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Research Article

Effect of Blue Blocking Lenses on Visual Performance

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Abstract

Aim: The purpose of this study is to understand the effect of blue-blocking lenses on visual performance.

Objectives: Comparison of visual performance with and without blue-blocking lenses (low block, high block) and assess the following parameters based on groups of refractive errors (myopia, hyperopia and emmetropia).

1. Visual Acuity. 2. Color vision. 3. Contrast sensitivity. 4. Stereopsis.

Methods: This Prospective observational study included 45 subjects aged between 18 to 35 years of Vittala International Institute of Ophthalmology. Complete routine eye examination was done, after that subjects were divided into three groups (i.e., emmetropes, myopes and hyperopes) and then visual performances like VA, contrast sensitivity, color vision, stereopsis was assessed with no blue blocking lenses and adaptation time of 15mins was given for low blue blocking lens (3x) on day 1 and high blue blocking lens (5X) on day 2. Visual performance was assessed, post adaptation to each of the blue blocking lenses.

Results: A total of 45 participants were enrolled in the study out of which 16 were males and 29 were females. Mean age was 25.4+_3.5 years. Among the participants, there were 15 emmetropes, 15 myopes and 15 hyperopes. The various parameters in three different conditions in the three refractive group including without blue block lens, with low blue block lens and high blue block lens was assessed. Repeated measures Analysis of Variance (ANOVA) was used to compare between the three conditions for various parameters. Significant differences were found in contrast sensitivity and stereoacuity between no BBLs, with low BBLs and with high BBLs but no significant difference was observed in near vision and color vision. The comparison between the low and high blue block conditions in the three refractive group respectively using a Paired T-test. Statistically significant difference were found in some parameters.

Conclusion: This study tried to analyse the role of BBLs on visual parameters and refractive error. The visual performances on parameters like VA, CS, CV and stereopsis. The result of this study shows that in emmetropes, myopes and hyperopes there is a significant difference in CS and Stereopsis when compared between without BBLs and with BBLs, but when comparing between low BBLs and high BBLs the parameters shows the significant difference in only emmetropes and myopes where there is no significant difference in hyperopes. There was no significant difference was observed in near vision and color vision.

This gives a idea about which of the BBLs dispensing will be better for the best ocular parameters like VA, CS, CV and Stereopsis which are important in clinical routine examination of eye for optometrists and also impact of the BBLs in ocular health.

Keywords: Visual Acuity; Stereopsis; Colorvision; Contrast Sensitivity; Blue-Blocking Lenses; Refractive Errors; Visual Performance

Abbreviations

BBLs: Blue-Blocking Lenses; VA: Visual Acuity; CS: Contrast Sensitivity; CV: Color Vision; NPA: Near Point of Accommodation; NPC: Near Point of Convergence; AA: Amplitude of Accommodation; AF: Accommodative Facility; VF: Vergence Facility; OD: Oculus Dexter; OS: Oculus Sinister; OU: Oculus Uterque

Introduction

Blue-blocking lenses

Blue blocking lenses (BBLs) selectively reflect or absorb blue light (440–500 nm) by 6–43% [1], with newer generation BBLs attenuating light within this range to preserve some of the benefits of blue light, particularly to the circadian rhythm and blue light perception. BBLs are sold commercially with claims to protect the eyes from the harmful effects of blue light, such as improve sleep at night [2] and protect the retina against Age-Related Macular Degeneration [3]. BBLs have different spectral transmittance characteristics depending on the brand [1], which allows them to selectively attenuate light at different intensities, particularly at shorter wavelengths. However, selectively filtering blue light may lead to unintended consequences such as alterations to normal visual functions, as has been reported by a number of previous studies [4-7]. Yet, BBLs are produced and sold commercially without the manufacturers or consumers being aware of its effects on visual function [8].

As BBLs selectively reduce the amount of blue light reaching the eyes, it is expected that there will be an overall reduction in image contrast, particularly if the reflectance/light-emitting properties of the object comprise predominantly short wavelengths [6,7], whilst leaving other wavelengths unaffected. Theoretically, the properties of BBLs may decrease contrast perception due to the attenuated amount of blue light reaching the S-cones, as complete activation of S-cones influences luminance contrast [9]. Therefore, blue light-filtering intraocular lenses (IOLs) reduce contrast detection, and it is possible that BBLs may also cause a similar effect. One of the study demonstrated that 7 commercially available BBLs reduced the detection of blue colours by 5–36% [1], suggesting that they potentially would affect the luminance contrast perception of objects.

Crizal sapphire 20% (no self interest in the trade mark) blue light filter and Crizal Prevencia (Essilor) (no self interest in the trade mark) 30% blue light filter. The spectral transmittance characteristics of these lenses have been previously reported and are different in regard to the extent of light filtration for all wavelengths of light. Crizal sapphire (no self interest in the trade mark) were previously revealed to transmit the least blue light, whereas Crizal Prevencia (no self interest in the trade mark) possessed more than that blue light transmittance profiles [1].

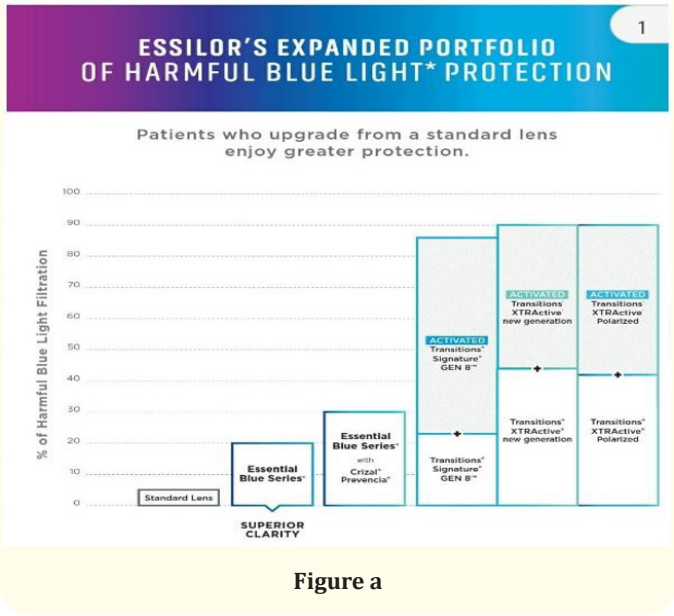

Figure a

This above mentioned graphs how the percentage of Blue light filtration by the types of lenses which has been used in our study.

