Original Article/นิพนธ์ต้นฉบับ

The Efficiency of Ultraviolet Light Absorption by Commercially Available Sunglasses Lenses in Bangkok and Circumference.

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Abstract

Objective: Data are lacking on the quality of sunglasses in Thailand. A study was conducted to measure the ultraviolet (UV) light protection of sunglasses sold in Bangkok and circumference.

Materials and Methods: Thirty-eight sunglasses were sampled randomly from department stores, optical shops, and stalls in Bangkok and circumference. Using the Spectrum 700 VU digital transmission meter, lenses were assessed for UV absorption in the 320 - 400 nanometers wavelength range.

Results: Sunglasses cost between 50 to 5,020 (median 1,250) Thai baht. Most sunglasses, 32/38 (84.2%), had an UV reading of 0%, indicating full UV absorption. The six pairs that had transmitted UV light, ranging from 7.67 to 58%, all cost ≤ 160 Thai baht. UV absorption and price were inversely related (Spearman's rho = -0.636, $p < 0.01$).

Conclusion: In this study, the ability of sunglasses to absorb UV light, and thus protect the eye, varied widely and was inversely related to price. Minimum standards for the quality of sunglasses need to be established and enforced by a relevant government department to protect the public from the hazards of UV light. **Thai J Ophthalmol 2006 ; July-December 20(2) : 133-139.**

Keywords: *sunglasses, lens, ultraviolet light*

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Introduction

Ultraviolet (UV) radiation is divided into A, B, and C forms. The UVA is ranged from 320-400 nanometers (nm.), the UVB is 280-320 nm., and the UVC is lower than 280 nm. Studies in animals have documented the harmful effects of exposure to ultraviolet radiation. Hairless mice were irradiated with a small dose of radiation to only cause cutaneous erythema each day for 12 months. The lifespan of unprotected, irradiated mice was significantly shorter than the protected groups[1]. UV radiation also caused hindlimb and eyes malformations in the northern leopard frog, *Rana pipiens*[2], and also produced several cancers such as invasive carcinoma[1], and malignant melanoma[3]. Excess UV exposure is also a risk factor for the development of pterygium[4-9], climatic droplet keratopathy[4,6], cataract[10-11], retinal pigment epithelium apoptosis[12], and infections and tumors by suppressing T cell mediated immunity[13].

Strategies to reduce the harmful effects of UV exposure, especially to the eye, include the wearing of a wide-brimmed hat or cap and well designed sunglasses[14]; UV-blocking soft contact lenses also have been reported to be effective[15-18]. Kwok et al found such lenses appeared to offer more UV protection than sunglasses[19]. UV induced injury to human conjunctival cells in culture can be prevented by incubation with iodide before UV irradiation due to the antioxidant effect of the iodide[20]. Antioxidant agents such as vitamin C and E show similar protective effects[21-23]. By contrast, the UV protection eye drops, 8-hydroxy-1-methylchinolinium methylsulphate, did not show a protective effect against solar UV radiation[24].

Ocular discomfort depends in part on two lumination factors: intensity and glare[25]. With high light intensity, the contrast diminishes between a viewed object and its background resulting in reduced visual acuity. This loss of contrast is caused by retinal irradiation. Another problem is intense miosis induced by extremely bright light, which can produce headache and eye discomfort. Glare is defined as visual interference by unwanted light and is classified as reflex or and scattered light glare. Reflex glare occurs when light is reflected from a reflective surface e.g. reading matter, a work surface, or chrome automobile parts, directly into the eyes. Scattered light glare is found in hazy and foggy conditions resulting from atmospheric moisture or dust. The tiny particles in the air scatter the shorter wavelength light and results in haze that is bluish in color.

Wearing sunglasses is an easy and popular way to protect the eyes against the hazards of sunlight exposure. Protection depends on the size and shape of frame[26], and the quality of the lens. If the lens is unable to reduce sufficiently the intensity of UV radiation, this may result in damage to the eye structures[27].

