

# The Effect of Tinted Spectacle Lenses on Visual Function

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**Abstract—Objective:** To check the Changes on Visual acuity by 85% ,75% & 50% Saturated Red, Yellow, Gray & Blue tinted lenses

To check the Changes on Contrast sensitivity by 85% ,75% & 50% Saturated Red, Yellow, Gray & Blue tinted lenses

To check the Changes on Color vision by 85% ,75% & 50% Saturated Red, Yellow, Gray & Blue tinted lenses

**Methods:** This study was a prospective Population based study to assess acute Effect of Tinted spectacle lenses on visual functions. A detailed demographic data was first carried out and then history was taken followed by visual acuity, refraction, slit lamp examination was done.

**Result:** A total of 50 students (15 males and 35 females) were evaluated falling under 18-30 age group

When compared to the baseline, the grey tint shows decrease in visual acuity. Blue tint shows decrease in grade 85%, 50% & slightly decrease in 75%. Yellow tint shows decrease in visual acuity grade 50%. Red tint shows decrease in visual acuity grade 50% & 75% and slightly decrease in grade 85%

The contrast sensitivity has same for all the tints with varying grades The color vision has same for all the tints with varying grades.

**Conclusion:** When prescribing tinted spectacle lenses regard less of the reason, one must consider the effect they may have on the person's visual performance. The results of this research indicated that the grey tint in all grades has decreased visual acuity and in Red, Yellow & Blue tints in all grades shown minimal effect in visual acuity. There was no effect seen in contrast sensitivity & Colour vision tinted lenses Different tasks may necessitate prescribing different tints and/or grades in the same patients. On the other hand, it is also important to advise patients choosing tinted lenses (for cosmetic purposes) of their effects.

## I. INTRODUCTION

Spectacle lens tints are prescribed by optometrists for many reasons. Purpose of tints are mainly to provide protection from exposure to high levels of ultraviolet radiation (UV) and infrared radiation (IR), decrease

glare from reflective surfaces such as snow, sand and water decrease illumination and thereby decrease sensitivity to light, decrease light scatter in conditions such as aphakia, albinism and retinitis pigmentosa and improve cosmetic appearance in disfigurements such as strabismus and decrease asthenopia<sup>1,4</sup>

Tinting a spectacle lens reduces transmission of light passing through the lens and striking the retina. The percentage of incident light that is transmitted through the lens is called transmittance. (20% transmission is the same as 80% absorption.)<sup>4</sup>

For a tinted lens, the wave length of light which the lens reduces transmittance is actually the opponent colour of that tinted lens. For example, a strong yellow tint reduces the transmittance of blue light (its opponent colour). Thus, all the different colour (or wavelengths of light) would have different transmittance values. The density of the tint can be varied as well to produce different grades of the tint, which in turn have their separate transmittance values. Furthermore, different lenses from different companies have different transmittance values for their lenses, which can be measured by using a spectrophotometer.<sup>1,4</sup>

Currently there is an increase in usage of tinted lenses in the form of sunglasses and tinted spectacle lenses traditional grey, green, and brown tinted glasses, other colours such as blue, violet and yellow are becoming popular<sup>3</sup>

In this study, commonly used tints (grey, red, yellow and blue) were evaluated. With an increase in the use of tinted lenses, variables of visual performance like visual acuity, contrast sensitivity and colour vision should preferably not be affected negatively. The two components of visual performance evaluated in this research study were visual acuity, contrast sensitivity and colour vision

**Visual acuity:** Visual acuity can be defined as the reciprocal of minimum angle of resolution.

**Contrast Sensitivity:** Contrast Sensitivity refers to the ability of the visual system to distinguish between an object and its background. The normal eye is maximally sensitive to 25 cycle per degree (cpd) of spatial frequency and less sensitive to frequency and less sensitive to frequencies in the extremities.<sup>1</sup>

**Colour Vision:** Colour Vision is the ability of an organism to distinguish objects based on the wavelengths of the light they reflect, emit or transmit. Colour vision is also different for every individual as it involves the complicated process of perception. Good colour vision is also important in driving, to properly see road signs and traffic signals. Colour vision can be tested by using Ishihara plates, Farnsworth D-15 test, FM 100 hue test. The type of colour vision defect are red green defects, blue yellow defects, total colour blindness.

