

## ORIGINAL RESEARCH

# A clinical study to assess the magnitude of asthenopia and its association with refractive errors in a population of 6-25 years of age presenting at eye OPD in a tertiary care centre

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**ABSTRACT Introduction:** Asthenopia decreases performance and productivity and affects quality of life. Children can experience many of the same symptoms related to computer use as by adults. Extensive viewing of the computer screen can lead to eye discomfort, fatigue, blurred vision and headaches, dry eyes and other symptoms of eyestrain. Hence, the present study was conducted to assess the magnitude of asthenopia and its association with refractive errors in a population of 6-25 years of age presenting at eye OPD in a tertiary care centre. **Material and Methods:** The present study was conducted among 1100 individuals aged 6-25 years who reported to out-patient department of Ophthalmology, People's College of Medical Science & Research Centre, Bhopal with symptoms of asthenopia. Baseline demographic data was collected in Proforma. Reports of eyestrain symptoms were sought in questionnaire on asthenopia related symptoms. Patients were first tested for non-cycloplegic auto-refraction, uncorrected visual acuity (UCVA) with help of Snellens chart, retinoscopy was done using a streak retinoscope and orientation of Streak for astigmatism was done. **Results:** A total of 1100 patients were screened, and of them 750 (68.2%) cases had asthenopia. 1500 eyes of 750 cases were analyzed and most common cause of asthenopia was refractive error (83.0%), followed by muscular weakness (36.2%). Headache was the most common clinical feature noted in 44.5% cases with asthenopia, followed by watering in 30.4% and blurring in 24.4% cases. Irritation and eye strain were associated features in 18.9% and 19.9% cases respectively. **Conclusion:** Thus, to conclude our study, we found that asthenopia is present in a significant portion of young population, refractive error being a major contributing factor besides muscular weakness, computer vision syndrome, dry eye. Moreover, until recently little information is available regarding the asthenopia with risk factors among children and college students. The decrease in asthenopia and morbidities associated with it among students (6-25 years of age) can lead to an important benefit to promote next generation of their career and health, both intellectually and psychologically, since these are the formative years in life, hence, justifying the need for research in this area.

**Keywords:** Asthenopia; Computer vision syndrome; Eyestrain

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## INTRODUCTION

Asthenopia is the formal diagnostic term (ICD 11-

09D 50) that is nearly synonymous with the more acquainted word "eyestrain". Asthenopia is a general

term used to define a group of somatic or perceptive symptoms that usually occur following computer work, reading, or other near visual activities.<sup>1</sup> This subjective problem entails 2 groups of symptoms; nonspecific symptoms including fatigue, burning, irritation, eye pain, aching eyes, sore eyes, and headache, and specific symptoms are defined as symptoms such as photophobia, blurred vision, double vision, itching, tearing, dryness feeling, and foreign body sensation.<sup>2</sup> Asthenopia decreases performance and productivity and affects quality of life.<sup>3</sup> Children can experience many of the same symptoms related to computer use as by adults. Extensive viewing of the computer screen can lead to eye discomfort, fatigue, blurred vision and headaches, dry eyes and other symptoms of eyestrain. These symptoms may be caused by poor lighting, glare, an improper work station set-up, vision problems of which the person was not previously aware, or a combination of these factors. In most cases, symptoms occur because the visual demands of the task exceed the visual abilities of the individual to comfortably perform the task. However, some unique aspects of how children use computers may make them more susceptible than adults to the development of these problems.<sup>4</sup> Hence, the present study was conducted to assess the magnitude of asthenopia and its association with refractive errors in a population of 6-25 years of age presenting at eye OPD in a tertiary care centre

**MATERIAL AND METHODS**

The present study was conducted among 1100 individuals aged 6-25 years who reported to outpatient department of Ophthalmology, People’s College of Medical Science & Research Centre, Bhopal with symptoms of asthenopia. Exclusion criteria included post traumatic patients, post-surgical cases, congenital and developmental anomalies, history of migraine, strabismus, ocular or

