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## Investigating Tourists' Environmental Awareness of the Negative Impacts of Sunscreens on Coral Reefs and its Impact on their Behavior

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### Keywords

Environmental awareness,  
Coral reefs,  
UV Filters,  
Coral bleaching,  
Reef-safe sunscreens.

### Abstract

Healthy coral reefs include several benefits for coastal destinations. They are indicated as a resource for nature-based tourism and a home for a large portion of marine life. In addition, coral reefs contribute to coastal protection and seafood production. Some of the public health threats of exposure to ultraviolet (UV) are harmful sunburn, skin cancer, and photoaging. Increased attention to these harmful impacts has led to an increased usage of sunscreens that contain UV filters. Studies have confirmed that sunscreens have several damage to coral reefs such as coral bleaching and damage to coral DNA. Data from 304 tourists have been obtained by filling in an available self-completed questionnaire in an electronic format and printed one. The statistical program for Social Science (SPSS program V 28) software has been used to analyze survey data. Tourists should have environmental awareness of the coral reefs' value besides the negative impact of sunscreens on them. Therefore, the necessity of environmental awareness leads to achieving the sustainable use of coral reefs by researching alternatives to sunscreens and encouraging the manufacture and use of reef-safe sunscreens.

## 1. Introduction

Healthy coral reefs are considered one of the most relevant ecosystems. Shoaira et al. (2019:21) have defined coral reefs as “physical structures built by the actions of many tiny coral animals that live in large colonies and lay down communal limestone skeletons”. Some people usually think of coral reefs as a type of plant or rock. Coral reefs are simple animals belonging to a group of invertebrates called cnidarians. Coral reefs are distributed all over the world in the coastal waters of several countries; however, they constitute only 0.1% of the total ocean area (Gattuso et al., 2014). Unregulated tourism has caused irreparable damage to coral reef systems although several countries depend on them economically (Shoaira et al., 2019).

Coral reefs are famous for diverse marine life, beautiful colors, and attractive shapes; however, using them to achieve economic gains, including tourism, has led to their deterioration and their loss (Prideaux et al., 2018). Singh et al. (2020) and many other books and studies have dealt with the biological importance of coral reefs. Rhodes et al. (2021) have also pointed out the various benefits of coral reefs. Despite the ecological and economic importance of coral reefs, they are exposed to several increased human disturbances that have led to the gradual degradation of coral reef ecosystems on a global scale. Among the challenges that coral reefs have encountered, there is the release of sunscreen products into seawater that are unremarkably used by tourists to protect their skin against the negative effects of

In recent years, several studies have indicated that the ingredients of ultraviolet rays. sunscreen products negatively affect coral reefs and endanger them. Some of the most common negative effects are the risk of bleaching, increased mortality, deformation of coral larvae, and DNA damage (Miller et al., 2021). There are no common studies that investigate the tourist’s environmental awareness of the negative impacts of sunscreens on coral reefs and discuss the extent to which tourists are willing to give up sunscreen protection in order to search for alternatives to protect coral reefs. Coral reefs grow very slowly (Probst, 2015; Mladenov, 2013), some of which grow only about three to twenty mm per year (Harris, 2022; Miththapala, 2008). Some coral reefs are formed over several million years (Ross et al., 2018).

The Egyptian coast has a large percentage and a large group of coral reefs found in the Red Sea. Coral reefs are extended from the North to Gulfs “Suez and Aqaba” to the South of Ras Hedarba on the border of Sudan. The Red Sea coast contains the highest diversity of coral reefs; therefore, the Red Sea coral reefs region is considered the one of perfect diving regions all over the world (Prideaux et al., 2018). The Egyptian Red Sea's coral reefs show the impact of tourism, which poses a threat to sustainability. They have been affected by ecological changes and human tension; however, remarkably tourist attractions. Egypt is a developing country that depends on tourism as a key income; therefore, protecting coral reefs is a top priority. Coral reefs provide tourists with a unique and enjoyable experience. In Egypt, although tourism movement in the Red Sea region has benefited financially from coral reefs as a tourist attraction, which has been accompanied by deterioration in coral reefs in the Red Sea (Hilmi et al., 2012).

