Ultraviolet Radiation Absorption by Sunglasses
Available through Iranian Optician Trade Union and Miscellaneous Vendors

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Abstract

Purpose: To compare the protection of eyes against visible light (VL) and ultraviolet radiation (UVR) by sunglasses available through the Iranian optician trade union (IOTU) shops and those provided by miscellaneous vendors.

Methods: Totally, 353 pairs of sunglasses, including 188 pairs from IOTU shops and 165 pairs from miscellaneous vendors were selected based on systematic random sampling. The amount of UVA, UVB and VL transmission of the samples were examined by spectrophotometer. American national standard institute (ANSI) standards were the reference for measuring the UV transmission.

Results: All of the sunglasses from IOTU shops met ANSI standards in transmission of UVA, UVB, while these percentages in miscellaneous vendors were 92.1% for UVB and 95.8% for UVA transmission (P<0.05). Mean of UVB transmission was 0.78% in IOTU shops and 1.8% in miscellaneous vendors. These percentages for UVA transmission was 0.92% and 7.1% respectively (P≤0.001). All of the nonstandard sunglasses regarding UVA transmission had graduated tints. 8.7% of graduated tints and 1.45% of smoky tints regarding UVB transmission did not meet the ANSI standards.

Conclusion: Although a number of sunglasses presented by miscellaneous vendors were not standard, but in cases that it is not possible to buy expensive sunglasses, it is advisable to use inexpensive ones with non-graduated tints for eye protection against UVR for daily and non-industrial use.

Keywords: Sunglass, Ultraviolet Protection, UVA, UVB, Visible Light


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Introduction

Ultraviolet (UV) light is a non-ionizing radiation with a wavelength shorter than that of visible light, and because of different biological effects in different lightwaves, it is divided into three bands: UVA: 320-400 nm, UVB: 290-320 nm, and UVC: 100-290 nm.

Despite ocular defence mechanisms like antioxidants, biochemical effects caused by sunlight contact lead to acute and chronic eye damage such as sunburn, photokeratitis, cataract, retinal burn, pterygium, pinguecula, acute exposure and macular degeneration, skin cancer, age-related cataract and endothelial degeneration in chronic ones. Sunglasses reduce eye damage and delay onset of senile ocular disease and decrease its incidence. Suitable sunglasses should decrease visible light to a comfortable level while blocking the invisible and potentially harmful ultraviolet radiations (UVR).

Some characteristics of a suitable sunglass are:

1) Color
2) Protection against UVR
3) Darkness
4) Lens material
5) Optical quality
6) Frame

In 1991, a spectrophotometric study carried out on 40 children sunglasses by Werner and Veatemptor, showed some sunglasses provided complete protection against UVR, while others did not. They also found that some labels on sunglasses about "appropriate UVR protection" could be misleading for customers. Besides, another study by SGH Otman et al in 2005 on 37 sunglasses on patients under PUVA therapy showed that modern sunglasses with UV400 label is suitable for UVR protection. On the other hand, inexpensive sunglasses with mentioned label could also show acceptable quality. Three known basic factors of eye damage are oxygen, heat, and UVR, and among these mentioned factors, UVR adverse effects can be human interacted. In recent years, more attention had been paid to UVR protection, especially in sunny countries like Iran due to ozone layer destruction. Hence, there are color sunglasses found in the market that decrease visible light but do not protect against UVR. These sunglasses dilate pupils while UVR amount remains unchanged. As a result, they can cause severe eye damages. Therefore, protection against UVR in sunglasses should be set up in countries similar to Iran's climate. Our goal in this study was to compare the protection of eyes against visible light (VL) and ultraviolet radiation (UVR) by sunglasses available through IOTU shops and those provided by miscellaneous vendors.

Methods

This case control study was set up to compare the ability of UVA, UVB and visible light (VL) absorption in sunglasses available from the Iranian optician trade union (IOTU) shops and those presented by miscellaneous vendors in 2004. The factors considered were the ability of UVR absorption, color, VL transmission, price and purchasing place. Consequently, we compared two sunglasses for absorbing ratio UV, VL between them. Samples from IOTU shops (first group) where chosen by random sampling and in miscellaneous vendors (second group) by systemic random sampling. 353 pairs of sunglasses, including 188 pairs from IOTU shops and 165 pairs from vendors were gathered. The amount of UVA, UVB and VL transmission of the samples were examined by spectrophotometer (SPE × AN: model 360 & 380) in Farabi Eye Hospital, and then were compared with ANSI standards, that consider maximum 5% UVB and UVA≤VL transmission. In this regard were considered measuring the UV transmission. The gathered data were analyzed by SPSS (Ver. 13.0) and verify by scandals. Amount of standard sunglasses among IOTU shops and vendors were compared by Chi-square test. In addition, Univariate logistic regression analysis was used to determine the effective factors in UVR transmission.