## II. REVIEW OF LITERATURE

The effect of tinted spectacle lenses on contrast sensitivity and colour vision. Shaik M, Majola PD, Nkgare LM et al, South African 2013 72(2) 61-70, pg no 2-3. Ninety subjects were included in this study each participant was screened for pathology, dyschromatopsia, severe dry eye (TBUT <5 seconds) and the presence of any more than low ametropia. Thereafter each successful participant was tested for CS and CV with their habitual prescription and then tested randomly with a white (clear) lens and tinted (blue, brown and grey). Light transmission was 85%, 75%, and 50% for grades A, B and C respectively. The Functional Acuity Contrast Test (FACT) chart and American Optical Hardy, Rand and Rittler (AO HRR) were used for the assessment of CS and CV respectively. This study shows do not alter color vision significantly in all lenses but for the selected levels of transmission of the tints used contrast sensitivity can be improved to some extent.<sup>1</sup>

Effect of colored filters on Visual function. Thomas k. Kuyk, Poul V. Garcia, distribution unlimited, 8 august 2008, public affair case file no. 08-194. The effect on visual performance of colored filters were investigated. Visual performance of 10 subjects of average age 30.5 was assessed while wearing yellow and pink tinted filters and compared to performance with transmission matched neutral filters and without any filters, this study shows wearing colored filters can enhance contrast and improve visual performance.<sup>2</sup>

Enhancement of contrast sensitivity and losses of chromatic discrimination with tinted lenses. Dolores de Fez M, Luque jose M, Valentin Viqueira, distribution on 19 November 2001. The contrast sensitivity functions (CSF) of 10 observers were measured under different illumination; the results show that the green, brown and blue filters do not cause significant changes in contrast sensitivity when compared with a grey filter of equal luminance, although chromatic discrimination is disturbed. Yellow and orange filters improve achromatic contrast at certain spatial frequencies, but impair chromatic discrimination.<sup>3</sup>

### 2.1 Aim:

To study the effect of Tinted Spectacle Lenses on Visual Functions.

### 2.2 Objective

This study was Investigate the effect of spectacle lenses of varying grades of tint on visual acuity, Contrast Sensitivity & Color Vision.

## III. METHODOLOGY

### Research Design

Study design: Prospective study

Study setting: Naseema Institute of Optometry and Research Bengaluru

Study duration: 2024 - 2025

Sample size: 50

Sample formula:  $NZ^2\sigma^2 / (N-1)e^2 + z^2 \sigma^2$

Where,

n= size of the sample

N= size of population

Z= value of the standard variant at a given confident level

$\sigma$ = standard deviation of population

e= acceptable error

### 3.1. Materials:

- Measuring tape
- Trial set, Trial frame, Pin hole and Occluder.
- Near vision chart
- Retinoscope
- Slit lamp
- Lux meter
- logMAR visual acuity chart for distance
- Pelli Robson contrast sensitivity chart
- Ishihara colour vision chart

- The 4 different colour tinted lens Red, Yellow, Grey & Blue with different percentage of absorption grades which is 85%, 75% and 50% resulting in 12 lenses total.

### 3.2. Inclusion & Exclusion Criteria:

Table 1:

| INCLUSION          | EXCLUSION                                 |
|--------------------|-------------------------------------------|
| BCVA (0.0 logMAR)  | Ocular Pathology& Binocular abnormalities |
| Age-18 to 30 years | Color Vision Defect                       |
| Trichromats        | Systemic Disease                          |

## IV. PROCEDURE

This is a prospective study which was conducted in Naseema Institute of Optometry and Research in Bengaluru, India between the time periods of 2024 to 2025. Every student was informed about the purpose and procedure of the study. A written consent form was acknowledged from each student prior to the enrolment into the study.

Students were included into the study based on inclusion and exclusion criteria of the study which in turns was determined through history taking. 50 students between the age group of 18-30 years. Habitual tests were done

The lenses selected randomly, all the procedures were carried under same standard room illumination and each test were done monocular.