Essential blue series-crizal sapphire (no self interest in the trade mark) and crizal preventia (no self interest in the trade mark), reduces the quantity of harmful blue light from reaching our eye (415-455nm), and does filtration of harmful blue light up to 20% and 30% respectively.

Distance visual acuity

Visual acuity (VA)is a measure of spatial resolution of the visual processing system. The minimal angle of resolution (MAR), that allows a human optical system to identify two points as different stimuli, is defined as the threshold of resolution. The MAR lies between 30 seconds and 1min of arc. Visual acuity is reciprocal of the threshold of resolution [10].

The logMar chart is designed to enable more accurate estimates of acuity as compared to other acuity charts. Each line of logMar

chart comprises the same number of test letters (effectively standardizing the test across letter size). The sloan font is used (Sloan letters area approximately equally legible one from another); letter size from line to line varies logarithmically, as does the spacing between lines (making the chart easy to use at nonstandard viewing distances) [10].

Near visual acuity

The near visual acuity is usually tested with the help of Jaeger test-types or Roman test-types. The Snellen's notation maintaining the same visual angle may also serve the purpose. In Jaeger test types, a series of different sizes of print types are arranged in increasing order and arbitrarily marked 1, 2, 3, 4, 5, 6 and 7. It is usually tested in good illumination preferably in day light. Patients with high hyperopia, presbyopia or anomalies of accommodation have defective near vision [10].

Contrast sensitivity

Contrast sensitivity is the ability of the eye to detect small changes in illumination at targets that do not have clearly defined limits. Standard visual acuity measurement is done with high contrast conditions. This does not provide any information about visual performance in many of the various activities we perform in our daily lives, such as driving at night or reading in low light, and a patient's vision cannot be fully assessed by evaluating visual acuity alone.

Contrast sensitivity is one of the main requisites for good vision and, unlike visual acuity, can be affected by many factors. It is revealed that impaired contrast sensitivity maybe present in cases of normal visual acuity. Contrast sensitivity can be measured by using different charts available like Pelli-Robson contrast sensitivity chart, Cambridge low-contrast gratings, Arden gratings, etc. [11].

Color vision

Color is a sensation and not a physical attribute of an object. Color is what we see and is result of stimulation of retina by radiant energy in a small band of wavelengths of the electromagnetic spectrum usually considered to span about one octave, from 380nm to 760nm. There are three main characteristics of color namely hue, saturation and brightness. Hue is a function of wavelength. It depends on what the eye and brain perceive to be the predominant wavelength of the incoming light. An object's "hue" is its "color". Saturation refers to the richness of a hue as compared to a gray of the same brightness. Saturation is also known as "chroma". Brightness is characterized by an object's being dim or bright, dark or light.

The spectral wavelengths of different colors are as follows: Violet 430nm, blue 460nm, green 520nm, yellow 575nm, orange 600nm and red 650nm. The concept of white light is vague, most agreeable definition is, white surface is one which has spectral reflection factors independent of wavelength (in the visible spectrum) and greater than 70 percent [12].

Stereopsis

Implies the ability to obtain an impression of depth by super imposition of the two picture of the same object which have been taken from different angle.

Depth perception means the perception of distance of objects from each other it is a visual appreciation of three dimensions during binocular vision. Depth may be perceived in two forms: Binocular Disparity (stereopsis) and Monocular Depth Clues.

Stereopsis is the perception of the relative depth of objects on the basis of binocular disparity which reflects the sight difference in the image presented to each eye.

Stereoacuity is the angular measurement of the minimal resolvable binocularity which is necessary for the appreciation of stereopsis. The ability to demonstrate stereops is indicates the presence of retinal correspondence. The normal level of stereopsis being 40 secs of arc [13].

Review of Literature

As part of our study we have conducted a lot of research regarding our topic and from the information, we came to know that no studies have been conducted on this four parameters like VA, CS, CV and stereopsis. So, we decided to study the status of effects of blue blocking lenses on visual performances.

Hind Saeed Alzahran, Maitreyee Roy, Vanessa Honson and Sieu K Khuu conducted a study on Effects of blue blocking lenses on color contrast sensitivity in the year 2020 on 5 subjects (one man and 4 women), aged between 23-39 years. Crizal Prevencia (Essi-

lor), Blue Guardian (Opticare), and Blu-OLP (GenOp) lenses were examined in this study in comparison to a control lens (clear lens without blue- filtering coating). In Experiment 1, colour contrast thresholds were measured using a visual search colour detection task in which the colour (CIE Lu'v' red, green, blue and yellow) of the target circle stimulus (randomly located in an annulus of achromatic circles) was systematically reduced using a staircase procedure. As blue-blocking lenses selectively block blue light, in Experiment 2, colour contrast thresholds were specifically quantified for a range of short wavelengths near the attenuation transmittance range of the blue-blocking lenses tested. They concluded that while reducing blue light potentially minimises the harmful effect of blue hazard light, blue-blocking lenses can unintentionally reduce colour contrast sensitivity, particularly at low light levels.

John G Lawrenson, Christophere, Laura E Downie conducted a study on the effect of blue-light blocking spectacle lenses on visual performance, macular health and the sleep-wake cycle: a systematic review of the literature in the year 2017 on 136 subjects. They included randomized controlled trials (RCTs), recruiting adults from the general population, which investigated the effect of BB spectacle lenses on visual performance, symptoms of eyestrain or eye fatigue, changes to macular integrity and subjective sleep quality. They concluded that Three studies (with 136 participants) these had limitations in study design and/or implementation. One study compared the effect of BBl enses with clear lenses on contrast sensitivity (CS) and color vision (CV) using a pseudo -RCT crossover design; there was no observed difference between lens types.

