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## Sunscreen Use Behaviour And Most Frequently Used Active Ingredients Among Beachgoers On Cancun, Mexico

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There is no conflict of interest of any of the authors with the results of this study

# Sunscreen Use Behaviour And Most Frequently Used Active Ingredients Among Beachgoers On Cancun, Mexico

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## Abstract

**Aim:** To have a better understanding of sun protecting habits of beachgoers and which are the active ingredients with higher prevalence.

**Methods:** Four-hundred people were randomly asked to answer a short questionnaire about sun exposure and the use of sunscreen in the summer of 2008 on Cancun beaches. Variables studied included gender, age, site of residence, schooling and skin colour.

**Results:** Participants had a media sun exposure time of 3.9 hours, 83.75% of them were using sunscreen and 29.5% reported sunburns. In general, groups that had a higher use of sunscreen products were the ones to have a higher prevalence of sunburns, which may indicate an inappropriate use of sunscreen products. Fifteen sunscreen active ingredients divided in 2 inorganic and 13 organic were found. Origin of the participants had an effect in the presence of certain sunscreen active **ingredients**.

**Conclusion:** Beachgoers on Cancun had a very high percentage of sunscreen use. Top seven active ingredients listed on this survey have been reported to have toxic effects on organisms. Campaigns about a correct use of sunscreen may have a benefit in both health and environmental issues, creating a balance between the need of human protection to UV radiation and the massive entrance of sunscreen active ingredients to the environment.

## Introduction

Skin cancer and sun are closely related [1-5]. Vacations in tropical destinations present the potential for high levels of intense sun exposure since preferred tourism activities are outdoors. Studies have emphasized the need of greater educational efforts directed toward changing public attitudes to high-risk sunbathing behavior at beaches [6].

In this study we evaluated sunscreen use behaviour on summer days on Cancun beaches, in order to have a better understanding of sun protecting habits and to

identify which are the most used active ingredients in an effort to link human health issues with potential environmental risks.

## Methods

A total of 400 people were asked to answer a short questionnaire about sun exposure and the use of sunscreen in the summer of 2008. The campaign was conducted all over Cancun's shore. People were selected randomly and all were informed that taking part of the study was voluntary. Children under 6 years of age were not included in the study.

Variables studied included gender, age, site of residence and schooling (formal years of education). Skin colour was self-reported and classified as very fair, fair, light-brown, dark-brown and black. The respondents answered two questions on present sunbathing habits: "How long are you going to stay exposed to the sun?" and "Do you have any sunburn?" Information about the use and type of sunscreen was also included in the questionnaire. The respondents were asked if they used sunscreen and the interviewer registered active ingredients, brand and SPF. Statistical analyses were done using Statistica v 6.0. Frequency tables were done using the basic statistics module. Differences between groups for sun exposure times were calculated using ANOVA. Criterion for significance was set at  $p \leq 0.05$ .

## Results

Table 1 shows gender, age, site of residence and schooling distribution of the interviewed beachgoers. A total of 243 female and 157 male were questioned. The most common age groups were 15-25, 25-35 and 35-45 years old. Beachgoers origin was from 25 countries. For analysis purposes participants were classified in 5 regions: Mexico, USA, Europe, Asia and Latin America (except Mexico). The last two groups were underrepresented with a total of 7 and 11 individuals respectively. Majority of the interviewed were from Mexico (55.5%), the rest of the studied population were principally from USA (26.5%) and

Europe (13.5 %). Schooling of participants was mainly 13-16 years and 10-12 years with 37% and 19.25% respectively. Table 2 shows skin colour of participants, fair and light-brown skins were the dominant types with 41.25 and 41.00 % respectively.