Among the challenges that coral reefs have encountered is the use of sunscreen products by tourists. Coral reefs have been threatened by releasing sunscreen products into the sea, which are frequently used by tourists to protect their skin from the damaging effects of UV rays. Sunscreen has led to rapid and widespread bleaching of

coral reefs. Producing sunscreen products that do not threaten the survival of coral reefs is thoroughly recommended (Shinn, 2019).

## **2. Study Objectives**

The study aims to measure the degree of environmental awareness among tourists and the extent of their interest in environmental issues. It also aims to explore the degree of tourists' awareness of the negative impact of sunscreens on coral reefs and the extent of this awareness's impact on tourists' behavior towards the use of sunscreens. In addition, the study explores the intention of tourists to forego sunscreen protection to preserve and protect coral reefs.

## **3. Study Questions**

- 1- Is there a statistical relationship between environmental awareness and tourists' awareness of the negative impact of sunscreens on coral reefs?
- 2- Is there a statistical relationship between environmental awareness and tourists' behavior toward the use of sunscreens?
- 3- Is there a statistical relationship between tourists' awareness of the negative impact of sunscreens on coral reefs and tourists' behavior towards the use of sunscreens?

## **4. Study Hypotheses**

H1: Environmental awareness significantly affects tourists' behavior towards the use of Sunscreens.

H2: tourists' awareness of the negative impact of Sunscreens on coral reefs significantly affects tourists' behavior towards the use of Sunscreens.

## **5. Literature Review**

### **5.1. Environmental Awareness**

The main challenge facing the tourism industry is the sustainable preservation of the environment. Recently, tourists are looking for eco-friendly products. Unplanned and improperly managed tourism leads to ecological degradation, losing biodiversity, and negative effects on local communities. Consequently, that is important for tourist destinations to conserve sustainable tourism principles. Tourism highly depends on natural resources. Conserving natural resources is essential to the success and survival of the tourism industry. Increasing environmental awareness among tourists leads to an increase in the demand for authenticity in the tourist destination. Therefore, it is necessary to preserve the natural environment and ensure the sustainable use of its resources (Mihanyar et al., 2015).

Environmental awareness is not only a personal trait but also a certain preference to practice environmentally friendly habits and activities, recognizing the important varieties in lifestyle as well as supportive green initiations. A tourist becomes environmentally friendly when s/he supports environmentally friendly goods and services and takes a cautious attitude towards the environment. Environmental awareness has become common in the tourism industry; moreover, it means

understanding the sensitivity of the environment and the importance of preserving and protecting it (Vorontsova et al., 2021).

The issues related to environmental conservation are important to the continuation and development tourism industry (Min, 2011). Environmental awareness refers to tourists' desire to positively affect the environment and take into account environmental concerns. Environmental awareness is the first and essential step to addressing environmental issues, reducing pollution (Ahmad et al., 2021), and bringing economic benefits (Wan et al., 2017).

## **5.2. The Importance of Coral Reefs**

One of the most valuable ecosystems on Earth is healthy coral reefs (Jungblut et al., 2020). Coral reefs provide several benefits to human societies around the world (Miller et al., 2021). Coral reefs indicate an important resource for nature-based tourism. They are known for their charming beauty, which attracts a massive number of tourists to enjoy unique shapes and colors (Hoek and Bayoumi, 2017). The Red Sea is considered one of the best diving spots that enable tourists to enjoy this wonderful underwater world (Hilmi et al., 2012).

One of the characteristics of coral reefs is their high biological diversity (Shoaira et al., 2019). As a result, they are known as sea rainforests due to their huge diversity (Miththapala, 2008). The coral reef ecosystem is home to a large amount of marine life, including plants, animals (Moberg and Folke, 1999), and about 4000 species of fish (Singh et al., 2020). In addition, coral reefs contribute to coastal protection (Grimsditch and Salm, 2006). They act as natural barriers that dissipate wave-generated energy (Maragos et al., 1996), decrease flooding and damage that may occur to the beach (Miththapala, 2008), and prevent coastal erosion (Reynolds, 2016).

According to Spalding et al. (2017) one of the most important benefits of coral reefs is that they contribute to the production of seafood since they support people who live depending on these natural resources as a main source of food and income. Coral reef fisheries are important sources of income. Many species that live on coral reefs contain compounds that can be used in medicine manufacture as treatments for many diseases (Hoek and Bayoumi, 2017). Another benefit of coral reefs is that they help to absorb and remove carbon dioxide from the atmosphere (Shoaira et al., 2019).