Jonathan B. Lin, Blair W. Gerratt, Carl J. Bassi, and Rajendra S. Apte conducted a study on Short- Wavelength Light-Blocking Eyeglasses Attenuate Symptoms of Eye Fatigue in the year 2016 on 36 subjects a total of 36 healthy subjects (20 male; 16 female) was randomized to wearing no block, low block, or high blocking eye glasses while performing a 2 hrs computer task. Asked questions of eye fatigue and evaluated symptoms of eye strain. They concluded the changes after computer task was significantly more positive (i.e., less eye fatigue)in high-block versus no-block and low-block groups. Subjects wearing high-blocking eye glasses reported significantly less feeling pain around/inside the eye when compared to subjects not wearing high-blocking lenses.

Need of the study

As no studies is conducted on these four parameters, so we decided to study on effects of blue blocking lenses on visual performance.

Aim

The purpose of this study is to understand the effect of blue-blocking lenses on visual performance.

Objectives

Comparison of visual performance with and without blue-blocking lenses (low block, high block) and assess the following parameters based on groups of refractive errors (myopia, hyperopia and emmetropia).

- Visual Acuity.
- Color vision.
- Contrast sensitivity.
- Stereopsis.

Materials and Methodology

Methods

- Source of data- The study was conducted on staffs and students of Vittala International Institute of Ophthalmology, Bangalore.
- Study design- Prospective observational study.
- Study method- Convenient sample.
- Sample size- 45subjects.
- Sample age- age group of 18 to 35yearssubjects.
- Study duration- March 2023 to December2023.
- Study area- This study was undertaken at Vittala International Institute of Ophthalmology.
- Data collection technique- Based on inclusion and exclusion criteria.

Inclusion criteria

- Age group of 18 to 35 years.
- Emmetropes and ametropes.
- Astigmatism refractive upto-1.00D.
- Best corrected visual acuity (0.0logMar,N6).
- Stereopsis ≥ 40 secs of arc.
- Contrast sensitivity ≥0.15 LogCS.
- Normal color vision without any color defects and colorblindness.

Exclusion criteria

- Amblyopia and Anisometropia.
- Dry eyes.
- Binocular vision anomalies.
- Ocular pathologies (Cataract, Pterygium, Keratitis).
- Systemic pathologies (Diabetes, Hypertension, Thyroid).

- Any current medications (Retinoids, Tamoxifen, Deferoxamine, Sildenafil, etc..)
- Previously blue-blocking lens wearers.

Materials used

- Visual acuity chart for distance (LogMar).
- Visual acuity chart for near (Reduced Snellen's chart).
- Trial set and trial frame.
- Retinoscope.
- Slit lamp (Haagstreit Biomicroscope).
- Direct ophthalmoscope.
- RAF ruler.
- Pelli-Robson Chart.
- Butterfly stereoacuity test with LEA symbols.
- Polarized glasses.
- Frans worth D-15 Color Vision test.
- Schirmers trips.
- Blue–blocking lenses (low BBLs–Crizal sapphire, high BBLs–Crizal prevencia).
- Accommodative flipper (+/-2.00D).
- Vergence flipper (12 prism BO, 3 prism BI)
- Accommodative and vergence target.
- Rock card (N8 target).
- Pentorch.
- Maddox rod.
- Modified Thorington card.

Statistical analysis

The analysis was done using SPSS (Statistical Package for Social Sciences) version 26.0. $P < 0.05$ is considered as statistically significant. VA, CS, CV and Stereopsis were compared. Repeated measures one- way Analysis of variance (ANOVA) was used in evaluating the effect of BBLs.

Paired t-test was used to compare low BBLs and high BBLs on visual performances.

Results

A total of 45 participants were included out of which 29 were female and 16 were male. Mean age was 25.4 ± 3.5 years. Among the 45 participants, there were 15 emmetropes, 15 myopes and 15 hyperopes.

Gender distribution

Gender	No.
Male	16
Female	29
Total	45

Table 1

Table 1 shows the total no. of gender distribution

Figure 1 shows the total no. of gender distribution in percentage.

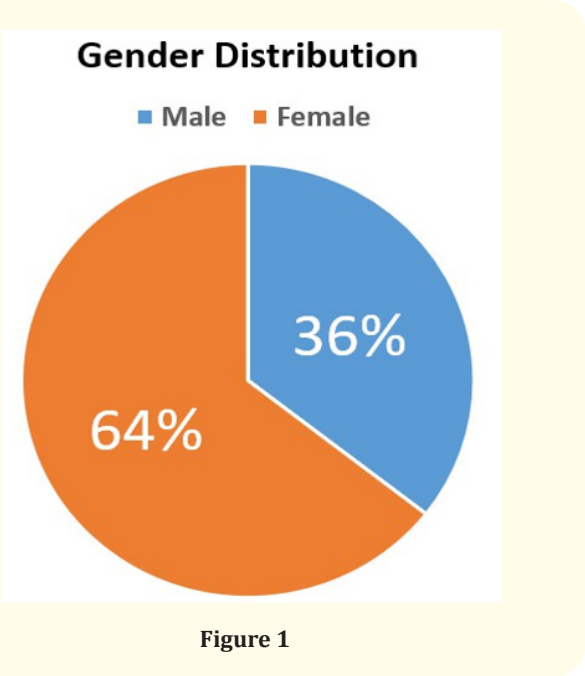

Figure 1

Comparison in emmetropes between without BBLS and with BBLs

Various parameters on different conditions in three refractive errors, Emmetropes were found significant difference in CS and stereopsis its p value is (<0.001) when compared between No BBLs, Low BBLs and High BBLs.

Table 2 shows the comparison in emmetropes between no BBLs, low BBLs and high BBLs in VA, CS and stereopsis.