systemic diseases affecting binocular vision, patient not willing to participate. A written informed consent was taken from the parents (<18 years) and students (19- 25 years) for inclusion into the study. Baseline demographic data was collected in Proforma. Reports of eyestrain symptoms were sought in questionnaire on asthenopia related symptoms. Patients were first tested for non-cycloplegic auto-refraction. In the next stage, all participants were tested for uncorrected visual acuity (UCVA) with help of Snellens chart. Then, auto-refraction results were refined through trial lenses. For each individual, first the right and, then, the left eye was tested. For any case with UCVA worse than 6/9 in either eye, subjective refraction was done and the best corrected visual acuity (BCVA) was recorded. Retinoscopy was done using a streak retinoscope. Patient was asked to fixate on a distant target after dilating the eyes with a cycloplegic agent according to age (as mentioned in table below) in order to relax accommodation. Examiner was seated at one arm’s length from the patient. Reflex motions in Retinoscopy were assessed. Next, orientation of Streak for astigmatism was done. As the streak was moved from side to side, oblique movement of the reflex was observed. The beam was rotated until its parallel with the reflex motion. Neutralization of “with” or “against movement” seen here was done. The secondary meridian is 90 degrees away and is at the axis of the patient’s astigmatism. Neutralization of the “with” or “against movement” in this second meridian was done to find the cylindrical power. The same procedure was done with the left eye. The working distance was subtracted before writing the prescription. Schirmers test was done to rule out dry eye disease. This was followed by Slit lamp examination and fundus examination by direct ophthalmoscopy followed by indirect ophthalmoscopy with 20 D lens and 90 D lens.

**RESULTS**

**Table 1- Magnitude of asthenopia among study population**

Asthenopia	Frequency	Percentage
Present	750	68.2
Absent	350	31.8
<b>Total screened</b>	<b>1100</b>	<b>100</b>

A total of 1100 patients were screened, and of them 750 (68.2%) cases had asthenopia (table 2).

**Table 2: Distribution of cases according to age and gender**

Age	Frequency (n=750)	Percentage
6-10	45	6.0
11-15	162	21.6
16-20	246	32.6
21-25	297	39.6
<b>Sex</b>	<b>Frequency (n=750)</b>	<b>Percentage</b>
Male	305	40.7
Female	445	59.3

Mean age of patients with asthenopia was 18.4±4.79 years (range -6 years to 25 years). Majority of patients belonged to age range of 21 to 25 years (39.6%). Only 6% cases belonged to 6 to 10 years of age (table 2). Female predominance was observed for asthenopia in our study with male:female ratio of 0.67:1. About 59.3% cases were females and only

40.7% cases with asthenopia were males (table 2). History of ophthalmic examination prior to the current examination was positive in 10.4% cases, of them, 9.5% cases sought care for refraction and 0.9% cases underwent ophthalmic examination to rule out ophthalmic causes of headache (table 3).

**Table 3: Distribution of cases according to past medical and surgical history**

Past history	Frequency (n=750)	Percentage
History of ophthalmic examination	78	10.4
• For refraction	71	9.5
• For headache	7	0.9

**Table 4: Distribution according to hours of computer or digital device use**

Hours of computer /digital device use	Frequency (n=750)	Percentage
None	5	0.7
<2 hours	119	15.9
3-4 hours	287	38.3
5-6 hours	214	28.5
≥7 hours	130	17.3

Mean duration of usage of digital device was 4.72±2.4 hours and majority of cases used the device for 3 to 4 hours (38.3%) and 5 to 6 hours (28.5%). Only 0.7% cases with asthenopia did not use any digital device (table 4).

**Table 5- Distribution according to etiology of asthenopia**

Etiology		Frequency (n=1500)	Percentage	
Refractive errors	Present	1245	83	
	Myopia	295	19.7	
	Astigmatism	925	61.7	
	Hypermetropia	25	1.7	
Amblyopia		104	6.9	
Dry eye		156	10.4	
CVS		206	13.7	
Muscular	Heterophoria	Exodeviation	90	6.0
		Esodeviation	26	1.7
	Convergence insufficiency		258	17.2

In present study, 1500 eyes of 750 cases were analyzed and most common cause of asthenopia was refractive error (83.0%), followed by muscular weakness (36.2%). Most common refractive error associated with asthenopia in our study was astigmatism (61.7%), whereas convergence insufficiency was the most common muscular cause of asthenopia. Other causes of asthenopia were CVS (13.7%), dry eye (10.4%) and amblyopia (6.9%) (table 5).

**Table 6: Distribution according to type and severity of refractive error**

Refractive error		Frequency (n=1500)	Percentage
Emmetropia		255	17
Myopia	Mild	268	17.9
	Moderate	20	1.3
	High	7	0.5
Astigmatism	Simple myopic	327	21.8
	Compound myopic	564	37.6
	Simple hypermetropic	12	0.8
	Compound hypermetropic	14	0.9
	Mixed	8	0.5
Hypermetropia	Mild	19	1.3
	Moderate	5	0.3
	High	1	0.1

Emmetropia was noted in only 17% eyes whereas 83% eyes had refractive error. Most common refractive error was astigmatism, and most common form of astigmatism was compound myopic (37.6%). Mild, moderate and high myopia was noted in 17.9%, 1.3% and 0.5% cases respectively. Hypermetropia was noted in 1.7% cases, most common was mild hypermetropia (1.3%) (table 6).