## **5.3. Composition of Sunscreens**

Sunscreens perform a physical barrier between the skin and the sun's rays by These filters are divided into organic, containing specific UV filters (Wood, 2018). chemical filters, and inorganic, mineral filters (Yuan et al., 2022; El-Boury et al., 2007). Organic filters include benzophenone-3 (oxybenzone), para-aminobenzoic acid (PABA), PABA esters, cinnamates, salicylates, camphor derivatives, dibenzoylmethanes and anthranilates (Serpone et al., 2006). The most inorganic filters that are commonly used are zinc oxide and titanium (Manaia et al., 2013).

In addition, there are other used minerals in sunscreens such as silicate-based substances (materials) that contain talc and kaolin. They also consist of inactive

ingredients such as anti-microbial preservatives, moisturizers, and anti-oxidants (Wood, 2018). Organic filters can absorb ultraviolet rays, while inorganic filters reflect and scatter ultraviolet rays (Jesus et al., 2022).

#### **5.4. Impact of Sunscreens on Coral Reefs**

Exposure to the sun's ultraviolet rays is a threat to human health. This threat is the risk of sunburn, aging, and skin cancer. Concern about these risks of UV rays has led to that both increased use of sunscreens. In recent years, many studies have proven sunscreens and other cosmetic products contain chemicals that increase the pollution range for coral reefs (Shinn, 2019). Each year, about 6000 to 14,000 tons of sunscreens are thrown by humans onto coral reefs; as a result, these chemicals can kill coral reefs. One of the components of sunscreens is oxybenzone. In more than 4 million gallons of water, one drop of oxybenzone is enough to threaten living creatures (Mohiuddin, 2019).

The use of sunscreens leads to bleaching hard corals by promoting viral infections even at trace concentrations (Danovaro et al., 2008). Coral bleaching is defined as losing corals' color due to partial to whole elimination of the symbiotic algae (Douglas, 2003). Coral bleaching occurs when the coral is stressed and the algae that live in its tissues are expelled. Corals are not necessarily dead when bleaching, but bleaching is a clear indication that corals are in danger (Casas-Beltran et al., 2020).

The use of sunscreens also leads to deformation and damage of coral larvae (Moeller et al., 2021) and harm to coral DNA and procreation advance. It was proven that oxybenzone is a genotoxic substance that destroys the DNA of coral reefs, reducing the lifespan of coral reefs and their immunity against diseases and disrupting reproduction and normal growth (Wood, 2018). Bans have been implemented on many sunscreen products in various regions such as Hawaii, the USA, the Virgin Islands, and Palau. This ban includes oxybenzone and octinoxate which are widely used in sunscreens (Miller et al., 2021). All of these sunscreens' side effects on coral reefs require action for finding UV filters that do not threaten the coral reef's survival (European Commission, 2008).

#### **5.5. Reef-Safe Sunscreen**

After a ban on some sunscreens has been implemented in Hawaii and followed by other countries, consumers have become more aware of the potential effects of their sunscreen products on the coral environment. Many cosmetic manufacturers have incorporated the term "reef-safe or reef-friendly" into their marketing policies for their sunscreen products. A survey in Hawaii reported that most people are ready to buy labeled harmless sunscreens for coral reefs (Miller et al., 2021).

### **6. Methodology**

Data from 304 tourists have been obtained that a self-submitted questionnaire is available in an electronic web-based format and printed copy. The survey has been divided into four main parts. Firstly, socio-demographic characteristics contain three items. Secondly, environmental awareness includes 14 items (Clauses Nos. 1, 7, 9, 10, and 11 from Hou and Wu, 2021) (Clauses Nos. 2 and 3 from Kim and Kang, 2022) (Clauses Nos. 4, 5, and 6 from Sharma et al., 2018) (Clauses Nos. 8, 12, 13 and 14 from Kaltenborn et al., 2011). Thirdly, tourists' awareness of the negative impact of

sunscreens on coral reefs involves four items (Lindqvist and Andersson, 2015). Finally, tourists’ behavior towards the use of sunscreens includes nine items (Clauses No. 1 to No. 7 from Kim and Kang, 2022) (Clauses Nos. 8 and 9 from Lindqvist and Andersson, 2015). Closed questions with checklists have been used for socio-demographic questions, and a five-point Likert scale has been used to rate environmental awareness, tourists’ awareness of the negative impact of sunscreens on coral reefs, and tourists’ behavior towards the use of sunscreens. The statistical program for Social Science (SPSS program V 28) software has been used to analyze survey data. Data analysis has included several statistical techniques. These techniques are frequency table, correlation coefficients, descriptive statistics, Pearson correlation coefficient, and statistical regression.

