

Protective properties of spectacle lenses used as ultraviolet blockers

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Abstract

In this study, we evaluated the UV transmittance of spectacle lenses in the Turkish market, which are reported to have UV blocking properties, and tested their suitability. Samples were obtained from patients who were admitted to the ophthalmology outpatient clinic of our hospital for refractive error and who wore glasses as UV block. No limitation was made regarding the spectacle size and duration of spectacle wear. Measurements were tested by the principal investigator using an ultraviolet detector. The right and left lens were measured separately. All measurements were performed at room temperature (22-25°C) in a humidity regulated (20-40%) room without direct light. UV protection level was measured for 120 spectacles used for refractive errors. Only 28 (23.3%) of 120 glasses had protection level up to 400 nm UV. Twenty-four (20%) of the glasses had a protection level of 0 even though they were labeled as having UV blocking properties. It is clear that strict regulations need to be implemented to improve the protection levels of glasses.

Keywords: Ultraviolet radiation, spectacle lenses, cataract, eyeglasses, UV blocking

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Introduction

The sun's rays have waves of ultraviolet radiation (UVR) ranging from 200-400 nm. The ozone layer can completely absorb the deleterious ultraviolet C (UVC) range and partially absorb ultraviolet B (UVB) waves. However, ultraviolet A (UVA) in the 315-400 nm range reaches the earth's surface in large amounts [1]. Long-term exposure to both UVB and UVA radiation has been reported to cause serious ocular problems such as cataracts, corneal degenerations, conjunctival degenerations and retinal degenerations [2,3]. Wide-brimmed hats and appropriately manufactured sunglasses are used for protection against ocular UVR [1,4]. In recent years, sunglasses and eyeglasses that provide protection against UV radiation are especially preferred due to the increased awareness of the harmful effects of UV radiation on the eyes [5]. However, it is not easy to find sunglasses and eyeglasses with appropriate and effective protection. One of the reasons for this is that spectacle lenses produced by different brands do not guarantee that they provide adequate protection [6]. Even in developed countries, the public is not aware of the protective properties of sunglasses against UV radiation [3]. As a result, it is often the last resort for most consumers to rely on retailers to get a good pair of UV-blocking glasses [3,7]. There are no standards for sunglass filtering properties in most countries, and there are studies in different countries on the UV transmittance of marketed sunglasses [1,3,8]. However, there is no study evaluating the protection of spectacle lenses. In this study, we evaluated the UV transmittance of spectacle lenses in the Turkish market, which are reported to have UV blocking properties, and tested their suitability.

Materials and Methods

This study was approved by Niğde Ömer Halisdemir University Ethics Committee (2023/55) and verbal and written informed consent was obtained from each patient before the study. The study was carried out according to the principles of the Declaration of Helsinki.

Procedure

Samples were obtained from patients who were admitted to the ophthalmology outpatient clinic of our hospital for refractive error and who wore glasses as UV block. Patients were asked to come to us for control within one week after the prescription of glasses. No limitation was made regarding the spectacle size and duration of spectacle wear. Measurements were tested by the principal investigator using an ultraviolet detector (anti-radiation UV sun detector, China). The right and left lens were measured separately. All measurements were performed at room temperature (22-25°C) in a humidity regulated (20-40%) room without direct light.

After cleaning the lens surface, the front surface center of the glasses was placed towards the ultraviolet radiation source. For consistency, all measurements were taken by a single investigator and recorded by averaging three readings. Glasses blocking wavelengths up to 400 nm were considered to be safe and in compliance with standards.

Statistical Analysis

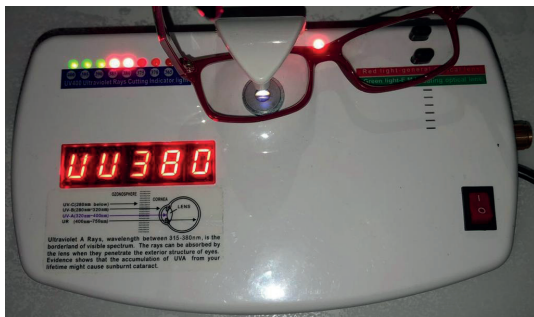
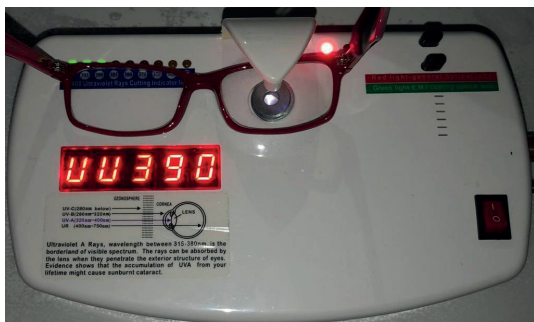
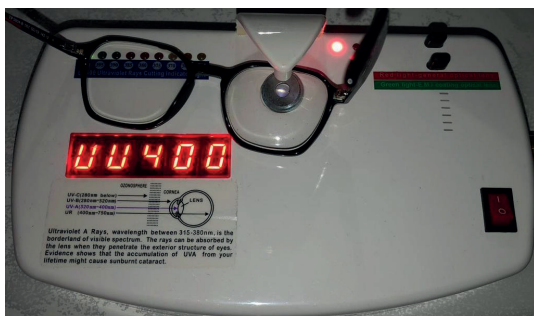
Statistical analysis was done using the Statistical Package for Social Science (SPSS) by IBM, version 25. Descriptive data were analyzed using mean and frequency (percentage, %) as appropriate.