The results of sunscreen use, prevalence of sunburns and the mean exposure time is presented in table 3. Sunscreen use percentage was higher in female participants with 88.07% but the percentage of sunburn prevalence was slightly higher than in male participants (30.86%). An ANOVA for exposure time between genders showed to be statistically significant, the mean exposure time was higher in male participants ( $p=0.0014$ ). In general, sunscreen use was higher in participants with light-skin tone though, very fair and fair skinned individuals had the highest prevalence of sunburns. An ANOVA of mean exposure time showed that there was differences between skin types ( $p=0.015$ ) a Fisher post-hoc test indicated that dark brown-skin individuals were the ones with higher sun exposure time, on the contrary, black-skin participants were the ones with the lowest sun exposure time. The results of sunscreen use when individuals were grouped by residency indicated that Mexicans were the ones that had the lowest use percentage (73.87%). The prevalence of sunburns was higher on Asians and Americans with 71.42% and 43.39% respectively. An ANOVA indicated that there was no statistical differences in the mean sun exposure time with respect their site of residence. When age was the classification factor in the use of sunscreen, results indicated that the groups that had the lowest use were individuals above 55 years old and between 16-25 years old; on the contrary, younger individuals ranging 6-15 years old had the highest percentage use. With respect to sunburn prevalence values were from 24.07% to 35.48% in individuals between 46-55 years old and in children between 6-15 years old respectively. An ANOVA indicated that there was no differences between age groups in sun exposure time ( $p=0.222$ ).

Schooling of the participants indicated that individuals that had 7-9 years of formal education were the ones with the lowest percentage of sunscreen use. The highest percentages were found on individuals with more of 13 years of formal education. Interestingly, they had the highest percentages of sunburns. An ANOVA indicated that there was no differences in sun exposure time between different schooling levels ( $p=0.263$ ). Results of SPF preference among beachgoers indicated that 18.5 % used sunscreen products with 15 or less, 38.5% used products with a SPF between 15-45 and 40% used a product with a SPF higher than 45.

Table 4 presents the results of the listed sunscreen's active ingredients used by beachgoers. Fifteen sunscreen active ingredients divided in 2 inorganic and 13 organic were found. Titanium oxide was the most used inorganic active ingredient. Top seven organic ingredients were oxybenzone, homosalate, octyl salicylate, octyl dimethyl PABA, avobenzone, octyl methoxy cinnamate and octocrylene. Origin of beachgoers seemed to have an effect in the presence of active ingredients of sunscreen formulas (Table 5). For example, Americans used sunscreen lotions where oxybenzone, homosalate and avobenzone were more common with 88.23%, 68.62% and 64.7% respectively when compared to products used by Mexicans or Europeans. On the other hand, titanium dioxide was more frequent in products used by Mexicans (31.70%) and Europeans (23.52%) when compared to the ones used by Americans (2.84%).

## Discussion

In this study we evaluated sunscreen use behaviour on summer days on Cancun beaches. The aim was to have a better understanding of sun protecting habits of beachgoers and how this could be linked to the presence of certain chemicals in the environment. This is an effort to link human health issues with environmental related risks. Four hundred individuals were interviewed. In Cancun, as happens in world class vacation destinations, the origin of the population gives the opportunity to sample a very complex mixture of cultures, in this study represented with people from 25 countries. The results for the interviewed beachgoers on 2008 summer indicated that the population at the time of the survey was predominately female, between 16-45 years old. Similar results have been previously reported [6-8] and have been attributed to the fact that sunbathing is more popular in young women. There was gender differences in sunscreen use, females used sunscreen products in a higher percentage, similar results had been also found in different countries [7,9-11]. Adult women are the providers of sunscreen to their family members [12]; this statement may give the impression that females are more aware of sun protection practices. In contrast, in the present study prevalence of sunburns was higher in females but their sun exposure time was lower than in males. This could be explained with the public messages that especially females get, where fashion industry promotes tanned bodies as a beauty standard [13]. The use of sunscreen products also depended of skin color. In general, sunscreen was used in a higher percentage