Emmetropes	Eye	No blue block lens		With low blue block lens		With high blue block lens		P value
		Average	SD	Average	SD	Average	SD	
Visual Acuity	OD	0.000	0.000	-0.008	0.028	-0.014	0.029	0.14
	OS	0.000	0.000	-0.008	0.028	-0.014	0.029	0.14
Contrast Sensitivity	OD	1.708	0.130	1.823	0.083	1.869	0.099	<0.001
	OS	1.708	0.130	1.823	0.083	1.869	0.099	<0.001
	OU	1.846	0.128	1.927	0.083	1.973	0.083	<0.001
Stereoacuity	OU	23.615	3.525	20.385	1.387	20.000	0.000	<0.001

Table 2

Comparison in myopes between without BBLs and with BBLs

Various parameters on different conditions in three refractive errors, Myopes were found significant difference in CS and Stereopsis its p value is (<0.001)when compared between No BBLs, Low BBLs and High BBLs.

Table 3 shows the comparison in myopes between no BBLs, low BBLs and high BBLs in VA,CS and stereopsis.

Comparison in hyperopes between without BBLs and with BBLs

Various parameters on different conditions in three refractive errors, Hyperopes were found significant difference in CS in OD, OS its p value is (<0.001) and OU P value is (0.001), stereopsis p value is (0.001) when compared between without BBLs and with BBLs.

Table 4 shows the comparison in myopes between no BBLs, low BBLs and high BBLs in VA, CS and stereopsis.

Myopes	Eye	No blue block lens		With low blue block lens		With high blue block lens		P value
		Average	SD	Average	SD	Average	SD	
Visual Acuity	OD	0.000	0.000	-0.002	0.010	-0.006	0.021	0.42
	OS	0.000	0.000	-0.002	0.010	-0.007	0.022	0.42
Contrast Sensitivity	OD	1.756	0.127	1.879	0.094	1.906	0.127	<0.001
	OS	1.765	0.125	1.879	0.094	1.906	0.127	<0.001
	OU	1.871	0.094	1.959	0.064	2.003	0.091	<0.001
Stereoacuity	OU	26.471	4.017	21.176	2.186	20.000	0.000	<0.001

Table 3

Comparison in emmetropes between low BBLs and high BBLs

Comparison between low BBL and high BBL conditions in three refractive groups respectively. CS shows significant difference its p value is (<0.05) between high BBLs and low BBLs in emmetropes.

Table 5 shows the comparison in emmetropes between low BBLs and high BBLs in VA, CS and stereopsis.

Hyperopes	Eye	No blue block lens		With low blue block lens		With high blue block lens		P value
		Average	SD	Average	SD	Average	SD	
Visual Acuity	OD	0.00	0.00	-0.01	0.03	-0.02	0.03	0.06
	OS	0.00	0.00	-0.01	0.03	-0.02	0.03	0.06
Contrast Sensitivity	OD	1.83	0.12	1.92	0.08	1.93	0.08	<0.001
	OS	1.83	0.12	1.92	0.08	1.95	0.08	<0.001
	OU	1.90	0.09	1.97	0.05	1.99	0.07	0.001
Stereoacuity	OU	23.27	4.25	20.00	0.00	20.00	0.00	0.001

Table 4

Emmetropes	Eye	Mean difference (Low–High blue block condition)		P value
		Average	SD	
Visual Acuity	OD	-0.006	0.013	0.10
	OS	0.046	0.072	0.10
Contrast Sensitivity	OD	0.046	0.072	0.04
	OS	0.046	0.072	0.04
	OU	-0.385	1.387	0.04
Stereoacuity	OU	-0.006	0.013	0.34

Table 5

Visual acuity in emmetropes

Comparing VA in emmetropes without BBLs, with low BBLs and high BBLs. The mean value of VA without BBLs in both OD and OS shows (0.000 LogMAR), with low BBLs in both OD and OS shows (-0.008 LogMAR) and with high BBLs in both OD and OS shows (-0.014 LogMAR) respective with significant p value 0.14 respectively.

Figure 2 shows the mean difference of visual acuity in emmetropes.

CONTRAST SENSITIVITY IN EMMETROPES

Comparing CS in emmetropes without BBLs, with low BBL sand high BBLs. The mean value of VA without BBLs in both OD and OS shows (1.708 Log CS) OU shows (1.846 Log CS), with low BBLs in both OD and OS shows (1.823 LogCS) OU shows (1.927 LogCS) and with high BBLs in both OD and OS shows (1.869 Log CS) OU shows (1.973 Log CS) respective with significant p value (< 0.001) respectively.

Figure 3 shows the mean difference of contrast sensitivity in emmetropes.

Stereo acuity in emmetropes

Comparing stereopsis in emmetropes without BBLs, with low BBLs and high BBLs. The mean value of Stereopsis without BBLs shows (23.615 sec so far c), with low BBLs shows (20.385 sec so far c) and high BBLs shows (20.000 secs of arc) respective with significant p value (< 0.001) respectively.

Figure 4 shows the mean difference of stereops is in emmetropes.