## 7. Results and Discussion

### 7.1. Socio-demographic profile

These questions clarify the distribution of the sample according to age, gender, and level of education.

**Table 1 Socio-demographic profile of the sample**

Attribute		Frequency	Percent
<b>Age</b>	18-25	166	54.6
	26-40	85	28.0
	41-60	47	15.5
	more than 61	4	1.3
	less than 18	2	0.7
<b>Gender</b>	Male	101	33.2
	Female	203	66.8
<b>Level of education</b>	High school	44	14.5
	Bachelors	185	60.9
	Postgraduate	75	24.7
<b>Total</b>		304	100.0

The result in Table 1 shows that people at age of 18-25 represent 54.6%. People at age of 26-40 represent 28%. People at age of 41-60 represent 15.5%. The total samples of age group “more than 61” are four samples representing 1.3% while the total samples of age group “less than 18” are two samples representing 0.7%.

Data tabulated in Table 1 shows that the total samples of the gender group “female” are 203 samples representing 66.8% while the total samples of the gender group “male” are 101 samples representing 33.2 %. The total samples demonstrate that the extent and degree of awareness of tourists about the negative impact of sunscreens on coral reefs as a tourist resource have the highest percentage in the female category.

As clearly shown in Table 1, the majority of people showing 60.9% are bachelors while 24.7% of people represent postgraduate. The rest of the sample, 14.5%, represents the high school.

**Description of the study axes:**

**7.2. Environmental awareness**

The following table measures the degree of tourists’ environmental awareness in the study sample and their interest in environmental issues.

**Table 2 Descriptive statistics of environmental awareness**

Attribute	strongly disagree	disagree	Neutral	Agree	strongly agree	Mean	Std. Deviation	relative importance	trend
1) I am extremely worried about the world's environment for now and future.	-	4	28	85	187	4.50	0.72	89.93	strongly agree
	-	1.3	9.2	28.0	61.5				
2) I am willing to devote more effort and time to environmental protection	1	9	45	129	120	4.18	0.81	83.55	agree
	0.3	3.0	14.8	42.4	39.5				
3) I prefer to use eco-friendly products	1	3	30	94	176	4.45	0.74	89.01	strongly agree
	0.3	1.0	9.9	30.9	57.9				
4) I am interested in attending or participating in environmental awareness programs/campaigns	3	21	91	100	89	3.83	0.96	76.51	agree
	1.0	6.9	29.9	32.9	29.3				
5) I contribute to creating awareness of environmental issues	2	15	75	121	91	3.93	0.89	78.68	agree
	0.7	4.9	24.7	39.8	29.9				
6) I'm interested in learning more about environmental issues	1	6	49	140	108	4.14	0.78	82.89	agree
	0.3	2.0	16.1	46.1	35.5				
7) human interference with nature often produces disastrous consequences	2	7	24	81	190	4.48	0.79	89.61	strongly agree
	0.7	2.3	7.9	26.6	62.5				
8) Environmental balance is critical and easily upset		7	20	105	172	4.45	0.72	89.08	strongly agree
		2.3	6.6	34.5	56.6				
9) Humans must live in environmental harmony to survive		4	14	71	215	4.63	0.64	92.70	strongly agree
		1.3	4.6	23.4	70.7				
10) I think environmental problems are very important	1	6	10	72	215	4.63	0.68	92.50	strongly agree
	0.3	2.0	3.3	23.7	70.7				
11) I think environmental problems are very urgent	2	2	13	72	215	4.63	0.66	92.63	agree
	0.7	0.7	4.3	23.7	70.7				

12) Humans are rightful to adjust the natural environment to satisfy their necessities	19	50	76	62	97	3.55	1.26	71.05	agree
	6.3	16.4	25.0	20.4	31.9				
13) Animals and plants as well as humans are appropriate to live on the Earth planet		7	16	74	207	4.58	4.58	91.64	strongly agree
		2.3	5.3	24.3	68.1				
14) In case of proceeding on the present course as now, surely we will experience an ecological catastrophe	1	6	26	84	187	4.48	0.76	89.61	strongly agree
	0.3	2.0	8.6	27.6	61.5				
Environmental Awareness						4.65	0.51	93.00	strongly agree