Results

All sunglasses were above 10,000 tomans presented by IOTU shops (first group) and those presented by vendors (second group) were below 10,000 tomans. The mean price of first group was significantly higher than...
second group (89642 tomans vs. 3198 tomans, P<0.001). 100% sunglasses in the first group met ANSI standards in transmission of UVA and UVB, while those in the second group just reached up to 92.1% for UVB and 95.8% for UVA transmission (P<0.05). In the other hand, we found a significant difference regarding UVB transmission (7.9%) and also for UVA (4.2%). (P<0.05) Moreover, 22.9% in first group and 16.4% in second group met standards considering VL transmission, and no significant difference were found between two groups. Mean UVB transmission was markedly less (0.78%) in IOTU shops comparing to of vendors (1.8%). (P<0.0001) UVA transmission rate was 0.92% in first group and 7.1% in second group (P<0.001). All nonstandard sunglasses, which had insufficient UVA transmission (n=7, 5.6%) had graduated tints. 8.7% of graduated tints (n=11) and 1.4 % (n=2) of smoky tints with impaired UVB transmission did not meet the ANSI standards, while 100% of green tints and brown tints did. According to the regression model, graduated tints, green tints and availability in IOTU shops were the determiners of price (P<0.0001). However, the amount of UVA, UVB and VL transmission were not known as predictive factors. UVB and VL transmission and tints were the determiners of price, while UVA transmission had no effect on it. In different tints, mean transmission of UVB, regardless to their purchasing places were 0.68% for smoky ones (n=146), 0.61% in brown (n=45), 1% in green ones (n=13), 2.25% in graduated tinted glasses (n=126) and 0.93% in other tints (n=23). The mean transmission of UVA was 1.26% in the total number of sunglasses (n=353). Consecutively, we detected that the mean UVA transmission rate, regardless to their buying location, followed as 1.67% in smoky, 0.81% in brown, 1% for green, 8.8% in graduated and 1.8% for others. The mean range of UVA transmission was 3.83% in all sunglasses. Table 1 reflects our results extracted from our data.

<table>
<thead>
<tr>
<th>Sunglasses from</th>
<th>Smoky</th>
<th>Brown</th>
<th>Green</th>
<th>Graduated</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>IOTU shops</td>
<td>n=86</td>
<td>n=34</td>
<td>n=13</td>
<td>n=43</td>
<td>n=12</td>
<td>n=188</td>
</tr>
<tr>
<td></td>
<td>45.7%</td>
<td>18.1%</td>
<td>6.9%</td>
<td>22.9%</td>
<td>6.4%</td>
<td>100%</td>
</tr>
<tr>
<td>Vendors</td>
<td>n=60</td>
<td>n=11</td>
<td></td>
<td>n=83</td>
<td>n=11</td>
<td>n=165</td>
</tr>
<tr>
<td></td>
<td>36.4%</td>
<td>6.7%</td>
<td></td>
<td>50.3%</td>
<td>6.7%</td>
<td>100%</td>
</tr>
<tr>
<td>Total</td>
<td>n=146</td>
<td>n=45</td>
<td>n=13</td>
<td>n=126</td>
<td>n=23</td>
<td>n=353</td>
</tr>
<tr>
<td></td>
<td>41.4%</td>
<td>12.7%</td>
<td>3.7%</td>
<td>35.7%</td>
<td>6.5%</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Table 1.** Comparison between the sunglasses offered by domestic vendors and those presented by IOTU shops (P= 0.001)

**Discussion**

Protection of eyes against sunlight and solar radiation, particularly the UVR is considered as an essential issue. Therefore, choosing sunglasses that provide appropriate UV protection could be effective in protecting eyes from ocular damage such as cataract. The color, UV protection, darkness, lens material, optic quality and frame shape are important points to look for when purchasing sunglasses are detailed below. Our study showed that all sunglasses from IOTU shops met ANSI standards in transmission of UVA, UVB, while in sunglasses obtained from different vendors were 92.1% for UVB and 95.8% for UVA transmission. A study by Moseley et al in 1987 revealed that, from 58 sunglasses, 66% met standard and in another survey by Yung Leow, this rate was 61.8% in 34 pairs of sunglasses. All of sunglasses from IOTU shops in all colors met ANSI standards in
transmission of UVA, UVB, at the same time as in miscellaneous vendors 100% of sunglasses that did not provide standard in transmission of UVA, were graduated, while the others were about standard. In this group 100% of brown and green for UVB transmission were standard although 8.7% graduated and 1.4% smoky were substandard.

Moseley et al in 1987, demonstrated similar results in 58 pairs of sunglasses. According to his study, all twenty pairs of sunglasses had non-depolarizing filter and all four kinds of graduated tints were in this group. Our study proved that, there are not relation between UVA, UVB and VL transmission and sunglass price. Therefore, color and availability in IOTU shops were the determiners of price. However, in IOTU shops, as UVB protection rises, there will be a notable increase in price. In addition, increasing of VL transmission leads to price decrease. Considering the great number of non-standards sunglasses in the market, and low public awareness about the results caused by using them, we suggest the important points to look for when purchasing sunglasses:

1. Sunglasses provided by IOTU shops are in priority if the customer affords enough to buy a standard one. In such case, there is no difference between different colors considering UV protection.

2. Regarding the fact that about half of the sunglasses presented by vendors are graduated tints, (50.3%) it is advisable that not to choose them. Furthermore, due to the presence of some degree of optic diopter in such sunglasses, they should firstly be tested and be evaluated.

**Conclusion**

Although we found significant difference between two groups regarding the acceptable standards, the calculated difference was due to a low number of sunglasses, and mostly with graduated tints. Considering the fact that there is no relation between UVR transmission and price, in cases that it is not possible to buy expensive sunglasses, it is worthwhile to use inexpensive ones with non-graduated tints for eye protection against UVR for daily and non-industrial use.

**References**