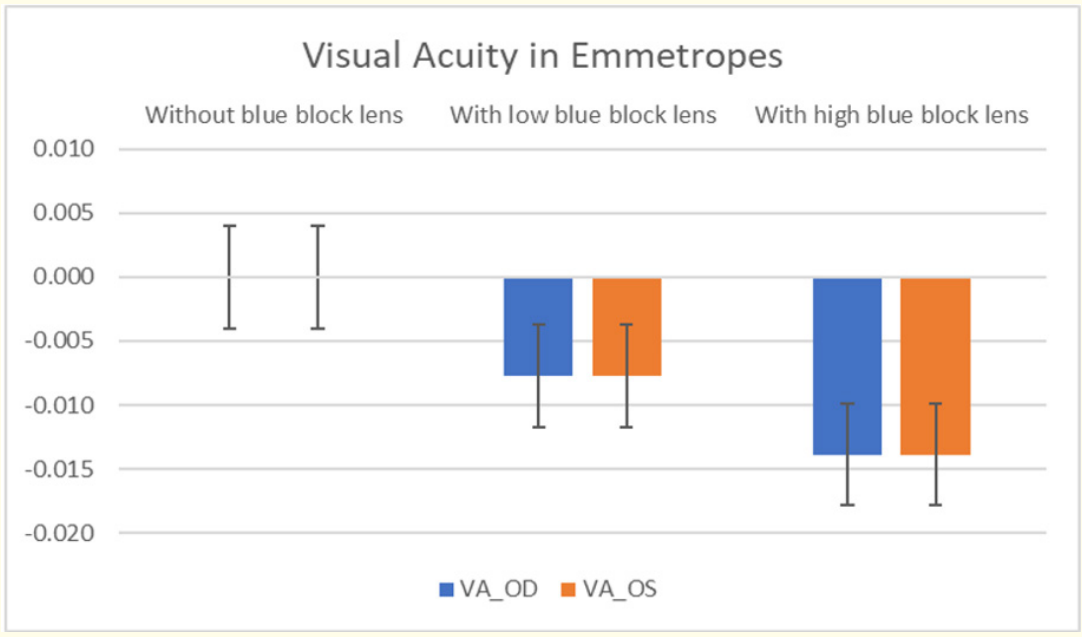

Figure 2

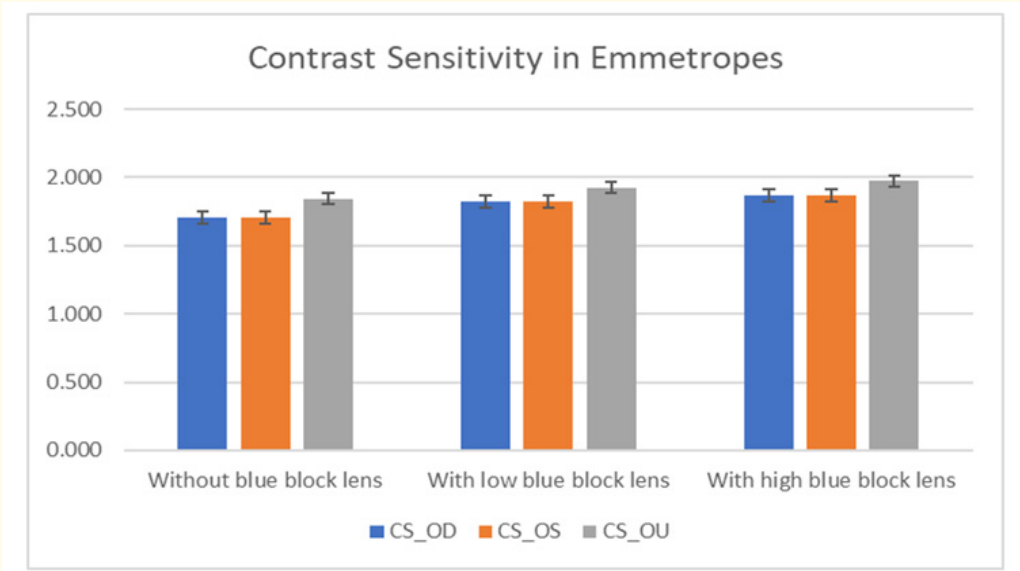

Figure 3

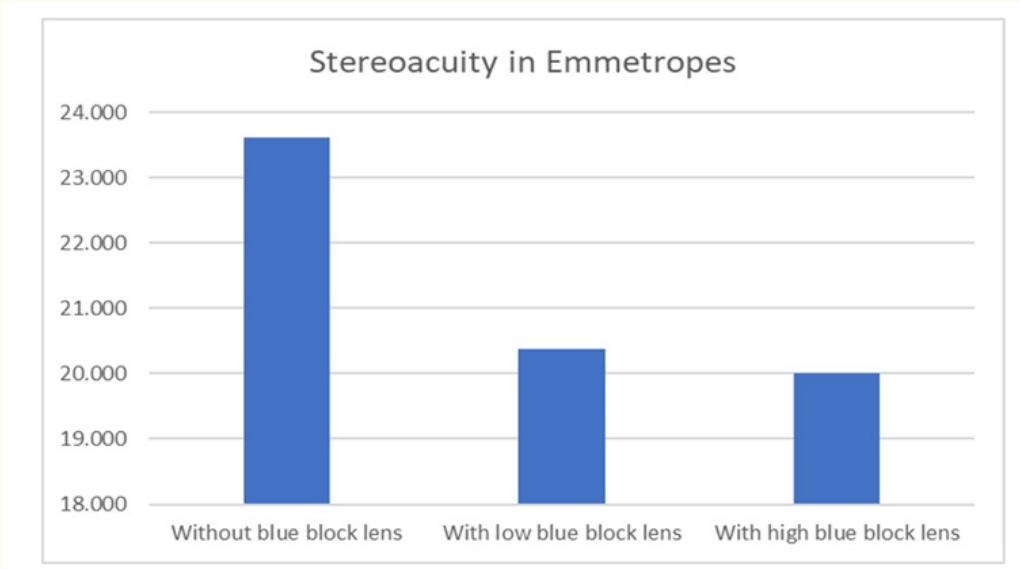

Figure 4

Comparison in myopes between low BBLs and high BBLs

Comparison between low BBL and high BBL conditions in three refractive groups respectively. CS in OU and stereopsi show significant difference (p value <0.05) between high BBLs and low BBLs in myopes.

Table 6 shows the comparison in myopes between low BBLs and high BBLs in VA, CS and stereopsis.