#### Visual acuity:

- 4m log MAR chart was used
- The patient was asked to read the chart with each eye separately without any lenses in front of eye, Visual acuity was recorded.
- Again, with the tinted lenses same procedure is performed. Room illumination was maintained correctly.



Fig 1: Visual acuity testing

#### Contrast sensitivity

- Test performed using Pelli Robson chart at 1 m distance.
- The patient was asked to read the chart with each eye separately without any lenses in front of eye. Contrast sensitivity was recorded
- Again, with the tinted lenses same procedure is performed.



Fig 2: Contrast sensitivity testing

#### Color Vision:

- Ishihara color vision chart was used at 40cm □ Test was done monocularly.
- 21 plates were shown to subject and the number of plates read by the subjects was recorded.



Fig 3: Color Vision testing

## V. STATISTICAL ANALYSIS

Data was analyzed using Anova test

After the completion of data collection, data Entry was done in Microsoft Excel 2016. Statistical Analysis was performed with SPSS Version 20.0 Descriptive analysis was done for the demographic details. Parametric Statistical tests were done for the analysis.

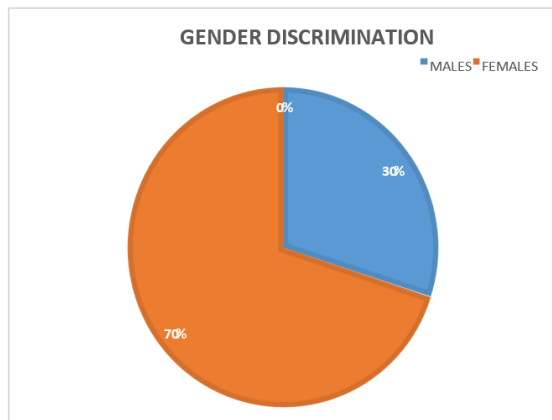
A p-value of  $< 0.05$  was considered to be statistically significant.

## VI. RESULTS

A total of 50 students were evaluated falling under 18-30 age group.

Students were selected from NIRMAL EYE INSTITUTE based on the inclusion and exclusion criteria of 50 subjects were participated, 15 were males & 35 were females

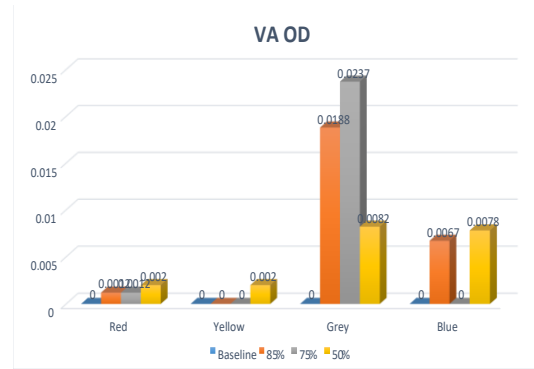
Pie Chart 1: Number of Males and Females included in the study.



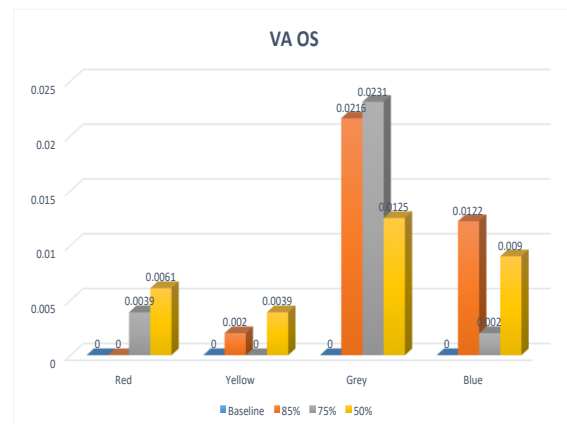
Mean value of before and after tinted lens

| Filters      | Visual acuity (OD) Mean Value | Visual acuity (OS) Mean Value |
|--------------|-------------------------------|-------------------------------|
| Unaided      | 0.00                          | 0.00                          |
| Red (85%)    | 0.0012                        | 0                             |
| Red (75%)    | 0.0012                        | 0.0039                        |
| Red (50%)    | 0.002                         | 0.0061                        |
| Yellow (85%) | 0                             | 0.002                         |
| Yellow (75%) | 0                             | 0                             |
| Yellow (50%) | 0.002                         | 0.0039                        |
| Grey (85%)   | 0.0188                        | 0.0216                        |
| Grey (75%)   | 0.0237                        | 0.0231                        |
| Grey (50%)   | 0.0082                        | 0.0125                        |
| Blue (85%)   | 0.0067                        | 0.0122                        |
| Blue (75%)   | 0                             | 0.002                         |
| Blue (50%)   | 0.0078                        | 0.009                         |