According to table 2, the phrase that has the highest mean is “Humans must live in environmental harmony to survive”. It represents an average of (4.63 out of 5) and a relative weight of (92.50%), which indicates that the sample members are highly homogeneous and that humans must live in a balance with the environment for survival. As for the phrase that indicates the lowest mean in terms of rank is “Humans are rightful to adjust the natural environment to satisfy their necessities”. It represents an average of (3.55 out of 5) and a relative weight of (71.05%), which indicates that the sample members are highly homogeneous and that humans are exact to change the natural environment to meet their needs. In general, the mean of the axis as a whole is 4.65 from 5, and its relative weight is 93%, which indicates that there is an agreement between the responses of the sample members in the paragraphs on environmental awareness.

### 7.3. Tourists’ awareness of the negative impact of sunscreens on coral reefs

The following table shows the distribution of sample according to the degree of tourists’ awareness of the negative impact of sunscreens on coral reefs.

**Table 3 Descriptive statistics of tourists’ awareness of the negative impact of sunscreens on coral reefs**

Attribute	strongly disagree	disagree	Neutral	Agree	strongly agree	Mean	Std. Deviation	relative importance	trend
1) I fully understand the negative impact of sunscreen on coral reefs	3	31	82	109	79	3.76	0.99	75.13	agree
	1.0	10.2	27.0	35.9	26.0				
2) The effects of sunscreens on coral reefs are much worse than we realize	2	19	96	94	93	3.85	0.95	76.91	agree
	0.7	6.3	31.6	30.9	30.6				
3) I am convinced that reef-safe sunscreens will provide better protection for coral reefs.	3	16	54	106	125	4.10	0.94	81.97	agree
	1.0	5.3	17.8	34.9	41.1				
4) I am willing to learn more about the effect of sunscreens on coral reefs so that I can	3	4	29	89	179	4.44	0.80	88.75	strongly agree
	1.0	1.3	9.5	29.3	58.9				



conserve them.									
Tourists' awareness of the negative impact of sunscreens on coral reefs	4.03	0.7	80.60	agree					

The results of table 3 indicate that the mean value of the “Tourists’ awareness of the negative impact of sunscreens on coral reefs” items ranges between (3.76 -4.44). The phrase that has the highest meaning is “I am willing to learn more about the effect of sunscreens on coral reefs so that I can conserve them”. It represents an average of (4.44 out of 5) and a relative weight of (88.75%), which indicates that the sample members are highly homogeneous and that they are willing to learn more about the effect of sunscreens on coral reefs so that they can conserve them. The phrase that has the lowest mean in terms of rank is “I fully understand the negative impact of sunscreen on coral reefs”. It represents an average of (3.55 out of 5) and a relative weight of (71.05%), which indicates that the sample members are highly homogeneous and that they fully understand the negative impact of sunscreen on coral reefs. In general, the mean of the axis as a whole was 4.03 from 5, and its relative weight (80.60%), which indicates that there is an agreement between the responses of the sample members in the paragraphs on Tourists’ awareness of the negative impact of sunscreens on coral reefs.

#### 7.4. Tourists’ behavior toward the use of sunscreens

The following table explains tourists’ behavior toward the use of sunscreens.

**Table 4 Descriptive statistics of tourists’ behavior toward the use of sunscreens**

Attribute	strongly disagree	disagree	neutral	Agree	strongly agree	mean	Std. Deviation		trend
1) I make sure of buying an eco-friendly sunscreen to protect coral reefs	2	12	52	108	130	4.16	0.89	83.16	agree
	0.7	3.9	17.1	35.5	42.8				
2) Protecting coral reefs from the damage of sunscreen is important to me	4	20	61	102	117	4.01	0.98	80.26	agree
	1.3	6.6	20.1	33.6	38.5				
3) I am looking for other means of protection instead of sunscreen to protect coral reefs	4	26	84	96	94	3.82	1.01	76.45	agree
	1.3	8.6	27.6	31.6	30.9				
4) I am willing to pay more money to buy eco-friendly sunscreen.	2	12	57	105	128	4.13	0.90	82.70	agree
	0.7	3.9	18.8	34.5	42.1				
5) I'm willing to pressure companies to make reef-safe sunscreens.	3	7	55	109	130	4.17	0.87	83.42	agree
	1.0	2.3	18.1	35.9	42.8				
6) I will positively speak to others about reef-safe	8	32	75	89	100	3.79	1.09	75.86	agree
	2.6	10.5	24.7	29.3	32.9				