in very fair and fair skins when compared to light-brown and dark-brown skins. Interestingly, when exposure time was compared, dark brown-skinned participants expended more time exposed to sun than lighter-skinned individuals and the prevalence of sunburns was much lower. Pigmented skins differ from fair skin in terms of responses to chemical and environmental factors and require specific skin care [14]; darkly pigmented skin ensures better protection against UV-induced damage in the lower epidermis [15, 16], and they are less susceptible to sunburns. Nevertheless, all skin types should be aware of temporary and cumulative sun exposures since UV radiation exposure is a commonly recognized risk factor for skin cancer [17, 18]. Distinct lifestyle and cultural habits were also revealed as a factor to be considered in sunscreen use, Mexicans were the group that had the lowest percentage of sunscreen use, and very few campaigns have been done in Mexico to educate about the risks of sun exposure. In our knowledge this is the first survey conducted on Mexican beaches on regard to sunscreen use habits and sunburn prevalence. All groups had individuals that self-reported sunburns representing 29.5% of the sampled population. Participants from other countries had the tendency of wearing more sunscreen than Mexicans but with a higher prevalence of sunburns, despite the fact that exposure time was comparable. Americans, Europeans and Asians had the highest prevalence of sunburns. In previous studies it has been found that paradoxically, sunburns tend to be more frequent among sunscreen users, probably because of greater natural sun sensitivity [9]. It is also known from previous studies that the majority of sunscreen users apply less than the recommended dose [19] or apply the product just before swimming, conditions that make users exposed to higher concentrations of UV radiation but with the false expectation that they are sun protected. With respect to different age groups there was not a clear tendency regarding the use of sunscreen, young people between 16-25 years old and people above 56 years old were the ones that had a lower percentage of sunscreen use. The prevalence of self reported sunburns indicated that children younger than 15 years old were the ones that had a slightly higher percentage of occurrences. Giving the fact that skin cancer has been associated to excessive sun exposure during childhood and adolescence [12, 18] it is important to understand why these groups do not use sunscreen or if they use, why they get sunburns. These questions are also a point to be considered in older individuals, who suffers age-related pigmentary changes, such as a decrease on the enzymatically

active melanocytes [20].

Schooling of the participants indicated that most of them had a good level of preparation. Interestingly the higher the education level the higher the use of sunscreen products, and as has happened before, the higher the prevalence of sunburns. Similar results were found in a Southern Brazil study where individuals with higher educational achievement were more likely to use sunscreen [9].

The results of occurrence of active ingredients indicated that 15 active ingredients were present on the products used by beachgoers, most of them were organic and only two were inorganic. Titanium dioxide was the most used inorganic active ingredient. Previous reports have demonstrated that titanium dioxide, especially when it is as a nanoparticle has shown to be genotoxic [21]. It has also been reported to cause oxidative stress related effects, including inflammation, cytotoxicity and genomic instability [22]. Top seven organic ingredients found on products used on Cancun beachgoers were oxybenzone, homosalate, octyl salicylate, octyl dimethyl PABA, avobenzone, octylmethoxycinnamate and octocrylene. Most of them have been reported as endocrine disrupters. Some of these organic sunscreen actives have reported estrogenic activity: oxybenzone [23], homosalate, octyl dimethyl PABA and octyl methoxy cinnamate [24]. Octyl methoxy cinnamate has been reported also as a potent progesterone receptor antagonism [25]. Oxybenzone and homosalate possess antiandrogenic activity [26]. Octyl methoxy cinnamate has been reported to have an effect on several metabolic parameters such as fat and lipid homeostasis as well as on thyroid hormone production [27]. In addition to those properties, ingredients such as octyl salicylate and octyl methoxycinnamate had been reported as enhancers of dermal penetration of pollutants [28]. It has been also demonstrated that oxybenzone, octocrylene and octyl methoxy cinnamate penetrate through the stratum corneum and they can generate highly reactive oxygen species in the cytoplasm of the nucleated keratinocytes in the epidermis [29]. Results of all the above mentioned studies had been carried out in either mammalian or piscine models. This may have implications in the assessment of health risk associated with the use of sunscreen products and in the ecotoxicological impact following their leakage into the environment. Studies are underway to evaluate transport rates and fate of sunscreen active ingredients to sand and water, phenomena that may have health and environmental risk implications.

## Conclusion

In summary, in an effort to have a better understanding of how sun exposure habits may be linked to environmental impacts we evaluated sunscreen use of beachgoers on Cancun. Four hundred beachgoers on Cancun were interviewed on the summer of 2008, 83.75% were using sunscreen, 29.5% self-reported sunburns and had a media exposure time of 3.9 hours. Fifteen active ingredients were listed in the products participants were using; some of these active ingredients have been reported to have toxic effects on organisms. Campaigns about a correct use of sunscreen products that may have a benefit in both health and environmental issues may create a balance between the need of human protection to UV radiation and the massive entrance of sunscreen active ingredients to the environment.