Table- 2: Comparison of visual acuity with and without tinted lenses GRAPH 1: Comparison of visual acuity OD with and without tinted lenses.



GRAPH 2: Comparison of visual acuity OS with and without tinted lenses



Visual Acuity is measured using logMAR for both OD and OS

Graph 1 and 2 shows the effect that each study lens had on visual acuity when compared to the baseline situation shown in blue colour in both OD and OS.

The mean values N = 50 participants of visual acuity were used to plot the various columns on the graph. The Baseline column (blue column) is an average for the 50 participants

Here, for all the tints, the visual acuity has decreased in OD and OS.

When compared to the baseline, the grey tint shows decrease in visual acuity. Blue tint shows decrease in grade 85%, 50% & slightly decrease in 75%. Yellow tint shows decrease in visual acuity grade 50%. Red tint shows decrease in visual acuity grade 50% & 75% and slightly decrease in grade 85%

In comparing how the four colour of tint for a specific shade may affect visual acuity, results showed that statistically significant difference were found among

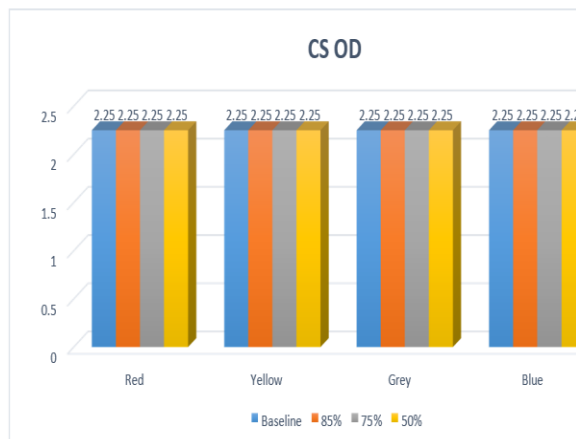
all the colours in comparison to each other for the darker shades.

Darker shade showed decrease in visual acuity.

Table- 3: Comparison of Contrast sensitivity with and without tinted lenses

| Filters      | Contrast sensitivity (OD) | Contrast sensitivity (OS) |
|--------------|---------------------------|---------------------------|
| Unaided      | 2.25                      | 2.25                      |
| Red (85%)    | 2.25                      | 2.25                      |
| Red (75%)    | 2.25                      | 2.25                      |
| Red (50%)    | 2.25                      | 2.25                      |
| Yellow (85%) | 2.25                      | 2.25                      |
| Yellow (75%) | 2.25                      | 2.25                      |
| Yellow (50%) | 2.25                      | 2.25                      |
| Grey (85%)   | 2.25                      | 2.25                      |
| Grey (75%)   | 2.25                      | 2.25                      |
| Grey (50%)   | 2.25                      | 2.25                      |
| Blue (85%)   | 2.25                      | 2.25                      |
| Blue (75%)   | 2.25                      | 2.25                      |
| Blue (50%)   | 2.25                      | 2.25                      |

GRAPH 3: Comparison of Contrast sensitivity OD with and without tinted lenses



GRAPH 4: Comparison of Contrast sensitivity OS with and without tinted lenses

Graph 3 & 4 shows the effect that each study lens had on contrast sensitivity when compared to the baseline situation shown in Blue in OD and OS.

The mean values of 50 participants of contrast sensitivity were used to plot the various columns on the graph.

Here, the contrast sensitivity has same for all the tints with varying grades.

