 years or older, with black skin color, with lower education levels (0 to 4 years), and with a monthly income between R$ 1,001.00 and R$ 2,000.00. The same behavior was observed among smokers, those without paid employment, those without health insurance, as well as those whose household was registered at a UBS, and those who had not had a medical or dental consultation in the last year. Those who did not walk in their free time, did not commute on foot or by bicycle, and did not engage in sufficient physical activity also showed a higher prevalence of the studied outcome. Individuals who had never had skin cancer and those who had had cancer of another nature also showed lower adherence to photoprotection.

After adjusting for potential confounding factors, the variables of sex, age, education, smoking, health insurance, and walking in free time remained associated with the outcome. Male individuals were 57% more likely to use sunscreen irregularly (PR: 1.57; 95% CI 1.39-1.77) compared to females. Regarding age, a linear trend was observed (p<0.001) for not using sunscreen, that is, the older the age, the higher the prevalence of irregular sunscreen use, being 62% higher in individuals aged 60 years or older (PR: 1.62; 95% CI 1.26-2.09). Concerning education, an inverse linear trend was evidenced (p<0.001), that is, the higher the education level, the lower the occurrence of irregular sunscreen use, reaching a prevalence ratio of 1.27 (95% CI 0.94-1.71) in individuals with 12 years or more of study. Smokers were 19% more likely not to use sunscreen regularly compared to non-smokers (PR: 1.19; 95% CI 1.031.37).

On the other hand, having supplementary health insurance was associated with a 16% lower prevalence of irregular sunscreen use (PR: 0.84; 95% CI 0.71-0.99), compared to those without health insurance. Similarly, individuals who walked in their free time were 24% less likely not to use sunscreen regularly (PR: 0.76; 95% CI 0.640.90), compared to those who did not walk in their free time. The variable of paid employment lost its association with the outcome after adjustments for possible confounders.

Table 2. Crude and Adjusted Analyses of the Association between Irregular Use of Sunscreen and Studied Exposure Variables - Criciúma, SC, Brazil, 2019 (n=820)

Variables	% of Sunscreen Non-Use	Crude Analysis		Adjusted Analysis**	
		PR (CI95%)	p-value*	PR (CI95%)	p-value*
Sex			<0.001		<0.001
Male	68.7	1.57 (1.39-1.78)		1.57 (1.39-1.77)	
Female	43.8	-		-	
Age (years)			<0.001[a]		<0.001[a]
18-29	39.6	-		-	
30-59	45.1	1.14 (0.87-1.49)		1.16 (0.89-1.52)	
60 or more	63.7	1.61 (1.25-2.07)		1.62 (1.26-2.09)	
Skin Color*			0.302		0.308
White	50.9	-		-	
Black	73.5	1.44 (1.20-1.74)		1.49 (1.24-1.80)	
Brown	53.8	1.06 (0.86-1.30)		1.05 (0.86-1.27)	
Education (years)			<0.001[a]		<0.001[a]
0-4	64.8	1.90 (1.44-2.49)		1.57 (1.16-2.13)	
5-8	58.2	1.70 (1.29-2.25)		1.49 (1.11-2.00)	
9-11	46.6	1.36 (1.02-1.81)		1.27 (0.94-1.71)	
12 or more	34.2	-		-	
Monthly Income (in reais)*			0.631		0.205
<500	46.4	-		-	
500-1,000	52.4	1.13 (0.90-1.42)		0.94 (0.75-1.17)	
1,001-2,000	57.7	1.24 (1.02-1.52)		0.99 (0.81-1.22)	
2,001-4,000	54.3	1.17 (0.94-1.46)		0.89 (0.71-1.12)	
>4,000	42.4	0.92 (0.66-1.27)		0.81 (0.58-1.11)	
Paid Employment			0.008		0.557
No	56.2	-		-	
Yes	46.3	0.82 (0.71-0.95)		0.95 (0.81-1.12)	
Smoking			0.011		0.021
No	51.1	-		-	
Yes	67.2	1.23 (1.05-1.43)		1.19 (1.03-1.37)	
Registration in PHCU			0.141		0.446
No	40.5	-		-	
Yes	53.6	1.32 (0.91-1.92)		1.16 (0.82-1.65)	