Sunglasses were initially developed for medical purposes and first introduced for steelworkers, polar explorers, the blind, and those with symptoms of eye fatigue. Later, sunglasses became an item of fashion. Appropriate sunglasses should have the following properties[25]: (i) lens transmittance in visible light should be 20-30% for ordinary outdoor activity, (ii) UV should be filtered to reduce potential photochemical damage to the eyes, (iii) the lens should be polarizing to reduce the reflex glare, (iv) the lens color should permit reasonable color discrimination, especially important for traffic safety, (v) the frame should have side shields for better protection against oblique incident light, this is important for industrial workers, and (vi) the lens and frame should meet standards for flammability, durability, impact-resistance, and appropriate refractive correction.

A literature search has failed to identify any

published research on the quality of sunglasses in Thailand. Therefore, a study was conducted to assess sunglasses in Thailand. The results are reported herein.

Materials and Methods

This study was conducted in Bangkok and circumference between February and May 2005. Sunglasses, of different brands, price range 50 to 5000 Thai baht, and colors, were purchased randomly from department stores, optical shops, and market stalls.

A pilot study for calculating correlation coefficient® value in order to calculate the suitable population by the price of sunglasses and UV transmission percentage, which the value of correlation coefficient® was equal to -0.672, following this formula[28]:

$$N = [(Z_{1-\square} + Z_{1-\square})^2 / Z_0^2] + 3,\ Z_0 = \ln [(1+r) / (1-r)]$$

$Z_{1-\square}$ = 1.96 for two tails hypothesis, $\square$ = 0.05

$Z_{1-\square}$ = 1.64 for one tail hypothesis, $\square$ = 0.95

Z_0^2 = 0.663

$N = [(1.96 + 1.64)^2 / 0.663] + 3 = 22.55$

So the amount of sunglasses in this study should not be less than 23 pairs.

The randomized sunglasses were tested for their ability to transmit UV light using a Spectrum 700 VU machine (Phantom Research Laboratories, Inc. 4580 Alvarado Canyon Rd. Suite E, San Diego, CA 92120 USA). This model is able to measure UV light in the wavelength range of 320 to 400 nm. This covers the spectrum of UVA, which is 320 to 400 nm. When activated in UV mode, the machine LCD shows the readout from the internal UV light source. The LCD reading is adjusted until it reads 100%. This means that 100% of the UV light source is detected. Then the sunglass is placed into the machine between the UV light source and the UV light meter. The LCD meter reading is noted. Both lenses were tested three times, the readings recorded, and the mean values calculated. Data were recorded onto a case record form, and entered onto the SPSS version 10.0 software. The results were analyzed using Spearman's Rho correlation.

Results

Thirty-eight pairs of sunglasses were tested and were priced between 50 and 5,020 Thai baht for a median of 1250. The majority 32/38 (84.2%) of the sunglasses were able to reduce UV radiation transmission to zero (Table 1). The degree of UV transmission of the remaining six sunglasses ranged from 7.67 to 58%, median 12.8%. These glasses were from the lowest price range, 50 to 160 Thai baht. There was a negative correlation (Spearman's Rho correlation coefficient = -0.636, $p < 0.01$) between the price and the amount of UV light transmitted by the lens (Figure 1).

Discussion

Our results have shown that most tested sunglasses performed well and did not allow the transmission of UV light. Those sunglasses that failed to block UV light were at the lower end of the price range. A minority of sunglasses did allow some UV light to pass through. All were priced at the lower end of the price range. These results suggest that in Thailand a number of commercially available and inexpensively price sunglasses are of a low standard and could be deleterious to the eyes if used over a prolonged period of time.

This result is different from the other studies, which found no association between UV absorbance and cost[29]. Because several countries have set minimum standards for sunglasses with respect to UV protection, which must be followed by the manu-

Table 1. Prices of sunglasses and the percentage of UV transmission.