Visual acuity in myopes

Comparing VA in myopes without BBLs, with low BBLs and high BBLs. The mean value of VA without BBLs in both OD and OS shows

Myopes	Eye	Mean difference (Low and High blue block condition)		P value
		Average	SD	
Visual Acuity	OD	-0.005	0.023	0.51
	OS	0.027	0.059	0.41
Contrast Sensitivity	OD	0.027	0.059	0.08
	OS	0.044	0.070	0.08
	OU	-1.177	2.186	0.02
Stereoacuity	OU	-0.005	0.023	0.04

Table 6

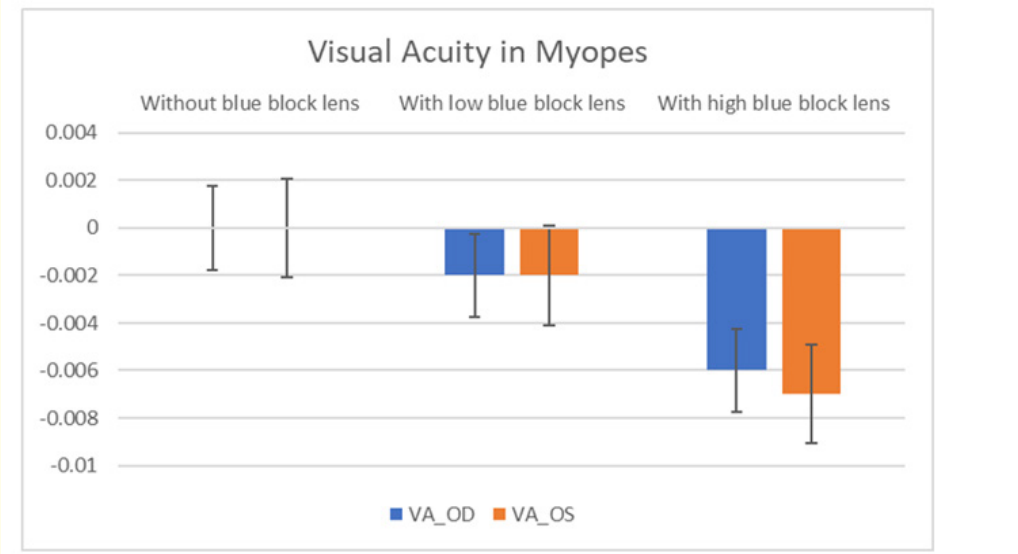

Figure 5

(0.000 LogMAR), with low BBLs in both OD and OS shows (-0.002 LogMAR), with high BBLs in OD shows (-0.006 LogMAR) and OS shows (-0.007 LogMAR) respective with significant p value 0.42 respectively.

Figure 5 shows the mean difference of visual acuity in myopes.

Contrast sensitivity in myopes

Comparing CS in myopes without BBLs, with low BBLs and high BBLs. The mean value of VA without BBLs in both OD shows (1.756 LogCS) OS shows (1.765 Log CS) and OU shows (1.871 LogCS),with low BBLs in both OD and OS shows (1.879 Log CS) OU shows (1.959 LogCS)and with high BBLs in both OD and OS shows (1.906 Log CS) OU shows (2.003 Log CS) respective with significant p value (< 0.001) respectively.

Figure 6 shows the mean difference of contrast sensitivity in myopes.

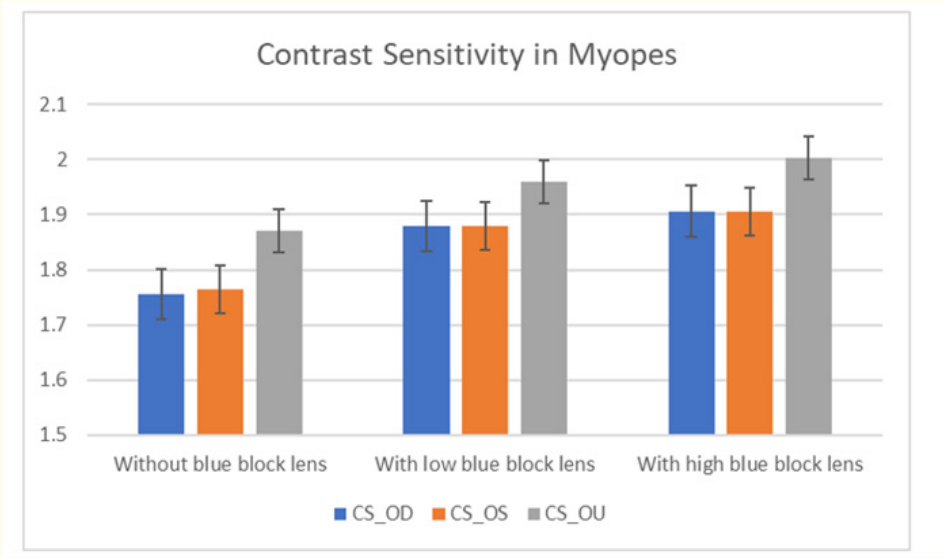

Figure 6

Stereoacuity in myopes

Comparing stereopsis in myopes without BBLs, with low BBLs and high BBLs. The mean value of Stereopsis without BBLs shows (26.471 secs of arc), with low BBLs shows (21.176 secs of arc) and high BBLs shows (20.000 secs of arc) respective with significant P value (< 0.001) respectively.

Figure 7 shows the mean difference of Stereopsis in myopes.

Comparison in hyperopes between low BBLs and high BBLs

Comparison between low BBL and high BBL conditions in three refractive groups respectively. There is no significant difference shows when compared between high BBLs and low BBLs in hyperopes.