sunscreen and advise them to use it or look for alternatives									
7) I am willing to compromise my sunscreens protection to protect coral reefs as a tourist resource	4	16	55	121	108	4.03	0.93	80.59	agree
	1.3	5.3	18.1	39.8	35.5				
8) I feel personally obliged to use reef-safe sunscreens instead of traditional sunscreens	1	9	50	126	118	4.15	0.82	83.09	agree
	0.3	3.0	16.4	41.4	38.8				
9) I feel morally obligated to take into consideration the environmental problems of sunscreens when making these options	1	4	63	106	130	4.18	0.83	83.68	agree
	0.3	1.3	20.7	34.9	42.8				
Tourists' behavior toward the use of sunscreens						4.05	0.66	81.00	agree

Table 4 shows that the mean value of the “Tourists’ behavior towards the use of 3.79- 4.18). The highest mean phrase is “I feel (sunscreens” items ranges between morally obligated to take into consideration the environmental problems of sunscreens when making these options”. It represents an average of (4.18 out of 5) and a relative weight of (83.68%), which indicates that the sample members are highly homogeneous and that they are willing to learn more about the effect of sunscreens on coral reefs so that they can conserve them. The lowest mean phrase is “I will positively speak to others about reef-safe sunscreen and advise them to use it or look for alternatives”. It represents an average of (3.79 out of 5) and a relative weight of (75.86%), which indicates that the sample members are highly homogeneous that they positively speak to others about reef-safe sunscreen and advise them to use it or look for alternatives. In general, the mean of the axis as a whole was 4.05 from 5 and its relative weight (81%), which indicates that there is an agreement between the responses of the sample members in the paragraphs on tourists’ behavior towards the use of Sunscreens.

## 7.5. Correlations analysis:

### 7.5.1. The relationship between environmental awareness and tourists’ awareness of the negative impact of sunscreens on coral reefs

The following table shows whether or not there is a relationship between environmental awareness and tourists’ awareness of the negative impact of Sunscreens on coral reefs.

**Table 5 The relationship between environmental awareness and tourists’ awareness of the negative impact of sunscreens on coral reefs**

		Environmental awareness	Tourists' awareness of the negative impact of sunscreens on coral reefs
Environmental awareness	Pearson Correlation	1	.586**
	Sig. (2-tailed)		0.000
Tourists' awareness of the negative impact of sunscreens on coral reefs	Pearson Correlation	.586**	1
	Sig. (2-tailed)	0.000	

Table 5 shows that the Pearson correlation between environmental awareness and tourists' awareness of the negative impact of Sunscreens on Coral Reefs is .586\*\* between (0.4 - 0.6), and this is a median positive coefficient correlation at sig-level 0.01. Therefore, there is a relationship between environmental awareness and tourists' awareness of the negative impact of sunscreens on coral reefs.

**7.5.2. The relationship between environmental awareness and tourists' behavior toward the use of Sunscreens**

The following table shows whether or not there is a relationship between environmental awareness and tourists' behavior toward the use of sunscreens.

**Table 6 The relationship between environmental awareness and tourists' behavior toward the use of sunscreens**

		Environmental awareness	Tourists' behavior toward the use of sunscreens
Environmental awareness	Pearson Correlation	1	.614**
	Sig. (2-tailed)		0.000
Tourists' behavior towards the use of S=sunscreens	Pearson Correlation	.614**	1
	Sig. (2-tailed)	0.000	

Table 6 shows that the Pearson correlation between environmental awareness and tourists' behavior towards the use of sunscreens is .614\*\* between (0.4 - 0.6), and this is a median positive coefficient correlation at sig-level 0.01. Therefore, there is a relationship between environmental awareness and tourists' behavior toward the use of sunscreens.

**7.5.3. The relationship between tourists' awareness of the negative impact of sunscreens on coral reefs and tourists' behavior towards the use of sunscreens**

The following table shows whether or not there is a relationship between tourists' awareness of the negative impact of sunscreens on coral reefs and tourists' behavior toward the use of sunscreens.