No.	Price (Baht)	Color	Percent of UV transmission			
			1st test	2nd test	3rd test	average
1	5020.00	Brown	0.00	0.00	0.00	0.00
2	4800.00	Brown	0.00	0.00	0.00	0.00
3	2400.00	Gray	0.00	0.00	0.00	0.00
4	2200.00	Gray	0.00	0.00	0.00	0.00
5	2500.00	Green	0.00	0.00	0.00	0.00
6	2600.00	Gray	0.00	0.00	0.00	0.00
7	2400.00	Brown	0.00	0.00	0.00	0.00
8	2400.00	Gray	0.00	0.00	0.00	0.00
9	1900.00	Gray	0.00	0.00	0.00	0.00
10	1600.00	Brown	0.00	0.00	0.00	0.00
11	1600.00	Gray	0.00	0.00	0.00	0.00
13	1600.00	Green	0.00	0.00	0.00	0.00
14	1600.00	Brown	0.00	0.00	0.00	0.00
15	1600.00	Pink	0.00	0.00	0.00	0.00
16	1700.00	Gray	0.00	0.00	0.00	0.00
17	1800.00	Brown	0.00	0.00	0.00	0.00
18	1200.00	Brown	0.00	0.00	0.00	0.00
19	1300.00	Gray	0.00	0.00	0.00	0.00
20	1200.00	Gray	0.00	0.00	0.00	0.00
21	1400.00	Green	0.00	0.00	0.00	0.00
22	1500.00	Green	0.00	0.00	0.00	0.00
23	1200.00	Gray	0.00	0.00	0.00	0.00
24	1200.00	Brown	0.00	0.00	0.00	0.00
25	800.00	Gray	0.00	0.00	0.00	0.00
26	800.00	Gray	0.00	0.00	0.00	0.00
27	600.00	Gray	0.00	0.00	0.00	0.00
28	600.00	Brown	0.00	0.00	0.00	0.00
29	600.00	Gray	0.00	0.00	0.00	0.00
30	600.00	Green	0.00	0.00	0.00	0.00
31	299.00	Gray	0.00	0.00	0.00	0.00
32	199.00	Violet	0.00	0.00	0.00	0.00
33	160.00	Violet	8.00	7.00	8.00	7.67
34	160.00	Brown	7.00	8.00	8.00	7.67
35	150.00	Brown	9.00	9.00	9.00	9.00
36	50.00	Gray	58.00	58.00	58.00	58.00
37	50.00	Green	47.00	47.00	48.00	47.33
38	50.00	Brown	15.00	14.00	15.00	14.67

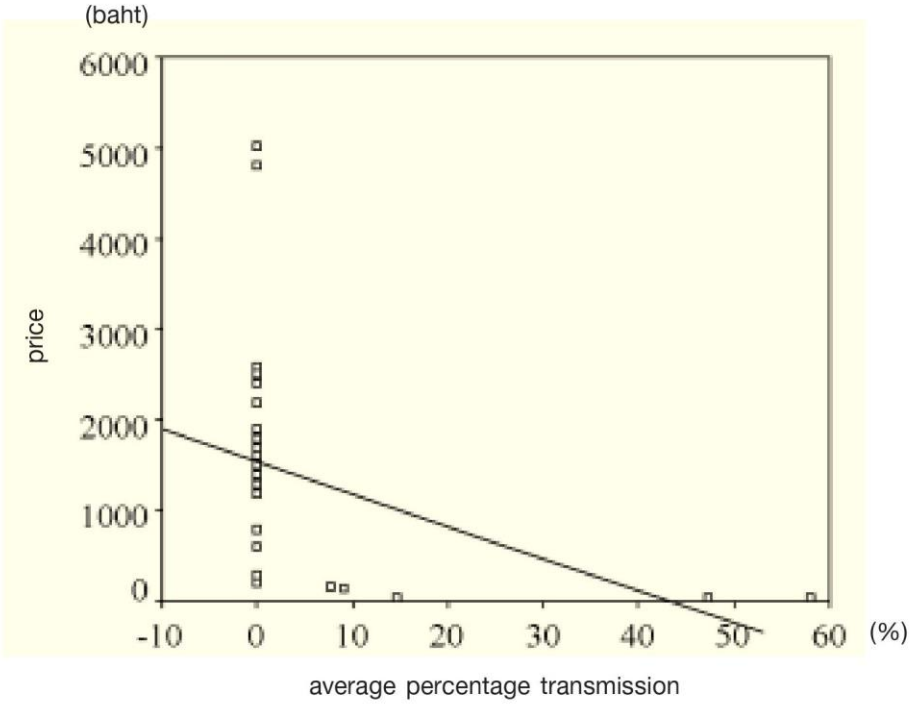

Figure 1. *Association graph between sunglasses price and average percentage UV transmission.*

facturers[26]. Therefore, the cost does not influence the efficiency of UV absorption and consumers can be confident that they are buying sunglasses that do offer UV protection. The broad range in pricing for sunglasses is due to fashion branding.