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## Illustrations

### Illustration 1

&nbsp;Distribution of gender, origin, age and schooling of questioned beachgoers

		<b>Number of participants</b>	<b>Percentage</b>
<b>Gender</b>	<b>Male</b>	157	39.25%
	<b>Female</b>	243	60.75%
<b>Site of Residence</b>	<b>Mexico</b>	222	55.5%
	<b>United States</b>	106	26.5%
	<b>Europe</b>	54	13.5%
	<b>Asia</b>	7	1.75%
	<b>Latin America</b>	11	2.75%
	<b>Age</b>	<b>6-15</b>	62
<b>16-25</b>		84	21.0%
<b>26-35</b>		80	20.0%
<b>36-45</b>		88	22.0%
<b>46-55</b>		54	13.5%
<b>55-65</b>		20	5.0%
<b>65 +</b>		12	3.0%
<b>Schooling</b>	<b>6 or less</b>	65	16.25%
	<b>7-9</b>	52	13.0%
	<b>10-12</b>	77	19.25%
	<b>13-16</b>	148	37.0%
	<b>16+</b>	58	14.5%

## Illustration 2

&nbsp;Skin colour (self-reported) distribution of beachgoers in Cancun

<b>Skin Colour</b>	<b>Number of participants</b>	<b>Percentage</b>
Very Fair	43	10.75
Fair	165	41.25
Light Brown	164	41.0
Dark Brown	23	5.75
Black	5	1.25

### Illustration 3

&nbsp;Sunscreen use, prevalence of sunburns (self-reported) and mean exposure time of questioned participants

		Sunscreen use % (number)	Prevalence of Sunburns % (number)	Mean exposure time (h)	
<b>Total</b>		83.75% (335)	29.5% (118)	3.9	
<b>Gender</b>	<b>Male</b>	77.07%(121)	27.38% (43)	4.3	
	<b>Female</b>	88.07%(214)	30.86% (75)	3.5	
<b>Skin colour</b>	<b>Very fair</b>	100%(43)	55.81% (24)	3.7	
	<b>Fair</b>	95.75%(158)	36.96% (61)	3.9	
	<b>Light brown</b>	75.00%(123)	19.5% (32)	3.8	
	<b>Dark Brown</b>	30.43%(7)	4.34% (1)	5.2	
	<b>Black</b>	80.00% (4)	20 % (1)	1.0	
	<b>Site of residence</b>	<b>Mexico</b>	73.87% (164)	22.07% (49)	3.7
		<b>United States</b>	96.22% (102)	43.39% (46)	4.1
<b>Europe</b>		94.44% (51)	31.48% (17)	3.6	
<b>Asia</b>		100.00% (7)	71.42%(5)	4.4	
<b>Latin America</b>		100% (11)	9.09% (1)	5.3	
<b>Age</b>		<b>0-15</b>	93.54%(58)	35.48% (22)	3.6
	<b>16-25</b>	78.57%(66)	28.57% (24)	3.5	
	<b>26-35</b>	81.25% (65)	28.75% (23)	4.4	

## Illustration 4

Occurrence of sunscreen active ingredients listed in products used by beachgoers on Cancun. Active ingredients marked with \* are only permitted by the European Union

Sunscreen active ingredients	Occurrence Percentage (number)
<b>Inorganic</b>	
Titanium dioxide	21.76% (74)
Zinc oxide	0.58% (2)
<b>Organic</b>	
Oxybenzone	56.17% (191)
Homosalate	47.94% (163)
Octyl salicylate	43.52% (148)
Octyl dimethyl PABA	42.35% (144)
Avobenzone	32.64%(111)
Octyl methoxy cinnamate	26.47% (90)
Octocrylene	18.23%(62)
*Tinosorb S	4.70% (16)
Ensulizole	3.23% (11)
* 4-Methylbenzylidene camphor	3.52% (12)
* Octyl triazone	2.64%(9)
* Tinosorb M	0.58% (2)
Sulisobenzone	0.29% (1)

## Illustration 5

Occurrence of the principal sunscreen active ingredients listed in products used by participants from different regions

<b>Active Ingredient</b>	<b>Mexico</b>	<b>USA</b>	<b>Europe</b>
Titanium dioxide	31.7%	2.94%	23.52%
Oxybenzone	47.56%	88.23%	15.68%
Octyl methoxy cinnamate	16.43%	18.62%	27.45%
Octocrylene	16.46%	21.56%	15.68%
Octyl salicylate	35.36%	56.86%	41.17%
Homosalate	38.41%	68.62%	39.21%
Avobenzone	22.56%	64.7%	7.84%
Octyl dimethyl PABA	40.24%	50%	39.21%

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