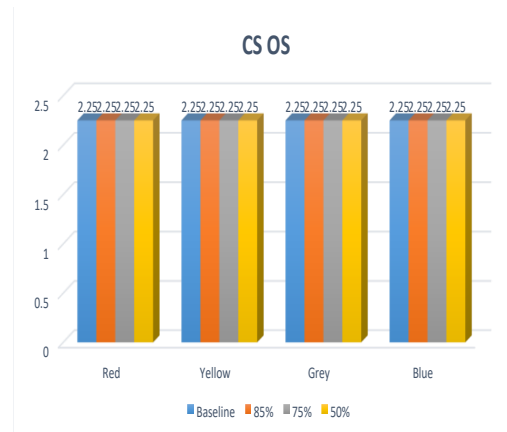
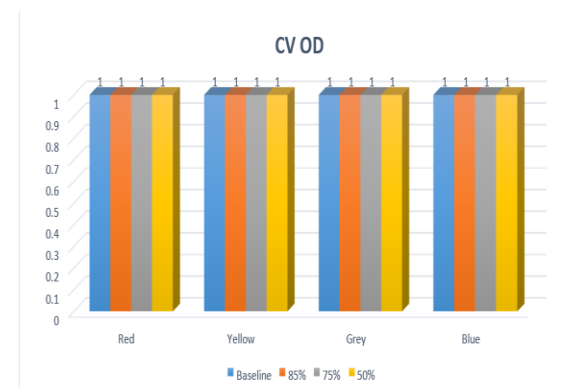


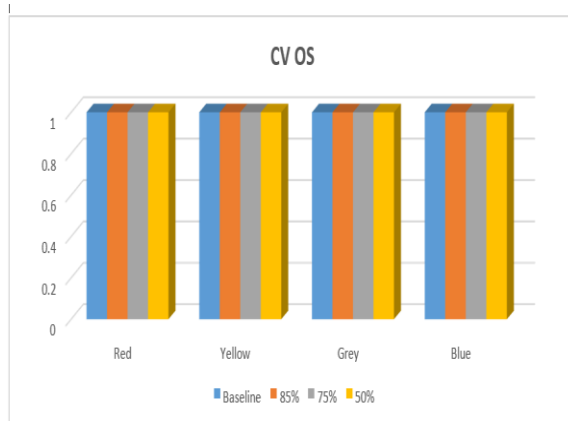
Table- 4: Comparison of Color vision with and without tinted lenses

| Filters      | Color vision (OD) | Color vision (OS) |
|--------------|-------------------|-------------------|
| Unaided      | 1                 | 1                 |
| Red (85%)    | 1                 | 1                 |
| Red (75%)    | 1                 | 1                 |
| Red (50%)    | 1                 | 1                 |
| Yellow (85%) | 1                 | 1                 |
| Yellow (75%) | 1                 | 1                 |
| Yellow (50%) | 1                 | 1                 |
| Grey (85%)   | 1                 | 1                 |
| Grey (75%)   | 1                 | 1                 |
| Grey (50%)   | 1                 | 1                 |
| Blue (85%)   | 1                 | 1                 |
| Blue (75%)   | 1                 | 1                 |
| Blue (50%)   | 1                 | 1                 |

GRAPH 5: Comparison of Color vision with and without tinted lenses



GRAPH 6: Comparison of Color vision with and without tinted lenses



Graph 5 & 6 shows the effect that each study lens had on colour vision when compared to the baseline situation shown in blue

The mean values of 50 participants of colour vision were used to plot the various columns on the graph. Here, the colour vision has same for all the tints with varying grades.

## VII. DISCUSSION

### Visual Acuity:

According to the study done in 2008 by Thomas K et al, pink and yellow filters showed good enhancement in the contrast and also the visual acuity<sup>2</sup>

According to the current study, there was significant decrease in visual acuity in grey tint for all grade (50%, 75% & 85%). Whereas there was minimal decrease in other tints (Red, Yellow & Blue) with varying grade.

As the tests were done in room illumination of around 400-800 lux there was significant decrease in the visual acuity. If the illumination varies then it might alter the visual acuity as well.