In Thailand, there are no legally enforceable, manufacturing standards for sunglasses that are produced locally. Indeed, some sunglass lenses are simply made of dyed plastic sheet that offer little UV protection. Consumers in Thailand are probably not aware that sunglasses are ineffective and may be harmful to use over the long term. More research in these areas is needed. Those who are able to afford the more expensive sunglasses are probably safe but more testing of sunglasses is needed before we can be confident that highly priced sunglasses guarantee adequate UV protection.

Thailand should develop its own standards for sunglass production and lens quality so that all consumers could be properly protected.

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การศึกษาประสิทธิภาพการกรองแสงเหนือม่วงของเลนส์แว่นตากันแดดในกลุ่มราคาต่างๆ กันที่จำหน่ายในกรุงเทพมหานครและปริมณฑล

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บทคัดย่อ

วัตถุประสงค์ เพื่อศึกษาประสิทธิภาพในการกรองแสงเหนือม่วงของเลนส์แว่นตากันแดดในกลุ่มราคาต่างๆ กันที่จำหน่ายในกรุงเทพมหานครและปริมณฑล

วิธีการวิจัย เป็นการศึกษาแบบ prospective study โดยทำการสุ่มตัวอย่างแว่นตากันแดดชนิดต่างๆ ที่มีจำหน่ายอยู่ในท้องตลาดในราคาต่างๆ กัน จากนั้นนำเลนส์แว่นตากันแดดที่สุ่มมานั้นมาเข้าเครื่องตรวจหาความสามารถในการกรองแสงเหนือม่วงโดยใช้เครื่องวัดค่าความสามารถในการกรองแสงเหนือม่วงของบริษัท Phantom Research Laboratories, Inc. รุ่น Spectrum 700 VU โดยการวัดเลนส์แว่นตากันแดดว่าสามารถให้แสงเหนือม่วงที่ความยาวคลื่นตั้งแต่ 320 - 400 นาโนเมตรผ่านได้เป็นจำนวนร้อยละเท่าใด

ผลการวิจัย กลุ่มตัวอย่างแว่นตากันแดดจำนวน 38 อัน สุ่มมาจากห้างสรรพสินค้า ร้านแว่นตาทั่วไป และแผงลอยข้างถนน โดยมีสีที่ใช้ในการกันแดดแตกต่างกันมีราคาตั้งแต่ 50 บาท ถึง 5,020 บาท (ค่ามัธยฐาน 1,250 บาท) ซึ่งพบว่าเลนส์แว่นตากันแดดที่มีราคามากกว่า 160 บาทขึ้นไป จะไม่ยอมให้แสงเหนือม่วงผ่านได้เลย ในขณะที่แว่นตากันแดดที่มีราคาตั้งแต่ 160 บาทลงมา มีความไม่แน่นอนของประสิทธิภาพในการกรองแสงเหนือม่วง และจากการหาค่าสถิติโดยใช้ Spearman's rhocorrelationระหว่างราคากับค่าเฉลี่ยร้อยละของการส่องผ่านแสงเหนือม่วงพบว่ามีความสัมพันธ์กันอย่างมีนัยสำคัญทางสถิติ (Spearrman's rho = -0.636, $p < 0.01$) โดยที่เมื่อราคายิ่งลดลง ประสิทธิภาพในการกรองแสงเหนือม่วงยิ่งลดลง

สรุป ถึงแม้ว่าปัจจัยด้านราคาของแว่นตากันแดดในกรุงเทพมหานครและปริมณฑลจะมีผลต่อประสิทธิภาพในการกรองแสงเหนือม่วง โดยที่แว่นตากันแดดราคาถูกจะมีประสิทธิภาพในการกรองแสงเหนือม่วงที่ลดลง จึงเป็นการสมควรที่จะให้หน่วยงานที่เกี่ยวข้องได้ตระหนักถึงอันตรายและความสำคัญของแสงเหนือม่วงที่จะมีผลกระทบต่อดวงตาได้และกำหนดมาตรฐานของแว่นตากันแดดเช่นเดียวกับในต่างประเทศเพื่อเป็นประโยชน์ต่อผู้บริโภคต่อไป **จักษุเวชสาร 2549 ; กรกฎาคม-ธันวาคม 20(2) : 133-139.**

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