**Table 7 The relationship between tourists' awareness of the negative impact of sunscreens on coral reefs and tourists' behavior toward the use of sunscreens**

	Environmental awareness	Tourists' awareness of the	Tourists' behavior
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			negative impact of sunscreens on coral reefs	toward the use of sunscreens
Environmental awareness	Pearson Correlation	1	.586**	.614**
	Sig. (2-tailed)		0.000	0.000
Tourists' awareness of the negative impact of sunscreens on coral reefs	Pearson Correlation	.586**	1	.735**
	Sig. (2-tailed)	0.000		0.000
Tourists' behavior toward the use of sunscreens	Pearson Correlation	.614**	.735**	1
	Sig. (2-tailed)	0.000	0.000	
**. Correlation is significant at the 0.01 level (2-tailed).				

Table 7 shows that the Pearson correlation between tourists' awareness of the negative impact of sunscreens on coral reefs and tourists' behavior towards the use of Sunscreens is .735\*\* between (0.7 - 0.9), and this is a high positive coefficient correlation at sig-level 0.01. Therefore, there is a relationship between tourists' awareness of the negative impact of sunscreens on coral reefs and tourists' behavior toward the use of sunscreens.

**7.5.4. The effect of environmental awareness on tourists' behavior toward the use of sunscreens**

The statistical regression model has been applied to test the effect of environmental awareness on tourists' behavior toward the use of sunscreens and this verifies the first hypothesis.

**Table 8 The effect of environmental awareness on tourists' behavior toward the use of sunscreens**

Tourists' behavior toward the use of sunscreens	B	Sig.	R	R Square	F	Sig.
(Constant)	3.634	0.138	.614 <sup>a</sup>	0.377	182.552	.000 <sup>b</sup>
Environmental awareness	0.543	0.000				

Table 8 shows that Sig = 0.000, and it is less than 0.05 =  $\alpha$ . There is an effect of environmental awareness on tourists' behavior toward the use of sunscreens. The value of correlation coefficient is .614, which indicates a median positive correlation between environmental awareness on tourists' behavior toward the use of sunscreens. The value of the coefficient of determination is 0.38, which indicates environmental awareness, and can explain 38% of the values of the changes in tourists' behavior towards the use of sunscreens, There is a statistically significant effect of environmental awareness, and looking at the value of 0.543= b the greater effect environmental awareness represented by 1 unit, tourists' behavior towards the use of sunscreens increases by 0.543.

**7.5.5. The effect of tourists’ awareness of the negative impact of sunscreens on coral reefs on tourists’ behavior towards the use of sunscreens**

The statistical regression model has been used to test the effect of tourists’ awareness of the negative impact of sunscreens on coral reefs on tourists’ behavior towards the use of sunscreens and this verifies the second hypothesis.

**Table 9 The effect of tourists’ awareness of the negative impact of sunscreens on coral reefs on tourists’ behavior toward the use of sunscreens**

Tourists’ behavior toward the use of sunscreens	B	Sig.	R	R Square	F	Sig.
(Constant)	11.483	0.000	.735a	0.540	354.748	.000b
Tourists’ awareness of the negative impact of sunscreens on coral reefs	1.548	0.000				

Table 9 shows that Sig = 0.000, and it is less than  $0.05 = \alpha$ . There is an effect of tourists’ awareness of the negative impact of sunscreens on coral reefs on tourists’ behavior towards the use of sunscreens. The value of the correlation coefficient is .735, which indicates a median positive correlation between tourists’ awareness of the negative impact of sunscreens on coral reefs on tourists’ behavior toward the use of sunscreens. The value of the coefficient of determination is 0.54, which indicates tourists’ awareness of the negative impact of sunscreens on coral reefs, which can explain 54% of the values of the changes in tourists’ behavior towards the use of sunscreens, there is a statistically significant effect of tourists’ awareness of the negative impact of sunscreens on coral reefs. Looking at the value of 1.548= b the greater effect tourists’ awareness of the negative impact of sunscreens on coral reefs represented by 1 unit, tourists’ behavior towards the use of sunscreens increases by 1.548.

**8. Conclusion**

The study confirms that among the challenges faced by coral reefs is the use of sunscreens by tourists. The ingredients in sunscreens cause several damage to coral reefs. There is a need to increase the environmental awareness of tourists about these damages. Coral reefs have many benefits that encourage the need to protect and preserve them.