**Table 7: Distribution according to clinical features**

Clinical features	Frequency (n=750)	Percentage
Blurring	183	24.4
Headache	334	44.5
Difficulty in focusing	68	9.1
Eye strain	149	19.9
Sore eyes	32	4.3
Watering	228	30.4
DOV	87	11.6
Pain in eye	83	11.1
Dry eye	138	18.4
Burning sensation	65	8.7
Heavy Eye	63	8.4
Irritation	142	18.9
Visual discomfort	64	8.5
Redness	3	0.4
Itching	4	0.5

Headache was the most common clinical feature noted in 44.5% cases with asthenopia, followed by watering in 30.4% and blurring in 24.4% cases. Irritation and eye strain were associated features in 18.9% and 19.9% cases respectively (table 7).

**Table 8: Distribution of cases according to duration of asthenopia symptoms**

Duration of symptoms	Frequency (n=750)	Percentage
<1 month	370	49.3
1 to 6 months	369	49.2
6 to 12 months	8	1.1
>12 months	3	0.4

Mean duration since onset of symptoms was 5.55±1.9 months. Symptoms were present since less than 1 month and 1 month to 6 months in 49.3% and 49.2% cases respectively. Symptoms were present in 0.4% since more than 12 months (table 8).

**Table 9: Symptoms based upon asthenopia questionnaire**

Asthenopia questionnaire	Frequency (n=750)	Percentage
Do you have tired and heavy eyes since past 3 weeks?	97	12.9
Do you have sore eye/eye ache since past 3 weeks?	124	16.5
Do you have irritation in eyes since past 3 weeks?	146	19.5
Do you have watering from eyes since past 3 weeks?	233	31.1
Do you have dryness in eyes since past 3 weeks?	142	18.9
Do you have hot/burning (burning sensation) in the eyes or around the eyes since past 3 weeks?	69	9.2
Do you have eye strain since past 3 weeks?	153	20.4
Do you have blurred vision since past 3 weeks?	253	33.7
Do you have difficulty in focusing since past 3 weeks?	75	10.0
Do you have visual discomfort since past 3 weeks?	76	10.1

Most common symptom was blurred vision (33.7%), followed by watering from eyes (31.1%), eye strain (20.4%), irritation (19.5%) and dryness (18.9%). Burning sensation in the eyes was the least common symptom in our study participants (9.2%) (table 9).

## DISCUSSION

The dependency on digital device among children have been observed from younger age. Asthenopia may be observed in higher rate in such children and it may interfere with learning as well as routine activities among children. Apart from this, asthenopia may aggravate the age-related eye diseases. The present study aimed to assess the percentage of asthenopia among children belonging to 6 years to 25 years of age. We reported asthenopia in 68.2% children enrolled in our study. Our study findings were concordant to the findings of Amalia H et al (2020),<sup>5</sup> in which authors included 99 students pursuing computer science and asthenopia was documented in 69.7% students. Hashemi H et al (2019)<sup>6</sup> also reported prevalence of asthenopia of 70.9% among children with mean age of 22.8±3.1. Our study findings were also supported by the findings of Sawaya RI et al (2020),<sup>7</sup> where the prevalence of asthenopia was documented to be 67.8% among college students. Sen MA et al (2021)<sup>8</sup> reported the prevalence of digital eye strain among students attending online classes was 50.23% with mild, moderate and severe symptoms in 26.3%, 12.9% and 11.1% cases respectively. However, in another study of Hashemi H et al (2017),<sup>9</sup> the prevalence of asthenopia among school going children was 49.4%, with prevalence slightly higher in males (62.8%) as compared to females (47.7%). Vilela MA et al (2015)<sup>10</sup> documented prevalence of asthenopia in 24.7% children belonging to age range of 6 to 16 years. The higher prevalence of asthenopia in our study population could be attributed to increased usage of digital technologies for study purpose (online classes) during the lockdown and as all the outdoor activities were shut down during the pandemic, children across all age group were using digital devices for prolonged period. Also, ours was a hospital-based study where most of the patients who approached were symptomatic. Asthenopia or eye strain may be due to multiple underlying causes such as refractive errors, convergence insufficiency, amblyopia, dry eyes etc. Use of digital devices for prolonged period have further worsened the problem.<sup>2</sup> In present study, majority of cases with asthenopia were using digital devices in the form of smart phones or computer for 3 to 4 hours and the mean duration of device usage was 4.72±2.4 hours duration of computer use was not associated with asthenopia in a study of Amalia H et al (2020).<sup>5</sup> Use of device for less than 4 hours for communication and pattern of device use for less than 3 years to be significantly associated with asthenopia ( $p < 0.05$ ) in a study of Sawaya RI et al (2020).<sup>7</sup> Qasim MS et al (2021) documented use of electronic device for 4 to 6 hours in majority of cases studied (30%).<sup>11</sup> Sen MA et al (2021) reported mean duration of digital device use of 3.9 ± 1.9 hours during the COVID era, which increased significantly as compared to pre COVID era (1.9 ± 1.1 hours).<sup>8</sup> Among various causes