	%	PR (95%CI)*	p	PR (95%CI)**	p
Health Insurance			0.001		0.044
No	56.8	-		-	
Yes	42.4	0.75 (0.63-0.88)		0.84 (0.71-0.99)	
Preventive Medical Consultation			0.151		0.146
No	54.9	-		-	
Yes	49.7	0.90 (0.79-1.04)		0.91 (0.80-1.03)	
Preventive Dental Consultation			0.482		0.878
No	52.4	-		-	
Yes	49.8	0.95 (0.83-1.09)		0.99 (0.87-1.13)	
Walking in Leisure Time			<0.001		0.001
No	57.3	-		-	
Yes	42.4	0.74 (0.63-0.87)		0.76 (0.64-0.90)	
Walking for Commuting			0.003		0.201
No	60.2	-		-	
Yes	49.4	0.82 (0.71-0.92)		0.92 (0.82-1.04)	
Bicycle for Commuting			0.106		0.295
No	53.4	-		-	
Yes	40.9	0.77 (0.53-1.10)		0.82 (0.57-1.19)	
Sufficient Physical Activity			<0.001		0.139
No	57.1	-		-	
Yes	40.0	0.70 (0.58-0.84)		0.87 (0.71-1.05)	
History of Skin Cancer			0.132		0.076
No	53.2	-		-	
Yes	25.0	0.47 (0.18-1.26)		0.41 (0.15-1.10)	
History of Cancer of Other Organs			0.696		0.706
No	52.6	-		-	
Yes	55.6	1.06 (0.81-1.38)		0.95 (0.74-1.22)	

PHCU: Primary Health Care Unit. PR: prevalence ratio.

* Poisson Regression.

** Poisson Regression adjusted for the variables in this table considering hierarchical levels of determination.

*** Minimum wage in 2019: R$998.00.

[a] Wald test for linear trend.

DISCUSSION

This study aimed to assess the prevalence and factors associated with irregular use of sunscreens in a population-based study in southern Brazil, revealing significant findings on the high occurrence of this outcome and its main risk factors.

Irregular sunscreen use, reported by over half (52.8%) of the population studied, supports the findings of Olsen et al. (2018), who noted that this prevalence is high even in regions with higher sunlight exposure[8]. In Pelotas (RS), the prevalence of this outcome was 39.8% at the beach, 69.8% during outdoor sports, and 86.3% during work hours[12], indicating that sunscreens are not yet part of most citizens' routines, especially during work hours. This is supported by the research of Cardoso et al. (2017), where two-thirds of participants (65.8%; 95% CI: 59.8-71.8) also reported not using sunscreens during this period. However, Silva and Dumith (2019), in a study conducted in Rio Grande (RS), found a lower prevalence of irregular sunscreen use (38.2%; 95% CI 34.6-41.8)[11], possibly because it is a coastal city where a higher degree of adherence to photoprotection is naturally expected.

The prevalence of irregular sunscreen use found in this study is notably high, given that, according to INCA data, Santa Catarina leads the national incidence of melanoma and is second in incidence of non-melanoma skin cancer. Regular use of sunscreens has proven widely effective in preventing photorelated diseases, from simple extrinsic aging (induced by solar radiation) to cutaneous melanoma[8,20-22].

Analyzing the association between the outcome and the studied variables, there was a higher prevalence of irregular sunscreen use in men, a finding consistent with several studies[11,12,23–25]. Griffith et al. (2016) showed that men indeed exhibit more health risk behaviors[26], a fact that McKenzie et al. (2019) related to macho behavior[27]. In leisure activities such as resorts or swimming pools, the habit of not wearing a shirt and not having long hair, protecting the neck and back against solar rays, favors the appearance of melanomas in these body segments. The need to address this topic more vehemently with this group is emphasized, as most positions in manual labor exposed to the sun (construction, agriculture, fishing, among others) are occupied by men (additionally of low income and low education level)[28-30].

Regarding age, a direct linear trend with the outcome was identified in the studied sample, meaning that the older the age group, the higher the prevalence of irregular sunscreen use. This reveals that in the city of Criciúma (SC), age is an independent risk factor for not using sunscreens, and older individuals have a higher prevalence of this outcome than younger ones. Silva and Dumith (2019) in their study also found the same association between these variables[11], and other studies have also verified that older individuals have a lower prevalence of sunscreen use[15,23,31]. Possible explanations include the fact that older people prefer alternative measures of photoprotection, such as wearing long clothes, using hats, and walking in the shade[15]. The irregular use of sunscreens by older individuals may also be related to the few hours of outdoor activities practiced by the older population, a reflection of the domestic isolation to which they are often subjected[32]. Additionally, it is known that older individuals have less autonomy over their

needs, whether due to vision limitations, motor skills, or cognitive issues, often depending on others, including for self-care activities[32-34]. Given the multiplicity of variables that can affect sunscreen use by the older population, further studies directed at this group are necessary to better assess their interaction with these products.

Another result found in this study was the inverse linear association with the education variable, which is corroborated by findings from various authors[11,23,25,31,35]. Thus, irregular sunscreen use is higher in individuals with lower education levels, positing that a lower level of education is associated with less knowledge about photoprotection and a lower level of understanding about the harms of excessive sun exposure. Similarly, a low level of education is also associated with other behaviors that denote a reduced sense of self-preservation, such as smoking and excessive alcohol consumption[19]. Moreover, there is a natural tendency for individuals with low education levels to be absorbed by the manual labor sectors of the labor market, including activities exposed to the sun, as previously discussed[28-30].