This study has shown that the sample members are highly homogeneous these humans must live in balance with the environment to remain alive. The results have revealed that tourists are willing to learn more about the effect of sunscreens on coral reefs so that they can conserve them. They also have an ethical obligatory sense in taking into consideration environmental problems caused by sunscreens when making sunscreen choices. In addition, the degree of environmental awareness among tourists and their awareness of the negative effects of sunscreens on coral reefs affects their behavior towards the use of sunscreens.

For achieving sustainable usage of coral reefs, tourists need for using alternatives to sunscreens or use coral-friendly sunscreens, and provoke companies should be thoroughly reinforced to manufacture such reef-friendly sunscreens. Coastal destinations should also implement awareness campaigns about the harmful impacts of sunscreens on coral reefs and take various measures and actions that would reduce these harmful effects.

## 9. Recommendations

The following are some recommendations to protect ourselves and the coral reefs at the same time. While going to the beach, you must do so responsibly and seek shade between the hours of 10 am and 2 pm. You can also cover up with light clothes when exposed to the sun and use reef-friendly sunscreens. Consumer pressure can be used to encourage the manufacture of reef-friendly sunscreens, as well as reading their ingredients to make sure that they are sunscreen labels carefully and checking safe for coral reefs before buying or using them.

As a coastal destination, the state can take several measures to encourage the manufacture and use of coral-friendly sunscreens, such as:

- Increasing the production of reef-friendly sunscreens,
- Promoting the usage of reef-friendly sunscreens as well as various methods of UV protection,
- Controlling both trading and usage of sunscreens that contain toxins.
- Presenting financial restrictions for manufacturing or usage of potentially harmful sunscreens,
- Continued research into the impacts of sunscreens on coral reefs that obviously indicates a regulatory framework for manufacturers to adhere to,
- Conducting awareness campaigns about the negative impact of sunscreens on coral reefs and the need to use reef-friendly sunscreens,
- Encouraging resorts and diving centers in the coastal destinations to provide their guests with reef-friendly sunscreens,
- Awarding certificates and awards to manufacturers of reef-friendly sunscreens,
- Extending news coverage by the coastal tourism destination to increase general awareness of the negative impacts of sunscreens on coral reefs,
- Establishing marine regions to protect coral reefs and banning the use of harmful sunscreens on coral reefs,
- Building awareness at the national level about coral reefs and their diversity, providing the services that may help mitigate threats to coral reefs, and encouraging coral reef users to change their attitude to sustainable use,
- And, developing environmental education programs to enhance awareness by the tourism industry in order to reveal the importance of healthy coral reefs.

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## تقصى الوعي البيئي للسائحين بالآثار السلبية لواقبات الشمس على الشعاب المرجانية وأثره على سلوكهم

د/ هايدى السهيلي

مدرس - قسم الدراسات السياحية - كلية السياحة والفنادق - جامعة حلوان

### المستخلص

الشعاب المرجانية الصحية تشمل العديد من الفوائد للوجهات الساحلية كما يشار إليها كمورد للسياحة القائمة على الطبيعة وملجأ لجزء كبير من الحياة البحرية. بالإضافة إلى ذلك، تساهم الشعاب المرجانية في حماية السواحل وإنتاج المأكولات البحرية. التعرض للأشعة فوق البنفسجية يؤدي إلى بعض التهديدات الصحية العامة مثل حروق الشمس الضارة وسرطان الجلد والشيخوخة الضوئية. أدى الاهتمام المتزايد بهذه الآثار الضارة إلى زيادة استخدام واقبات الشمس التي تحتوي على فلتر للأشعة فوق البنفسجية. أكدت الدراسات أن واقبات الشمس لها العديد من الأضرار التي تلحق بالشعاب المرجانية مثل تبيض المرجان وتلف الحمض النووي للشعاب المرجانية. تم توزيع عدد 304 استمارة استبيان بشكل عشوائي على عينة من السائحين جميعها صالحة للتحليل. الوعي البيئي بقيمة الشعاب المرجانية إلى جانب التأثير السلبي للواقبات الشمسية عليهم تؤدي إلى تحقيق الاستخدام المستدام للشعاب المرجانية من خلال البحث عن بدائل لواقبات الشمس وتشجيع تصنيع واستخدام واقبات الشمس الآمنة للشعاب المرجانية.

### الكلمات الدالة

الوعي البيئي  
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