of asthenopia, we reported refractive error to be the predominant cause (83%), followed by muscular weakness (36.2%). The causes were isolated or overlapped with other causes. Astigmatism was the most common refractive error (61.7%), followed by myopia. CVS (13.7%), dry eye (4%) and amblyopia (6.9%) were also noted in few cases of asthenopia. We also classified patients based upon the severity of refractive errors. Most common was compound myopic astigmatism (37.6%) whereas mild myopia and mild hypermetropia were noted in 17.9% and 1.3% cases respectively. Our study findings were supported by the findings of Amalia H et al (2020),<sup>5</sup> in which the authors reported refractive asthenopia as the most common type of asthenopia (95.7%), and accommodative insufficiency was noted in 50.7% cases. Wajuihian S et al (2015) documented astigmatism as most common cause of asthenopia similar to present study.<sup>3</sup> Gupta R et al (2013) reported myopia in 47.4% children with asthenopia and convergence insufficiency was found in 34.14%.<sup>12</sup> Abdi S et al (2005)<sup>13</sup> included 120 children and reported accommodative problems as the most common cause of asthenopia in 49 case whereas hypermetropia alone and hypermetropia with astigmatism was noted in 9 and 13 cases respectively. Our study findings were concordant with the findings of Hashemi H et al (2019)<sup>6</sup> in which astigmatism was an independent factor associated with asthenopia. Junghans BM et al (2020) documented convergence insufficiency in 45% students using CISS score and documented significantly higher CISS scores in hypermetropic, amblyopic and strabismic individuals.<sup>14</sup> All the cases were subjected to thorough history taking and their chief complaints pertaining to specific and non-specific features of asthenopia were noted. Later, all the study participants were subjected to asthenopia questionnaire and symptoms were recorded based upon the questionnaire. Blurred vision was the most common symptom among patients with asthenopia reported in 33.7% cases, followed by watering from eyes (31.1%) and eye strain (20.4%). Other symptoms such as tired and heavy eyes, sore eye/ eye ache, irritation, dryness, burning sensation, difficulty in focusing and visual discomfort during past 3 weeks were noted in less than 20% cases each. Apart from these features, headache was the predominant symptom (not included in asthenopia questionnaire) noted in 44.5% cases. Majority of patients (>95%) were suffering from these symptoms since less than 6 months and mean duration of symptoms was 5.55±1.9 months. Amalia H et al (2020)<sup>5</sup> reported visual fatigue, heavy eyes, blurred vision and headache to be significantly associated with asthenopia supporting our study findings. Similarly, Wajuihian S et al (2015)<sup>3</sup> documented headache as the most common symptom associated with asthenopia (40.8%), followed by photophobia. In another study by Hashemi H et al

(2017),<sup>9</sup> the authors reported tearing as the most common symptom associated with asthenopia in 20.03%, followed by eye pain (19.88%). Nunes FM et al (2018)<sup>15</sup> documented headache and poor memory in significantly higher proportions of women with asthenopia whereas sleepiness while reading as well as poor time management was observed in males with asthenopia. Sen MA et al (2021)<sup>8</sup> documented itching in eyes and headache as most common symptoms associated with asthenopia (53.9%).

## CONCLUSION

Thus, to conclude our study, we found that asthenopia is present in a significant portion of young population, refractive error being a major contributing factor besides muscular weakness, computer vision syndrome, dry eye. Asthenopia was found majorly in astigmatic patients followed by myopia and hypermetropia respectively. Severity of asthenopia was more in low grades of refractive error which are treatable but remain highly undetected. Moreover, until recently little information is available regarding the asthenopia with risk factors among children and college students. The decrease in asthenopia and morbidities associated with it among students (6-25 years of age) can lead to an important benefit to promote next generation of their career and health, both intellectually and psychologically, since these are the formative years in life, hence, justifying the need for research in this area.

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