### Contrast Sensitivity:

According to the study done in 2013 by Shaik M et al, darker tints have reduced contrast sensitivity function at high spatial frequencies. Alternatively, darker tints improve contrast at low spatial frequencies possibly due to the tints decreasing glare, thus having the highest contrast sensitivity function at low spatial frequencies. Lighter tints allow for better contrast sensitivity function at high spatial frequencies.<sup>1</sup>

According to the current study in all the tints with varying grades (50%, 75% & 85%) have same contrast sensitivity

### Colour Vision:

According to the study done in 2013 by Shaik M et al, the results indicated that the white, grey, brown & blue spectacle lenses and their varying grades do not cause any marked alteration in colour vision<sup>1</sup>

According to the current study in all the tints with varying grades (50%, 75% & 85%) have same colour vision.

## VIII. CONCLUSION

When prescribing tinted spectacle lenses regard less of the reason, one must consider the effect they may have on the person's visual performance. The results of this research indicated that the grey tint in all grades has decreased visual acuity and in Red, Yellow & Blue tints in all grades shown minimal effect in visual acuity. There was no effect seen in contrast sensitivity & Colour vision tinted lenses Different tasks may necessitate prescribing different tints and/or grades in the same patients. On the other hand, it is also important to advise patients choosing tinted lenses (for cosmetic purposes) of their effects. Information here in should assist the Optometrist when managing patients, with different requirements for tinted spectacle lenses, as it is essential that optical devices do not have any adverse effects on visual performances.

## IX. LIMITATIONS AND FUTURES COPE

### Limitation:

All the tinted lenses which are available in market were not used in this study.

### Futurescope;

The effect of tinted spectacle lens on visual function can be included another colour like Black, Pink & green.

It can be done in larger population.

## REFERENCES

- [1] M. Shaik *et al.*, "The Effect of Tinted Spectacle Lenses on Contrast Sensitivity and Color Vision," *South African Optometrist*, vol. 72, no. 2, pp. 61–70, 2013.
- [2] T. K. Kuyk *et al.*, "Effect of Coloured Filters on Visual Function," Distribution Unlimited, Public After Case File No. 08-194, Aug. 8, 2008.

[3] M. Dolores de Fez and V. Viqueira, "Enhancement of Contrast Sensitivity and Losses of Chromatic Discrimination with Tinted Lenses," Nov. 19, 2001.

[4] C. W. Brooks, "Absorptive Lenses," in *System for Ophthalmic Dispensing*, 3rd ed. Oxford, U.K.: Elsevier Butterworth-Heinemann, 2007, pp. 526–565.

## ANNEXURES

### PROFORMA

Nirmal Eye Institute

Title: The Effects of Tinted Spectacles Lenses on Visual Functions.

Investigators: Ms. Nimisha Bhatt

Guide Name: Dr. Mohammad Zeeshan

Demographic Data:

SL.NO:

Name: ..... Date:

Age: .....Year Gender: Male/Female Mobile No: .....

Occupation: ..... Mail I'd: .....

HISTORY:

Chief Complain: .....

Ocular History: Surgery/Trauma/Spectacle wearer: .....

Systemic History: DM/HTN/IHD/RA/Other: .....

Medication: .....

Family history: DM/GLAUCOMA/HTN: .....

Allergies: .....

### VISUAL ACUITY:

|                     |           |           |
|---------------------|-----------|-----------|
| Distance Unaided VA | OD:       | OS:       |
| Distance Aided VA   | OD:       | OS:       |
| Near VA             | OD: @40CM | OS: @40CM |

### SLIT LAMP EXAMINATION:

| OD | DESCRIPTION | OS |
|----|-------------|----|
|    | ADNEXA      |    |
|    | CORNEA      |    |
|    | CONJUNCTIVA |    |
|    | AC          |    |
|    | PUPIL       |    |
|    | IRIS        |    |
|    | LENS        |    |

### Without Tint lenses:

|                      | OD | OS |
|----------------------|----|----|
| Visual Acuity        |    |    |
| Contrast Sensitivity |    |    |
| Colour Vision        |    |    |

| 50% |  | Red Tint lens | Yellow Tint lens | Grey Tint lens | Blue Tint lens |
|-----|--|---------------|------------------|----------------|----------------|
| VA  |  |               |                  |                |                |
|     |  |               |                  |                |                |
| CS  |  |               |                  |                |                |
|     |  |               |                  |                |                |
| CV  |  |               |                  |                |                |
|     |  |               |                  |                |                |