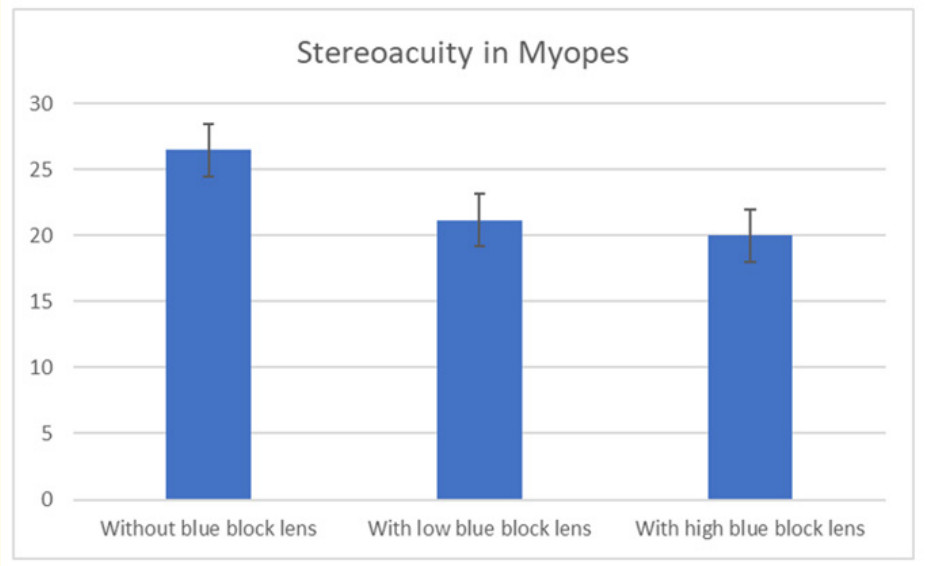

Figure 7

Hyperopes	Eye	Mean difference (Low and High blue block condition)		P value
		Average	SD	
Visual Acuity	OD	-0.003	0.007	0.16
	OS	0.010	0.039	0.16
Contrast Sensitivity	OD	0.030	0.062	0.33
	OS	0.020	0.053	0.08
	OU	0.000	0.000	0.16
Stereoacuity	OU	-0.003	0.007	0.16

Table 7

Table 7 shows the comparison in hyperopes between low BBLs and high BBLs in VA, CS and stereopsis.

Visual acuity in hyperopes

Comparing VA in hyperopes without BBLs, with low BBLs and high BBLs. The mean value of VA without BBLs in both OD and OS shows (0.000 LogMAR), with low BBLs in both OD and OS shows (-0.01 LogMAR) and with high BBLs in both OD and OS shows (-0.02 LogMAR) respective with significant p value 0.06 respectively.

Figure 8 shows theme and difference of visual acuity in hyperopes.

Contrast sensitivity in hyperopes

Comparing CS in hyperopes without BBLs, with low BBLs and high BBLs. The mean value of VA without BBLs in both OD and OS shows (1.83 LogCS) OU shows (1.90 LogCS), with low BBLs in both OD and OS shows (1.92 Log CS) OU shows (1.97 Log CS) and with high BBLs in both OD shows (1.93 Log CS), OS shows (1.95 Log CS) respective with significant P value is (< 0.001) and OU shows (1.99 Log CS) respective with significant p value 0.001 respectively.

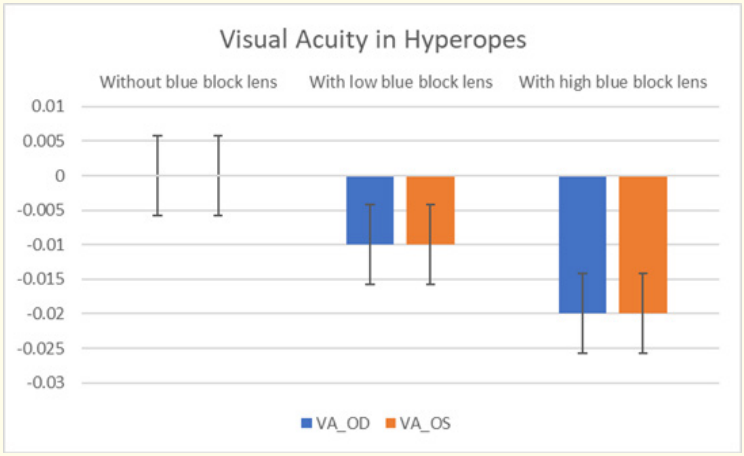

Figure 8

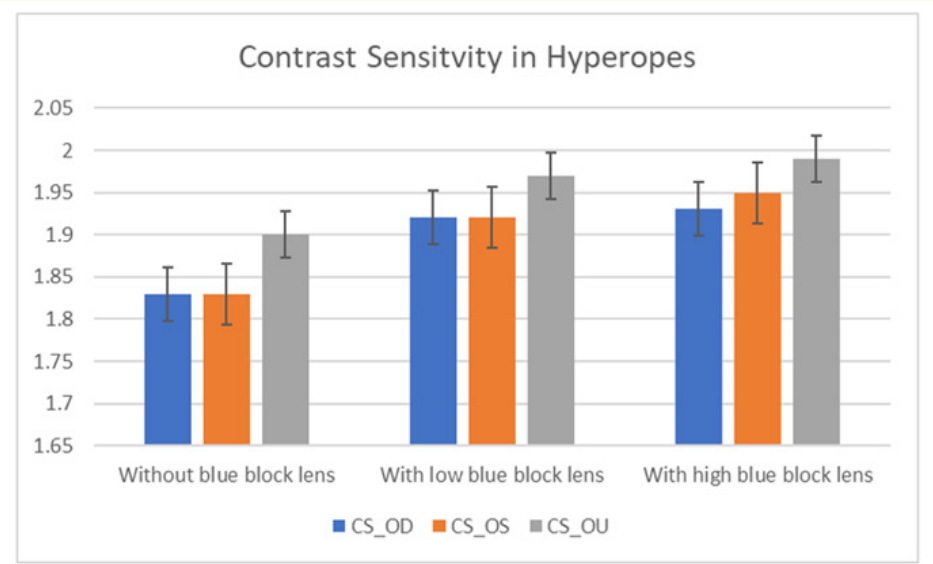

Figure 9

Figure 9 shows theme and difference of contrast sensitivity in hyperopes.

Stereoacuity in hyperopes

Comparing stereopsis in myopes without BBLs, with low BBLs and high BBLs. The mean value of Stereopsis without BBLs shows (23.27 secs of arc), with low BBLs shows (20.00 secs of arc) and high BBLs shows (20.00 secs of arc) respective with significant p value 0.001 respectively.

Figure 10 shows the mean difference of Stereopsis in hyperopes.

