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Original Article

# Effect of ambient light intensity on auto-refractometer results

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**Objective:** To determine difference in auto-refractometer results in dim and bright light.

**Study Design and Methods:** It was a descriptive cross-sectional study conducted on 100 patients having different degree of myopia and hyperopia. This study includes the effect of ambient light intensity on auto-refractometer results in myopic and hyperopic patients with no associated ocular pathology. Distance (6m) visual acuity was measured by using Snellen distance visual acuity chart which was followed by retinoscopy. Results were obtained by asking the patient to fill a proforma.

**Results:** Light intensity affects results in hyperopic and myopic patients (mild and moderate). A difference of 0.25 diopters between dim and bright light auto-refractometer results was seen in 26% patients, 0.50 diopter difference in 22%, 1.0 diopter difference in 14%, while no difference was seen in 38% patients.

**Conclusion**: Significant number of patients with myopia and hypermetropia show minor difference in auto-refractometer readings in dark and light room. In high refractive errors the difference in results between dim and bright light was large as compared to that in small refractive error.

## Introduction

One of the leading causes of blindness in people over 65 Autorefractometry is a method to objectively find out the refractive error of the eye that include (far sightedness, near sightedness, astigmatism). It is measured by how light changes its path when it enters into the eye. The test can be speedy, easy, and minimum co-operation is required from the subjects.[1] Auto refractometer is a computer-controlled instrument that projects the light rays into the eye and light rays falling onto the retina after refraction come into the cornea. It is a device for measuring the refractive index of the eye that can be calculated from Snell's law.[2]

Certain evidences have shown that in development of hypermetropia as compared to myopia heredity play an important role and environmental factors have little influence on hypermetropia.[3] There are two main contradictory views in treatment of hypermetropia.[4] One view suggests that visual input play a vital role in the emmetropization of refractive error.[5] According to this suggestion, process of emmetropization may stop by wearing spectacle correction.[6]

When light rays do not focus on retina but focus in front of retina then this condition is called myopia. In myopia axial length of eye is too long and curvature of cornea and lens is too steep.[7] With change in sharpness of retinal image contrast sensitivity changes if accommodation is intact. A shift in contrast sensitivity occurs due to development of refractive error therefore it co-relates with induced myopia such as due to negative lenses. Contrast sensitivity reverses when myopia is recovered.[8] A high amount of myopia is a risk factor for several sight-threatening diseases.[9] In case of low amount of refractive error, the effect of ambient light on eye and accommodation is little but in case of high amount of refractive errors, the effect of ambient light intensity is larger. Sometimes, there is no difference in auto refractometer readings mostly in case of adults because at younger age, focus of accommodation is difficult to be maintained in the dark.

According to Yang's study, for obtaining and maintenance of optical axis of eye, pupil itself is not a stable reference. Pupil size and its position both are changed by ambient illumination. During bright light miosis occur and pupil moves nasally with reference to center of cornea.[10] It was also observed that on the variable corneal compensation and retardation the effect of increased size of pupil in dim light may be associated with corneal and lenticular optical aberrations or to the off-axis scanning.[11] Another study proves that anomalous myopia or instrumental myopia, empty field and magnitude of night are highly correlated with amount of dark focus accommodation. When there is no need of accommodation or when the stimulus for accommodation is absent then we interpret this anomalous myopia as the result of passive return of accommodation to an individually determined dark focus.[12]

When we lower the illumination, the vergence and accommodation both come in resting position. As the subjects viewed a light spot 0.4mm in diameter and illumination was increased, accommodation was not affected significantly however vergence was changed. The critical luminance level ranged from 0.01 to 0.45 cd/m$^2$.[13] Light intensity must be kept low to perform the tests. It is necessary to understand the coaxial illumination principle. In myopia or near sightedness objects at far distance are blurred and clear at near. This may be due to increased axial length and steep corneal curvature.[14] In hyperopia or far sightedness objects at near are blurred and clear at distance. This may be due to short axial length and less corneal and lens curvature.[15]

## Study Design and Methods

:It was a descriptive cross-sectional study conducted at College of Ophthalmology and Allied Vision Sciences (COAVS) Lahore on 100 patients having different degree of myopia and hyperopia. This study included the effect of ambient light intensity on auto-refractometer results in myopic and hyperopic patients with no associated ocular pathology. Distance (6m) visual acuity was measured by using Snellen distance visual acuity chart followed by retinoscopy. Individuals below 12 years and those who could not give history or unable to undergo examination were excluded from the study. Before the start of research, the objectives and the process of research were explained to them in detail. Individuals having refractive errors were prescribed glasses. The data was recorded by asking the patient to fill a proforma, fed on the computer using the SPSS 20.0 software. The results were analyzed and tabulated using the same software.

## Result

**Table 1: Type of Refractive Errors**

| Refractive error | Frequency | Percent |
|---|---|---|
| Myopia | 73 | 73.0 |
| Hyperopia | 27 | 27.0 |
| Total | 100 | 100.0 |

In this study 73% were myopic patients and 27% were hyperopic patients.