Results

UV protection level was measured for 240 lenses of a total of 120 spectacles used for refractive errors. The protection levels of all glasses were symmetrical (right and left). Of the 120 patients, 66 were female (55%) and 54 were male (45%). The mean age of the patients was 34.3 ± 16 years. Only 28 (23.3%) of 120 glasses had protection level up to 400 nm UV. Twenty-four (20%) of the glasses had a protection level of 0 even though they were labeled as having UV blocking properties. Figures showing the measurements of some lenses are shown below. (Figure 1-3). 4 lenses provided protection up to 390 nm, 4 lenses provided protection up to 380 nm and 6 glasses provided protection up to 375 nm. The other glasses had variable protection levels between 360-370 nm (Table 1). 65% of lenses provided protection below 375nm.

Table 1. UV blocking thresholds of spectacle lenses.

	Number (%)
400 nm	28 (23.3%)
390 nm	4 (3.3%)
380 nm	4 (3.3%)
375 nm	6 (5%)
370 nm	22 (18.3%)
365 nm	4 (3.3%)
360 nm	28 (23.3%)
0 nm	24 (20 %)

**Figure 1:** Measurement of a 380 nm UV blocking lens.**Figure 2:** Measurement of a 390 nm UV blocking lens.**Figure 3:** Measurement of a 400 nm UV blocking lens.

Discussion

Sunlight is the primary source of UV radiation. UV radiation is not included in the visible light spectrum and therefore cannot be detected. Since it cannot be perceived by the visual system, its harmful effects cannot be felt until ocular damage develops [9]. The harmful effect of UV on human health increases with cumulative exposure [10]. There are various ways to protect the eye to prevent ocular damage. Wearing a hat or umbrella, UVR-blocking glasses, sunglasses or contact lenses are the most commonly used methods [11]. The most common method is eyewear with a UV protection filter that filters out 100% of UV radiation [12]. Maximum UVR protection with sunglasses is considered mandatory, especially in the equatorial region where UVR exposure is high [1].

The reference point supported by international standards is 400 nm UVR protection level [13]. While there are many studies in the literature investigating the adequacy of the protection level of sunglasses sold in various countries, studies investigating the protection level of eyeglasses are limited. In our study, the protection levels of prescription UV blocking eyeglasses used for refractive reasons were evaluated. It was found that only 23% of the eyeglasses had 400nm protection and 20% of the eyeglasses had no protection even though they were reported to have UV blocking properties.

Although there are not many studies in the literature examining the UV protection levels of eyeglasses, there are a wide variety of examples evaluating sunglasses. In a study conducted in Ethiopia, only 73.0% of non-prescription sunglasses complied with the standards and were protective against 400nm ultraviolet radiation [1].

In the study by Bazzani et al., this rate was found to be 92.6% [14]. In addition, Adul-Kabir et al. reported that all over-the-counter sunglasses purchased from optical stores provided appropriate protection, while 53.0% of sunglasses purchased from roadside vendors did not meet the standard [15]. In a study conducted in Canada, reported that almost 100% of sunglasses whose UV levels were evaluated

complied with Canadian standards [16]. Abdulrahim et al reported that sunglasses do not provide full protection against UV radiation and that sunglasses may pose a danger to eye health [17]. When the literature studies are compared, it is seen that there are variable results depending on the development levels, socioeconomic status and living conditions of the countries.

The fact that it is one of the rare studies evaluating the degree of UV block of spectacles in the literature makes our study powerful, but there are some limitations. The glasses evaluated in our study were purchased within 1 week after prescription. However, we do not have data on how long after the lens is manufactured, it is mounted on the spectacle frame. In addition, the evaluation of UVR protection by an anti-radiation UV sun detector may not be as accurate as a spectrophotometer.

Conclusion

In conclusion, since glasses sold as UV blocking should be reassuring against UVR before they are distributed to users, information about the level of protection should be provided and the level of UV blocking should be indicated on the user card. It is clear that strict regulations need to be implemented to improve the protection levels of glasses.

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Conflict of interest

There are no conflicts of interest.

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