The direct association between smoking and irregular sunscreen use, scarcely addressed in the scientific literature, was confirmed in this study, showing that individuals who smoke are 19% more likely not to use sunscreen. It is known, according to Vigitel data from 2020[36], that smoking is more prevalent in men and that, based on data from this study and corroborated by the literature, men are more likely not to use sunscreen[11,12,23–25]. However, the multivariate analysis kept smoking associated with the outcome regardless of sex. The hypothesis about such a linkage comes from the particular belief that

both the habit of smoking, connected to the outcome, and not protecting the skin from the harmful rays of the sun denote a certain carelessness with one's health, therefore, being a possible behavioral pattern. This thought aligns with the reasoning of Moreira et al. (1995) who, through a populationbased study conducted in the city of Porto Alegre (RS), analyzed the variables associated with smoking[37]. Although it also has a cross-sectional design (which does not allow the determination of a causal relationship), the authors suggested that the behavioral pattern is the link between smoking and other poor health habits.

Having access to supplementary health insurance was shown to be a protective factor against irregular use of sunscreen, with a 16% reduction in the prevalence of this outcome. The discussion in the literature about this association is still scarce, but it is believed that the explanation is based on the greater ease of access to health care for individuals with health insurance, leading to easier access to information on disease prevention, including dermatological conditions. Regarding the ease of access to care, it is known that despite the advances achieved by public healthcare, outside the supplementary health sector, the routine of care is still marked by queues and delays in scheduling appointments with specialists, such as dermatologists. Thus, the absence of queues, greater resolution, flexible service hours, shorter distance between patient and healthcare team, and quick access to specialists are conditions that can promote easier access to important information about health self-care. This hypothesis is supported by a study that observed user satisfaction with the public health service was associated with ease of ac-

cess, proximity, quality, and resolution of services provided, quality of infrastructure, and attention to spontaneous demand[34]. However, this research found no association between the outcome and household registration in UBS, highlighting a possible gap between what is proposed and what actually happens with the primary care user in the Unified Health System (SUS).

Another finding of this study is that respondents who reported walking in their free time were 24% less likely to not use sunscreen, corroborating the findings of Silva (2017)[11]. However, a similar association was not found in individuals who walked or cycled for commuting, possibly because of the reduced number of respondents (5.1%) who have this habit, compromising the statistical analysis. However, it is important to note that walking for leisure (or for health care) differs from walking (or cycling) for commuting out of necessity, as leisure and necessity are distinct conditions practiced by individuals with different socioeconomic and cultural characteristics. Therefore, it is presumed that those who walk for leisure or health care possess a level of understanding that correlates with a higher level of education, a variable that, as already demonstrated, has an inverse linear association with the outcome.

Contrary to Cardoso's (2017)[19] results, this study found no difference in the prevalence of photoprotection among individuals who had skin cancer and those who had not. This could be due to the low number of people with skin cancer in the study population (1.5%), leading to a lack of statistical power to find this association. This low number of occurrences is influenced by both the underdiagnosis and underreporting of skin cancer, which affects the determination of the actual prevalence of this disease. It is highlighted that the variable "history of skin cancer" was self-reported, which could lead to inaccuracies in these data. Individuals who have had skin cancer have an increased risk of recurrence[40], emphasizing the importance of photoprotection for individuals whose skin has been affected by cancer.

The study's limitations include the potential underestimation of irregular sunscreen use due to respondents possibly overreporting their use to avoid embarrassment. The data collection instrument did not allow for an assessment of sunscreen use details, such as application frequency (as much in the number of applications per day as in the number of days per week), affecting the characterization of use as regular. Variables generated by self-reported information (such as skin cancer history) may also have compromised reliability. Moreover, the cross-sectional design does not allow for establishing causal relationships between independent variables and the outcome. Despite being a population-based study, hence having a representative sample, specific characteristics of the studied population might limit the extrapolation of the results, as the sample showed a predominance of women and older individuals.

As a strength, it is highlighted that the sampling process of the study was conducted in two stages and included a representative sample from a municipality in southern Brazil. Additionally, significant independent variables that are scarcely explored in the literature on this topic were analyzed.

CONCLUSION

Sunscreen protection is a simple measure with a direct influence on reducing skin cancer incidence, yet its non-use or irregular use is more common than expected. In Criciúma (SC), the prevalence of irregular sunscreen use was 52.8%, higher among males, smokers, those without supplementary health insurance, and those not walking in their free time. The prevalence of non-use also increased linearly with age and decreased linearly with higher education levels.

Encouraging regular and correct use of sunscreens, especially among the most vulnerable individuals, is a straightforward approach to reducing morbidity and mortality from photo-mediated diseases, primarily skin cancer, and the financial effect on the healthcare system. Studies supporting the evidence found here and clarifying other factors associated with non-use or irregular use of sunscreens are necessary. They could help health managers direct preventive actions and promote sunscreen use among population strata at higher risk of not adopting this behavior.

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