**Table 2: Age of Patient**

| Age | Frequency | Percent |
|---|---|---|
| 11 - 20 | 16 | 16 |
| 21 - 30 | 35 | 35 |
| 31 - 40 | 19 | 19 |
| 41 - 50 | 22 | 22 |
| 51 - 60 | 6 | 6 |
| 61 - 70 | 2 | 2 |
| Total | 100 | 100 |

**Table 3**

| Difference in Readings | Frequency | Percent |
|---|---|---|
| 0.25D | 26 | 26 |
| 0.5 0 D | 22 | 22 |
| ≥1.00 D | 14 | 14 |
| No difference | 38 | 38 |
| Total | 100 | 100 |

This table represents that there was difference of 0.25 diopters in auto refractometer readings between dim and bright light in 26 patients and 0.50 diopter difference in 22 patients, difference of 1.0 diopter or more in 14 patients whereas no difference was found in 38 patients.

**Table 4**

| Visual acuity right eye * Difference in readings Cross tabulation | | | | | |
|---|---|---|---|---|---|
| Visual acuity right eye without glasses | Difference in readings | | | | Total |
| | 0.25D (1) | 0.5D (2) | 1.0 &>1D (3) | No diff (4) | |
| 6/6 - 6/12 (1) | 13 | 13 | 5 | 20 | 51 |
| 6/18 - 6/36 (2) | 11 | 6 | 7 | 11 | 35 |
| 6/60 - 3/60 (3) | 2 | 3 | 2 | 7 | 14 |
| Total | 26 | 22 | 14 | 38 | 100 |

This table represents relation between visual acuity or amount of refractive error and difference in auto refractometer readings between dim and bright light in the right eye. In this 0.25D difference was in 26 patients having visual acuity 6/6-6/12 mostly. 0.5D difference was in 22 patients. 1.0D difference was in 14 patients and no difference was in 38 patients in which visual acuity was 6/6-6/12 mostly. Mann Whitney U value 3.52 with p-value 0.74 (i.e. difference is not statistically significant)

**Table 5**

| Visual acuity left eye * Difference in readings Cross tabulation | | | | | |
|---|---|---|---|---|---|
| Visual acuity left eye without glasses | Difference in readings | | | | Total |
| | 0.25D (1) | 0.5D (2) | 1.0 &>1D (3) | No diff (4) | |
| 6/6 - 6/12 (1) | 11 | 5 | 15 | 12 | 43 |
| 6/18 - 6/36 (2) | 10 | 7 | 12 | 7 | 36 |
| 6/60 - 3/60 (3) | 5 | 2 | 11 | 3 | 21 |
| Total | 26 | 14 | 38 | 22 | 100 |

This table represents relation between visual acuity or amount of refractive error and difference in auto refractometer readings between dim and bright light. In this 0.25D difference was in 26 patients having visual acuity 6/6-6/12 mostly. 0.5D difference was in 14 patients having visual acuity 6/18-6/36 mostly. 1.0D difference was in 38 patients and no difference was in 22 patients in which visual acuity was 6/6-6/12 mostly. Mann-Whitney U value was 7.300 with p-value of 0.39 (i.e. not significant statistically).

**Table 6**

| Age groups * difference in readings Cross tabulation | | | | | |
|---|---|---|---|---|---|
| Age groups | Difference in readings | | | | Total |
| | 0.25D | 0.5D | 1&>1.0D | No diff | |
| 11 -15 | 1 | 1 | 1 | 1 | 4 |
| 16 -20 | 2 | 0 | 0 | 1 | 3 |
| 21 -25 | 3 | 0 | 0 | 0 | 3 |
| 26 -30 | 5 | 2 | 0 | 5 | 12 |
| 31 -35 | 3 | 5 | 3 | 15 | 26 |
| 36 -40 | 3 | 1 | 4 | 1 | 9 |
| 41 -45 | 3 | 1 | 3 | 0 | 7 |
| 46 -50 | 2 | 4 | 1 | 5 | 12 |
| 51 -55 | 2 | 3 | 0 | 2 | 7 |
| 56 -60 | 2 | 4 | 2 | 7 | 15 |
| 61 -70 | 0 | 1 | 0 | 1 | 2 |
| Total | 26 | 22 | 14 | 38 | 100 |

This table represents age groups and difference in auto-refractometer readings. More difference was seen in children as compared to adults because child can change its dark focus of accommodation easily as compared to adults.

## Discussion

The basic purpose of this study was to determine the effect of ambient light intensity on auto-refractometer results and thus to evaluate the effect of accommodation on refractive errors in dim and bright room light. The study was conducted at OPD of eye department of Mayo hospital

Lahore.

In this study, 100 patients with myopic and hypermetropic refractive error were included in which 36 were male and 64 were female. Myopic patients were 74 and hypermetropic patients were 26. Auto-refractometry was done in dark and normal light room. 0.25D difference was recorded in 26 patients and 0.50D difference was recorded in 22 patients. 1.0D & > 1.0D difference was recorded in 14 patients and no difference was recorded in 38 patients. The difference was not significant.

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