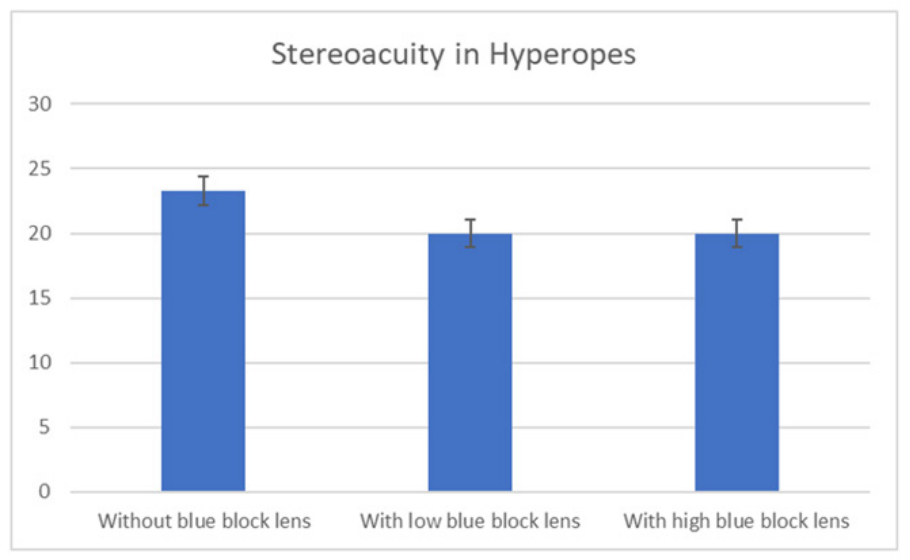

Figure 10

Discussion

The purpose of the present study was to evaluate the effects of blue blocking lenses on visual performances. In this study we used Crizal sapphire as low BBLs and Crizal Prevencia as high BBLs, LogMAR chart for distance visual acuity and reduced Snellen's chart for near visual acuity, Pelli-robson chart for contrast sensitivity and Frans worth D-15 test for color vision. In this we found the significant difference in ocular parameters with No BBLs, Low BBLs and High BBLs. In this it shows that in emmetropes, myopes and hyperopes there is a significant difference in CS and Stereopsis when compared between without BBLs and with BBLs, but when comparing between low BBLs and high BBLs the parameters shows the significant difference in only emmetropes and myopes where there is no significant difference in hyperopes when compared between low BBLs and high BBLs.

There was no significant difference observed in near vision and color vision.

In other studies, conducted on Effects of blue blocking lenses on color contrast sensitivity, they used Crizal Prevencia, Blue Guardian, and Blu- OLP lenses. In Experiment 1, colour contrast thresholds were measured using a visual search colour detection task in which the colour (CIE Lu'v' red, green, blue and yellow) of the target circle stimulus (randomly located in an annulus of achromatic circles) was systematically reduced using a staircase procedure. As blue-blocking lenses selectively block blue light, in Experiment 2, colour contrast thresholds were specifically quantified for a range of short wavelengths near the attenuation transmittance range of the blue-blocking lenses tested. They concluded that while reducing blue light potentially minimises the harmful effect of blue hazard light, blue-blocking lenses can unintentionally reduce colour contrast sensitivity, particularly at low light levels, whereas in our study we used Crizal sapphire as low BBLs and Crizal Prevencia as high BBLs, Pelli-robson chart for contrast sensitivity and Frans worth D-15 test for color vision. In this we found the significant difference in ocular parameters with No BBLs, Low BBLs and High

BBLs. In this it shows that in emmetropes, myopes and hyperopes there is a significant difference in CS when compared between without BBLs and with BBLs, but when comparing between low BBLs and high BBLs the parameters shows the significant difference in only emmetropes and myopes where there is no significant difference in hyperopes. There was no significant difference was observed in color vision.

Conclusion

This study tried to analyse the role of BBLs on visual parameters and refractive error. The visual performances on parameters like VA, CS, CV and stereopsis. This study shows that in emmetropes, myopes and hyperopes there is a significant difference in CS and stereopsis when compared between without BBLs and with BBLs, but when comparing between low BBLs and high BBLs the parameters shows the significant difference in only emmetropes and myopes where there is no significant difference in hyperopes. There was no significant difference was observed in near vision and color vision.

This gives an idea about which of the BBLs dispensing will be better for the best ocular parameters like VA,CS,CV and Stereopsis which are important in clinical routine examination of eye for optometrists and also impact of the BBLs in ocular health.

Bibliography

1. Alzahrani H., *et al*. "Modeling the effect of commercially available blue-blocking lenses on visual and non-visual functions". *Clinical and Experimental Optometry* 103 (2020): 339-346.

2. Ayaki M., *et al*. "Protective effect of blue-light shield eye wear for adults against light pollution from self- luminous devices used at night". *Chronobiology International* 33 (2016): 134-139.

3. Downie L., *et al*. "Blue-light filtering ophthalmic lenses: To prescribe, or not to prescribe?" *Ophthalmic and Physiological Optics* 37 (2017): 640-643.

4. De Fez MD., *et al*. "Enhancement of contrast sensitivity and losses of chromatic discrimination with tinted lenses". *Optometry and Vision Science* 79 (2002): 590-597.

5. Wirtitsch MG., *et al*. "Influence of blue-light-filtering intraocular lenses on color perception and contrast acuity". *Ophthalmology* 116 (2009): 39-45.

6. Wang H., *et al*. "Comparison of photochromic, yellow, and clear intraocular lenses in human eyes under photopic and mesopic lighting conditions". *Journal of Cataract and Refractive Surgery* 36 (2010): 2080-2086.

7. Singh S., *et al*. "Insights into Australian optometrists' knowledge and attitude towards prescribing blue light-blocking ophthalmic devices". *Ophthalmic and Physiological Optics* 39 (2019): 194-204.

8. Zhao ZC., *et al*. "Research progress about the effect and prevention of blue light on eyes". *International Journal of Ophthalmology* 11 (2018): 1999-2003.

9. Kara-Junior N., *et al*. "Effects of blue light-filtering intraocular lenses on the macula, contrast sensitivity, and color vision after a long-term follow-up". *Journal of Cataract and Refractive Surgery* 37 (2011): 2115-2119.

10. Mitchell Scheimen., *et al*. "Clinical Management of Binocular Vision: Heterophoric, Accommodative, and Eye Movement Disorders". 4th Edition- 31st August (2013): 752.

11. Figueiro MG., *et al*. "The impact of light from computer monitors on melatonin levels in college students". *Biog Amines* 25 (2011): 106-116.